Answers

Unit 1

Chapter 1

Exercise 1.1

1 **a** {3, 4, 6, 11, 16, 19, 25}
b {4, 6, 16}
c {3, 11, 19, 25}
d {−4, −1, 0, 3, 4, 6, 11, 16, 19, 25}
e {−4, −1}
f $\{\frac{1}{2}, 0.75\}$
g {4, 16, 25}
h {3, 11, 19}
i $\{-4, -1, 0, \frac{1}{2}, 0.75, 6\}$

2 **a** {109, 111, 113, 115}
b Various, e.g. {2010, 2012, 2014, 2016} or {2020, 2022, 2024, 2026} etc.
c {995, 997, 999, 1001, 1003, 1005}
d {1, 4, 9, 16, 25}
e Various, e.g. {0.49, 048, 0.47, 0.46, 0.45} or {0.4, 0.3, 0.2, 0.1}
f Various, e.g. $\frac{11}{20}, \frac{3}{5}, \frac{13}{20}, \frac{7}{10}$ etc.

3 **a** even **b** even **c** odd
d odd **e** even **f** even

4 **a** A perfect number is a number that is half of the sum of all of the positive numbers that will divide into it (including itself). For example, 6 is equal to half the sum of all the positive number that will divide into it $(1 + 2 + 3 + 6) \div 2 = 6$.
b A palindromic number is a 'symmetrical' number like 16461 that remains the same when its digits are reversed.
c A narcissistic number is one that is the sum of its own digits each raised to the power of the number of digits, e.g. $371 = 3^3 + 7^3 + 1^3$

Exercise 1.2

1 **a** $19 < 45$ **b** $12 + 18 = 30$
c $0.5 = \frac{1}{2}$ **d** $0.8 \neq 8.0$
e $-34 < 2 \times -16$ **f** $\therefore x = \sqrt{72}$
g $x \leqslant -45$ **h** $\pi \approx 3.14$
i $5.1 > 5.01$ **j** $3 + 4 \neq 3 \times 4$
k $12 - (-12) > 12$
l $(-12) + (-24) < 0$
m $12x \approx -40$

2 **a** false **b** true **c** true
d true **e** true **f** true
g false **h** true **i** true
j true **k** false **l** false
m true **n** false

3 Students' own discussions.

Exercise 1.3

1 **a** 2, 4, 6, 8, 10
b 3, 6, 9, 12, 15
c 5, 10, 15, 20, 25
d 8, 16, 24, 32, 40
e 9, 18, 27, 36, 45
f 10, 20, 30, 40, 50
g 12, 24, 36, 48, 60
h 100, 200, 300, 400, 500

2 **a** 29, 58, 87, 116, 145, 174, 203, 232, 261, 290
b 44, 88, 132, 176, 220, 264, 308, 352, 396, 440
c 75, 150, 225, 300, 375, 450, 525, 600, 675, 750
d 114, 228, 342, 456, 570, 684, 798, 912, 1026, 1140
e 299, 598, 897, 1196, 1495, 1794, 2093, 2392, 2691, 2990
f 350, 700, 1050, 1400, 1750, 2100, 2450, 2800, 3150, 3500
g 1012, 2024, 3036, 4048, 5060, 6072, 7084, 8096, 9108, 10 120
h 9123, 18 246, 27 369, 36 492, 45 615, 54 738, 63 861, 72 984, 82 107, 91 230

3 **a** 32, 36, 40, 44, 48, 52
b 50, 100, 150, 200, 250, 300, 350
c 4100, 4200, 4300, 4400, 4500, 4600, 4700, 4800, 4900

4 576, 396, 792, 1164

5 **c** and **e** not a multiple of 27

Exercise 1.4

1 **a** 10 **b** 40 **c** 12
d 9 **e** 385 **f** 66
g 8 **h** 60 **i** 72
j 21 **k** 40 **l** 36

2 No – the common multiples are infinite.

Exercise 1.5

1 **a** $F_4 = 1, 2, 4$
b $F_5 = 1, 5$
c $F_8 = 1, 2, 4, 8$
d $F_{11} = 1, 11$
e $F_{18} = 1, 2, 3, 6, 9, 18$
f $F_{12} = 1, 2, 3, 4, 6, 12$
g $F_{35} = 1, 5, 7, 35$
h $F_{40} = 1, 2, 4, 5, 8, 10, 20$
i $F_{57} = 1, 3, 19, 57$
j $F_{90} = 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90$
k $F_{100} = 1, 2, 4, 5, 10, 20, 25, 50, 100$
l $F_{132} = 1, 2, 3, 4, 6, 11, 12, 22, 33, 44, 66, 132$
m $F_{160} = 1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 80, 160$
n $F_{153} = 1, 3, 9, 17, 51, 153$
o $F_{360} = 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 30, 36, 40, 45, 60, 72, 90, 120, 360$

2 **a** 4 **b** 45 **c** 14
d 22 **e** 8

3 **a** false **b** true **c** true
d true **e** true **f** true
g true **h** false

4 The smallest factor is 1 and the largest factor is the number itself.

Exercise 1.6

1 **a** 3 **b** 8 **c** 5
d 14 **e** 4 **f** 2
g 22 **h** 6

2 **a** 3 **b** 3 **c** 11

3 **a** Any two from: 4, 6, 10, 14.
b 12 and 18 are the only possible two, less than 20.

4 1 because each prime number has only 1 and itself as factors

5 18 m

6 20 students

7 150 bracelets

Exercise 1.7

1 2

2 14

3 **a** 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28

b $6 = 3 + 3$, $8 = 3 + 5$, $9 = 2 + 7$, $10 = 5 + 5$, $12 = 5 + 7$, $14 = 3 + 11$, $15 = 2 + 13$, $16 = 5 + 11$, $18 = 5 + 13$, $20 = 3 + 17$, $21 = 2 + 19$, $22 = 5 + 17$, $24 = 5 + 19$ or $17 + 7$, $25 = 2 + 23$, $26 = 3 + 23$ or $13 + 13$, 27 = not possible, $28 = 5 + 23$

4 3 and 5, 5 and 7, 11 and 13, 17 and 19, 29 and 31, 41 and 43, 59 and 61, 71 and 73

5 149 is prime. Determined by trial division by all integers from 2 to $\sqrt{149}$

6 **a** 233, 239, 293, 311, 313, 317, 373, 379
b 2333, 2339, 2393, 2399, 2939
c no

Exercise 1.8

1 **a** $30 = 2 \times 3 \times 5$
b $24 = 2 \times 2 \times 2 \times 3$
c $100 = 2 \times 2 \times 5 \times 5$
d $225 = 3 \times 3 \times 5 \times 5$
e $360 = 2 \times 2 \times 2 \times 3 \times 3 \times 5$
f $504 = 2 \times 2 \times 2 \times 3 \times 3 \times 7$
g $650 = 2 \times 5 \times 5 \times 13$
h $1125 = 3 \times 3 \times 5 \times 5 \times 5$
i $756 = 2 \times 2 \times 3 \times 3 \times 3 \times 7$
j $9240 = 2 \times 2 \times 2 \times 3 \times 5 \times 7 \times 11$

Exercise 1.9

1 **a** 12
b 24
c 18
d 26
e 25
f 22
g 78
h 5

2 **a** 540
b 216
c 360
d 240
e 360
f 2850
g 270
h 360

3 **a** HCF = 36
LCM = 216
b HCF = 25
LCM = 200
c HCF = 5
LCM = 2280
d HCF = 12
LCM = 420

4 120 listeners

5 36 minutes

Exercise 1.10

1 **a** 65, 10, 70, 500
b 104, 64 **c** 21, 798

2 **a** true **b** false **c** false
d false **e** false **f** true
g false **h** false **i** true
j false

3 **a** no **b** no **c** no

4 **a** no **b** yes **c** no

5 **a** 2, 3, 4, 6
b 2, 3, 4, 6, 9, 12, 18
c Express the number as a product of its prime factors and then check that the prime factors of 12, 15 or 24 are included in the product.

6 4 times (12 is the lowest common multiple of 3 and 4, so they will both face each other again after 12 seconds. In 12 seconds, Jacqueline will have completed $\frac{12}{3} = 4$ rotations)

Exercise 1.11

1 **a** 9
b 49
c 121
d 144
e 441
f 361
g 1024
h 10 000
i 196
j 4624

2 **a** 1
b 27
c 64
d 216
e 729
f 1000
g 1 000 000
h 5832
i 27 000
j 8 000 000

3 **a** $x = 5$
b $x = 2$
c $x = 11$
d $x = 9$
e $x = 18$
f $x = 20$
g $x = 20$
h $x = 15$
i $x = 1$
j $x = 81$
k $x = 1$
l $x = 6561$
m $x = 8$
n $x = 1$
o $x = 4$

4 **a** 3 **b** 8 **c** 1
d 2 **e** 10 **f** 0
g 9 **h** 20 **i** 36
j 42 **k** 2 **l** 1
m 3 **n** 4 **o** 10
p 6 **q** 8 **r** 9
s 12 **t** 18

5 **a** $324 = \underbrace{2 \times 2} \times \underbrace{3 \times 3} \times \underbrace{3 \times 3}$
$\sqrt{324} = 2 \times 3 \times 3$
$\sqrt{324} = 18$

b $225 = \underbrace{3 \times 3} \times \underbrace{5 \times 5}$
$\sqrt{225} = 3 \times 5$
$\sqrt{225} = 15$

c $784 = \underbrace{2 \times 2} \times \underbrace{2 \times 2} \times \underbrace{7 \times 7}$
$\sqrt{784} = 2 \times 2 \times 7$
$\sqrt{784} = 28$

d $2025 = \underbrace{3 \times 3} \times \underbrace{3 \times 3} \times \underbrace{5 \times 5}$
$\sqrt{2025} = 3 \times 3 \times 5$
$\sqrt{2025} = 45$

e $19\,600 = \underbrace{2 \times 2} \times \underbrace{2 \times 2} \times \underbrace{5 \times 5} \times \underbrace{7 \times 7}$
$\sqrt{19600} = 2 \times 2 \times 5 \times 7$
$\sqrt{19600} = 140$

f $250000 = \underbrace{2 \times 2} \times \underbrace{2 \times 2} \times \underbrace{5 \times 5} \times \underbrace{5 \times 5} \times \underbrace{5 \times 5}$
$\sqrt{250000} = 2 \times 2 \times 5 \times 5 \times 5$
$\sqrt{250000} = 500$

6 **a** $27 = \underbrace{3 \times 3 \times 3}$
$\sqrt[3]{27} = 3$

b $729 = \underbrace{3 \times 3 \times 3} \times \underbrace{3 \times 3 \times 3}$
$\sqrt[3]{729} = 3 \times 3$
$\sqrt[3]{729} = 9$

c $2197 = \underbrace{13 \times 13 \times 13}$

$\sqrt[3]{2179} = 13$

d $1000 = \underbrace{2 \times 2 \times 2} \times \underbrace{5 \times 5 \times 5}$

$\sqrt[3]{1000} = 2 \times 5$

$\sqrt[3]{1000} = 10$

e $15\,625 = \underbrace{5 \times 5 \times 5} \times \underbrace{5 \times 5 \times 5}$

$\sqrt[3]{15\,625} = 5 \times 5$

$\sqrt[3]{15\,625} = 25$

f $32\,768 = \underbrace{2 \times 2 \times 2} \times \underbrace{2 \times 2 \times 2} \times \underbrace{2 \times 2 \times 2} \times \underbrace{2 \times 2 \times 2} \times \underbrace{2 \times 2 \times 2}$

$\sqrt[3]{32\,768} = 2 \times 2 \times 2 \times 2 \times 2$

$\sqrt[3]{32\,768} = 32$

7 **a** 25 **b** 49 **c** 64
d 32 **e** 7 **f** 5
g 14 **h** 10 **i** 8
j 4 **k** 10 **l** 10
m 6 **n** 6 **o** 3
p $\frac{3}{2}$

8 **a** 10 cm **b** 27 cm
c 41 mm **d** 40 cm

9 **a** 31 **b** 17
c 65 **d** 17
e 68 **f** 24
g 730 **h** 82
i 33 **j** 129

10 **a** 128 **b** 486 **c** 85
d 96 **e** 320 **f** 512

11 **a** $2^4 \times 3^4$ is greater by 1040
b $4\sqrt{625} \times 3^6$ is greater by 2877

Exercise 1.12

1 **a** +$100 **b** −25 km
c −10 marks **d** +2 kg
e −1.5 kg **f** 8000 m
g −10 °C **h** −24 m
i −$2000 **j** +$250
k −2 h **l** +400 m
m +$450.00

Exercise 1.13

1 **a** $2 < 8$ **b** $4 < 9$
c $12 > 3$ **d** $6 > -4$
e $-7 < 4$ **f** $-2 < 4$
g $-2 > -11$ **h** $-12 > -20$
i $-8 < 0$ **j** $-2 < 2$
k $-12 < -4$ **l** $-32 < -3$
m $0 > -3$ **n** $-3 < 11$
o $12 > -89$

2 **a** −12, −8, −1, 7, 10
b −10, −8, −4, −3, 4, 9
c −12, −11, −7, −5, 0, 7
d −94, −90, −83, −50, 0

3 **a** 1 °C **b** −1 °C
c −3 °C **d** 12 °C
e −3 °C

4 **$28.50**

5 **a** −$420 **b** $920
c −$220

6 **−11 m**

7 **−3 °C**

8 **a** 7 p.m. **b** 12 p.m.
c 10 p.m. **d** 1 a.m.

Exercise 1.14

1 **a** $(4 + 7) \times 3$
$= 11 \times 3$
$= 33$

b $(20 - 4) \div 4$
$= 16 \div 4$
$= 4$

c $50 \div (20 + 5)$
$= 50 \div 25$
$= 2$

d $6 \times (2 + 9)$
$= 6 \times 11$
$= 66$

e $(4 + 7) \times 4$
$= 11 \times 4$
$= 44 \quad = 180$

f $(100 - 40) \times 3$
$= 60 \times 3$

g $16 + (25 \div 5)$
$= 16 + 5$
$= 21$

h $19 - (12 + 2)$
$= 19 - 14$
$= 5$

i $40 \div (12 - 4)$
$= 40 \div 8$
$= 5$

j $100 \div (4 + 16)$
$= 100 \div 20$
$= 5$

k $121 \div (33 \div 3)$
$= 121 \div 11$
$= 11$

l $15 \times (15–15)$
$= 15 \times 0$
$= 0$

2 **a** 108 **b** 72 **c** 3
d 10 **e** 32 **f** 9
g 5 **h** 1 **i** 140

3 **a** 13 **b** 8 **c** 58
d 192 **e** 12 000 **f** 1660
g 260 **h** 24 **i** 868

4 **a** 78 **b** 6 **c** 336
d 18 **e** 3 **f** 3
g 8 **h** 4 **i** 9

5 **a** $3 \times (4 + 6) = 30$
b $(25 - 15) \times 9 = 90$
c $(40 - 10) \times 3 = 90$
d $(14 - 9) \times 2 = 10$
e $(12 + 3) \div 5 = 3$
f $(19 - 9) \times 15 = 150$
g $(10 + 10) \div (6 - 2) = 5$
h $(3 + 8) \times (15 - 9) = 66$
i $(9 - 4) \times (7 + 2) = 45$
j $(10 - 4) \times 5 = 30$
k $6 \div (3 + 3) \times 5 = 5$
l BODMAS means that brackets are not needed
m $(1 + 4) \times (20 \div 5) = 20$
n $(8 + 5 - 3) \times 2 = 20$
o $36 \div (3 \times 3 - 3) = 6$
p $3 \times (4 - 2) \div 6 = 1$
q $(40 \div 4) + 1 = 11$
r BODMAS means that brackets are not needed

Exercise 1.15

1 **a** $5 \times 10 + 3$
$= 50 + 3$
$= 53$

b $5 \times (10 + 3)$
$= 5 \times 13$
$= 65$

c $2 + 10 \times 3$
$= 2 + 30$
$= 32$

d $(2 + 10) \times 3$
$= 12 \times 3$
$= 36$

e $23 + 7 \times 2$
$= 23 + 14$
$= 37$

f $6 \times 2 \div (3 + 3)$
$= 12 \div 6$
$= 2$

g $\frac{15-5}{2\times5}$
$= \frac{10}{10}$
$= 1$

h $(17 + 1) \div 9 + 2$
$= 18 \div 9 + 2$
$= 2 + 2$
$= 4$

i $\frac{16-4}{4-1}$
$= \frac{12}{3}$
$= 4$

j $17 + 3 \times 21$
$= 63 + 17$
$= 80$

k $48 - (2 + 3) \times 2$
$= 48 - 5 \times 2$
$= 48 - 10$
$= 38$

l $12 \times 4 - 4 \times 8$
$= 48 - 32$
$= 16$

m $15 + 30 \div 3 + 6$
$= 15 + 10 + 6$
$= 31$

n $20 - 6 \div 3 + 3$
$= 20 - 2 + 3$
$= 21$

o $10 - 4 \times 2 \div 2$
$= 10 - 4 \div 1$
$= 10 - 4$
$= 6$

2 **a** 7 **b** 7 **c** 3
d 0 **e** 3 **f** 10

3 **a** false **b** true
c false **d** true

4 **a** $2 - 10 \div 5 = 0$
b $13 - 18 \div 9 = 11$
c $8 \div (16 - 14) - 3 = 1$
d $(9 + 5) - (6 - 4) = 12$
or $(9 + 5) - (12 - 4) = 6$

Exercise 1.16

1 **a** −10 **b** 8.86 **c** 13
d 29 **e** −22 **f** 8.75
g 20 **h** 0 **i** 4
j 70 **k** 12 **l** 20
m 8 **n** 15 **o** 20

2 **a** correct
b incorrect = 608
c correct
d correct
e incorrect = 368
f incorrect = 10

3 **a** $12 \div (28 - 24) = 3$
b $84 - 10 \times 8 = 4$
c $3 + 7(0.7 + 1.3) = 17$
d $23 \times 11 - 22 \times 11 = 11$
e $40 \div 5 \div (7 - 5) = 4$
f $9 + 15 \div (3 + 2) = 12$

4 **a** 0.5 **b** 2 **c** 0.183
d 0.5 **e** $\frac{1}{3} \approx 0.333$ (3sf)
f 1 **g** 2
h $\frac{2}{3} \approx 0.667$ (3sf)

5 correct to 3 significant figures
a 0.0112 **b** 0.0386
c −0.317 **d** 0.339

6 correct to 3 significant figures
a 89.4 **b** 20.8 **c** 7.52
d 19.6 **e** 2.94 **f** 1.45
g 0.25 or $\frac{1}{4}$ **h** 1.72

In questions 4, 5 and 6 you may find that your calculator gives an exact answer rather than a decimal. This may include a root or a fraction. Check your calculator manual to find out how to change this to a decimal.

