

# Answers



## Chapter 1

### Pre-test

- 1 a 17      b 11      c 3      d 8  
 e -4      f -1      g -6      h 2
- 2 a  $2\frac{1}{5}$       b 2.2
- 3 a 9      b 5      c 16      d 8
- 4  $\frac{7}{9} > \frac{3}{4}$
- 5 a 2.654, 2.645, 2.564, 2.465  
 b 0.654, 0.564, 0.456, 0.0456
- 6 a 7.99      b 10.11      c 7.11
- 7 a 1.4      b 0.06      c 3.68  
 d 16.38      e 3.7      f 180
- 8 a 34.5      b 374 000      c 0.03754      d 0.00003754
- 9 a 15      b 12      c 10
- 10 a  $\frac{5}{7}$       b 1      c  $\frac{1}{2}$       d  $\frac{1}{4}$
- 11 a 13      b 60      c 8.1

### Exercise 1A

- 1 a 1, 2, 4, 8, 16      b 1, 2, 4, 7, 8, 14, 28, 56  
 c HCF = 8      d 3, 6, 9, 12, 15, 18, 21  
 e 5, 10, 15, 20, 25, 30      f LCM = 15  
 g 2, 3, 5, 7, 11, 13, 17, 19, 23, 29  
 h 83, 89, 97, 101, 103, 107, 109
- 2 a 121      b 225      c 12      d 20  
 e 27      f 125      g 2      h 4
- 3 a -5      b -8      c -1      d 9  
 e -1      f -16      g 15      h 9  
 i -6      j -84      k 22      l 42  
 m -9      n -6      o 10      p 19
- 4 a 2      b 2      c 10      d 16  
 e -9      f -3      g -4      h 10  
 i -11      j 2      k -3      l 4  
 m -23      n 10      o 0      p 3  
 q -9      r 7      s -1      t 4
- 5 a 28      b 24      c 187      d 30
- 6 a 4      b 5      c 1      d 23
- 7 a 4      b 23      c -3      d 2      e -2  
 f -18      g -6      h -1      i 1

- 8 a -2      b -38      c -8      d 27  
 e 1      f 24      g 21      h 0
- 9 a  $-2 \times [11 + (-2)] = -18$       b  $[-6 + (-4)] \div 2 = -5$   
 c  $[2 - 5] \times (-2) = 6$       d  $-10 \div [3 + (-5)] = 5$   
 e  $3 - [(-2) + 4] \times 3 = -3$       f  $[(-2)^2 + 4] \div (-2) = -2^2$
- 10 4      11 252 days
- 12 a 7 and -2      b -5 and 2      13 8
- 14 a i 16      ii 16      b  $a = \pm 4$       c  $a = 3$   
 d the square of a negative number has negative signs occurring in pairs and will create a positive answer  
 e -3  
 f as the squaring of any number produces a positive answer  
 g i -4      ii -125      iii -9      iv -16  
 h no      i yes  
 j Prime numbers have only two factors – itself and one, therefore the only common factor for any pair of prime numbers is 1.  
 k again as there are only 2 factors of any prime, the LCM must be the multiple of primes
- 15 a False      b False      c True      d True      e False      f True
- 16 a i  $1 + 2 + 3 = 6$   
 ii  $28 (1 + 2 + 4 + 7 + 14 = 28)$   
 iii  $1 + 2 + 4 + 8 + 16 + 31 + 62 + 124 + 248 = 496$
- b i
- 6

10

15

21
- ii 28, 36
- c i 0, 1, 1, 2, 3, 5, 8, 13, 21, 34  
 ii -21, 13, -8, 5, -3, 2, -1, 1, 0, 1 ... ∴ -21, -8, -3, -1

### Exercise 1B

- 1 a 40      b 270      c 7.9      d 0.04
- 2 a 32 100      b 432      c 5.89  
 d 0.443      e 0.001 97
- 3 a 60      b 57.375      c 2.625
- 4 a 17.96      b 11.08      c 72.99      d 47.86  
 e 63.93      f 23.81      g 804.53      h 500.57  
 i 821.27      j 5810.25      k 1005.00      l 2650.00

- 5 a 7      b 73      c 130      d 36 200  
 6 a 0.333      b 0.286      c 1.182      d 13.793  
 7 a 2400      b 35 000      c 0.060      d 34  
     e 110 000      f 0.0025      g 2.1      h 0.71  
 8 a 30 000      b 200      c 0.05      d 0.0006  
 9 a 3600, 3693      b 760, 759.4  
     c 4000, 4127.16      d 3000, 3523.78  
     e 0, 0.722 16      f 4, 0.716 245  
     g 0.12, 0.1186      h 0.02, 0.02254  
     i 10, 8.4375      j 1600, 1683.789156  
     k 0.08, 0.074957...      l 11, 10.25538...  
 10 a A: 54.3, B: 53.8, 0.5      b A: 54.28, B: 53.79, 0.49  
     c A: 54, B: 54, 0      d A: 50, B: 50, 0  
 11 a each to 1 significant figure  
     b each to 2 significant figures  
     c each to the nearest whole number  
 12 8.33 m      13 0.143 tonnes  
 14 2.14999 is closer to 2.1 correct to 1 decimal place  $\therefore$  round down  
 15 as magnesium in this case would be zero if rounded to two decimal places rather than 2 significant figures  
 16 a i 50      ii 624      b i 50      c 600  
     d The addition is the same as the original but the multiplication is lower  $-20 \times 30 < 24 \times 26$   
 17 a 0.18181818      b i 8      ii 1      iii 8  
     c 0.1428571428571      d i 4      ii 2      iii 8      e Not possible

### Exercise 1C

- 1 a  $\frac{2}{5}$       b  $\frac{1}{3}$       c  $4\frac{4}{11}$       d  $6\frac{8}{53}$   
 2 a  $\frac{11}{7}$       b  $\frac{16}{3}$       c  $\frac{19}{2}$       d  $\frac{238}{13}$   
 3 a  $\frac{2}{5}$       b  $\frac{4}{29}$       c  $4\frac{1}{6}$       d  $-72\frac{1}{8}$   
 4 a 9      b 24      c 21      d 35  
     e 3      f 7      g 10      h 6  
 5 a 2.75      b 0.35      c 3.4      d 1.875  
     e 2.625      f 3.8      g 2.3125      h 0.218 75  
 6 a  $0.\overline{27}$       b  $0.\overline{7}$       c  $1.\overline{285714}$       d  $0.4\overline{16}$   
     e 1.1      f 3.83      g 7.26      h  $2.\overline{63}$   
 7 a  $\frac{7}{20}$       b  $\frac{3}{50}$       c  $3\frac{7}{10}$       d  $\frac{14}{25}$   
     e  $1\frac{7}{100}$       f  $\frac{3}{40}$       g  $3\frac{8}{25}$       h  $7\frac{3}{8}$   
     i  $2\frac{1}{200}$       j  $10\frac{11}{250}$       k  $6\frac{9}{20}$       l  $2\frac{101}{1000}$   
 8 a  $\frac{5}{6}$       b  $\frac{13}{20}$       c  $\frac{7}{10}$       d  $\frac{5}{12}$   
     e  $\frac{7}{16}$       f  $\frac{11}{14}$       g  $\frac{19}{30}$       h  $\frac{11}{27}$

- 9 a  $\frac{5}{12}, \frac{7}{18}, \frac{3}{8}$       b  $\frac{5}{24}, \frac{3}{16}, \frac{1}{6}$       c  $\frac{7}{12}, \frac{23}{40}, \frac{8}{15}$   
 10 a  $\frac{9}{20}$       b  $\frac{3}{20}$       c  $\frac{32}{45}$       d  $\frac{23}{75}$   
 11 a  $\frac{11}{6}, \frac{7}{3}$       b  $\frac{2}{5}, \frac{2}{15}$       c  $\frac{11}{12}, 1$       d  $\frac{5}{7}, \frac{11}{14}$   
 12 Weather forecast  
 13 a  $\frac{3}{5}$       b  $\frac{5}{9}$       c  $\frac{8}{13}$       d  $\frac{23}{31}$   
 14 a 31, 32      b 36, 37, 38, ..., 55  
     c 4, 5      d 2, 3  
     e 43, 44, 45, ... 55  
 15  $\frac{ac+b}{c}$   
 16 a yes, e.g.  $\frac{7}{14} = \frac{1}{2}$  and 7 is prime  
     b no as a and b will have no common factors other than one  
     c no as then a factor of 2 can be used to cancel  
     d yes e.g.  $\frac{5}{7}$   
 17 a  $\frac{8}{9}$       b  $1\frac{2}{9}$       c  $\frac{81}{99}$       d  $3\frac{43}{99}$   
     e  $9\frac{25}{33}$       f  $\frac{44}{333}$       g  $2\frac{917}{999}$       h  $13\frac{8125}{9999}$

### Exercise 1D

- 1 a 6      b 63      c 65      d 30  
     e 4      f 33      g 60      h 87  
 2 a  $\frac{7}{3}$       b  $\frac{39}{5}$       c  $\frac{41}{4}$       d  $\frac{137}{6}$   
 3 a  $\frac{9}{6} + \frac{8}{6} = \frac{17}{6}$       b  $\frac{4}{3} - \frac{2}{5} = \frac{20}{15} - \frac{6}{15} = \frac{14}{15}$       c  $\frac{5}{3} \times \frac{7}{2} = \frac{35}{6}$   
 4 a  $\frac{3}{5}$       b  $\frac{4}{9}$       c  $1\frac{2}{7}$       d  $\frac{19}{20}$   
     e  $\frac{19}{21}$       f  $1\frac{7}{40}$       g  $\frac{7}{10}$       h  $\frac{17}{27}$   
 5 a 5      b  $3\frac{2}{5}$       c  $5\frac{1}{7}$   
     d  $6\frac{11}{15}$       e  $7\frac{17}{63}$       f  $17\frac{13}{16}$   
 6 a  $\frac{2}{5}$       b  $\frac{1}{45}$       c  $\frac{11}{20}$       d  $\frac{1}{10}$   
     e  $\frac{1}{18}$       f  $\frac{1}{8}$       g  $\frac{13}{72}$       h  $\frac{5}{48}$   
 7 a  $1\frac{1}{2}$       b  $\frac{3}{4}$       c  $\frac{13}{20}$   
     d  $\frac{29}{40}$       e  $\frac{5}{6}$       f  $1\frac{16}{77}$   
 8 a  $\frac{6}{35}$       b  $\frac{1}{2}$       c  $\frac{1}{12}$       d  $\frac{4}{9}$   
     e  $4\frac{1}{2}$       f  $5\frac{1}{3}$       g  $7\frac{1}{2}$       h 5

- i 15      j 26      k  $\frac{2}{3}$       l  $\frac{5}{6}$   
 m  $2\frac{1}{4}$       n  $3\frac{1}{2}$       o 6      p  $1\frac{1}{3}$   
 9 a  $\frac{1}{3}$       b  $\frac{7}{5}$       c 8      d  $\frac{9}{13}$   
 10 a  $\frac{20}{21}$       b  $1\frac{1}{8}$       c  $\frac{45}{56}$       d  $\frac{27}{28}$   
 e  $1\frac{1}{3}$       f  $1\frac{1}{2}$       g 6      h  $\frac{7}{8}$   
 i 18      j 9      k 16      l 64  
 m  $\frac{1}{10}$       n  $\frac{1}{12}$       o  $\frac{4}{27}$       p  $3\frac{1}{3}$   
 q 4      r  $\frac{1}{6}$       s  $1\frac{1}{2}$       t  $\frac{7}{8}$   
 11 a  $\frac{2}{7}$       b  $\frac{8}{15}$       c 16  
 d  $\frac{66}{85}$       e  $2\frac{10}{21}$       f  $\frac{3}{13}$   
 12  $\frac{7}{8}$  tonnes      13  $5\frac{29}{56}$  tonnes      14  $5\frac{5}{12}$  hours (25 min)

15 7 truckloads      16 3 hours

17  $\frac{5}{6}$ , problem is the use of negatives in the method since  $\frac{1}{3} < \frac{1}{2}$

- 18 a  $\frac{b}{a}$       b  $\frac{c}{ac+b}$   
 19 a 1      b  $\frac{a^2}{b^2}$       c 1      d  $\frac{c}{a}$       e a      f  $\frac{c}{b}$   
 20 a  $-\frac{2}{3}$       b  $\frac{5}{4}$       c  $\frac{83}{10}$       d 1      e  $\frac{50}{31}$       f  $\frac{81}{400}$   
 g  $\frac{329}{144}$       h  $\frac{969}{100}$       i  $\frac{583}{144}$       j  $\frac{5}{11}$

### Exercise 1E

- 1 a 4      b 12      c 24      d 72      e 3      f 9      g 11      h 3  
 2 a 9      b  $\frac{4}{9}$       c  $\frac{5}{9}$       d 8      e 10  
 3 a i 240 km      ii 40 km      iii 520 km  
 b i 5 h      ii  $4\frac{1}{2}$  h      iii 15 min  
 4 a \$4      b \$3      c \$2.50  
 5 a 1:5      b 2:5      c 3:2      d 4:3  
 e 9:20      f 45:28      g 3:14      h 22:39  
 i 1:3      j 1:5      k 20:7      l 10:3  
 6 a 1:10      b 1:5      c 2:3      d 7:8  
 e 25:4      f 1:4      g 1:4      h 24:5  
 i 4:20:5      j 4:3:10      k 5:72      l 3:10:40  
 7 a \$200, \$300      b \$150, \$350  
 c \$250, \$250      d \$175, \$325  
 8 126 g  
 9 a \$10, \$20, \$40      b \$14, \$49, \$7      c \$40, \$25, \$5  
 10 a 15 km/h      b 2000 rev/min  
 c 45 strokes/min      d 14 m/s  
 e 8 mL/h      f 92 beats/min

- 11 a 55 km      b  $16\frac{1}{2}$  km      c  $5\frac{1}{2}$  km  
 12 a 3 kg deal      b red delicious      c 2.4 L      d 0.7 GB  
 13 a coffee A: \$3.60, coffee B: \$3.90. Therefore, coffee A is the best buy.  
 b pasta A: \$1.25, pasta B: \$0.94. Therefore, pasta B is the best buy.  
 c cereal A: \$0.37, cereal B: \$0.40. Therefore, cereal A is the best buy.

- 14 120  
 15 \$3000, \$1200, \$1800 respectively  
 16 \$15.90  
 17 108 L  
 18 \$3600, \$1200, \$4800 respectively  
 19 \$1.62  
 20 1:4  
 21  $36^\circ$ ,  $72^\circ$ ,  $108^\circ$ ,  $144^\circ$   
 22 Find cost per kilogram or number of grams per dollar. Cereal A is the best buy.  
 23 a False      b False      c True      d True  
 24 a  $a+b$       b  $\frac{a}{a+b}$       c  $\frac{b}{a+b}$   
 25 a i 100 mL      ii 200 mL      b i 250 mL      ii 270 mL  
 c i 300 mL      ii 1:4  
 d i 1:3      ii 7:19      iii 26:97      iv 21:52  
 e jug 3 and 4

### Exercise 1F

- 1 a  $\frac{3}{100}$       b  $\frac{11}{100}$       c  $\frac{7}{20}$       d  $\frac{2}{25}$   
 2 a 0.04      b 0.23      c 0.86      d 0.463  
 3 a 50%      b 60%      c 25%      d 90%  
 e 75%      f 50%      g 20%      h  $12\frac{1}{2}\%$   
 4 a 34%      b 40%      c 6%      d 70%  
 e 100%      f 132%      g 109%      h 310%  
 5 a 0.67      b 0.3      c 2.5      d 0.08  
 e 0.0475      f 0.10625      g 0.304      h 0.4425  
 6 a  $\frac{67}{100}$       b  $\frac{3}{10}$       c  $2\frac{1}{2}$       d  $\frac{2}{25}$   
 e  $\frac{19}{400}$       f  $\frac{17}{160}$       g  $\frac{38}{125}$       h  $\frac{177}{400}$

7	Percentage	Fraction	Decimal
	10%	$\frac{1}{10}$	0.1
	50%	$\frac{1}{2}$	0.5
	5%	$\frac{1}{20}$	0.05
	25%	$\frac{1}{4}$	0.25
	20%	$\frac{1}{5}$	0.2
	12.5%	$\frac{1}{8}$	0.125

Percentage	Fraction	Decimal
1%	$\frac{1}{100}$	0.01
11.1%	$\frac{1}{9}$	0.1
22.2%	$\frac{2}{9}$	0.2
75%	$\frac{3}{4}$	0.75
15%	$\frac{3}{20}$	0.15
90%	$\frac{9}{10}$	0.9
37.5%	$\frac{3}{8}$	0.375
$33\frac{1}{3}\%$	$\frac{1}{3}$	0.3
$66\frac{2}{3}\%$	$\frac{2}{3}$	0.6
62.5%	$\frac{5}{8}$	0.625
16.6%	$\frac{1}{6}$	0.16

- 8 a 25%    b  $33\frac{1}{3}\%$     c 16%  
d 200%    e 2800%    f 25%
- 9 a \$36    b \$210    c 48 kg  
d 30 km    e 15 apples    f 350 m  
g 250 people    h 200 cars    i \$49
- 10 a \$120    b \$700    c \$300  
d \$7    e \$0.20    f \$400
- 11 a \$540    b \$600    c \$508  
d \$1250    e \$120    f \$40
- 12  $16\frac{2}{3}\%$     13  $6\frac{1}{4}\%$
- 14 48 kg    15 15 students
- 16 9 students    17 \$1150
- 18 a  $P = 100$     b  $P > 100$     c  $P < 100$
- 19 a  $x = 2y$     b  $x = 5y$     c  $x = \frac{3}{5}y$  (or  $5x = 3y$ )    d  $14x = 5y$
- 20 a 72    b  $\frac{10}{11}$     c 280%    d  $3\frac{1}{4}$     e 150%

### Exercise 1G

- 1 a 1.4    b 1.26    c 60%    d 21%  
e 0.8    f 0.27    g 6%    h 69%
- 2 a \$30    b 25%    3 a 12 kg    b 11.1%
- 4 a \$52.50    b 37.8 min (37 min 48 s)  
c 375 mL    d 1.84 m    e 27.44 kg  
f 36 watts    g \$13 585    h \$1322.40
- 5 a 19.2 cm    b 24.5 cm    c 39.06 kg  
d 48.4 min (49 m 24 s)    e \$78.48  
f 202.4 mL    g 18°C    h \$402.36
- 6 50%    7 44%
- 8 28%    9 4%
- 10 a 22.7%    b 26.7%    c 30.9%    d 38.4 %
- 11 \$21.50    12 30 068

- 13 \$14 895    14 193 474 ha  
15 \$10.91    16 \$545.45  
17 a \$900    b \$990  
c as 10% of 1000 = 100 but 10% of 900 = 90
- 18 25%    19 100%    20 42.86%
- 21 a \$635.58    b \$3365.08  
c \$151.20    d \$213.54
- 22 a 79.86 g    b \$ 97 240.50  
c \$336 199.68    d 7.10 cm

### Exercise 1H

- 1 a \$3 profit, \$2.50 loss, \$1.40 profit, \$7.30, \$65.95 loss, \$2070  
b \$30.95, \$80, \$395.95, \$799.95, \$18 799, \$8995  
c \$28, \$9.05, \$22.70, \$199, \$345.50, \$2037
- 2 a 90%    b 80%    c 85%    d 92%
- 3 a i \$2    ii 20%    b i \$5    ii 25%  
c i \$16.80    ii 14%    d i \$2450    ii 175%
- 4 167.67%    5 40%
- 6 92.5%    7 \$37.50
- 8 \$1001.25    9 28%
- 10 42.3%    11 \$148.75
- 12 \$760.50    13 \$613.33
- 14 \$333 333    15 increased by 4%
- 16 25%
- 17 a \$54.75    b 128%
- 18 No, either way it gives the same price.
- 19 \$2100
- 20 a i \$54 187.50    ii \$33 277.90    b 10 years
- 21 a \$34 440    b \$44 000    c \$27 693.75  
d \$32 951.10    e \$62 040    f \$71 627.10

### Exercise 1I

- 1 a \$3952    b \$912    c \$24
- 2 a \$79.80    b \$62.70    c \$91.20    d \$102.60
- 3 a \$200    b \$56    c \$900    d \$145.10
- 4 a \$46 166    b \$23 247
- 5 a i \$19.50    ii \$27    iii \$42.50  
b i \$30 201.60    ii \$44 044    iii \$20 134.40
- 6 a \$82.80    b \$119.60    c \$184  
d \$276    e \$257.60    f \$404.80
- 7 a 7    b 18    c 33    d 25    e 37    f 40
- 8 \$14.50 per hour    9 \$12.20 per hour
- 10 \$490    11 \$4010
- 12 a i \$40 035    ii 17.0%  
b i \$53 905.80    ii 20.1%  
c i \$41 218.20    ii 15%  
d i \$30 052.56    ii 22.2%
- 13 a \$1830    b \$8043  
c \$12 617.50    d \$23 772.80

- 14 Cate, Adam, Ed, Diana, Bill    15 \$839.05  
 16 \$1239.75    17 4.58%    18 \$67 400  
 19 a 12 hours  
     b 12 and 0, 9 and 2, 6 and 4, 3 and 6 or 0 and 8  
 20 a i \$920    ii \$1500  
     b i  $A = 0.02x$     ii  $A = 1200 + 0.025(x - 60\,000)$   
 21 a \$5500  
     b Choose plan A if you expect that you will sell less than \$5500 worth of jewellery in a week or plan B if you expect to sell more than \$5500.  
 22 a i \$2000    ii \$11 500    iii \$35 000  
     b
- | Income              | Rate | Tax payable                           |
|---------------------|------|---------------------------------------|
| \$40 001 – \$90 000 | 25%  | \$3750 + 25% of (income – \$40 000)   |
| \$90 001 –          | 33%  | \$16 250 + 33% of (income – \$90 000) |
- c i \$2000    ii \$6300    iii \$24000    iv \$40 000.50  
     d an extra dollar of income can push you into a higher tax bracket where you don't just pay the higher tax rate on the dollar but on your entire income. No incentive to earn more.

### Exercise 1J

- 1 a \$12 000    b 6% p.a.    c 3.5 years  
     d \$720    e \$1440    f \$2520  
 2 a \$3000    b \$3600    c \$416    d \$315  
 3 \$2700, \$17 700    4 \$1980, \$23 980  
 5 \$2560    6 9 months  
 7 16 months    8 \$2083.33  
 9 choice 2    10 a \$14 400    b \$240  
 11 10%  
 12 a \$P    b 12.5%  
     c i 20 years    ii 40 years    iii double  
 13 a \$51000    b 4 years  
 14 a  $P = \frac{100}{rt}$     b  $t = \frac{100}{Pr}$     c  $r = \frac{100}{Pt}$   
 15 a \$1750 a month    b \$18 000  
     c \$6000    d 2%

### Exercise 1K

- 1 a \$200    b \$2200    c \$220  
     d \$2420    e \$242    f \$2662  
 2 a 2731.82    b 930.44  
     c 2731.82    d 930.44  
 3 a  $\$4000 \times (1.2)^3$     b  $\$15\,000 \times (1.07)^6$   
     c  $\$825 \times (1.11)^4$   
 4 a \$6515.58    b \$10 314.68  
     c \$34 190.78    d \$5610.21

- 5 \$293 865.62  
 6 a 21.7%    b 19.1%    c 136.7%    d 33.5%  
 7 \$33 776  
 8 a \$23 558    b \$33 268    c \$28 879    d \$25 725  
 9 \$543 651    10 6142 people    11 6.54 kg  
 12 Trial and error gives 12 years    13 Trial and error gives 5 years  
 14 a 35%    b 40.26%  
     c as it calculates each years interest on the original \$400 not the accumulated total that compound interest uses  
 15 a 15.76%    b 25.44%    c 24.02%  
     d 86.96%    e  $\left(1 + \frac{r}{100}\right)^t - 1 \times 100\%$   
 16 a \$7509.25    b 9.39% p.a.  
 17 a 70.81%    b 7.08%  
 18 a 5.39% p.a.    b 19.28% p.a.

### Challenges

- 1 Discuss with classmates as more than one answer for each may be possible. Some suggestions are given below (be creative).

$$\begin{aligned} (4 - 4) \times (4 + 4) &= 0 & (4 - 4) + (4 \div 4) &= 1 \\ 4 \div 4 + 4 \div 4 &= 2 & \sqrt{4 \times 4} - (4 \div 4) &= 3 \\ 4 + (4 - 4) \times 4 &= 4 & \sqrt{4 \times 4} + 4 \div 4 &= 5 \\ (4 + 4 + 4) \div \sqrt{4} &= 6 & 4 + 4 - 4 \div 4 &= 7 \\ \sqrt{4} + \sqrt{4} + \sqrt{4} + \sqrt{4} &= 8 & \sqrt{4} \times \sqrt{4} \times \sqrt{4} + \sqrt{4} &= 10 \end{aligned}$$

- 2 12    3 a  $\frac{4}{7}$     b  $\frac{14}{17}$   
 4 125 mL    5 40.95% reduction  
 6 7.91% p.a.    7 a 44%    b 10%  
 8 200 000 cm<sup>2</sup> (20 m<sup>2</sup>)  
 9 9, 7, 2, 14, 11, 5, 4, 12, 13, 3, 6, 10, 15, 1, 8

### Multiple-choice questions

- 1 D    2 B    3 C    4 A    5 E    6 E  
 7 D    8 E    9 C    10 A    11 C    12 B

### Short-answer questions

- 1 a -16    b 2    c 0  
     d 10    e -23    f 1  
 2 a 21.5    b 29 100    c 0.153    d 0.002 41  
 3 a 200    b 60    c 2  
 4 a 2.125    b 0.83    c  $1.857142$   
 5 a  $\frac{3}{4}$     b  $1\frac{3}{5}$     c  $2\frac{11}{20}$   
 6 a  $\frac{1}{2}$     b  $2\frac{1}{6}$     c  $\frac{7}{24}$   
     d 2    e  $3\frac{3}{4}$     f  $2\frac{19}{28}$

- 7 a 5 : 2      b 16 : 9      c 75 : 14  
 8 a 50, 30      b 25, 55      c 10, 20, 50  
 9 a store A: \$2.25/kg; store B: \$2.58/kg ∴ A is best buy  
 b store A: 444 g/\$; store B: 388 g/\$

Decimal	Fraction	Percentage
0.6	$\frac{3}{5}$	60%
0.3	$\frac{1}{3}$	$33\frac{1}{3}\%$
0.0325	$\frac{13}{400}$	$3\frac{1}{4}\%$
0.75	$\frac{3}{4}$	75%
1.2	$1\frac{1}{5}$	120%
2	2	200%

- 11 a \$77.50      b 1.65      12 a 150      b 25  
 13 a 72      b 1.17      c 20%      14 12.5 kg  
 15 \$1800      16 a \$25      b  $16\frac{2}{3}\%$   
 17 a \$18.25      b \$14.30      18 \$50 592      19 \$525  
 20  $4\frac{1}{2}$  years      21 \$63 265.95      22 \$39 160

### Extended-response questions

- 1 a \$231      b \$651      c i \$63      ii \$34.65  
 2 a i \$26 625      ii \$46 928.44      b 87.71%  
 c \$82 420      d 26.26%      e 7.4% p.a.

## Chapter 2

### Pre-test

- 1 a  $x+3$       b  $ab$       c  $2y-3$       d  $\frac{x+2}{3}$   
 2 a 1      b -2      c 5      d -6  
 3 a  $3x$       b  $6y+xy$       c 0      d  $17y$   
 e  $10a+a^2$       f  $5xy-7y$   
 4 a  $6a$       b  $-21xy$       c  $4b$       d  $\frac{3m}{2}$   
 5  $4 \times 5 + 3 \times 5 = 35$  or  $(4+3) \times 5 = 35$   
 6 a  $2x+6$       b  $3a-15$       c  $12x-8xy$       d  $-6b+3$   
 7  $b, c$   
 8 a 9      b 10      c 4      d 21  
 9 a T      b F      c T      d T  
 e F      f T  
 10 a  $y=7$       b  $y=1$       c  $y=9$       d  $y=6$   
 11 A      12 E

### Exercise 2A

- 1 a 2      b 2      c 3      d 1  
 2 A c B d C b D a E f F e

- 3 a 5      b -2      c  $\frac{1}{3}$       d  $-\frac{2}{5}$   
 4 a i  $4+r$       ii  $t+2$       iii  $b+g$       iv  $x+y+z$   
 b i  $6P$       ii  $10n$       iii  $2D$       iv  $5P+2D$   
 c  $\frac{500}{C}$   
 5 a  $2+x$       b  $ab+y$       c  $x-5$       d  $3x$   
 e  $3x-2y$  or  $2y-3x$       f  $3p$       g  $2x+4$   
 h  $\frac{x+y}{5}$       i  $4x-10$       j  $(m+n)^2$       k  $m^2+n^2$   
 l  $\sqrt{x+y}$       m  $a+\frac{1}{a}$       n  $(\sqrt{x})^3$   
 6 a -31      b -25      c -33      d -19  
 e  $\frac{1}{2}$       f 4      g 1      h 85  
 7 a  $1\frac{1}{6}$       b  $4\frac{1}{4}$       c  $\frac{1}{6}$       d  $-1\frac{1}{3}$   
 8 a  $60m^2$       b length =  $12+x$ , width =  $5-y$   
 c  $A = (12+x)(5-y)$   
 9 a 18 square units      b 1, 2, 3, 4, 5  
 10 a  $\frac{P}{10}$       b  $\frac{nP}{10}$   
 11 a i  $P=2x+2y$       ii  $A=xy$       b i  $P=4p$       ii  $A=p^2$   
 c i  $P=x+y+5$       ii  $A=\frac{5x}{2}$   
 12 a  $A: 2(x+y)$       B:  $2x+y$ , different      b Same  
 13 a B      b  $A: c^2 = (a+b)^2$   
 14 a  $\frac{n(n+1)}{2}$       b i 10      ii 55      c  $\frac{n^2}{2} + \frac{n}{2}$   
 d 10, 55      e Half the sum of  $n$  and the square of  $n$ .

### Exercise 2B

- 1 a variable (pronumeral)      b  $5x$       c unlike  
 2 a  $\frac{2}{3}$       b  $\frac{5}{2}$       c 3      d  $\frac{1}{5}$   
 e  $-\frac{2}{7}$       f  $-\frac{1}{20}$       g  $-\frac{11}{53}$       h -17  
 3 a like      b unlike      c unlike      d unlike      e like  
 f like      g like      h unlike      i like  
 4 a  $10m$       b  $12b$       c  $15p$       d  $6xy$   
 e  $18pr$       f  $16mn$       g  $-14xy$       h  $-15mn$   
 i  $-12cd$       j  $30ab$       k  $-24rs$       l  $-40jk$   
 5 a  $24n^2$       b  $-3q^2$       c  $10s^2$       d  $21a^2b$       e  $-15mn^2$   
 f  $18gh^2$       g  $12x^2y^2$       h  $8a^2b^2$       i  $-6m^2n^2$   
 6 a  $4b$       b  $-\frac{a}{3}$       c  $\frac{2ab}{3}$       d  $\frac{m}{2}$       e  $-\frac{x}{4}$   
 f  $\frac{5s}{3}$       g  $uv$       h  $\frac{5rs}{8}$       i  $\frac{5ab}{9}$       j  $\frac{7}{y}$   
 7 a  $\frac{2x}{5}$       b  $\frac{4}{3a}$       c  $\frac{11mn}{3}$       d  $6ab$

- e  $-\frac{5}{gh}$  f 8 g -3 h  $\frac{7n}{3}$   
 i  $-\frac{9q}{2}$  j 3b k -5x l  $\frac{m}{2}$   
 8 a  $\frac{4x}{y}$  b  $\frac{5p}{2}$  c -6ab d  $-\frac{3a}{2b}$   
 e  $\frac{7n}{5m}$  f  $\frac{10s}{t}$  g 8n h 3y  
 i 4b j 6xy k 5m l  $3pq^2$   
 9 a 10a b 7n c 8y d 11x  
 e 3ab f 7mn g y+8 h 3x+5  
 i 7xy+4y j 12ab+3 k 2-6m l 4-x  
 10 a 5a+9b b 6x+5y c 4t+6 d 11x+4  
 e 5xy+4x f 7mn-9 g 5ab-a h 0  
 11 a  $xy^2$  b  $7a^2b$  c  $3m^2n$  d  $p^2q^2$   
 e  $7x^2y-4xy^2$  f  $13rs^2-6r^2s$  g  $-7x-2x^2$   
 h  $4a^2b-3ab^2$  i  $7pq^2-8pq$  j  $8m^2n^2-mn^2$   
 12 a x+y b 4x+2y 13 a 8x b  $3x^2$   
 14 a 30x cm b  $30x^2\text{cm}^2$  15  $\frac{20x+75}{21}$   
 16 a True b False c True d False e False f True  
 17 a 4x+4y b 8x+4 c 2x-2  
 18 a  $a^3$  b  $\frac{b^2}{3}$  c  $\frac{b^2}{3}$  d  $\frac{3ab}{8}$   
 e  $\frac{2a^3}{3}$  f  $\frac{2}{5a^2}$  g  $\frac{2}{5a^5}$  h  $\frac{a^2}{4b^3}$   
 i  $3a^3b$  j  $\frac{4b^3}{a}$  k  $\frac{a^3}{3b}$  l  $-\frac{a}{2b^3}$

### Exercise 2C

- 1 a i 5x ii 10  
 b 5x+10 c x+2 d 5(x+2) e 5x+10  
 2 a i -16 ii -4 b No, -2x-6  
 c i -27 ii -33 d No, -3x+3  
 3 a 2x+6 b 5x+60 c 2x-14 d 7x-63  
 e 6+3x f 21-7x g 28-4x h 2x-12  
 4 a -3x-6 b -2x-22 c -5x+15 d -6x+36  
 e -8+4x f -65-13x g -180-20x h -300+300x  
 5 a 2a+2b b 5a-10 c 3m-12 d -16x-40  
 e -12x-15 f -4x^2+8xy g -18ty+27t h 3a^2+4a  
 i 2d^2-5d j -6b^2+10b k 8x^2+2x l 5y-15y^2  
 6 a 2x+11 b 6x-14 c 15x-3 d 1+3x  
 e 4x-5 f 2x+1 g -3x-4 h -5x-19  
 i 11-x j 12-x k 2-2x l 6-3x  
 7 a 5x+12 b 4x-8 c 11x-2 d 17x-7  
 e -4x-6 f x-7 g 2x-4 h -27x-4  
 i -4x-18 j -13x-7 k 11x-7 l 2x-15  
 8 A = x^2 + 4x  
 9 a 2x+2 b 2x^2-3x c 6x^2-2x  
 d 2x^2+4x e x^2+2x+6 f 20+8x-x^2  
 10 20n-200 11 0.2x-2000

- 12 a 2x+12 b x^2-4x c -3x-12  
 d -7x+49 e 19-2x f x-14  
 13 a 6(50+2)=312 b 9(100+2)=918  
 c 5(90+1)=455 d 4(300+26)=1304  
 e 3(100-1)=297 f 7(400-5)=2765  
 g 9(1000-10)=8910 h 6(900-21)=5274  
 14 a a = \$6000, b = \$21 000  
 b i \$3000 ii \$12 600 iii \$51 000  
 c i 0 ii 0.2x-4000 iii 0.3x-9000  
 iv 0.5x-29 000

### Exercise 2D

- 1 a 3 b 40 c 5 d 6  
 2 a 3 b 2 c 2 d 12  
 e 12 f -5 g 6 h 1  
 3 a, d, e, f, h  
 4 a 2 b 1 c 4 d -1  
 e -3 f -6 g -4 h  $-3\frac{2}{3}$   
 i  $1\frac{2}{3}$  j  $4\frac{1}{2}$  k  $\frac{1}{2}$  l  $1\frac{1}{3}$   
 m  $\frac{5}{7}$  n  $\frac{1}{8}$  o  $-\frac{3}{20}$   
 5 a 8 b 2 c 12 d -6  
 e -6 f 30 g -15 h -8  
 i 12 j 20 k -5 l -10  
 6 a -3 b -1 c 2 d 8  
 e  $-1\frac{2}{5}$  f  $-2\frac{5}{7}$  g  $\frac{3}{8}$  h  $1\frac{3}{4}$   
 7 a 9 b 6 c  $-6\frac{3}{4}$  d  $-7\frac{1}{2}$   
 e  $\frac{2}{3}$  f  $-\frac{4}{25}$  g 12 h 12  
 i -9 j -8 k 6 l  $-1\frac{1}{2}$   
 8 a 11 b 6 c -10 d -12  
 e -5 f -1 g 7 h 5  
 i  $4\frac{2}{7}$  j  $5\frac{1}{3}$  k -7 l 3  
 9 a 26 b 28 c 3 d 28  
 e 8 f  $3\frac{3}{7}$  g 7 h \$900  
 10 a should have + 1 before ÷ 2  
 b should have × 3 before - 2  
 c need to ÷ -1 as -x = 7  
 d should have + 4 before × 3  
 11 a i 5 ii -3 iii  $\frac{1}{5}$  iv 3 v  $-\frac{5}{6}$  vi  $\frac{3}{10}$   
 b When the common factor divides evenly into the RHS

12 a  $a = b + c$    b  $a = \frac{c-b}{2}$    c  $a = \frac{c-2d}{b}$    d  $a = c(b+d)$   
 e  $a = -\frac{cd}{b}$    f  $a = \frac{b}{2c}$    g  $a = \frac{c(3-d)}{2b}$    h  $a = \frac{2d(b-3)}{c}$   
 i  $a = cd - b$    j  $a = b + cd$    k  $a = \frac{2be+6c}{d}$    l  $a = \frac{d-3ef}{4c}$

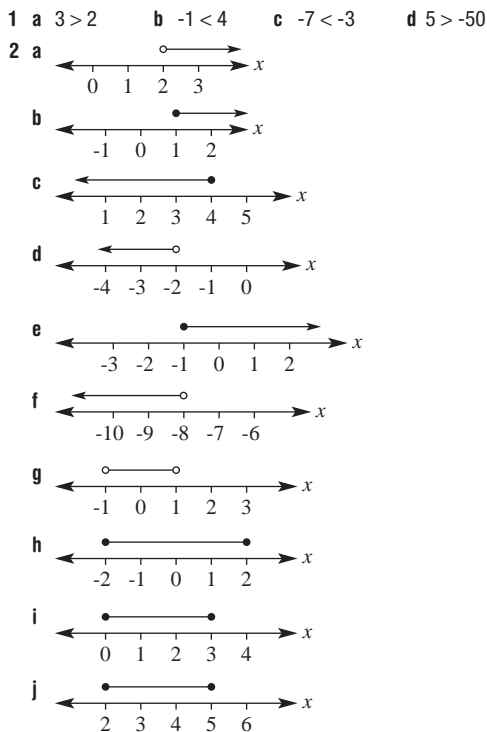
### Exercise 2E

1 a  $4x - 12$    b 2   c  $5x - 9$    d  $3 - 9x$   
 e  $3x - 7$    f  $24 - 12x$   
 2 a  $2x + 6 = 5$    b  $5 + 2x - 2 = 7$    c  $2x + 1 = -6$    d  $2x - 3 = 1$   
 3 a  $2\frac{1}{2}$    b  $-1\frac{2}{5}$    c  $6\frac{1}{3}$    d  $4\frac{3}{5}$   
 e  $-3\frac{3}{4}$    f  $9\frac{1}{2}$    g  $\frac{1}{2}$    h  $-5\frac{1}{2}$   
 i  $\frac{4}{5}$    j  $\frac{1}{14}$    k  $3\frac{1}{6}$    l  $\frac{2}{3}$   
 m  $\frac{9}{10}$    n  $1\frac{1}{6}$    o  $-\frac{1}{8}$   
 4 a 1   b -10   c 1   d -2   e 5   f 0  
 g 1   h 5   i 3   j 1  
 5 a 1   b -4   c 2   d 8   e 8   f 3  
 g 4   h -1   i  $\frac{5}{11}$   
 6 a -1   b  $3\frac{1}{2}$    c -9   d -14  
 e -16   f 3   g 19   h -3  
 i -13   j -26   k  $-2\frac{2}{3}$    l  $-1\frac{1}{10}$   
 7 a  $\frac{1}{2}$    b  $2\frac{2}{3}$    c  $1\frac{1}{2}$    d  $-\frac{5}{6}$   
 e  $\frac{2}{5}$    f  $1\frac{1}{2}$    g -6  
 8 \$5/hour   9 11 marbles  
 10 a  $x = 5$    b  $x = 5$   
 c Dividing both sides by 3 is faster because  $9 \div 3$  is a whole number  
 11 a  $x = 4\frac{1}{3}$    b  $x = 4\frac{1}{3}$   
 c Expanding the brackets is faster because  $7 \div 3$  gives a fraction answer  
 12 a  $x = 4$    b  $x = 4$   
 c Method a: don't have to deal with negatives  
 Final step in method a: divide both sides by a positive number  
 Final step in method b: divide both sides by a negative number  
 13 a  $x = \frac{d}{a-b}$    b  $x = \frac{2}{a-b}$    c  $x = \frac{c}{5a-b}$   
 d  $x = -\frac{6}{3a-4b}$  or  $\frac{6}{4b-3a}$    e  $x = -c$    f  $x = b$   
 g  $x = \frac{d+bd+c}{a-b}$    h  $x = -\frac{ab+bc}{a-b+1}$  or  $\frac{ab+bc}{b-a-1}$

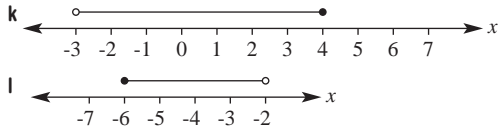
### Exercise 2F

1 a  $x - 3 = 4x - 9$    b  $3(x+7) = 9$    c  $4(x-9) = 12$   
 d  $2x = x + 5$    e  $x - 8 = 3x + 2$   
 2 a Let  $e$  be the number of goals for Emma  
 b  $e + 8$    c  $e + e + 8 = 28$    d  $e = 10$   
 e Emma scored 10 goals, Leonie scored 18 goals  
 3 a Let  $w$  be the width in centimetres   b length =  $4w$   
 c  $2w + 2(4w) = 560$    d  $w = 56$   
 e length = 224 cm, width = 56 cm  
 4 6 days   5 10 km, 20 km   6 \$360, \$640  
 7 15, 45   8 19 km   9 A \$102.50, B \$175, C \$122.50  
 10 4 fiction, 8 non-fiction books   11 I am 10 years old  
 12 Eric is 18 yrs old now  
 13 First leg = 54 km, Second leg = 27km, Third leg = 18 km,  
 Fourth leg = 54 km  
 14 2 hours   15 8 pm  
 16 Rectangle  $L = 55$  m,  $W = 50$  m. Triangle side = 70 m  
 17 a 27, 28, 29  
 b i  $x, x+2, x+4$    ii 4, 6, 8  
 c i  $x, x+2, x+4$    ii 15, 17, 19  
 d i  $x, x+3, x+6$    ii 24, 27, 30  
 18 a  $T = 8x + 7200$    b 300   c  $R = 24x$   
 d  $x = 350$    e 3825  
 19 \$15 200   20 438 km   21 Anna 6; Henry 4; Chloe 12; twins 11

### Exercise 2G







- 3 a  $x < 3$     b  $b > 5$     c  $y > 6$     d  $m < 5$   
 e  $x \geq 3$     f  $t > -5$     g  $x \geq 12$     h  $y \geq -10$   
 i  $m < 6$     j  $a \geq \frac{1}{2}$     k  $x < 1$     l  $x > 8$
- 4 a  $x < 4$     b  $n \leq -1$     c  $x \geq \frac{3}{5}$     d  $a \geq 4$   
 e  $x \geq -6$     f  $x \geq 10$     g  $x < -6$     h  $t \leq -2$

i  $m > -4\frac{5}{6}$

- 5 a  $x \leq 16$     b  $x \leq -9$     c  $x \leq 20$     d  $x < 11$   
 e  $x > -2\frac{2}{3}$     f  $x \geq -2$

- 6 a  $x < 1$     b  $a < -8$     c  $x \leq -2$   
 d  $x < 2\frac{1}{2}$     e  $y < -3\frac{1}{5}$     f  $x < -\frac{4}{7}$

- 7 a  $x \geq 2\frac{1}{2}$     b  $t > -\frac{3}{5}$     c  $y \leq \frac{3}{8}$   
 d  $a < 1\frac{1}{5}$     e  $m \geq 6$     f  $b < 5\frac{1}{2}$

- 8 less than 18    9  $w < 13$

- 10 a 3    b 2    c 4    d 0

- 11  $x = 3$  or  $x = 4$  or  $x = 5$     12 399 km

- 13 a i -0.9, 0, 0.5, 1, 1.8 etc    ii numbers must be less than 2  
 b i -4, -2, 0, 1, 5 etc    ii numbers must be greater than -5  
 c i  $x < a$     ii  $x > -a$

- 14 a  $x < 3$     b  $x < 3$   
 c Reverse inequality sign when dividing by a negative number

- 15 a  $x < -13$     b  $x \geq -3$     c  $x > \frac{4}{7}$     d  $x \leq \frac{13}{5}$

e  $x > \frac{10}{17}$     f  $x \geq \frac{3}{4}$

- 16 a  $x > \frac{b-c}{a}$     b  $x \geq b-a$     c  $x \leq a(b+c)$     d  $x \leq \frac{ac}{b}$

e  $x < \frac{cd-b}{a}$     f  $x \geq \frac{b-cd}{2}$     g  $x < \frac{c}{a-b}$     h  $x > \frac{b-cd}{a}$

i  $x < b - \frac{c}{a}$     j  $x \leq \frac{b+c}{1-a}$     k  $x < \frac{b+1}{b-a}$     l  $x \leq \frac{c-b}{b-a}$

### Exercise 2H

- 1 a A    b D    c M    d A  
 2 a 21    b 24    c 2    d 6  
 e 452.16    f 33.49    g 25.06    h 14.95  
 i 249.86    j 80  
 3 a 36    b 5    c 20    d 4.14  
 e 3.39    f 18.67    g 0.06

4 a  $r = \frac{A}{2\pi h}$     b  $r = \frac{100I}{Pt}$     c  $n = \frac{p}{m} - x$     d  $x = \frac{cd-a}{b}$

e  $r = \sqrt{\frac{v}{\pi h}}$     f  $v = \sqrt{PR}$     g  $h = \frac{S-2\pi r^2}{2\pi r}$

h  $p = -q \pm \sqrt{A}$     i  $g = \frac{4\pi^2 l}{T^2}$     j  $A = (4C - B)^2$

- 5 a 88.89 km/h    b i  $d = st$     ii 285 km

- 6 a i  $212^\circ \text{F}$     ii  $100.4^\circ \text{F}$     b  $C = \frac{5}{9}(F-32)$

- c i  $-10^\circ \text{C}$     ii  $36.7^\circ \text{C}$

- 7 a 35 m/s    b 2 s

- 8 a decrease    b 3988 L  
 c 6 hours 57 minutes    d 11 hours 7 minutes

- 9 a  $D = \frac{c}{100}$     b  $d = 100e$     c  $D = 0.7M$     d  $V = 1.15P$

e  $C = 50 + 18t$     f  $d = 42 - 14t$     g  $C = \frac{c}{b}$

- 10 a  $a = \frac{P}{4}$     b  $a = 180 - b$     c  $a = 90 - b$

d  $a = \frac{180-b}{2}$     e  $a = \sqrt{c^2 - b^2}$     f  $a = \sqrt{\frac{4A}{\pi}}$

- 11 a 73    b 7    c 476.3

### Exercise 2I

- 1 a  $y = 5$     b  $x = -3$     c  $x = 10$

- 2 a A    b C

- 3 a yes    b no    c no    d yes

- 4 a  $x = 1, y = 2$     b  $x = 5, y = 1$     c  $x = \frac{1}{2}, y = \frac{3}{2}$

- d  $x = -2, y = -1$     e  $x = 2, y = 6$     f  $x = -3, y = 9$

- 5 a  $x = 3, y = 9$     b  $x = -1, y = 3$     c  $x = 1, y = 0$

- d  $x = 6, y = 11$     e  $x = 4, y = 3$     f  $x = 12, y = -3$

- g  $x = -18, y = -4$     h  $x = -2, y = 10$     i  $x = 2, y = -4$

- 6 a  $x = 2, y = 1$     b  $x = 1, y = 3$     c  $x = 0, y = 4$

- d  $x = 3, y = -2$     e  $x = 4, y = 1$     f  $x = -1, y = 4$

- 7 17, 31

- 8 10 tonnes, 19 tonnes

9 width =  $1\frac{2}{3}$  cm, length =  $3\frac{5}{6}$  cm

- 10  $x - (3x - 1) = x - 3x + 1$ , to avoid sign error use brackets when substituting

- 11 a  $x = \frac{1}{3}, y = 2\frac{1}{3}$     b  $x = -\frac{5}{6}, y = 6\frac{1}{3}$     c  $x = -22, y = -7$

12 a  $x = \frac{b}{a+b}, y = \frac{b^2}{a+b}$     b  $x = \frac{b}{a+1}, y = \frac{1}{a+1}$

c  $x = \frac{a-b}{2}, y = \frac{a+b}{2}$     d  $x = \frac{a-ab}{a-b}, y = \frac{a-ab}{a-b} - a$

e  $x = \frac{2a}{a-b}, y = \frac{2ab}{a-b} + a$     f  $x = \frac{2a+ab}{a-b} - b, y = \frac{2a+ab}{a-b}$

### Exercise 2J

- 1 a -            b +            c +            d -
- 2 a i subtraction    ii addition    iii subtraction  
 b i addition    ii subtraction    iii addition
- 3 a  $x=1, y=1$     b  $x=10, y=2$     c  $x=1, y=3$   
 d  $x=1, y=1$     e  $x=2, y=2$     f  $x=2, y=-1$
- 4 a  $x=2, y=4$     b  $x=8, y=-1$     c  $x=-2, y=6$
- 5 a  $x=-3, y=-13$     b  $x=2, y=3$     c  $x=1, y=3$
- 6 a  $x=-3, y=4$     b  $x=2, y=1$     c  $x=2, y=1$   
 d  $x=-2, y=3$     e  $x=7, y=-5$     f  $x=5, y=4$   
 g  $x=5, y=-5$     h  $x=-3, y=-2$     i  $x=-1, y=-3$
- 7 a  $x=3, y=-5$     b  $x=2, y=-3$     c  $x=2, y=4$   
 d  $x=3, y=1$     e  $x=-1, y=4$     f  $x=3, y=-2$   
 g  $x=5, y=-3$     h  $x=-2, y=-2$     i  $x=2, y=1$   
 j  $x=-5, y=-3$     k  $x=-3, y=9$     l  $x=-1, y=-2$
- 8 21 and 9    9 102, 78    10  $L=261.5$  m,  $W=138.5$  m
- 11 11 mobile phones, 6 iPods
- 12 a  $x=2, y=1$                       b  $x=2, y=1$   
 c method (b) is preferable as it avoids the use of a negative coefficient
- 13 rearrange one equation to make  $x$  or  $y$  the subject  
 a  $x=4, y=1$                       b  $x=-1, y=-1$
- 14 a no solution                      b no solution
- 15 a  $x=\frac{a+b}{2}, y=\frac{a-b}{2}$                       b  $x=\frac{b}{2a}, y=-\frac{b}{2}$   
 c  $x=\frac{-a}{2}, y=-\frac{3a}{2b}$                       d  $x=0, y=b$   
 e  $x=\frac{1}{3}, y=\frac{b}{3a}$                       f  $x=-\frac{4}{a}, y=6$   
 g  $x=\frac{3b}{7a}, y=\frac{b}{7}$                       h  $x=\frac{3b}{7a}, y=-\frac{b}{7}$   
 i  $x=0, y=\frac{b}{a}$                       j  $x=-\frac{c}{a}, y=c$   
 k  $x=\frac{b-4}{ab-4}, y=\frac{1-a}{ab-4}$                       l  $x=1, y=0$   
 m  $x=\frac{c-bd}{a(b+1)}, y=\frac{c+d}{b+1}$                       n  $x=\frac{a+2b}{a-b}, y=\frac{3a}{a-b}$   
 o  $x=\frac{3b}{a+3b}, y=\frac{3b-2a}{a+3b}$                       p  $x=-\frac{b}{a-bc}, y=\frac{bc-2a}{a-bc}$   
 q  $x=\frac{c+f}{a+d}, y=\frac{cd-af}{b(a+d)}$                       r  $x=\frac{c-f}{a-d}, y=\frac{af-cd}{b(a-d)}$

### Exercise 2K

- 1 a  $x+y=42, x-y=6$                       b  $x=18, y=24$   
 c One number is 18, the other number is 24
- 2 a  $l=w+5, 2l+2w=84$                       b  $L=23.5, w=18.5$   
 c length = 23.5 cm, width = 18.5 cm
- 3 a  $l=3w, 2l+2w=120$                       b  $L=45, w=15$   
 c length = 45 m, width = 15 m
- 4 a Let \$ $m$  be the cost of milk  
 Let \$ $c$  be the cost of chips

- b  $3m+4c=17, m+5c=13$   
 c  $m=3, c=2$   
 d bottle of milk costs \$3 and a bag of chips \$2.
- 5 a Let \$ $g$  be the cost of lip gloss.  
 Let \$ $e$  be the cost of eye shadow.  
 b  $7g+2e=69, 4g+3e=45$   
 c  $g=9, e=3$   
 d lip gloss \$9; eye shadow \$3
- 6 cricket ball \$12; tennis ball \$5
- 7 4 chips, 16 hot dogs
- 8 300 adults, 120 children
- 9 potatoes 480; corn 340
- 10 11 five-cent and 16 twenty-cent
- 11 Michael is 35 years old now.
- 12 Jenny \$100, Kristy \$50
- 13 160 adults and 80 children
- 14 5 hours
- 15 jogging 3 km/h, cycling 9 km/h
- 16 a Malcolm is 14 years old  
 b The second digit of Malcolm's age is 3 more than the first digit.  
 c 6: 14, 25, 36, 47, 58 or 69
- 17 Original number is 37
- 18 Any two-digit number that has the first digit 2 more than the second (e.g. 42 or 64 etc.)

### Challenges

- 1  $x=3$
- |   |   |   |
|---|---|---|
| 4 | 9 | 2 |
| 3 | 5 | 7 |
| 8 | 1 | 6 |
- 2 \$140
- 3 8
- 4 a i >            ii <            iii >            iv <  
 b  $c, b, a, d$
- 5  $x=1, y=-2, z=5$
- 6 a  $x=\frac{ab}{a-b}$     b  $x=\frac{10}{3}$     c  $x=-\frac{7}{11}$     d  $x=\frac{29}{4}$

### Multiple-choice questions

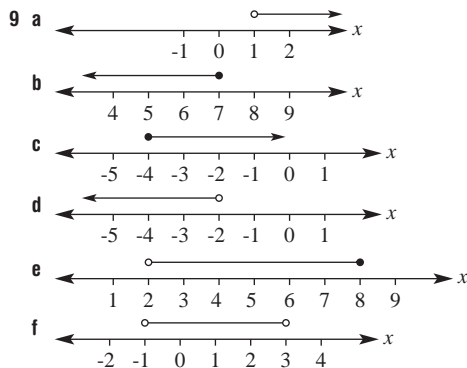
- 1 C    2 D    3 D    4 C    5 B    6 A  
 7 A    8 E    9 B    10 A    11 B    12 D

### Short-answer questions

- 1 a 7m            b  $2(x+y)$             c 3m            d  $\frac{n}{4}-3$
- 2 a -7            b 7            c 24            d 8
- 3 a  $8mn$             b  $\frac{xy}{3}$             c  $6b^2$             d  $4-3b$   
 e  $2mn+2m-1$                       f  $2p+4q$
- 4 a  $2x+14$             b  $-6x-15$             c  $6x^2-8x$   
 d  $-10a+8a^2$             e  $13-4x$             f  $27x-10$

- 5 a  $x=9$     b  $x=26$     c  $x=15$     d  $x=1$   
 e  $x=2$     f  $x=-9$     g  $x=-10$     h  $x=\frac{5}{7}$
- 6 a  $2n+3=21, n=9$     b  $\frac{l-5}{3}=7, l=26$     c  $\frac{x}{4}-5=0, x=20$
- 7 a  $x=5$     b  $x=1\frac{5}{6}$     c  $x=4$     d  $x=-5$   
 e  $x=1$     f  $x=4$

8 \$260



- 10 a  $x < 12$     b  $m > -1$     c  $y \geq -6$     d  $x < 17$   
 e  $a > 4$     f  $x \geq 2$

11  $n(\text{sales}) \geq \$24\,000$

- 12 a  $E=60$     b  $a=5$     c  $h=10$

- 13 a  $x = \frac{v^2 - u^2}{2a}$     b  $\theta = \frac{2A}{r^2}$     c  $l = \sqrt{\frac{P}{R}}$     d  $a = \frac{2S}{n} - 1$

- 14 a  $x=8, y=2$     b  $x=-\frac{3}{5}, y=-1\frac{3}{5}$     c  $x=4, y=11$   
 d  $x=11, y=4$     e  $x=-3, y=-5$     f  $x=4, y=1$

15 3 show bags, 6 rides

### Extended-response questions

- 1 a  $0 < b \leq 10$     b  $b = \frac{2A}{h} - a$     c 8 m    d  $h = \frac{2A}{a+b}$     e 8 m

2 a \$5 per ride

b i Let \$c be the cost of chips

Let \$d be the cost of a drink

ii  $2d + c = 11, 3d + 2c = 19$

iii  $d = 3, c = 5$

iv Chips cost \$5 per bucket and drinks cost \$3 each

## Chapter 3

### Pre-test

- 1 a 9    b 400    c 20    d 900  
 2 a 5.92    b 15.36    c 4.86    d 8.09  
 3 a  $x=2$     b  $x=4$     c  $x=5$     d  $x=13$   
 4 a  $x=3$     b  $x=4$     c  $x=5$     d  $x=8$

- 5 a 0.4568    b 0.3457    c 0.0456    d 0.2800  
 6 a 4.23    b 5.68    c 76.90    d 23.90  
 7 a  $x=2$     b  $x=3$     c  $x=12$     d  $x=6$   
 e  $x=12$     f  $x=30$     g  $x=28$     h  $x=182$   
 i  $x=9$     j  $x=2\frac{1}{2}$     k  $x=12$     l  $x=8$
- 8 a  $x=15.04$     b  $x=15.60$     c  $x=1.38$     d  $x=6.30$
- 9 a  $x=0.6$     b  $x=0.6$     c  $x=2.1$     d  $x=0.5$   
 e  $x=0.6$     f  $x=2.0$     g  $x=9.1$     h  $x=7.1$
- 10 a  $x=64$     b  $x=28$     c  $x=108$   
 d  $x=60$     e  $x=50$     f  $x=55$

### Exercise 3A

- 1 a 17    b 50    c  $\sqrt{8}$
- 2 a  $c^2 = a^2 + b^2$     b  $x^2 = y^2 + z^2$     c  $j^2 = k^2 + l^2$
- 3 a 81    b 10.24    c 13    d 106  
 e 6    f 10    g 4.90    h 3.61
- 4 a  $c=10$     b  $c=13$     c  $c=17$     d  $c=15$   
 e  $c=25$     f  $c=41$     g  $c=50$     h  $c=30$   
 i  $c=25$
- 5 a 4.47    b 3.16    c 15.62    d 11.35  
 e 7.07    f 0.15
- 6 a  $\sqrt{5}$     b  $\sqrt{58}$     c  $\sqrt{34}$     d  $\sqrt{37}$   
 e  $\sqrt{109}$     f  $\sqrt{353}$
- 7 a 21.63 mm    b 150 mm    c 50.99 mm  
 d 155.32 cm    e 1105.71 m    f 0.02 m
- 8 a 8.61 m    b 5.24 m    c 13.21 cm  
 d 0.19 m    e 17.07 mm    f 10.93 cm
- 9 42 units    10 4.4 m    11 250 m
- 12 495 m    13 2.4 m    14 a 5    b  $\frac{25}{3}$
- 15 5.83 m
- 16 a no    b no    c yes    d no    e yes    f yes
- 17 a 5.66 cm    b 5.66 cm, 4 cm    c yes
- 18 a 77.78 cm    b 1.39 m    c reduce by 8 cm  
 d 43.73 cm
- 19 42.43 cm, 66.49 cm

### Exercise 3B

- 1 a 14    b 11    c 12    d 20  
 e 4    f 24    g 8    h 8
- 2 a T    b F    c F    d T    e T    f F
- 3 a 16    b 24    c 6    d 21    e 60    f 27
- 4 a 8.66    b 11.31    c 5.11  
 d 17.55    e 7.19    f 0.74
- 5 a 30 cm    b 149.67 cm    c 1.65 cm  
 d 2.24 km    e 12 cm    f 52.92 mm
- 6 a  $\sqrt{\frac{25}{2}} = \frac{5}{\sqrt{2}}$     b  $\sqrt{8}$     c  $\sqrt{\frac{1521}{200}} = \frac{39}{\sqrt{200}} = \frac{39}{10\sqrt{2}}$
- 7 a  $\sqrt{187}$     b  $\sqrt{567}$     c 40

- 8 35.3 m    9 5.3 m    10 49 cm    11 1.86 m

12 a  $\sqrt{\frac{81}{5}} = \frac{9}{\sqrt{5}}$     b  $\sqrt{5}$     c  $\sqrt{\frac{5}{2}}$

13 a  $\frac{\sqrt{5}}{2}, 3\sqrt{\frac{5}{2}}$     b  $\frac{10}{\sqrt{13}}, \frac{15}{\sqrt{13}}$     c  $\frac{25}{\sqrt{74}}, \frac{35}{\sqrt{74}}$

- 14 a the side  $c$     b  $\sqrt{6}$     c no,  $c^2$  is enough  
d error due to rounding,  $x$  would not be exact

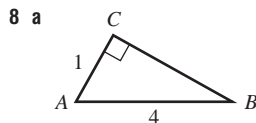
15 a i  $\sqrt{8}$     ii  $\sqrt{7}$     iii  $\sqrt{6}$

b OB: 2.6, OC: 2.79, OD: 2.96

c differ by 0.04; the small difference is the result of rounding errors

### Exercise 3C

- 1 a C, II    b A, III    c B, I  
2 142.9 m    3 3.0 m    4 3823 mm    5 1060 m  
6 a 6.4 m    b 5.7 cm    c 6.3 m    d 6.0 m  
7 466.18 m



b 3.9 cm

- 9 a 27 m    b 118.3 m

10 171 cm

11 a  $\frac{5}{\sqrt{2}}$     b  $6 + \frac{5}{\sqrt{2}}$     c 10.2

12 a 1.1 km    b 1.1 km    c 3.8 km

13 a 28.28 cm    b i 80 cm    ii 68.3 cm    iii 48.3 cm

### Exercise 3D

- 1 a yes    b yes    c no    d yes    e yes  
f no    g yes    h no    i yes

2 a 11.18    b 0.34    c 19.75

3 a 3.6    b 2.5    c 3.1

4 a 18 cm    b 7 mm    c 0.037 m

5 a  $\sqrt{2}$  cm    b 1.7 cm

6 a  $\sqrt{208}$  cm    b 15.0 cm

7 84 m    8 2.86 cm    9 1 :  $\sqrt{2}$

10 a i  $\sqrt{8}$  cm    ii 3.74 cm

b i  $\sqrt{50}$  cm    ii 5.45 cm

11 a  $\sqrt{65}$     b 8.06    c  $\sqrt{69}, 8.31$

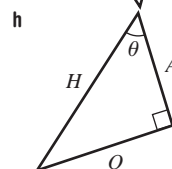
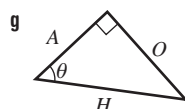
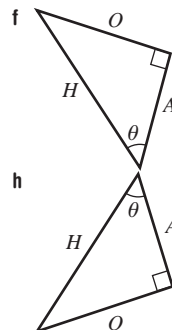
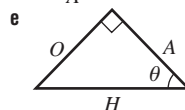
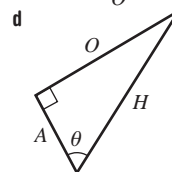
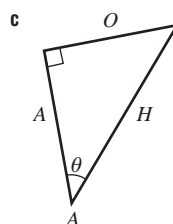
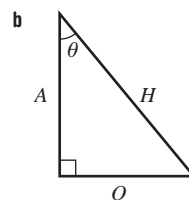
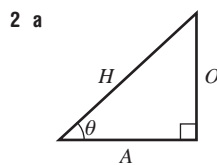
d 8.30    e Rounding errors have accumulated

12 a i 11.82 m    ii 12.15 m    iii 11.56 m    iv 11.56 m

b Shortest is 10.44 m

### Exercise 3E

- 1 a hypotenuse    b opposite    c adjacent  
d opposite    e hypotenuse    f adjacent



3 a 5    b 4    c 3    d 3    e 4

4 a  $\sin \theta = \frac{4}{7}$     b  $\tan \theta = \frac{5}{4}$     c  $\cos \theta = \frac{3}{5}$     d  $\sin \theta = \frac{2}{3}$

e  $\tan \theta = 1$     f  $\cos \theta = \frac{x}{y}$     g  $\tan \theta = \frac{4}{5}$     h  $\cos \theta = \frac{a}{2b}$

i  $\tan \theta = \frac{5y}{3x}$

5 a i  $\frac{5}{13}$     ii  $\frac{5}{13}$     iii the same

b i  $\frac{12}{13}$     ii  $\frac{12}{13}$     iii the same

c i  $\frac{5}{12}$     ii  $\frac{5}{12}$     iii the same

6 a  $\sin \theta = \frac{3}{5}$      $\cos \theta = \frac{4}{5}$      $\tan \theta = \frac{3}{4}$

b  $\sin \theta = \frac{12}{13}$      $\cos \theta = \frac{5}{13}$      $\tan \theta = \frac{12}{5}$

c  $\sin \theta = \frac{12}{13}$      $\cos \theta = \frac{5}{13}$      $\tan \theta = \frac{12}{5}$

7 a  $\frac{4}{5}$     b  $\frac{3}{5}$     c  $\frac{3}{5}$

d  $\frac{3}{4}$     e  $\frac{4}{5}$     f  $\frac{4}{3}$

8  $\frac{3}{4}$

9 a  $\frac{3}{5}$     b  $\frac{4}{5}$     c  $\frac{3}{4}$

10 a i 5

ii  $\sin \theta = \frac{3}{5}$

$\cos \theta = \frac{4}{5}$

$\tan \theta = \frac{3}{4}$

b i 25

ii  $\sin \theta = \frac{7}{25}$

$\cos \theta = \frac{24}{25}$

$\tan \theta = \frac{7}{24}$

c i 15

ii  $\sin \theta = \frac{9}{15} = \frac{3}{5}$

$\cos \theta = \frac{12}{15} = \frac{4}{5}$

$\tan \theta = \frac{9}{12} = \frac{3}{4}$

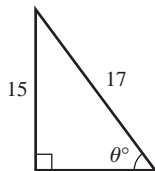
d i 10

ii  $\sin \theta = \frac{8}{10} = \frac{4}{5}$

$\cos \theta = \frac{6}{10} = \frac{3}{5}$

$\tan \theta = \frac{8}{6} = \frac{4}{3}$

11 a



b 8      c  $\sin \theta = \frac{15}{17}$ ,  $\cos \theta = \frac{8}{17}$ ,  $\tan \theta = \frac{15}{8}$

12 a i  $\frac{1}{2}$       ii  $\frac{\sqrt{3}}{2}$       iii  $\frac{1}{\sqrt{3}}$

iv  $\frac{\sqrt{3}}{2}$       v  $\frac{1}{2}$       vi  $\sqrt{3}$

b i they are equal      ii they are equal

13 a answers may vary

b i 0.766      ii 0.643      iii 0.839  
iv 0.766      v 1.192      vi 0.643

c  $\sin 40^\circ = \cos 50^\circ$ ,  $\sin 50^\circ = \cos 40^\circ$ ,  $\tan 50^\circ = \frac{1}{\tan 40^\circ}$   
 $\tan 40^\circ = \frac{1}{\tan 50^\circ}$

14 a yes, any isosceles right-angled triangle

b no, as it would require the hypotenuse (the longest side) to equal the opposite

c no, adjacent side can't be zero

d no, as the numerator < denominator for sin and cos as the hypotenuse is the longest side

15 a  $\sin \theta = \frac{3}{5}$        $\tan \theta = \frac{3}{4}$

b i  $\cos \theta = \frac{\sqrt{3}}{2}$        $\tan \theta = \frac{1}{\sqrt{3}}$

ii  $\tan \theta = \sqrt{3}$        $\sin \theta = \frac{\sqrt{3}}{2}$

iii  $\sin \theta = \frac{1}{\sqrt{2}}$        $\cos \theta = \frac{1}{\sqrt{2}}$

c equals one

d  $(\sin \theta)^2 + (\cos \theta)^2 = 1$  (the Pythagorean identity)

### Exercise 3F

- 1 a A      b 0      c H  
2 a sin      b tan      c cos  
3 a 0.34      b 0.80      c 2.05      d 0.73  
e 0.10      f 0.25      g 0.46      h 0.24  
4 a 3.06      b 18.94      c 5.03  
d 0.91      e 1.71      f 9.00  
g 2.36      h 4.79      i 7.60  
5 a 5.95      b 0.39      c 13.38      d 3.83  
e 8.40      f 1.36      g 29.00      h 1.62  
i 40.10      j 4.23      k 14.72      l 13.42  
m 17.62      n 5.48      o 9.75      p 1.01  
6 1.12 m      7 44.99 m      8 10.11 m  
9 a 20.95 m      b 10 cm  
10 a  $65^\circ$       b 1.69      c 1.69  
11 a i  $80^\circ$       ii  $62^\circ$       iii  $36^\circ$       iv  $9^\circ$   
b i both 0.173...      ii both 0.469...  
iii both 0.587...      iv both 0.156...  
c  $\sin \theta^\circ = \cos (90^\circ - \theta^\circ)$   
d i  $70^\circ$       ii  $31^\circ$       iii  $54^\circ$       iv  $17^\circ$   
12 a  $\sqrt{2}$   
b i  $\frac{1}{\sqrt{2}}$       ii  $\frac{1}{\sqrt{2}}$       iii 1      c  $\sqrt{3}$   
d i  $\frac{1}{2}$       ii  $\frac{\sqrt{3}}{2}$       iii  $\frac{1}{\sqrt{3}}$       iv  $\frac{\sqrt{3}}{2}$       v  $\frac{1}{2}$       vi  $\sqrt{3}$
- ### Exercise 3G
- 1 a  $x=2$       b  $x=5$       c  $x=3$       d  $x=4$   
e  $x=7$       f  $x=4$       g  $x=0.5$       h  $x=0.2$   
2 a 4.10      b 6.81      c 37.88      d 0.98  
e 12.80      f 14.43      g 9.52      h 114.83  
i 22.05  
3 a 13.45      b 16.50      c 57.90      d 26.33  
e 15.53      f 38.12      g 9.15      h 32.56  
i 21.75      j 49.81      k 47.02      l 28.70

- 4 a  $x = 7.5, y = 6.4$       b  $a = 7.5, b = 10.3$   
 c  $a = 6.7, b = 7.8$       d  $x = 9.5, y = 12.4$   
 e  $x = 12.4, y = 9.2$       f  $x = 21.1, y = 18.8$   
 g  $m = 56.9, n = 58.2$       h  $x = 15.4, y = 6.0$
- 5 40 m      6 3848 m
- 7 a 26 m      b 97 m      8 a 23.7 m      b 124.9 m
- 9 a B as student B did not use an approximation in their working out  
 b use your calculator and do not round  $\sin 31^\circ$  during working  
 c i difference of 0.42      ii difference of 0.03
- 10 a i 10.990      ii 11.695      b i 0.34      ii 0.94      iii 0.36  
 c equal to  $\tan 20^\circ$       d i  $\frac{b}{c}$       ii  $\frac{a}{c}$       iii  $\frac{b}{a}$       iv  $\frac{b}{a}$   
 e same as  $\tan \theta$

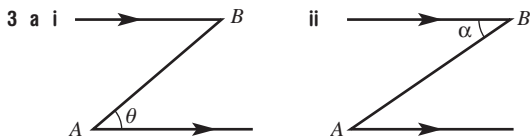
### Exercise 3H

- 1 a 11.54      b 64.16      c 41.41  
 d 64.53      e 26.57      f 68.20
- 2 a  $\frac{1}{2}$       b  $50^\circ$       c  $45^\circ = \tan^{-1}(1)$
- 3 a  $47^\circ$       b  $12^\circ$       c  $18^\circ$       d  $51^\circ$   
 e  $24^\circ$       f  $42^\circ$       g  $79^\circ$       h  $13^\circ$   
 i  $3^\circ$
- 4 a sine      b sine      c cosine      d tan
- 5 a  $30^\circ$       b  $60^\circ$       c  $45^\circ$       d  $30^\circ$   
 e  $45^\circ$       f  $30^\circ$       g  $90^\circ$       h  $50^\circ$   
 i  $90^\circ$       j  $55^\circ$       k  $0^\circ$       l  $70^\circ$
- 6 a  $34.85^\circ$       b  $19.47^\circ$       c  $64.16^\circ$       d  $75.52^\circ$   
 e  $36.87^\circ$       f  $38.94^\circ$       g  $30.96^\circ$       h  $57.99^\circ$   
 i  $85.24^\circ$
- 7 a  $43^\circ$       b  $31^\circ$       c  $41^\circ$       d  $16^\circ$   
 e  $55^\circ$       f  $50^\circ$       g  $49^\circ$       h  $41^\circ$
- 8  $17^\circ$       9  $23.13^\circ$       10  $25.4^\circ$       11  $26.6^\circ$
- 12 a  $128.7^\circ$       b  $72.5^\circ$       c  $27.3^\circ$
- 13 a  $90^\circ, 37^\circ, 53^\circ$       b  $90^\circ, 23^\circ, 67^\circ$       c  $90^\circ, 16^\circ, 74^\circ$
- 14  $45^\circ$       15  $\angle ACM = 18.4^\circ$   $\angle ACB = 33.7^\circ$ , no it is not half
- 16 a  $18^\circ$       b  $26^\circ$       c  $45^\circ$       d 5.67 m      e up to  $90^\circ$

### Exercise 3I

1  $a = 65, b = 25$

2 a  $22^\circ$       b  $22^\circ$



b yes,  $\theta = \alpha$ , alternate angles are equal on parallel lines

- 4 29 m      5 16 m      6 157 m      7 38 m  
 8 90 m      9  $37^\circ$       10  $6^\circ$       11  $10^\circ$   
 12 yes by 244.8 m      13 a  $6^\circ$       b 209 m  
 14 4634 mm      15  $15^\circ, 4319$  mm      16 1.25 m

- 17 a 6.86 m      b  $26.6^\circ$       c i  $m = h + y$   
 ii  $y = x \tan \theta$       iii  $m = h + x \tan \theta$
- 18  $A = \frac{1}{2} a^2 \tan \theta$
- 19 a i 47.5 km      ii 16.25 km      b no,  $\sin(2 \times \theta) < 2 \times \sin \theta$   
 c yes,  $\sin\left(\frac{1}{2}\theta\right) > \frac{1}{2} \sin \theta$
- 20 a yes      b 12.42 km  
 c no, after 10 mins will be above 4 km  
 d 93 km/h or more
- 21 a 1312 m      b 236.16 km/h

### Exercise 3J

- 1 a  $0^\circ$       b  $045^\circ$       c  $090^\circ$       d  $135^\circ$   
 e  $180^\circ$       f  $225^\circ$       g  $270^\circ$       h  $315^\circ$
- 2 a  $070^\circ$       b  $130^\circ$       c  $255^\circ$       d  $332^\circ$
- 3 a i  $040^\circ\text{T}$       ii  $220^\circ\text{T}$       b i  $142^\circ\text{T}$       ii  $322^\circ\text{T}$   
 c i  $210^\circ\text{T}$       ii  $030^\circ\text{T}$       d i  $288^\circ\text{T}$       ii  $108^\circ\text{T}$   
 e i  $125^\circ\text{T}$       ii  $305^\circ\text{T}$       f i  $067^\circ\text{T}$       ii  $247^\circ\text{T}$   
 g i  $330^\circ\text{T}$       ii  $150^\circ\text{T}$       h i  $228^\circ\text{T}$       ii  $048^\circ\text{T}$   
 i i  $206^\circ\text{T}$       ii  $26^\circ\text{T}$
- 4 3.28 km      5 59.45 km      6 3.4 km      7 11 km
- 8 a 39 km      b  $320^\circ\text{T}$       9 a 11.3 km      b  $070^\circ\text{T}$
- 10 310 km      11 3.6 km      12 6.743 km
- 13 a  $180 + a$       b  $a - 180$
- 14 a  $320^\circ$       b  $245^\circ$       c  $065^\circ$       d  $238^\circ$       e  $278^\circ$
- 15 a 620 km      b 606 km      c 129 km
- 16 a i 115 km      ii 96 km      b 158 km  
 c i 68 km      ii 39.5 min

### Investigation

- a 45 m      b 42.4 km      c 78 m  
 d top  $\angle = 20^\circ$       bottom  $\angle = 9^\circ$        $\therefore$  viewing  $\angle = 11^\circ$

### Challenges

- 1  $P = 4 + 2\sqrt{8}$       2  $10\text{ m}^2$       3 15 cm      4  $010^\circ$   
 5 round peg square hole      6  $122^\circ$   
 7 a i 3, 4, 5      ii 5, 12, 13      b  $m^2 + n^2$

### Multiple-choice questions

- 1 A      2 B      3 A      4 C      5 B  
 6 C      7 D      8 C      9 A      10 B

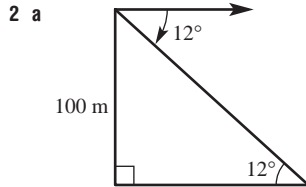
### Short-answer questions

- 1 a 37      b  $\sqrt{12}$       c  $\sqrt{50}$   
 2 4.49 m      3 a 13 cm      b 13.93 cm      4 19 m  
 5 a 4.91 m      b  $x = 2.83, h = 2.65$   
 6 a 0.64      b 2.25      c 0.72

- 7 a 11.33    b 48.02    c 50.71  
 8 28.01 m    9 25 m    10 a 59.45 km    b 53.53 km  
 11 177.91 m    12 053.13°    13 63.2 m    14 5.3 m  
 15 a 52.5 km    b 13.59 km

**Extended-response questions**

- 1 a 2.15 m    b 0.95 m    c i 3.05 m    ii yes

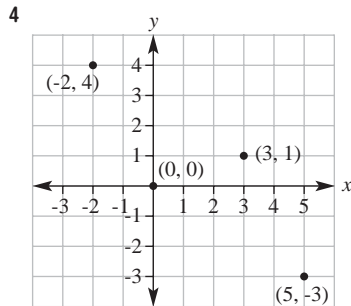


- b 470 m    c 3°    d 1530 m  
 3 a 35 km    b 399 km

**Chapter 4**

**Pre-test**

- 1 a 3    b -4    c 4    d -3  
 2 a 1    b 7    c -5    d -8  
 3 a  $x=4$     b  $x=-2$     c  $x=4$   
 d  $x=-4$     e  $x=5$     f  $x=6$

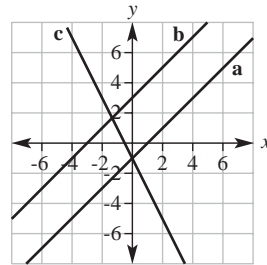


- 5 a 7    b 6.5    c 3    d -5  
 6 a 5    b 4    c 5    d 3  
 7 a 4    b 5    c 7    d 3  
 8 a  $y=2x+5$     b  $y=-3x+2$   
 c  $y=2x+3$     d  $y=6x-8$   
 9 a False    b True    c True    d False  
 10 a 2    b -5    c -3    d 9

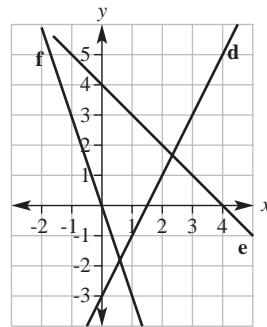
**Exercise 4A**

- 1 a A (4, 1)    B (2, 3)    C (0, 3)    D (-2, 2)  
 E (-3, 1)    F (-1, 0)    G (-3, -2)    H (-2, -4)  
 I (0, -3)    J (2, -2)    K (3, -4)    L (2, 0)  
 b i F, L    ii C, I    c i D, E    ii J, K  
 2 a 2    b -1    c -4    d -7  
 3 a 1    b -5    c 3    d 21

- 4 a
- |   |    |    |    |    |   |   |   |
|---|----|----|----|----|---|---|---|
| x | -3 | -2 | -1 | 0  | 1 | 2 | 3 |
| y | -4 | -3 | -2 | -1 | 0 | 1 | 2 |
- b
- |   |    |    |    |   |   |   |   |
|---|----|----|----|---|---|---|---|
| x | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| y | 0  | 1  | 2  | 3 | 4 | 5 | 6 |
- c
- |   |    |    |    |    |    |    |    |
|---|----|----|----|----|----|----|----|
| x | -3 | -2 | -1 | 0  | 1  | 2  | 3  |
| y | 5  | 3  | 1  | -1 | -3 | -5 | -7 |
- a  $y=x-1$     b  $y=x+3$     c  $y=-2x-1$



- d
- |   |    |    |    |    |    |   |   |
|---|----|----|----|----|----|---|---|
| x | -3 | -2 | -1 | 0  | 1  | 2 | 3 |
| y | -9 | -7 | -5 | -3 | -1 | 1 | 3 |
- e
- |   |    |    |    |   |   |   |   |
|---|----|----|----|---|---|---|---|
| x | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| y | 7  | 6  | 5  | 4 | 3 | 2 | 1 |
- f
- |   |    |    |    |   |    |    |    |
|---|----|----|----|---|----|----|----|
| x | -3 | -2 | -1 | 0 | 1  | 2  | 3  |
| y | 9  | 6  | 3  | 0 | -3 | -6 | -9 |
- d  $y=2x-3$     e  $y=-x+4$     f  $y=-3x$

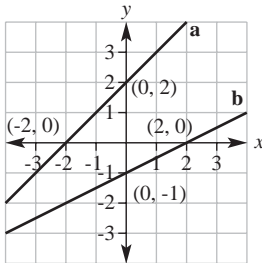


- 5 a (1, 0) (0, 1)    b (-2, 0) (0, 2)    c (4, 0) (0, 8)  
 d (-5, 0) (0, 10)    e (2, 0) (0, 3)    f (7, 0) (0, -3)  
 g (-11, 0) (0, 5)    h (-2, 0) (0, -5)  
 6 a  $y=-2x+3$     b  $y=3x-1$     c  $y=-3x+2$   
 d  $y=x+2$     e  $2x-y=1$     f  $3x+y=4$   
 g  $x-3y=1$     h  $2x-7y=-2$   
 7 a  $y=x+2$     b  $y=2x$     c  $y=2x+1$     d  $y=-x+2$   
 8 a  $y=-\frac{2}{3}x+2$     b  $y=\frac{3}{4}x-\frac{3}{4}$     c  $y=x-4$   
 d  $y=2x+7$     e  $y=\frac{1}{3}x-\frac{1}{3}$     f  $y=\frac{4}{7}x-\frac{10}{7}$   
 9 A c, B d, C b, D a  
 10 a False    b True    c True    d False  
 11 a For  $\frac{1}{2}$  across, graph moves 1 down.  
 b For  $\frac{1}{2}$  across, graph moves 1 up.

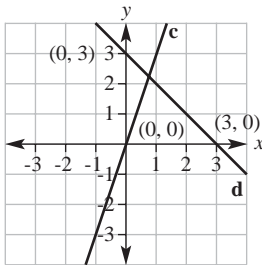
- 12 a yes    b no    c no    d yes  
 13 a  $y=2x+7$     b  $y=-x+20$     c  $y=-3x-10$   
 d  $y=-5x+4$     e  $y=\frac{1}{2}x+\frac{1}{2}$     f  $y=-\frac{1}{2}x-\frac{3}{2}$

**Exercise 4B**

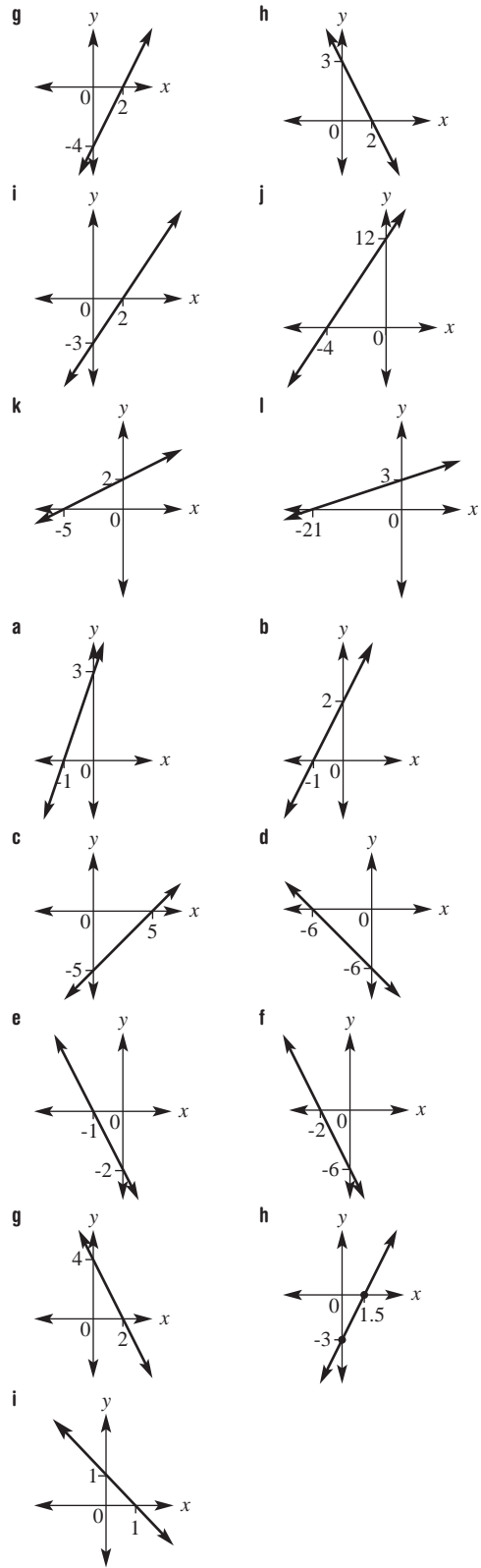
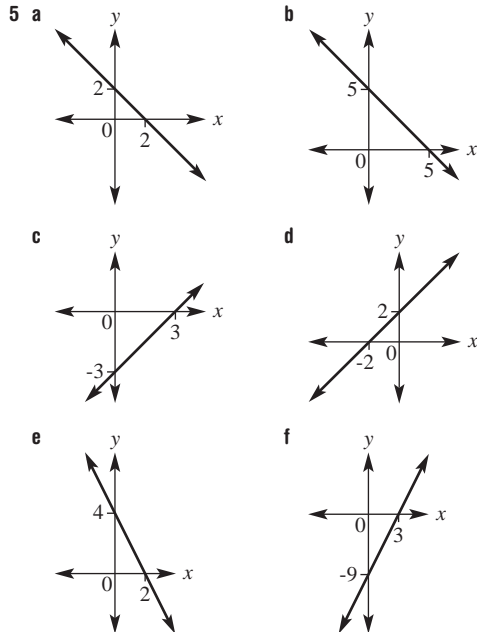
- 1 a  $y=x+2$     b  $y=\frac{1}{2}x-1$



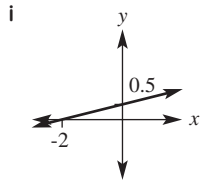
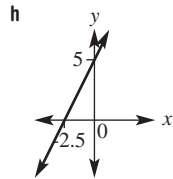
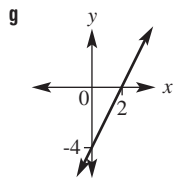
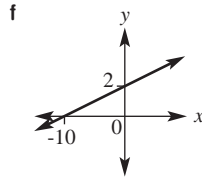
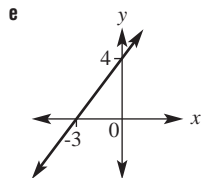
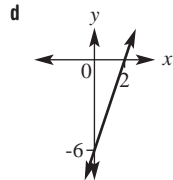
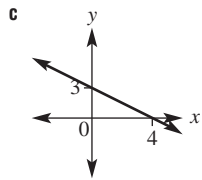
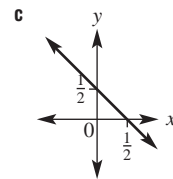
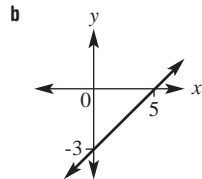
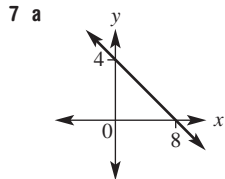
- c  $y=3x$     d  $y=-x+3$



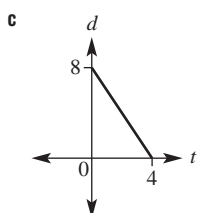
- 2 a i 3    ii 4    iii -3    iv -1    v -6    vi 4  
 b i 6    ii 10    iii 1    iv 2    v 6    vi -3  
 3 a (0, 4)    b (0, -5)    c (0, 3)    d (0, -4)  
 4 a (5, 0)    b (-2, 0)    c (3, 0)    d (2, 0)





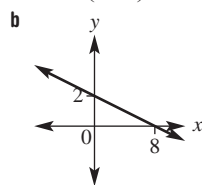
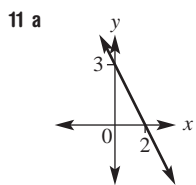


8 a 8 m    b 4 seconds



9 a 100 m  
10 a  $(\frac{2}{3}, 0)$   $(0, -2\frac{1}{2})$   
c  $(6\frac{1}{2}, 0)$   $(0, -13)$   
e  $(3, 0)$   $(0, -1\frac{1}{2})$

b 12.5 s  
b  $(-7, 0)$   $(0, -1\frac{2}{5})$   
d  $(-\frac{1}{2}, 0)$   $(0, -1)$   
f  $(\frac{1}{3}, 0)$   $(0, -\frac{1}{7})$

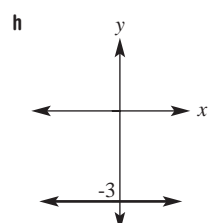
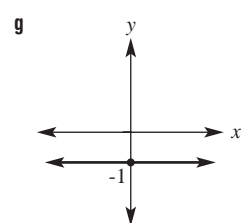
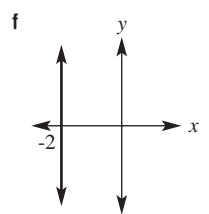
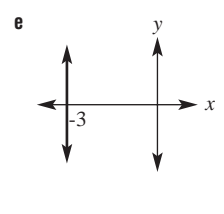
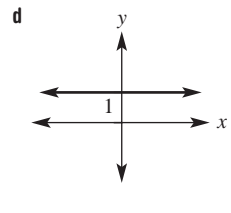
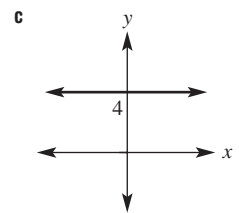
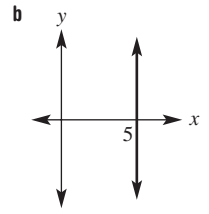
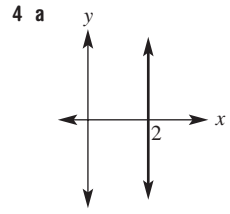


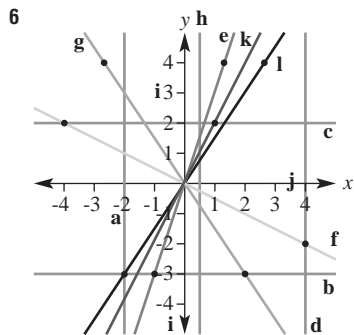
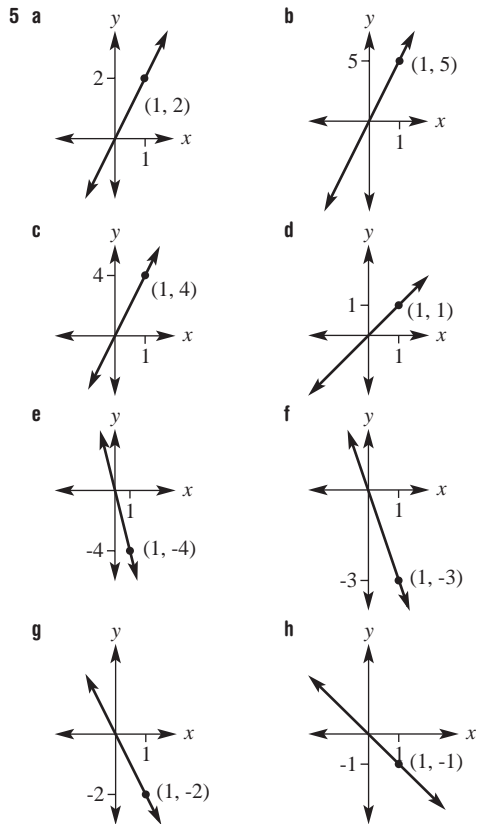
12  $(0, 0)$  is the  $x$ - and  $y$ -intercept for all values of  $a$  and  $b$   
13 a  $x + y = 4$     b  $x + y = 2$     c  $x - y = 3$   
d  $x - y = -1$     e  $x + y = k$     f  $x + y = -k$

14 a  $(\frac{c}{a}, 0)$ ,  $(0, \frac{c}{b})$     b  $(-\frac{cb}{a}, 0)$ ,  $(0, c)$     c  $(\frac{c}{a}, 0)$ ,  $(0, -\frac{c}{b})$   
d  $(-\frac{c}{b}, 0)$ ,  $(0, \frac{c}{a})$     e  $(-\frac{c}{b}, 0)$ ,  $(0, \frac{c}{a})$     f  $(\frac{bc}{a}, 0)$ ,  $(0, \frac{bc}{a})$

**Exercise 4C**

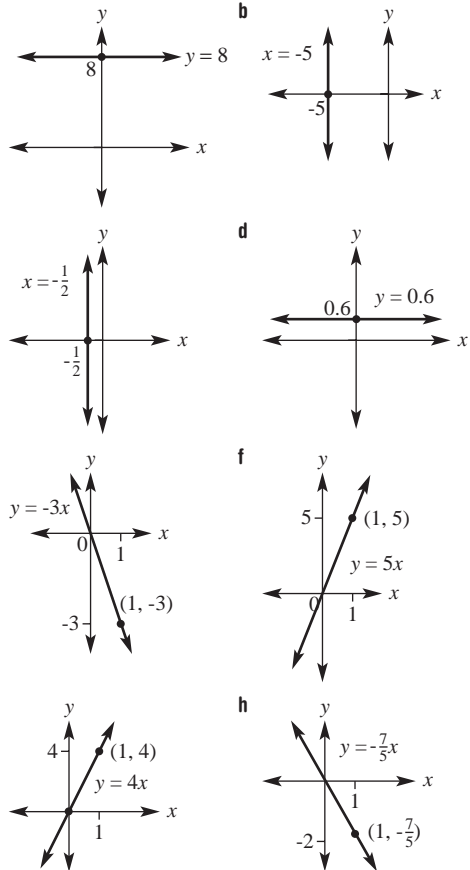
1 a  $(2, 0)$     b  $(-3, 0)$     c  $(0, 0)$   
2 a  $(0, 3)$     b  $(0, -2)$     c  $(0, 0)$     d  $(0, 0)$   
3 a 5    b  $\frac{1}{3}$     c -4    d -0.1