Exercise 1.17

1 **a** 3.19 **b** 0.06 **c** 38.35
d 2.15 **e** 1.00 **f** 0.05
g 0.01 **h** 41.57 **i** 8.30
j 0.42 **k** 0.06 **l** 0.01
m 3.02 **n** 12.02 **o** 15.12

2 **a** **i** 4512 **ii** 4510
iii 5000
b **i** 12310 **ii** 12300
iii 10000
c **i** 65240 **ii** 65200
iii 70000
d **i** 320.6 **ii** 321
iii 300
e **i** 25.72 **ii** 25.7
iii 30
f **i** 0.0007650 **ii** 0.000765
iii 0.0008
g **i** 1.009 **ii** 1.01
iii 1
h **i** 7.349 **ii** 7.35
iii 7
i **i** 0.009980 **ii** 0.00998
iii 0.010
j **i** 0.02814 **ii** 0.0281
iii 0.03
k **i** 31.01 **ii** 31.0
iii 30
l **i** 0.006474 **ii** 0.00647
iii 0.006

3 **a** 2.556 **b** 2.56 **c** 2.6
d 2.56 **e** 2.6 **f** 3

Examination practice

Exam-style questions

1 **a** 3, 4, 6, 9, 15, 16, 19, 20
b 4, 9, 16 **c** −4, −1
d 3, 19 **e** 4, 6, 16, 20
f 4, 16, 20

2 **a** 1, 2, 3, 4, 6, 12
b 1, 2, 3, 4, 6, 8, 12, 24 **c** 12

3 16

4 **a** 12, 24, 36, 48, 60
b 18, 36, 54, 72, 90
c 30, 60, 90, 120, 150
d 80, 160, 240, 320, 400

5 72

6 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37

7 **a** $2^4 \times 5^2$
b $2^3 \times 3^3 \times 5$
c **i** $2^4 \times 3^3 \times 5^2 = 10\,800$
ii $2^3 \times 5 = 40$
iii $2^2 \times 5 = 20$
iv 1080 is not a cube number. Not all the factors are powers with indices that are multiples of 3.

8 **a** 676 **b** 79507

9 **a** 102 **b** 110 **c** 104

10 −4°C

11 **a** 32 **b** 340 **c** 25

12 $(7 + 14) \div (4 - 1) \times 2 = 14$

Past paper questions*

1 $6 + 5 \times (10 - 8) = 16$

2 20

3 3.590

4 **a** 9, 16 **b** 11

5 **a** $2 \times 3^2 \times 5$ **b** 630

Chapter 2

Exercise 2.1

1 **a** $6xy$ **b** $7ab$ **c** xyz
d $2y^2$ **e** $4ab$ **f** $12xy$
g $5ab$ **h** yz^2 **i** $\frac{6}{x}$
j $\frac{4x}{2y} = \frac{2x}{y}$ **k** $\frac{x+3}{4}$
l $\frac{m^3}{m^2} = m$
m $4x + 5y$ **n** $7a - 2b$
o $2x(x - 4)$ **p** $\frac{3(x+1)}{2x}$
q $\frac{2(x+4)}{3}$ **r** $\frac{4x}{6x} = \frac{2}{3}$

2 **a** $m + 13$ **b** $m + 5$
c $25 - m$ **d** m^3
e $\frac{m}{3} + 3$ **f** $4m - 2m = 2m$

3 **a** $x + 3$ **b** $x - 6$ **c** $10x$
d $-8 + x$ **e** $x + x^2$ **f** $x + 2x$
g $\frac{2x}{x+4}$

4 **a** $\$(x - 10)$ **b** $\$\frac{x}{4}$ **c** \$15

5 **a** $m + 10$ years **b** $m - 10$ years
c $\frac{m}{2}$ years

6 **a** $\$\frac{p}{3}$ **b** $\$\frac{p}{5}$, $\$\frac{p}{5}$ and $\$\frac{3p}{5}$

Exercise 2.2

1 **a** 9 **b** 30 **c** 10
d 27 **e** 18 **f** 7
g 16 **h** 36 **i** 4
j 6 **k** 6 **l** 30
m 5 **n** 2

2 **a** 30 **b** 45 **c** 16
d 5 **e** 13 **f** 16
g 31 **h** 450 **i** 24
j 8 **k** 24 **l** 5
m $\frac{26}{3}$ **n** 10 **o** 4
p 3 **q** 6 **r** 225
s 12 **t** −10

3 **a** **i** $y = 0$ **ii** $y = 12$
iii $y = 16$ **iv** $y = 40$
v $y = 200$
b **i** $y = 1$ **ii** $y = 10$
iii $y = 13$ **iv** $y = 31$
v $y = 151$
c **i** $y = 100$ **ii** $y = 97$
iii $y = 96$ **iv** $y = 90$
v $y = 50$
d **i** $y = 0$ **ii** $y = \frac{3}{2}$
iii $y = 2$ **iv** $y = 5$
v $y = 25$
e **i** $y = 0$ **ii** $y = 9$
iii $y = 16$ **iv** $y = 100$
v $y = 2500$
f **i** 0 (or undefined)
ii $y = 33.3$ (3 sf)
iii $y = 25$ **iv** $y = 10$
v $y = 2$
g **i** $y = 4$ **ii** $y = 10$
iii $y = 12$ **iv** $y = 24$
v $y = 104$
h **i** $y = -6$ **ii** $y = 0$
iii $y = 2$ **iv** $y = 14$
v $y = 94$
i **i** $y = 0$ **ii** $y = 81$
iii $y = 192$ **iv** $y = 3000$
v $y = 375\,000$

4 **a** $(3x + 2y)$
b **i** \$18 **ii** \$100 **iii** \$350

5 **a** $P = 42$ cm **b** $P = 8$ m
c $P = 60$ cm **d** $P = 20$ cm

6 **a** **i** 43 **ii** 53
iii 71 **iv** 151
b They're all prime numbers
c when $n = p$, $n^2 + n + p$ becomes $n(n + 2)$; in other words it has factors n and $n + 2$, so is obviously not a prime

Exercise 2.3

1 **a** $6x$, $4x$, x **b** $-3y$, $\frac{3}{4}y$, $-5y$
c ab, $-4ba$ **d** $-2x$, $3x$
e $5a$, $6a$ and $5ab$, ab
f $-1xy$, $-yx$

2 **a** $8y$ **b** $7x$ **c** $13x$
d $22x$ **e** $5x$ **f** 0
g $-x$ **h** $-3y$ **i** $4x$
j $7xy$ **k** $4pq$ **l** $13xyz$
m $2x^2$ **n** $5y^2$ **o** $-y^2$
p $12ab^2$ **q** $5x^2y$ **q** $2xy^2$

3 **a** $5x + y$ **b** $4x + 2y$
c $7x$ **d** $4 + 4x$
e $6xy - 2y$ **f** $-x^2 + 2x$
g $-x + 4y$ **h** $3x + 3y$
i $8x + 6y$ **j** $8x - 2y$
k $14x^2 - 4x$ **l** $10x^2$
m $12xy - 2x$ **n** $8xy - 2xz$
o $-x^2 - 2y^2$ **p** $8x^2\,y - 2xy$
q $6xy - x$ **r** $6xy - 2$

4 **a** $2y - 8$ **b** $4x^2 - 5x$
c $7x + 4y$ **d** $y^2 + 5y - 7$
e $x^2 - 5x + 3$ **f** $x^2 + 5x - 7$
g $3xyz - 3xy + 2xz$
h $8xy - 10$ **i** $-3x^2 + 6x - 4$

5 **a** $P = 8x$ **b** $P = 4x + 14$
c $P = 6x + 3$ **d** $P = 5x + 4$
e $P = 12y - 6$ **f** $P = 8y^2 + 2y + 14$
g $P = 12y - 4$ **h** $P = 18x - 1$

Exercise 2.4

1 **a** $12x$ **b** $8y$ **c** $12m$
d $6xy$ **e** $8xy$ **f** $27xy$
g $24yz$ **h** $12xy$ **i** $8x^2y^2$
j $8x^2y$ **k** $27xy^2$ **l** $24xy^2$
m $8a^2b$ **n** $12ab^2c$
o $12a^2bc$ **p** $16a^2b^2c$
q $24abc$ **r** $72x^2y^2$

2 **a** $24x$ **b** $30x^2y$
c $12x^2y^2$ **d** x^3yz
e $48x$ **f** $24x^3y$
g $4x^2y^2$ **h** $12a^2bc$
i $60xy$ **j** $8xy$
k $9x^3y$ **l** $8x^3y^3$
m $42x^2y^2z^2$ **n** $56x^3y^2$
o $36x^2y^2z$ **p** $18x^4y^4$
q $54x^4y$ **r** $6x^3y^3$

3 **a** $5x$ **b** $4x$ **c** $3x$
d $6y$ **e** $7x$ **f** $2y$
g $\frac{y}{4}$ **h** $\frac{1}{4y}$ **i** $\frac{z}{2}$
j $6y$ **k** $\frac{1}{4}$ **l** $\frac{1}{9}$

4 **a** $4x$ **b** $6y$ **c** $\frac{4x}{y}$
d 8 **e** $\frac{7x^2}{y^2}$ **f** $3x$
g $\frac{x}{3}$ **h** $\frac{1}{4y}$ **i** $7y$
j $\frac{9y}{4}$ **k** $4xy$ **l** $\frac{4y}{x}$

5 **a** $\frac{xy}{6}$ **b** $\frac{x^2}{12}$ **c** $\frac{5x^2y}{6}$
d $\frac{10x}{3y}$ **e** $\frac{3xy}{8}$ **f** $\frac{25x^2}{4}$
g 2 **h** $\frac{x^2}{3}$ **i** $2xy$
j $\frac{8x}{3}$ **k** $\frac{1}{4}$ **l** x^2

Exercise 2.5

1 **a** $2x + 12$ **b** $3x + 6$
c $8x + 12$ **d** $10x - 60$
e $4x - 8$ **f** $6x - 9$
g $5y + 20$ **h** $24 + 6y$
i $9y + 18$ **j** $14x - 14y$
k $6x - 4y$ **l** $4x + 16y$
m $10x - 10y$ **n** $18x - 12y$
o $12y - 6x$ **p** $4y - 16x^2$
q $9x^2 - 9y$ **r** $28x + 7x^2$

2 **a** $2x^2 + 2xy$ **b** $3xy - 3y^2$
c $2x^2 + 4xy$ **d** $12x^2 - 8xy$
e $x^2y - xy^2$ **f** $12xy + 6y$
g $18xy - 8xy^2$ **h** $6x^2 - 4x^2y$
i $12x^2 - 12x^3$ **j** $36x - 8xy$
k $10y - 5xy$ **l** $12x - 3xy$
m $2x^2y^2 - 4x^3y$ **n** $12xy^2 - 8x^2y^2$
o $3x^2y^2 + 3xy^3$ **p** $2x^3y + x^2y^2$
q $81x^2 - 18x^3$ **r** $12xy^2 - 4x^2y^2$

3 **a** $A = x^2 + 7x$ **b** $A = 2x^3 - 2x$
c $A = 4x^2 - 4x$

Exercise 2.6

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

2 **a** $6x+154$ **b** $4x+2$
c $7x+26$ **d** 92
e $2x^2+16$ **f** $6x^2+10x$
g $24xy+4x$ **h** $2xy+4x$
i $-3x-18xy$
j $21x-12y-2xy$ **k** $22x^2-7x^3$
l $x^2-xy+6x-3y$
m $16x-3xy-8$ **n** $2x^2$
o $4x^2+8xy$ **p** $2x^2-3x+15$
q $9x-17$ **r** $7xy+9x$

Exercise 2.7

1 **a** 2^5 **b** 3^4 **c** 7^2
d 11^3 **e** 10^5 **f** 8^5
g a^4 **h** x^5 **i** y^6
j a^3b^2 **k** x^2y^4 **l** p^3q^2
m x^4y^3 **n** x^3y^4 **o** a^3b^3c

2 **a** 10 000 **b** 343
c 279 936 **d** 262 144
e 100 000 **f** 1
g 1024 **h** 6 561
i 64 **j** 648
k 164 025 **l** 65 536
m 5184 **n** 2304
o 30 375

3 **a** 2^6 **b** 3^5 **c** $2^4\times5^2$
d $2^6\times5^2$ **e** 2^{14} **f** $2^8\times3^4$
g 3^{10} **h** 5^8

4 $25=5^2$
$36=2^2\times3^2$
$64=2^6$
Power is always even.

Exercise 2.8

1 **a** 3^8 **b** 4^{11} **c** 8^2
d x^{13} **e** y^9 **f** y^7
g y^6 **h** x^5 **i** $6x^7$
j $9y^6$ **k** $2x^4$ **l** $6x^7$
m $15x^3$ **n** $8x^7$ **o** $8x^7$
p $4x^8$

2 **a** x^2 **b** x^9 **c** y
d x^2 **e** x^4 **f** x^2
g $3x^2$ **h** $3x^3$ **i** $4y$
j $\frac{x}{2}$ **k** 3 **l** $3x$
m $\frac{1}{3x}$ **n** $4xy$ **o** 1

3 **a** x^4 **b** x^6 **c** x^{12}
d y^6 **e** $32x^{10}$ **f** $9x^4y^4$
g 1 **h** $125x^6$ **i** x^6y^6
j $x^{10}y^{20}$ **k** x^3y^{12} **l** $16x^2y^4$
m $81x^8$ **n** x^4y^{24} **o** 1

4 **a** $12x^6$ **b** $24x^3y$
c $4x^4$ **d** $\frac{x^2}{4}$
e $44x^3a^4b^2$ **f** $4x^3+28x$
g $4x^3-x^5$ **h** x^2
i $\frac{7}{x^4}$ **j** $2x^2$
k $\frac{x^{12}}{y^6}$ **l** $\frac{x^4y^8}{16}$
m 1 **n** $8x^5$ **o** $2xy^3$

Exercise 2.9

1 **a** $\frac{1}{4}$ **b** $\frac{1}{3}$ **c** $\frac{1}{8}$
d $\frac{1}{125}$ **e** $\frac{1}{1296}$ **f** $\frac{1}{32}$

2 **a** true **b** false
c false **d** false

3 **a** $\frac{1}{x^2}$ **b** $\frac{1}{y^3}$ **c** $\frac{1}{x^2y^2}$
d $\frac{2}{x^2}$ **e** $\frac{12}{x^3}$ **f** $\frac{7}{y^3}$
g $\frac{8x}{y^3}$ **h** $\frac{12}{x^3y^4}$

4 **a** x **b** $\frac{6}{x^6}$ **c** $\frac{1}{3x^4}$
d $\frac{1}{x^{11}}$ **e** $\frac{1}{8x^6}$ **f** $\frac{1}{x^6}$
g x **h** $\frac{1}{x^5}$

Exercise 2.10

1 **a** 2 **b** 2 **c** 16
d 36 **e** 64

2 **a** $x^{\frac{2}{3}}$ **b** $x^{\frac{7}{6}}$ **c** $\frac{1}{x^3}$
d $\frac{x^3}{y}$ **e** $x^{\frac{4}{7}}$ **f** $\frac{7x^2}{4}$
g $\frac{2}{x^2}$ **h** $\frac{3}{4x}$ **i** $\frac{1}{4x^{\frac{3}{2}}}$
j $\frac{x}{4}$ **k** $\frac{3x^{\frac{3}{4}}}{2}$ **l** $\frac{x}{8}$

3 **a** $x=6$ **b** $x=\frac{1}{2}$
c $x=16\,807$ **d** $x=257$
e $x=4$ **f** $x=4$
g $x=6$ **h** $x=5$
i $x=2$ **j** $x=-4$
k $x=\frac{1}{6}$ **l** $x=\frac{3}{4}$
m $x=3$

Examination practice

Exam-style questions

1 **a** $n+12$ **b** $2n-4$
c $(nx)^2$ **d** $(n^2)^3$ or $(n^3)^2$

2 **a** $15xy+x$ **b** $5xy+3y$

3 **a** a^2b **b** $2x^6$ **c** $6x^4y^2$
d 1 **e** $4x^5y^3$

4 **a** $x=5$ **b** $x=-3$

5 **a** $8x-4$ **b** x^2+37xy

6 **a** 10 **b** 10 **c** 10

7 **a** x^3 **b** $\frac{4}{x^2}$
c $\frac{1}{(2x-2)^3}=\frac{1}{8x^3-24x^2+24x-8}$

8 **a** $15x$ **b** $9y^3$ **c** $4x$

Past paper questions*

1 $\frac{1}{8}x^2$

2 **a** $5t^{25}$ **b** -2 **c** -64

Chapter 3

Diagrams provided as answers are NOT TO SCALE and are to demonstrate construction lines or principles **only**.

Exercise 3.1

1

	a	b	c
i	acute	Answers will vary	40°
ii	acute		70°
iii	obtuse		130°
iv	acute		30°
v	obtuse		170°
vi	right		90°
vii	acute		70°
viii	acute		60°
ix	obtuse		140°

d 290°

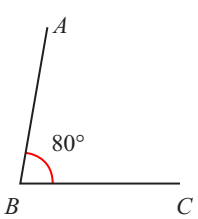
2 **a** This protractor is able to measure angles from 0° to 360°.

b Student's own answer. Something like: ensure that the 0°/360° marking of the protractor is aligned with one of the arms of the angle you are measuring, and the vertex of the angle is aligned with the centre of the protractor. Whether you use the inner or outer scale will be determined by what arm you aligned with 0 – use the scale that gives an angle < 180°.

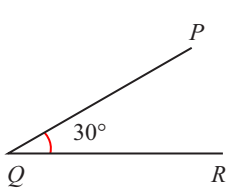
c You would use the scale that gives you an angle > 180°.

Exercise 3.2

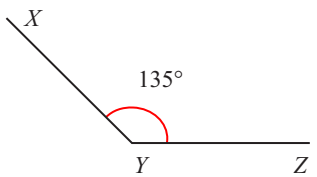
a



b



c



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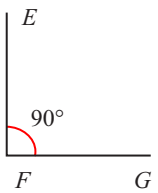

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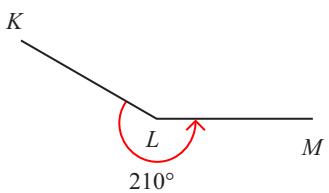
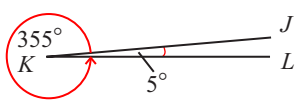


f



Exercise 3.3

1 **a** *EBF* and *FBC*; or *ABD* and *DBE*

b *ABE* and *EBC*; or *DBA* and *CBG*; or *DBC* and *ABG*

c *ABD*, and *DBC*;
or *ABE* and *EBC*;
or *ABF* and *FBC*;
or *ABG* and *CBG*;
or *DBE* and *EBG*;
or *DBF* and *FBG*;
or *DBC* and *CBG*;
or *DBA* and *ABG*;
or *ABG* and *GBC*;

d *DBE*, *EBF*, *FBC* and *CBG*
or *DBA* and *ABG*
or *DBF*, *FBC* and *CBG*
or *DBF* and *FBG*
or *DBC* and *CBG*
(and combinations of these)

e *FBC** **f** *EBA*

2 **a** $x = 68°$ **b** $x = 40°$
c $x = 65°$; $y = 115°$
d $x = 59°$; $y = 57°$
e $x = 16°$; $y = 82°$; $z = 16°$
f $x = 47°$; $y = 43°$; $z = 133°$
g $x = 57°$ **h** $x = 71°$
i $x = 38°$

3 **a** 30° **b** 15° **c** 30°

4 60° and 120°

5 53°, 127° and 53°.

Exercise 3.4

1 **a** $a = 112°$ alternate angles equal
$b = 112°$ vertically opposite angles equal

b $x = 105°$ alternative angles equal
$y = 30°$ sum of triangle
$z = 45°$ alternate angles equal

c $c = 40°$ vertically opposite angles equal
$b = 72°$ corresponding angles equal
$a = 68°$ angles on a line
$d = 68°$ vertically opposite angles equal
$e = 40°$ alternate angles equal

d $a = 39°$ corresponding angles equal
$b = 102°$ angle sum of triangle

e $x = 70°$ angle on a line
$y = 70°$ corresponding angles equal
$z = 85°$ corresponding angles equal
(180–95 = 85°, angles on a line, z is corresponding angle equal to 85°)

f $x = 45°$ alternate angles equal
$y = 60°$ Alternate angles equal

g $x = 82°$ co-interior angles supplementary
$y = 60°$ corresponding angles equal
$z = 82°$ angles on a line

h $x = 42°$ alternate angles equal
$y = 138°$ angles on a line
$z = 65°$ alternate angles equal

i $a = 40°$ alternate angles equal
$b = 140°$ angles on a line
$d = 75°$ angles on a line
$c = 75°$ corresponding angles equal
$e = 105°$ corresponding angles equal

2 **a** AB||DC alternate angles equal
b AB∦DC co-interior angles not supplementary
c AB||DC co-interior angles supplementary

Exercise 3.5

1 **a** $x = 54°$ angle sum of triangle
b $x = 66°$ base angle isosceles Δ
c $x = 115°$ angle sum of triangle
$y = 65°$ exterior angle of triangle equal to sum of the opposite interior angles OR angles on a line
$z = 25°$ angle sum of triangle

2 **a** $x = 60°$ exterior angle of Δ equal to sum of opposite interior angles, so $x + x = 120°$, $x = 60°$.

b $x = 44.\dot{3}°$
$4x = 86 + (180 - 2x)$
(exterior angle equals sum of opposite interior angles, and angle angle of triangle)
$6x = 266$
$x = 44.3°$

3 **a** angle BAC = 180 − 95°
(angles on a straight line) = 85°
angle ACB = 180° − 105°
(angles on a straight line) = 75°
$180 = x + 75 + 85$
(angle sum of triangle)
$x = 180 - 160$
$x = 20°$

b angle CAB = 56°
(vertically opposite angles equal)
$180 = 56 + 68 + x$
(angle sum of triangle)
$x = 180 - 124$
$x = 56°$

c angle ACE = 53° (angles on straight line)
$x = 53°$ (comp angles equal)
OR
angle CDE = 59° (comp angles equal)
$180 = 68 + 59 + x$ (angle sum of Δ)
$x = 180 - 127$
$x = 53°$

d 180 = 58 + angle ACB + angle CBA
(angle sum of triangle)
angle ACB = angle CBA (isosceles Δ)
$\Rightarrow 180 = 58 + 2y$
$2y = 122$
$y = 61$
$x = 180 - 61$
(exterior angles of a triangle equal to sum of opposite interior angles)
$x = 119°$

e angle AMN = 180 − (35 + 60)
(angle sum of Δ)
angle AMN = 85°
$x = 85°$
(corresponding angles equal)

f angle ACB = 360 − 295
(angles around a point)
angle ACB = 65°
angle ABC = 65° (isosceles Δ)
$x = 180 - (2 \times 65)$ (angle sum of Δ)
$x = 50°$

Exercise 3.6

1 **a** rhombus, kite or square
b square

2 **a** angle $QRS = 112°$ (vertically opposite angles equal)
$x = 112°$ (opposite angles in ||gram)

b $x = 62°$ (isosceles Δ)

c $360 = 110 + 110 + 2x$
(angle sum of quadrilateral)
$140 = 2x$
$x = 70°$

d angle $MLQ = 180 - 110$
(angles on a straight line)
angle $MN = 180 - 98$
(angles on a straight line)
$360 = 70 + 82 + 92 + x$
(angle sum of quadrilateral)
$x = 116°$

e $360 = 3x + 4x + 2x + x$
(angle sum of quadrilateral)
$360 = 10x$
$x = 36°$

f $360 = (180 - x) + 50 + 110 + 90$
(angles on a straight line, and angle sum of quadrilateral)
$360 = (180 - x) + 250$
$110 = 180 - x$
$x = 70°$

3 **a** $180 = 70 + 2y$ (angle sum on a Δ, isosceles Δ to give $2y$)
$110 = 2y$
$y = 55$
∴angle $PRQ = 55°$
$x = 180 - (55 + 55)$
(angles on a straight line, and isosceles triangle)
$x = 70°$

b angle $MNP = 98°$
(opposite angles n ||gram)
angle $RNM = 180 - 98$
(angles on a straight line)
$= 82°$
$180 = 2x + 82$ (angle sum of a triangle, and isosceles triangle)
$2x = 98$
$x = 49°$

Exercise 3.7

1

Number of sides	5	6	7	8	9	10	12	20
Angle sum	540°	720°	900°	1080°	1260°	1440°	1800°	3240°

2 **a** 108° **b** 120° **c** 135°
d 144° **e** 150° **f** 165.6°

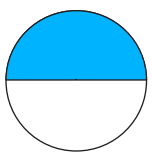
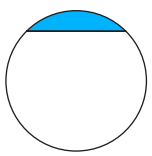
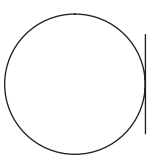
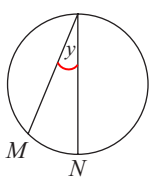
3 **a** 2340° **b** 360°
c 156° **d** 24°

4 24 sides

5 **a** $x = 135°$ **b** $x = 110°$
c $x = 72°$

Exercise 3.8

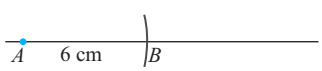
1 **a** diameter **b** major arc
c radius **d** minor sector
e chord **f** major segment

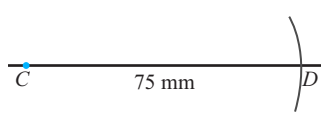
2 **a** 
b 
c 
d 

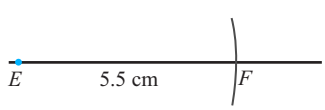
3 **a** radius **b** diameter
c minor arc
d *DO*, *FO* or *EO*
e major arc **f** sector

Exercise 3.9

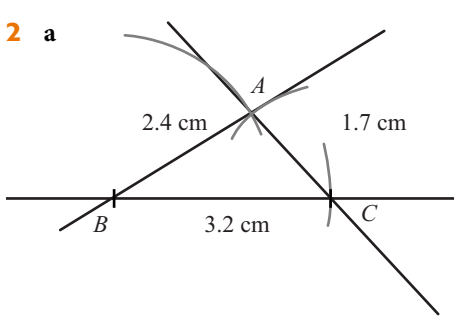
NOT TO SCALE

1 **a** 

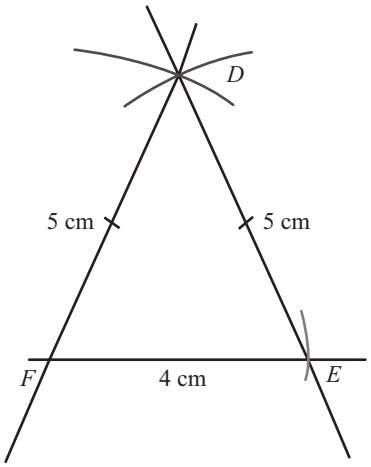
b 

c 

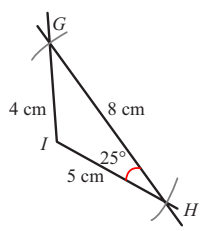
NOT TO SCALE

2 **a** 

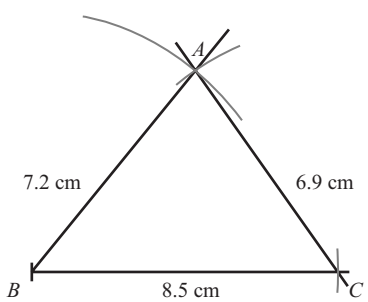
b



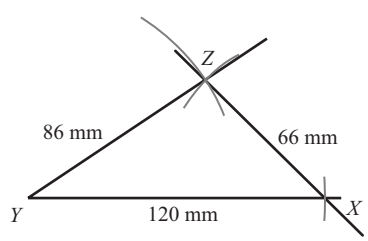
c



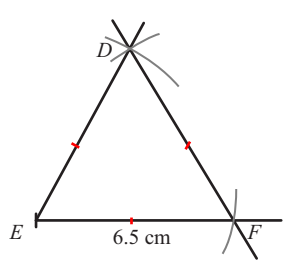
3 a



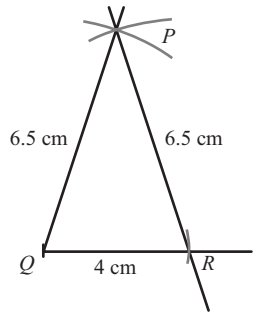
b



c



d



Exercise 3.10

1 The two perpendicular bisectors meet at the centre of the circle. This happens because they are both lines of symmetry, and hence diameters, of the circle.

Examination practice

Exam-style questions

1 a $x = 99°$ co-interior angles supplementary

b $x = 65°$ corresponding angles equal

c $x = 75°$ angle sum of isosceles Δ

d $x = 112°$ opposite angles of ||gram

e $x = 110°$

If y = angle AEC

$\Rightarrow 360 = 90 + 110 + 90 + y$

$y = 70°$

$\therefore$ angle $AEC = 70°$

angle $ADE = 70°$ (isosceles triangle)

$x = 180 - 70$ (angles on a line)

$x = 110°$

f $x = 72.5°$

Let y stand for base angles of isosceles Δ.

$2y + 35 = 180$ (base angles isosceles Δ and angle sum of Δ)

$y = 72.5°$

$\Rightarrow$ angle $QRP = 72.5°$

angle $NRQ = 35°$ (alternate angles equal)

$180 = x + 72.5 + 35$

$x = 72.5°$

2 a angle sum of triangle

b $y = 53°$

3 720°

4 a 360°

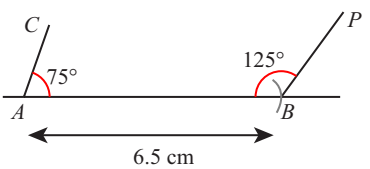
b 24° if a regular polygon

c 156°

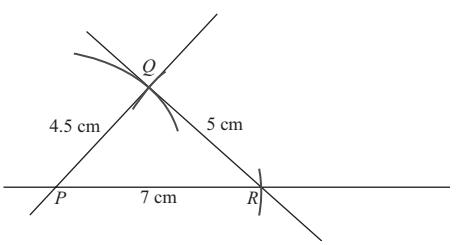
5 a Exterior angle of triangle is equal to the sum of two opposite interior angles $\frac{x}{2} + \frac{x}{2} = x$.

b Opposite angles of parallelogram equal, and vertically opposite angles equal.

6 NOT TO SCALE



7 a NOT TO SCALE



Past paper questions*

1 45 sides

2 a 47° **b** 117°

Chapter 4

Exercise 4.1

1 a b Students' answers will vary, below are possible answers.

Categorical data	Numerical data
Hair colour	*Number of brothers and sisters*
Eye colour	Hours spent doing homework
Gender	Hours spent watching TV
Mode of transport to school	Number of books read in a month
Brand of toothpaste used	Shoe size
Of cell phone	Test scores

** Cambridge International Examinations bears no responsibility for the example answers to questions taken from its past question papers which are contained in this publication.*

2 **a** continuous **b** discrete
c continuous **d** continuous
e discrete **f** continuous
g continuous **h** discrete
i continuous **j** discrete
k discrete **l** discrete

3 **a** **i** Experiment
ii primary
iii numerical
iv Discrete

b **i** survey
ii Primary
iii Categorical
iv Discrete

c **i** Use existing data
ii Secondary
iii Numerical
iv Continuous

d **i** Survey
ii Primary
iii Categorical
iv Discrete

e **i** Use existing data
ii Secondary
iii Numerical
iv Discrete

f **i** Experiment
ii Primary
iii Numerical
iv Discrete

g **i** Survey
ii Primary
iii Numerical
iv Continuous

h **i** Use existing data
ii Secondary
iii Categorical
iv Discrete

i **i** Use existing data
ii Secondary
iii Numerical
iv Discrete

j **i** Survey
ii Primary
iii Numerical
iv Discrete

Exercise 4.2

1

Score	Tally	Total
1	𝍸 | | |	8
2	𝍸 𝍸 | |	12
3	𝍸 | |	7
4	𝍸 | | |	8
5	𝍸 | | |	8
6	𝍸 | |	7
		50

2 Students' own answers.

3 **a** 7 **b** 2 and 12
c Impossible with two dice.
d There are 3 ways of getting each of these scores.

Exercise 4.3

1 **a**

Number of coins	0	1	2	3	4	5	6	7	8
Frequency	6	2	6	4	4	2	4	1	1

b 8 **c** 2
d None or two coins
e 30: add column and total the frequencies.

2 **a**

Amount ($)	0–9.99	10–19.99	20–29.99	30–39.99	40–49.99	50–59.99
Frequency	7	9	5	2	1	1

b 16 **c** 1 **d** $10 – $19.99

3

Call length	Frequency
0–59 s	0
1 min–1 min 59 s	4
2 min–2 min 59 s	3
3 min–3 min 59 s	6
4 min–4 min 59 s	4
5 min–5 min 59 s	3

Exercise 4.4

1

4	5 8 9 9
5	3 3 4 5 5 5 6 6 6 8 9
6	0 0 3 7 8

Key
Key 4 | 5 = 45 kg

2 **a**

Branch A		Branch B
5	11	
	12	
4 2	13	
9 9 0	14	2
5 2	15	9
9 8 6 4	16	0 5 9
9 9 5 2	17	7
9 8 8 6 0 0	18	0 5 6 7 7 8 8 8 8
9 8 0	19	0 0 1 1 3 6 8
1 0 0	20	0 0 0 1 4 5

Key	
Branch A	5 | 11 = 115 pairs
Branch B	4 | 2 = 142 pairs

b Branch B 205 pairs
c Branch B as the data are clustered round the bottom of the diagram where the higher values are located.

3 **a** 26 **b** 12 cm
c 57 cm **d** 6
e **i** More data clustered round top of diagram; possibly need to add 0 as a stem.
ii Data clustered round bottom of the diagram, possibly need to add more stems (ie higher than 5).

4 **a** 7 **b** 101 **c** 142
d Exercise raised the heart rate of everyone in the group. Data moved down the stems after exercise, indicating higher values all round.

Exercise 4.5

1 **a** 9 **b** 33
c Mostly right-handed **d** 90

2 Student's own answers.

3 **a**

	Algebra	Geometry
Boys	4	2
Girls	2	4

b The boys prefer Algebra while the girls prefer Geometry.

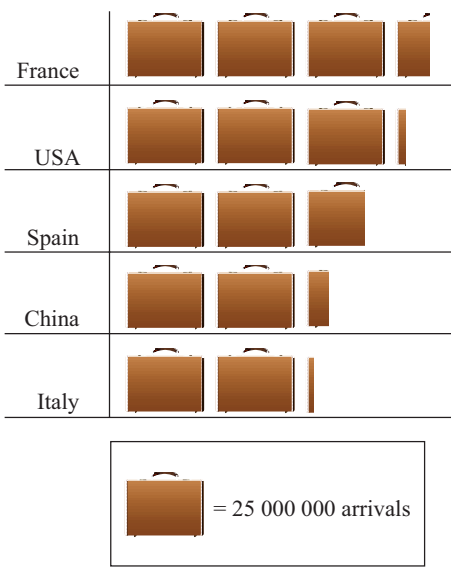
Exercise 4.6

a **i** 3695 miles **ii** 8252 miles
iii 4586 miles
b Istanbul to Montreal
c 21 128 miles
d 4 hours
e Blanks match a city to itself so there is no flight distance.

Exercise 4.7

1 **a** 250 000 **b** 500 000
c 125 000 **d** 375 000

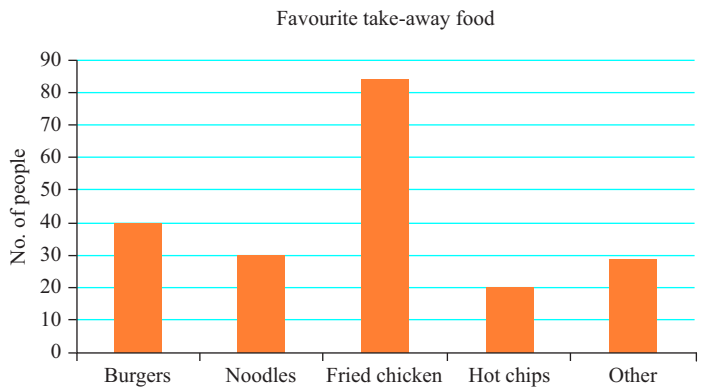
2 Answers may vary. Example:



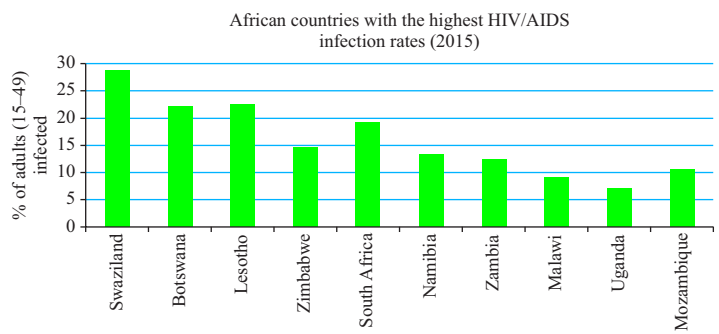
3 **a** Reel deal **b** Fish tales
c Golden rod – 210 fish;
Shark bait – 420 fish;
Fish tales – 140 fish;
Reel deal – 490 fish;
Bite-me – 175 fish

Exercise 4.8

1 **a**



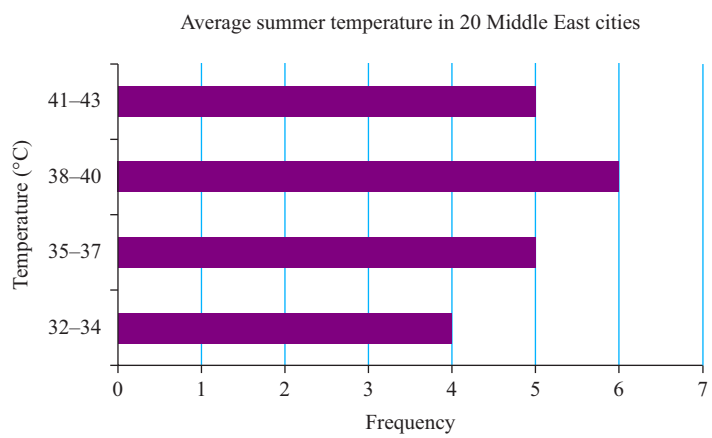
b



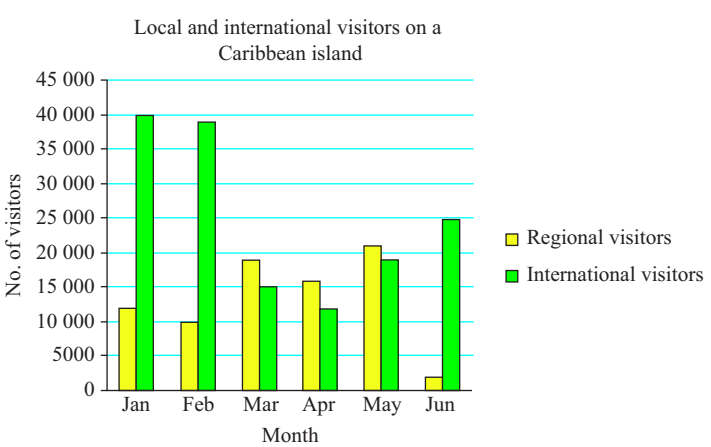
2 **a**

Temperature (°C)	32–34	35–37	38–40	41–43
Frequency	4	5	6	5

b

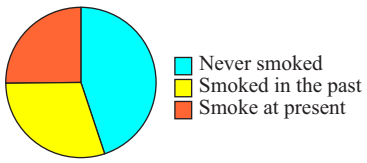


3

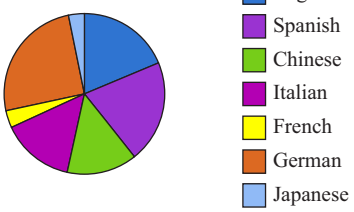


Exercise 4.9

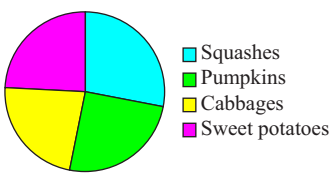
1 Smoking habits among students



2 Home language of people passing through an international airport



3 Land used on a farm to grow vegetables



4 **a** $\frac{1}{4}$ **b** ≈11% **c** 0.25

d **i** 225 **ii** 100
iii 200 **iv** 150

Exercise 4.10

1 Answers may vary, examples include:

a Line graph – will show trends.
b Pie chart – most popular show will be clearly shown.
c Bar chart – different time slots will be displayed clearly.
d Pie chart – favourite subject will be clearly displayed.
e Bar chart – different reasons will be clearly displayed.
f Pie chart – will give a good pictorial representation of the different languages spoken.
g Bar chart – each car size will be shown clearly.