- 7 a  $y = -2$     b  $y = 4$     c  $x = -2$   
 d  $x = 5$     e  $y = 1.5$     f  $x = -6.7$
- 8 a  $y = 3$     b  $x = 5$     c  $x = -2$     d  $y = 0$
- 9 a  $y = 250$     b  $y = -45$
- 10 a (1, 2)    b (-3, 5)    c (0, -4)  
 d (4, 0)    e (0, 0)    f (1, 3)  
 g (3, -27)    h (5, 40)    i (3, 15)
- 11 a  $A = 15$  square units    b  $A = 68$  square units
- 12 a i  $y = 1$  or  $y = -5$     ii  $y = 0$  or  $y = -4$   
 iii  $y = 3\frac{1}{2}$  or  $y = -7\frac{1}{2}$   
 b i  $y = 1$  or  $y = -5$     ii  $y = 7$  or  $y = -11$   
 iii  $y = 9\frac{1}{2}$  or  $y = -13\frac{1}{2}$

- 13 a  $y = 2x$     b  $y = -x$     c  $y = 3x$     d  $y = -3x$   
 14 a  $y = 3x$     b  $y = 4x$     c  $y = -5x$     d  $y = -2x$   
 15 a



- 16  $x = -1, y = -5, y = 5x$   
 17 a (b, c)    b  $m = \frac{c}{b}$     18  $m = \frac{1}{2}$

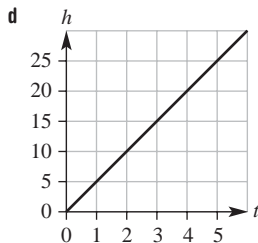
Exercise 4D

- 1 a 2    b  $\frac{1}{2}$     c 3    d -1    e -3    f  $-\frac{1}{4}$
- 2 a zero    b negative    c positive    d undefined
- 3 a positive, 1    b positive, 2    c zero    d zero  
 e negative,  $-\frac{2}{3}$     f negative,  $-\frac{3}{4}$     g undefined    h undefined
- i positive,  $\frac{1}{2}$     j positive, 3    k positive, 2    l negative, -4
- 4 a 2    b 1    c  $-\frac{1}{4}$     d  $\frac{4}{3}$     e 2    f -2  
 g -1    h  $\frac{1}{2}$     i  $\frac{3}{2}$     j  $-\frac{5}{2}$     k  $\frac{1}{3}$     l  $\frac{5}{2}$
- 5 A 1    B -2    C 1    D  $\frac{1}{2}$     E -2    F 3
- 6 a  $\frac{1}{20}$     b 17.5    c  $-\frac{1}{5}$     d 7.5
- 7 a 6    b -1    c 4    d  $-\frac{1}{2}$

- 8 300 m
- 9 A (0, 9)    B (-4, 0)    C (-1, 0)  
 D (0, 4)    E (0, -0.4)    F (2.4, 0)
- 10  $\frac{7}{11} = \frac{35}{55}$ ,  $\frac{3}{5} = \frac{33}{55}$  hence  $\frac{7}{11} > \frac{3}{5}$  so  $\frac{7}{11}$  is steeper
- 11 a run =  $x_2 - x_1$     b rise =  $y_2 - y_1$     c  $m = \frac{y_2 - y_1}{x_2 - x_1}$
- d i  $m = \frac{3}{2}$     ii  $m = \frac{5}{4}$     iii  $m = -\frac{5}{3}$     iv  $m = \frac{4}{3}$
- e yes, the rise and the run work out regardless
- 12 a i -1    ii -3    b (4.5, 0)
- c i (6, 0)    ii (2.4, 0)    iii  $(\frac{2}{7}, 0)$     iv (7.5, 0)

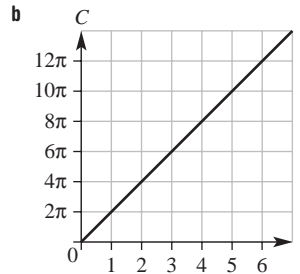
### Exercise 4E

- 1 a i 10 km    ii 20 km    iii 30 km  
 b 10 km/h    c 10    d they are the same
- 2 a 15 mm    b i 6 days    ii 20 days
- c
- |     |   |   |    |    |    |
|-----|---|---|----|----|----|
| $t$ | 0 | 1 | 2  | 3  | 4  |
| $h$ | 0 | 5 | 10 | 15 | 20 |



- e  $m = 5$
- 3 a 100 L/hour
- b
- 
- c i 100    ii  $V = 100t$     d i  $V = 150L$     ii  $t = 20$  hours
- 4 a 25 km/h
- b
- 
- c i 25    ii  $d = 25t$     d i 62.5 km    ii 1.6 hours
- 5 a  $d = 50t$     b  $g = 2t$     c  $C = 1.25n$     d  $P = 20t$
- 6 a 100 km/h    b 7 cm/s    c 2.5 cm/minute    d 49 mm/min
- 7 a 10.2 L    b 72.25 L    c 800 km

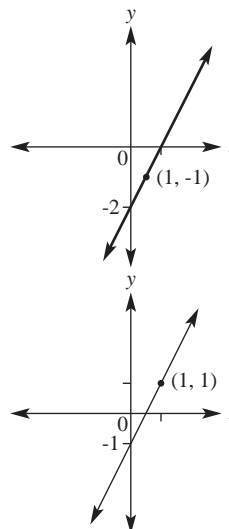
- 8 Sally    9 Leopard    10 25 months
- 11 a i 0    ii  $4\pi$     iii  $12\pi$



- c gradient is  $2\pi$ , the coefficient of  $r$
- 12 No,  $A = \pi r^2$  so area ( $A$ ) is proportional to square of radius ( $r^2$ ).
- 13 a  $A = 2h$   
 b  $2 \text{ cm}^2$  increase for each 1 cm increase in height
- 14 Yes, for any fixed time, e.g.  $t = 5$ ,  $s = \frac{d}{5}$
- 15 1.2 mins or 72 seconds    16  $\frac{5}{12} \text{ km}$

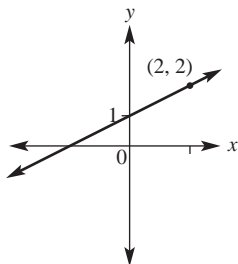
### Exercise 4F

- 1 a  $y = 2x + 5$     b  $y = 3x - 1$     c  $y = -2x + 3$   
 d  $y = -x - 2$     e  $y = -\frac{1}{2}x - 10$     f  $y = -\frac{2}{3}x + \frac{5}{2}$
- 2 a 1    b -5    c -5    d -11    e 9    f 2
- 3 a  $y = x + 7$     b  $y = -x + 3$     c  $y = 2x + 5$
- 4 a gradient = 3,  $y$ -intercept = -4  
 b gradient = -5,  $y$ -intercept = -2  
 c gradient = -2,  $y$ -intercept = 3  
 d gradient =  $\frac{1}{3}$ ,  $y$ -intercept = 4  
 e gradient = -4,  $y$ -intercept = 0  
 f gradient = 2,  $y$ -intercept = 0  
 g gradient = 2.3,  $y$ -intercept = 0  
 h gradient = -0.7,  $y$ -intercept = 0
- 5 a 1, -2,

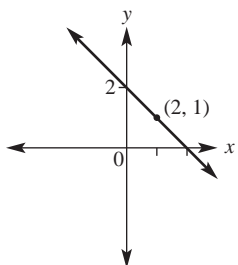


- b 2, -1,

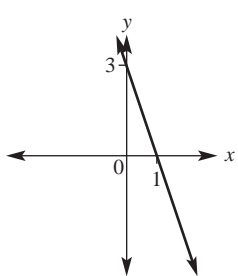
c  $\frac{1}{2}, 1,$



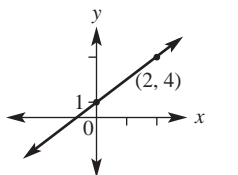
d  $-\frac{1}{2}, 2,$



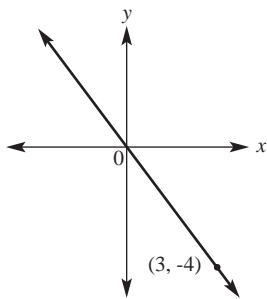
e  $-3, 3,$



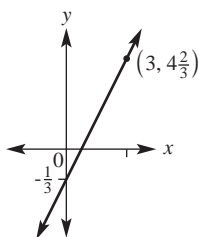
f  $\frac{3}{2}, 1,$



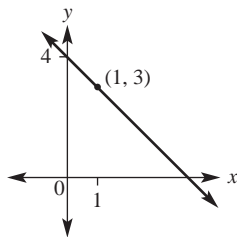
g  $-\frac{4}{3}, 0,$



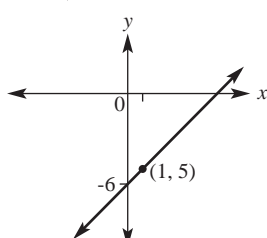
h  $\frac{5}{3}, \frac{1}{3},$



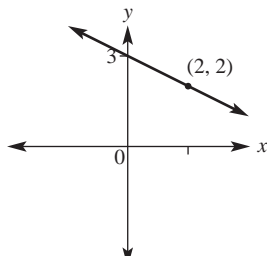
6 a  $-1, 4,$



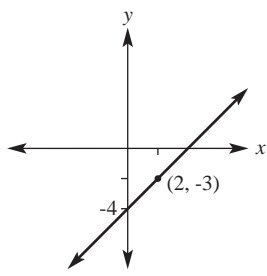
b  $1, -6,$



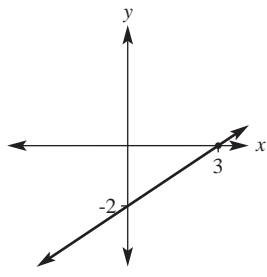
c  $-\frac{1}{2}, 3,$



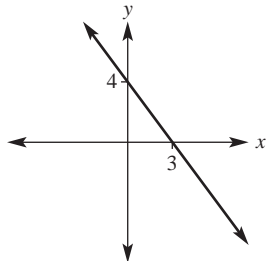
d  $\frac{1}{2}, -4,$



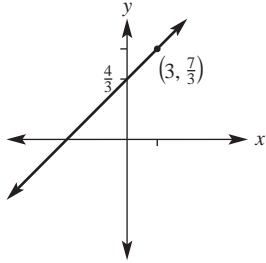
e  $\frac{2}{3}, -2,$



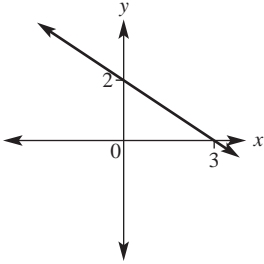
f  $-\frac{4}{3}, 4,$



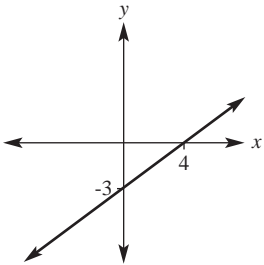
g  $\frac{1}{3}, \frac{4}{3}$ ,



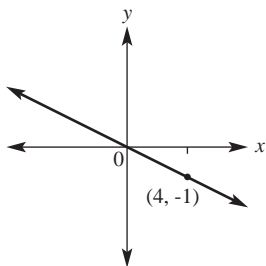
h  $-\frac{2}{3}, 2$ ,



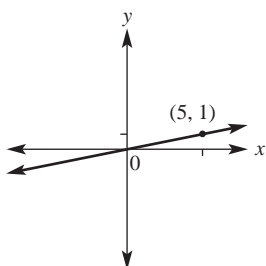
i  $\frac{3}{4}, -3$ ,



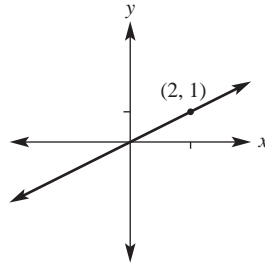
j  $-\frac{1}{4}, 0$ ,



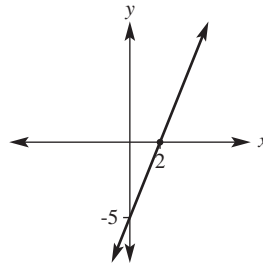
k  $\frac{1}{5}, 0$ ,



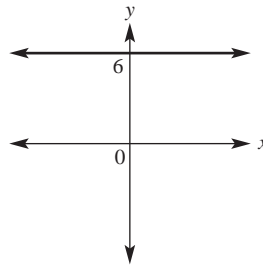
l  $\frac{1}{2}, 0$ ,



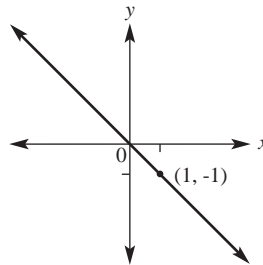
- 7 a yes b no c yes d yes e no f no  
 8 a no b yes c no d no e yes f no  
 9 i d ii f iii c iv b v e vi a  
 10 a



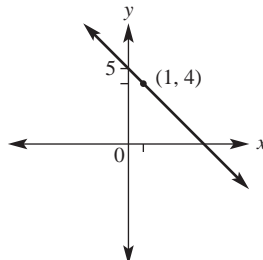
b

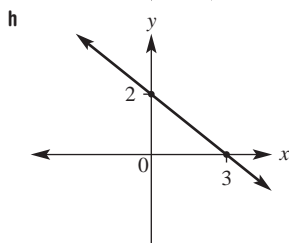
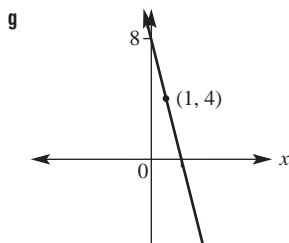
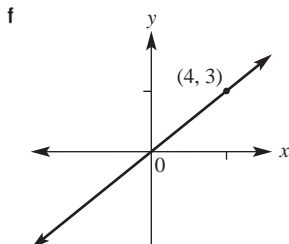
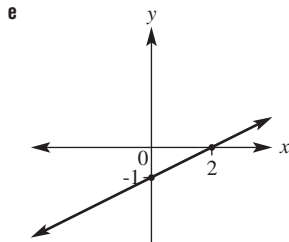


c



d





11 a no    b no    c yes    d no

12 c, d, f, h

13 a  $y = 2x + 2$ , y-intercept is 2    b expand brackets and simplify

14  $y = k$     15  $y = -\frac{a}{b}x + \frac{d}{b}$ ,  $m = -\frac{a}{b}$ ,  $c = \frac{d}{b}$

16 a  $y = 2x + 3$     b  $y = -x + 2$     c  $y = \frac{5}{3}x + \frac{2}{3}$   
 d  $y = -\frac{2}{5}x - \frac{1}{5}$

### Exercise 4G

- 1 a  $y = 2x + 5$     b  $y = 4x - 1$   
 c  $y = -2x + 5$     d  $y = -x - \frac{1}{2}$
- 2 a 1    b 3    c 9    d 10    e 5    f 2
- 3 a  $y = x + 3$     b  $y = x + 2$     c  $y = -2x - 4$   
 d  $y = 2x - 2$     e  $y = 8x + 8$     f  $y = -x + 4$

4 a  $y = \frac{3}{4}x + 3$     b  $y = -\frac{3}{4}x + 3$     c  $y = -\frac{5}{4}x + 3$

d  $y = \frac{3}{2}x + 4$     e  $y = \frac{3}{5}x$     f  $y = -\frac{1}{3}x - 1$

5 a  $y = 3x + 5$     b  $y = -2x - 1$     c  $y = -3x + 8$

d  $y = x - 3$     e  $y = -3x + 3$     f  $y = 5x - 1$

g  $y = -x + 8$     h  $y = -3x + 6$     i  $y = -2x + 2$

j  $y = -4x - 9$

6 a i 2    ii  $y = 2x + 2$     b i -1    ii  $y = -x + 3$

c i -4    ii  $y = -4x + 11$     d i 1    ii  $y = x - 4$

7  $x = 2\frac{1}{2}$     8  $(\frac{3}{5}, 0), (0, -\frac{3}{4})$

9  $V = -20t + 120$ ,  $V = 120$  L initially

10 a  $y = 5x$     b  $y = 6.5x + 2$

11 a 1    b 8    c -6    d  $\frac{5}{2}$

12 a  $c = 3$     b  $c = 3$

c no, y-intercept is fixed for any given line

13  $y = -\frac{b}{a}x$

14 a  $y = 2x$     b  $y = -2x + 4$     c  $y = 2x + 5$

d  $y = -\frac{3}{2}x + 2$     e  $y = \frac{5}{7}x + \frac{1}{7}$     f  $y = -\frac{13}{3}x - \frac{11}{3}$

### Exercise 4H

1 a 4    b 8    c 1    d -3

2 a 5.5    b 2.5    c -1.5    d -2.5

3 a 2.24    b 8.60    c 10.20

4 a (3, 3)    b (2, 2)    c (1, 5)    d (4, 1)

e (-1, 3)    f (-1, -1)    g (1.5, 1.5)    h (2.5, 2)

i (0.5, 3)    j (-1.5, -2.5)    k (-3, -8.5)    l (0.5, -2.5)

5 a 5.10    b 2.83    c 5.39    d 4.47

e 3.61    f 2.83    g 8.94    h 7.21

i 6.71

6 B(8, 0) A(-6, 5) A(-6, 9)

7 a (-3, 1)    b (1, -4)    c (8, 2.5)

8 a 12.8    b 24.2

9 (0, 0) (0, 4) (2, 0) (2, 4)

10 a  $x = \frac{x_1 + x_2}{2}$     b  $y = \frac{y_1 + y_2}{2}$     c M(1, -0.5)

11 a i  $x_2 - x_1$     ii  $y_2 - y_1$     iii  $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

12 a  $\frac{1}{3}$     b  $\frac{1}{3}$

c i (1, 1)    ii (-2, -0.5)    iii (2, 1.5)

d i (-1, 1)    ii (-2, 5)    iii (0.4, -1.8)    iv (-2.4, 2.6)

### Exercise 4I

- 1 a yes    b yes    c no  
 d yes    e no    f yes

2 a  $-\frac{1}{5}$     b  $-\frac{1}{10}$     c  $\frac{1}{3}$     d  $\frac{1}{6}$

3 a yes    b no    c no    d yes

4 a  $y = 2x + 1$     b  $y = 4x + 8$     c  $y = -x + 5$

d  $y = -2x - 7$     e  $y = \frac{2}{3}x - 5$     f  $y = -\frac{4}{5}x + \frac{1}{2}$

5 a  $y = -\frac{1}{3}x + 3$     b  $y = -\frac{1}{5}x + 7$     c  $y = \frac{1}{2}x - 4$

d  $y = x + 4$     e  $y = \frac{1}{7}x - \frac{1}{2}$     f  $y = -x + \frac{5}{4}$

6 a i  $y = 1$     ii  $y = -3$     iii  $y = 6$     iv  $y = -2$

b i  $x = 3$     ii  $x = -4$     iii  $x = 1$     iv  $x = -3$

c i  $x = 2$     ii  $x = -1$     iii  $x = 0$     iv  $x = 3$

d i  $y = 7$     ii  $y = -\frac{1}{2}$     iii  $y = 3$     iv  $y = \frac{1}{2}$

7 a  $y = -3x + 9$     b  $y = \frac{1}{2}x + \frac{5}{2}$

c  $y = -\frac{1}{5}x + 6\frac{1}{5}$     d  $y = x + 5$

8  $y = 0, y = x + 3, y = -x + 3$     9  $y = 2x - 10$  or  $y = 2x + 10$

10 a i  $\frac{3}{2}$     ii -5    iii 7    iv  $\frac{11}{3}$     b  $-\frac{b}{a}$

11 a i  $-\frac{1}{2}$     ii 3    b i 1    ii  $-\frac{1}{7}$

12 a  $y = -\frac{1}{2}x + 4$     b  $y = \frac{2}{3}x + 1\frac{2}{3}$     c  $y = 2x - 3$

d  $y = -2x - 5\frac{1}{2}$     e  $y = \frac{3}{7}x - \frac{5}{7}$     f  $y = -\frac{5}{6}x + \frac{1}{6}$

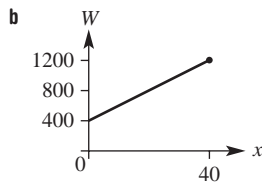
### Exercise 4J

1 B

2 a i \$1200    ii \$1500    iii \$2200    b  $A = 1000 + 100n$

3 a 46    b 3.5    c 2    d 3

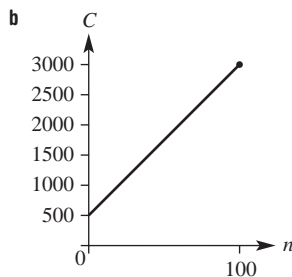
4 a  $W = 20x + 400$



c \$640    d 30

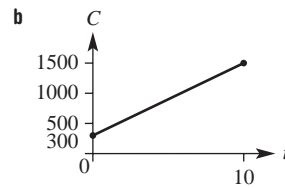
5 a  $C = 50n + 40$     b \$240    c \$640

6 a  $C = 25n + 500$



c \$1500    d 70

7 a  $C = 120t + 300$



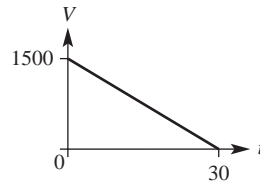
c \$1020    d 3 hours

8 a  $F = 18t + 12$     b 3 minutes    c 2.5 minutes

9 a  $V = 4000 - 20t$     b 2200 L    c 175 minutes

d 2 hours 55 minutes or 175 minutes

10 a



b  $V = 1500 - 50t$

c the number of litres drained per minute

d 1250 L    e 15 minutes

11 a 80 km/h

b rate changes i.e. new gradient = 70,  $d = 50 + 70t$

12 a 20 m/sec    b -20 m/sec    c 350 m

d 17.5 sec    e increasing altitude at rate of 20 m/sec

13 a i  $C = 0.4n + 20$     ii 160

b i  $P = 0.8n - 20$     ii 25    iii 120

14 a  $C = 10x + 6700$     b \$8700

c 630    d \$11700

e 670    f  $P = 10x - 6700$

g  $T = \frac{10x - 6700}{x}$     h 1340

### Exercise 4K

1 a (1, 3)    b (-1, 2)    c (2, 2)

2 a True    b False    c False    d True

3 a yes    b yes    c yes

4 a yes    b yes    c no    d no

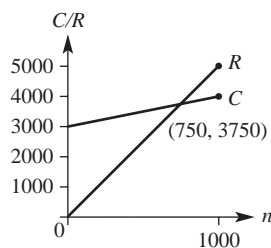
e yes    f yes    g no    h no

5 a (2, 2)    b (3, 2)    c (2, -4)    d (3, 2)

e (2, 1)    f (3, 7)    g (1, 2)    h (2, 4)

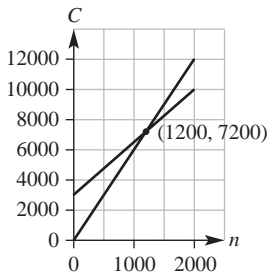
i (4, 1)    j (-1, 3)    k (-1, -5)    l (1, 3)

6 a



b 750

7 1200 DVDs



8 10 seconds

9 Parallel lines i.e. same gradient

10 a (0, 0)                      b (0, 0)

c no intersection              d no intersection

e (0, 1)                          f (0, 3)

11 a 2                              b -3

12 a (1, 3)                      b  $A = 6.75 \text{ units}^2$

13 a  $18.75 \text{ units}^2$               b  $24 \text{ units}^2$               c  $16 \text{ units}^2$

d  $27 \text{ units}^2$                       e  $7 \text{ units}^2$

### Challenges

1 101

2 2.5 hours

3 (0.5, 5.5), diagonals intersect at their midpoint

4 602

5 length  $AB = \text{length } AC$

6  $A = 13.5 \text{ square units}$ ,  $P = 20 \text{ units}$

7 (6, 7)

8 20 days

9 31 hours

### Multiple-choice questions

1 C    2 D    3 C    4 B    5 A    6 E

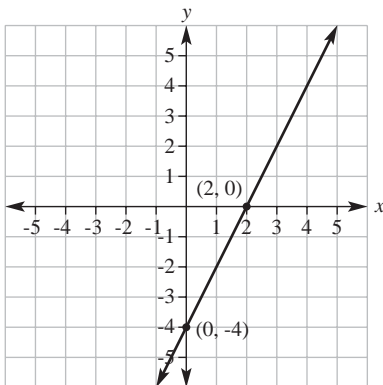
7 B    8 A    9 D    10 D

### Short-answer questions

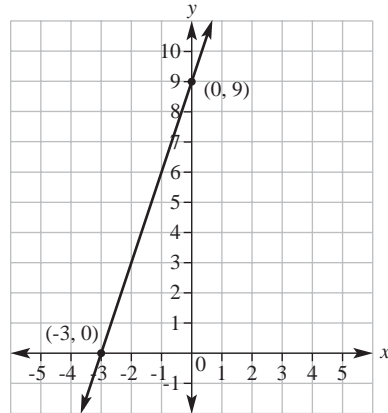
1 a (-2, 0), (0, 4)

b (3, 0), (0, -2)

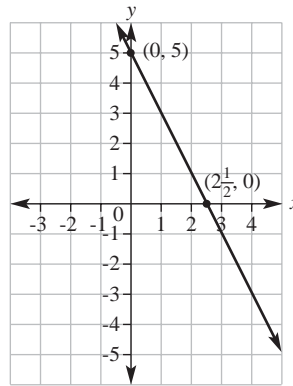
2 a



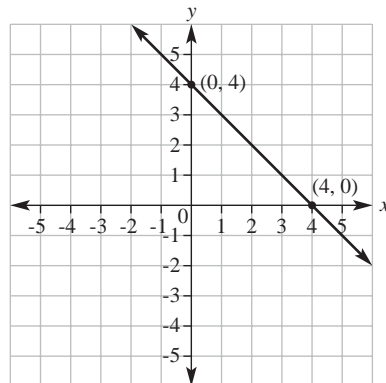
b



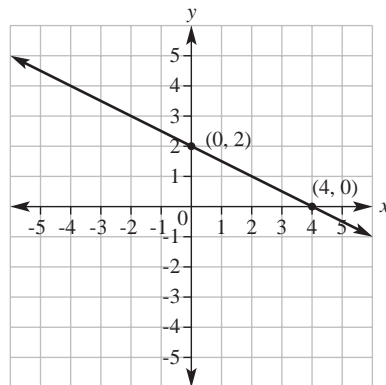
c



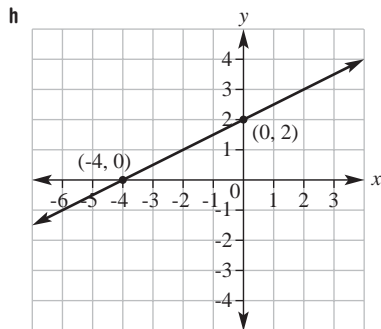
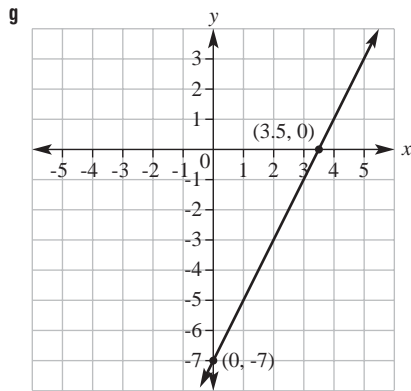
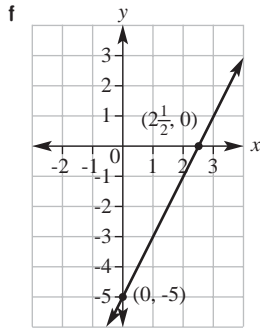
d



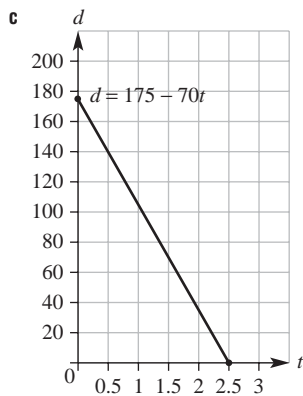
e





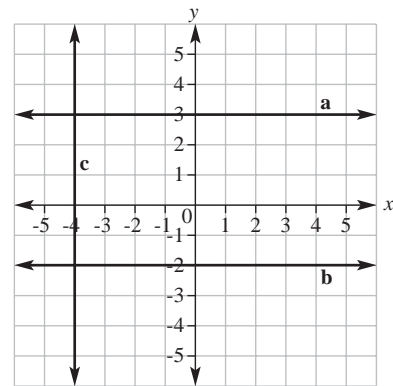


- 3 a** 175 km  
**b** 2.5 hours

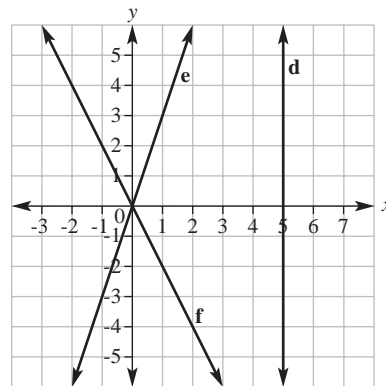


- 4 a**  $y = 3$   
**b**  $y = -2$

**c**  $x = -4$

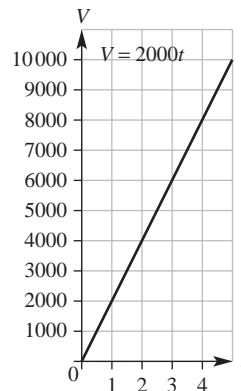


- d**  $x = 5$   
**e**  $y = 3x$   
**f**  $y = -2x$



- 5 a** 2                      **b** -1  
**c**  $\frac{5}{2}$                       **d**  $\frac{4}{3}$   
**e** 2                        **f**  $-\frac{10}{3}$

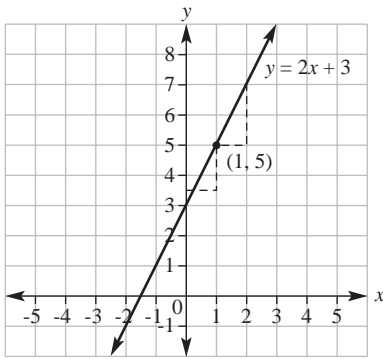
- 6 a** 2000 L/hr  
**b**



- c**  $V = 2000t$   
**d** 2.5 hours

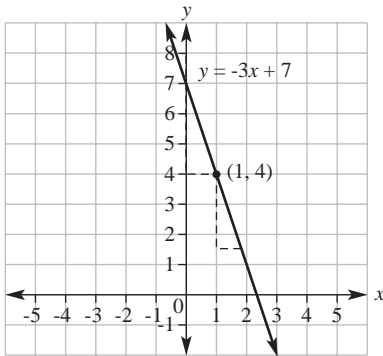
7 a Gradient = 2

y-intercept = 3



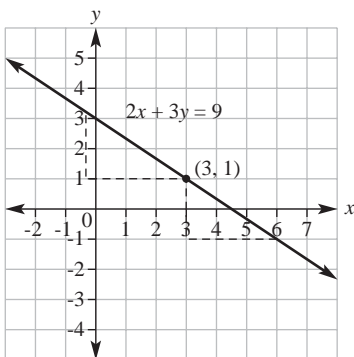
b Gradient = -3

y-intercept = 7



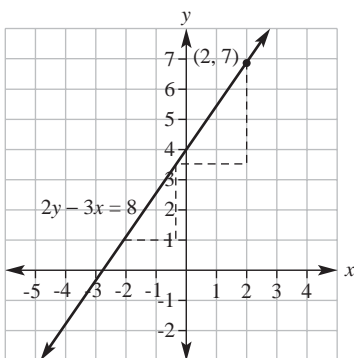
c Gradient =  $-\frac{2}{3}$

y-intercept = 3



d Gradient =  $\frac{3}{2}$

y-intercept = 4



8 a  $y = 3x + 2$  b  $y = -2x + 6$  c  $y = \frac{4}{3}x - 5$

9 a  $y = \frac{x}{2} - 1$  b  $y = -3x + 6$  c  $y = 3x - 2$  d  $y = -2x + 2$

10 a  $y = 2x + 4$  b  $y = -x - 3$  c  $y = -\frac{1}{2}x - 1$  d  $y = 3x + 4$

e  $y = 3x + 1$  f  $3x + 2y = 8$  or  $y = -\frac{3x}{2} + 4$

11 a  $M(4, 6), 5.66$  b  $M(7.5, 4.5), 7.07$

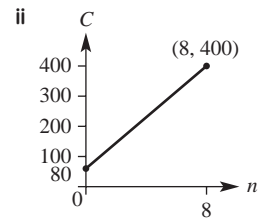
c  $M(0, 4), 7.21$  d  $M(-3, 2.5), 9.85$

12 a  $n = 9$  b  $n = 10$  c  $n = 6$

13 a no b yes 14 a (2, 0) b (-2, 4)

### Extended-response questions

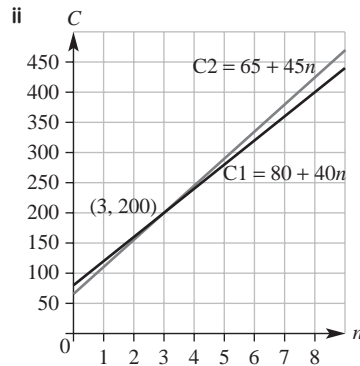
1 a i \$40/hr, \$80



iii \$180

iv 5 hours

b i  $C = 65 + 45n$



c (3, 200)

d 3 hours

2 a  $C = 8v + 90$  b i \$90 ii \$8 per vase c 23 vases

## Chapter 5

### Pre-test

1 a 23 b 48 c 2.7

d 5.2134 e 50 f 72.16

2 a  $A = 4 \text{ cm}^2, P = 8 \text{ cm}$  b  $A = 6 \text{ m}^2, P = 10 \text{ m}$

c  $A = 8 \text{ cm}^2, P = 18 \text{ cm}$

3 a cylinder b circle

4 a 7 b 4.5 c 12

5 a 3 b 6 c 27

6 a 30 mm b 2000 cm c 1600 m d 2.3 cm

e 3.167 km f 0.72 m g 20 m h 3000 cm

- 7 a  $30 \text{ cm}^2$     b  $4 \text{ m}^2$     c  $49 \text{ km}^2$   
 d  $3 \text{ m}^2$     e  $24 \text{ cm}^2$     f  $66 \text{ m}^2$   
 8  $C = 31.42 \text{ m}$      $A = 78.54 \text{ m}^2$

### Exercise 5A

- 1 a 50 mm    b 280 cm    c 52.1 cm  
 d 0.837 m    e 4600 m    f 2.17 km  
 2 825 cm, 2.25 cm  
 3 a  $a = 3, b = 6$     b  $a = 12, b = 4$     c  $a = 6.2, b = 2$   
 4 a 12 m    b 27 cm    c 24 mm  
 d 18 km    e 10 m    f 36 cm  
 5 a 90 cm    b 80 cm    c 170 cm  
 d 30.57 m    e 25.5 cm    f 15.4 km  
 6 a 9 cm    b 4015 m    c 102.1 cm  
 7 a 8000 mm    b 110 m    c 1 cm  
 d 20 mm    e 0.284 km    f 62.743 km  
 8 a  $x = 4$     b  $x = 2.2$     c  $x = 14$   
 d  $x = 9.5$     e  $x = 6$     f  $x = 4.2$   
 9 108 m  
 10 a 86 cm    b 13.6 m    c 40.4 cm  
 11 a  $x = 2$     b  $x = 2.1$     c  $x = 7$   
 12 88 cm  
 13 a  $P = 2a + 2b$     b  $P = 4x$     c  $P = 2a + b$   
 d  $P = 2x + 2y$     e  $P = 4(a + b)$     f  $P = 2x$   
 14 All vertical sides add to 13 cm and all horizontal sides add to 10 cm  
 15 a 25 cm, 75 cm    b 40 cm, 60 cm  
 c 62.5 cm, 37.5 cm    d 10 cm, 20 cm, 30 cm, 40 cm  
 16 a i 96 cm    ii 104 cm    iii 120 cm  
 b  $P = 4(20 + 2x)$      $\therefore P = 8x + 80$   
 c i 109.6 cm    ii 136.4 cm    d i  $x = 1.25$     ii  $x = 2.75$   
 e No, as with no frame the picture has a perimeter of 80 cm

### Exercise 5B

- 1 a 2.8 cm    b 96 mm  
 2 a  $6\pi$     b  $12\pi$     c  $\frac{35\pi}{2}$   
 d  $3 + 2\pi$     e  $12 + 3\pi$     f  $10 + 4\pi$   
 g  $8 + 2\pi$     h  $3 + \frac{3\pi}{4}$     i  $7 + \frac{\pi}{12}$   
 3 a  $\frac{1}{4}$     b  $\frac{1}{2}$     c  $\frac{3}{4}$     d  $\frac{1}{6}$     e  $\frac{5}{12}$     f  $\frac{5}{8}$   
 4 a 50.27 m    b 87.96 cm    c 9.42 mm    d 12.57 km  
 5 a 9.14 cm    b 14.94 m    c 33.13 cm  
 d 10.00 cm    e 20.05 m    f 106.73 km  
 6 a 12.56 m    b 62.8 cm    c 22 mm    d 44 m  
 7 a  $10\pi$     b  $20\pi$     c  $11\pi$   
 d  $15\pi$     e  $3\pi$     f  $41\pi$   
 8 a  $8 + 2\pi$     b  $4 + 2\pi$     c  $10\pi + 20$   
 d  $12 + 2\pi$     e  $5\pi + 6$     f  $5\pi + 8$   
 9 28.27 m    10 4.1 m    11 31.42 cm

- 12 a 188.50 cm    b i 376.99 cm    ii 1979.20 cm    c 531  
 13 a  $\frac{23\pi}{2} \text{ m}$     b  $2.4 + 0.6\pi$     c  $21 + \frac{7\pi}{2}$   
 d  $5 + \frac{15\pi}{2}$     e  $40 + 20\pi$     f  $23 + \frac{23\pi}{4}$   
 14 a  $r = \frac{C^8}{2\pi}$     b i 1.6 cm    ii 4.0 m    c  $d = \frac{C}{\pi}$     d 67 cm  
 15 a 131.95 m    b 791.68 m    c i 3.79    ii 15.16    d 63.66 m

### Exercise 5C

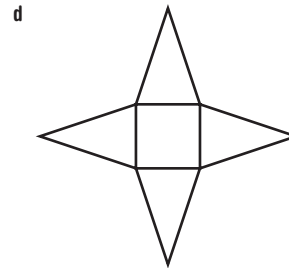
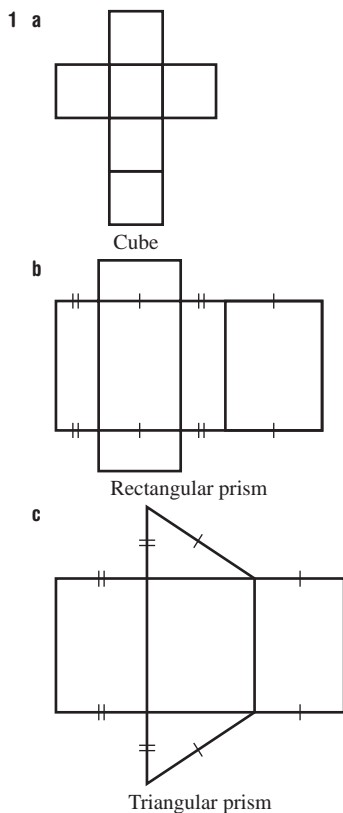
- 1 a 6    b 16    c 12    d 1    e 12    f 153  
 2 a rectangle    b circle    c rhombus/kite  
 d sector of circle    e triangle    f trapezium  
 g parallelogram    h square    i semicircle  
 3 a  $\frac{1}{4}$     b  $\frac{1}{3}$     c  $\frac{3}{4}$     d  $\frac{1}{6}$     e  $\frac{5}{8}$     f  $\frac{5}{18}$   
 4 a  $200 \text{ mm}^2$     b  $5 \text{ cm}^2$     c  $21\,000 \text{ cm}^2$   
 d  $21 \text{ m}^2$     e  $1000 \text{ m}^2$     f  $3.2 \text{ km}^2$   
 5 a  $24 \text{ m}^2$     b  $10.5 \text{ cm}^2$     c  $20 \text{ km}^2$   
 d  $25.2 \text{ m}^2$     e  $15 \text{ m}^2$     f  $36.8 \text{ m}^2$   
 6 a  $21 \text{ mm}^2$     b  $12 \text{ cm}^2$     c  $17 \text{ cm}^2$   
 d  $63 \text{ m}^2$     e  $6.205 \text{ m}^2$     f  $15.19 \text{ km}^2$   
 7 a  $12.25 \text{ cm}^2$     b  $3.04 \text{ m}^2$     c  $0.09 \text{ cm}^2$   
 d  $6.5 \text{ mm}^2$     e  $18 \text{ cm}^2$     f  $2.4613 \text{ cm}^2$   
 8 a  $21.23 \text{ m}^2$     b  $216.51 \text{ km}^2$     c  $196.07 \text{ cm}^2$   
 9 a  $7.07 \text{ m}^2$     b  $157.08 \text{ cm}^2$     c  $19.24 \text{ cm}^2$   
 d  $84.82 \text{ m}^2$     e  $26.53 \text{ m}^2$     f  $62.86 \text{ m}^2$   
 10 a  $1.5 \times 10^{10}$  (15 000 000 000)  $\text{cm}^2$     b  $5 \text{ mm}^2$     c  $0.075 \text{ m}^2$   
 11  $500\,000 \text{ m}^2$     12  $0.175 \text{ km}^2$     13  $0.51 \text{ m}^2$   
 14 12.89%    15 31%  
 16 a  $r = \sqrt{\frac{A}{\pi}}$     b i 1.3 cm    ii 1.5 m    iii 2.5 km  
 17 a i  $64^\circ$     ii  $318^\circ$   
 b as angle would be greater than  $360^\circ$  which is not possible  
 ( $28.3 \text{ m}^2$  is the largest area possible, i.e. full circle)  
 18 a i 1.5 m    ii 1.5 m    b  $78 \text{ m}^2$     c yes  
 19 46.7%

### Exercise 5D

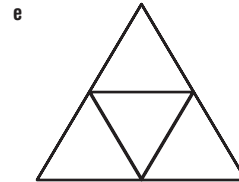
- 1 a semicircle and rectangle    b triangle and semicircle  
 c rhombus and parallelogram  
 2 a  $P = 2 \times 5 + 3 + \frac{1}{2} \times 2\pi r$      $A = bh + \frac{1}{2}\pi r^2$   
 $= 10 + 3 + 1.5\pi$      $= 5 \times 2 + \frac{1}{2} \times \pi \times 1.5^2$   
 $= 13 + 1.5\pi$      $= 10 + 1.125\pi$   
 $= 17.7 \text{ m}$      $= 13.5 \text{ m}^2$   
 b  $P = 20 + 12 + 12 + 10 + 6$      $A = lw - \frac{1}{2}bh$   
 $= 60 \text{ cm}$      $= 12 \times 20 - \frac{1}{2} \times 8 \times 6$   
 $= 240 - 24$   
 $= 216 \text{ cm}^2$   
 3 a 46 m,  $97 \text{ m}^2$     b 34 m,  $76 \text{ m}^2$   
 c 40 m,  $90 \text{ m}^2$     d 18.28 m,  $22.28 \text{ m}^2$   
 e 19.42 m,  $26.14 \text{ m}^2$     f 85.42 mm,  $326.37 \text{ mm}^2$

- 4 a  $17 \text{ cm}^2$    b  $3.5 \text{ cm}^2$    c  $21.74 \text{ cm}^2$   
 d  $6.75 \text{ m}^2$    e  $189 \text{ cm}^2$    f  $115 \text{ cm}^2$
- 5 a  $108 \text{ m}^2$    b  $33 \text{ cm}^2$    c  $98 \text{ m}^2$   
 d  $300 \text{ m}^2$    e  $16 \text{ cm}^2$    f  $22.5 \text{ m}^2$
- 6 a  $37.70 \text{ m}, 92.55 \text{ m}^2$    b  $20.57 \text{ mm}, 16 \text{ mm}^2$   
 c  $18.00 \text{ cm}, 11.61 \text{ cm}^2$    d  $12.57 \text{ m}, 6.28 \text{ m}^2$   
 e  $25.71 \text{ cm}, 23.14 \text{ cm}^2$    f  $33.56 \text{ m}, 83.90 \text{ m}^2$
- 7 a  $90 \text{ cm}^2$    b  $15 \text{ m}^2$    c  $9 \text{ m}^2$    d  $7.51 \text{ cm}^2$   
 e  $7.95 \text{ m}^2$    f  $180.03 \text{ cm}^2$    g  $8.74 \text{ mm}^2$    h  $21.99 \text{ cm}^2$   
 i  $23.83 \text{ mm}^2$
- 8  $189.27 \text{ m}^2$    9  $68.67 \text{ cm}^2$
- 10 a  $136.3 \text{ cm}^2$    b  $42.4 \text{ m}^2$    c  $345.6 \text{ m}^2$    11  $8 \text{ cm}$
- 12 a  $36 + 18\pi$    b  $16$    c  $12 - \frac{\pi}{8}$    d  $2\pi$
- e  $12.96 + 3.24\pi$    f  $25 + \frac{75\pi}{4}$
- 13  $7.1 \text{ cm}$
- 14 a hypotenuse (diameter) would equal 4.24 not 5  
 b hypotenuse (sloped edge) should be 13 cm not 14 cm  
 c hypotenuse (diameter) should be 5.83 not 8 m
- 15  $5267.1 \text{ cm}^2$
- 16 a  $34 \text{ cm}, 18 \text{ cm}$    b  $222.4 \text{ cm}^2$    c  $389.6 \text{ cm}^2$

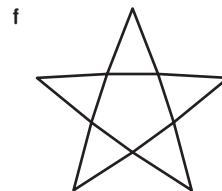
### Exercise 5E





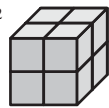
Square pyramid



Tetrahedron  
(triangular pyramid)

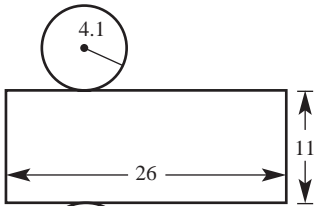


Pentagonal pyramid

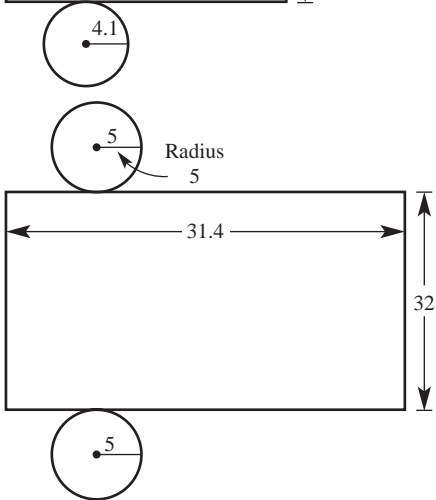
- 2 a  $TSA = 2 \times 8 \times 7 + 2 \times 8 \times 3 + 2 \times 7 \times 3$   
 $= 112 + 48 + 42$   
 $= 202 \text{ m}^2$
- b  $TSA = 2 \times \frac{1}{2} \times 4 \times 3 + 5 \times 7 + 4 \times 7 + 3 \times 7$   
 $= 12 + 35 + 28 + 21$   
 $= 96 \text{ cm}^2$
- 3 a  $52 \text{ cm}^2$    b  $242 \text{ cm}^2$    c  $76 \text{ m}^2$   
 d  $192 \text{ cm}^2$    e  $68.16 \text{ m}^2$    f  $85.76 \text{ m}^2$
- 4 a  $39 \text{ mm}^2$    b  $224 \text{ cm}^2$    c  $9.01 \text{ m}^2$
- 5 a  $96 \text{ cm}^2$    b  $199.8 \text{ cm}^2$    c  $0.96 \text{ m}^2$    d  $44.2 \text{ m}^2$   
 e  $22 \text{ cm}^2$    f  $28 \text{ cm}^2$
- 6  $6 \text{ m}^2$
- 7  $14.54 \text{ m}^2$
- 8  $34000 \text{ cm}^2$
- 9 a  $44.4 \text{ m}^2$    b  $4.44 \text{ L}$
- 10 a  $1400 \text{ cm}^2$    b  $1152 \text{ cm}^2$
- 11 a  $10 \text{ cm}^2$     b  $16 \text{ cm}^2$  
- c  $24 \text{ cm}^2$  
- 12 a  $[6, 10, 14, 18, 22, 26, 30, 34, 38]$    b  $S = 4n + 2$
- 13 a  $17.7 \text{ cm}^2$    b  $96 \text{ m}^2$    c  $204 \text{ cm}^2$   
 d  $97.9 \text{ m}^2$    e  $137.8 \text{ cm}^2$    f  $43.3 \text{ mm}^2$