2 Students' own answers.

Examination practice

Exam-style questions

1 **a** Primary data – it is data collected by counting.

b Discrete data – the data can only take certain values.

c

No. of broken biscuits	Tally	Frequency
0	𝍸 𝍸 ||	12
1	𝍸 𝍸	10
2	𝍸 𝍸 |	11
3	𝍸 |	6
4	|	1
		40

d Bar chart – it will give a good representation of breakages.

2 **a** Heathrow

b 15 397

c

Gatwick	24 000
Heathrow	40 000
London City	6 000
Luton	11 000
Stansted	15 000

d

Gatwick	◀◀◀
Heathrow	◀◀◀◀
London city	◀
Luton	◀◀
Stansted	◀◀

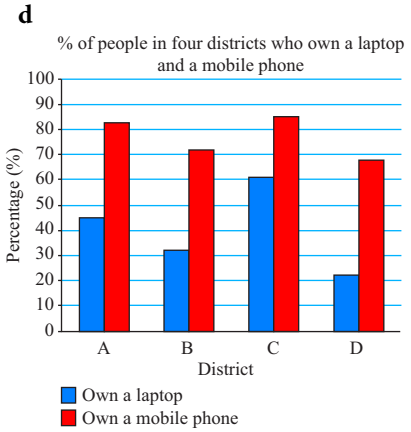
Key: ◀ = 10 000 flights

3 **a** A two–way table.

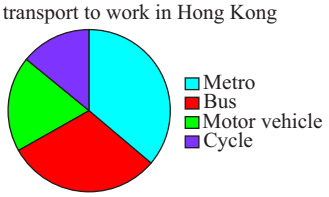
b 4980

c District C – it has the highest percentage of laptops.

d



4 Mode of transport to work in Hong Kong



5 **a** Sport played by students.

b five

c baseball

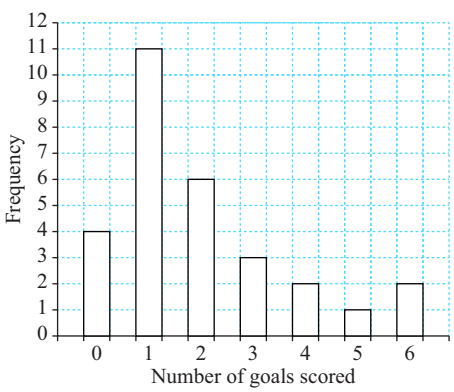
d $\frac{1}{4}$

e 28 (to nearest whole number)

f 83 (to the nearest whole number)

Past paper questions*

1



2 **a** **i** 55, tennis, hockey, gymnastics, hockey

ii 30

Unit 2

Chapter 5

Exercise 5.1

1 **a** $\frac{5}{9} = \frac{10}{18} = \frac{15}{27} = \frac{20}{36}$

b $\frac{3}{7} = \frac{6}{14} = \frac{9}{21} = \frac{12}{28}$

c $\frac{12}{18} = \frac{6}{9} = \frac{2}{3} = \frac{8}{12}$

d $\frac{18}{36} = \frac{1}{2} = \frac{2}{4} = \frac{3}{6}$

e $\frac{110}{128} = \frac{55}{64} = \frac{165}{192} = \frac{220}{256}$

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

Exercise 5.2

1 **a** $\frac{10}{27}$ **b** $\frac{3}{14}$ **c** $\frac{2}{9}$
d $\frac{1}{4}$

2 **a** $\frac{1}{5}$ **b** $\frac{8}{21}$
c 2 **d** $\frac{92}{35} = 2\frac{22}{35}$
e 32 **f** $\frac{319}{8} = 39\frac{7}{8}$
g 180 **h** $80\frac{1}{2}$ or $\frac{161}{2}$

Exercise 5.3

1 **a** $\frac{2}{3}$ **b** $\frac{5}{7}$ **c** $\frac{3}{4}$
d $\frac{13}{9} = 1\frac{4}{9}$ **e** $\frac{11}{30}$ **f** $\frac{1}{24}$
g $\frac{7}{8}$ **h** $2\frac{1}{16}$

2 **a** $3\frac{1}{3}$ **b** $6\frac{5}{11}$ **c** $18\frac{1}{4}$
d $3\frac{3}{4}$ **e** $-\frac{5}{6}$ **f** $12\frac{11}{16}$
g $6\frac{13}{16}$ **h** $2\frac{29}{60}$
i $1\frac{25}{42}$ **j** $\frac{1}{2}$
k $9\frac{5}{12}$ **l** $3\frac{7}{60}$

3 **a** $\frac{1}{4} + \frac{1}{2}$ **b** $\frac{1}{2} + \frac{1}{6}$
c $\frac{1}{2} + \frac{1}{8}$ **d** $\frac{1}{16} + \frac{1}{8}$

Exercise 5.4

1 $\frac{3}{7}$
2 $\frac{14}{15}$
3 $\frac{4}{63}$
4 $\frac{2}{11}$
5 $\frac{147}{5} = 29\frac{2}{5}$
6 $\frac{48}{85}$
7 $\frac{189}{122} = 1\frac{67}{122}$
8 $\frac{13}{14}$
9 **a** $\frac{7}{10}$ **b** $\frac{77}{60}$

Exercise 5.5

1 $\frac{1}{40}$
2 $\frac{4}{5}$
3 $\frac{60}{7} = 8\frac{4}{7}$
4 5
5 24
6 $\frac{1}{8}$
7 $\frac{3}{8}$
8 $9\frac{3}{5}$

Exercise 5.6

1 90 people
2 $\frac{4}{21}$
3 98
4 $\frac{3}{7}$
5 $\frac{1}{4}$
6 3 cups and $3\frac{3}{4}$ cups of water

Exercise 5.7

1 **a** $\frac{7}{10}$ **b** $\frac{3}{4}$ **c** $\frac{1}{5}$
d $\frac{9}{25}$ **e** $\frac{3}{20}$ **f** $\frac{1}{40}$
g $\frac{43}{20}$ **h** $\frac{33}{25}$ **i** $\frac{47}{40}$
j $\frac{271}{250}$ **k** $\frac{1}{400}$ **l** $\frac{1}{50000}$

2 **a** 60% **b** 28% **c** 85%
d 30% **e** 4%
f $41.\dot{6}\% = 41\frac{2}{3}\%$

Exercise 5.8

1 40%
2 25%
3 27.0 (3sf)%
4 77.8 (3sf)%
5 79.2 (3sf)%
6 25%
7 0.025%

Exercise 5.9

1 4%
2 21%
3 7%
4 19%
5 25%
6 44%

Exercise 5.10

1 **a** 44 **b** 46 **c** 50
d 42 **e** 41.6

2 **a** 79.5 **b** 97.52
c 60.208 **d** 112.36
e 53.265

3 **a** 111.6 **b** 105.4
c 86.8 **d** 119.04
e 115.32

4 **a** 3.62 **b** 23.3852
c 36.0914 **d** 0
e 36.019

5 33 h
6 \$13.44
7 26 199
8 126 990
9 10 h 34 min

Exercise 5.11

1 175
2 362.857
3 1960
4

Sale price (\$)	% reduction	Original price (\$)
52.00	10	57.78
185.00	10	205.56
4 700.00	5	4 947.37
2.90	5	3.05
24.50	12	27.84
10.00	8	10.87
12.50	7	13.44
9.75	15	11.47
199.50	20	249.38
99.00	25	132.00

5 **a** \$20.49 **b** \$163.93
c \$11.89 **d** \$19.66
e \$12.95 **f** \$37.54

g \$24.39 **h** \$105.90
i \$0.81 **j** \$0.66

6 **a** 40 students **b** 33 students

7 \$20

8 80 kg

9 210 litres (3sf)

Exercise 5.12

1 **a** 3.8×10^2 **b** 4.2×10^6
c 4.56×10^{10} **d** 6.54×10^{13}
e 2×10^1 **f** 1×10^1
g 1.03×10^1 **h** 5×10^0

2 **a** 2 400 000 **b** 310 000 000
c 10 500 000 **d** 9 900
e 71

3 **a** 8×10^{30} **b** 4.2×10^{12}
c 2.25×10^{26} **d** 1.32×10^9
e 1.4×10^{32} **f** 3×10^1
g 2×10^1 **h** 3×10^3
i 3×10^{42} **j** 1.2×10^3
k 5×10^2 **l** 1.764×10^{15}

4 **a** 3.4×10^4 **b** 3.7×10^6
c 5.627×10^5 **d** 7.057×10^9
e 5.7999973×10^9

Exercise 5.13

1 **a** 4×10^{-3} **b** 5×10^{-5}
c 3.2×10^{-5} **d** 5.64×10^{-8}

2 **a** 0.000 36 **b** 0.000 000 016
c 0.000 000 203 **d** 0.0088
e 0.71

3 **a** 8×10^{-20} **b** 6.4×10^{-12}
c 3.15×10^{-9} **d** 3.3×10^{-2}
e 2×10^{33} **f** 7×10^{-37}
g 5×10^{12} **h** 1.65×10^1

4 **a** 2.731×10^{-2} **b** 2.88×10^{-1}
c 7.01056×10^3 **d** 1.207×10^{-5}

5 8.64×10^4 seconds

6 **a** 3×10^9 metres
b 6×10^9 metres
c 3.06×10^{10} metres

7 **a** 1.07×10^9 **b** 1.07×10^{12}

Exercise 5.14

1 Display will vary according to the calculator used.
a 4.2×10^{12} **b** 0.000018
c 2700000 **d** 0.0134
e 0.000000001 **f** 42300000
g 0.0003102 **h** 3098000000
i 2.076×10^{-23}

2 **a** **i** 1.09×10^5
ii 2.876×10^{-6}
iii 4.012×10^9
iv 1.89×10^7
v 3.123×10^{13}
vi 2.876×10^{-4}
vii 9.02×10^{15}
viii 8.076×10^{-12}
ix 8.124×10^{-11}
x 5.0234×10^{19}

b 8.076×10^{-12}
8.124×10^{-11}
2.876×10^{-6}
2.876×10^{-4}
1.09×10^5
1.89×10^7
4.012×10^9
3.123×10^{13}
9.02×10^{15}
5.0234×10^{19}

3 **a** 1.3607×10^{18} **b** 1.0274×10^{-15}
c 1.0458×10^0 **d** 1.6184×10^{11}
e 5.2132×10^{19} **f** 3.0224×10^{-16}
g 2.3141×10^{12} **h** 1.5606×10^{17}

4 **a** 2.596×10^6 **b** 7.569×10^{-5}
c 4.444×10^{-3} **d** 1.024×10^{-7}
e 3.465×10^{-4} **f** 2.343×10^7
g 5.692×10^3 **h** 3.476×10^{-3}
i 1.604×10^{-3}

Exercise 5.15

1	**2**(1dp)
a $\frac{23.6}{6.3} \approx \frac{24}{6} \approx 4$	3.7
b $\frac{4}{0.09 \times 4} \approx \frac{4}{0.36} \approx 11$	12.7
c $\frac{7 \times 0.5}{9} \approx \frac{3.5}{9} \approx 0.39$	0.4
d $\frac{5 \times 6}{2.5 + 1} \approx \frac{30}{3.5} \approx 8.6$	8.0
e $\frac{\sqrt{49}}{2.5 + 4} \approx \frac{7}{6.5} \approx 1$	1.0
f $(0.5 + 2)(6.5 - 2) \approx (2.5)(4.5) \approx 11.3$	10.8
g $\frac{24 + 20}{5 + 6} \approx \frac{44}{11} \approx 4$	4.2
h $\frac{110 - 45}{19 - 14} \approx \frac{65}{5} \approx 13$	11.7
i $3^2 \times \sqrt{49} \approx 9 \times 7 \approx 63$	44.4
j $\sqrt{224 \times 45} \approx \sqrt{10080} \approx 100$	100.5
k $\sqrt{9} \times \sqrt{100} \approx 3 \times 10 \approx 30$	30.4
l $4^3 \times 2^4 \approx 64 \times 16 \approx 1024$	898.2

Examination practice

Exam-style questions

1 $\frac{5}{16}$

2 **a** 5% **b** $\frac{6}{25}$ **c** 17 822

3 29 975

4 7.5%

Past paper questions*

1 5.74×10^{-5}

2 **a** $\frac{2}{3}$
b $\frac{2}{5}$

3 7.7 kg

4 $3\frac{7}{40}$

5 \$96

6 $\left(\frac{1}{10}\right)^2 + \left(\frac{2}{5}\right)^2$
$= \frac{1}{100} + \frac{4}{25}$
$= \frac{1}{100} + \frac{16}{100}$
$= \frac{17}{100} = 0.17$

7 \$88.20

8 \$461.25

9 2500

10 $1\frac{1}{8}$

Chapter 6

Exercise 6.1

1 **a** $-30p-60$ **b** $-15x-21$
c $-20y-1$ **d** $-3q+36$
e $-24t+84$ **f** $-12z+6$

2 **a** $-6x-15y$ **b** $-24p-30q$
c $-27h+54k$ **d** $-10h-10k+16j$
e $-8a+12b+24c-16d$
f $-6x^2-36y^2+12y^3$

3 **a** $-5x-8$ **b** $-5x+12$
c $10x-38$ **d** $-13f$
e $-36g+37$ **f** $12y-20$

4 **a** $-26x^2-76x$ **b** $-x^2+77x$
c $-9x^2+30x$ **d** $24q$
e $-42pq+84p$ **f** $-48m+48n$

5 **a** $12x-6$ **b** $13x-6$
c $-2x+17$ **d** $x+13$
e $23-7x$ **f** $10x-8$
g $7x-5$ **h** x^2-5x+8
i $3x^2-7x+2$ **j** $2x^2+3x+6$
k $2x-18$ **l** $6x^2+6x-6$

Exercise 6.2

1 **a** $x=7$ **b** $x=-5$
c $x=9$ **d** $x=-\frac{62}{7}$
e $x=5$ **f** $n=11$
g $q=1.75$ **h** $t=0.5$
i $x=11.5$ **j** $x=10.5$
k $x=16.7$ **l** $x=3$
m $x=-\frac{1}{7}$ **n** $x=10$

2 **a** $x=2$ **b** $x=-10$
c $y=-3$ **d** $x=\frac{11}{15}$
e $p=1$ **f** $x=60$

3 **a** $x=2$ **b** $p=3$ **c** $t=1$
d $m=5$ **e** $n=10$ **f** $p=-\frac{5}{2}$
g $p=\frac{20}{13}$ **h** $x=-1$

4 **a** $x=2$ **b** $x=2$
c $x=12$ **d** $x=\frac{-13}{6}$
e $x=1$ **f** $x=\frac{15}{4}$

5 **a** $x=1$ **b** $x=\frac{1}{3}$ **c** $x=-\frac{3}{4}$
d $x=\frac{1}{3}$ **e** $x=\frac{1}{5}$ **f** $x=-\frac{1}{6}$

Exercise 6.3

1 **a** $3(x+2)$ **b** $3(5y-4)$
c $8(1-2z)$ **d** $5(7+5t)$
e $2(x-2)$ **f** $3x+7$
g $2(9k-32)$ **h** $11(3p+2)$
i $2(x+2y)$ **j** $3(p-5q)$
k $13(r-2s)$
l $2(p+2q+3r)$

2 **a** $7(3u-7v+5w)$
b $3x(y+1)$ **c** $3x(x+1)$
d $3p(5q+7)$ **e** $3m(3m-11)$
f $10m^2(9m-8)$
g $12x^3(3+2x^2)$ **h** $4pq(8p-q)$

3 **a** $2m^2n^2(7+2mn)$
b $abc(17+30b)$
c $m^2n^2(49m+6n)$
d $\frac{1}{2}(a+3b)$ **e** $\frac{1}{8}x(6x^3+7)$
f $8(x-4)$ **g** $(x+1)^2(1-4x)$
h $2x^3(3+x+2x^2)$
i $7xy(x^2-2xy+3y)$
j $(y+3)(x+2)$

Exercise 6.4

1 **a** $a=c-b$ **b** $r=p-q$
c $h=\frac{g}{f}$ **d** $b=\frac{d-c}{a}$
e $a=bc$ **f** $n=\frac{t+m}{a}$

2 **a** $m=an-t$ **b** $a=\frac{t}{n-m}$
c $x=\frac{tz}{y}$ **d** $x=bc+a$
e $y=c-\frac{d}{x}$ **f** $b=a-c$

3 **a** $r=q(p-t)$ **b** $b=\frac{x-a}{c}$
c $m=n-\frac{t}{a}$ **d** $a=\frac{bc}{d}$
e $a=x-bc$ **f** $z=\frac{xy}{t}$

4 **a** $b=c^2$ **b** $b=\frac{c^2}{a}$
c $b=\left(\frac{c}{a}\right)^2$ **d** $b=c^2-c$
e $b=x-c^2$ **f** $y=\left(\frac{x}{c}\right)^2$

5 $a=\frac{(v-u)}{t}$

6 $s=\frac{\sqrt{n}(b-a)}{3}$

7 $l=g\left(\frac{T^2}{4\pi^2}\right)$

Examination practice

Exam-style questions

1 $T=31$

2 **a** Temperature will be 19 °C
b You will need to climb to 1500 m.

3 **a** $n=\frac{e}{3}$ **b** $n=7$

Past paper questions*

1 $2x(1-2y)$

2 v^3-p

3 $3y-y^4$

4 $4y(x+3z)$

5 $y=14.5$

6 $x=7$

7 $2y(3xy+4)$

Chapter 7

Exercise 7.1

1 **a** 12.5 cm **b** 11.5 cm
c 9 cm **d** 9.6 cm

2 **a** 16 cm **b** 12 cm
c 25 cm **d** 38 cm
e 35 m **f** 23 km

3 **a** 55 cm^2 **b** 15 m^2
c 10 m^2 **d** 2.24 cm^2
e 16 m^2 **f** 7.84 cm^2
g 40 cm^2 **h** 42 m^2
i 8 cm^2 **j** 54 cm^2

4 **a** 50 m^2 **b** 52.29 m^2
c 33.1 cm^2 (3sf) **d** 37.8 cm^2
e 36 cm^2
f 145.16 cm^2
g 55.7 cm^2 (3sf)

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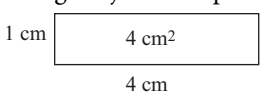
5 **a** $h = 6$ cm **b** $b = 17$ cm
c $a = 2.86$ cm (3sf)
d $b = 5$ cm
e $h = 10.2$ cm (3sf)

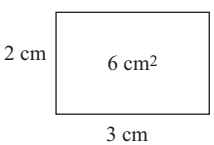
6 183 tiles

7 14.14 cm × 14.14 cm

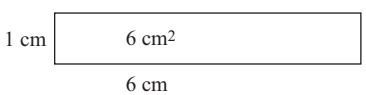
8 Students' answers will vary; the following are just examples.

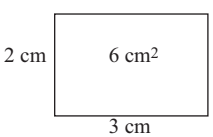
a



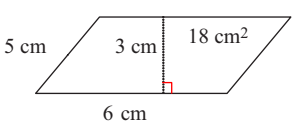


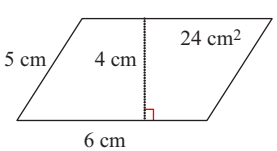
b



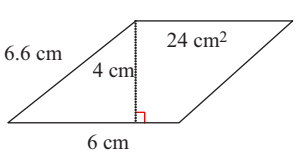


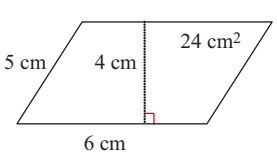
c





d





9 Area = 440 square units and perimeter = 102 units

Exercise 7.2

1 Answers are correct to 3sf.
a $A = 50.3$ m² $C = 25.1$ m
b $A = 7.55$ mm² $C = 9.74$ mm
c $A = 0.503$ m² $C = 2.51$ m
d $A = 0.785$ cm² $C = 3.14$ cm
e $A = 1.57$ km² $C = 4.44$ km
f $A = 1.27$ m² $C = 4$ m (exact)

2 Answers correct 3sf.
a $A = 250$ cm²
b $A = 13.7$ cm²
c $A = 68.3$ m²
d $A = 55.4$ cm²
e $A = 154$ m²
f $A = 149$ cm²

3 23 bags

4 white = 0.1 m² red = 1.0 m²

5 0.03 m²

6 2 × 12 cm pizza ≈ 226.2 cm² and 24 cm pizza ≈ 452.4 cm², so two small pizzas is not the same amount of pizza as one large pizza.

Exercise 7.3

1 **a** C = 9π cm; A = 20.25π cm²
b C = 74π cm; A = 1369π cm²
c C = 120π mm; A = 3600π mm²
d $C = \frac{14\pi}{2} + 14$ cm; $A = \frac{49\pi}{2}$ cm²
e $C = \frac{12\pi}{2} + 12$ cm; $A = \frac{36\pi}{2}$ cm²
f $C = \frac{18.4\pi}{2} + 18.4$ cm;
$A = \frac{84.64\pi}{2}$ cm²

2 **a** C = 10π cm
b C = 14π cm
c A = 0.9025π cm²
d $A = \frac{9\pi}{2}$ cm²

3 **a** 12 cm
b A = $144 - 36\pi$ cm²

4 A = 32π mm²

Exercise 7.4

1 Answers correct to 3sf.
a $A = 12.6$ cm² $P = 16.2$ cm
b $A = 25.1$ cm² $P = 22.3$ cm
c $A = 1.34$ cm² $P = 7.24$ cm
d $A = 116$ cm² $P = 44.2$ cm
e $A = 186$ m² $P = 55.0$ m
f $A = 0.185$ cm² $P = 1.88$ cm
g $A = 36.3$ cm² $P = 24.6$ cm
h $A = 98.1$ m² $P = 43.4$ m

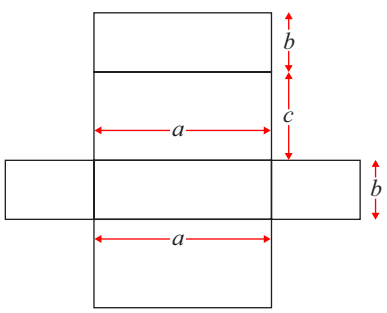
2 Answers correct to 3sf.
a $A = 198$ m² $l = 22.0$ m
b $A = 70.4$ cm² $l = 17.2$ cm
c $A = 94.7$ cm² $l = 29.6$ cm
d $A = 14.5$ m² $l = 9.69$ m
e $A = 16.4$ m² $P = 6.54$ m
f $A = 243$ cm² $P = 62.5$ cm

3 Answers correct 3sf.
a $A = 30.2$ cm² $P = 28.9$ cm
b $A = 77.4$ cm² $P = 31.3$ cm
c $A = 46.9$ m² $P = 39.2$ m
d $A = 15.1$ cm² $P = 43.2$ cm
e $A = 69.5$ m² $P = 56.5$ m

4 Answers correct to 3sf.
a $P = 144$ cm $A = 1400$ cm²
b $P = 7.07$ cm $A = 3.63$ cm²
c $P = 12.8$ cm $A = 19.0$ cm²
d $P = 26.6$ cm $A = 35.6$ cm²

Exercise 7.5

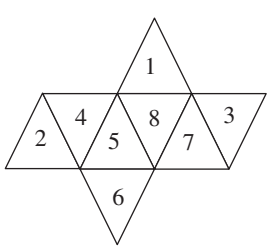
1



2 **a** Trapezium-based prism
b O and S
c $PQ = RQ = UV = VW$

3 **a**

4



Exercise 7.6

1 volume = 66 cm³
surface area = 144 cm²

2 **a** **i** 720 cm³
ii 548 cm²
b **i** 13.8 mm³ (3sf)
ii 40.3 mm² (3sf)

3 432 000 cm³

4 **a** 768 cm³
b 816 cm²

5 3.39 m^3 (3sf)
6 76.7 cm^2 (3sf)
7 241 cm^3 (3sf)

8 **a** 448 m^3
b 358 boxes
c 8.5 m^2

9 **a** 48 m^3 **b** Yes

Exercise 7.7

1 **a** 5030 cm^2 (3sf)
b 33500 cm^3 (3sf)

2 5300 cm^3 (3sf)

3 2570000 m^3 (3sf)

4 **a** $1070 = m^2$ (3sf)
b $2280 = m^3$ (3sf)

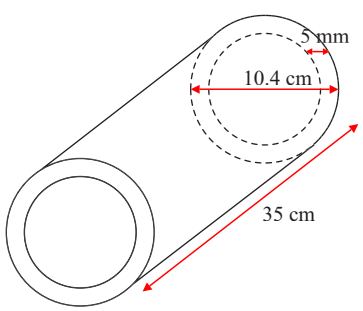
5 **a** $754 = cm^3$ (3sf)
b $415 = cm^2$ (3sf)

6 2.29 cm (3sf)

7 $\frac{R}{r} = \sqrt[3]{2}$

8 **a** 200π cm^3
b 542 cm^2 (3sf)

9 **a**



b volume of metal in the tube =

$$\left(\pi\times\left(\frac{10.4}{2}\right)^2\times 35\right) - \left(\pi\times\left(\frac{10.4-1}{2}\right)^2\times 35\right) \text{cm}^3$$

c 544 cm^3 (3sf)
d Total surface area of tube = 2 × area of ring + area of outer tube + area of inner tube (Note 'ring' is the 5 mm thick end of the cylinder.)

$$2\times\left[\pi\times\left(\frac{10.4}{2}\right)^2 - \pi\left(\frac{10.4-1}{2}\right)^2\right] + (\pi\times 10.4\times 35) + \left[\pi\times(10.4-1)\times 35\right] \text{cm}^2$$

Examination practice

Exam-style questions

1 33 900 mm (3sf)

2 $P = 32.3$ cm (3sf) Area = 47.7 cm^2

3 2.31 m^3 (3sf)

Past paper questions*

1 **d** 64 m **e** 33.3 m^3

2 170 m^2

3 3620 cm^2 (3sf)

4 261.8

5 36.8

Chapter 8

Exercise 8.1

1 $\frac{7}{50}$

2 **a** $\frac{1}{10}$ **b** $\frac{3}{20}$ **c** $\frac{131}{260}$ **d** $\frac{141}{260}$

3 **a** $\frac{235}{300} = 0.783$ **b** 233

4 5750

5 **a** $\frac{1}{77}$ **b** $\frac{76}{77}$

6 **a** $\frac{4}{9}$ **b** $\frac{5}{9}$ **c** $\frac{0}{9}$ **d** 1

7 9 blue balls

8 **a** $\frac{1}{13}$ **b** $\frac{1}{4}$ **c** $\frac{1}{2}$ **d** $\frac{4}{13}$

Exercise 8.2

1 **a**

Second throw \ First throw	H	T
H	HH	TH
T	HT	TT

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

2 **a**

Second die \ First die	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

b **i** $\frac{1}{36}$ **ii** $\frac{0}{36}$ **iii** $\frac{2}{9}$
iv $\frac{7}{9}$ **v** $\frac{1}{6}$ **vi** $\frac{2}{9}$

3 **a**

Tetrahedral die \ Spinner	1	2	3	4	5
2	2	2	3	4	5
4	4	4	4	4	5
6	6	6	6	6	6
8	8	8	8	8	8

b **i** $\frac{17}{20}$ **ii** $\frac{3}{20}$ **iii** $\frac{3}{10}$
iv $\frac{1}{4}$ **v** $\frac{7}{20}$

4 **a**

Second throw \ First throw	4	6	10	12	15	24
4	4	2	2	4	1	4
6	2	6	2	6	3	6
10	2	2	10	2	5	2
12	4	6	2	12	3	12
15	1	3	5	3	15	3
24	4	6	2	12	3	24

b **i** $\frac{5}{18}$ **ii** $\frac{2}{3}$ **iii** 1
iv $\frac{17}{18}$ **v** $\frac{2}{9}$ **vi** $\frac{8}{18}$

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5 **a**

Set A

+	1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8	9
2	3	4	5	6	7	8	9	10
3	4	5	6	7	8	9	10	11
4	5	6	7	8	9	10	11	12

Set B

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

b Set B, but set A is not far away from being sensible

Exercise 8.3

1 **a** $\frac{1}{36}$ **b** $\frac{1}{4}$ **c** $\frac{1}{6}$ **d** $\frac{5}{6}$

2 **a** red, red; red, blue; blue, red; blue, blue

b **i** $\frac{7}{12}$ **ii** $\frac{5}{12}$ **iii** $\frac{35}{144}$

iv $\frac{74}{144}$ **v** $\frac{70}{144}$ **vi** $\frac{49}{144}$

vii $\frac{95}{144}$

3 **a** $\frac{1}{169}$ **b** $\frac{1}{2704}$ **c** $\frac{1}{52}$

d $\frac{3}{8}$ **e** $\frac{1}{2}$ **f** $\frac{1}{2}$

4 **a** 0.24 **b** 0.24 **c** 0.36

d 0.76 **e** 0.52

Examination practice

Exam-style questions

1 **a** $\frac{8}{19}$ **b** $\frac{7}{18}$

2 **a** $\frac{2}{5}$ **b** 0

3 $\frac{7}{12}$

4 **a** red, black, black; black, red, black; black, black, red

b $\frac{2}{3}$

5 **a**

Face	1	2	3	4
Probability	$\frac{2}{9}$	$\frac{1}{3}$	$\frac{5}{18}$	$\frac{1}{6}$
	$\frac{4}{18}$	$\frac{6}{18}$	$\frac{5}{18}$	$\frac{3}{18}$

b 2 **c** 1 **d** $\frac{13}{18}$

6 **a**

		Josh						
	+	$5	$1	$1	50c	20c	20c	20c
Soumik	$5	$10	$6	$6	$5.50	$5.20	$5.20	$5.20
	$5	$10	$6	$6	$5.50	$5.20	$5.20	$5.20
	$5	$10	$6	$6	$5.50	$5.20	$5.20	$5.20
	$2	$7	$3	$3	$2.50	$2.20	$2.20	$2.20
	50c	$5.50	$1.50	$1.50	$1	70c	70c	70c
	50c	$5.50	$1.50	$1.50	$1	70c	70c	70c
	50c	$5.50	$1.50	$1.50	$1	70c	70c	70c

b $\frac{6}{49}$ **c** $\frac{18}{49}$ **d** $\frac{25}{49}$

Past paper questions*

1 **a** 0.3

b 0

2 **a** **i**

Total	Tally	Frequency
2	||	2
3	𝍸	5
4	𝍸 ||||	10
5	|||	3
6	𝍸 𝍸 |||| ||	17
7	𝍸 𝍸 |	11
8	𝍸 ||||	9
9	𝍸 |||	8
10	|||	3
11	|	1
12	|	1

ii $\frac{3}{70}$

3 **a** $\frac{2}{6} = \frac{1}{3}$

b 200

4 **a** 0.05

b 15

c **i** 0.75

ii 0.135

iii 0.12

d 0.243

5 **a** $\frac{2}{3}$

b 66

Unit 3

Chapter 9

Exercise 9.1

1 **a** 5 7 9 11 13 **15 17 19** ... (+2 +2 +2 +2 +2 +2 +2 +2)

b 3 8 13 18 23 **28 33 38** ... (+5 +5 +5 +5 +5 +5 +5 +5)

c 3 9 27 81 243 **729 2187 6561** ... (×3 ×3 ×3 ×3 ×3 ×3 ×3 ×3)

d 0.5 2 3.5 5 6.5 **8 9.5 11** ... (+1.5 +1.5 +1.5 +1.5 +1.5 +1.5 +1.5 +1.5)

e 8 5 2 –1 –4 **–7 –10 –13** ... (–3 –3 –3 –3 –3 –3 –3 –3)

f 13 11 9 7 5 **3 1 –1** ... (–2 –2 –2 –2 –2 –2 –2 –2)

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g 6 4.8 3.6 2.4 1.2 **0** **–1.2** **–2.4** ...
–1.2 –1.2 –1.2 –1.2 –1.2 –1.2 –1.2 –1.2

h 2.3 1.1 –0.1 –1.3 **–2.5** **–3.7** **–4.9** ...
–1.2 –1.2 –1.2 –1.2 –1.2 –1.2 –1.2

2 a 81, –243, 729
Rule = multiply previous term by –3.
b Fr, Sa, Su
Rule = days of the week.
c u, b, j = skip 1 extra letter of the alphabet each time.
d 5, 10, 6, 12
Rule = even position numbers increase by 2 and odd position numbers increase by 1. Rule.

Exercise 9.2

1 a i 33 **ii** $2n + 3$
b i 73 **ii** $5n - 2$
c i 14 348 907 **ii** 3^n
d i 21.5 **ii** $1.5n - 1$
e i –34 **ii** $-3n + 11$
f i –15 **ii** $-2n + 15$
g i –10.8 **ii** $-1.2n + 7.2$
h i 450 **ii** $2n^2$

2 a $4(2n - 1)$ **b** 3996 **c** 30
d Rule is $8n - 4$, so $8n - 4 = 154$ should give integer value of n if 154 is a term:
$8n - 4 = 158$
$8n = 158$
$n = 19.75$
OR
19th term = 148 and 20th term = 156 therefore 154 is not a term.

3 a $\frac{1}{2^n}$ **b** $\frac{4n-1}{3n+5}$
c $\frac{(4n-1)^2}{(3n+5)^2}$ **d** $\frac{n}{2} - \frac{7}{6}$

4 a 1, –2, –5, … ; –56
b 1, 0, –1, … ; –18
c $\frac{1}{2}$, 2, 4.5, … ; 200
d 0, 6, 24, … ; 7980
e $\frac{3}{2}$, 1, $\frac{3}{4}$, … ; $\frac{1}{7}$
f 2, 16, 54, … ; 16 000

5 $x = -2$

6 x can take any value.

7 a 23 27 31 **b** 49 64 81
c –17 –31 –47

Exercise 9.3

a

Pattern number n	1	2	3	4	5	6	n	300
Number of matches m	4	7	10	13	16	19	$m = 3n + 1$	901

b

Pattern number p	1	2	3	4	5	6	p	300
Number of circles c	1	3	5	7	9	11	$c = 2p - 1$	599

c

Pattern number p	1	2	3	4	5	6	p	300
Number of triangles t	5	8	11	14	17	20	$t = 3p + 2$	902

d

Pattern number p	1	2	3	4	5	6	p	300
Number of squares s	5	10	15	20	25	30	$s = 5p$	1500

Exercise 9.4

1 a 5, 9, 13 …101
b –2, 1, 4, …70
c $4\frac{1}{2}, 9\frac{1}{2}, 14\frac{1}{2}$ …$124\frac{1}{2}$
d –1, –3, –5 … –49
e $1\frac{1}{2}, 2, 2\frac{1}{2}$ … $13\frac{1}{2}$
f 1, 7, 17 … 1 249
g 1, 4, 9 … 625
h 2, 4, 8 … 33 554 432

2 30 is T_6 and 110 is T_{11}.

3 T_9

4 a 153 **b** n = 6

5 a The subscript n + 1 means the term after u_n, so this rule means that to find the term in a sequence, you have to add 2, to the current term (u_n). So, if the term is 7, then $u_n + 1$ is 7 + 2 = 9
b –8, –6, –4, –2, 0

Exercise 9.5

1 a $x = \frac{5}{9}$
b $x = \frac{17}{99}$

2 a $\frac{5}{9}$ **b** $\frac{1}{9}$ **c** $\frac{8}{9}$
d $\frac{8}{33}$ **e** $\frac{61}{99}$ **f** $\frac{32}{99}$
g $\frac{206}{333}$ **h** $\frac{233}{999}$ **i** $\frac{208}{999}$
j $\frac{1}{45}$ **k** $\frac{17}{90}$ **l** $\frac{31}{990}$
m $\frac{27}{11}$ **n** $\frac{1034}{333}$ **o** $\frac{248}{99}$
p $\frac{9990}{999} = 10$ **q** $\frac{5994}{999} = 6$
r $\frac{8}{9}$ **s** $\frac{999}{999} = 1$

3 a i 0.1 **ii** 0.01 **iii** 0.001 **iv** 0.000000001
b As number subtracted tends to 1, answer tends to 0. Yes it will reach 0.
c $\frac{2}{3}$, $\frac{2}{9}$ **d** $0.\dot{8}$
e $\frac{8}{9}$ **f** $\frac{4}{9}, \frac{5}{9}, 0.\dot{9}, 1$
g As the fractions represent infinite 9's there is no 1 at the end of the infinite 0's and so 0.999… = 1

4 a 4.41 > 4.1 but 4.1 < 4.5
b Another 9 could be added to the end of 4.49999.
c Yes. $X = 4.4\dot{9}$
$10x = 44.\dot{9}$
$9x = 40.5$
$x = \frac{40.5}{9} = \frac{9}{2} = 4.5$
No.

Exercise 9.6

1 a rational **b** rational
c rational **d** rational
e irrational **f** irrational
g rational **h** rational
i rational **j** rational
k rational **l** rational
m rational **n** irrational
o irrational **p** irrational

2 a $\frac{6}{1}$ **b** $\frac{19}{8}$ **c** $\frac{37}{33}$
d $\frac{8}{9}$ **e** $\frac{427}{1000}$ **f** $\frac{311}{99}$

3 Possible answers include:
a 2 **b** $\sqrt{5}$ **c** 1 **d** 2

4 The set of rational numbers and the set of irrational numbers are both infinite sets. But the set of rational numbers is 'countable' whereas the set of irrational numbers is 'uncountable'. This might suggest that there are more irrational numbers than rational numbers.

The term 'countable' does not mean finite.

In this context we mean that, if you tried to pair up every rational number with exactly one irrational number, you would have a lot of irrational numbers left over that you couldn't pair up but no rational numbers would be upaired.

5 Students' own answers. Example: An 'imaginary number' is a quantity of the form ix, where x is a real number and i is the positive square root of -1, e.g. $\sqrt{-3} = \sqrt{3}i$.