**Exercise 5F**

1 a



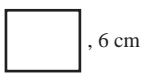
b



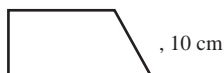
- 2 a 22 cm by 10 cm      b 12.57 cm by 8 cm  
 c 50.27 m by 5 m
- 3 a 25.13 m<sup>2</sup>      b 471.24 cm<sup>2</sup>      c 50.27 m<sup>2</sup>
- 4 a 44.0 cm<sup>2</sup>      b 603.2 cm<sup>2</sup>      c 113.1 m<sup>2</sup>
- 5 395.84 cm<sup>2</sup>
- 6 a 251.33 cm<sup>2</sup>      b 207.35 mm<sup>2</sup>      c 24.13 m<sup>2</sup>
- 7 a 54.56 m<sup>2</sup>      b 218.23 m<sup>2</sup>      c 63.98 cm<sup>2</sup>  
 d 71.91 cm<sup>2</sup>      e 270.80 m<sup>2</sup>      f 313.65 km<sup>2</sup>  
 g 326.41 m<sup>2</sup>      h 593.92 m<sup>2</sup>      i 43.71 mm<sup>2</sup>
- 8 7539.82 cm<sup>2</sup>      9 80 424.8 cm<sup>2</sup>
- 10 a 18 849.556 cm<sup>2</sup>      b i 1.88 m<sup>2</sup>      ii 37.70 m<sup>2</sup>      c 239
- 11 a 8π m<sup>2</sup>      b 150π cm<sup>2</sup>      c 16π m<sup>2</sup>
- 12 Half cylinder is more than half surface area as it includes new rectangular surface.
- 13 a  $\left(\frac{135\pi}{2} + 36\right)$  cm<sup>2</sup>      b  $\left(\frac{70\pi}{3} + 12\right)$  cm<sup>2</sup>      c  $\left(\frac{29\pi}{12} + 4\right)$  m<sup>2</sup>

**Exercise 5G**

1 a



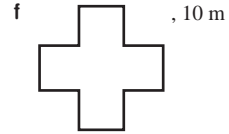
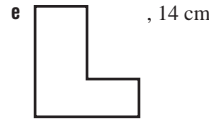
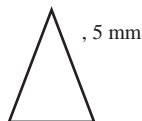
b



c



d



- 2 a square      b triangle      c rectangle  
 d trapezium      e hexagon      f triangle
- 3 a 3000 mm<sup>3</sup>      b 2 cm<sup>3</sup>      c 8 700 000 cm<sup>3</sup>  
 d 0.0059 m<sup>3</sup>      e 10 000 m<sup>3</sup>      f 0.000 0217 km<sup>3</sup>  
 g 3000 mL      h 200 L      i 3.5 L  
 j 21 mL      k 37 kL      l 42.9 ML
- 4 a 8 cm<sup>3</sup>      b 84 m<sup>3</sup>      c 21 mm<sup>3</sup>
- 5 a 4 cm<sup>3</sup>      b 10.5 m<sup>3</sup>      c 11.96 cm<sup>3</sup>  
 d 29 cm<sup>3</sup>      e 14.88 m<sup>3</sup>      f 8.1351 cm<sup>3</sup>  
 g 108 m<sup>3</sup>      h 29.82 m<sup>3</sup>      i 0.382 044 cm<sup>3</sup>
- 6 a 75 m<sup>3</sup>      b 30 cm<sup>3</sup>      c 1.25 cm<sup>3</sup>
- 7 a 16 cm<sup>3</sup>      b 42.875 m<sup>3</sup>      c 15 cm<sup>3</sup>
- 8 a 8 L      b 0.36 L      c 0.48 L
- 9 8000 cm<sup>3</sup>      10 0.19 m<sup>3</sup>
- 11 Yes, the tank only holds 20 L
- 12 a 67.2 cm<sup>3</sup>      b 28 m<sup>3</sup>      c 8.9 km<sup>3</sup>  
 d 28 m<sup>3</sup>      e 0.4 m<sup>3</sup>      f 29232 mm<sup>3</sup>
- 13 a 15 L      b 112 500 L      c 8000 L
- 14 a 55 m<sup>2</sup>      b 825 m<sup>3</sup>
- 15 a i 1000      ii  $\frac{1}{1000}$       iii 1000  
 b i 1000 000      ii 1000      iii 1000 000 or 1000<sup>2</sup>
- 16 a  $V = x^2h$       b  $V = s^3$       c  $V = 6t^3$       17 b  $\frac{1}{3}$

**Exercise 5H**

- 1 a  $r = 4, h = 10$       b  $r = 2.6, h = 11.1$   
 c  $r = 2.9, h = 12.8$       d  $r = 9, h = 23$   
 e  $r = 5.8, h = 15.1$       f  $r = 10.65, h = 10.4$
- 2 a 12.57 cm<sup>2</sup>      b 8.04 m<sup>2</sup>      c 78.54 cm<sup>2</sup>      d 2.54 km<sup>2</sup>
- 3 a 2 L      b 4.3 mL      c 3700 cm<sup>3</sup>  
 d 1000 L      e 38 m<sup>3</sup>      f 200 mL
- 4 a 226.19 cm<sup>3</sup>      b 18.85 m<sup>3</sup>      c 137.44 m<sup>3</sup>  
 d 100.53 cm<sup>3</sup>      e 8.48 m<sup>3</sup>      f 68.05 m<sup>3</sup>
- 5 a 18 L      b 503 L      c 20 L  
 d 4712 L      e 589 049 L      f 754 L
- 6 a 25.133 m<sup>3</sup>      b 25 133 L
- 7 37 699 L      8 Cylinder by 0.57 m<sup>3</sup>
- 9 a 502.65 cm<sup>3</sup>      b 1.02 m<sup>3</sup>      c 294.52 m<sup>3</sup>  
 d 35 342.92 m<sup>3</sup>      e 47.12 cm<sup>3</sup>      f 1017.88 cm<sup>3</sup>
- 10 a 0.707      b 2.523
- 11 a 160π m<sup>3</sup>      b 320π cm<sup>3</sup>      c 54π km<sup>3</sup>  
 d  $\frac{3\pi}{4}$  cm<sup>3</sup>      e 1500π cm<sup>3</sup>      f 144π mm<sup>3</sup>
- 12 A number of answers. Require  $h = 2\pi r$ .
- 13 a 113.10 cm<sup>3</sup>      b 10471.98 m<sup>3</sup>      c 3.73 m<sup>3</sup>  
 d 20.60 cm<sup>3</sup>      e 858.41 cm<sup>3</sup>      f 341.29 m<sup>3</sup>

## Challenges

- 1 100 L      2 non-shaded is half the shaded area  
 3  $163.4 \text{ m}^2$       4  $\sqrt{200} \text{ cm} = 14.14 \text{ cm}$       5  $\frac{1}{6} \text{ cm}$   
 6 16 days      7  $V = 2\pi^2 r^3$       8  $h = \frac{1-r^2}{r}$

## Multiple-choice questions

- 1 B      2 C      3 E      4 B      5 A  
 6 D      7 B      8 E      9 C      10 E

## Short-answer questions

- 1 a 380 cm      b 1270 m      c  $2.73 \text{ cm}^2$   
 d  $52\,000 \text{ cm}^2$       e  $10\,000 \text{ cm}^3$       f  $53.1 \text{ cm}^3$   
 g 3.1 L      h 43 mL      i 2830 L  
 2 a 14 m      b 51 mm      c 16.2 cm  
 3 a  $4 \text{ cm}^2$       b  $1122 \text{ mm}^2$       c  $30.34 \text{ mm}^2$   
 d  $7.5 \text{ m}^2$       e  $15 \text{ cm}^2$       f  $3 \text{ cm}^2$   
 4 a  $2.5 \text{ m}^2$       b  $37.4 \text{ m}^2$   
 5 a  $A = 28.27 \text{ cm}^2, P = 18.85 \text{ cm}$       b  $A = 5.38 \text{ m}^2, P = 9.51 \text{ m}$   
 c  $A = 2.36 \text{ cm}^2, P = 6.71 \text{ cm}$   
 6 a  $P = 15.24 \text{ m}, A = 13.09 \text{ m}^2$       b  $P = 14.10 \text{ m}, A = 10.39 \text{ m}^2$   
 c  $P = 24.76 \text{ km}, A = 33.51 \text{ km}^2$   
 7 a 8.86 m,  $4.63 \text{ m}^2$       b 45.56 cm,  $128.54 \text{ cm}^2$   
 8 a  $46 \text{ cm}^2$       b  $114 \text{ m}^2$       9 a  $659.73 \text{ mm}^2$       b  $30.21 \text{ m}^2$   
 10 a  $30 \text{ cm}^3$       b  $54 \text{ m}^3$       c  $31.42 \text{ mm}^3$

## Extended-response questions

- 1 a 517.08 cm      b \$65  
 c  $15853.98 \text{ cm}^2$       d  $1.58 \text{ m}^2$ , claim is correct  
 2 a 1 cm      b  $15.71 \text{ cm}^2$       c  $125\,680 \text{ cm}^3$       d  $0.125\,68 \text{ m}^3$   
 e 18.85 cm      f  $15 \text{ m}^2$       g \$1200

## Semester review 1

### Reviewing number and financial mathematics

#### Multiple-choice questions

- 1 B      2 E      3 D      4 D      5 A

#### Short-answer questions

- 1 a  $\frac{19}{28}$       b  $\frac{7}{9}$       c  $\frac{3}{8}$       d  $1\frac{4}{5}$   
 2 a 60%      b 31.25%      c 10%      d 25%  
 3 a 5 : 3      b 55 km/h      c 2.4 mL/h      4 \$892

#### Extended-response question

- a i \$17 500      ii \$23 520      iii 9 years      iv 27%  
 b \$23635.69  
 c i Jim by \$116      ii Jim by \$922

## Linear and simultaneous equations

### Multiple-choice questions

- 1 E      2 A      3 C      4 B      5 D

### Short-answer questions

- 1 a  $x = 6$       b  $x > \frac{9}{2}$       c  $m = \frac{3}{8}$   
 d  $y = -1$       e  $a \leq \frac{1}{11}$       f  $x = -\frac{3}{14}$   
 2 a  $\frac{m-3}{2} = 6$       b Noah gets \$15 pocket money  
 3 a 155      b  $I = \frac{2S}{n} - a$       c 18  
 4 a  $x = 6, y = 3$       b  $x = -1, y = -5$   
 c  $x = 5, y = -2$       d  $x = -3, y = 4$

### Extended-response question

- a i  $12x + 20 > 74$       ii 5 games  
 b i Let \$ $x$  be the cost of a raffle ticket and \$ $y$  the cost of a badge.  
 ii  $5x + 2y = 11.5$  and  $4x + 3y = 12$   
 iii A raffle ticket costs \$1.50 and a badge costs \$2.

## Pythagoras' theorem and trigonometry

### Multiple-choice questions

- 1 D      2 A      3 C      4 A      5 E

### Short-answer questions

- 1 a  $x = 15.1$       b  $x = 5.7$       c  $x = 11.2$       d  $\theta = 29.5$   
 2 a  $x = 13, y = 14.7$       b  $x = 9.9$   
 3 a 19.21 m      b  $38.7^\circ$   
 4 a 16.3 km west      b  $115^\circ$

### Extended-response question

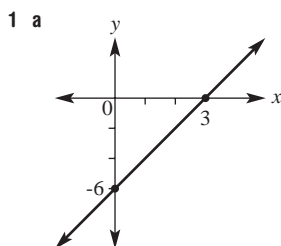
- a 17.75 m      b  $14.3^\circ$       c i 18.8 m      ii 6.8 s

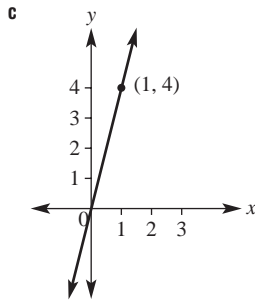
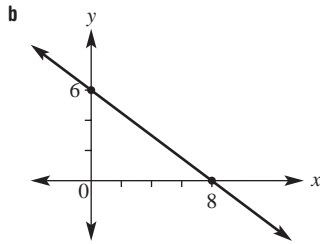
## Linear relations

### Multiple-choice questions

- 1 C      2 D      3 B      4 C      5 A

### Short-answer questions

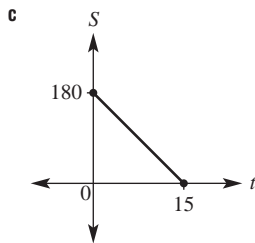




- 2 a  $\frac{2}{3}$       b -3      c -2      d  $\frac{4}{3}$
- 3 a  $y = -3x + 6$       b  $y = 3x - 1$   
 c  $y = 2x$       d  $y = -\frac{1}{3}x + 2$
- 4 (3, 2)

**Extended-response question**

- a 12 kg/hr      b  $S = 180 - 12t$



- d 15 hours      e i  $P = 40 + 25h$       ii \$415

**Measurement**

**Multiple-choice questions**

- 1 C      2 E      3 D      4 A      5 A

**Short-answer questions**

- 1 a  $24.57 \text{ m}^2$       b  $36 \text{ cm}^2$   
 2 4 tins  
 3 a  $216 \text{ m}^2$       b  $25.45 \text{ m}^2$   
 4 a  $x = 4$       b  $y = 8.5$

**Extended-response question**

- a  $45.71 \text{ m}^2$   
 b i  $0.0377 \text{ m}^2$       ii  $3.77 \text{ m}^2$   
 c 1213      d  $37.85 \text{ m}^3$       e  $19.45 \text{ m}^3$

**Chapter 6**

**Pre-test**

- 1 a 25      b 100      c 16      d 27      e 9  
 2 a 24, 1, 12, 2, 8, 3, 6, 4      b 45, 1, 15, 3, 9, 5  
     c 2, 3      d 3, 5  
 3 a  $ab^2$       b  $5^3 ab^2$       c  $3^2 x^2$       d  $6ac^3$   
 4 a  $2^3$       b  $2^6$       c  $2^5$   
 5 a  $3^4$       b  $x^2 y^2$       c  $2^2 a^2$       d  $\frac{3^2}{4^2}$   
 6 a  $\frac{1}{16}$       b  $\frac{1}{8}$       c  $\frac{1}{216}$       d  $\frac{4}{9}$   
 7 a 3.73      b 24.62      c 18.37      d 4.40  
 8 a 5      b 4      c 2      d 3  
 9 a 38      b 2310      c 0.172      d 0.0018  
     e 1000      f 10 000  
 10 a 15      b 4      c 125      d 32  
 11 a  $10a - 4b$       b  $3a + 3$       c  $ab + 8a$       d  $2ab^2 - a^2 b$

**Exercise 6A**

- 1 a 25      b 8      c 27      d 16  
 2 a 3      b 6      c 1.2      d -7  
     e  $\frac{2}{3}$       f  $y$       g  $w$       h  $t$   
 3 a 3      b 8      c 7      d 4  
     e 11      f 13      g 9      h 2  
 4 a 2, 3      b 3, 5      c 2, 3, 5      d 7, 11  
 5 a a, a, a, a      b b, b, b      c x, x, x  
     d  $x \times p \times x \times p \times x \times p \times x \times p \times x \times p \times x \times p$   
     e  $5 \times a \times 5 \times a \times 5 \times a \times 5 \times a$   
     f  $3 \times y \times 3 \times y \times 3 \times y$   
     g  $4 \times x \times x \times y \times y \times y \times y \times y$   
     h  $p \times q \times p \times q$   
     i  $-3 \times s \times s \times s \times t \times t$   
     j  $6 \times x \times x \times x \times y \times y \times y \times y \times y$   
     k  $5 \times y \times z \times y \times z \times y \times z \times y \times z \times y \times z \times y \times z$   
     l  $4 \times a \times b \times a \times b \times a \times b$   
 6 a 36      b 16      c 243      d 12  
     e -8      f -1      g 81      h 25  
     i  $\frac{8}{27}$       j  $\frac{9}{16}$       k  $\frac{1}{216}$       l  $\frac{25}{4}$   
     m  $\frac{8}{27}$       n  $\frac{81}{256}$       o  $\frac{1}{16}$       p  $\frac{3125}{32}$   
 7 a  $3^3$       b  $8^6$       c  $y^2$       d  $3x^3$   
     e  $4c^5$       f  $5^3 d^2$       g  $x^2 y^3$       h  $7^3 b^2$   
 8 a  $\left(\frac{2}{3}\right)^4$       b  $\left(\frac{3}{5}\right)^5$       c  $\left(\frac{4}{7}\right)^2 \left(\frac{1}{5}\right)^4$       d  $\left(\frac{7x}{9}\right)^2 \left(\frac{y}{4}\right)^3$   
 9 a  $3^3 x^3 y^2$       b  $(3x)^2 (2y)^2$  or  $3^2 2^2 x^2 y^2$   
     c  $(4d)^2 (2e)^2$  or  $4^2 2^2 d^2 e^2$       d  $6^3 b^2 y^3$   
     e  $(3pq)^4$  or  $3^4 p^4 q^4$       f  $(7mn)^3$  or  $7^3 m^3 n^3$

- 10 a  $2 \times 5$     b  $2^3$     c  $2^4 \times 3^2$     d  $2^9$   
 e  $2^3 \times 3^3$     f  $2^2 \times 3^5$
- 11 a 36    b -216    c 1    d  $-\frac{8}{27}$   
 e -18    f 15    g -36    h 216
- 12 a 4    b 8    c 5    d 2  
 e -4    f -2    g  $\frac{1}{2}$     h 4
- 13 a i 10 mins    ii 20 mins    iii 30 mins  
 b  $2^{24} = 16\,777\,216$  cells
- 14 a  $1000 \times 3^5 = \$243\,000$     b 5 years
- 15 7 months
- 16 a i 9    ii 9    iii -9    iv -9  
 b Same signs give positive when multiplying  
 c A positive answer is multiplied by the negative one out the front
- 17 a i 8    ii -8    iii -8    iv 8  
 b i A positive cubed is positive  
 ii A negative answer is multiplied by negative  
 c ii A negative number cubed will be negative  
 iii A positive answer is multiplied by negative one
- 18 a  $\frac{1}{8}$     b  $\frac{1}{16}$     c  $\frac{1}{125}$     d  $\frac{1}{64}$     e  $\frac{49}{100}$   
 f  $\frac{81}{16}$     g  $\frac{169}{25}$     h  $\frac{12769}{100}$     i  $\frac{289}{25}$
- 19 a LCM = 12, HCF = 2    b LCM = 84, HCF = 14  
 c LCM = 72, HCF = 12    d LCM = 30, HCF = 5  
 e LCM = 360, HCF = 10    f LCM = 300, HCF = 10  
 g LCM = 1764, HCF = 14    h LCM = 13068, HCF = 198

### Exercise 6B

- 1 a multiply, base, add    b divide, base, subtract
- 2 a  $3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$   
 b  $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 = 6^7$   
 c  $\frac{5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5} = 5^2$     d  $\frac{9 \times 9 \times 9 \times 9}{9 \times 9} = 9^2$
- 3 a True    b True    c False    d False  
 e True    f False    g False    h True
- 4 a  $2^7$     b  $5^9$     c  $7^6$     d  $8^{10}$   
 e  $3^8$     f  $6^{14}$     g  $3^3$     h  $6^5$   
 i  $5^3$     j 10    k  $9^3$     l  $(-2)^2$
- 5 a  $x^7$     b  $a^9$     c  $t^8$     d  $y^5$   
 e  $d^3$     f  $y^7$     g  $b^8$     h  $q^{11}$   
 i  $x^7y^5$     j  $x^9y^4$     k  $5x^4y^9$     l  $4x^2y^5z$   
 m  $15m^5$     n  $8e^6f^4$     o  $20c^7d^2$     p  $18y^2z^7$
- 6 a  $a^2$     b  $x^3$     c  $q^{10}$     d  $d$   
 e  $2b^5$     f  $\frac{d^5}{3}$     g  $2a^7$     h  $2y^3$   
 i  $9m$     j  $14x^3$     k  $5y^2$     l  $6a$   
 m  $\frac{m^5}{4}$     n  $\frac{w}{5}$     o  $\frac{a}{5}$     p  $\frac{x^4}{9}$

- q  $\frac{4x^6y^3}{3}$     r  $\frac{3st^2}{7}$     s  $\frac{4mn}{3}$     t  $-5x$
- 7 a  $b^6$     b  $y^6$     c  $c^7$     d  $x$   
 e  $t$     f  $p^6$     g  $d^6$     h  $x^{10}$   
 i  $4x^2y^3$     j  $6b^2g$     k  $3m^5n^6$     l  $p^5q^4$
- 8 a  $\frac{m^5}{n^5}$     b  $\frac{x^4}{y^2}$     c  $a^3b^3$     d  $\frac{6a^5}{c^7}$     e  $6f^6$   
 f  $12x^4b^2$     g  $6k^3m^3$     h  $\frac{15x^4y}{2}$     i  $\frac{3m^2n^3}{2}$
- 9 a 12    b 8    c 3    d 3  
 e 1    f 18    g 12    h 11  
 i 4    j 15    k 2    l 39
- 10 a  $7^2 = 49$     b 10    c  $13^2 = 169$     d  $2^3 = 8$   
 e 101    f  $200^2 = 40\,000$   
 g  $7 \times 31 = 217$     h  $3 \times 50^2 = 7500$
- 11 a 7 ways    b 14 ways
- 12 a  $a^5$ , power of one not added  
 b  $x^6$ , power of one not subtracted  
 c  $\frac{a^2}{2}$ ,  $3 \div 6$  is  $\frac{1}{2}$  not 2  
 d  $\frac{x^4}{2}$ , numerator power is larger hence  $x^4$  in numerator  
 e  $6x^{11}$ , multiply coefficients not add  
 f  $= a^3 \times a = a^4$ , order of operations done incorrectly
- 13 a  $4x$     b  $12x^2$     c  $10x^3$     d  $-4x$   
 e  $40x^6$     f  $\frac{5x}{4}$     g  $\frac{8}{5}$     h  $-20x^4$
- 14 a  $2^{x+y}$     b  $5^{a+b}$     c  $t^{x+y}$     d  $3^{x-y}$   
 e  $10^{p-q}$     f  $t^{x-y}$     g  $2^{p+q-r}$     h  $10^{p-q-r}$   
 i  $2^{5a}$     j  $a^{3x-2}b^{x+3}$     k  $a^{x+y}b^{x+y}$     l  $a^{x-y}b^{y-x}$   
 m  $w^{2-x}b^{x+3}$     n  $a^{x+y-2}$     o  $p^aq^{b-5}$     p  $4m^{y-3-2x}$

### Exercise 6C

- 1 a multiply    b 1
- 2 a 16, 8, 4, 2, 1    b 64, 16, 4, 1
- 3 a  $4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^6$   
 b  $12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12 = 12^8$   
 c  $x \times x \times x \times x \times x \times x \times x \times x = x^8$   
 d  $a \times a \times a \times a \times a \times a \times a \times a \times a = a^{10}$
- 4 a  $y^{12}$     b  $m^{18}$     c  $x^{10}$     d  $b^{12}$   
 e  $3^6$     f  $4^{15}$     g  $3^{30}$     h  $7^{10}$   
 i  $5m^6$     j  $4q^{28}$     k  $-3c^{10}$     l  $2j^{24}$
- 5 a 1    b 1    c 1    d 1  
 e -1    f 1    g 1    h 1  
 i 5    j -3    k 4    l -6  
 m 1    n 3    o 1    p 0
- 6 a  $4^7$     b  $3^9$     c  $x$     d  $y^{13}$   
 e  $b^{14}$     f  $a^{10}$     g  $d^{24}$     h  $y^{16}$   
 i  $z^{25}$     j  $a^{11}r^{13}$     k  $x^{14}y^5$     l  $5rs^8$
- 7 a  $7^2$     b 4    c  $3^8$     d 1    e  $y^3$   
 f  $h^2$     g  $b^6$     h  $x^5$     i  $y^6$



- 8 a  $\frac{2}{x^5}$     b  $\frac{10}{x^3}$     c  $3x^8$     d  $\frac{d^2e}{2}$     e  $\frac{2m^6n}{5}$     f  $\frac{a^{12}}{8}$   
 9 a i 400    ii 6400    iii 100  
    b i 800    ii 12800    iii 102400    c 13 years  
 10 5 ways  
 11 a 4    b 1000    c 1    d 1    e 4    f 1  
 12 a  $4 \times 5$  not  $4 + 5$ ,  $a^{20}$   
    b power of 2 only applies to  $x^3$ ,  $3x^6$   
    c power zero applies to whole bracket, 1  
 13 a i  $2^{24}$     ii  $(-2)^{30} = 2^{30}$     iii  $x^{84}$     iv  $a^{48}$   
    b i  $2^{abc}$     ii  $a^{mnp}$     iii  $x^{6yz}$   
 15 a  $2^{12}$     b  $2^{15}$     c  $3^6$     d  $3^{20}$     e  $5^{10}$   
    f  $3^{50}$     g  $2^{72}$     h  $7^{80}$     i  $10^{50}$

**Exercise 6D**

- 1 a  $a^m \times b^m$     b  $\frac{a^m}{b^m}$   
 2 a  $5a \times 5a \times 5a$   
     $= 5 \times 5 \times 5 \times a \times a \times a$   
     $= 5^3 \times a^3$   
 b  $ab \times ab \times ab \times ab$   
     $= a \times a \times a \times a \times b \times b \times b \times b$   
     $= a^4 \times b^4$   
 c  $\frac{x}{6} \times \frac{x}{6} \times \frac{x}{6}$   
     $= \frac{x \times x \times x}{6 \times 6 \times 6}$   
     $= \frac{x^3}{6^3}$   
 d  $\frac{a}{b} \times \frac{a}{b} \times \frac{a}{b} \times \frac{a}{b} \times \frac{a}{b}$   
     $= \frac{a \times a \times a \times a \times a}{b \times b \times b \times b \times b}$   
     $= \frac{a^5}{b^5}$   
 3 a  $8x^3$     b  $25y^2$     c  $64a^6$     d  $9r^2$   
    e  $-81b^4$     f  $-343r^3$     g  $(-2)^4h^8 = 16h^8$     h  $625c^8d^{12}$   
    i  $32x^{15}y^{10}$     j  $9p^6q^{12}$     k  $2x^6y^2$     l 1  
    m  $-27w^9y^3$     n  $-4p^8q^2r^2$     o  $25s^{14}t^2$     p  $8x^{12}y^3z^9$   
 4 a  $\frac{p^3}{q^3}$     b  $\frac{x^4}{y^4}$     c  $\frac{64}{y^3}$     d  $\frac{625}{p^8}$   
    e  $\frac{4}{r^6}$     f  $\frac{s^6}{49}$     g  $\frac{32m^5}{n^5}$     h  $\frac{8a^6}{27}$   
    i  $\frac{27n^9}{8m^{12}}$     j  $\frac{16r^4}{n^4}$     k  $\frac{9f^2}{64g^{10}}$     l  $\frac{25w^8y^2}{4x^6}$   
    m  $\frac{9x^2}{4y^6g^{10}}$     n  $\frac{27k^3m^9}{64n^{21}}$     o  $\frac{25w^8y^2}{4z^2x^6}$     p  $\frac{9x^4y^6}{4a^{10}b^6}$   
 5 a  $9ab^2$     b  $27ab^6$     c  $-12a^8b^8$     d  $54x^6y^9$   
    e  $-64b^6c^{15}d^3$     f  $8a^4$     g  $9a^5$     h  $-40a^{15}b^3$   
    i  $160m^{15}p^5t^{10}$     j  $-49d^4f^8g^2$     k  $1024x^{12}y^3z^9$     l  $-16a^8b^7$

- 6 a  $x^{24}$     b  $256x^{24}$     c  $a^{17}b^8$     d  $a^{10}b^{11}$   
    e  $8m^5n^3$     f  $12c^8d^7$     g  $\frac{-27x^6}{125a^{15}b^9}$     h  $-3a^4b^5$   
    i  $15n$     j  $a^{11}bc^5$     k  $x^{11}y^2z$     l  $\frac{r^9t^{10}}{s}$   
 7 a i 8    ii 125    b  $N = \frac{t^3}{8}$   
    c i 27    ii 8    d i 8    ii 2  
 8 a 2    b 4    c 2  
    d 2    e 1    f 14  
 9 a By simplifying, there are smaller numbers to raise to powers  
    b i 8    ii 16    iii  $\frac{1}{81}$     iv  $\frac{1}{1000}$   
 10 a  $F, (-2)^2 = +(2)^2$     b  $T, (-3)^3 = -(3)^3$   
    c  $T, (-5)^5 = -(5)^5$     d  $F, (-4)^4 = +(4)^4$   
 11 a 25    b 13    c no  
    d no,  $(3-2)^2 \neq 3^2 - 2^2$   
    e i T    ii F    iii T    iv F

**Exercise 6E**

- 1 a  $\frac{1}{2^2}$     b  $\frac{1}{3^2}$     c  $\frac{1}{5^3}$     d  $\frac{1}{3^3}$   
 2 a 

Index form	$3^4$	$3^3$	$3^2$	$3^1$
Whole number or fraction	81	27	9	3

Index form	$3^0$	$3^{-1}$	$3^{-2}$	$3^{-3}$
Whole number or fraction	1	$\frac{1}{3}$	$\frac{1}{9} = \frac{1}{3^2}$	$\frac{1}{27} = \frac{1}{3^3}$

  
 b 

Index form	$10^4$	$10^3$	$10^2$	$10^1$
Whole number or fraction	10000	1000	100	10

Index form	$10^0$	$10^{-1}$	$10^{-2}$	$10^{-3}$
Whole number or fraction	1	$\frac{1}{10}$	$\frac{1}{100} = \frac{1}{10^2}$	$\frac{1}{1000} = \frac{1}{10^3}$

  
 3 a  $\frac{1}{x}$     b  $\frac{1}{a^4}$     c  $\frac{1}{b^6}$     d  $\frac{1}{25}$   
    e  $\frac{1}{64}$     f  $\frac{1}{9}$     g  $\frac{5}{x^2}$     h  $\frac{4}{y^3}$   
    i  $\frac{3}{m^5}$     j  $\frac{p^7}{q^2}$     k  $\frac{m}{n^4}$     l  $\frac{x^4}{y^4}$   
    m  $\frac{2}{a^3b}$     n  $\frac{7}{r^2s^3}$     o  $\frac{v^2}{5u^8}$     p  $\frac{1}{9m^3n^5}$   
 4 a  $y$     b  $b^2$     c  $m^5$     d  $x^4$   
    e  $7q$     f  $3t^2$     g  $5h^4$     h  $4p^4$   
    i  $ab^2$     j  $de$     k  $2m^3n^2$     l  $\frac{x^2y^5}{3}$   
    m  $\frac{3y^4}{7}$     n  $-2b^8$     o  $\frac{3gh^3}{4}$     p  $\frac{9u^2t^2}{5}$

5 a  $\frac{b^3}{a^3}$     b  $\frac{y^5}{x^2}$     c  $\frac{h^3}{g^2}$     d  $\frac{n}{m}$   
 e  $\frac{343}{5}$     f  $\frac{64}{9}$     g  $\frac{6}{25}$     h 1  
 6 a  $\frac{7x^4}{y^3}$     b  $\frac{u^3}{v^2}$     c  $\frac{y^3}{5a^3}$     d  $\frac{2b^5}{a^4c^2}$   
 e  $\frac{5a^2b^2}{6c^4d}$     f  $\frac{4h^3m^2}{5k^2p}$     g  $\frac{12w^6}{tu^2v^2}$     h  $\frac{mn^4x^2}{16y^5}$   
 7 a  $\frac{1}{5}$     b  $\frac{1}{9}$     c  $\frac{1}{16}$     d  $\frac{1}{25}$   
 e  $\frac{1}{25}$     f  $\frac{1}{200}$     g  $\frac{3}{4}$     h  $\frac{1}{2}$   
 i  $\frac{1}{36}$     j  $\frac{1}{8}$     k  $\frac{4}{25}$     l  $\frac{7}{81}$   
 m 8    n 100    o -250    p 16  
 q -10    r 64    s  $\frac{64}{9}$     t  $\frac{27}{64}$   
 u 100    v  $\frac{1}{3}$     w -2    x 49

8 1.95 g

9 a -4    b -4    c -4    d -1    e -2    f -1

10 a negative power only applies to  $x$ ,  $\frac{2}{x^2}$

b  $5 = 5^1$  has a positive power,  $5a^{-4}$

c  $\frac{2}{3^{-2}b^{-2}} = 2 \times 3^2 \times b^2 = 18b^2$

11 a  $1 \div \frac{2}{3} = 1 \times \frac{3}{2}$     b i  $\frac{4}{5}$     ii  $\frac{7}{2}$     iii  $\frac{3}{x}$     iv  $\frac{b}{a}$

c (fraction)<sup>-1</sup> = reciprocal of fraction

d i  $\frac{9}{4}$     ii  $\frac{25}{16}$     iii 32    iv  $\frac{27}{343}$

12 a 4    b 4    c 2    d 3    e 2

f 4    g  $\frac{3}{2}$     h 4    i  $\frac{7}{3}$

### Exercise 6F

1 a 10 000    b 1000    c 100 000  
 d 1000    e 100 000    f 10 000  
 2 a  $10^5$     b  $10^2$     c  $10^9$   
 3 a positive    b negative    c positive    d negative  
 4 a  $4 \times 10^4$     b  $2.3 \times 10^{12}$     c  $1.6 \times 10^{10}$   
 d  $-7.2 \times 10^6$     e  $-3.5 \times 10^3$     f  $-8.8 \times 10^6$   
 g  $5.2 \times 10^3$     h  $3 \times 10^6$     i  $2.1 \times 10^4$   
 5 a  $3 \times 10^{-6}$     b  $4 \times 10^{-4}$     c  $-8.76 \times 10^{-3}$   
 d  $7.3 \times 10^{-10}$     e  $-3 \times 10^{-5}$     f  $1.25 \times 10^{-10}$   
 g  $-8.09 \times 10^{-9}$     h  $2.4 \times 10^{-8}$     i  $3.45 \times 10^{-5}$   
 6 a  $6 \times 10^3$     b  $7.2 \times 10^5$     c  $3.245 \times 10^2$   
 d  $7.869 03 \times 10^3$     e  $8.459 12 \times 10^3$     f  $2 \times 10^{-1}$   
 g  $3.28 \times 10^{-4}$     h  $9.87 \times 10^{-3}$     i  $-1 \times 10^{-5}$   
 j  $-4.601 \times 10^8$     k  $1.7467 \times 10^4$     l  $-1.28 \times 10^2$

7 a 57 000    b 3 600 000    c 430 000 000  
 d 32 100 000    e 423 000    f 90 400 000 000  
 g 197 000 000    h 709    i 635 700  
 8 a 0.00012    b 0.000 0046    c 0.000 000 0008  
 d 0.000 0352    e 0.3678    f 0.000 000 123  
 g 0.000 09    h 0.05    i 0.4  
 9 a  $6 \times 10^{24}$     b  $4 \times 10^7$     c  $1 \times 10^{-10}$   
 d  $1.5 \times 10^8$     e  $6.67 \times 10^{-11}$     f  $1.5 \times 10^{-4}$   
 g  $4.5 \times 10^9$   
 10 a 4 600 000 000    b 8 000 000 000 000    c 384 000  
 d 0.0038    e 0.000 000 000 00001    f 720 000  
 11 a  $3.6 \times 10^7$     b  $3.6 \times 10^5$     c  $4.92 \times 10^{-1}$   
 d  $3.8 \times 10^{-4}$     e  $2.1 \times 10^{-6}$     f  $5.2 \times 10^{-8}$   
 g  $4 \times 10^{-9}$     h  $1.392 \times 10^{-7}$     i  $3.95 \times 10^3$   
 j  $4.38 \times 10^3$     k  $4.3 \times 10^5$     l  $5 \times 10^2$   
 m  $8.28 \times 10^6$     n  $3 \times 10^{11}$   
 12 a  $\$1.84 \times 10^9$     b  $\$2.647 \times 10^9$   
 13  $1.62 \times 10^9$  km    14  $2.126 \times 10^{-2}$  g  
 15 a  $3.2 \times 10^4$     b  $4.1 \times 10^6$     c  $3.17 \times 10^4$   
 d  $5.714 \times 10^5$     e  $1.3 \times 10^4$     f  $9.2 \times 10^1$   
 g  $3 \times 10^5$     h  $4.6 \times 10^5$     i  $6.1 \times 10^{-2}$   
 j 4.24    k  $1.013 \times 10^{-3}$     l  $4.9 \times 10^4$   
 m  $2 \times 10^{-5}$     n  $4 \times 10^{-6}$     o  $3.72 \times 10^{-4}$   
 p  $4.001 \times 10^{-8}$   
 16 a  $8 \times 10^6$     b  $9 \times 10^8$     c  $6.25 \times 10^{-4}$   
 d  $3.375 \times 10^{-9}$     e  $1.25 \times 10^8$     f  $4 \times 10^6$   
 g  $9 \times 10^{-4}$     h  $2.5 \times 10^4$   
 17 a  $6 \times 10^6$     b  $8 \times 10^{11}$     c  $2 \times 10^4$   
 d  $3 \times 10^9$     e  $5.6 \times 10^5$     f  $1.2 \times 10^8$   
 g  $1.2 \times 10^3$     h  $9 \times 10^3$     i  $9 \times 10^{-9}$   
 j  $7.5 \times 10^{-8}$     k  $1.5 \times 10^{-5}$     l 1  
 18  $5 \times 10^2 = 500$  seconds  
 19 a  $3 \times 10^{-4}$  km = 30 cm  
 b  $1 \times 10^{-3}$  seconds (one thousandth of a second)  
 = 0.001 seconds

### Exercise 6G

1 a 57 260, 57 300, 57 000, 60 000  
 b 4 170 200, 4 170 000, 4 170 000, 4 200 000, 4 000 000  
 c 0.003 661, 0.003 66, 0.0037, 0.004  
 d 24.871, 24.87, 24.9, 25, 20  
 2 a yes    b no    c no    d no    e yes  
 f yes    g yes    h no    i no  
 3 a 3    b 4    c 5    d 2  
 e 3    f 1    g 3    h 3  
 i 3    j 4    k 3    l 3  
 4 a  $2.42 \times 10^5$     b  $1.71 \times 10^5$     c  $2.83 \times 10^3$   
 d  $3.25 \times 10^6$     e  $3.43 \times 10^{-4}$     f  $6.86 \times 10^{-3}$   
 g  $1.46 \times 10^{-2}$     h  $1.03 \times 10^{-3}$     i  $2.34 \times 10^1$   
 j  $3.26 \times 10^2$     k  $1.96 \times 10^1$     l  $1.72 \times 10^{-1}$

- 5 a  $4.78 \times 10^4$     b  $2.2 \times 10^4$     c  $4.833 \times 10^6$   
d  $3.7 \times 10^1$     e  $9.95 \times 10^1$     f  $1.443 \times 10^{-2}$   
g  $2 \times 10^{-3}$     h  $9 \times 10^{-2}$     i  $1 \times 10^{-4}$
- 6 a  $2.441 \times 10^{-4}$     b  $2.107 \times 10^{-6}$     c  $-4.824 \times 10^{15}$   
d  $4.55 \times 10^{-5}$     e  $1.917 \times 10^{12}$     f  $1.995 \times 10^8$   
g  $3.843 \times 10^2$     h  $1.71 \times 10^{-11}$     i  $1.524 \times 10^8$   
j  $3.325 \times 10^{15}$     k  $4 \times 10^3$     l  $-9.077 \times 10^{-1}$
- 7 a  $9.3574 \times 10^1$     b  $2.1893 \times 10^5$     c  $8.6000 \times 10^5$   
d  $8.6288 \times 10^{-2}$     e  $2.2985 \times 10^{15}$     f  $3.5741 \times 10^{28}$   
g  $6.4 \times 10^7$     h  $1.2333 \times 10^9$     i 1.8293  
j  $5.4459 \times 10^{-1}$
- 8  $1.98 \times 10^{30}$  kg  
9  $1.39 \times 10^6$  km  
10  $1.09 \times 10^{12}$  km<sup>3</sup>  
11  $2421 \times 10^3$ ,  $24.2 \times 10^5$ ,  $2.41 \times 10^6$ ,  $0.239 \times 10^7$ ,  $0.02 \times 10^8$   
12 a  $4.26 \times 10^6$     b  $9.1 \times 10^{-3}$     c  $5.04 \times 10^{11}$   
d  $1.931 \times 10^{-1}$     e  $2.1 \times 10^6$     f  $6.14 \times 10^{-11}$   
13 should be  $8.8 \times 10^{10}$   
14 a i  $2.30 \times 10^2$     ii  $4.90 \times 10^{-2}$     iii  $4.00 \times 10^6$   
b It is zero  
c It clarifies the precision of the number  
15 a  $5.40046 \times 10^{12}$   
b i  $4.32 \times 10^{13}$     ii  $1.61 \times 10^{19}$     iii  $4.01 \times 10^{51}$

### Exercise 6H

- 1 a 4, 2    b 8, 2    c 9, 3    d 27, 3  
e 16, 4    f 64, 4
- 2 a True    b False    c True    d True  
e False    f False    g False
- 3 a 2.6458    b 3.6056    c 9.1104
- 4 a  $\sqrt{3}$     b  $\sqrt{7}$     c  $\sqrt[3]{5}$     d  $\sqrt[3]{12}$   
e  $\sqrt[5]{31}$     f  $\sqrt[7]{18}$     g  $\sqrt[9]{9}$     h  $\sqrt[8]{3}$
- 5 a  $8^{\frac{1}{2}}$     b  $19^{\frac{1}{2}}$     c  $10^{\frac{1}{3}}$     d  $31^{\frac{1}{3}}$   
e  $5^{\frac{1}{4}}$     f  $9^{\frac{1}{5}}$     g  $11^{\frac{1}{8}}$     h  $20^{\frac{1}{11}}$
- 6 a 5    b 7    c 9    d 13  
e 2    f 4    g 5    h 10  
i 2    j 3    k 5    l 2
- 7 a a    b  $a^{\frac{2}{3}}$     c  $a^2$     d  $a^{\frac{5}{2}}$   
e  $x^{\frac{1}{3}}$     f x    g  $x^{\frac{5}{6}}$     h x  
i y    j  $y^2$     k  $y^{\frac{3}{2}}$     l  $x^{\frac{1}{4}}$   
m  $x^{\frac{8}{3}}$     n  $a^{\frac{2}{15}}$     o  $a^{\frac{3}{8}}$     p  $n^{\frac{4}{3}}$
- 8 a  $a^{\frac{4}{3}}$     b  $a^{\frac{7}{10}}$     c  $a^{\frac{23}{21}}$     d  $a^{\frac{8}{3}}$   
e  $b^{\frac{1}{6}}$     f  $x^{\frac{2}{15}}$

- 9 a  $\frac{1}{2}$     b  $\frac{1}{2}$     c  $\frac{1}{2}$     d  $\frac{1}{3}$   
e  $\frac{1}{5}$     f  $\frac{1}{3}$     g  $\frac{1}{10}$     h  $\frac{1}{4}$
- 10 a 9    b 16    c 27    d 125  
e 32    f 32    g 729    h 3125
- 11 a  $\sqrt{29}$     b  $\sqrt{13}$     c  $\sqrt{65}$     d  $\sqrt{125}$   
e  $\sqrt{10}$     f  $\sqrt{1700}$
- 12 a  $a^{\frac{1}{2} + (-\frac{1}{2})} = a^0 = 1$     b  $a^{\frac{2}{3} + (-\frac{2}{3})} = a^0 = 1$   
c  $a^{\frac{4}{7} - \frac{4}{7}} = a^0 = 1$     d  $a^{\frac{5}{6} - \frac{5}{6}} = a^0 = 1$   
e  $a^{\frac{1}{4} \times a^{-\frac{1}{4}}} = a^{\frac{1}{4} + (-\frac{1}{4})} = a^0 = 1$   
f  $a^2 \div a^2 = a^{2-2} = a^0 = 1$

13 Brackets needed for fractional power,  $9 \wedge (1/2) = 3$

- 14 a i 3    ii 5    iii 10  
b a    c  $(a^2)^{\frac{1}{2}} = a^{2 \times \frac{1}{2}} = a$   
d i 4    ii 9    iii 36  
e a    f  $(a^2)^{\frac{1}{2}} = a^{2 \times \frac{1}{2}} = a$   
g i a    ii a    iii a    iv a
- 15 a  $\frac{4}{5}$     b  $\frac{3}{7}$     c  $\frac{2}{9}$     d  $\frac{2}{3}$   
e  $\frac{4}{5}$     f  $\frac{2}{3}$     g  $\frac{4}{5}$     h  $\frac{10}{7}$
- 16 a  $\frac{2}{3}$     b  $\frac{12}{7}$     c  $\frac{5}{2}$     d  $\frac{5}{6}$

### Exercise 6I

- 1 a like    b like    c unlike    d unlike  
e unlike    f like    g like    h unlike
- 2 a both = 3.162    b both = 4.583  
c both = 1.732    d both = 2.449
- 3 a  $8\sqrt{7}$     b  $8\sqrt{11}$     c  $9\sqrt{5}$     d  $4\sqrt{6}$   
e  $7\sqrt{3} + 2\sqrt{5}$     f  $9\sqrt{7} + 3\sqrt{5}$     g  $-5\sqrt{5}$     h  $-4\sqrt{7}$   
i  $5\sqrt{7}$     j  $-\sqrt{14}$     k  $7\sqrt{2} - \sqrt{5}$     l  $3\sqrt{3} + 2\sqrt{7}$
- 4 a  $\sqrt{30}$     b  $\sqrt{21}$     c  $\sqrt{70}$     d 4  
e 6    f  $\sqrt{22}$     g 3    h 12  
i  $\sqrt{3}$     j  $\sqrt{10}$     k  $\sqrt{7}$     l  $\sqrt{3}$   
m 3    n 4    o  $\sqrt{7}$
- 5 a  $8 - 3\sqrt{3}$     b  $6\sqrt{2} - \sqrt{3}$     c  $7\sqrt{5} + 1$   
d  $\frac{5\sqrt{2}}{6}$     e  $\frac{7\sqrt{7}}{10}$     f  $\frac{3\sqrt{6}}{14}$   
g  $\frac{2\sqrt{10}}{3}$     h  $5 + \frac{\sqrt{3}}{3}$     i  $-\frac{19\sqrt{8}}{56}$

- 6 a  $15\sqrt{6}$     b  $6\sqrt{21}$     c  $8\sqrt{30}$     d  $10\sqrt{18}$   
 e  $2\sqrt{3}$     f  $3\sqrt{6}$     g  $4\sqrt{14}$     h  $\frac{\sqrt{2}}{2}$
- 7 a  $6\sqrt{15}+2\sqrt{3}$     b  $\sqrt{10}+\sqrt{15}$     c  $5\sqrt{12}+15\sqrt{30}$   
 d  $14\sqrt{30}-70$     e  $13-2\sqrt{39}$     f  $\sqrt{35}-10$
- 8 a  $2\sqrt{2}$     b  $2\sqrt{3}$     c  $3\sqrt{3}$     d  $3\sqrt{5}$   
 e  $5\sqrt{3}$     f  $10\sqrt{2}$     g  $2\sqrt{15}$     h  $6\sqrt{2}$
- 9 a  $5\sqrt{2}$     b  $\sqrt{2}$     c  $4\sqrt{2}$     d  $\sqrt{3}$   
 e  $6\sqrt{2}$     f  $5\sqrt{3}$     g  $2\sqrt{5}$     h  $4\sqrt{3}$
- 10 a  $2+\sqrt{10}+\sqrt{6}+\sqrt{15}$     b  $3+\sqrt{6}-\sqrt{15}-\sqrt{10}$   
 c  $6\sqrt{10}+8\sqrt{5}-3\sqrt{2}-4$     d  $2+3\sqrt{2}-6\sqrt{7}-9\sqrt{14}$   
 e 1    f 4    g 15    h 123  
 i  $3+2\sqrt{2}$     j  $15-6\sqrt{6}$     k  $13-4\sqrt{3}$     l  $22+4\sqrt{10}$