Exercise 9.7

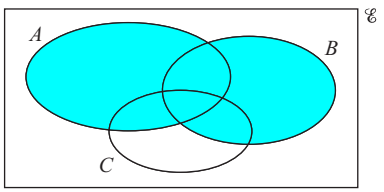
1 **a** {Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday}
b {Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec}
c {1, 2, 3, 4, 6, 9, 12, 18, 36}
d {Red, Orange, Yellow, Green, Blue, Indigo, Violet}
e {7, 14, 21, 28, 35, 42, 49}
f {2, 3, 5, 7, 11, 13, 17, 19, 23, 29}
g {TOY, OYT, YTO, YOT, OTY, TYO}

2 **a** hamster, rat
b peas, beans
c Dublin, Amsterdam
d Rhine, Yangtze
e redwood, palm
f soccer, rugby
g Italy, Spain
h Carter, Reagan
i Bach, Puccini
j lily, orchid
k 12, 15
l Labrador, Fox terrier
m Uranus, Neptune
n surprised, mad
o African, American
p pentagon, quadrilateral

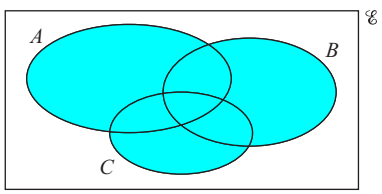
3 **a** square numbers
b continents of the world
c even numbers less than 10
d multiples of 2
e factors of 12

4 **a** false **b** true **c** true
d false **e** true

5 **a**



b



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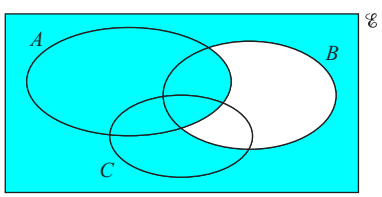

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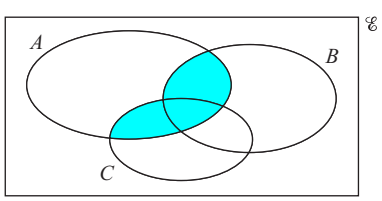

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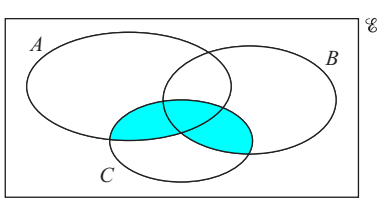

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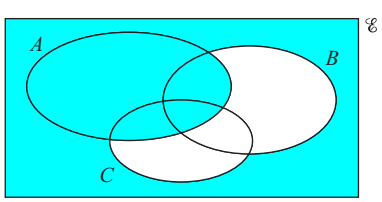
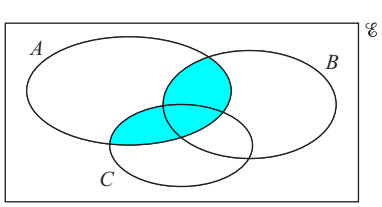


g



6 9

7 6

Exercise 9.8

1 **a** **i** $A \cap B = \{6, 8, 10\}$
ii $A \cup B = \{1, 2, 3, 4, 5, 6, 8, 10\}$
b **i** 3 **ii** 8

2 **a** **i** $C \cap D = \{a, g, u, w, z\}$
ii $C \cup D = \{a, b, g, h, u, w, x, y, z\}$
b Yes, u is an element of C and D.
c No, g is an element of both sets and will be an element of the union of the sets.

3 **a** Equilateral triangles have two sides equal.
b F. Redefine G as triangles with two or three equal sides.

4 **a** **i** $T \cup W = \{1, 2, 3, 6, 7, 9, 10\}$
ii $T \cap W = \{1, 3\}$
b Yes; 5 is not listed in T.

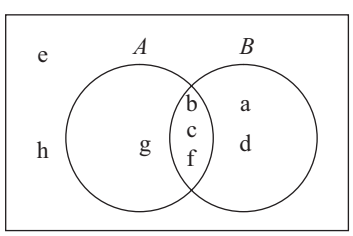
5 **a** {cat, dog, turtle, aardvark}
b {rabbit, emu, turtle, mouse, aardvark}
c {rabbit, cat, dog, emu, turtle, mouse, aardvark}
d { } or ∅
e {rabbit, emu, mouse }
f {rabbit, cat, dog, emu, turtle, mouse, aardvark}

Exercise 9.9

1 **a** $A = \{6, 12, 18, 24\}$ and $B = \{4, 8, 12, 16, 20, 24\}$
b $A \cap B = \{12, 24\}$
c $A \cup B = \{4, 6, 8, 12, 16, 18, 20, 24\}$

2 **a** **i** $P = \{a, b, c, d, e, f\}$
ii $Q = \{e, f, g, h\}$
b $P \cap Q = \{e, f\}$
c **i** $(P \cup Q)' = \{i, j\}$
ii $P \cap Q' = \{a, b, c, d\}$

3 **a**



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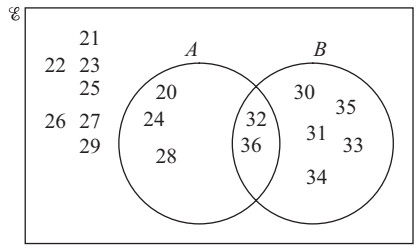
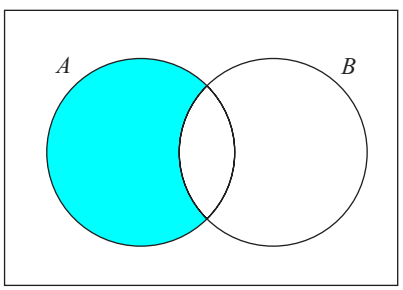


4 **a** $x = 6$
b $n(V) = 16$
c $n(S)' = 16$

5



Exercise 9.10

1 **a** $\{x : x$ is a square number less than 101$\}$
b $\{x : x$ is a day of the week$\}$
c $\{x : x$ is an integer, $x < 0\}$
d $\{x : 2 < x < 10\}$
e $\{x : x$ is a month of the year, x has 30 days$\}$

2 **a** $\{x : x$ is an integer, $1 < x < 9\}$
b $\{x : x$ is a letter of the alphabet, x is a vowel$\}$
c $\{x : x$ is a letter of the alphabet, x is a letter in the name Nicholas$\}$
d $\{x : x$ is an even number, $1 < x < 21\}$
e $\{x : x$ is a factor of 36$\}$

3 **a** {41, 42, 43, 44, 45, 46, 47, 48, 49}
b {equilateral triangle, square, regular pentagon, regular hexagon}
c {18, 21, 24, 27, 30}

4 **a** $A = \{x, y : y = 2x + 4\}$ is the set of ordered pairs on a straight line. The set is infinite, so you cannot list all the points on the line.
b $B = \{x : x^3$ is negative$\}$ this is the set of negative cubes; any negative number cubed will result in a negative cubed number, so the set is infinite.

5 $\{x : x$ is a multiple of 3 and 5$\}$

6 **a** **i** {5}
ii {1, 2, 3, 4, 5}
iii {1, 2, 3, 4, 5}
iv {6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17}
v {1, 2, 3, 4, 5}
b ℰ
c {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17}

Examination practice

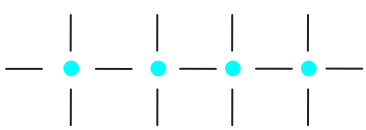
Exam-style questions

1 **a**

Pattern number n	1	2	3	4
Number of dots d	5	8	11	14

b $d = 3n + 2$ **c** 182 **d** 29

2 **a**



b

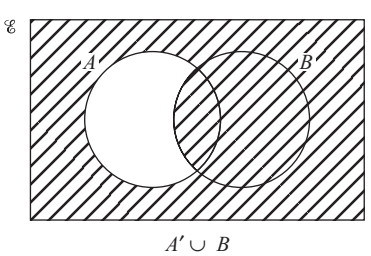
Dots n	1	2	3	4	5	6
Lines l	4	7	10	13	16	19

c 298 **d** $3n + 1$ **e** 28

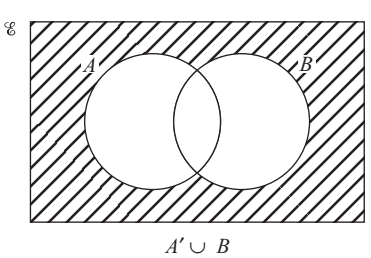
Past paper questions*

1 **a** **i** 11
ii subtract 4 from previous term.
b 2, 6, 10 **c** $3n - 4$

2



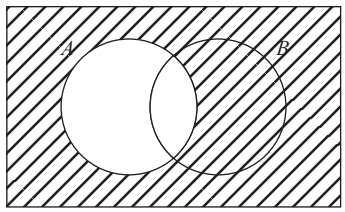
$A' \cup B$



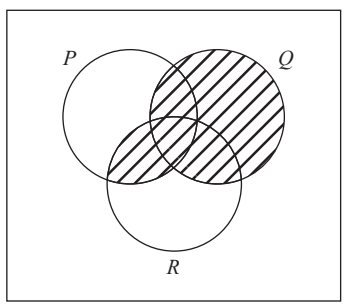
$A' \cup B$

3 $-4n + 17$

4

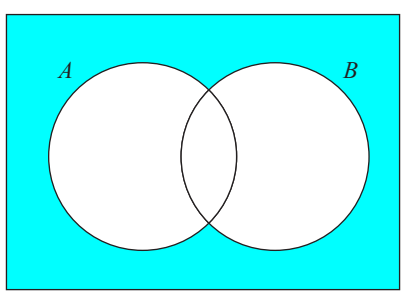


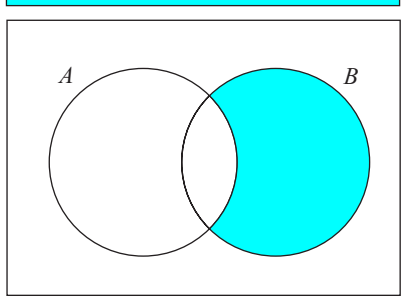
A'



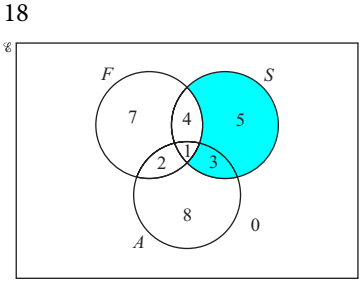
$(P \cap R) \cup Q$

5





6 **a** 18
b



7 **a** 28, 45; 17, 21; 45, 66
b **i** $4n - 3$ **ii** 237
iii 50

8 $\frac{11}{30}$

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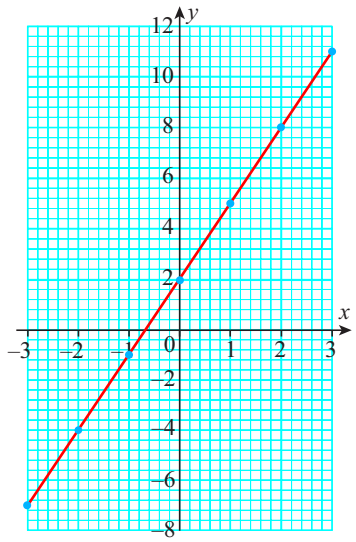
Chapter 10

Exercise 10.1

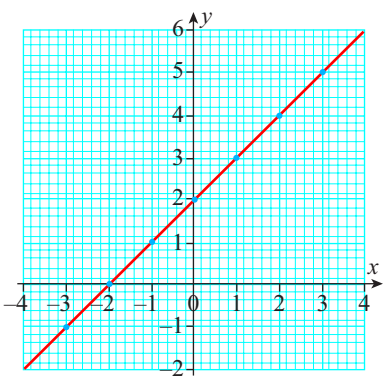
1 a

x	−3	−2	−1	0	1	2	3
y	−7	−4	−1	2	5	8	11



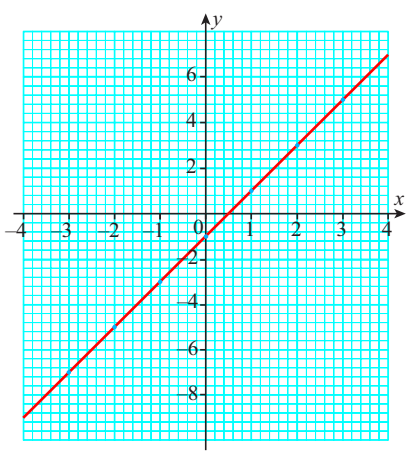
b

x	−3	−2	−1	0	1	2	3
y	−1	0	1	2	3	4	5



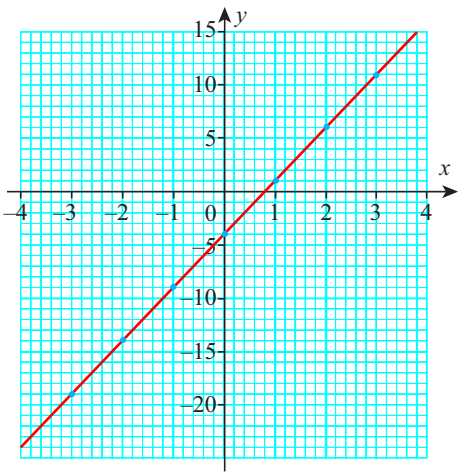
c

x	−3	−2	−1	0	1	2	3
y	−7	−5	−3	−1	1	3	5



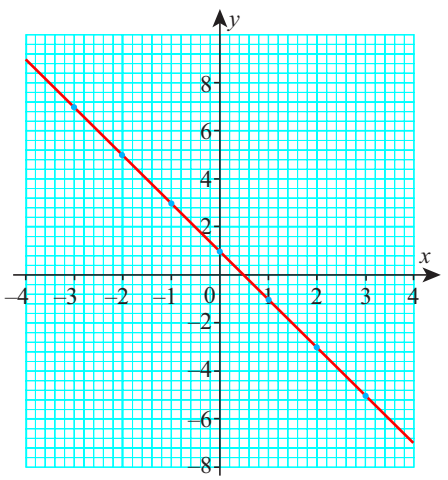
d

x	−3	−2	−1	0	1	2	3
y	−19	−14	−9	−4	1	6	11



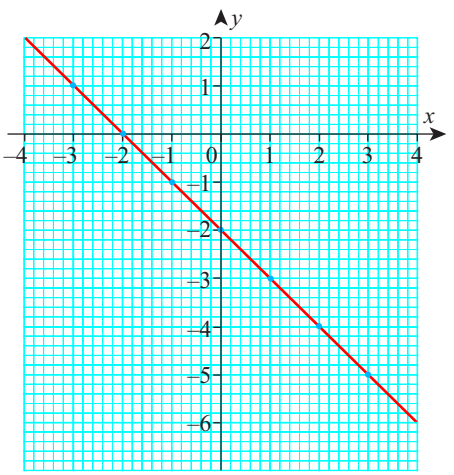
e

x	−3	−2	−1	0	1	2	3
y	7	5	3	1	−1	−3	−5



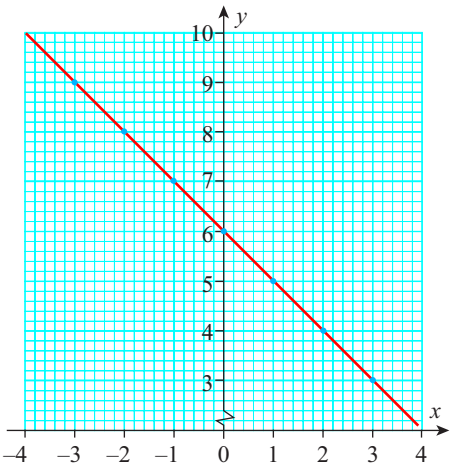
f

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



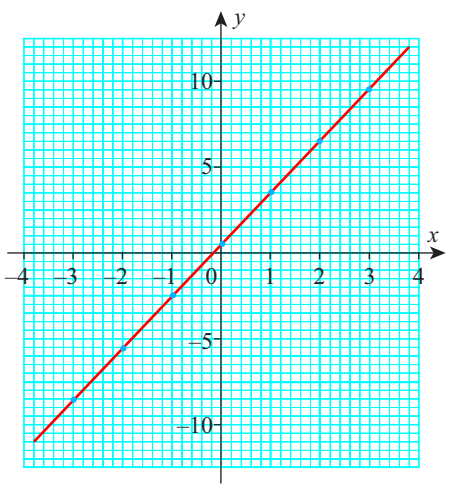
g

x	−3	−2	−1	0	1	2	3
y	9	8	7	6	5	4	3



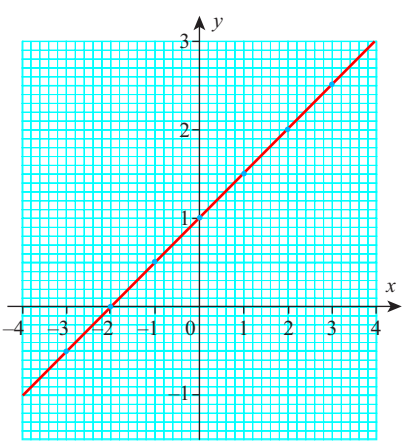
h

x	−3	−2	−1	0	1	2	3
y	−8.5	−5.5	−2.5	0.5	3.5	6.5	9.5



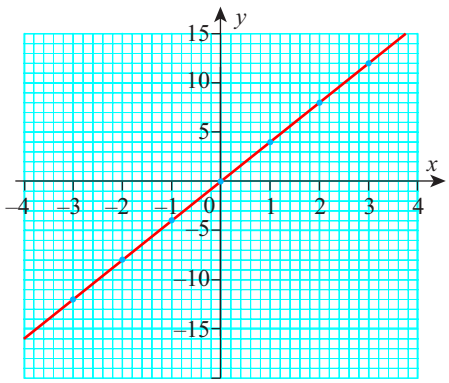
i

x	−3	−2	−1	0	1	2	3
y	−0.5	0	0.5	1	1.5	2	2.5



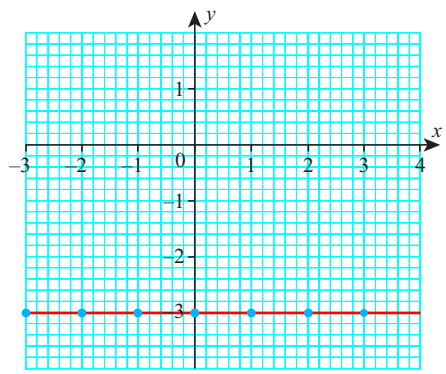
j

x	−3	−2	−1	0	1	2	3
y	−12	−8	−4	0	4	8	12



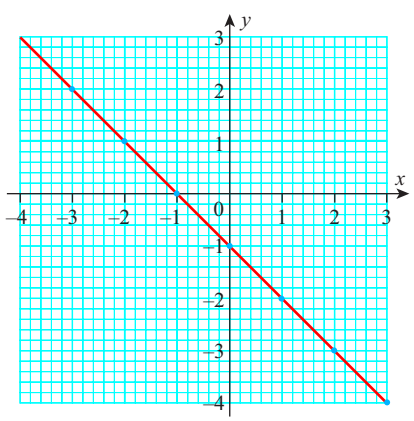
k

x	−3	−2	−1	0	1	2	3
y	−3	−3	−3	−3	−3	−3	−3



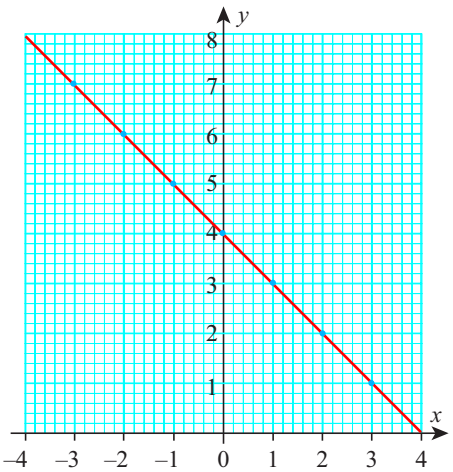
l

x	−3	−2	−1	0	1	2	3
y	2	1	0	−1	−2	−3	−4



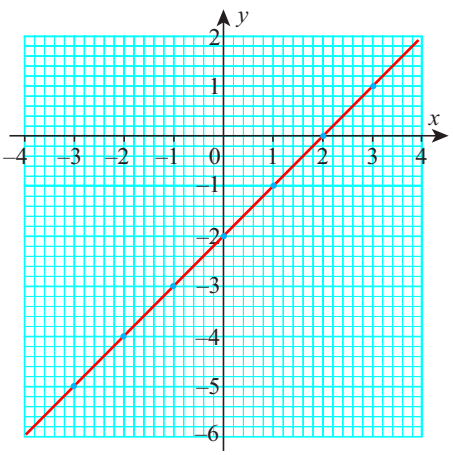
m

x	−3	−2	−1	0	1	2	3
y	7	6	5	4	3	2	1



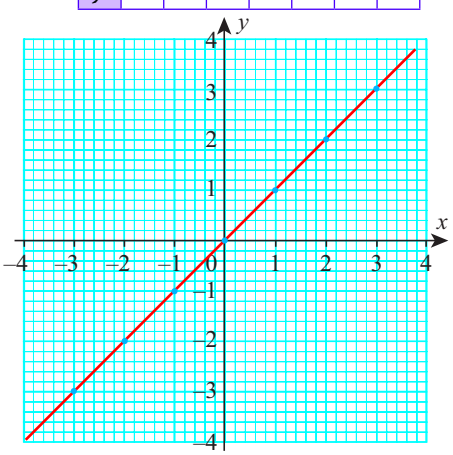
n

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



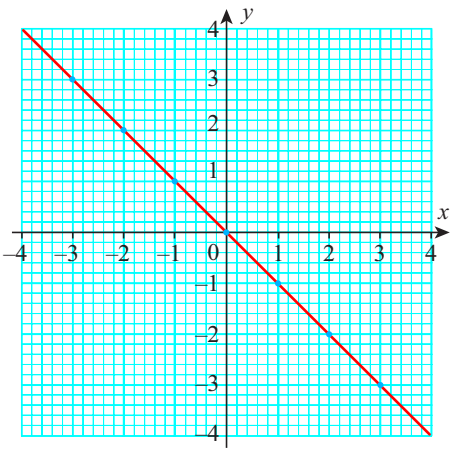
o

x	−3	−2	−1	0	1	2	3
y	−3	−2	−1	0	1	2	3

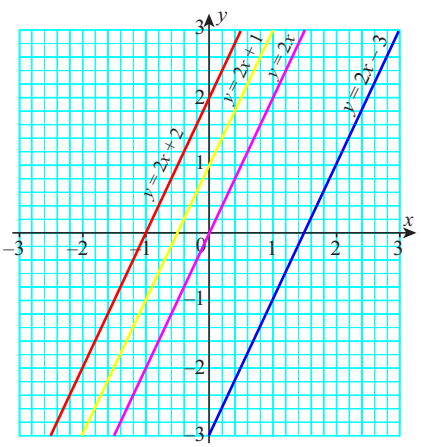


p

x	−3	−2	−1	0	1	2	3
y	3	2	1	0	−1	−2	−3



2



The lines are parallel.

3 **a**

x	−3	0	3
$y = x + 2$	−1	2	5

b

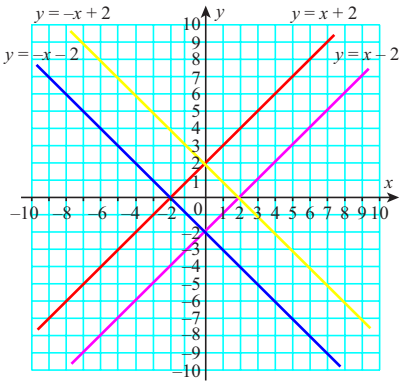
x	−3	0	3
$y = -x + 2$	5	2	−1

c

x	−3	0	3
$y = x - 2$	−5	−2	1

d

x	−3	0	3
$y = -x - 2$	1	−2	−5

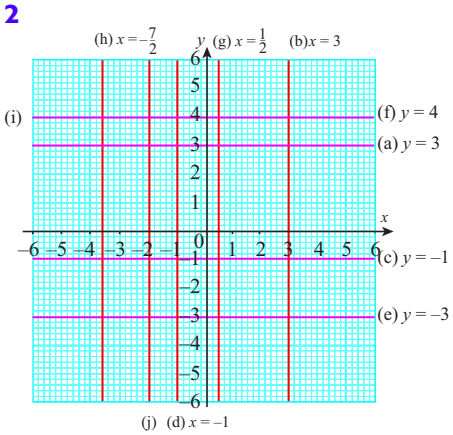


4 **a** $y = x + 2$ cuts the x-axis at $x = -2$
$y = -x + 2$ cuts the x-axis at $x = 2$
$y = x - 2$ cuts the x-axis at $x = 2$
$y = -x - 2$ cuts the x-axis at $x = -2$
b $y = x + 2$ and $y = x - 2$
c $-x + 2$ and $-x - 2$
d $y = x + 2$ and $y = -x + 2$
e $y = x - 2$ and $y = -x - 2$
f None of the graphs
g $y = x + 2$ is parallel to $y = x - 2$
$y = -x + 2$ is parallel to $y = -x - 2$
h Same coefficients of x but different constant values.

Exercise 10.2

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

2



Exercise 10.3

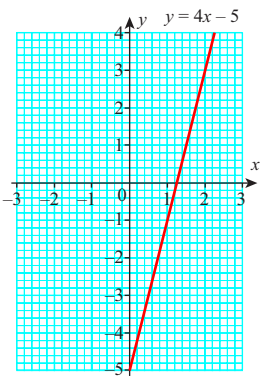
1 **a** 3 **b** 2
c 5 **d** −3
e −5 **f** −1
g $\frac{1}{3}$ **h** $\frac{2}{3}$ **i** $-\frac{1}{4}$

2 **a** 3 **b** 1
c 2 **d** −3
e −3 **f** $\frac{17}{4}$

3 450 m

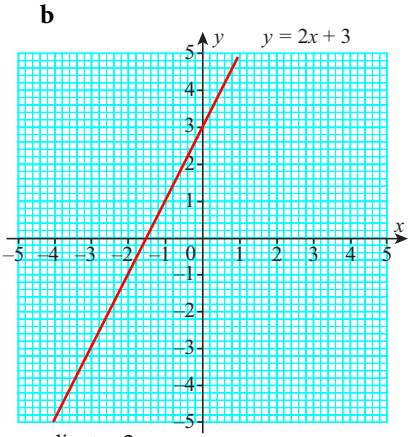
Exercise 10.4

1 **a**



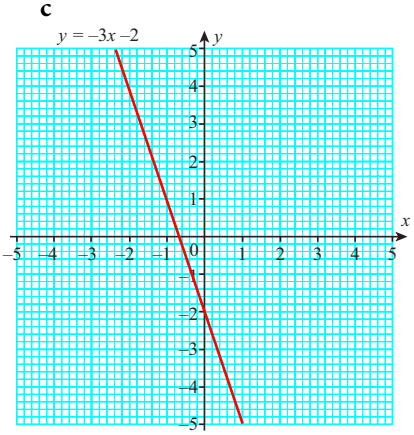
gradient = 4
y-intercept = −5

b



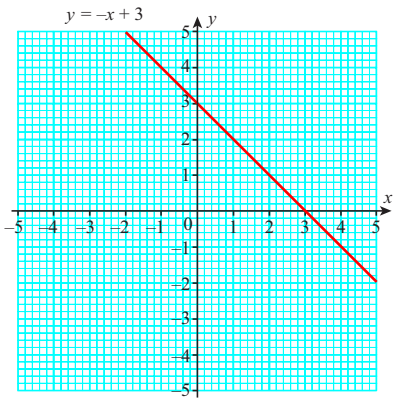
gradient = 2
y-intercept = 3

c



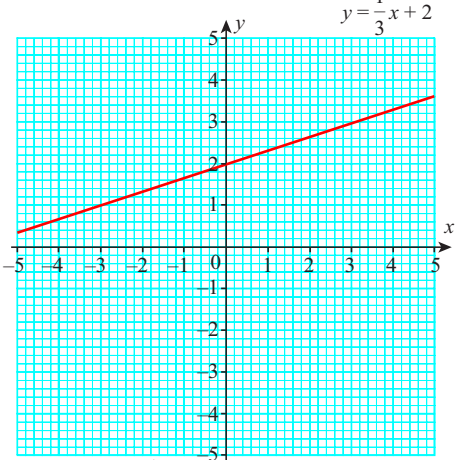
gradient = −3
y-intercept = −2

d



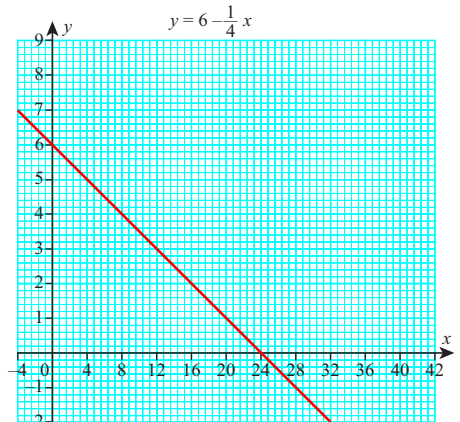
x-intercept = −1
y-intercept = 3

e



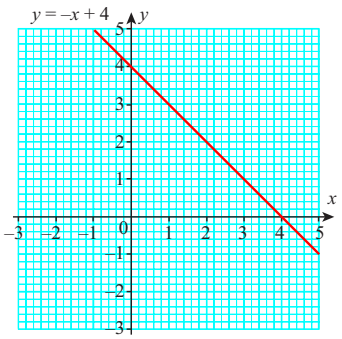
x-intercept = $\frac{1}{3}$
y-intercept = 2

f



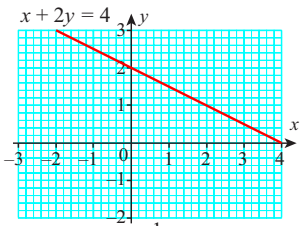
x-intercept = $-\frac{1}{4}$
y-intercept = 6

g



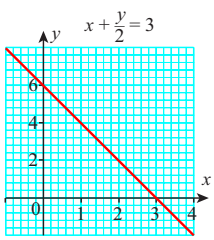
x-intercept $= -1$
y-intercept $= 4$

h



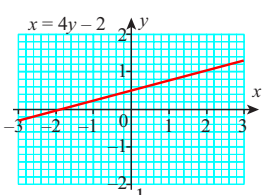
x-intercept $= -\frac{1}{2}$
y-intercept $= 2$

i



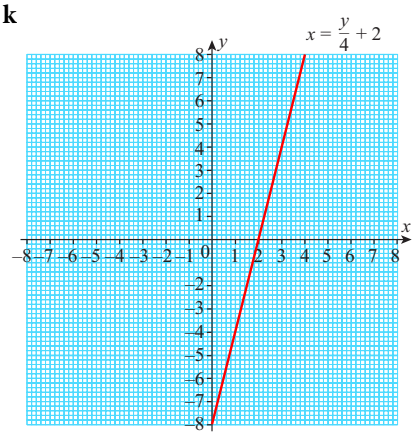
x-intercept $= -2$
y-intercept $= 6$

j



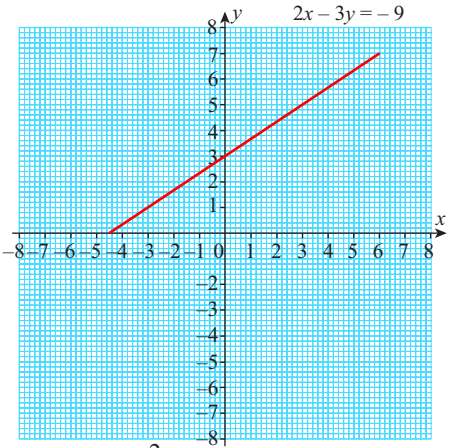
x-intercept $= \frac{1}{4}$
y-intercept $= \frac{1}{2}$

k



x-intercept $= 4$
y-intercept $= -8$

l



x-intercept $= \frac{2}{3}$
y-intercept $= 3$

2

	$y = mx + c$	Gradient	y-intercept
a	$y = \frac{1}{2}x - 2$	$\frac{1}{2}$	-2
b	$y = -2x + 1$	-2	1
c	$y = 2x + 4$	2	4
d	$y = 2x - 5$	2	-5
e	$y = 2x + 5$	2	5
f	$y = \frac{-1}{3}x + 2$	$\frac{-1}{3}$	2
g	$y = 3x - 2$	3	-2
h	$y = -4x + 2$	-4	2
i	$y = 2x + 4$	2	4
j	$y = 6x - 12$	6	-12
k	$y = \frac{1}{8}x - 3$	$\frac{1}{8}$	-3
l	$y = -12x + 6$	-12	6

3 **a** $y = 2x + 3$ **b** $y = -3x - 2$
c $y = 3x - 1$ **d** $y = -\frac{3}{2}x - 0.5$
e $y = -\frac{3}{4}x + 2$ **f** $y = \frac{1}{2}x - 3$
g $y = 0.75x - 0.75$
h $y = -2$ **i** $y = 4$

4 **a** $y = -4x - 1$ **b** $y = \frac{1}{3}x + 1$
c $y = -3x + 2$ **d** $y = 5x + 2$
e $y = 3x + 1$ **f** $y = -x + 2$
g $y = 2x - 3$ **h** $y = \frac{2}{3}x - 1$
i $y = \frac{1}{4}x - 2$

5 **a** $y = 4x - 5$ **b** $y = -3x + 17$
c $y = \frac{9}{5}x - \frac{6}{5}$ **d** $y = \frac{17}{4}x - \frac{71}{4}$

6 Any line with the same gradient, e.g.
a $y = -3x - 5$ **b** $y = 2x + 13$
c $y = \frac{x}{2} - 3$ **d** $y = -x - 4$
e $x = -8$ **f** $y = 6$

7 **a**, **c**

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

9 **a** Any line with gradient $\frac{2}{3}$, e.g. $y = \frac{2}{3}x - 5$
b Any line with same y-intercept, e.g. $y = 2x + 3$
c $y = 3$

Exercise 10.5

1 $y = -5x + 8$

2 **a** Gradient $AB = -2$; Gradient $PQ = \frac{1}{2}$; $-2 \times \frac{1}{2} = -1$, so AB is perpendicular to PQ

b Gradient $MN = \frac{1}{2}$; $\frac{1}{2} \times -2 = -1$, so MN is perpendicular to AB

3 $y = \frac{-1}{3}x + 5$

4 **a** $y = -\frac{1}{2}x + ½$ or $x + 2y - 1 = 0$
b $x + y + 1 = 0$

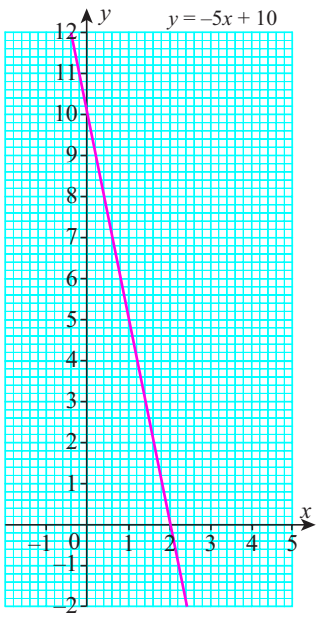
5 Gradient $A = -2$, Gradient $B = ½ - 2 \times ½ = -1$, so A is perpendicular to B

6 $y = 5x - 18$

7 Gradient $AB = \frac{10}{9}$; Gradient $AC = -1$ so AB is not perpendicular to AC and figure cannot be a rectangle.

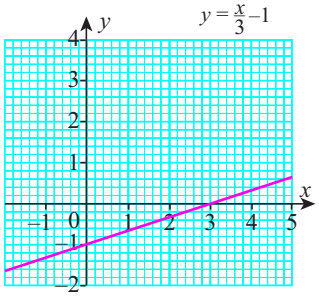
Exercise 10.6

1 a



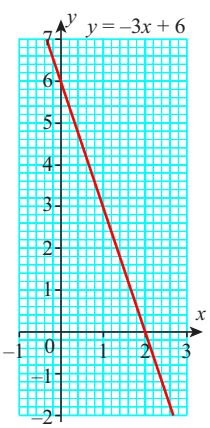
x-intercept = 2
y-intercept = 10

b



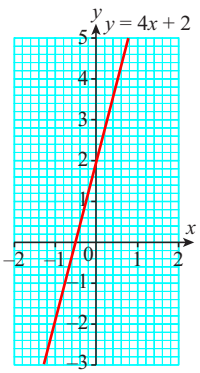
x-intercept = 3
y-intercept = –1

c



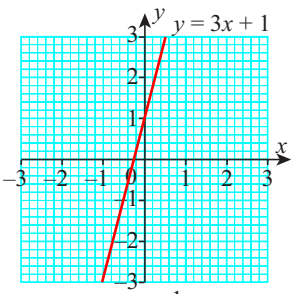
x-intercept = 2
y-intercept = 6

d



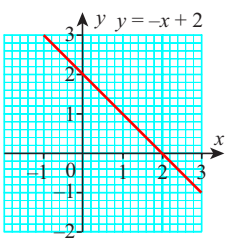
x-intercept = –0.5
y-intercept = 2

e



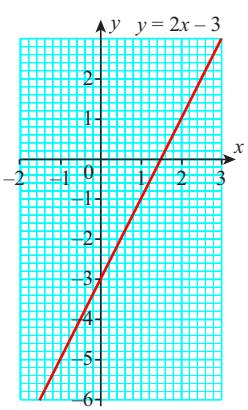
x-intercept = $-\frac{1}{3}$
y-intercept = 1

f



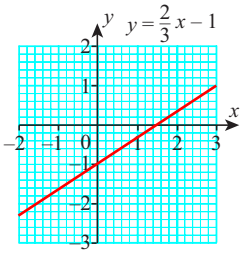
x-intercept = 2
y-intercept = 2

g



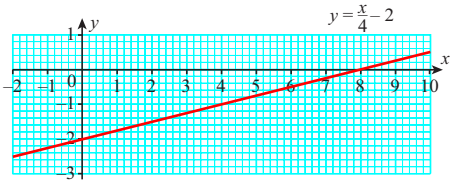
x-intercept = 1.5
y-intercept = –3

h



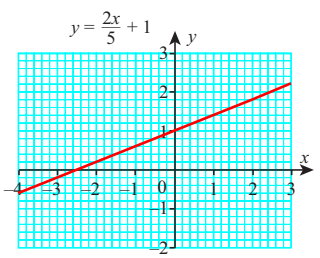
x-intercept = 1.5
y-intercept = –1

i



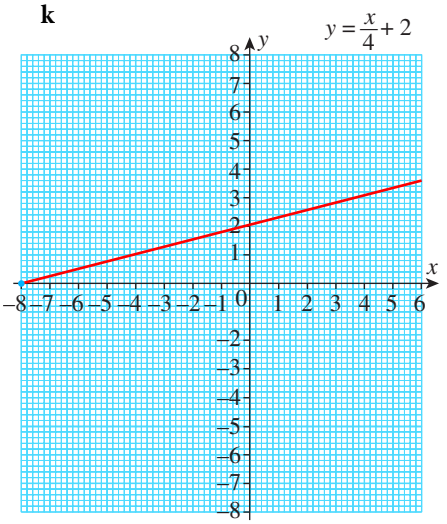
x-intercept = 8 *y*-intercept = –2

j



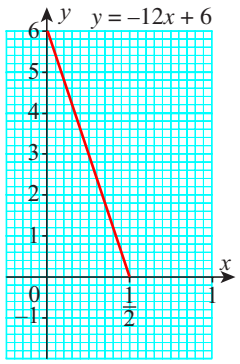
x-intercept = –2.5
y-intercept = 1

k



x-intercept = –8 *y*-intercept = 2

l



x-intercept = 0.5
y-intercept = 6

2 **a** $c = 2$ **b** $c = -4$
c $c = -9$ **d** $c = -8$
e $c = 4$ **f** $c = 3$
g $c = -2$ **h** $c = 2$