### Challenges

- 1 a 4    b 1    c 6  
 2 a 6    b 30  
 3  $\frac{9}{4}$     4 a  $2t^2$     b  $\frac{2}{t}$   
 5 100 minutes    6  $\frac{2}{3}$   
 7 a i  $2^{\frac{3}{24}}$     ii  $2^{\frac{7}{8}}$     iii  $2^{\frac{15}{16}}$     b 2  
 8  $2^7$   
 9 a  $7\sqrt{2}$     b  $\frac{3}{\sqrt{2}}$     c  $12\sqrt{10}$   
 11 a  $x=0$  or 1    b  $x=1$  or 2

### Multiple-choice questions

- 1 D    2 B    3 E    4 A    5 C    6 B  
 7 D    8 C    9 E    10 B    11 C    12 A

### Short-answer questions

- 1 a  $3^4$     b  $2x^3y^2$     c  $3a^2b^2$     d  $\left(\frac{3}{5}\right)^3 \times \left(\frac{1}{7}\right)^2$   
 2 a  $3^2 \times 5$     b  $2^2 \times 3 \times 5^2$   
 3 a  $x^{10}$     b  $12a^5b^6c$     c  $12m^4n^4$     d  $a^9$   
 e  $x^3y^2$     f  $\frac{b^2}{2a^2}$   
 4 a  $m^6$     b  $9a^8$     c  $-32a^{10}b^5$     d  $3b$   
 e 2    f  $\frac{a^6}{27}$   
 5 a  $\frac{1}{x^3}$     b  $\frac{4}{t^3}$     c  $\frac{1}{9t^2}$     d  $\frac{2x^2}{3y^3}$   
 e  $\frac{5}{x^6y^3}$     f  $5m^3$   
 6 a  $\frac{x^2}{2y^2}$     b  $\frac{x^3y^2}{9}$     c  $8m^7n^3$   
 7 0.0012,  $35.4 \times 10^{-3}$ ,  $3.22 \times 10^{-1}$ , 0.4,  $0.007 \times 10^2$ , 2.35

- 8 a 324    b 172 500    c 0.2753    d 0.00149  
 9 a  $2.25 \times 10^7$  people    b  $9.63 \times 10^6$  km<sup>2</sup>  
 c  $3.34 \times 10^{-9}$  seconds    d  $2.94 \times 10^{-7}$  m  
 10 a  $2.19 \times 10^5$     b  $1.2 \times 10^{-2}$   
 c  $4.32 \times 10^{-7}$     d  $5 \times 10^6$   
 11 a  $1.2 \times 10^{55}$     b  $4.3 \times 10^{-5}$   
 12 a 2    b 5    c 7    d 3    e  $\frac{1}{3}$     f  $\frac{1}{11}$   
 13 a  $s^2$     b  $9t^{\frac{3}{2}}$     c  $15x^{\frac{5}{2}}$     d  $9m^{\frac{3}{4}}n^4$   
 e  $\frac{t^{\frac{1}{2}}}{2}$     f  $4a^{\frac{2}{3}}$   
 14 a  $7\sqrt{7}+2$     b  $\sqrt{3}+9\sqrt{2}$     c 8    d  $\sqrt{15}$   
 e  $2\sqrt{14}$     f  $15\sqrt{22}$     g  $\sqrt{6}$     h 10    i  $\frac{\sqrt{5}}{2}$

### Extended-response questions

- 1 a  $\frac{16x^6}{3}$     b  $\frac{8b^8}{15a^2}$     c  $\frac{5m^8}{n^{10}}$     d  $3x$   
 2 a  $5.93 \times 10^{-11}$  N    b i  $1.50 \times 10^{11}$  m    ii  $3.53 \times 10^{22}$  N  
 c Earth  $a = 9.81$  ms<sup>-2</sup>, Mars  $a = 3.77$  ms<sup>-2</sup>  
 Acceleration due to gravity on Earth is more than  $2\frac{1}{2}$  times that on Mars

## Chapter 7

### Pre-test

- 1 a obtuse    b acute    c reflex    d right  
 2 a isosceles    b equilateral  
 c scalene    d right-angled  
 e equilateral    f right-angled, isosceles triangle  
 3 a 60°    b 75° each    c 50°  
 4 a  $x=55$     b  $x=100$     c  $x=110$     d  $x=45$   
 e  $x=40$     f  $x=108$   
 5 a  $a=60$     b  $b=110$     c  $a=60, b=120$   
 6 a pentagon    b parallelogram    c trapezium  
 d rhombus    e hexagon    f nonagon

### Exercise 7A

- 1 a right    b 180°    c revolution    d obtuse  
 e acute    f 180°    g 90°  
 h supplementary    i 180°    j equal  
 2 a isosceles triangle    b obtuse angle triangle  
 c equilateral triangle    d isosceles triangle  
 e acute angled triangle    f scalene triangle  
 g right-angled triangle  
 3 a i  $\angle BAC$     ii obtuse    iv 120°  
 b i  $\angle PRQ$     ii acute    iv 30°  
 c i  $\angle XYZ$     ii reflex    iv 310°

- d i  $\angle SRT$  ii straight angle iv  $180^\circ$   
 e i  $\angle ROB$  ii obtuse iv  $103^\circ$   
 f i  $\angle AOB$  ii right iv  $90^\circ$
- 4 a  $50^\circ$  b  $90^\circ$  c  $101^\circ$   
 d  $202^\circ$  e  $180^\circ$  f  $360^\circ$
- 5 a i  $125^\circ$  ii  $35^\circ$  b i  $149^\circ$  ii  $59^\circ$   
 c i  $106^\circ$  ii  $16^\circ$  d i  $170^\circ$  ii  $80^\circ$   
 e i  $91^\circ$  ii  $1^\circ$  f i  $158^\circ$  ii  $68^\circ$   
 g i  $142^\circ$  ii  $52^\circ$  h i  $115^\circ$  ii  $25^\circ$   
 i i  $133^\circ$  ii  $43^\circ$  j i  $103^\circ$  ii  $13^\circ$
- 6 a C b S c N d C  
 e S f N g S h N
- 7 a  $a = 63^\circ$  b  $a = 71^\circ$  c  $a = 38^\circ$   
 d  $a = 147^\circ$  e  $a = 233^\circ$  f  $a = 33^\circ$
- 8 a obtuse isosceles,  $40^\circ$  b acute scalene,  $30^\circ$   
 c right-angled scalene,  $90^\circ$  d equilateral,  $60^\circ$   
 e obtuse isosceles,  $100^\circ$  f right-angled isosceles,  $45^\circ$   
 g obtuse scalene,  $100^\circ$  h equilateral,  $60^\circ$   
 i obtuse isosceles,  $120^\circ$  j obtuse isosceles,  $40^\circ$   
 k right-angled scalene,  $90^\circ$  l acute scalene,  $70^\circ$
- 9 a  $s = 120$  b  $t = 20$  c  $r = 70$   
 d  $a = 60, x = 120$  e  $a = 100, b = 140$  f  $c = 115, d = 65$
- 10 a  $360^\circ$  b  $90^\circ$  c  $60^\circ$  d  $90^\circ$   
 e  $432^\circ$  f  $6^\circ$  g  $720^\circ$  h  $8640^\circ$
- 11 a  $x = 56$  b  $x = 155$  c  $x = 116$
- 12 a  $90^\circ$  b  $150^\circ$  c  $15^\circ$   
 d  $165^\circ$  e  $157.5^\circ$  f  $80^\circ$   
 g  $177.5^\circ$  h  $171^\circ$  i  $121.5^\circ$
- 13  $\angle AOB + \angle ABO = 120^\circ$  (exterior angle of triangle)  
 $\angle AOB = 30^\circ$   
 (reflex)  $x = 330$
- 14  $AO = BO$  (radii)  
 $\triangle AOB$  is isosceles, 2 sides equal,  $\angle AOB = 116^\circ$   
 $\therefore \angle OAB = 32^\circ$ , base angles of isosceles triangle
- 15 a  $160^\circ$  b  $165^\circ$   
 c  $\angle WYZ + a^\circ + b^\circ = 180^\circ$  angle sum of a triangle  
 $\angle XYZ + \angle WYZ = 180^\circ$  straight line  
 $\therefore \angle XYZ = a^\circ + b^\circ$
- 16 Let the interior angles of any triangle be  $a, b$  and  $c$   
 Now  $a + b + c = 180^\circ$   
 The exterior angles become,  $180^\circ - a^\circ, 180^\circ - b^\circ,$   
 $180^\circ - c^\circ$  (straight line)  
 Exterior sum =  $(180 - a) + (180 - b) + (180 - c)$   
 $= 540 - a - b - c$   
 $= 540 - (a + b + c)$   
 $= 540 - 180$   
 $= 360^\circ$
- 17 a  $4x = 90, x = 22.5$  b  $3x = 180, x = 60$   
 c  $10x = 360, x = 36$  d  $2(x + 15) + x = 180, x = 50$   
 e  $2x + 20 = 140, x = 60$  f  $6x + 90 = 360, x = 45$

### Exercise 7B

- 1 a equal b equal c supplementary
- 2 a  $125^\circ$ , alternate angles in  $\parallel$  lines  
 b  $110^\circ$ , cointerior angles in  $\parallel$  lines  
 c  $80^\circ$ , corresponding angles in  $\parallel$  lines  
 d  $66^\circ$ , alternate angles in  $\parallel$  lines  
 e  $96^\circ$ , vertically opposite  
 f  $126^\circ$ , corresponding angles on  $\parallel$  lines  
 g  $62^\circ$ , supplementary angles  
 h  $115^\circ$ , corresponding angles on  $\parallel$  lines  
 i  $116^\circ$ , cointerior angles on  $\parallel$  lines
- 3 a no, alternate angles are not equal  
 b yes, corresponding angles are equal  
 c yes, alternate angles are equal  
 d no, cointerior angles don't add to  $180^\circ$   
 e yes, cointerior angles add to  $180^\circ$   
 f yes, corresponding angles are equal  
 g no, corresponding angles are not equal  
 h no, alternate angles are not equal  
 i no, cointerior angles do not add to  $180^\circ$
- 4 a  $a = 60, b = 120$  b  $c = 95, d = 95$   
 c  $e = 100, f = 100, g = 100$  d  $a = 110, b = 70$   
 e  $a = 100, b = 80, c = 80$   
 f  $e = 140, f = 140, d = 140$
- 5 a  $x = 70, y = 40$  b  $t = 58, z = 122$   
 c  $u = 110, v = 50, w = 50$  d  $x = 118$   
 e  $x = 295$  f  $x = 79$
- 6 a  $105^\circ$  b  $105^\circ$  c  $56^\circ$   
 d  $105^\circ$  e  $90^\circ$  f  $85^\circ$
- 7 a 56 b 120 c 50
- 8 a  $180^\circ - a^\circ$  b  $180^\circ - a^\circ$   
 c  $180^\circ - (a^\circ + b^\circ)$  d  $180^\circ - (a^\circ + b^\circ)$   
 e  $a^\circ + c^\circ$  f  $180^\circ - 2c^\circ$
- 9  $\angle ABC = 100^\circ$   
 $\angle BCD = 80^\circ$   
 $\therefore AB \parallel DC$  as cointerior angles are supplementary  
 $\angle ABC + \angle BCD = 180^\circ$
- 10 a cointerior angles on parallel lines add to  $180^\circ$   
 b alternate angles are equal, on parallel lines  
 c  $\triangle ABC \Rightarrow a + b + c = 180$  and these are the three angles of the triangle
- 11 a  $\angle BAE = 180^\circ - a^\circ$  (alternate angles and  $AB \parallel DE$ )  
 $\angle ABC = 180^\circ - c^\circ - (180 - a)^\circ$  (angle sum of a triangle)  
 $= 180^\circ - c^\circ - 180^\circ + a^\circ$   
 $= -c^\circ + a^\circ$   
 $= a^\circ - c^\circ$   
 b  $\angle ABD = 180^\circ - (a^\circ + b^\circ)$  (angle sum of triangle  $\triangle ABD$ )  
 $\angle ABC + \angle ABD = 180^\circ$  (straight line)  
 $\therefore \angle ABC = a^\circ + b^\circ$

- c construct  $XY$  through  $B$  parallel to  $AE$   
 $\therefore \angle ABY = a^\circ$  (alternate angles,  $AE \parallel XY$ )  
 $\therefore \angle CBY = b^\circ$  (alternate angles,  $DC \parallel XY$ )  
 $\therefore \angle ABC = a^\circ + b^\circ$
- d Construct  $XY$  through  $A$  parallel to  $ED$   
 Now  
 $\angle XAD = 180^\circ - b^\circ$  (co-interior angles,  $ED \parallel XY$ )  
 $\angle DAB = 360^\circ - a^\circ$  (revolution)  
 $\therefore \angle XAB = 360^\circ - a^\circ - (180^\circ - b^\circ)$   
 $= 180^\circ + b^\circ - a^\circ$   
 $\angle ABC = \angle XAB$  (alternate angles and  $XY \parallel BC$ )

### Exercise 7C

- 1 a 5 b 7 c 4 d 11 e 9 f 12  
 2 a  $720^\circ$  b  $1080^\circ$  c  $1620^\circ$   
 3 a parallel b right c trapezium d equal  
 4 a convex quadrilateral b non-convex hexagon  
 c non-convex heptagon  
 5 a 115 b 159 c 30  
 d 121 e 140 f 220  
 6 a 110 b 70 c 54  
 d 33 e 63 f 109  
 7 a 110 b 150  
 c 210 d 20  
 e  $b = 108, a = 72$  f  $a = 140, b = 40$   
 g  $b = 120, a = 240$  h  $b = 128\frac{4}{7}, a = 231\frac{3}{7}$   
 i 108  
 8 a parallelogram, rectangle, kite b rectangle, square  
 c square, rectangle d square, rhombus, kite  
 9 a 16 b 25 c 102  
 10 a 255 b 80 c 115 d 37 e 28 f 111  
 11 A parallelogram has opposite sides parallel and equal and rectangles, squares and rhombi have these properties (and more) and are therefore all parallelograms.  
 12 a  $S = 180(n-2)$  b  $l = \frac{180(n-2)}{n}$  c  $E = \frac{360}{n}$  d  $36^\circ$   
 13 a i one ii two iii five b  $(n-3)$   
 14  $(180-a) + (180-b) + (180-c) + (180-d) + (180-e) = 360$   
 (sum of exterior angles is  $360^\circ$ )  
 $180 + 180 + 180 + 180 + 180 - (a+b+c+d+e) = 360$   
 $900 - (a+b+c+d+e) = 360$   
 $a+b+c+d+e = 540$   
 a  $a+b+c+d+e+f = 720$   
 b  $a+b+c+d+e+f+g = 900$

### Exercise 7D

- 1 a size b  $\triangle ABC \equiv \triangle STU$  c SAS, RHS, AAS  
 2 a i  $XY$  ii  $XZ$  iii  $YZ$   
 b i  $\angle A$  ii  $\angle B$  iii  $\angle C$

- 3 a  $\triangle ABC \equiv \triangle FGH$  b  $\triangle DEF \equiv \triangle STU$   
 c  $\triangle AMP \equiv \triangle CBD$  d  $\triangle BMW \equiv \triangle SLK$   
 4 a SAS b AAS c RHS d SAS  
 e SSS f RHS g AAS h SSS  
 5 a  $x = 3, y = 5$  b  $x = 2, y = 6$   
 c  $a = 105, b = 40$  d  $a = 65, b = 85$   
 e  $x = 2.5, b = 29$  f  $a = 142, x = 9.21, b = 7$   
 g  $y = 4.2, a = 28$  h  $a = 6.5, b = 60$   
 6 a  $\triangle ABC \equiv \triangle STU$ , RHS b  $\triangle DEF \equiv \triangle GHI$ , SSS  
 c  $\triangle ABC \equiv \triangle DEF$ , SAS d  $\triangle ABC \equiv \triangle GHI$ , AAS  
 7  $\triangle PBR \equiv \triangle FDE$   
 $\triangle LMN \equiv \triangle KIJ$   
 $\triangle FGH \equiv \triangle BCD$   
 $\triangle MNO \equiv \triangle RQP$   
 8 a  $BC = 13$  b  $BC = 85$   
 9 no – they can all be different sizes, one might have all sides 2 cm and another all sides 5 cm.  
 10 a one given, the other pair are vertically opposite  
 b AAS  
 11 a SSS b equal  
 12 a one given ( $BA = BC$ ) and side  $BD$  is common  
 b SAS  
 c  $\triangle ABD \equiv \triangle CBD$   
 d  $\angle ADB = \angle CDB$  (corresponding angles in congruent triangles)  
 but  $\angle ADB + \angle CDB = 180^\circ$  (straight angle)  
 $\therefore \angle ADB = \angle CDB = 90^\circ$   
 and AC is perpendicular to DB

### Exercise 7E

- 1 a  $BD$  b  $AC$  c  $AC$   
 2  $OA = OB$  radii of circle centre  $O$   
 3 a  $\angle ECD$  b  $\angle CBA$  c  $\angle DEC$   
 4 a SSS b  $\angle BMC$   
 5 a  $AD = CD$  (given)  
 $\angle DAB = \angle DCB = 90^\circ$  (given)  
 DB is common  
 $\therefore \triangle ABD \equiv \triangle CBD$  (RHS)  
 b AC is common  
 $AD = AB$  (given)  
 $\angle DAC = \angle BAC$  (given)  
 $\therefore \triangle ADC \equiv \triangle ABC$  (SAS)  
 c AC is common  
 $\angle ADC = \angle ABC$  (given)  
 $\angle DAC = \angle BAC$  (given)  
 $\triangle ADC \equiv \triangle ABC$  (AAS)  
 d AC is common  
 $AD = AB$  (given)  
 $DC = BC$  (given)  
 $\therefore \triangle ADC \equiv \triangle ABC$  (SSS)

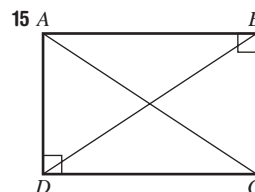
- e**  $AC = DC$  (given)  
 $BC = EC$  (given)  
 $\angle ACB \equiv \angle DCE$  (vertically opposite)  
 $\therefore \triangle ABC \equiv \triangle DEC$  (SAS)
- f**  $AC = EC$  (given)  
 $\angle CAB = \angle CED$  (alternate angles,  $AB \parallel DE$ )  
 $\angle ACB = \angle ECD$  (vertically opposite)  
 $\therefore \triangle ABC \equiv \triangle EDC$  (AAS)
- g**  $DC = BC$  (given)  
 $\angle EDC = \angle ABC$  (alternate angles,  $DE \parallel AB$ )  
 $\angle DCE = \angle BCA$  (vertically opposite)  
 $\triangle CDE \equiv \triangle CBA$  (AAS)
- h**  $BD$  is common  
 $AD = CD$  (given)  
 $\angle ADB = \angle CDB$  (given)  
 $\triangle ABD \equiv \triangle CBD$  (SAS)
- i**  $AC$  is common  
 $AB = CD$  (given)  
 $BC = DA$  (given)  
 $\therefore \triangle ABC \equiv \triangle CDA$  (SSS)
- j**  $BD$  is common  
 $\angle ABD = \angle CDB$  (alternate angles,  $AB \parallel CD$ )  
 $\angle ADB = \angle CBD$  (alternate angles,  $AD \parallel CB$ )  
 $\therefore \triangle ABD \equiv \triangle CDB$  (AAS)
- k**  $OA = OC$  (radii)  
 $OB$  is common  
 $AB = CB$  given  
 $\therefore \triangle AOB \equiv \triangle COB$  (SSS)
- l**  $OA = OD$  and  $OB = OC$  (radii)  
 $\angle AOB = \angle COD$  (vertically opposite)  
 $\triangle AOB \equiv \triangle COD$  (SAS)
- 6 a**  $DC = BC$  (given)  
 $EC = AC$  (given)  
 $\angle DCE = \angle BCA$  (vertically opposite)  
 $\therefore \triangle ABC \equiv \triangle EDC$  (SAS)
- b**  $\angle EDC = \angle ABC$  (corresponding angles in congruent triangles)  
 $\therefore AB \parallel DE$  (alternate angles are equal)
- 7 a**  $AE = CD$  (given)  
 $BE = BD$  (given)  
 $\angle ABE = \angle CBD$  (vertically opposite with  $\angle ABE$  given  $90^\circ$ )  
 $\therefore \triangle ABE \equiv \triangle CBD$  (RHS)
- b**  $\angle EAB = \angle DCB$  (corresponding angles in congruent triangles)  
 $\therefore AE \parallel CD$  (alternate angles equal)
- 8 a**  $DB$  is common  
 $AB = CD$  (given)  
 $AD = CB$  (given)  
 $\therefore \triangle ABD \equiv \triangle CDB$  (SSS)
- b**  $\angle ADB = \angle CBD$  (corresponding angles in congruent triangles)  
 $\therefore AD \parallel BC$  (alternate angles equal)

- 9 a**  $OB = OC$  (radii)  
 $OA = OD$  (radii)  
 $\angle AOB = \angle DOC$  (vertically opposite)  
 $\therefore \triangle AOB \equiv \triangle DOC$  (SAS)
- b**  $\angle ABO = \angle DCO$  (corresponding angles in congruent triangles)  
 $\therefore AB \parallel CD$  (alternate angles equal)
- 10 a**  $BD$  is common  
 $AD = CD$  (given)  
 $\angle ADB = \angle CDB$  (given)  
 $\therefore \triangle ABD \equiv \triangle CBD$  (SAS)
- b**  $\angle ABD = \angle CBD$  (corresponding angles in congruent triangles)  
and  $\angle ABD + \angle CBD = 180^\circ$  (straight line)  
 $\therefore \angle ABD = \angle CBD = 90^\circ$  and  $AC$  is perpendicular to  $BD$
- 11 a**  $DB$  is common  
 $\angle ABD = \angle CBD$  (given  $90^\circ$ )  
 $\angle ADB = \angle CDB$  (given)  
 $\therefore \triangle ABD \equiv \triangle CBD$  (AAS)
- b**  $AD = CD$  (corresponding side in congruent triangles)  
 $\therefore \triangle ACD$  is isosceles (2 equal sides)

- 12** Consider  $\triangle OAD$  and  $\triangle OBD$   
 $OD$  is common  
 $OA = OB$  (radii)  
 $AD = BD$  (given)  
 $\therefore \triangle OAD \equiv \triangle OBD$  (SSS)  
 $\angle ODA = \angle ODB = 90^\circ$  (corresponding angles in congruent triangles are equal and supplementary to a straight line)  
 $\therefore OC \perp AB$

- 13** Consider  $\triangle ADC$  and  $\triangle CBA$   
 $AC$  is common  
 $\angle DAC = \angle BCA$  (alternate angles,  $AD \parallel BC$ )  
 $\angle DCA = \angle BAC$  (alternate angles,  $DC \parallel AB$ )  
 $\therefore \triangle ADC \equiv \triangle CBA$  (AAS)  
So  $AD = BC$ ,  $AB = DC$  are equal corresponding sides in congruent triangles

- 14**  $AB = DC$  (opposite sides of parallelogram)  
 $\angle AEB = \angle CED$  (vertically opposite)  
 $\angle BAE = \angle DCE$  (alternate angles  $DC \parallel AB$ )  
 $\therefore \triangle ABE \equiv \triangle CDE$  (AAS)  
So  $AE = CE$  and  $BE = DE$ , corresponding sides in congruent triangles



- Consider  $\triangle ADC$  and  $\triangle BCD$   
 $AD = CB$  and  $DC$  is common (opposite sides of a rectangle are equal)

$\angle ADC = \angle BCD = 90^\circ$  (angles of a rectangle)  
 $\therefore \triangle ADC \equiv \triangle BCD$  (SAS)  
 So  $AC = BD$  (corresponding sides in congruent triangles)  
 $\therefore$  The diagonals of a rectangle are equal

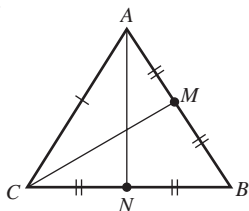
16 a Consider  $\triangle ABE$  and  $\triangle CDE$

$AB = CD$  (sides of a rhombus)  
 $\angle ABE = \angle CDE$  (alternate angles,  $AB \parallel CD$ )  
 $\angle BAE = \angle DCE$  (alternate angles,  $AB \parallel CD$ )  
 $\therefore \triangle ABE \equiv \triangle CDE$  (AAS)

b Consider  $\triangle DCE$  and  $\triangle BCE$

$CE$  is common  
 $DC = BC$  (sides of a rhombus)  
 $DE = BE$  (corresponding sides in congruent triangles)  
 $\therefore \triangle DCE \equiv \triangle BCE$  (SSS)  
 $\therefore DE = BE$  (corresponding sides in congruent triangles)  
 $\angle DEC = \angle BEC$  (corresponding angles in congruent triangles)  
 $\angle DEC + \angle BEC = 180^\circ$  (straight line)  
 $\therefore \angle DEC = \angle BEC = 90^\circ$   
 and  $AE = CE$  (corresponding sides in congruent triangles)  
 $\therefore AC$  bisects  $BD$  at  $90^\circ$

17



let  $\triangle ABC$  be any equilateral triangle  $AB = BC = AC$

**Step one**

Join C to M the midpoint of AB

Prove  $\triangle CAM \equiv \triangle CBM$  (SSS)

$\therefore \angle CAM = \angle CBM$  (corresponding angles in congruent triangles)

**Step two**

Join A to N, the midpoint of BC

Prove  $\triangle ANC \equiv \triangle ANB$

$\therefore \angle ACN = \angle ABN$  (corresponding angles in congruent triangles)

Now  $\angle CAB = \angle ABC = \angle ACB$

and as  $\angle CAB + \angle ABC + \angle ACB = 180^\circ$  (angle sum of  $\triangle ABC$ )

$\angle CAB = \angle ABC = \angle ACB = 60^\circ$

### Exercise 7F

- 1 a  $\angle F$     b  $\angle D$     c  $GH$     d  $AE$     e 2  
 2 a double    b double    c double    d 2    e yes  
 3 a  $OA'$  is a quarter of  $OA$     b  $OD'$  is a quarter of  $OD$   
 c  $\frac{1}{4}$     d yes  
 4 a yes    b 8 cm    c 25 m  
 5 drawings    a  $A'B'C'$  should have sides  $\frac{1}{3}$  that of  $ABC$   
 b  $A'B'C'$  should have sides double that of  $ABC$

6 b i  $A'B'C'D'$  should have sides lengths  $\frac{1}{2}$  that of  $ABCD$

ii  $A'B'C'D'$  should have side lengths 1.5 times that of  $ABCD$

7 a i 2    ii 14    iii 10

b i  $1\frac{1}{2}$     ii 9    iii 8

c i  $1\frac{1}{2}$     ii 45    iii 24

d i  $\frac{2}{5}$     ii 1    iii 1.4

e i 2.5    ii 0.6    iii 2

f i 1.75    ii 3.5    iii 3

8 a i 2    ii (0,0)    b i  $\frac{1}{2}$     ii (0,0)

c i  $\frac{1}{2}$     ii (3,0)    d i 3    ii (1,0)

9 a i 3.6 m    ii 9 m    iii 2.7 m

b i 5.4 m    ii 6.3 m    c i 4 m    ii 6 m

10 a 12.7 cm    b 3 cm    c 3 m

11 a  $a > 1$     b  $a < 1$     c  $a = 1$

12 a all angles of any square equal  $90^\circ$ , with only 1 side length

b all angles in any equilateral triangle equal  $60^\circ$  with only 1 side length

c The length and width might be multiplied by different numbers

d 2 isosceles triangles do not have to have the same size equal angles

13  $\frac{1}{k}$     14 a 100 000 cm = 1 km    b 24 cm

15 b i  $\frac{l}{2}$     ii  $\frac{l}{4}$     iii  $\frac{l}{128}$     c i  $\frac{3}{4}$     ii  $\frac{9}{16}$     iii  $\frac{243}{1024}$

d zero

### Exercise 7G

1 a  $E$     b  $C$     c  $DF$     d  $BC$     e  $\angle A$     f  $\angle E$

2 2.5

3 a SAS, AAA, and RHS    b shape, size

4 a AAA    b RHS    c SSS    d SAS

e RHS    f AAA    g SAS    h SSS

5 a  $\triangle ABC \parallel \triangle GHI$     b  $\triangle ABC \parallel \triangle MNO$

c  $\triangle ABC \parallel \triangle ADE$     d  $\triangle HFG \parallel \triangle HJI$

e  $\triangle ADC \parallel \triangle AEB$     f  $\triangle ABD \parallel \triangle ECD$

6 a AAA    b 12    7 a RHS    b 8

8 a i  $\frac{8}{5}$     ii 14.4    b i 3.5    ii 5

9 a AAA    b 15

10 a i AAA    ii 6.5    b i AAA    ii 10

c i AAA    ii 24

11 a 2    b 16    c 2.8

12 a  $\triangle DEF$     b  $\triangle DEF$     c  $\triangle ABC$     d  $\triangle DEF$

13  $\angle ACB = 25^\circ$ , AAA

14  $\angle WXY = 55^\circ$ , not similar as angles not equal

15 2 pairs of equal alternate angles are always formed

16 AAA, in congruency a side length is needed for the triangles to be the same size, in similarity it is not needed.



Triangle	Original	Image 1	2	3
Length scale factor	1	2	3	4
Area	4	16	36	64
Area scale Factor	1	4	9	16

- 17 a** Area scale factor = (length scale factor)<sup>2</sup>  
**c**  $n^2$    **d** i 100   ii 400   iii 10 000   **e**  $\frac{1}{4}$

### Exercise 7H

- 1**  $\angle C$   
**2 a**  $\angle ACB$  and  $\angle ECD$   
**b**  $\angle BAC = \angle DEC$  and  $\angle CBA = \angle CDE$   
**3 a**  $\angle C$    **b** i  $AC$    ii  $DB$   
**4 a**  $\angle AEB = \angle CDB$  (alternate angles,  $EA \parallel DC$ )  
 $\angle EAB = \angle DCB$  (alternate angles,  $EA \parallel DC$ )  
 $\angle EBA = \angle DBC$  (vertically opposite)  
 $\therefore \triangle AEB \parallel \triangle CDB$  (AAA)  
**b**  $\angle BAC = \angle DEC$  (alternate angles,  $AB \parallel DE$ )  
 $\angle ABC = \angle EDC$  (alternate angles,  $AB \parallel DE$ )  
 $\angle ACB = \angle ECD$  (vertically opposite)  
 $\therefore \triangle ACB \parallel \triangle ECD$  (AAA)  
**c**  $\angle C$  is common  
 $\angle CDB = \angle CEA$  (corresponding angles,  $AE \parallel BD$ )  
 $\angle CBD = \angle CAE$  (corresponding angles,  $AE \parallel BD$ )  
 $\therefore \triangle CBD \parallel \triangle CAE$  (AAA)  
**d**  $\angle A$  is common  
 $\angle AEB = \angle ADC$  (corresponding angles,  $EB \parallel DC$ )  
 $\angle ABE = \angle ACD$  (corresponding angles,  $EB \parallel DC$ )  
 $\therefore \triangle AEB \parallel \triangle ADC$  (AAA)  
**e**  $\angle A$  is common  
 $\angle ABE = \angle ADC$  (given)  
 $\therefore \triangle ABE \parallel \triangle ADC$  (AA)  
 (note 2 angles is enough –  $\angle AEB = \angle ACD$  (angle sum of a triangle))  
**f**  $\angle ABD = \angle BCD$  (given  $90^\circ$ )  
 $\angle BAD = \angle CBD$  (given)  
 $\therefore \triangle ABD \parallel \triangle BCD$  (AA)  
**5 a**  $\angle C$  is common.  
 $\frac{CA}{CD} = \frac{6}{2} = \frac{3}{1} = 3$   
 $\frac{CE}{CB} = \frac{9}{3} = 3$   
 $\therefore \triangle CDB \parallel \triangle CAE$  (SAS)  
**b**  $\angle D$  is common  
 $\frac{AD}{CD} = \frac{28}{7} = 4$   
 $\frac{DB}{DE} = \frac{48}{12} = 4$   
 $\therefore \triangle ABD \parallel \triangle CED$  (SAS)

- c**  $\angle DCE = \angle BCA$  (vertically opposite)  
 $\frac{EC}{AC} = \frac{2}{5}$   
 $\frac{DC}{BC} = \frac{3}{7.5} = \frac{2}{5}$   
 $\therefore \triangle DCE \parallel \triangle BCA$  (SAS)  
**6 a** AAA   **b** 40 m   **7 a** AAA   **b** 7.5 m  
**8** 6 m   **9** 20 m   **10** 7.2 m   **11**  $\frac{55}{6}$   
**12 a** Firstly,  $\angle ADC = \angle ACD = 80^\circ$  (base angles of isosceles  $\triangle ADC$ )  
 $\angle ACB = 100^\circ$  (straight angle)  
 $\angle CAB = 60^\circ$  (angle sum of  $\triangle ACB$ )  
 Now  $\angle DAB = 80^\circ$   
 Proof  $\angle DAC = \angle DBA$  (given  $20^\circ$ )  
 $\angle D$  is common  
 $\angle ACD = \angle BAD$  (both  $80^\circ$ )  
 $\therefore \triangle ACD \parallel \triangle BAD$  (AAA)  
**b**  $DC = \frac{20}{3}$     $CB = \frac{25}{3}$   
**13 a** i  $\angle B$  is common  
 $\angle DAB = \angle ACB$  (given  $90^\circ$ )  
 $\therefore \triangle ABD \parallel \triangle CBA$  (AA)  
 ii  $\angle D$  is common  
 $\angle DCA = \angle DAB$  (given  $90^\circ$ )  
 $\therefore \triangle ABD \parallel \triangle CAD$  (AA)  
**b** i  $BD = \frac{25}{3}$    ii  $AC = 4$    iii  $AB = \frac{20}{3}$   
**14 a**  $\angle ACB = \angle ECD$  (vertically opposite)  
 $\angle CAB = \angle CED$  (alternate angles,  $DE \parallel BA$ )  
 $\therefore \triangle ABC \parallel \triangle EDC$  (AA)  
 $\therefore \frac{DC}{BC} = \frac{EC}{AC}$  (ratio of corresponding sides in similar triangles)  
 $\frac{6}{2} = \frac{EC}{AC}$   
 $\therefore 3AC = CE$   
 as  $AC + CE = AE$   
 $AE = 4AC$   
**b**  $\angle C$  is common  
 $\angle DBC = \angle AEC$  (given)  
 $\therefore \triangle CBD \parallel \triangle CEA$  (AA)  
 $\therefore \frac{DB}{AE} = \frac{2}{4} = \frac{BC}{CE}$  (ratio of corresponding sides in similar triangles)  
 $\therefore 4BC = 2CE$   
 $BC = \frac{1}{2} CE$   
**c**  $\angle C$  is common  
 $\angle CBD = \angle CAE$  (corresponding angles,  $BD \parallel AE$ )  
 $\therefore \triangle CBD \parallel \triangle CAE$  (AA)  
 $\therefore \frac{CB}{CA} = \frac{CD}{CE}$  (ratio of corresponding sides in similar triangles)  
 $\therefore \frac{5}{7} = \frac{CD}{CE}$   
 $\therefore 5CE = 7CD$   
 $CE = \frac{7}{5} CD$

d  $\angle C$  is common

$$\angle CBD = \angle CAE \text{ (given } 90^\circ)$$

$$\therefore \triangle CBD \parallel \triangle CAE \text{ (AAA)}$$

$$\therefore \frac{BD}{AE} = \frac{CB}{CA} \text{ (ratio of corresponding sides in similar triangles)}$$

$$\frac{2}{8} = \frac{CB}{CA}$$

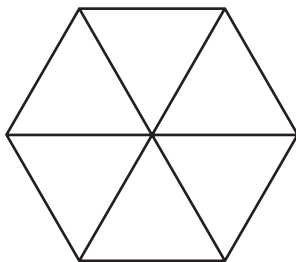
$$\frac{1}{4} = \frac{CB}{CB + AB}$$

$$CB + AB = 4CB$$

$$\therefore AB = 3CB$$

### Challenges

1



2 15

3  $40^\circ$

4 midpoints

5 170

6 11

7  $\frac{120}{7}$

### Multiple-choice questions

1 D

2 A

3 B

4 D

5 C

6 D

7 E

8 B

9 D

10 A

### Short-answer questions

1 a isosceles,  $x = 50$ ,  $y = 80$  b right angled,  $x = 25$

c obtuse angled,  $x = 30$ ,  $y = 110$

2 a  $a = 30$  (vertically opposite)  $b = 150$  (straight angle)

b  $x = 60$  (revolution)  $y = 120$  (co-interior angles in parallel lines)

c  $a = 70$  (alternate angles and parallel lines)

$b = 55$  (angle sum of isosceles triangle)

$c = 55$  (corresponding angles and parallel lines)

3  $\angle ABC = 75^\circ$

4 a  $a = 70$ ,  $b = 110$  b  $x = 15$  c  $x = 30$  d  $a = 120$

5 a SSS,  $x = 60$

b not congruent

c RHS,  $x = 12$

d AAS,  $x = 9$

6 a AD is common

$$\angle ADC = \angle ADB \text{ (given } 90^\circ)$$

$$CD = BD \text{ (given)}$$

$$\therefore \triangle ADC \cong \triangle ADB \text{ (SAS)}$$

b i  $AC = EC$  (given)

$$\angle BAC = \angle DEC \text{ (given)}$$

$$\angle ACB = \angle ECD \text{ (vertically opposite)}$$

$$\therefore \triangle ACB \cong \triangle ECD \text{ (AAS)}$$

ii as  $\angle BAC = \angle DEC$  (alternate angles are equal)

$$\therefore AB \parallel DE$$

7 For image  $\triangle A'B'C'$ ,  $OA' = 3OA$ ,  $OB' = 3OB$ ,  $OC' = 3OC$

8 a yes, SAS b yes, AAA c not similar

9 a 3.5

b 4

c 18

10 a  $\angle C$  is common

$$\angle DBC = \angle EAC = 90^\circ \text{ (given)}$$

$$\therefore \triangle BCD \parallel \triangle ACE \text{ (AAA)}$$

b 5 m

### Extended-response questions

1 a  $\angle ABC + \angle BCF = 180^\circ$  (co-interior angles,  $AB \parallel CF$ )

$$\therefore \angle BCF = 70^\circ$$

$$\therefore \angle DCF = 32^\circ$$

$$\text{Now } \angle EDC + \angle DCF = 32^\circ + 148^\circ$$

$$= 180^\circ$$

$$\therefore DE \parallel CF \text{ as co-interior angles add to } 180^\circ$$

b  $\angle CDA = 40^\circ$  (revolution)

$$\text{reflex } \angle BCD = 270^\circ \text{ (revolution)}$$

$$\angle DAB = 30^\circ \text{ (angle sum in isosceles triangle)}$$

$$BADC \text{ quadrilateral angle sum } 360^\circ$$

$$\therefore a = 360 - (30 + 270 + 40)$$

$$= 20$$

or other proof.

c  $AB = CD$  (given)

$$\angle ABC = \angle DCB \text{ (given)}$$

$BC$  is common

$$\therefore \triangle ABC \cong \triangle DCB \text{ (SAS)}$$

$$\therefore AC = BD \text{ (corresponding sides in congruent triangles)}$$

2 a  $\angle ECD$

b  $\angle ABC = \angle EDC$  (given  $90^\circ$ )

$$\angle ACB = \angle ECD \text{ (vertically opposite)}$$

$$\therefore \triangle ABC \parallel \triangle EDC \text{ (AAA)}$$

c 19.8 m

## Chapter 8

### Pre-test

1 a  $2x + 6$  b  $3a - 15$  c  $12x - 8xy$  d  $3 - 6b$

2 a 81

b 16

c 1

d 64

e 25

f 7

g 3

h -6

3 a 2

b 6

c  $2x$

d  $3y$

e  $5x$

f  $ab$

4 a  $2(a + 3)$  b  $3(x + 4y)$  c  $5x(x - 3)$  d  $2m(2 - 3n)$

5 a (1, 6), (2, 3), (-1, -6), (-2, -3)

b (1, 12), (2, 6), (3, 4), (-1, -12), (-2, -6), (-3, -4)

c (-1, 10), (1, -10), (-2, 5), (2, -5)

d (-1, 27), (1, -27), (-3, 9), (3, -9)

6 a  $\frac{20}{21}$

b  $\frac{11}{18}$

c  $\frac{1}{12}$

d  $1\frac{1}{2}$

- 7 a  $3x+2$     b  $x+4$     c  $-10-3x$     d  $5x-2$   
 8 a  $x=6$     b  $x=11$     c  $x=\frac{5}{8}$   
 9 a  $x(x+2), x^2+2x$     b  $(x+3)(x+4), x^2+7x+12$

### Exercise 8A

- 1 a  $x^2, 2x, 3x, 6$     b  $x^2+3x+2x+6 = x^2+5x+6$   
 2 a  $2x^2, 2x, 3x, 3$   
 b  $(2x+3)(x+1) = 2x^2+2x+3x+3 = 2x^2+5x+3$   
 3 a  $x^2+5x+x+5 = x^2+6x+5$   
 b  $x^2+2x-3x-6 = x^2-x-6$   
 c  $21x^2+6x-14x-4 = 21x^2-8x-4$   
 d  $12x^2-16x-3x+4 = 12x^2-19x+4$   
 4 a  $x^2+7x+10$     b  $b^2+7b+12$   
 c  $t^2+15t+56$     d  $p^2+12p+36$   
 e  $x^2+15x+54$     f  $d^2+19d+60$   
 g  $a^2+8a+7$     h  $y^2+12y+20$   
 i  $m^2+16m+48$   
 5 a  $x^2-x-12$     b  $x^2+3x-10$   
 c  $x^2-4x-32$     d  $x^2-4x-12$   
 e  $x^2+9x-10$     f  $x^2+2x-63$   
 g  $x^2+5x-14$     h  $x^2-3x+2$   
 i  $x^2-9x+20$     j  $8x^2+26x+15$   
 k  $6x^2+7x+2$     l  $15x^2+17x+4$   
 m  $6x^2+x-15$     n  $24x^2+23x-12$   
 o  $6x^2-x-2$     p  $10x^2-31x+14$   
 q  $6x^2+5x-6$     r  $16x^2-16x-5$   
 s  $18x^2-27x+10$     t  $15x^2-11x+2$   
 u  $21x^2-37x+12$   
 6 a  $a^2+ac+ab+bc$     b  $a^2+ac-ab-bc$   
 c  $ab+bc-a^2-ac$     d  $xy-xz-y^2+yz$   
 e  $yz-y^2-xz+xy$     f  $1+y-x-xy$   
 g  $2x^2-3xy-2y^2$     h  $2a^2-ab-b^2$   
 i  $6x^2+xy-y^2$     j  $6a^2+4a-3ab-2b$   
 k  $12x^2-25xy+12y^2$     l  $3x^2y-yz^2-2xyz$   
 7 a  $x^2+9x+20$   
 b i  $56\text{ m}^2$     ii  $36\text{ m}^2$   
 8 a  $2x^2$     b  $2x^2-30x+100$   
 9 a  $150-50x+4x^2$     b  $66\text{ m}^2$   
 10 a 3    b 2    c 6, 6    d 2, 18  
 e 2, 6    f 3, 15    g  $2x, 5x, 3$     h  $3x, 15x, 4$   
 i  $7x, 3, 17x$     j  $3x, 4, 11x$   
 11 a  $a=3, b=2$  or  $a=2, b=3$   
 b  $a=-3, b=-2$  or  $a=-2, b=-3$   
 c  $a=3, b=-2$  or  $a=-2, b=3$   
 d  $a=2, b=-3$  or  $a=-3, b=2$   
 12 a  $x^3+2x^2+2x+1$     b  $x^3-3x^2+5x-6$   
 c  $4x^3-4x^2+9x-4$     d  $x^3+2x^2-2x+3$   
 e  $10x^3-17x^2+7x-6$     f  $8x^3-18x^2+35x-49$

- g  $x^3+ax-a^2x+a^2$     h  $x^3-2ax^2+a^3$   
 i  $x^3+a^3$     j  $x^3-a^3$   
 13  $x^3+6x^2+11x+6$

### Exercise 8B

- 1 a  $+3x+9 = x^2+6x+9$     b  $+5x+25 = x^2+10x+25$   
 c  $-2x+4 = x^2-4x+4$     d  $-7x+49 = x^2-14x+49$   
 2 a i  $x^2+6x+9$     ii  $x^2+22x+121$   
 iii  $x^2+30x+225$   
 b i  $x^2-4x+4$     ii  $x^2-18x+81$   
 iii  $x^2-60x+900$   
 3 a  $+4x-16 = x^2-16$     b  $-10x-100 = x^2-100$   
 c  $+2x-2x-1 = 4x^2-1$     d  $-12x+12x-16 = 9x^2-16$   
 4 a  $x^2+2x+1$     b  $x^2+6x+9$   
 c  $x^2+4x+4$     d  $x^2+10x+25$   
 e  $x^2+8x+16$     f  $x^2+18x+81$   
 g  $x^2+14x+49$     h  $x^2+20x+100$   
 i  $x^2-4x+4$     j  $x^2-12x+36$   
 k  $x^2-2x+1$     l  $x^2-6x+9$   
 m  $x^2-18x+81$     n  $x^2-14x+49$   
 o  $x^2-8x+16$     p  $x^2-24x+144$   
 5 a  $4x^2+4x+1$     b  $4x^2+20x+25$   
 c  $9x^2+12x+4$     d  $9x^2+6x+1$   
 e  $25x^2+20x+4$     f  $16x^2+24x+9$   
 g  $49+28x+4x^2$     h  $25+30x+9x^2$   
 i  $4x^2-12x+9$     j  $9x^2-6x+1$   
 k  $16x^2-40x+25$     l  $4x^2-36x+81$   
 m  $9x^2+30xy+25y^2$     n  $4x^2+16xy+16y^2$   
 o  $49x^2+42xy+9y^2$     p  $36x^2+60xy+25y^2$   
 q  $16x^2-72xy+81y^2$     r  $4x^2-28xy+49y^2$   
 s  $9x^2-60xy+100y^2$     t  $16x^2-48xy+36y^2$   
 u  $81x^2-36xy+4y^2$   
 6 a  $9-6x+x^2$     b  $25-10x+x^2$   
 c  $1-2x+x^2$     d  $36-12x+x^2$   
 e  $121-22x+x^2$     f  $16-8x+x^2$   
 g  $49-14x+x^2$     h  $144-24x+x^2$   
 i  $64-32x+4x^2$     j  $4-12x+9x^2$   
 k  $81-36x+4x^2$     l  $100-80x+16x^2$   
 7 a  $x^2-1$     b  $x^2-9$     c  $x^2-64$   
 d  $x^2-16$     e  $x^2-144$     f  $x^2-121$   
 g  $x^2-81$     h  $x^2-25$     i  $x^2-36$   
 j  $25-x^2$     k  $4-x^2$     l  $49-x^2$   
 8 a  $9x^2-4$     b  $25x^2-16$   
 c  $16x^2-9$     d  $49x^2-9y^2$   
 e  $81x^2-25y^2$     f  $121x^2-y^2$   
 g  $64x^2-4y^2$     h  $100x^2-81y^2$   
 i  $49x^2-25y^2$     j  $36x^2-121y^2$   
 k  $64x^2-9y^2$     l  $81x^2-16y^2$   
 9 a i  $x^2$     ii  $x^2-4$   
 b No, they differ by 4

- 10 a**  $20 - 2x$   
**b**  $(20 - 2x)(20 - 2x) = 400 - 80x + 4x^2$   
**c**  $196 \text{ cm}^2$     **d**  $588 \text{ cm}^3$
- 11 a**  $a + b$     **b**  $(a + b)(a + b) = a^2 + 2ab + b^2$   
**c**  $a - b$     **d**  $(a - b)(a - b) = a^2 - 2ab + b^2$   
**e**  $4ab$     **f**  $ab$  so yes four courts area is  $4ab$
- 12 a**  $x^2 - 1$     **b** No, area of rectangle is 1 square unit less
- 13 a**  $a^2 - b^2$   
**b i**  $(a - b)^2 = a^2 - 2ab + b^2$   
**ii**  $b(a - b) = ab - b^2$   
**iii**  $b(a - b) = ab - b^2$   
**c** yes,  $a^2 - 2ab + b^2 + ab - b^2 + ab - b^2 = a^2 - b^2$
- 14 a**  $x^2 + 4x$     **b**  $-4x + 1$   
**c**  $x^2 + 6x - 9$     **d**  $-x^2 - 2x$   
**e** 1    **f**  $4x$   
**g**  $-12x - 8$     **h**  $-10x + 2$   
**i**  $x^2 + 4xy - y^2$     **j**  $8x^2 + 18$   
**k**  $-8x$     **l**  $2x^2 - 12x + 18$   
**m**  $9x^2 - 48x + 48$     **n**  $x^2 + 6xy + y^2$

### Exercise 8C

- 1 a** 4    **b** 10    **c** 5    **d** 6  
**e** 1    **f** 25    **g** 8    **h** 36
- 2 a**  $x$     **b**  $x$     **c**  $a$     **d**  $2a$   
**e**  $-2y$     **f**  $-3x$     **g**  $-2x$     **h**  $-10x$   
**i**  $-2x$
- 3 a i** 6    **ii**  $3x$     **iii**  $6x$   
**b iii**  
**c** terms have no common factor
- 4 a**  $2x$     **b**  $6a$     **c** 2    **d** 4  
**e** 3    **f** 1    **g**  $3x$     **h**  $3n$   
**i**  $2y$     **j**  $2x$     **k**  $2xy$     **l**  $5ab$
- 5 a**  $7(x + 1)$     **b**  $3(x + 1)$     **c**  $4(x - 1)$   
**d**  $5(x - 1)$     **e**  $4(1 + 2y)$     **f**  $5(2 + a)$   
**g**  $3(1 - 3b)$     **h**  $2(3 - x)$     **i**  $3(4a + b)$   
**j**  $6(m + n)$     **k**  $2(5x - 4y)$     **l**  $4(a - 5b)$   
**m**  $x(x + 2)$     **n**  $a(a - 4)$     **o**  $y(y - 7)$   
**p**  $x(1 - x)$     **q**  $3p(p + 1)$     **r**  $8x(1 - x)$   
**s**  $4b(b + 3)$     **t**  $2y(3 - 5y)$     **u**  $3a(4 - 5a)$   
**v**  $9m(1 + 2m)$     **w**  $16x(y - 3x)$     **x**  $7ab(1 - 4b)$
- 6 a**  $-4(2x + 1)$     **b**  $-2(2x + 1)$     **c**  $-5(2x + y)$   
**d**  $-7(a + 2b)$     **e**  $-3(3x + 4)$     **f**  $-2(3y + 4)$   
**g**  $-5(2x + 3y)$     **h**  $-4(m + 5n)$     **i**  $-3x(x + 6)$   
**j**  $-4x(2x + 3)$     **k**  $-2y(8y + 3)$     **l**  $-5a(a + 2)$   
**m**  $-2x(3 + 10x)$     **n**  $-3p(2 + 5p)$     **o**  $-8b(2 + b)$   
**p**  $-9x(1 + 3x)$
- 7 a**  $(x + 3)(4 + x)$     **b**  $(x + 1)(3 + x)$     **c**  $(m - 3)(7 + m)$   
**d**  $(x - 7)(x + 2)$     **e**  $(a + 4)(8 - a)$     **f**  $(x + 1)(5 - x)$   
**g**  $(y + 3)(y - 2)$     **h**  $(x + 2)(a - x)$     **i**  $(2t + 5)(t + 3)$   
**j**  $(5m - 2)(m + 4)$     **k**  $(4y - 1)(y - 1)$     **l**  $(7 - 3x)(1 + x)$

- 8 a**  $6(a + 5)$     **b**  $5(x - 3)$     **c**  $2(4b + 9)$   
**d**  $x(x - 4)$     **e**  $y(y + 9)$     **f**  $a(a - 3)$   
**g**  $xy(x - 4 + y)$     **h**  $2ab(3 - 5a + 4b)$     **i**  $(m + 5)(m + 2)$   
**j**  $(x + 3)(x - 2)$     **k**  $(b - 2)(b + 1)$     **l**  $(2x + 1)(x - 1)$   
**m**  $(3 - 2y)(y - 5)$     **n**  $(x + 4)(x + 9)$     **o**  $(y + 1)(y - 3)$
- 9 a**  $4(x + 2)$     **b**  $2(x + 3)$     **c**  $10(x + 2)$   
**d**  $2(x + 7)$     **e**  $2(2x + 3)$     **f**  $2(x + 7)$
- 10**  $4x$
- 11 a**  $t(5 - t)$   
**b i** 0 m    **ii** 6 m    **iii** 4 m  
**c** 5 seconds
- 12 a** 63    **b** 72    **c** -20    **d** -70  
**e** 69    **f** 189
- 13 a**  $3(a^2 + 3a + 4)$     **b**  $z(5z - 10 + y)$   
**c**  $x(x - 2y + xy)$     **d**  $2b(2y - 1 + 3b)$   
**e**  $-4y(3x + 2z + 5xz)$     **f**  $ab(3 + 4b + 6a)$
- 14 a**  $-4(x - 3) = 4(3 - x)$     **b**  $-3(x - 3) = 3(3 - x)$   
**c**  $-8(n - 1) = 8(1 - n)$     **d**  $-3(b - 1) = 3(1 - b)$   
**e**  $-5m(1 - m) = 5m(m - 1)$     **f**  $-7x(1 - x) = 7x(x - 1)$   
**g**  $-5x(1 - x) = 5x(x - 1)$     **h**  $-2y(2 - 11y) = 2y(11y - 2)$   
**i**  $-4n(2 - 3n) = 4n(3n - 2)$     **j**  $-4(2y - 5) = 4(5 - 2y)$   
**k**  $-5(3mn - 2) = 5(2 - 3mn)$     **l**  $-15(x - 3) = 15(3 - x)$
- 15 a**  $(x - 4)(x - 3)$     **b**  $(x - 5)(x + 2)$   
**c**  $(x - 3)(x + 3)$     **d**  $(x - 4)(3x - 5)$   
**e**  $(2x - 5)(3 - x)$     **f**  $(x - 2)(2x - 1)$   
**g**  $(x - 3)(4 - x)$     **h**  $(x - 5)(x - 2)$   
**i**  $(x - 3)(x - 2)$

### Exercise 8D

- 1 a**  $x^2 - 4$     **b**  $x^2 - 49$     **c**  $4x^2 - 1$     **d**  $x^2 - y^2$   
**e**  $9x^2 - y^2$     **f**  $a^2 - b^2$
- 2 a** 3    **b** 11    **c** 9    **d** 20  
**e**  $2x$     **f**  $3a$     **g**  $5b$     **h**  $7y$
- 3 a**  $(x + 4)(x - 4)$     **b**  $(x + 12)(x - 12)$   
**c**  $(4x + 1)(4x - 1)$     **d**  $(3a + 2b)(3a - 2b)$
- 4 a**  $(x + 3)(x - 3)$     **b**  $(y + 5)(y - 5)$   
**c**  $(y + 1)(y - 1)$     **d**  $(x + 8)(x - 8)$   
**e**  $(x + 4)(x - 4)$     **f**  $(b + 7)(b - 7)$   
**g**  $(a + 9)(a - 9)$     **h**  $(x + y)(x - y)$   
**i**  $(a + b)(a - b)$     **j**  $(4 + a)(4 - a)$   
**k**  $(5 + x)(5 - x)$     **l**  $(1 + b)(1 - b)$   
**m**  $(6 + y)(6 - y)$     **n**  $(11 + b)(11 - b)$   
**o**  $(x + 20)(x - 20)$     **p**  $(30 + y)(30 - y)$
- 5 a**  $(2x + 5)(2x - 5)$     **b**  $(3x + 7)(3x - 7)$   
**c**  $(5b + 2)(5b - 2)$     **d**  $(2m + 11)(2m - 11)$   
**e**  $(10y + 3)(10y - 3)$     **f**  $(9a + 2)(9a - 2)$   
**g**  $(1 + 2x)(1 - 2x)$     **h**  $(5 + 8b)(5 - 8b)$   
**i**  $(4 + 3y)(4 - 3y)$     **j**  $(6x + y)(6x - y)$   
**k**  $(2x + 5y)(2x - 5y)$     **l**  $(8a + 7b)(8a - 7b)$   
**m**  $(2p + 5q)(2p - 5q)$     **n**  $(9m + 2n)(9m - 2n)$

- o  $(5a+7b)(5a-7b)$       p  $(10a+3b)(10a-3b)$
- 6 a  $3(x+6)(x-6)$       b  $10(a+1)(a-1)$
- c  $6(x+2)(x-2)$       d  $4(y+4)(y-4)$
- e  $2(7+x)(7-x)$       f  $8(2+m)(2-m)$
- g  $5(xy+1)(xy-1)$       h  $3(1+xy)(1-xy)$
- i  $7(3+ab)(3-ab)$
- 7 a  $(x+8)(x+2)$       b  $(x+5)(x+1)$       c  $(x+14)(x+6)$
- d  $(x+2)(x-8)$       e  $(x-6)(x-8)$       f  $(x+3)(x-9)$
- g  $(10+x)(4-x)$       h  $-x(x+4)$       i  $(17+x)(1-x)$
- 8 a  $4(3+t)(3-t)$       b i 36 m      ii 20 m
- c 3 seconds
- 9 a i  $x^2$       ii  $(30+x)(30-x)$
- b i 500  $\text{cm}^2$       ii 675  $\text{cm}^2$
- 10 a  $(x+3)(x-3)$       b  $(4x+11)(4x-11)$
- c  $(2+5a)(2-5a)$       d  $(x+y)(x-y)$
- e  $(2b+5a)(2b-5a)$       f  $(c+6ab)(c-6ab)$
- g  $(yz+4x)(yz-4x)$       h  $(b+30a)(b-30a)$
- 11 a Factorise each binomial
- $(4x+2)(4x-2) = 2(2x+1)2(2x-1) = 4(2x+1)(2x-1)$
- b Take out common factor of 4
- 12  $9 - (x-1)^2$
- $= (3+x-1)(3-(x-1))$  insert brackets when subtracting a binomial
- $= (2+x)(3-x+1)$  remember  $-1 \times -1 = +1$
- $= (2+x)(4-x)$
- 13 a  $\left(x + \frac{1}{2}\right)\left(x - \frac{1}{2}\right)$       b  $\left(x + \frac{2}{5}\right)\left(x - \frac{2}{5}\right)$
- c  $\left(5x + \frac{3}{4}\right)\left(5x - \frac{3}{4}\right)$       d  $\left(\frac{x}{3} + 1\right)\left(\frac{x}{3} - 1\right)$
- e  $\left(\frac{a}{2} + \frac{b}{3}\right)\left(\frac{a}{2} - \frac{b}{3}\right)$       f  $5\left(\frac{x}{3} + \frac{1}{2}\right)\left(\frac{x}{3} - \frac{1}{2}\right)$
- g  $7\left(\frac{a}{5} + \frac{2b}{3}\right)\left(\frac{a}{5} - \frac{2b}{3}\right)$       h  $\frac{1}{2}\left(\frac{a}{2} + \frac{b}{3}\right)\left(\frac{a}{2} - \frac{b}{3}\right)$
- i  $(x+y)(x-y)(x^2+y^2)$       j  $2(a+b)(a-b)(a^2+b^2)$
- k  $21(a+b)(a-b)(a^2+b^2)$       l  $\frac{1}{3}(x+y)(x-y)(x^2+y^2)$

### Exercise 8E

- 1 a  $2x-2$       b  $3a+12$
- c  $-5+5a$       d  $-6+2x$
- e  $a^2+5a$       f  $2b-b^2$
- g  $x^2-4x$       h  $4y-y^2$
- i  $ax+x+2a+2$       j  $ax-3a+5x-15$
- k  $bx-2b-3x+6$       l  $c-cx-4+4x$
- 2 a  $2+a$       b  $3-a$       c  $5-a$       d  $x+7$
- e  $a+1$       f  $a-1$       g  $1-a$       h  $1+2a$
- 3 a  $(x-3)(x-2)$       b  $(x+4)(x+3)$
- c  $(x-7)(x+4)$       d  $(2x+1)(3-x)$
- e  $(3x-2)(4-x)$       f  $(2x+3)(2x-3)$

- g  $(5-x)(3x+2)$       h  $(x+1)(2-3x)$
- i  $(x-2)(x+1)$
- 4 a  $(x+3)(x+a)$       b  $(x+4)(x+c)$
- c  $(x+7)(x+b)$       d  $(x-6)(x+b)$
- e  $(x-4)(x+2a)$       f  $(x-3)(x+2b)$
- g  $(x+2)(x-3c)$       h  $(x+3)(x-2a)$
- i  $(x+4)(x-2b)$       j  $(x-2)(x-a)$
- k  $(x-3)(x-3c)$       l  $(x-5)(x-3a)$
- 5 a  $(3a+5c)(b+d)$       b  $(4b-7c)(a+d)$
- c  $(y-4z)(2x+3w)$       d  $(s-2)(5r+t)$
- e  $(x+3y)(4x-3)$       f  $(2b-a)(a-c)$
- 6 a  $(x-b)(x+1)$       b  $(x-c)(x+1)$
- c  $(x+b)(x+1)$       d  $(x+c)(x-1)$
- e  $(x+a)(x-1)$       f  $(x-b)(x-1)$
- 7 a  $(b+4)(a+3)$       b  $(y+5)(x+2)$
- c  $(x+3)(2a-1)$       d  $(1-2y)(3x+4)$
- e  $(x-5)(11+a)$       f  $(3-2x)(4y-1)$
- g  $(n+2)(3m-1)$       h  $(3-r)(5p+8)$
- i  $(2-y)(8x+3)$
- 8 a  $x^2+4x-ax-4a$       b  $x^2-dx-cx+cd$
- c  $2x-xz+2y-yz$       d  $ax+bx-a-b$
- e  $3cx-3bx-bc+b^2$       f  $2xy+2xz-y^2-yz$
- g  $6ab+15ac+2b^2+5bc$       h  $3my+mz-6xy-2xz$
- 9 a  $(x+2)(x+5)$       b  $(x+3)(x+5)$
- c  $(x+4)(x+6)$       d  $(x-3)(x+2)$
- e  $(x+6)(x-2)$       f  $(x-9)(x-2)$
- 10 a Method 1:  $a(x+7)-3(x+7) = (x+7)(a-3)$
- Method 2:  $x(a-3)+7(a-3) = (a-3)(x+7)$
- b i  $(x-3)(b+2)$       ii  $(x+2)(y-4)$
- iii  $(2m+3)(2m-5n)$       iv  $(2-n)(m-3)$
- v  $(1-2b)(4a+3b)$       vi  $(3a-1)(b+4c)$
- 12 a  $(a-3)(2-x-c)$       b  $(2a+1)(b+5-a)$
- c  $(a+1)(x-4-b)$       d  $(a-b)(3-b-2a)$
- e  $(1-a)(c-x+2)$       f  $(x-2)(a+2b-1)$
- g  $(a-3c)(a-2b+3bc)$       h  $(1-2y)(3x-5z+y)$
- i  $(x-4)(3x+y-2z)$       j  $(ab-2c)(2x+3y-1)$

### Exercise 8F

- 1 a  $x^2+4x+3$       b  $x^2+9x+14$       c  $x^2+8x-33$
- d  $x^2+x-30$       e  $x^2+7x-60$       f  $x^2+9x-52$
- g  $x^2-8x+12$       h  $x^2-31x+220$       i  $x^2-10x+9$
- 2 a 3, 2      b 5, 2      c 12, 1
- d 4, 5      e 5, -1      f -7, 1
- g 5, -3      h -6, 5      i -3, -2
- j -9, -2      k -5, -8      l -50, -2
- 3 a  $(x+2)(x+1)$       b  $(x+3)(x+1)$       c  $(x+6)(x+1)$
- d  $(x+9)(x+1)$       e  $(x+7)(x+1)$       f  $(x+14)(x+1)$
- g  $(x+4)(x+2)$       h  $(x+3)(x+4)$       i  $(x+8)(x+2)$
- j  $(x+5)(x+3)$       k  $(x+4)(x+5)$       l  $(x+8)(x+3)$

- 4 a  $(x+4)(x-1)$     b  $(x+2)(x-1)$     c  $(x+5)(x-1)$   
 d  $(x+7)(x-2)$     e  $(x+5)(x-3)$     f  $(x+10)(x-2)$   
 g  $(x+6)(x-3)$     h  $(x+9)(x-2)$     i  $(x+4)(x-3)$
- 5 a  $(x-5)(x-1)$     b  $(x-1)(x-1)$     c  $(x-1)(x-4)$   
 d  $(x-8)(x-1)$     e  $(x-2)(x-2)$     f  $(x-6)(x-2)$   
 g  $(x-9)(x-2)$     h  $(x-7)(x-3)$     i  $(x-3)(x-2)$
- 6 a  $(x-8)(x+1)$     b  $(x-4)(x+1)$     c  $(x-6)(x+1)$   
 d  $(x-8)(x+2)$     e  $(x-6)(x+4)$     f  $(x-5)(x+3)$   
 g  $(x-4)(x+3)$     h  $(x-12)(x+1)$     i  $(x-6)(x+2)$
- 7 a  $2(x+4)(x+1)$     b  $2(x+10)(x+1)$     c  $3(x+2)(x+4)$   
 d  $2(x+10)(x-3)$     e  $2(x-9)(x+2)$     f  $4(x-1)(x-1)$   
 g  $2(x-2)(x+3)$     h  $6(x-6)(x+1)$     i  $5(x-4)(x-2)$   
 j  $3(x-5)(x-6)$     k  $2(x-5)(x+2)$     l  $3(x-4)(x+3)$
- 8 a  $6x$     b  $6x$  or  $10x$     c  $x, 4x, 11x$   
 d  $x, 4x, 11x$     e  $9x, 11x, 19x$     f  $9x, 11x, 19x$   
 g  $0x, 6x, 15x$     h  $0x, 24x$
- 9 a i  $x(x+2)$     ii  $x^2+2x-15$     iii  $(x+5)(x-3)$   
 b i  $105\text{ m}^2$     ii  $48\text{ m}^2$
- 10 a  $(x+4)^2$     b  $(x+5)^2$     c  $(x+15)^2$     d  $(x-1)^2$   
 e  $(x-7)^2$     f  $(x-13)^2$     g  $2(x+1)^2$     h  $5(x-3)^2$   
 i  $-3(x-6)^2$
- 11 b, c, e, f
- 12 a  $(x-1)^2-9$     b  $(x+2)^2-5$     c  $(x+5)^2-22$   
 d  $(x-8)^2-67$     e  $(x+9)^2-74$     f  $(x-16)^2-267$

### Exercise 8G

- 1 a 2, 3    b 2, 6    c 5, -2    d 8, -3  
 e -6, -3    f -5, -7    g -10, 3    h -7, 4
- 2 a  $= 2x^2 + 2x + 5x + 5$   
 $= 2x(x+1) + 5(x+1)$   
 $= (x+1)(2x+5)$   
 b  $= 3x^2 + 6x + 2x + 4$   
 $= 3x(x+2) + 2(x+2)$   
 $= (x+2)(3x+2)$   
 c  $= 2x^2 - 3x - 4x + 6$   
 $= x(2x-3) - 2(2x-3)$   
 $= (2x-3)(x-2)$   
 d  $= 5x^2 + 10x - x - 2$   
 $= 5x(x+2) - 1(x+2)$   
 $= (x+2)(5x-1)$   
 e  $= 4x^2 + 8x + 3x + 6$   
 $= 4x(x+2) + 3(x+2)$   
 $= (x+2)(4x+3)$   
 f  $= 6x^2 - 9x + 2x - 3$   
 $= 3x(2x-3) + 1(2x-3)$   
 $= (2x-3)(3x+1)$
- 3 a  $(2x+1)(x+4)$     b  $(3x+1)(x+2)$     c  $(2x+3)(x+2)$   
 d  $(3x+2)(x+2)$     e  $(5x+2)(x+2)$     f  $(2x+3)(x+4)$   
 g  $(3x+5)(2x+1)$     h  $(4x+1)(x+1)$     i  $(4x+5)(2x+1)$

- 4 a  $(3x+5)(x-1)$     b  $(5x-4)(x+2)$     c  $(2x+3)(4x-1)$   
 d  $(2x+1)(3x-8)$     e  $(2x+1)(5x-4)$     f  $(x-3)(5x+4)$   
 g  $(2x-5)(2x-3)$     h  $(x-6)(2x-3)$     i  $(2x-5)(3x-2)$   
 j  $(3x-4)(4x+1)$     k  $(2x-3)(2x-3)$     l  $(x+3)(7x-3)$   
 m  $(x+5)(9x-1)$     n  $(x-2)(3x-8)$     o  $(2x-5)(2x+3)$
- 5 a  $(2x+1)(5x+11)$     b  $(3x+4)(5x-2)$     c  $(2x-3)(10x-3)$   
 d  $(2x+1)(9x-5)$     e  $(5x-3)(5x+4)$     f  $(4x+1)(8x-5)$   
 g  $(3x+2)(9x-4)$     h  $(3x+1)(11x+10)$     i  $(6x-5)(9x+1)$   
 j  $(2x-3)(6x-7)$     k  $(3x-1)(25x-6)$     l  $(6x-1)(15x+8)$
- 6 a  $2(3x-2)(5x+1)$     b  $6(x-1)(2x+5)$     c  $3(3x-5)(3x-1)$   
 d  $7(x-3)(3x-2)$     e  $4(3x-2)(3x+5)$     f  $5(2x-3)(5x+4)$
- 7 a  $-(x-2)(2x-3)$     b  $-(x-1)(5x+8)$     c  $-(2x+1)(3x-8)$   
 d  $-(x+3)(5x-6)$     e  $-(2x-5)(2x-3)$     f  $-(2x-1)(4x-5)$
- 8 a  $(x+4)(2x-5)$   
 b  $(2x-5)(x+4)$   
 c No, you get the same result  
 d i  $(x+3)(3x-4)$     ii  $(x-2)(5x+7)$     iii  $(2x-1)(3x+4)$

10 see answers to Questions 4 and 5

### Exercise 8H

- 1 a  $\frac{1}{3}$     b  $\frac{3}{2}$     c  $\frac{x}{2}$     d  $\frac{7x}{2}$   
 e  $\frac{3}{x}$     f  $\frac{1}{2x}$     g  $\frac{x+1}{2}$     h  $2(x-4)$
- 2 a  $3(x+2)$     b  $20(1-2x)$     c  $x(x-7)$     d  $6x(x+4)$
- 3 a  $\frac{2(x-2)}{8} = \frac{x-2}{4}$     b  $\frac{6(2-3x)}{x(2-3x)}$     c  $\frac{(x+3)(x+2)}{2(x-1)}$
- 4 a  $\frac{3}{4}$     b  $\frac{1}{3}$     c 4    d  $x-5$   
 e  $\frac{2(x-1)}{3}$     f  $\frac{2}{x+4}$
- 5 a  $x-1$     b  $\frac{2(x-3)}{5}$     c  $\frac{2}{3}$     d 2  
 e  $x-3$     f  $\frac{2(2x+5)}{5}$     g  $\frac{3}{2}$     h  $\frac{4}{3}$
- 6 a  $x+2$     b  $x+4$     c  $x-3$     d  $\frac{1}{x+3}$   
 e  $\frac{1}{x-2}$     f  $\frac{1}{x-10}$
- 7 a  $\frac{x-4}{2}$     b  $x-3$     c  $3(x-3)$     d  $\frac{x+4}{2(x-5)}$
- 8 a  $x$     b  $\frac{2(x-2)}{x+2}$     c  $\frac{4}{x+1}$     d  $\frac{x-2}{2(x+2)}$   
 e  $\frac{2(x+2)^2}{3(x+4)}$     f  $\frac{5}{x+2}$
- 9 a  $x-10$     b  $x-7$     c  $x-5$     d  $\frac{2}{x+20}$   
 e  $\frac{5}{x+6}$     f  $\frac{3}{x-9}$
- 10 a  $(x+2)(x-5)$     b  $\frac{x+2}{x+3}$

- c  $\frac{x-3}{x-4}$       d  $\frac{x-5}{x+2}$   
 e  $\frac{3x-1}{2-15x}$       f  $\frac{x-4}{3-x} = \frac{x-4}{x-3}$   
 g  $\frac{x+5}{2(x+4)}$       h  $\frac{3}{2(x+3)}$
- 11 a -1      b -1      c -8  
 d  $\frac{1}{3}$       e  $\frac{1}{6}$       f  $-(x+3)$
- 12 a  $a+1$       b  $5(a-3)$       c  $\frac{x+7}{2}$   
 d  $\frac{x+2}{6}$       e  $\frac{x+3}{2}$       f  $\frac{11}{x-2}$
- 13 a  $\frac{-x+3}{2}$       b  $\frac{x-7}{3}$       c  $\frac{-x-8}{x+8}$       d  $-\frac{2}{x+2}$   
 e  $-\frac{4}{x+3}$       f  $\frac{3(x+1)}{4}$       g  $\frac{3(2x+3)}{2x}$       h  $-\frac{1}{2(x+2)}$   
 i  $\frac{x}{3}$       j  $\frac{2}{x-2}$

### Exercise 8I

- 1 a 24      b 15      c 143      d 36  
 2 a  $4x$       b  $21x$       c 3      d 2  
 e 8      f 90
- 3 a  $\frac{3x}{12} + \frac{8x}{12} = \frac{11x}{12}$   
 b  $\frac{25x}{35} - \frac{14x}{35} = \frac{11x}{35}$   
 c  $\frac{2(x+1)}{4} + \frac{(2x+3)}{4} = \frac{2x+2+2x+3}{4} = \frac{4x+5}{4}$
- 4 a 15      b 14      c 8      d 6      e 10
- 5 a  $\frac{9x}{14}$       b  $\frac{2x}{5}$       c  $\frac{x}{8}$       d  $\frac{14x}{45}$   
 e  $\frac{y}{56}$       f  $\frac{13a}{22}$       g  $\frac{2b}{9}$       h  $\frac{m}{6}$   
 i  $\frac{11m}{12}$       j  $\frac{15a}{28}$       k  $\frac{x}{2}$       l  $\frac{20p}{63}$   
 m  $\frac{5b}{18}$       n  $\frac{61y}{40}$       o  $\frac{13x}{35}$       p  $\frac{5x}{12}$
- 6 a  $\frac{7x+11}{10}$       b  $\frac{7x}{12}$       c  $\frac{15a-51}{56}$       d  $\frac{11y+9}{30}$   
 e  $\frac{13m+28}{40}$       f  $\frac{5x-13}{24}$       g  $\frac{11b-6}{24}$       h  $\frac{7x}{6}$   
 i  $\frac{7y-8}{14}$       j  $\frac{5t-4}{16}$       k  $\frac{34-10x}{21}$       l  $\frac{8m-9}{12}$
- 7 a  $\frac{11}{2x}$       b  $\frac{1}{3x}$       c  $\frac{-3}{4x}$       d  $\frac{14}{9x}$   
 e  $\frac{7}{20x}$       f  $\frac{13}{15x}$       g  $\frac{-31}{4x}$       h  $\frac{29}{12x}$

- 8 a  $\frac{3x+2}{x^2}$       b  $\frac{5+4x}{x^2}$       c  $\frac{7x+3}{x^2}$   
 d  $\frac{4x-5}{x^2}$       e  $\frac{3-8x}{x^2}$       f  $\frac{x-4}{x^2}$   
 g  $\frac{6x-7}{2x^2}$       h  $\frac{9-2x}{3x^2}$
- 9 a  $\frac{8+x^2}{4x}$       b  $\frac{x^2-10}{2x}$       c  $\frac{-6-4x^2}{3x}$   
 d  $\frac{6-5x^2}{4x}$       e  $\frac{9x^2-10}{12x}$       f  $\frac{3-x^2}{9x}$   
 g  $\frac{15x^2-4}{10x}$       h  $\frac{-25-6x^2}{20x}$
- 10 a  $\frac{x}{3}$       b  $\frac{x}{8}$       c  $\frac{x}{2}$       d  $\frac{x}{5}$   
 e  $\frac{8x}{9}$       f  $\frac{x}{4}$

- 11 a didn't make a common denominator,  $\frac{7x}{15}$   
 b didn't use brackets:  $2(x+1) = 2x+2$ ,  $\frac{7x+2}{10}$   
 c didn't use brackets:  $3(x-1) = 3x-3$ ,  $\frac{13x-3}{6}$   
 d didn't multiply numerator in  $\frac{2}{x}$  by  $x$  as well as denominator,

- $\frac{2x-3}{x^2}$
- 12 a  $\frac{8x+2}{8} = \frac{2(4x+1)}{8} = \frac{4x+1}{4}$       b  $\frac{4x+1}{4}$   
 c Using denominator 8 does not give answer in simplified form and requires extra steps. Preferable to use actual LCD
- 13 a  $\frac{43x}{30}$       b  $\frac{5x}{12}$       c  $\frac{13x}{24}$       d  $\frac{43x-5}{60}$   
 e  $\frac{23x-35}{42}$       f  $\frac{29x+28}{40}$       g  $\frac{14}{3x}$       h  $\frac{1}{6x}$   
 i  $\frac{11}{20x}$       j  $\frac{24-x}{6x^2}$       k  $\frac{60x-21}{14x^2}$       l  $\frac{3-4x}{9x^2}$   
 m  $\frac{30-2x^2}{15x}$       n  $\frac{11x^2-3}{6x}$       o  $\frac{18-2x^2}{45x}$

### Exercise 8J

- 1 a  $-2x-6$       b  $-5x-5$       c  $-14-21x$   
 d  $-3x+3$       e  $-30+20x$       f  $-16+64x$
- 2 a 9      b 16      c  $x^2$       d  $2x$   
 e  $(x-1)(x+1)$       f  $(x-2)(x+3)$   
 g  $(2x-1)(x-4)$       h  $(x+1)^2$
- 3 a  $\frac{1-x}{12}$       b  $\frac{2x-14}{15}$       c  $\frac{x-9}{6}$   
 d  $\frac{-7x-14}{10}$       e  $\frac{9x-4}{8}$       f  $\frac{-x-24}{28}$   
 g  $\frac{5x-3}{12}$       h  $\frac{1-18x}{15}$       i  $\frac{8x-23}{30}$

4 a  $\frac{13-x}{6}$  b  $\frac{2x+2}{35}$  c  $\frac{x-5}{4}$   
d  $\frac{22x-41}{21}$  e  $\frac{17x}{20}$  f  $\frac{30-13x}{24}$   
g  $\frac{14x+4}{9}$  h  $\frac{20x-9}{28}$  i  $\frac{10-11x}{56}$

5 a  $\frac{7x-1}{(x-1)(x+1)}$  b  $\frac{7x-7}{(x+4)(x-3)}$  c  $\frac{7x+1}{(x-2)(x+3)}$   
d  $\frac{5x+13}{(x-4)(x+7)}$  e  $\frac{4x+15}{(x+2)(x+3)}$  f  $\frac{x-26}{(x+4)(x-6)}$   
g  $\frac{x+9}{(x+5)(x+1)}$  h  $\frac{16-6x}{(x-3)(x-2)}$  i  $\frac{7-2x}{(x-5)(x-6)}$

6 a  $\frac{1-3x}{(x+1)^2}$  b  $\frac{-4x-10}{(x+3)^2}$  c  $\frac{3x-2}{(x-2)^2}$  d  $\frac{18-2x}{(x-5)^2}$   
e  $\frac{9-x}{(x-6)^2}$  f  $\frac{14-3x}{(x-4)^2}$  g  $\frac{4x+7}{(2x+1)^2}$  h  $\frac{1-12x}{(3x+2)^2}$   
i  $\frac{20x-1}{(1-4x)^2}$

7 a  $\frac{5x-2}{(x-1)^2}$  b  $\frac{19x+8}{12x}$  c  $\frac{10x^2-11x+4}{20x}$   
d  $\frac{x^2+7x}{(x-5)(x+1)}$  e  $\frac{2x^2-5x-3}{(4-x)(x-1)}$  f  $\frac{x^2+2x+1}{(x-3)^2}$   
g  $\frac{3-2x}{(x-2)^2}$  h  $\frac{-x^2-11x}{(2x+1)(x+2)}$  i  $\frac{x^2-4x-1}{(x+1)^2}$

8 a second line  $-2 \times (-2) = +4$  not  $-4$  b  $\frac{33x+4}{10}$

9 a  $\frac{3x+11}{(x+3)(x+4)(x+5)}$  b  $\frac{2-2x}{(x+1)(x+2)(x+4)}$   
c  $\frac{26-10x}{(x-1)(x-3)(2-x)}$  d  $\frac{3x-2}{(x+1)(x-5)}$   
e  $\frac{2x+9}{(x-4)(3-2x)}$  f  $\frac{7x^2+7x}{(x+4)(2x-1)(3x+2)}$

10 a  $\frac{5}{1-x}$  b  $\frac{4x-3}{5-x}$  c  $\frac{9}{7x-3}$   
d  $\frac{1-2x}{4-3x}$  e 1 f 0

11 a  $\frac{11}{2(x+2)}$  b  $\frac{1}{3(x-1)}$   
c  $\frac{23}{4(2x-1)}$  d  $\frac{13-3x}{(x+3)(x-3)}$   
e  $\frac{5x-6}{2(x+2)(x-2)}$  f  $\frac{30x+33}{(3x-4)(3x+4)}$   
g  $\frac{9x-27}{(x+3)(x+4)(x-5)}$  h  $\frac{x+11}{(x-1)(x+3)^2}$   
i  $\frac{2x+5}{5(x-2)(x-5)}$  j  $\frac{-2}{x(x-1)(x+1)}$

### Exercise 8K

1 a 15 b 4 c 6 d 28 e 30 f 8  
2 a  $4x$  b  $3x$  c  $2(x+3)$  d  $2x+5$  e 3  
f  $-(x+2)$  g  $4(x-1)$  h  $2(1-x)$  i  $2x-1$

3 a 10 b 12 c 24 d 10 e  $\frac{6}{7}$   
f  $7\frac{1}{2}$  g -8 h 15 i 4

4 a 13 b 1 c  $1\frac{3}{5}$  d 59 e 1  
f 5 g 8 h  $3\frac{2}{7}$  i  $-3\frac{1}{4}$

5 a -3 b -4 c 5 d 1  
e -1 f 6

6 a  $\frac{1}{16}$  b  $\frac{1}{12}$  c  $\frac{8}{15}$  d  $\frac{1}{36}$  e  $\frac{3}{4}$   
f  $\frac{5}{24}$  g  $\frac{5}{12}$  h  $\frac{1}{6}$  i  $2\frac{5}{6}$

7 a  $\frac{5}{2}$  b -5 c -19 d -4  
e -1 f -6

8 a  $\frac{x}{2} + \frac{2x}{3} = 4$  b  $x = 3\frac{3}{7}$

9 a  $\frac{1}{6}$  b 2 c 0  
d  $\frac{9}{13}$  e  $\frac{3}{7}$  f  $\frac{2}{11}$   
g  $1\frac{5}{7}$  h 0 i -12

10 a  $\frac{x}{3} + \frac{x}{4} = 77$  b 132 games

11 On the second line, not every term has been multiplied by 12.  
The  $2x$  should be  $24x$  to give an answer  $x = \frac{3}{29}$ .

12 On third line of working,  $-2 \times (-1) = +2$  not  $-2$ , giving answer  $x = -4$

13 a  $4\frac{1}{2}$  b  $5\frac{2}{3}$  c  $1\frac{1}{2}$   
d 3 e 15 f -2

14 a  $x = 2ab$  b  $x = \frac{2bd}{2a-bc}$  c  $x = \frac{ac}{c-b}$   
d  $x = \frac{bd+be-ac}{c}$  e  $x = \frac{4c-3b}{3a-4}$  f  $x = \frac{6b+a}{5}$   
g  $x = -\frac{a^2}{2a-b-a^2}$  h  $x = \frac{ac}{c-a}$  i  $x = \frac{ac}{b}$   
j  $x = \frac{c-a}{b}$  k  $x = \frac{b-bc}{a-c}$  l  $x = \frac{ad-b}{c-d}$   
m  $x = ab-2a$  n  $x = \frac{a+b}{1-a}$  o  $x = \frac{2ab-a^2}{a-b}$

### Challenges

1 a 48, 49 b 33, 35 c 12, 15  
2 a 15 b 5  
3  $a=2, b=1, c=7$  and  $d=8$   
4 a  $(n+1)^2 + 1$  or  $n^2 + 2n + 2$  b a number of answers  
5  $(n-1)(n+1)$   
i  $n-1$  and  $n+1$  are both even, since they are consecutive even numbers one of them is divisible by 4 hence their product is



- ii  $n - 1, n, n + 1$  are 3 consecutive numbers, one of them must be divisible by 3. Since  $n$  is prime it must be  $n - 1$  or  $n + 1$  so their product is divisible by 3
- iii  $n^2 - 1$  is divisible by 3 and 4 and since they have no common factor it must also be divisible by  $3 \times 4 = 12$ .

- 6 Factorise each expression and cancel.
- 7  $4x^2 - 4x + 1 = (2x - 1)^2$  which is always greater than or equal to zero
- 8 Ryan

### Multiple-choice questions

- 1 A      2 E      3 D      4 C      5 B  
6 D      7 A      8 E      9 B      10 A

### Short-answer questions

- 1 a  $x^2 + x - 12$       b  $x^2 - 9x + 14$   
c  $6x^2 - 5x - 6$       d  $9x^2 + 3x - 12$
- 2 a  $x^2 + 6x + 9$       b  $x^2 - 8x + 16$       c  $9x^2 - 12x + 4$   
d  $x^2 - 25$       e  $49 - x^2$       f  $121x^2 - 16$
- 3 a  $4(a + 3b)$       b  $3x(2 - 3x)$       c  $-5xy(x + 2)$   
d  $(x - 7)(x + 3)$       e  $(2x + 1)(x - 1)$       f  $(x - 2)(x - 6)$
- 4 a  $(x + 10)(x - 10)$       b  $3(x + 4)(x - 4)$       c  $(5x + y)(5x - y)$   
d  $(7 + 3x)(7 - 3x)$       e  $(x - 12)(x + 6)$       f  $(1 - x)(1 + x)$
- 5 a  $(x - 3)(x + 2y)$       b  $(2a + 5)(2x - 1)$       c  $(x - 4)(3 + 2b)$
- 6 a  $(x + 3)(x + 5)$       b  $(x - 6)(x + 3)$       c  $(x - 6)(x - 1)$   
d  $3(x + 7)(x - 2)$       e  $2(x + 4)^2$       f  $(5x + 2)(x + 3)$   
g  $(2x - 3)(2x + 1)$       h  $(3x - 4)(2x - 3)$
- 7 a  $x + 4$       b  $\frac{2}{3}$       c  $\frac{x - 3}{5}$
- 8 a  $\frac{1}{4}$       b  $\frac{x - 4}{2}$       c  $\frac{x}{3}$   
d  $\frac{2}{5}$       e 4      f  $\frac{2x + 3}{50x}$
- 9 a  $\frac{11x}{12}$       b  $\frac{x - 13}{24}$       c  $\frac{5}{4x}$   
d  $\frac{7x - 2}{x^2}$       e  $\frac{8x + 11}{(x + 1)(x + 2)}$       f  $\frac{15 - 2x}{(x - 4)^2}$
- 10 a  $x = 20$       b  $x = \frac{1}{6}$       c  $x = 7$       d  $x = -1\frac{2}{9}$

### Extended-response questions

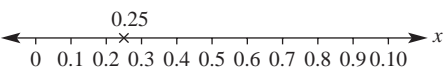
- 1 a  $(x + 3)m$   
b i No change  
ii  $(x^2 - 1)m^2$ , 1 square metre less in area  
c i width =  $(x - 3)m$ , decreased by 3 metres  
ii  $A = (x + 7)(x - 3) = (x^2 + 4x - 21)m^2$   
iii  $A = 0m^2$
- 2 a  $400m^2$   
b i  $L = W = (20 + 2x)m$   
ii  $(4x^2 + 80x + 400)m^2$   
c  $\frac{1}{4}$       d  $4x(x + 20)m^2$       e  $x = 5$

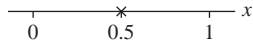
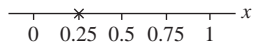
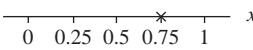
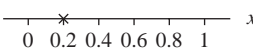
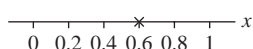
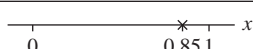
## Chapter 9

### Pre-test

- 1 a 0.1      b 0.25      c 0.3      d 0.85      e 0.237
- 2 a  $\frac{1}{2}$       b  $\frac{1}{3}$       c  $\frac{2}{3}$       d 1  
e 0      f  $\frac{1}{12}$       g  $\frac{1}{2}$       h  $\frac{18}{29}$   
i  $\frac{2}{3}$       j  $\frac{2}{7}$
- 3 a 1, 2, 3, 4, 5 or 6  
b i 3      ii 2      iii 3      iv 5      v 5      vi 3
- 4 a 5      b 7      c 6      d 7      e 4      f 6
- 5 a 8      b 20      c  $\frac{3}{20}$
- 6 a 6      b 5      c 5      d 12  
e i  $\frac{2}{9}$       ii  $\frac{7}{9}$       iii  $\frac{5}{9}$

### Exercise 9A

- 1 a i  $\frac{1}{4}$       ii 0.25      iii 25%
- b 

	Percentage	Decimal	Fraction	Number line
a	50%	0.5	$\frac{1}{2}$	
b	25%	0.25	$\frac{1}{4}$	
c	75%	0.75	$\frac{3}{4}$	
d	20%	0.2	$\frac{1}{5}$	
e	60%	0.6	$\frac{3}{5}$	
f	85%	0.85	$\frac{17}{20}$	

- 3  $0.15, \frac{2}{9}, 1$  in 4,  $0.28, \frac{1}{3}, \frac{2}{5}, \frac{3}{7}, 2$  in 3, 0.7, 0.9
- 4 a i {1, 2, 3, 4, 5, 6, 7}      ii  $\frac{1}{7}$       iii  $\frac{6}{7}$   
iv  $\frac{2}{7}$       v  $\frac{6}{7}$

- b i {2, 2, 6, 7}    ii  $\frac{1}{2}$     iii  $\frac{1}{2}$     iv  $\frac{1}{2}$     v 1
- c i {1, 2, 2, 2, 2, 3}    ii  $\frac{2}{3}$     iii  $\frac{1}{3}$     iv  $\frac{5}{6}$     v  $\frac{5}{6}$
- d i {1, 1, 2, 2, 3, 3}    ii  $\frac{1}{3}$     iii  $\frac{2}{3}$     iv  $\frac{2}{3}$     v  $\frac{2}{3}$
- e i {1, 1, 2, 3, 3, 4, 4}    ii  $\frac{1}{7}$     iii  $\frac{6}{7}$     iv  $\frac{3}{7}$     v  $\frac{5}{7}$

- f i {2, 2, 2, 2}    ii 1    iii 0    iv 1    v 1
- 5 a  $\frac{1}{2}$     b  $\frac{3}{8}$     c  $\frac{1}{6}$     d  $\frac{1}{4}$     e 1    f 0

- 6 a  $\frac{1}{2}$     b  $\frac{5}{8}$     c  $\frac{5}{6}$     d  $\frac{3}{4}$     e 0    f 1

- 7 a  $\frac{1}{8}$     b  $\frac{7}{8}$

- 8 a  $\frac{1}{8}$     b  $\frac{1}{4}$     c  $\frac{3}{8}$     d  $\frac{3}{8}$     e  $\frac{5}{8}$     f 1

- g 0    h  $\frac{1}{4}$     i  $\frac{3}{4}$     j  $\frac{3}{4}$

- 9 a {H, A, R, S}    b  $\frac{1}{4}$     ii  $\frac{1}{2}$     iii  $\frac{1}{2}$

- 10 a  $\frac{1}{52}$     b  $\frac{1}{13}$     c  $\frac{1}{26}$     d  $\frac{1}{2}$

- e  $\frac{2}{13}$     f  $\frac{12}{13}$     g  $\frac{23}{26}$     h  $\frac{25}{26}$

- 11 a  $\frac{1}{6}$     b  $\frac{1}{6}$     c  $\frac{5}{6}$     d  $\frac{1}{3}$     e  $\frac{2}{3}$

- f 1    g  $\frac{1}{3}$     h  $\frac{1}{2}$     i  $\frac{5}{6}$

- 12 a  $\frac{2}{11}$     b  $\frac{9}{11}$     c  $\frac{4}{11}$     d  $\frac{7}{11}$

- e  $\frac{7}{11}$     f  $\frac{3}{11}$     g  $\frac{7}{11}$     h  $\frac{4}{11}$

13 The sample space has four elements as the letter O appears twice {S, L, O, O} Amanda has only considered the name of the letter, not the total number of elements in the sample space.  
 $\Pr(S) = \frac{1}{4}$

- 14 a, d, f

- 15 a  $\frac{12}{25}$     b  $\frac{8}{25}$     c  $\frac{1}{5}$     d  $\frac{9}{25}$     e  $\frac{8}{25}$

- f  $\frac{16}{25}$     g  $\frac{4}{25}$     h  $\frac{17}{25}$     i 0

- 16 a 31 mins    b  $\frac{3}{31}$

- c i  $\frac{4}{31}$     ii  $\frac{4}{31}$     iii  $\frac{20}{31}$     iv  $\frac{5}{31}$     v  $\frac{8}{31}$     vi  $\frac{11}{31}$

**Exercise 9B**

- 1 a 26
- b i 10    ii 14    iii 5    iv 9
- v 4    vi 7    vii 19
- c i 12    ii 17

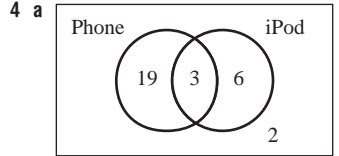
- 2 a B    b D    c A    d C

3 a

	A	Not A	Total
B	7	8	15
Not B	3	1	4
Total	10	9	19

b

	A	Not A	Total
B	2	5	7
Not B	9	4	13
Total	11	9	20



- b i 28    ii 21    iii 6

- c i  $\frac{1}{10}$     ii  $\frac{1}{15}$     iii  $\frac{19}{30}$

- 5 a i  $\frac{2}{5}$     b i  $\frac{3}{7}$

- ii  $\frac{1}{3}$     ii  $\frac{12}{35}$

- iii  $\frac{7}{15}$     iii  $\frac{13}{35}$

- iv  $\frac{1}{15}$     iv  $\frac{3}{35}$

- v  $\frac{13}{15}$     v  $\frac{34}{35}$

- vi  $\frac{2}{15}$     vi  $\frac{1}{35}$

6 a

	Cream	Not cream	Total
Ice cream	5	20	25
Not ice cream	16	9	25
Total	21	29	50

- b i 29    ii 9    c i  $\frac{21}{50}$     ii  $\frac{8}{25}$     iii  $\frac{41}{50}$

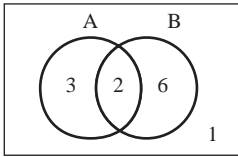
- 7 a i  $\frac{5}{8}$     ii  $\frac{3}{8}$     iii  $\frac{3}{8}$     iv  $\frac{3}{4}$     v  $\frac{1}{8}$     vi  $\frac{1}{4}$

- b i  $\frac{17}{26}$     ii  $\frac{9}{26}$     iii  $\frac{11}{26}$     iv  $\frac{21}{26}$

- v  $\frac{2}{13}$     vi  $\frac{5}{26}$

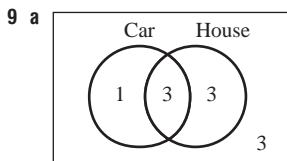
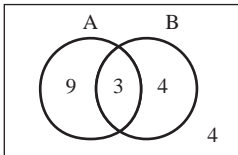
8 a

	A	Not A	Total
B	2	6	8
Not B	3	1	4
Total	5	7	12



**b**

	A	Not A	Total
B	3	4	7
Not B	9	4	13
Total	12	8	20



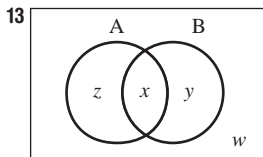
**b** 3      **c**  $\frac{1}{10}$

**10 a**

	Rain water	No rain water	Total
Tap water	12	36	48
No tap water	11	41	52
Total	23	77	100

**b** 12      **c**  $\frac{9}{25}$       **d**  $\frac{59}{100}$

**11** 23      **12**  $\frac{7}{15}$



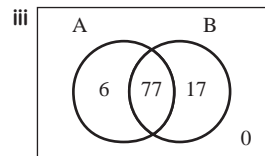
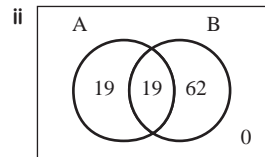
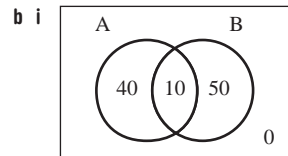
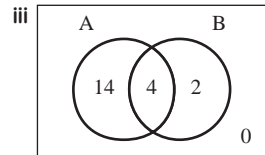
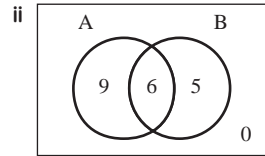
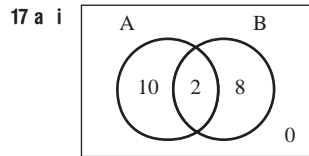
- 14 a**  $T - x - y + z$       **b**  $T - x$   
**c**  $T - y$       **d**  $x - z$   
**e**  $y - z$       **f**  $y - z$   
**g**  $T - x + z$

**15**

	A	Not A	Total
B	0	12	12
Not B	11	-4	7
Total	11	8	19

Filling in table so totals add up requires a negative number— impossible!

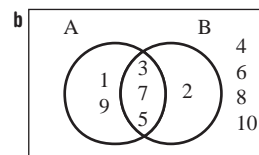
**16** 4



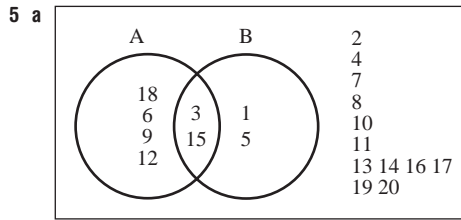
**c** overlap = (A + B) - Total

**Exercise 9C**

- 1 a** C      **b** D      **c** E      **d** A  
**e** F      **f** B  
**2 a** B      **b** D      **c** A      **d** C  
**3 a** 2      **b** 10      **c** 7      **d** 9  
**4 a i** {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}  
**ii** {1, 3, 5, 7, 9}  
**iii** {2, 3, 5, 7}



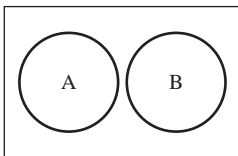
- c i {3, 5, 7}      ii {1, 2, 3, 5, 7, 9}  
 iii {2, 4, 6, 8, 10}      iv {2}
- d i 5      ii  $\frac{1}{2}$       iii 3      iv  $\frac{3}{10}$



- b i {3, 15}      ii {1, 3, 5, 6, 9, 12, 15, 18}  
 iii {1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20}  
 iv {1, 5}
- c i 4      ii  $\frac{1}{5}$       iii 2      iv  $\frac{1}{10}$       v 8      vi  $\frac{2}{5}$
- 6 a i False      ii True      iii False      iv True  
 v True      vi False      vii True      viii False
- b i  $\frac{1}{2}$       ii  $\frac{1}{2}$       iii 0
- 7 a i  $\frac{1}{6}$       ii  $\frac{11}{12}$       iii  $\frac{5}{12}$
- b i  $\frac{6}{25}$       ii  $\frac{21}{25}$       iii  $\frac{8}{25}$
- c i  $\frac{1}{3}$       ii  $\frac{11}{15}$       iii  $\frac{2}{5}$
- d i  $\frac{5}{21}$       ii  $\frac{17}{21}$       iii  $\frac{4}{7}$
- 8 a i {Fred, Ron, Rachel}      ii {Fred, Rachel, Helen}  
 iii {}      iv {Fred, Rachel}
- b i  $\frac{3}{4}$       ii  $\frac{1}{4}$       iii 0      iv 1  
 v  $\frac{1}{2}$       vi 1
- 9 a 26      b 5      c 3      d 18
- e  $\frac{5}{26}$       f  $\frac{21}{26}$       g  $\frac{3}{26}$       h  $\frac{5}{13}$
- 10 a 11      b 21      c 1      d  $\frac{9}{25}$

- 11 a own both a dog and a cat  
 b own dogs or cats or both  
 c does not own a cat  
 d owns a cat but no dogs

12 a yes

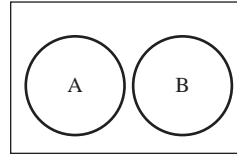


- b No as  $A \cup B$  includes only elements from sets A and B  
 13  $B \text{ only} = B \cap A'$

14

	A	A'	Total
B	$n(A \cap B)$	$n(B \cap A')$	$n(B)$
B'	$n(A \cap B')$	$n(A' \cap B')$	$n(B')$
Total	$n(A)$	$n(A')$	$n(\text{sample space})$

15 Mutually exclusive events have no common elements,  
 i.e.  $A \cap B = \emptyset$



- 16 a i {2, 3, 5, 7, 11, 13, 17, 19}  
 ii {1, 2, 3, 4, 6, 12}  
 iii {2, 3}  
 iv {1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 17, 19}  
 v {1, 4, 6, 12}  
 vi {5, 7, 11, 13, 17, 19}  
 vii {1, 2, 3, 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20}  
 viii {2, 3, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20}  
 ix {1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
- b i  $\frac{3}{5}$       ii  $\frac{1}{10}$       iii  $\frac{1}{5}$       iv  $\frac{2}{5}$   
 v  $\frac{4}{5}$       vi  $\frac{9}{10}$       vii  $\frac{9}{10}$       viii  $\frac{2}{5}$
- c they are equal

### Exercise 9D

1 a 9 outcomes

	1	2	3
1	(1, 1)	(2, 1)	(3, 1)
2	(1, 2)	(2, 2)	(3, 2)
3	(1, 3)	(2, 3)	(3, 3)

b 12 outcomes

	1	2	3	4	5	6
H	(1, H)	(2, H)	(3, H)	(4, H)	(5, H)	(6, H)
T	(1, T)	(2, T)	(3, T)	(4, T)	(5, T)	(6, T)

c 6 outcomes

	A	B	C
A	X	(B, A)	(C, A)
B	(A, B)	X	(C, B)
C	(A, C)	(B, C)	X

d 6 outcomes

		1st		
		•	○	○
2nd	•	×	(○, •)	(○, •)
	○	(•, ○)	×	(○, ○)
	○	(•, ○)	(○, ○)	×

2 a Table A

b Table B

c i  $\frac{1}{9}$

ii  $\frac{1}{6}$

d i 5

ii 4

3 a

		A	
		•	○
B	•	(•, •)	(○, •)
	○	(•, ○)	(○, ○)
	○	(•, ○)	(○, ○)

b 6

c i  $\frac{1}{3}$

ii  $\frac{1}{2}$

iii  $\frac{1}{2}$

4 a

	1	2	3	4
1	(1, 1)	(2, 1)	(3, 1)	(4, 1)
2	(1, 2)	(2, 2)	(3, 2)	(4, 2)
3	(1, 3)	(2, 3)	(3, 3)	(4, 3)
4	(1, 4)	(2, 4)	(3, 4)	(4, 4)

Sample space = {(1, 1), (2, 1), ... (4, 4)} i.e. all pairs from table.

b  $\frac{1}{16}$

c  $\frac{1}{4}$

5 a

	1	2	3	4	5	6
1	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(5, 1)	(6, 1)
2	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(5, 2)	(6, 2)
3	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(5, 3)	(6, 3)
4	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(5, 4)	(6, 4)
5	(1, 5)	(2, 5)	(3, 5)	(4, 5)	(5, 5)	(6, 5)
6	(1, 6)	(2, 6)	(3, 6)	(4, 6)	(5, 6)	(6, 6)

b 36

c i  $\frac{1}{36}$

ii  $\frac{1}{6}$

iii  $\frac{1}{12}$

iv  $\frac{5}{9}$

6 a

	D	O	G
D	X	(O, D)	(G, D)
O	(D, O)	X	(G, O)
G	(D, G)	(O, G)	X

b  $\frac{1}{6}$

c  $\frac{2}{3}$

7 a

		1st			
		1	2	3	4
2nd	1	X	(2, 1)	(3, 1)	(4, 1)
	2	(1, 2)	X	(3, 2)	(4, 2)
	3	(1, 3)	(2, 3)	X	(4, 3)
	4	(1, 4)	(2, 4)	(3, 4)	X

b i  $\frac{1}{12}$

ii  $\frac{1}{12}$

c i  $\frac{1}{6}$

ii  $\frac{5}{6}$

iii  $\frac{1}{6}$

iv  $\frac{1}{2}$

8 a

	1	2	3	4
1	2	3	4	5
2	3	4	5	6
3	4	5	6	7
4	5	6	7	8

b i  $\frac{1}{16}$

ii  $\frac{3}{16}$

iii  $\frac{3}{8}$

iv  $\frac{3}{16}$

v  $\frac{13}{16}$

9 a

	A	B	C	D	E
A	(A, A)	(B, A)	(C, A)	(D, A)	(E, A)
B	(A, B)	(B, B)	(C, B)	(D, B)	(E, B)
C	(A, C)	(B, C)	(C, C)	(D, C)	(E, C)
D	(A, D)	(B, D)	(C, D)	(D, D)	(E, D)
E	(A, E)	(B, E)	(C, E)	(D, E)	(E, E)

b i  $\frac{1}{25}$

ii  $\frac{1}{5}$

iii  $\frac{4}{5}$

c i  $\frac{8}{25}$

ii  $\frac{1}{25}$

10 a i  $\frac{1}{36}$

ii  $\frac{1}{12}$

iii  $\frac{1}{12}$

iv  $\frac{7}{12}$

v  $\frac{5}{12}$

vi  $\frac{1}{6}$

vii  $\frac{1}{6}$

viii 0

b  $7, \frac{1}{6}$

11 a i 169

ii 156

b i 25

ii 12

12 yes as if one 0 is removed another remains to be used.

13 a  $\frac{1}{25}$

b  $\frac{1}{20}$

14 7, 8, 9, 10, 11

15 a  $\frac{1}{2500}$

b  $\frac{1}{50}$

c  $\frac{1}{1250}$

d  $\frac{49}{2500}$

e  $\frac{23}{1250}$

16 a without replacement

b 2652

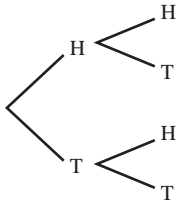
c  $\frac{1}{1326}$

d i  $\frac{1}{221}$

ii  $\frac{1}{17}$

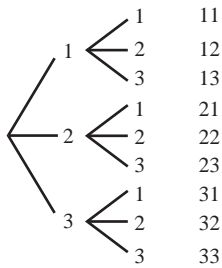
### Exercise 9E

- 1 a HHH, HHT, HTH, HTT, THH, THT, TTH, TTT (8 outcomes)  
 b TT, TO, OT, OO (4 outcomes)
- 2 a 6 outcomes      b 6 outcomes
- 3 a HH, HT, TH, TT



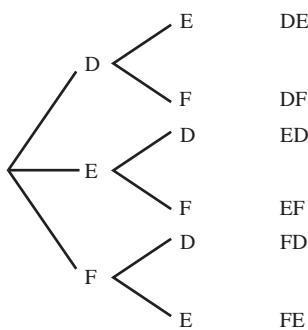
- b 4  
 c i  $\frac{1}{4}$       ii  $\frac{1}{2}$       iii  $\frac{3}{4}$       iv  $\frac{3}{4}$

- 4 a Spin 1    Spin 2    Outcomes



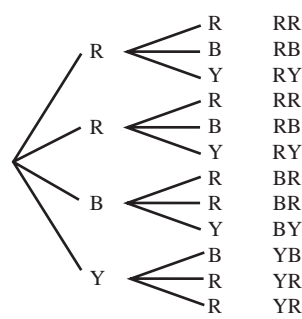
- b 9      c i  $\frac{1}{9}$   
 ii  $\frac{5}{9}$   
 iii  $\frac{8}{9}$   
 iv  $\frac{4}{9}$

- 5 a Person 1    Person 2    Outcomes



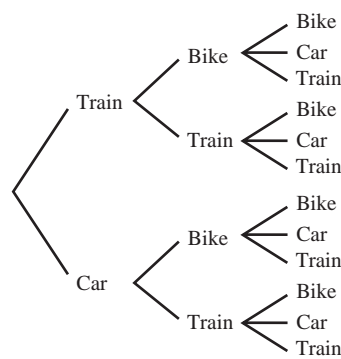
- b i  $\frac{1}{3}$       ii  $\frac{2}{3}$       iii 1

- 6 a Sock 1    Sock 2    Outcomes



- b i  $\frac{1}{3}$       ii  $\frac{1}{6}$       iii  $\frac{1}{6}$       iv  $\frac{5}{6}$
- 7 a  $\frac{4}{9}$       b  $\frac{2}{9}$       c  $\frac{1}{27}$       d  $\frac{8}{27}$
- 8 a  $\frac{1}{16}$       b  $\frac{1}{16}$       c  $\frac{5}{16}$       d  $\frac{11}{16}$       e  $\frac{15}{16}$

- 9 a To A    To B    To C



- b 12  
 c i  $\frac{1}{12}$       ii  $\frac{1}{3}$       iii  $\frac{1}{2}$       iv  $\frac{1}{4}$       v  $\frac{2}{3}$
- 10 a  $\frac{1}{16}$       b  $\frac{1}{4}$       c  $\frac{3}{8}$       d  $\frac{1}{4}$       e  $\frac{1}{16}$
- 11 a 32      b  $2^n$

12 yes, there is a difference; probability of obtaining two of the same colour is lower without replacement

- 13 a  $\frac{1}{9}$       b  $\frac{1}{9}$       c  $\frac{7}{18}$       d  $\frac{7}{18}$       e  $\frac{1}{2}$   
 f 0      g  $\frac{1}{6}$       h  $\frac{2}{3}$       i  $\frac{1}{9}$       j  $\frac{17}{18}$

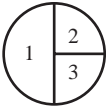
### Exercise 9F

- 1 a A:  $\frac{5}{20}=0.25$     B:  $\frac{30}{100}=0.3$

b C as it is a larger sample size

- 2 a 5      b 10      c 50      d 4

3 0.41, from the 100 throws as the more times an experiment is carried out the closer the experimental probability becomes to the actual/theoretical probability

- 4 a 0.6  
 b i 60      ii 120      iii 360
- 5 a  $\frac{7}{8}$   
 b i 350      ii 4375      iii 35
- 6 a  $\frac{1}{15}$       b  $\frac{2}{5}$       c  $\frac{11}{60}$
- 7 a 20      b 40      c 60      d 40
- 8 a 20  
 b i  $\frac{1}{4}$       ii  $\frac{7}{20}$       c i 25      ii 20      iii 45
- 9 a 0.64      b SEE
- 10 a i 0.52      ii 0.48      iii 0.78  
 b 78  
 c  $\frac{1}{2}, \frac{1}{4}, \frac{1}{4}$
- 
- 11 a  $\frac{9}{10}$   
 b No, as the number of throws increases, the experiment should produce results closer to the theoretical probability ( $\frac{1}{6}$ ).
- 12 a fair, close to 0.5 chance of tails  
 b biased, nearly all results are heads  
 c can't determine on such a small sample
- 13 a  $\frac{\text{Shaded Area}}{\text{Total Area}} = 0.225 \therefore 100 \text{ shots} \approx 23$   
 b  $\frac{1}{10} \times 100 = 10$   
 c  $\frac{150 - 32}{150} \times 100 \approx 79$   
 d  $\frac{225\pi - 25\pi}{225\pi} \times 100 \approx 89$
- 14 a no      b true  
 c no      d true
- 15 3 blue, 2 red, 4 green, 1 yellow
- 16 2 strawberry, 3 caramel, 2 coconut, 4 nut, 1 mint

### Exercise 9G

1 a common      b middle      c mean

2

	mean	median	mode
a	3	2	2
b	8	9	10
c	7	7	7
d	7	7	3
e	15	16	20
f	7	7	2

3

	mean	median	mode
a	6	7	8
b	8	6	5, 10
c	6	6	2
d	11	12	none
e	4	3.5	2.1
f	5	4.5	none
g	3	3.5	-3
h	0	2	3

- 4 a outlier = 33      mean = 12      median = 7.5  
 b outlier = -1.1      mean = 1.075      median = 1.4  
 c outlier = -4      mean = -49      median = -59
- 5 a yes      b no      c no      d yes
- 6 a 24.67 s      b 24.8 s
- 7 a 15      b 26
- 8 a 90      b 60
- 9 g
- 10 answers may vary  
 a 1, 4, 6, 7, 7 is a set      b 2, 3, 4, 8, 8 is a set  
 c 4, 4, 4, 4, 4 is a set      d 2.5, 2.5, 3, 7, 7.5 is a set  
 e -3, -2, 0, 5, 5 is a set      f  $0, \frac{1}{2}, 1\frac{1}{4}, 1\frac{1}{4}, 2$  is a set
- 11 a \$1 700 000  
 b (\$354 500 and \$324 000) drops \$30 500  
 c (\$570 667 and \$344 800) drops \$225 867
- 12 An outlier has a large impact on the addition of all the scores and therefore significantly affects the mean. An outlier does not move the middle of the group of scores significantly.
- 13 a 15      b 1.2      c 1      d 1  
 e No, as it will still lie in the 1 column.
- 14 a 2      b 3      c 7
- 15 a 76.75      b i 71.4, B<sup>+</sup>      ii 75, B<sup>+</sup>      iii 80.2, A  
 c 81.4, he cannot get an A<sup>+</sup>  
 d i 43      ii 93  
 e  $\frac{307+m}{5}$       f  $m = 5M - 307$

### Exercise 9H

- 1 a 9      b i 8 min      ii 35 min      c 21 min      d 21 min
- 2 a 26      b i 0 mm      ii 6 mm      c i 21 mm      ii 24 mm  
 d i 8 mm      ii 15 mm      e skewed      f symmetrical
- 3 a i
- | stem | leaf          |
|------|---------------|
| 1    | 9 9           |
| 2    | 3 4 6 6 8 8 8 |
| 3    | 2 2 3 5       |
| 4    | 1             |
| 5    | 4             |
- ii 28      iii 28      iv skewed

**b i**

stem	leaf
1	5 5
2	1 3 3 3 6
3	0 1 1 3 4 5 5 7 9
4	2 2 5 5 5 8
5	0 0 1

**ii** 35      **iii** 23, 45      **iv** almost symmetrical

**c i**

stem	leaf
32	0
33	3 7 8
34	3 4 5 5 7 8 9
35	2 2 4 5 8
36	1 3 5
37	0

**ii** 34.85      **iii** 35.2, 34.5      **iv** almost symmetrical

**d i**

stem	leaf
15	7 8 9 9 9 9
16	1 4 7 7 7
17	3 5 7 7
18	5 5 7 9
19	3 8
20	0 2

**ii** 173      **iii** 159      **iv** skewed

**4 a**

stem	leaf
0	5 6 6 8 8 9
1	0 1 1 2 2 2 4 4 5 6 7
2	0 1 2

**b** 9

**c** 12

**5 a i**

Set A	Set B
3 2	3 1
9	3
3 3 0 0	4 0 1 3 4 4
8 7 6 5	4 6 7 8 8 9 9
4 4 3	5 1 3

**ii** Set A has values spread between 32 and 54 while Set B has most of its values between 40 and 53 with an outlier at 31.

**b i**

Set A	Set B
9 8 6 4 3 2 2 1	0 9
7 7 6 1 1 0 0	1 8 9 9
9 6 4 3 3 2	2 0 1 3 4 7 8
7 6 6 5 0	3 1 7 7 8 9 9 9
8 3 1	4 0 1 1 3 4 4 5 7
0	5 0 0 1 3 3 4 4 5 6

**ii** Set A has values between 1 and 50 with the frequency decreasing as the numbers increase whereas Set B has values between 9 and 56 with the frequency increasing as the numbers increase.

**c i**

Set A	Set B
8 7 4 3	0 1 1 1 2 3 6 6 9 9
9 9 7 6 4	1 2 3 5 8 9
6 5 3 1	2 1 5 6
9 9 6 4 3 2	3 3 4 9
7 3 1	4 3 7 8
7 3 2	5 2 3 7
2 1	6 1 2
8 3	8 3 8
1	9

**ii** Set A and B are similar. The frequency decreases as the numbers increase.

**6 a**

Collingwood	St Kilda
8 3	6 6 8 8
8 7 2 1 0	7 8
9 9 8 2 0	8 0 0 2 2 3 4 7 8
8 7 5 1	9 0 4
4 3 3 3	10 6 9
9 8 5	11 1 3 7 8
7	12 2 5 6
	13 8

**b** Collingwood  $33\frac{1}{3}\%$  St Kilda  $41\frac{2}{3}\%$

**c** Collingwood is almost symmetrical data and based on these results seem to be consistent. St Kilda has groups of similar scores and while less consistent, they have higher scores.

**7 a** 9 days      **b**  $18^{\circ}\text{C}$       **c**  $7^{\circ}\text{C}$

**8 a** 16.1 s      **b** 2.3 s      **c** yes 0.05 lower

**9 a**

Battery lifetime	Brand A	Brand B
	3 7	2 3 4
		7 5 6 8 9 9
	4 2	8 0 1 3
	9 8 7 5	8
	4 4 3 2 1 0	9 0 1 2 3 4
	9 9 8 7 6 5 5	9 5 6 8 8

8 | 3 represents 8.3 hours

**b** Brand A, 12; Brand B, 8

**c** Brand A consistently performs better than Brand B.

**10 a** **c** = 2      **b** 0.02

**c** i 5, 6, 7 or 8      **ii** 0, 1, 2, 3, 4, 5 or 6

**11 a** 48%      **b** 15%

**c** In general, birth weights of babies are lower for mothers who smoke.

**12** In symmetrical data the mean is close to the median as the data is spread evenly from the centre with an even number of data values with a similar difference from the median above and below it.

**13 a** 52      **b** 17.8



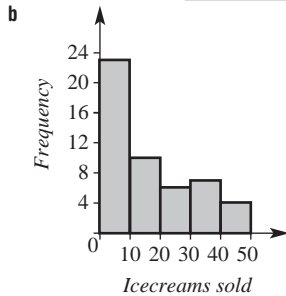
- 14 a mean = 41.06 median = 43  
 b median as more of the scores exist in the higher stems but a few low scores lower the mean.  
 c the mean is higher for positively skewed data as the majority of the scores are in the lower stems however a few high scores increase the mean.  
 d symmetrical data

**Exercise 9I**

- 1 a 3      b 360 000 – 370 000  
 2 a  $a = 15$      $b = 2$        $c = 30\%$        $d = 40\%$   
      $e = 20\%$   $f = 100\%$   
 b  $a = 50$        $b = 28\%$      $c = 12\%$        $d = 40$   
      $e = 100\%$   
 3 a 2      b 20      c i 30%      ii 65%

4 a

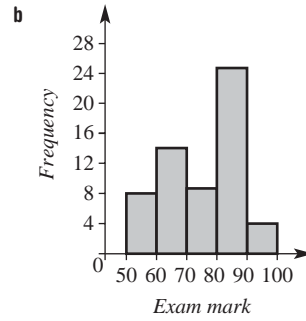
Class	Frequency	Percentage frequency
0–9	23	46%
10–19	10	20%
20–29	6	12%
30–39	7	14%
40–49	4	8%
	50	100%



- c i 33      ii 11      d 34%

5 a

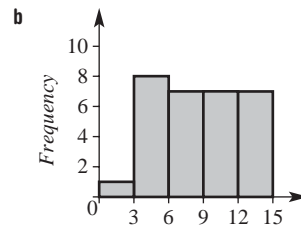
Class	Frequency	Percentage frequency
50–59	8	13.33%
60–69	14	23.33%
70–79	9	15%
80–89	25	41.67%
90–99	4	6.67%
	60	100%



- c i 22      ii 48.33%

6 a

Number of goals	Frequency
0–2	1
3–5	8
6–8	7
9–11	7
12–14	7
	30



- c 9      d 7

- 7 a symmetrical data      b skewed data  
 8 a  $a = 6$      $b = 27.5$      $c = 17.5$        $d = 4$   
      $e = 12$      $f = 30$        $g = 100$   
 b  $a = 1$      $b = 18$        $c = 8$        $d = 24$   
      $e = 20$      $f = 40$        $g = 100$   
 9 a i 20%    ii 55%    iii 80%    iv 75%    v 50%  
 b i 30      ii 45      c i 2      ii 22

10 85.5%

11 Because you only have the number of scores in the class interval not the individual scores

12 The number of data items within each class

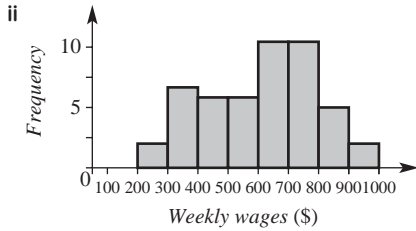
13 a Student A

b Make the intervals for their groups of data smaller so that the graph conveys more information.

14 a minimum wage: \$204; maximum wage: \$940

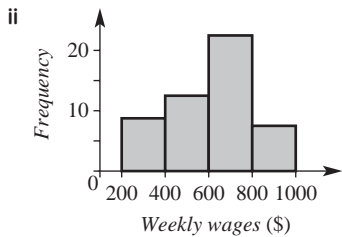
b i

Weekly wages (\$)	Frequency
200–	2
300–	7
400–	6
500–	6
600–	11
700–	11
800–	5
900–	2



c i

Weekly wages	Frequency
200–	9
400–	12
600–	22
800–	7



d More intervals shows greater detail. Since first graph has each pair of intervals quite similar, these two graphs are quite similar.

### Exercise 9J

- 1 a 6      b 7  
 c i 5      ii 8      d 3  
 2 a 12      b 5  
 c i 3      ii 8      d 5

3

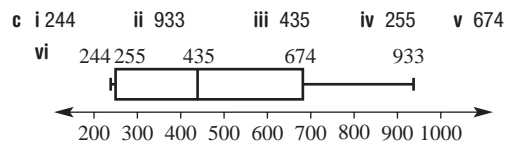
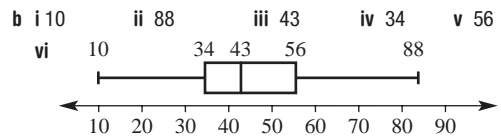
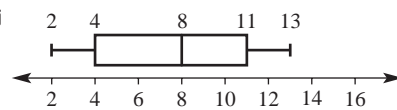
	Range	$Q_2$	$Q_1$	$Q_3$	IQR
a	11	6	2.5	8.5	6
b	23	30	23.5	36.5	13
c	170	219	181.5	284.5	103
d	851	76	28	367	339
e	1.3	1.3	1.05	1.85	0.8
f	34.98	10	0.1	23	22.9

- 4 a 110  
 b i 119.5 min      ii 106 min  
 iii 130 min      iv 24 min  
 c The middle 50% of videos rented varied in length by 24 min  
 5 a i \$12 000      ii \$547 000  
 iii \$71 500      iv \$46 000  
 v \$78 000      vi \$32 000  
 b The middle 50% of prices differs by less than \$32 000  
 c No effect on  $Q_1, Q_2$  or  $Q_3$  but the mean would increase.

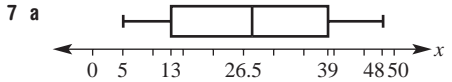
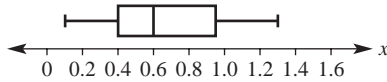
- 6 a 17.5      b 2.1  
 7 a 2      b 2  
 c No, only the many value has changed so no impact on IQR.  
 8 No, as the range is the difference in the highest and lowest score and different sets of two numbers can have the same difference ( $10 - 8 = 2, 22 - 20 = 2$ )  
 9 a Yes – the lowering of the highest price reduces the range  
 b No – the middle price will not change  
 c No; as only one value, the highest has changed, yet it still remains the highest,  $Q_1$  and  $Q_3$  remain unchanged.  
 10 a Yes (3, 3, 3, 4, 4, 4; IQR =  $4 - 3 = 1$ ; Range = 1)  
 b Yes (4, 4, 4, 4, 4 has IQR = 0)  
 11 a i  $Q_1 = 25; Q_2 = 26; Q_3 = 27$   
 ii  $Q_1 = 22; Q_2 = 24.5; Q_3 = 27$   
 b 27 jelly beans      c 22 jelly beans  
 d i IQR = 2      ii IQR = 5  
 e Shop B is less consistent than shop A and its data is more spread out  
 f Shop A

### Exercise 9K

- 1 a minimum value      b lower quartile,  $Q_1$   
 c median,  $Q_2$       d upper quartile,  $Q_3$   
 e maximum value      f scale  
 g whisker      h box  
 2 a the minimum from the maximum  
 b the lower quartile  $Q_1$  from the upper quartile  $Q_3$   
 3 D  
 4 a min = 35 cm      max = 60 cm      b 25 cm  
 c 50 cm      d 10 cm  
 e 50 cm      f 55 cm  
 g 20 babies  
 5 a min = 0 rabbits, max = 60 rabbits  
 b 60      c 25      d 25  
 e 35      f 25      g 25  
 6 a i 2      ii 13      iii 8      iv 4      v 11



- d i 0.1      ii 1.3      iii 0.6      iv 0.4      v 0.95  
vi 0.1    0.4 0.6    0.95    1.3

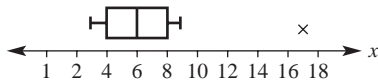


- b i 100%      ii 50%      iii 75%      iv 25%
- 8 a Africa      b 10 kg      c yes, 25 kg  
d i 50%      ii 75%      e African
- 9 a Mac      b 75%      c 50%
- d They are the same. Mac has 100% of times within same range as middle 50% of PC start up times. Mac is more consistent.

- 10 a Waldren      b Yeng      c Yeng  
d Yeng, smaller range and IQR  
e Yeng, higher median

- 11 a 1, 3, 5, 6, 6      b 1, 4, 4, 4, 5, 6
- 12 No, the median is anywhere within the box, including at times at its edges.
- 13 Yes, one reason is if an outlier is the highest score then the mean  $> Q_3$  [e.g. 1, 1, 3, 5, 6, 7, 256]

- 14 a  $Q_1 = 4$   
 $Q_2 = 6$   
 $Q_3 = 8$   
b yes, 17  
c 9



### Challenges

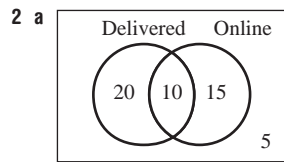
- 1 a  $2^5 = 32$       b  $\frac{3}{16}$       c  $\frac{31}{32}$
- 2 a  $\frac{1}{6}$       b  $\frac{1}{3}$
- 3 a i  $\frac{1}{4}$       ii  $\frac{1}{2}$       b  $\frac{1}{6}$   
c  $\frac{1}{12}$       d  $\frac{1}{3}$
- 4 a mean and median increase by 5, range unchanged  
b mean, median and range all double  
c mean and median double and decrease by 1, range doubles
- 5 5m
- 6 a 3, 5, 7, 8, 10 or 3, 5, 7, 9, 10      b 2, 2, 8, 12  
7 1, 4, 6, 7, 7; 2, 3, 6, 7, 7 and 1, 2, 5, 6, 6

### Multiple-choice questions

- 1 B      2 A      3 D      4 B      5 D  
6 B      7 E      8 C      9 B      10 E

### Short-answer questions

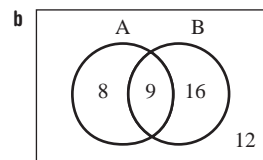
- 1 a  $\frac{2}{3}$       b  $\frac{5}{9}$       c  $\frac{3}{5}$



- b 15      c i  $\frac{1}{5}$       ii  $\frac{2}{5}$       iii  $\frac{3}{10}$

3 a

	A	A'	Total
B	9	16	25
B'	8	12	20
Total	17	28	45

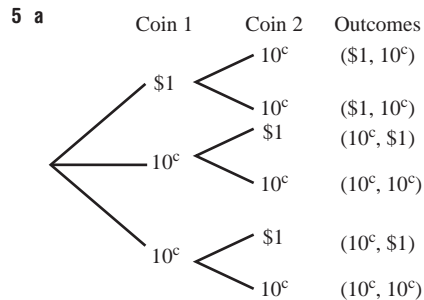


- c i  $\frac{4}{9}$       ii  $\frac{1}{5}$       iii 8      iv 33

- 4 a 12 outcomes

	1	2	3	4
red	(red, 1)	(red, 2)	(red, 3)	(red, 4)
green	(green, 1)	(green, 2)	(green, 3)	(green, 4)
blue	(blue, 1)	(blue, 2)	(blue, 3)	(blue, 4)

- b i  $\frac{1}{6}$       ii  $\frac{1}{6}$       iii  $\frac{2}{3}$



- b  $\frac{2}{3}$

- 6 a  $\frac{48}{120} = \frac{2}{5}$       b 14  
7 a 26      b 26.5      c 23, 31

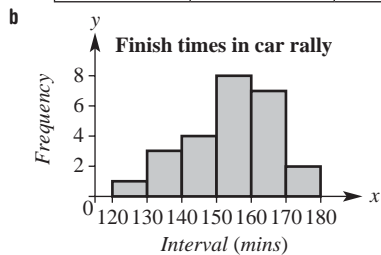
**8 a**

	Employee 1		Employee 2
	9	1	7 7
	5 3 1	2	0 4 8 9
	9 8 6 5 5 4	3	2 7 7 8
	6 5 0	4	0 1 2 5 8
	3 1	5	
	2   4 means 24		

- b i** Employee 1: 36, Employee 2: 37  
**ii** Employee 1: 36, Employee 2: 33  
**c** Employee 1, they have a higher mean and more sales at the high end.  
**d** Employee 1 symmetrical, employee 2 skewed

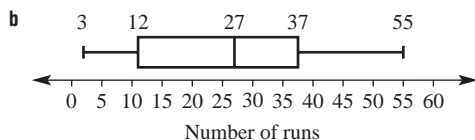
**9 a**

Class interval	Frequency	Percentage frequency
120–	1	4
130–	3	12
140–	4	16
150–	8	32
160–	7	28
170–180	2	8
Total	25	100%



- c i** 4      **ii** 60%

**10 a** 52 runs



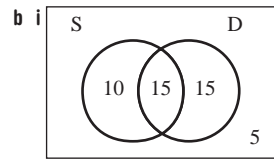
**c** 37 runs

### Extended-response questions

**1 a i**

		1st spin				
		1	2	3	4	5
2nd spin	1	(1, 1)	(2, 1)	(3, 1)	(4, 1)	(5, 1)
	2	(1, 2)	(2, 2)	(3, 2)	(4, 2)	(5, 2)
	3	(1, 3)	(2, 3)	(3, 3)	(4, 3)	(5, 3)
	4	(1, 4)	(2, 4)	(3, 4)	(4, 4)	(5, 4)
	5	(1, 5)	(2, 5)	(3, 5)	(4, 5)	(5, 5)

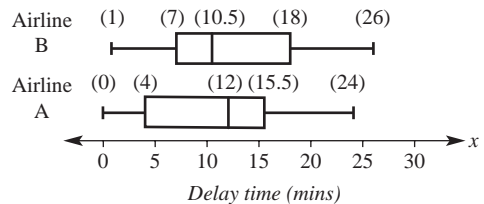
- ii**  $\frac{12}{25}$       **iii**  $\frac{4}{25}$       **iv** 24      **v** \$68



- ii** 5      **iii** 10      **iv**  $\frac{1}{3}$       **v**  $\frac{4}{9}$   
**vi**  $\frac{7}{9}$ , the probability a person did not buy a sausage on its own

**2 a** Yes, 52 mins      **b i** 12      **ii** 4      **iii** 15.5

**c and e**



**d** No, the median time is 12 mins so half the flights have less than 12 minute delay.

**f** Airline A: range = 24, IQR = 11.5

Airline B: range = 25, IQR = 11

Both airlines have a very similar spread of their data when the outlier is removed.

**g** There is not much difference when airline A's outlier is removed. It has a marginally better performance with 75% of flights delayed less than 15.5 mins compared with 18 mins for airline B.

## Chapter 10

### Pre-test

- 1 a i** 0      **ii** 4      **iii** 1      **iv** 9  
**b i** 0      **ii** 2      **iii** 5      **iv** 27  
**c i** 3      **ii** -1      **iii** 2      **iv** -6  
**d i** -1      **ii** 7      **iii** -2      **iv** 2
- 2 a** yes      **b** no      **c** yes
- 3 a** 0      **b** 3      **c** -5      **d** -3  
**e** 4      **f**  $\frac{4}{3}$
- 4 a**  $a^2 - 2a = 0$       **b**  $a^2 - 3a + 1 = 0$
- 5 a**  $2x$       **b**  $x$       **c**  $3x$       **d**  $2x$   
**e** 4      **f** 5
- 6 a**  $(x+3)(x-3)$       **b**  $(x+5)(x-5)$   
**c**  $(x+8)(x-8)$       **d**  $(x+4)(x-4)$
- 7 a**  $(x+6)(x+2)$       **b**  $(x+4)(x+1)$   
**c**  $(x-7)(x+4)$       **d**  $(x-5)(x-4)$

- 8 a  $2x-6$     b  $2x-x^2$     c  $x^2-x-2$   
 d  $x^2-7x+12$   
 9 a  $A=x^2+2x$     b  $A=x^2-9$   
 c  $A=x^2+x-2$   
 10 a (2, 0), (0, -4)    b (4, 0), (0, 2)  
 11 a  $x=5$     b  $x=3$     c  $x=1$     d  $x=5.5$

### Exercise 10A

- 1 a 12    b -4    c 6  
 d -1    e 20    f 4  
 g 72    h 0    i -27  
 2 a no    b no    c yes    d yes  
 e yes    f no    g no    h yes  
 i yes  
 3 a 1    b -3    c -11  
 d -2    e 3    f -6  
 4 a  $x-5=0, x=5$   
 b  $2x+1=0, 2x=-1$  or  $x=3, x=-\frac{1}{2}$  or  $x=3$   
 5 a  $x^2+2x-5=0$     b  $x^2-5x+2=0$   
 c  $x^2-4x+1=0$     d  $x^2-7x-2=0$   
 e  $2x^2+2x+1=0$     f  $3x^2-3x+4=0$   
 g  $3x^2+4=0$     h  $x^2-3x-1=0$   
 i  $2x^2+5x-10=0$   
 6 a yes    b yes    c no  
 d no    e yes    f yes  
 g no    h no    i no  
 7 both are solutions    8 both are solutions  
 9 a 0, -1    b 0, -5    c 0, 2    d 0, 7  
 e -1, 3    f 4, -2    g -7, 3    h  $-\frac{1}{2}, \frac{1}{2}$   
 i 0, -5    j  $0, \frac{2}{3}$     k  $0, \frac{2}{3}$     l 0, -2  
 10 a  $\frac{1}{2}, -2$     b  $-\frac{2}{3}, \frac{1}{3}$     c  $-\frac{2}{5}, -4$     d  $1, \frac{1}{3}$   
 e  $-5, -\frac{2}{7}$     f  $\frac{2}{3}, -\frac{1}{5}$     g  $\frac{7}{11}, \frac{13}{2}$     h  $-\frac{9}{4}, \frac{7}{2}$   
 i  $\frac{4}{3}, -\frac{1}{7}$   
 11 a 0, -3    b  $0, \frac{7}{2}$     c 1, -4  
 d  $\frac{1}{2}, -6$     e  $-\frac{3}{2}, \frac{1}{2}$   
 12 a  $4x^2+x+1=0$     b  $3x^2-3x=0$   
 c  $3x^2-x-4=0$     d  $5x^2+x-2=0$   
 e  $2x^2-x-3=0$     f  $3x^2-10x+6=0$   
 g  $x^2-x-5=0$     h  $4x^2-5x-6=0$   
 13 a -1, 2    b 1, 3    c 0, 4    d 0, -3  
 e -4, 1    f -4, 4  
 14 a  $(x+2)(x+2)=0$     b both solutions are the same,  $x=-2$   
 c i -3    ii 5    iii  $\frac{1}{2}$     iv  $\frac{7}{5}$   
 15 a  $(x-1)(x+2)=0$     b  $x=1, x=-2$   
 c multiplying by a constant doesn't change a zero value.  
 d i -2, 3    ii 0, -2    iii -1, 3

- 16 a i no    ii no    iii no    iv no  
 b It has no solutions as  $(x-3)^2$  is always  $\geq 0$ , so  
 $(x-3)^2+1 \geq 1$   
 17 a Linear    b Quadratic    c Quintic    d Cubic  
 e Quartic    f Quintic  
 18 a -2, -1, 3    b -11, 2, 5  
 c  $-\frac{2}{3}, \frac{1}{5}, \frac{1}{2}$     d  $-\frac{10}{7}, -\frac{4}{5}, -\frac{2}{3}, \frac{6}{2}$

### Exercise 10B

- 1 a 2    b 5    c 2    d 8  
 e  $x$     f  $x$     g  $3x$     h  $3x$   
 2 a  $2(x-2)(x+2)$     b  $4(x-3)(x+3)$     c  $3(x-5)(x+5)$   
 d  $12(x-1)(x+1)$     e  $x(x-3)$     f  $x(x+7)$   
 g  $2x(x-2)$     h  $5x(x-3)$     i  $2x(3x+2)$   
 j  $9x(x-3)$     k  $4x(1-4x)$     l  $7x(2-3x)$   
 3 a  $x=0, x=3$     b  $x=0, x=-1$     c  $x=0, x=-2$   
 d  $x=-1, x=1$     e  $x=-5, x=5$     f  $x=-\frac{1}{2}, x=\frac{1}{2}$   
 4 a  $x=0, x=-3$     b  $x=0, x=-7$     c  $x=0, x=-4$   
 d  $x=0, x=5$     e  $x=0, x=8$     f  $x=0, x=2$   
 g  $x=0, x=-\frac{1}{3}$     h  $x=0, x=\frac{1}{2}$   
 5 a  $x=0, x=3$     b  $x=0, x=4$     c  $x=0, x=-5$   
 d  $x=0, x=3$     e  $x=0, x=3$     f  $x=0, x=-4$   
 6 a  $x=0, x=3$     b  $x=0, x=2$     c  $x=0, x=4$   
 d  $x=0, x=-3$     e  $x=0, x=-4$     f  $x=0, x=-3$   
 7 a  $x=3, x=-3$     b  $x=4, x=-4$     c  $x=5, x=-5$   
 d  $x=12, x=-12$     e  $x=9, x=-9$     f  $x=20, x=-20$   
 8 a  $x=2, x=-2$     b  $x=3, x=-3$     c  $x=5, x=-5$   
 d  $x=2, x=-2$     e  $x=2, x=-2$     f  $x=2, x=-2$   
 g  $x=4, x=-4$     h  $x=3, x=-3$   
 9 a  $x=2, x=-2$     b  $x=5, x=-5$     c  $x=10, x=-10$   
 d  $x=0, x=-7$     e  $x=0, x=7$     f  $x=-1, x=1$   
 g  $x=0, x=\frac{2}{3}$     h  $x=0, x=\frac{3}{5}$     i  $x=-\sqrt{3}, x=\sqrt{3}$   
 10 a  $x=-2, x=2$     b  $x=-6, x=6$     c  $x=-1, x=1$   
 d  $x=-1, x=1$     e  $x=0, x=-7$     f  $x=0, x=4$   
 11 a 0 or 7    b 8 or -8    c 0 or -4  
 12 a  $(x+2)(x-2)=x^2-4$  not  $x^2+4$   
 b No,  $\sqrt{-4}$  is not a real number  
 13 a  $ax^2+bx=x(ax+b)=0, x=0$  is always one solution  
 b  $x=-\frac{b}{a}$   
 14 a  $x=-\frac{4}{3}, x=\frac{4}{3}$     b  $x=-\frac{6}{5}, x=\frac{6}{5}$     c  $x=-\frac{1}{5}, x=\frac{1}{5}$   
 d  $x=-\frac{9}{5}, x=\frac{9}{5}$     e  $x=-\frac{8}{11}, x=\frac{8}{11}$     f  $x=-\frac{12}{7}, x=\frac{12}{7}$   
 15 a  $x=-1, x=5$     b  $x=-1, x=-9$     c  $x=-1, x=0$   
 d  $x=-\frac{2}{5}, x=\frac{8}{5}$     e  $x=1, x=7$     f  $x=-1, x=\frac{13}{7}$

### Exercise 10C

- 1 a 3, 2      b 4, 2      c -2, -1      d -5, -2  
 e 2, -1      f 5, -1      g -4, 3      h -6, 2
- 2 a  $(x+5)(x+4) = 0$       b  $(x-6)(x+4) = 0$   
 $x+5=0$  or  $x+4=0$        $x-6=0$  or  $x+4=0$   
 $x=-5$  or  $x=-4$        $x=6$  or  $x=-4$
- c  $(x+9)(x-5) = 0$       d  $(x-8)(x-2) = 0$   
 $x+9=0$  or  $x-5=0$        $x-8=0$  or  $x-2=0$   
 $x=-9$  or  $x=5$        $x=8$  or  $x=2$
- 3 a -6, -2      b -8, -3      c -5, -2  
 d -7, 2      e -6, 2      f -10, 3  
 g 4, 8      h 3, 6      i 3, 7  
 j -3, 5      k -2, 8      l -5, 9  
 m 4, 6      n -6, 7      o -12, 7  
 p -3, -1      q -3, 9      r 2, 10
- 4 a -3      b -2      c -7  
 d -12      e 5      f 8  
 g 6      h 9      i 10
- 5 a -2, 5      b 2, 5      c 3  
 d -4, 1      e -7, 2      f 4  
 g -6, 2      h -6, 1      i 3, 5  
 j -8, 2      k -4, -2      l -9, 2
- 6 a -2, 3      b -5, -3      c -2, 8  
 d 2, 3      e 2      f -1  
 g 5      h -3      i -7, 1
- 7 a 2, 3      b 3      c -10, 2  
 d -5, 7      e -1      f 2
- 8 a  $x^2 - 3x + 2$       b  $x^2 - x - 6$   
 c  $x^2 + 3x - 4$       d  $x^2 - 7x - 30$   
 e  $x^2 - 10x + 25$       f  $x^2 + 22x + 121$

9 11 am, 6 pm

10 a Equation is not written in standard form  $x^2 + bx + c = 0$  so cannot apply Null Factor Law in this form.

b  $x = -2, x = 3$

11 It is a perfect square,  $(x-1)(x-1), (x-1)^2 = 0, x = 1$

12 a  $(x-a)(x-a) = 0$  or  $(x-a)^2 = 0$

b  $(x-a)(x-b) = 0$

13 a  $x = -3$  or  $x = -\frac{1}{5}$       b  $x = \frac{2}{3}$  or  $x = -2$

c  $x = \frac{1}{3}$  or  $x = -\frac{1}{2}$       d  $x = \frac{1}{2}$  or  $x = -1$

e  $x = \frac{3}{2}$  or  $x = -5$       f  $x = \frac{3}{2}$

g  $x = \frac{7}{3}$  or  $x = -2$       h  $x = \frac{3}{5}$  or  $x = -4$

i  $x = -\frac{5}{3}$       j  $x = \frac{1}{3}$  or  $x = \frac{5}{2}$

### Exercise 10D

- 1 a  $x(x+2) = 8$       b 2, -4  
 c 2, width > 0      d  $L = 4$  cm,  $W = 2$  cm

2 a  $x(x+5) = 14$       b 2, -7  
 c 2, width > 0      d  $L = 7$  m,  $W = 2$  cm

3 a -6, 3      b 5, -4      c 2, -5

4 -8, 6      5 -5, 12      6 -2, 15

7  $L = 9$  cm,  $W = 4$  cm      8  $L = 3$  m,  $W = 23$  m

9 a  $A = 100 - x^2$       b  $x = 6$

10  $h = 5$

11 a  $A = x^2 + 5x + 15$       b  $x = 7$

12 a  $x = 3$  (-4 not valid)      b  $x = 12$       c  $x = 25$

13 -8 not valid because dimensions must be > 0

14  $x = -2$  or  $x = 3$  both valid as both are integers

15 a 10, 15, 21      b i 28      ii 210      c i 9      ii 15

16 a 9, 14      b i 8      ii 12

17 a  $A = (20 + 2x)^2 = 4x^2 + 80x + 400$       b 10 cm

18 4 cm

### Exercise 10E

1 a highest      b parabola      c intercepts

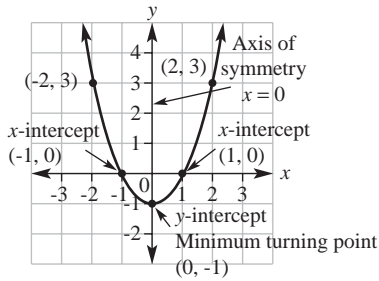
d vertex      e lowest      f zero

2 a  $x = 3$       b  $x = 1$       c  $x = -2$       d  $x = -5$

	i axis of symmetry	ii turning point	iii type of turning point	iv x-intercepts	v y-intercept
a	$x = 2$	(2, -1)	minimum	(1, 0), (3, 0)	(0, 3)
b	$x = 0$	(0, -4)	minimum	(-2, 0), (2, 0)	(0, -4)
c	$x = 0$	(0, 3)	maximum	(-1, 0), (1, 0)	(0, 3)
d	$x = 0$	(0, 4)	maximum	(-2, 0), (2, 0)	(0, 4)
e	$x = 2$	(2, 1)	minimum	none	(0, 4)
f	$x = -1$	(-1, 7)	maximum	(-4, 0), (2, 0)	(0, 6)
g	$x = 0$	(0, 0)	minimum	(0, 0)	(0, 0)
h	$x = 0$	(0, -4)	minimum	(-2, 0), (2, 0)	(0, -4)
i	$x = 3$	(3, 4)	maximum	(1, 0), (5, 0)	(0, -5)
j	$x = 3$	$(3, -\frac{1}{2})$	minimum	(2, 0), (4, 0)	(0, 4)
k	$x = 0$	(0, 2)	maximum	(-1, 0), (1, 0)	(0, 2)
l	$x = -2$	(-2, -1)	maximum	none	(0, -4)

x	-2	-1	0	1	2
y	3	0	-1	0	3

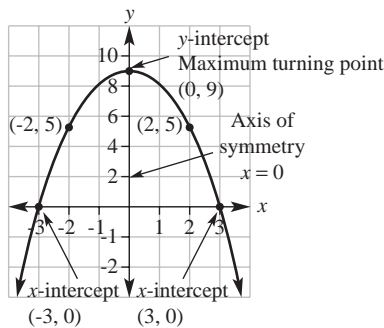
$y = x^2 - 1$



5

x	-3	-2	-1	0	1	2	3
y	0	5	8	9	8	5	0

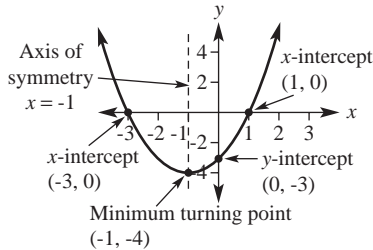
$y = 9 - x^2$



6

x	-4	-3	-2	-1	0	1	2
y	5	0	-3	-4	-3	0	5

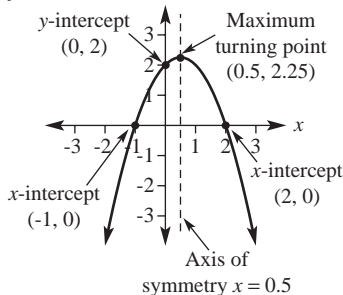
$y = x^2 + 2x - 3$



7

x	-2	-1	0	1	2	3
y	-4	0	2	2	0	-4

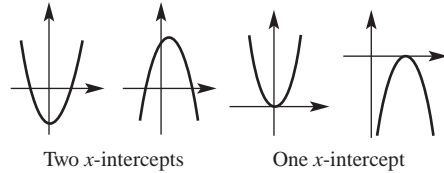
$y = -x^2 + x + 2$



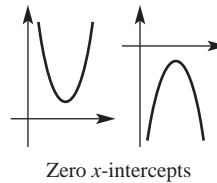
8 a i 1 s, 3 s

ii one time is on the way up and the other is on the way down

- b i 2 s    ii 12 m    iii 4 s  
 9 a 100 m    b 155 m    c 5 s  
 d journey takes 1 s longer to go down to the ground  
 10 a  $x = 1$   
 b (1, -3)  
 11 a  $x = 1$     b (2, 0)  
 12 a  $y = x^2$     b  $y = x^2 - 4$   
 c  $y = 1 - x^2$     d  $y = x^2 - 2x + 1$   
 e  $y = -x^2 - 2x$     f  $y = x^2 - 3x - 4$   
 13 a Yes    b Yes



c Yes



d No

- 14 a  $-2^2 = -1 \times 2^2 = -4$ . It is not  $(-2)^2 = 4$ , so correct solution is  $y = -2^2 + 2 \times 2 = -4 + 4 = 0$   
 b  $(-3)^2 = -1 \times 9 = -9$ . It is not  $-3^2 = +9$ , so correct solution is  $y = -3 - (-3)^2 = -3 - 9 = -12$   
 15 a  $x = -2, x = 2$     b  $x = 0$   
 c i infinite    ii one    iii none  
 16 a i  $x = 0, x = 2$     ii  $x = -1, x = 3$   
 b two, a parabola is symmetrical  
 c one, this is the minimum turning point  
 d none, -1 is the minimum y-value so there are no values of y less than -1

Exercise 10F

- 1 a  $y = 3x^2, y = x^2, y = \frac{1}{2}x^2$     b  $y = -3x^2, y = -x^2, y = -\frac{1}{2}x^2$   
 c (0, 0)    d  $x = 0$   
 e i  $y = 3x^2$     ii  $y = \frac{1}{2}x^2$     iii  $y = -3x^2$     iv  $y = -\frac{1}{2}x^2$   
 f i  $y = -x^2$     ii  $y = -3x^2$     iii  $y = \frac{1}{2}x^2$   
 2 a positive    b negative  
 3 a  $y = -x^2$     b  $y = 4x^2$     c  $y = 5x^2$     d  $y = \frac{1}{3}x^2$

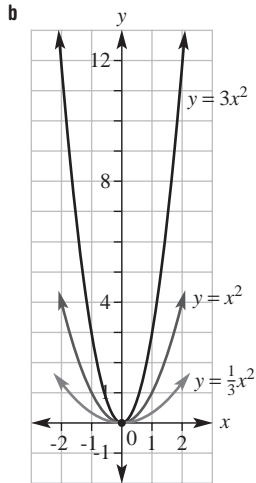
4 a

x	-2	-1	0	1	2
y	4	1	0	1	4

x	-2	-1	0	1	2
y	12	3	0	3	12

$x$	-2	-1	0	1	2
$y$	$\frac{4}{3}$	$\frac{1}{3}$	0	$\frac{1}{3}$	$\frac{4}{3}$

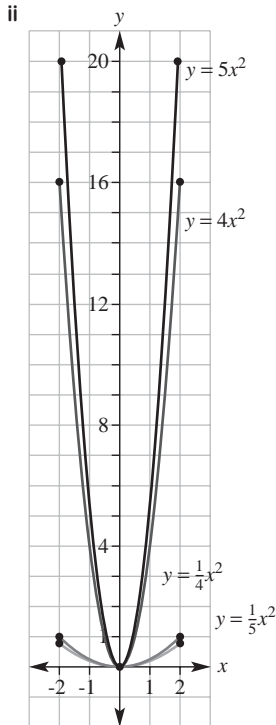


**c** For all 3 graphs, the turning point is a minimum at  $(0, 0)$  and the axis of symmetry is  $x = 0$

**d** i narrower                      ii wider

**5 a i**

$x$	-2	-1	0	1	2
$y$	16	4	0	4	16



**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$

**iv** narrower

**b i**

$x$	-2	-1	0	1	2
$y$	20	5	0	5	20

**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$ ;  $x$ - and  $y$ -intercept:  $(0, 0)$

**iv** narrower

**c i**

$x$	-2	-1	0	1	2
$y$	1	$\frac{1}{4}$	0	$\frac{1}{4}$	1

**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$

**iv** wider

**d i**

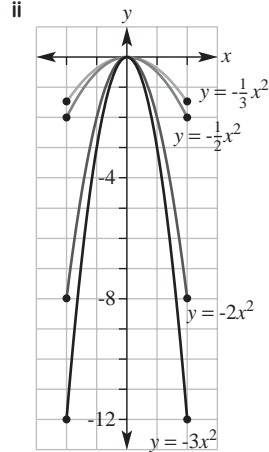
$x$	-2	-1	0	1	2
$y$	$\frac{4}{5}$	$\frac{1}{5}$	0	$\frac{1}{5}$	$\frac{4}{5}$

**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$

**iv** wider

**5 a i**

$x$	-2	-1	0	1	2
$y$	-8	-2	0	-2	-8



**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$ ;  $x$ - and  $y$ -intercept:  $(0, 0)$

**iv** narrower

**b i**

$x$	-2	-1	0	1	2
$y$	-12	-3	0	-3	-12

**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$ ;  $x$ - and  $y$ -intercept:  $(0, 0)$

**iv** narrower

**c i**

$x$	-2	-1	0	1	2
$y$	-2	$-\frac{1}{2}$	0	$-\frac{1}{2}$	-2

**iii** axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$ ;  $x$ - and  $y$ -intercept:  $(0, 0)$

**iv** wider

**d i**

$x$	-2	-1	0	1	2
$y$	$-\frac{4}{3}$	$-\frac{1}{3}$	0	$-\frac{1}{3}$	$-\frac{4}{3}$



iii axis of symmetry:  $x = 0$ ; turning point:  $(0, 0)$ ;  $x$ - and  $y$ -intercept:  $(0, 0)$

iv wider

7 a A                    b H

8 i d                    ii c                    iii a

iv e                    v f                    vi b

9 a reflection in the  $x$ -axis, dilating by a factor of 3 from the  $x$ -axis

b reflection in the  $x$ -axis, dilating by a factor of 6 from the  $x$ -axis

c reflection in the  $x$ -axis, dilating by a factor of  $\frac{1}{2}$  from the  $x$ -axis

d reflection in the  $x$ -axis, dilating by a factor of 2 from the  $x$ -axis

e reflection in the  $x$ -axis, dilating by a factor of 3 from the  $x$ -axis

f reflection in the  $x$ -axis, dilating by a factor of  $\frac{1}{3}$  from the  $x$ -axis

10 a  $y = -4x^2$     b  $y = \frac{1}{3}x^2$     c  $y = -4x^2$     d  $y = -\frac{4}{3}x^2$

11 No because both transformations are multiplying to 'a' and multiplication is commutative:  $bc = cb$

12  $y = ax^2$ , has  $y$ -axis as axis of symmetry so it is symmetrical about the  $y$ -axis

13 a  $y = 5x^2$     b  $y = 7x^2$     c  $y = x^2$     d  $y = \frac{7}{4}x^2$

e  $y = \frac{4}{25}x^2$     f  $y = \frac{26}{9}x^2$     g  $y = 5x^2$     h  $y = -52x^2$

14  $y = \frac{67}{242064}x^2$

### Exercise 10G

1 a i  $(-2, 0)$     ii  $(3, 0)$     b i  $(0, 4)$     ii  $(0, -9)$

c left            d right

2 a i  $(0, -3)$     ii  $(0, 2)$     b i  $(0, -3)$     ii  $(0, 2)$

c down            d up

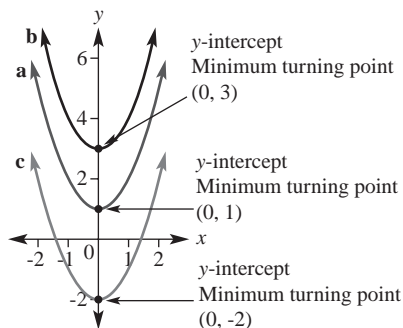
3 a i  $(2, 3)$     ii  $(-1, -1)$     b i  $(0, -1)$     ii  $(0, 0)$

c i one, left, one, down

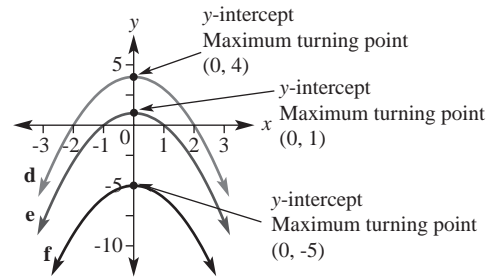
ii two, right, three, up.

4 a  $(0, 3)$     b  $(0, -4)$     c  $(0, -4)$     d  $(0, 25)$

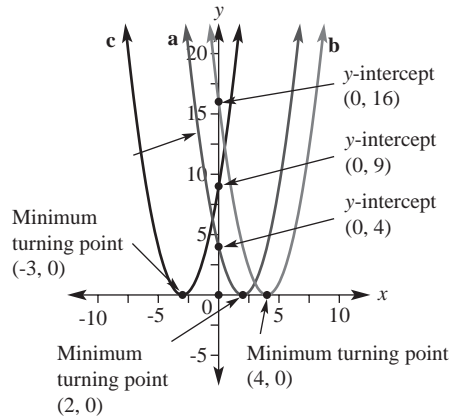
5 a  $y = x^2 + 1$     b  $y = x^2 + 3$     c  $y = x^2 - 2$



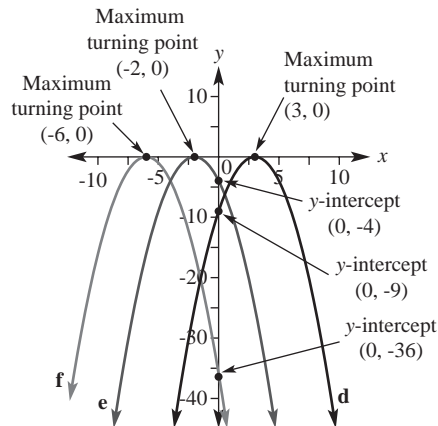
d  $y = -x^2 + 4$     e  $y = -x^2 + 1$     f  $y = -x^2 - 5$



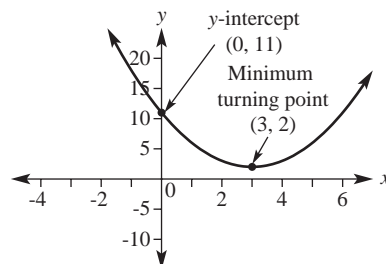
6 a  $y = (x-2)^2$     b  $y = (x-4)^2$     c  $y = (x+3)^2$



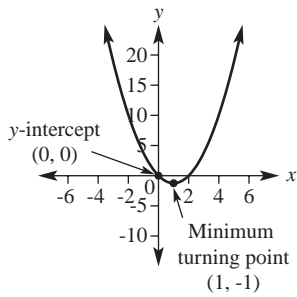
d  $y = -(x-3)^2$     e  $y = -(x+2)^2$     f  $y = -(x+6)^2$



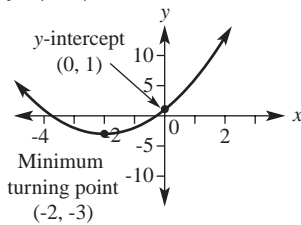
7 a  $y = (x-3)^2 + 2$



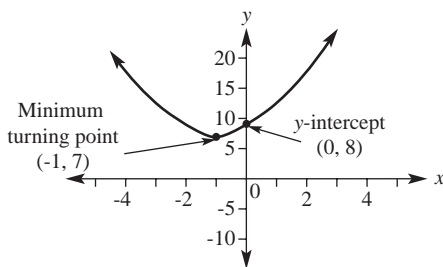
**b**  $y = (x - 1)^2 - 1$



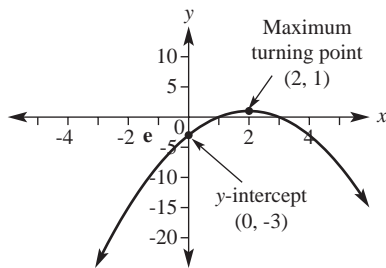
**c**  $y = (x + 2)^2 - 3$



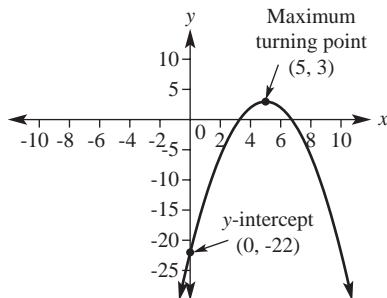
**d**  $y = (x + 1)^2 + 7$



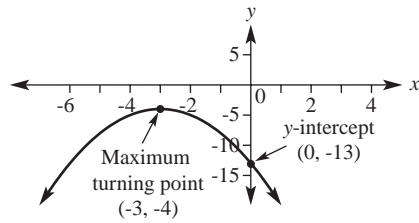
**e**  $y = -(x - 2)^2 + 1$



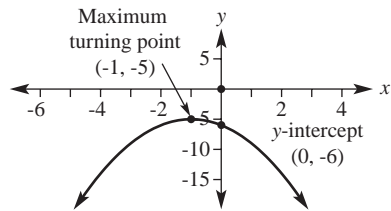
**f**  $y = -(x - 5)^2 + 3$



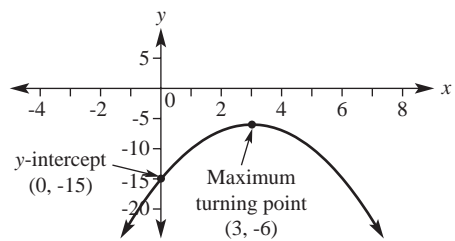
**g**  $y = -(x + 3)^2 - 4$



**h**  $y = -(x + 1)^2 - 5$



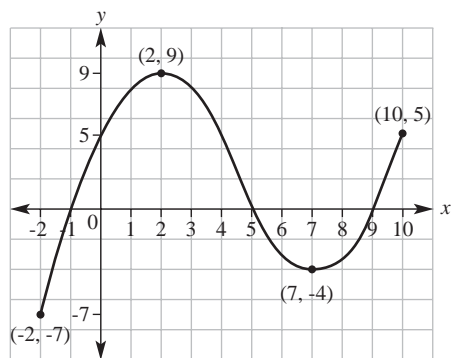
**i**  $y = -(x - 3)^2 - 6$



- |              |        |       |
|--------------|--------|-------|
| <b>8</b> i j | ii d   | iii b |
| iv h         | v k    | vi g  |
| vii a        | viii e | ix l  |
| x i          | xi f   | xii c |
- 9** a  $y = (x - 1)^2 + 1$       b  $y = (x + 2)^2 + 2$   
 c  $y = (x + 1)^2 - 3$       d  $y = -(x - 1)^2 + 4$   
 e  $y = -(x - 2)^2 - 2$       f  $y = -(x + 2)^2 + 4$

- 10** a  $y = -(x - 2)^2 + 9$ , turning point (2, 9)  
 $y = (x - 7)^2 - 4$ , turning point (7, -4)

**b**

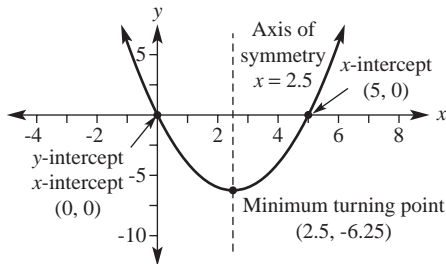


- |                                    |                         |
|------------------------------------|-------------------------|
| <b>11</b> a i $y = -(x + 1)^2 + 3$ | ii $y = (x + 3)^2 + 4$  |
| iii $y = (x - 1)^2 - 3$            | iv $y = -(x - 5)^2 - 7$ |
| v $y = -x^2 - 2$                   | vi $y = x^2 - 6$        |
- b** i (-1, 3)    ii (-3, 4)    iii (1, -3)    iv (5, -7)  
 v (0, -2)    vi (0, -6)

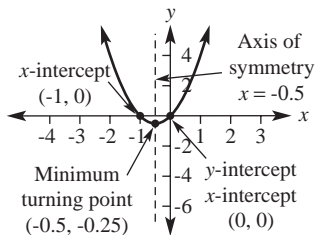
- 12 a  $(h, k)$       b  $y = ah^2 + k$   
 13 a  $(2-x)^2 = (-1(x-2))^2 = (-1)^2(x-2)^2 = (x-2)^2$ , so graphs are the same  
 b graphs are the same  
 14 a  $y = x^2 + 3$                       b  $y = x^2 - 4$   
 c  $y = x^2 - 3$                           d  $y = x^2 - 5$   
 15 a  $y = -x^2 + 4$                       b  $y = -x^2 + 4$   
 c  $y = -x^2 + 24$                       d  $y = -x^2 + 10$   
 16 a  $y = (x+3)^2$  or  $y = (x-5)^2$       b  $y = (x-2)^2$  or  $y = (x-4)^2$   
 c  $y = (x+4)^2$  or  $y = (x-2)^2$       d  $y = x^2$  or  $y = (x-6)^2$   
 17 a  $y = -(x-1)^2 + 1$                   b  $y = (x+2)^2$   
 c  $y = -(x-3)^2$                       d  $y = -(x+3)^2 + 2$   
 e  $y = (x+1)^2 + 4$                   f  $y = (x-3)^2 - 9$

**Exercise 10H**

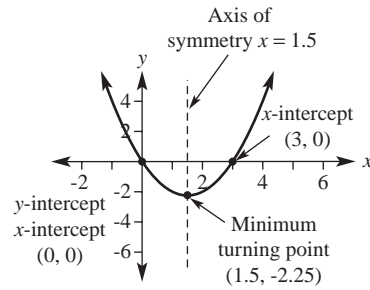
- 1 a  $x(x+2)$       b  $x(x-3)$       c  $5x(x-2)$   
 d  $(x+3)(x-3)$       e  $(x+1)(x-1)$       f  $(x+7)(x-7)$   
 g  $(x+2)(x+1)$       h  $(x+3)(x+2)$       i  $(x-4)(x+3)$   
 j  $(x-7)(x+4)$       k  $(x-2)(x-2) = (x-2)^2$   
 l  $(x+5)(x+5) = (x+5)^2$   
 2 a 0                  b 0                  c -3  
 d 8                  e -1                  f -1  
 g -0.5              h 4.5              i 6  
 3 a -4                b -1                c -9  
 d -1                e -9                f -9  
 4 a i (0, 0) (-7, 0)      ii (0, 0)      b i (0, 0) (-3, 0)      ii (0, 0)  
 c i (0, 0) (-4, 0)      ii (0, 0)      d i (4, 0) (-2, 0)      ii (0, -8)  
 e i (-2, 0) (5, 0)      ii (0, -10)      f i (-3, 0) (7, 0)      ii (0, -21)  
 g i (-3, 0) (1, 0)      ii (0, -6)      h i (-4, 0) (-1, 0)      ii (0, 12)  
 i i (2, 0) (3, 0)      ii (0, 6)  
 5 a  $y = x(x-5)$



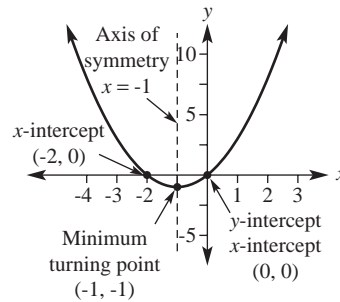
b  $y = x(x+1)$



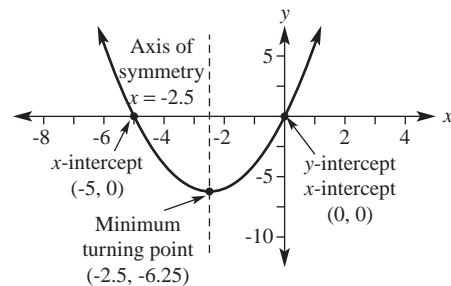
c  $y = x(x-3)$



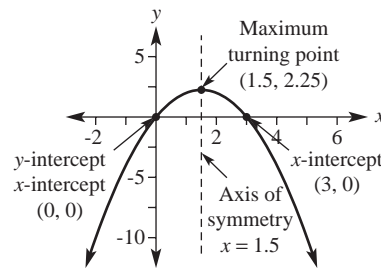
d  $y = x(2+x)$



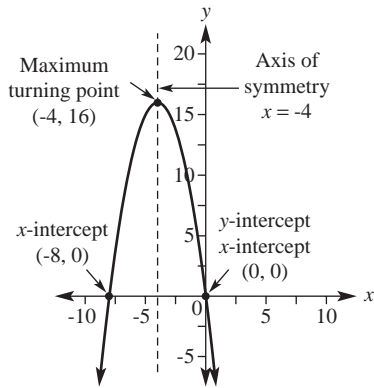
e  $y = x(5+x)$



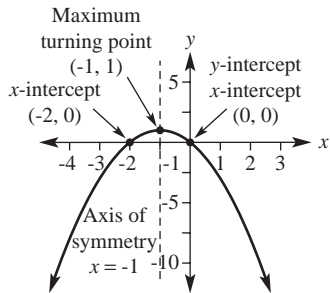
f  $y = x(3-x)$



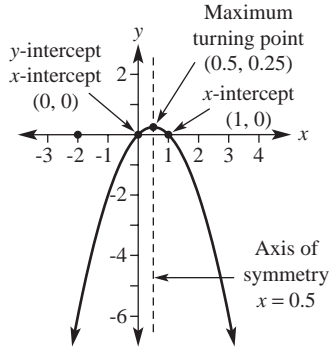
**g**  $y = -x(x + 8)$



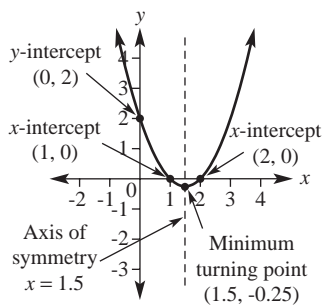
**h**  $y = -x(2 + x)$



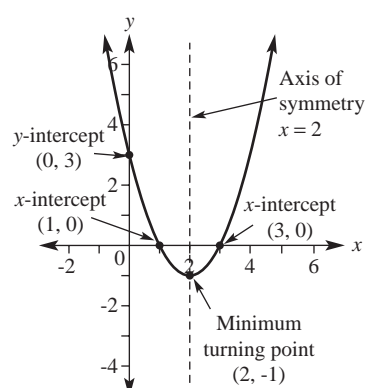
**i**  $y = -x(x - 1)$



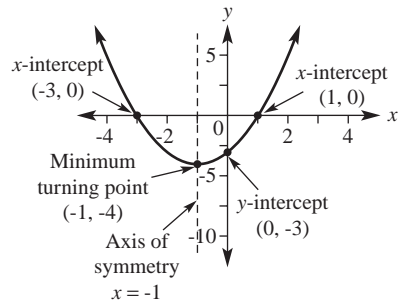
**6 a**  $y = (x - 2)(x - 1)$



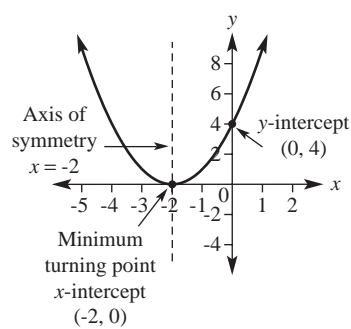
**b**  $y = (x - 3)(x - 1)$



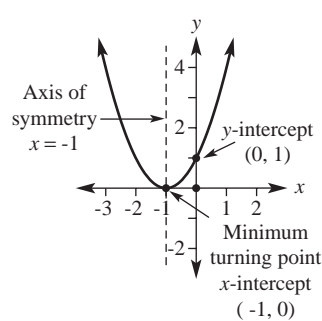
**c**  $y = (x + 3)(x - 1)$



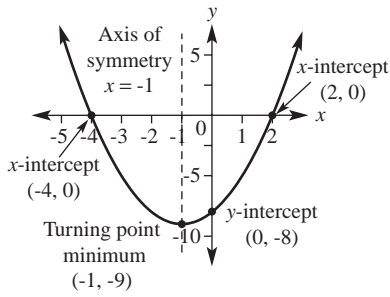
**d**  $y = (x + 2)^2$



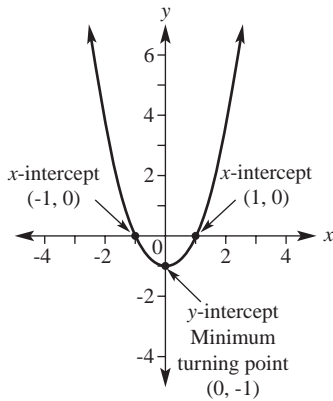
**e**  $y = (x + 1)^2$



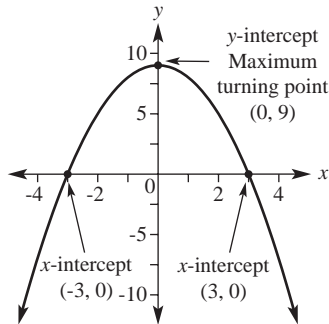
f  $y = (x+4)(x-2)$



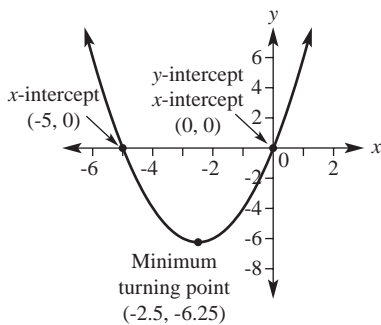
7 a  $y = x^2 - 1$



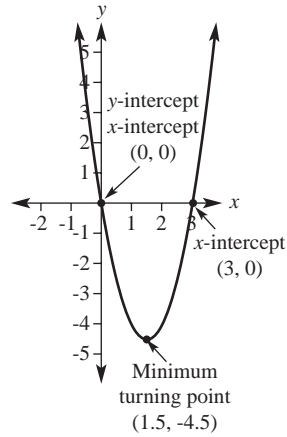
b  $y = 9 - x^2$



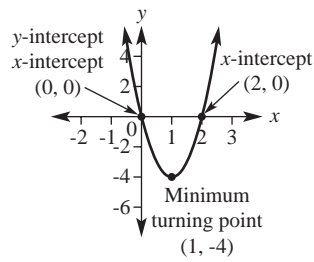
c  $y = x^2 + 5x$



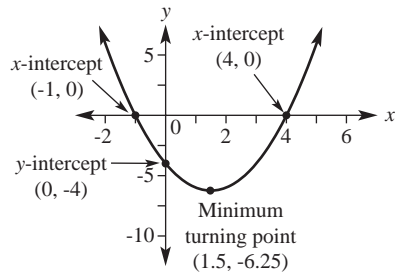
d  $y = 2x^2 - 6x$



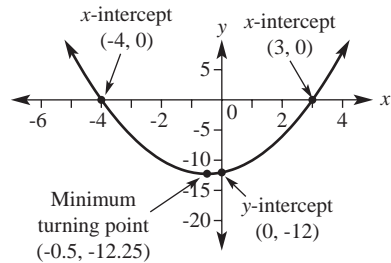
e  $y = 4x^2 - 8x$



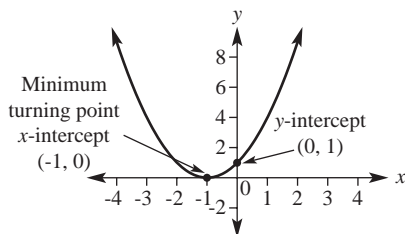
f  $y = x^2 - 3x - 4$



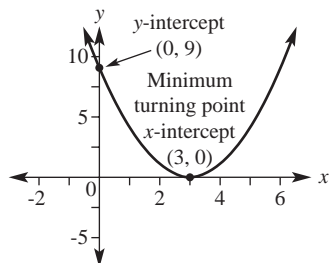
g  $y = x^2 + x - 12$



h  $y = x^2 + 2x + 1$



i  $y = x^2 - 6x + 9$



8 a -3 b 2 c 3 d -4 e -5 f 6

9 a 30 m b 225 m 10 a 200 m b 1000 m

11 There is only one x-intercept so this must be the turning point

12 a  $y = c$  b  $y = ab$

13 a (1, -16) b (5, 0) (-3, 0) TP  $\left(\frac{5+(-3)}{2}, -16\right) = (1, -16)$

c  $y = (x-2)^2 - 49$ ,  $h = 2$ ,  $k = -49$

14 b  $y = (x+3)(x-1)$  c  $y = 2(x+5)(x-1)$

d  $y = -(x+1)(x-5)$  e  $y = -(x+8)(x+2)$

f  $y = \frac{1}{2}(x+8)(x-2)$  g  $y = -\frac{1}{3}(x+3)(x-7)$

### Challenges

1 a they are square numbers; b  $100^2 = 10\,000$

2 a  $\frac{5}{3}, -\frac{7}{2}$  b 2, -1 c  $2^{\frac{2}{3}} + 1$

3 6 seconds 4  $\frac{n(n+1)}{2}$ ;  $n = 11$  5  $x = 2$

6 a 20 units, 21 units, 29 units

b 17 units

7 a  $k < 0$  b  $k = 0$  c  $k > 0$

### Multiple-choice questions

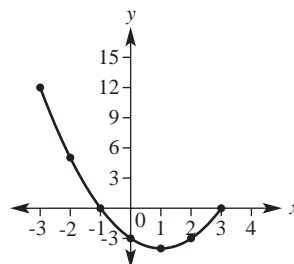
1 D 2 B 3 C 4 A 5 D

6 B 7 E 8 C 9 B 10 A

### Short-answer questions

1  $y = x^2 - 2x - 3$

x	-3	-2	-1	0	1	2	3
y	12	5	0	-3	-4	-3	0



2 a 0, -2 b 0, 4 c -3, 7

d 2, -2 e  $-1, \frac{2}{5}$  f  $\frac{1}{2}, \frac{4}{3}$

3 a 0, -3 b 0, 4 c -5, 5

d -9, 9 e -2, 2 f -4, 4

g -3, -7 h -5, 8 i 4

4 a  $x^2 - 5x = 0$ ;  $x = 0, 5$  b  $3x^2 - 18x = 0$ ;  $x = 0, 6$

c  $x^2 + 8x + 12 = 0$ ;  $x = -6, -2$  d  $x^2 - 2x - 15 = 0$ ;  $x = -3, 5$

e  $x^2 - 8x + 15 = 0$ ;  $x = 3, 5$  f  $x^2 + 3x - 4 = 0$ ;  $x = -4, 1$

5 a  $x^2 + 2x - 80 = 0$ ;  $x = 8$  units b  $x^2 + 5x - 24 = 0$ ;  $x = 3$  units

c  $x^2 + 3x - 28 = 0$ ;  $x = 4$  units

6 a i  $x = 3$  ii minimum (3, -2)

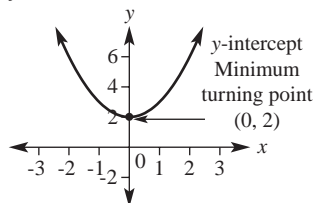
b i  $x = -1$  ii maximum (-1, 3)

c i  $x = 5$  ii minimum (5, 0)

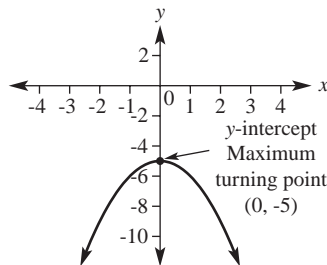
7 a  $y = 2x^2$  b  $y = -x^2 + 2$  c  $y = (x+1)^2$

d  $y = (x-3)^2$  e  $y = x^2 - 4$

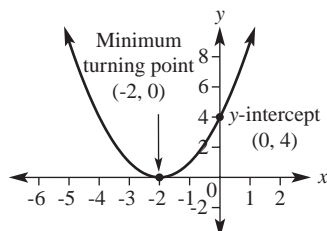
8 a  $y = x^2 + 2$



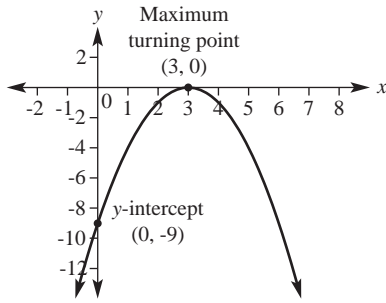
b  $y = -x^2 - 5$



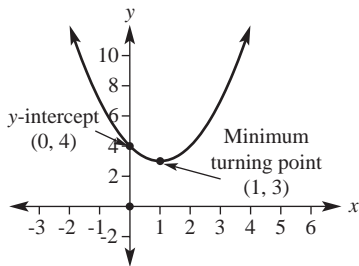
c  $y = (x+2)^2$



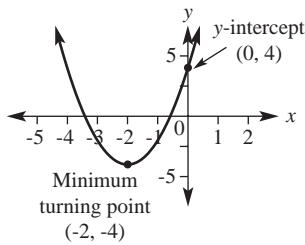
d  $y = -(x - 3)^2$



e  $y = (x - 1)^2 + 3$

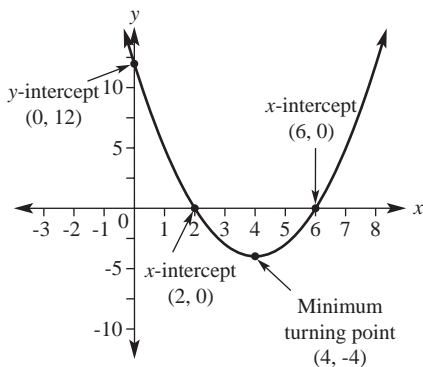


f  $y = 2(x + 2)^2 - 4$

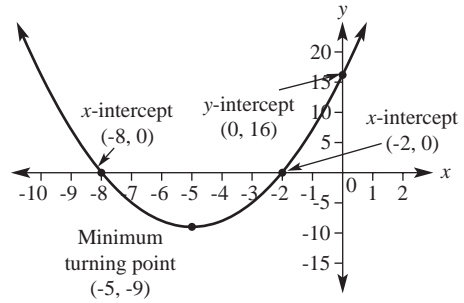


- 9 a  $y = x^2$  translated up 2 units  
 b  $y = x^2$  reflected in the  $x$ -axis and translated down 5 units  
 c  $y = x^2$  translated 2 units left  
 d  $y = x^2$  reflected in the  $x$ -axis then translated 3 units right  
 e  $y = x^2$  translated 1 unit right then 3 units up  
 f  $y = x^2$  dilated by a factor of 2 from the  $x$ -axis, translated 2 units left and then down 4 units

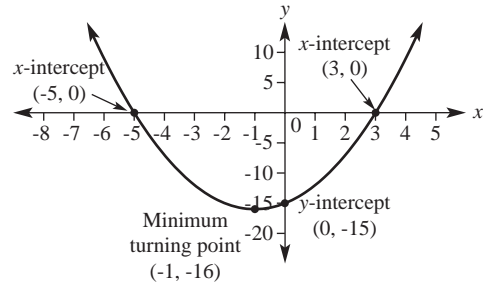
10 a  $y = x^2 - 8x + 12$



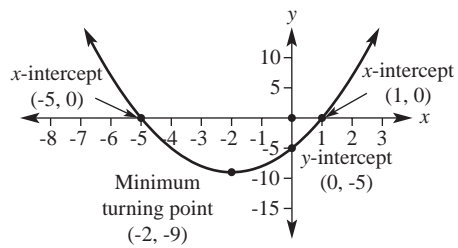
b  $y = x^2 + 10x + 16$



c  $y = x^2 + 2x - 15$



d  $y = x^2 + 4x - 5$

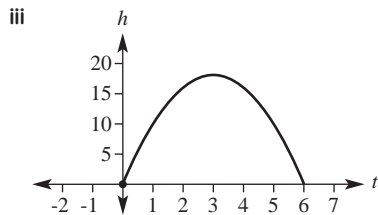


**Extended-response questions**

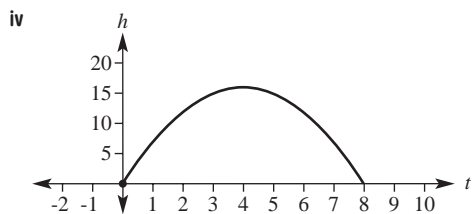
1 a  $x + 5$    b  $A = x^2 + 5x$    c  $x = 2$  ( $x = -7$  not valid as  $x > 0$ )

d Base = 4 m, Height = 7 m

2 a i (0, 0), (6, 0)   ii Maximum at (3, 18)



b i (0, 0)   ii (4, 16)   iii (0, 0), (8, 0)



- c i Connor's rocket, 8 s  
 ii Sam's rocket, 2 m higher  
 iii 16 m, the same height

## Semester review 2

### Indices and surds

#### Multiple-choice questions

- 1 C      2 B      3 D      4 E      5 C

#### Short-answer question

- 1 a  $\frac{a^2b}{2}$       b  $2x^3y^5$       c  $8x^6 - 2$   
 2 a  $5m^2$       b  $\frac{2a^8}{3b^5}$       c  $\frac{3x^2}{y}$   
 3 a  $3.07 \times 10^{-2}$  kg      b  $4.24 \times 10^6$  kg  
 c  $1.22 \times 10^4$  seconds      d  $2.35 \times 10^{-7}$  seconds  
 4 a 12      b 3      c  $\sqrt{3+7}\sqrt{5}$       d  $\sqrt{7}$

#### Extended-response question

- a i 74 000 000 000  
 ii  $7.4 \times 10^{10}$   
 b  $1.87 \times 10^{17}$   
 c  $8.72 \times 10^{-7}$

### Geometry

#### Multiple-choice questions

- 1 C      2 B      3 A      4 E      5 B

#### Short-answer questions

- 1 a  $a = 100, b = 140$       b  $a = 70, b = 55$   
 c  $x = 67, y = 98$       d  $x = 35$   
 2  $85^\circ$   
 3  $CB = CD$  (given equal sides)  
 $\angle ACB = \angle ACD$  (given equal angles)  
 $AC$  is common  
 $\therefore \triangle ABC \equiv \triangle ADC$  (SAS)  
 4 a AAA      b 2.4

#### Extended-response question

- a  $\angle ABD = \angle ECD$  (given right angles)  
 $\angle ADB = \angle EDC$  (common angle)  
 $\angle DAB = \angle DEC$  (corresponding angles in parallel lines are equal)  
 $\therefore \triangle ABD \equiv \triangle ECD$  (AAA)  
 b 7.5 m      c 3.75 m      d 4.3 m

### Algebra

#### Multiple-choice questions

- 1 E      2 D      3 B      4 A      5 D

#### Short-answer questions

- 1 a  $x^2 - 9$       b  $x^2 + 4x + 4$   
 c  $6x^2 - 17x + 12$   
 2 a  $2ab(4 + a)$       b  $(3m - 5)(3m + 5)$   
 c  $3(b - 4)(b + 4)$       d  $(a + 4)(a + 10)$   
 e  $(x + 3)^2$       f  $(x - 2)(x + 10)$   
 g  $2(x - 3)(x - 5)$       h  $(2x - 3)(x - 4)$   
 i  $(2x - 1)(3x + 4)$   
 3 a  $(x - 3a)(x - 1)$       b  $(x + 2)(2a - 5b)$   
 4 a i  $\frac{3}{2}$       ii  $\frac{4}{x+3}$   
 iii  $\frac{13x+21}{14}$       iv  $\frac{1}{3x}$   
 v  $\frac{11x-10}{(x+1)(x-2)}$       vi  $\frac{2x+25}{(x-5)(x+2)}$   
 b i  $x = \frac{17}{12}$       ii  $x = -11$

#### Extended-response question

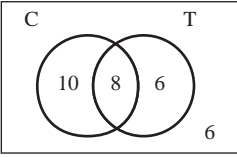
- a  $10 - 2x$  and  $8 - 2x$   
 b  $(10 - 2x)(8 - 2x) = 80 - 36x + 4x^2$   
 c  $48 \text{ m}^2$   
 d  $4(x - 4)(x - 5)$   
 e Area of rug is 0 as it has no width  
 f  $x = 2.5$

### Probability and statistics

#### Multiple-choice questions

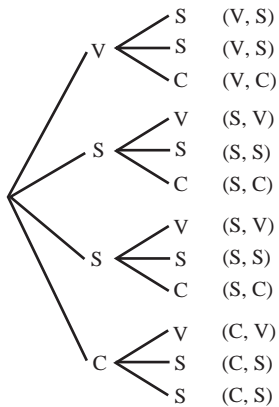
- 1 D      2 A      3 C      4 B      5 C

#### Short-answer questions

- 1 a   
 b i 24      ii 16  
 c i  $\frac{1}{5}$       ii  $\frac{1}{3}$



2 a Outcome



b i  $\frac{1}{3}$     ii  $\frac{1}{6}$     iii  $\frac{1}{2}$

3 a

Stem	Leaf
1	0 1 1 2 3 5 7 8
2	2 5 5 5 6
3	1 2 2

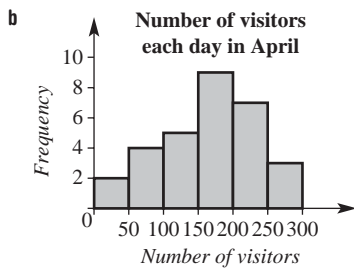
1 | 3 means 13 aces

b mode = 25, median = 20

c skewed

4 a

Class interval	Frequency	Percentage Frequency
0–	2	6.7
50–	4	13.3
100–	5	16.7
150–	9	30
200–	7	23.3
250–	3	10
Total	30	100



c i 6    ii 60%

### Extended-response question

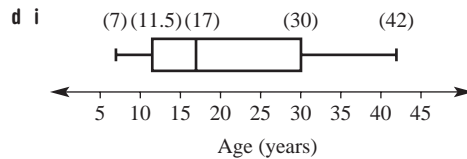
a

		Red		
		1	2	3
Green	1	(1, 1)	(1, 2)	(1, 3)
	2	(2, 1)	(2, 2)	(2, 3)
	3	(3, 1)	(3, 2)	(3, 3)

b  $\frac{4}{9}$

c i  $\frac{1}{3}$

ii 18



ii 11.5 yrs

iii 90

### Introduction to quadratic equations and graphs

#### Multiple-choice questions

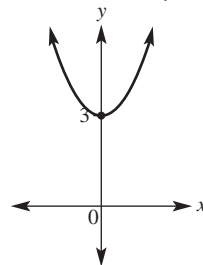
1 B    2 B    3 E    4 C    5 E

#### Short-answer questions

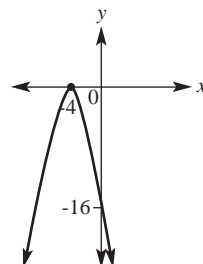
1 a  $x = -5, 3$     b  $x = \frac{1}{2}, -\frac{5}{3}$     c  $x = 0, -2$   
 d  $x = -3, 3$     e  $x = 2, 7$     f  $x = -4$

2 15 m by 8 m

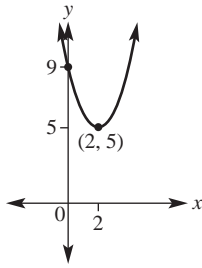
3 a translated 3 units up



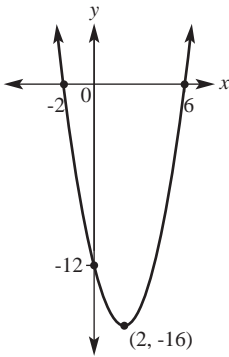
b reflected in the  $x$ -axis and translated 4 units left



c translated 2 units right and 5 units up



- 4 a  $y = -12$   
b  $x = -2, 6$   
c  $(2, -16)$



### Extended-response question

- a Lands after 6 seconds.  
b i 180 cm  
ii 3 seconds  
c After 2 seconds and 4 seconds  
d