Exercise 10.7

1 **a** Length = 8.49 midpoint = (6, 9)
b Length = 4.47 midpoint = (3, 8)
c Length = 5.66 midpoint = (6, 5)
d Length = 3.16
midpoint = (4.5, 9.5)
e Length = 5 midpoint = (2.5, 5)
f Length = 1.41
midpoint = (11.5, 3.5)
g Length = 5 midpoint = (1, 3.5)
h Length = 6.08 midpoint = (4.5, 2)
i Length = 11.05
midpoint = (−2.5, 1.5)

2 $AB = 5.39$ midpoint = (3, 4.5)
$CD = 4.47$ midpoint = (−4, 6)
$EF = 8.60$ midpoint = (−2.5, 2.5)
$GH = 7.07$ midpoint = (3.5, 0.5)
$IJ = 5.10$ midpoint = (2.5, −3.5)
$KL = 12.6$ midpoint = (1, −3)
$MN = 5.39$ midpoint = (−3.5, −2)
$OP = 7.81$ midpoint = (−4.5, −4)

3 5.83
4 B
5 B
6 $AB = 6.40$
$AC = 4.24$
$BC = 7.28$
7 $a = 7$
8 $E = (-6, -2)$

Exercise 10.8

1 **a** $x^2 + 4x + 3$ **b** $x^2 + 10x + 24$
c $x^2 + 19x + 90$ **d** $x^2 + 15x + 36$
e $x^2 + 2x + 1$ **f** $x^2 + 9x + 20$
g $x^2 - 3x - 28$ **h** $x^2 + 5x - 24$
i $x^2 - 1$ **j** $x^2 - x - 72$
k $x^2 - 13x + 42$ **l** $x^2 - 9x - 52$
m $y^2 - 11y - 42$ **n** $z^2 - 64$
o $t^2 + 13t - 68$ **p** $h^2 - 6h + 9$
q $g^2 + 3\frac{1}{2}g - 2$ **r** $d^2 + \frac{3}{4}d - \frac{9}{8}$

2 **a** $12 - 7x + x^2$
b $3 + 7x - 6x^2$
c $6m^2 - 17m + 7$
d $-8x^2 + 2x + 3$
e $8a^2 - 2b^2$
f $-8m^2 - 2mn + 3n^2$
g $x^2 + \frac{3}{4}x + \frac{1}{8}$
h $2x^2 - \frac{2}{3}x - \frac{1}{6}$
i $-2x^4 + 6x^2y - 4y^2$
j $-36b^2 - 26b + 42$
k $-4x^4 + 2xy^2 - 4x^3y + 2y^3$
l $6x^2 + 9x - 15$

3 **a** $2x^2 + 9x + 9$
b $3y^2 + 10y + 7$
c $7z^2 + 15z + 2$
d $4t^2 + 17t - 15$
e $2w^2 - 23w + 56$
f $16g^2 - 1$
g $72x^2 + 23x - 4$
h $360c^2 - 134c + 12$
i $-2m^2 + 10m - 12$

4 **a** $6x^3 + 9x^2 + 2x + 3$
b $15x^4 - 18x^2 + 3$
c $6x^3 + 9x^2y - 2xy - 3y^2$

5 **a** $15x^3 + 21x^2 - 24x - 12$
b $x^3 - 5x^2 - 25x + 125$
c $12x^3 + x^2 - 9x + 2$
d $4x^3 + 32x^2 + 80x + 64$
e $12x^3 - 32x^2 + 25x - 6$
f $18x^3 - 33x^2 + 20x - 4$
g $x^3 + 6x^2 + 12x + 8$
h $8x^3 - 24x^2 + 24x - 8$
i $x^4y^4 - x^4$
j $\frac{1}{81} - \frac{x^2}{18} + \frac{x^4}{16}$

6 **a** $V = (2x + \frac{1}{2})(x - 2)^2$ cm^3
b $2x^3 - 7.5x^2 + 6x + 2$
c 0.196 cm^3

Exercise 10.9

1 **a** $x^2 - 2xy + y^2$
b $a^2 + 2ab + b^2$
c $4x^2 + 12xy + 9y^2$
d $9x^2 - 12xy + 4y^2$
e $x^2 + 4xy + 4y^2$
f $y^2 - 8x^2y + 16x^4$
g $x^4 - 2x^2y^2 + y^4$
h $4 + 4y^3 + y^6$
i $4x^2 + 16xy^2 + 16y^4$
j $\frac{1}{4x^2} - \frac{1}{4xy} + \frac{1}{16y^2}$
k $\frac{9x^2}{16} - \frac{3xy}{4} + \frac{y^2}{4}$
l $a^2 + ab + \frac{b^2}{4}$
m $a^2b^2 + 2abc^4 + c^8$
n $9x^4y^2 - 6x^2y + 1$
o $\frac{4x^2}{9} + \frac{16xy}{3} + 16y^2$
p $x^2 - 6x + 9$

2 **a** $4x - 12$
b $2x^2 + 2x - 19$
c $2y^2 + 8x^2$
d $\frac{x^2}{2} + \frac{8x}{3} - 2$
e $6x^2 + 13.8x + 3.6$
f $-16x^2 + 8xy + 2x - 2y^2$
g $-x^2 + 3x - 22$
h $4x^2 - 12xy - 19y^2$
i $-2x^3 - x^2 - 17x$
j $4x^2 - 13x - 1$

3 **a** −49 **b** 9
c 66 **d** 36
e 0 **f** 321

Exercise 10.10

1 **a** $(x + 12)(x + 2)$
b $(x + 2)(x + 1)$
c $(x + 4)(x + 3)$
d $(x + 7)(x + 5)$
e $(x + 9)(x + 3)$
f $(x + 6)(x + 1)$
g $(x + 6)(x + 5)$
h $(x + 8)(x + 2)$
i $(x + 10)(x + 1)$
j $(x + 7)(x + 1)$
k $(x + 20)(x + 4)$
l $(x + 7)(x + 6)$

2 **a** $(x - 6)(x - 2)$
b $(x - 4)(x - 5)$
c $(x - 4)(x - 3)$
d $(x - 4)(x - 2)$
e $(x - 8)(x - 4)$

f $(x-7)(x-7)$
g $(x-10)(x+2)$
h $(x-9)(x+2)$
i $(x-8)(x+4)$
k $(x+3)(x-2)$
l $(x+11)(x-3)$
m $(x+12)(x-2)$

3 **a** $(y+17)(y-10)$
b $(p-6)(p+14)$
c $(x-12)(x-12)$
d $(t+18)(t-2)$
e $(v+15)(v+5)$
f $(x-10)(x+10)$

Exercise 10.11

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

2 71
3 6

Exercise 10.12

1 **a** $x=0$ or $x=9$
b $x=0$ or $x=-7$
c $x=0$ or $x=21$
d $x=4$ or $x=5$
e $x=-7$ or $x=-1$
f $x=-3$ or $x=2$
g $x=-2$ or $x=-1$
h $x=-10$ or $x=-1$
i $x=3$ or $x=4$
j $x=6$ or $x=2$
k $x=10$ or $x=-10$
l $t=-18$ or $t=2$
m $y=-17$ or $y=10$
n $p=-14$ or $p=6$
o $w=12$

Examination practice

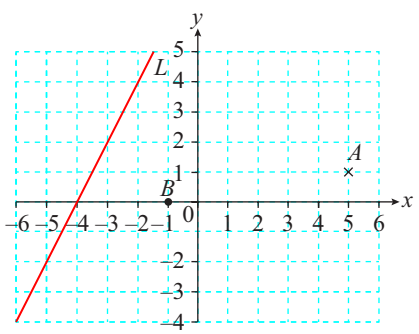
Exam-style questions

1 **a** $x^2+20x+36$ **b** $4x^2-9$
c $12y^4-5y^2-3$

2 **a** **i** $6x(2x-1)$
ii $(y-6)(y-7)$
iii $(d+14)(d-14)$
b **i** $x=0$ or $x=\frac{1}{2}$
ii $y=6$ or $y=7$
iii $d=14$ or $d=-14$

Past paper questions*

1 **a**



b $(-1, 0)$
c 2

2 **a** $(0, 5)$ **b** -1

3 $(3w-10)(3w+10)$

4 $(p-6q)(m+n)$

Chapter 11

Exercise 11.1

1 **a** $x=10\,\text{cm}$ **b** $y=13.4\,\text{cm}$
c $h=2.59\,\text{cm}$ **d** $p=1.62\,\text{cm}$
e $t=7.21\,\text{m}$

2 **a** $x=7.42\,\text{m}$ **b** $y=3.63\,\text{cm}$
c $t=8.66\,\text{cm}$ **d** $p=12\,\text{m}$
e $a=6\,\text{cm}$

3 **a** $x=2.80\,\text{cm}$ **b** $y=4.47\,\text{cm}$
c $h=4.28\,\text{cm}$ **d** $p=8.54\,\text{km}$
e $k=10.4\,\text{cm}$ **f** $h=8.06\,\text{cm}$
g $d=6.08\,\text{m}$ **h** $f=13\,\text{m}$

4 **a** Right-angled
b Not right-angled
c Not right-angled
d Right-angled
e Right-angled

Exercise 11.2

1 53.2 inches
2 3.03 m
3 277 m
4 3.6 m
5 0.841 m
6 **a** 5.39 **b** 3.16
c 9.90 **d** 10.30
7 $P=42.4\,\text{cm}$

Exercise 11.3

1 **a** Similar; all angles equal.
b Similar; sides in proportion.
c Not similar; angles not equal.
d Not similar; sides not in proportion.
e Similar; angles equal.
f Similar; sides in proportion.
g Not similar; sides not in proportion.
h Similar; sides in proportion.
i Similar; angles equal.
j Similar; all angles equal.

2 **a** $x=12$ **b** $y=5$
c $p=12$ **d** $a=12$
e $b=5.25$ **f** $c=5.14$

3 $AC=8.75\,\text{cm}$
4 $CE=4.51\,\text{cm}$
5 $BC=2.97\,\text{m}$
6 lighthouse = 192 m
7 $r=8$
8 $x=60$

Exercise 11.4

1 **a** $\frac{4}{2}=2$ $\frac{6}{5}=1.2$
The ratio of corresponding sides are not the same so the shapes are not similar.
b All sides of shape 1 have length x and all sides of shape 2 have length y so the ratio of corresponding sides will be equal and the shapes are similar.
c $\frac{5}{4}=1.25$ $\frac{4}{3}=1.\dot{3}$
Ratios not equal, so not similar.

d $\frac{80}{60} = 1.\dot{3}$ $\frac{60}{45} = 1.\dot{3}$

Ratios of corresponding sides equal, therefore they are similar.

e $\frac{12}{8} = 1.5$ $\frac{9}{6} = 1.5$

Ratios of corresponding sides equal, therefore they are similar.

f They are not similar because not all corresponding angles are equal.

2 **a** $x = 9$ **b** $y = 14$
c $p = 3.30$ **d** $y = 7.46$
e $x = 50, y = 16$
f $x = 22.4, y = 16.8$
g $x = 7.5, y = 12.5$
h $x = 178$

Exercise 11.5

1 **a** 421.88 cm² **b** 78.1 m²
c 1562.5 m² **d** 375 cm²

2 **a** $x = 24$ cm **b** $x = 30$ m
c $x = 2.5$ cm **d** **d** $x = 15$ cm

3 **a** Area will be 4 times larger.
b Area will be 9 times larger.
c Area will be smaller by a factor of 4.

4 8 : 3

Exercise 11.6

1 $k^2 : k^3$

2 **a** 4 **b** 16 : 1 **c** 64 : 1

3 216 cm²

4 172 cm²

5 **a** 16 mm **b** 157.9 cm²
c 83.2 cm³

6 **a** $20.8\dot{3}$ cm³ **b** $21.\dot{3}$ mm³
c 0.75 m³ **d** 56.64 m³

7 **a** 525 cm² **b** 6860 cm³
c 36 cm **d** 14.15 cm

8

Height	13 cm	11 cm	9 cm
Surface area	x cm²	$\frac{121x}{169}$ cm²	$\frac{81x}{169}$ cm²
Volume	y cm³	$\frac{1331y}{2197}$ cm³	$\frac{729y}{2197}$ cm³

9 $x = 3.72$

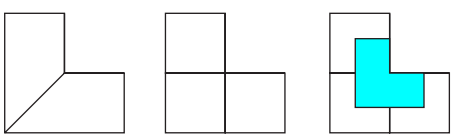
Exercise 11.7

1 **a** **i** SM **ii** PQ **iii** BC
b **i** MSR **ii** EFG **iii** OPQ
c ABCDEFG is congruent to SMNOPQR

2 **a** A, C, I **b** D, F
c B, G **b** E, H, L

3 **a** DEF similar GHI
b ABCD similar EFGH
c MNOP congruent STQR
d ABCDEFGH congruent PIJKLMNO and both similar to WXQRSTUV
e ABC similar MON

4



Exercise 11.8

1 Triangles *ACB* and *PQR* are congruent because SSS is satisfied.

2 Triangles *ACB* and *PQR* are congruent because ASA is satisfied.

3 Triangles *ABC* and *PQR* are congruent because RSH is satisfied.

4 Triangles *ABC* and *QPR* are congruent because SSS is satisfied.

5 The triangles are congruent because SAS is satisfied.

6 Triangles *ABC* and *QPR* are congruent because RSH is satisfied.
OR
Triangles *ABC* and *QPR* are congruent because ASA is satisfied.

7 Triangles *BAC* and *PQR* are congruent because SAS is satisfied.

8 Triangles *ABC* and *QPR* are congruent because RHS is satisfied.

11 Construct PM and NQ
POM = QON (vertically opp)
MO = NO (given)
PO = QO (given)
☐ PMO congruent to QNO (S, A, S)
So, PM = QN (corresponding sides of congruent triangles)

12 Since triangle FAB and FED are congruent:
Angle FAB = angle FED and that makes Triangle CAE a right angled isosceles triangle.
It follows that AC − BC = EC − DC, so BC = CD.
BF = DF (corr sides of congruent triangles)
Therefore BFCD is a kite (two pairs of adjacent equal sides)

Examination practice

Exam-style questions

1 215 m further

2 4.21 m

3 **a** 35 cm **b** 37 cm

4 **a** $a^2 + b^2 = c^2$
$(7x)^2 + (24x)^2 = 150^2$
$49x^2 + 576x^2 = 22500$
$625x^2 = 22500$
$x^2 = 36$
b 336 cm

Past paper questions*

1 6.24

2 432 cm²

3 12

Chapter 12

Exercise 12.1

1 **a** **i** Mode = 12
ii Median = 9
iii Mean = 8
b **i** Mode = 8
ii Median = 6
iii Mean = 5.7
c **i** Mode = 2.1 and 8.2
ii Median = 4.15
iii Mean = 4.79
d **i** Mode = 12
ii Median = 9
iii mean = 11.7

2 Mean increased from 8 to 11.7 because of the extreme value of 43 in(d). No change to mode or median.

3 **a** Andrew's median = 54
Barbara's median = 48.5
b Andrew's mean = 84.25
Barbara's mean = 98.875

4 For example, 1, 2, 3, 4, 15

5 Mode = none; mean = 96.4; median = 103
He will choose the median because it's the highest.

6 4451.6 cm

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7 2.38 kg

8 $91.2\dot{6}$ °C

9 For example, 3, 4, 4, 6, 8

10 For example, 2, 3, 4, 7, 9

11 $\dfrac{mX+nY}{m+n}$

Exercise 12.2

1 **a** Ricky **i** mean = 0.152
ii range = 0.089
Oliver **i** mean = 0.139
ii range = 0.059
b Ricky
c Oliver

2 **a** Archimedes median = 13
Bernoulli median = 15
b Archimedes range = 16
Bernou**lli range = 17**
c Archimedes
d Archimedes

3 Backlights. Footlights has the best mean but the range is large, whereas Backlights and Brightlights have the same range but Backlights has a higher mean.

Exercise 12.3

1 **a** Mean = 4.5 **b** Median = 4
c Mode = 4 and 5 **d** Range = 8

2 **a**

Price	Frequency	Total
$6.50	180	$1170
$8	215	$1720
$10	124	$1240
		$4130

b $7.96

3 **a** Mode = no letters
b Median = 1 letter
c Mean = 0.85 letters
d Range = 5

4 **a** Mode = 1
b Median = 2
c Mean = 2.12

5 **a** Mode = 8
b Median = 6.5
c Mean = $6.0\dot{3}$
d If she wants to suggest the class is doing better than it really is, she would use the mode and say something like: most students got 8 of 10.

6 **a**

Stem	Leaf
4	6
5	0 0 4
5	5 7 8 9
6	0 1 1 2 3 3
6	6 6 8 9
7	0 4

Key
4 | 6 = 46 kilograms

b 12
c Data has many modes.
d 74 – 46 = 28
e 60.5 kg

7 **a**

Stem	Leaf
12	1 5
12	6 6 8 8 8 9 9
13	0 1 2 3 3 4
13	6 8
14	0 0 2 2 3
14	6
15	0

Key
12 | 1 = 121 Components per hour

b 29
c 132.5

Exercise 12.4

1 Mean height = 141.7 cm

2 **a** 5.28 min **b** 5 min 17 s

3 Mean temperature = 57.36 °C

4 **a** Hawks mean mass = 76.7 kg Eagles mean mass = 78.4 kg
b 45 kg for both (this is group range not *actual* data range)
c The range of masses of the players within each team is the same for both teams. So, one can say that on average, the Eagles have a larger mass than the Hawks.

5 Mean = 39.2 cm

6 Mean age = 42.23 years

Exercise 12.5

1 **a** Median = 6, $Q_1 = 4$, $Q_3 = 9$, IQR = 5
b Median = 17, $Q_1 = 12$, $Q_3 = 21$, IQR = 9
c Median = 14, $Q_1 = 5$, $Q_3 = 18$, IQR = 13
d Median = 3.4, $Q_1 = 2.45$, $Q_3 = 4.95$, IQR = 2.5
e Median = 15.65, $Q_1 = 13.9$, $Q_3 = 18.42$, IQR = 4.53

2 Median = 6, $Q_1 = 4$, $Q_3 = 8$, IQR = 4

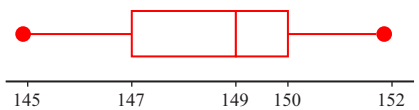
3 **a** Summer: median = 18.5, $Q_1 = 15.5$, $Q_3 = 23.5$
Winter: median = 11.5, $Q_1 = 9.25$, $Q_3 = 12.75$
b Summer: IQR = 8
Winter: IQR = 3.5
c The lower IQR in winter shows that car numbers are more consistent. In poor weather people either use their own transport or take transport more consistently.

4 **a** Julian: median = 23, $Q_1 = 13$, $Q_3 = 24$
Aneesh: median = 18, $Q_1 = 14$ $Q_3 = 20$
b Julian: IQR = 11
Aneesh: IQR = 6
c The IQR for the *Algebraist* is more consistent than that for the *Statistician* and is therefore more likely to have a particular audience while the variation is greater for the *Statistician* and therefore could appeal to a varying audience.

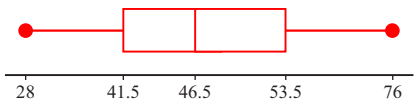
5 **a** **i** 6.5 **ii** 5.9
b **i** 10.85 **ii** 14.05
c **i** 3.275 **ii** 3.65
d At first glance it seems like country driving gets much better fuel consumption as it appears that the data is distributed more towards the higher end of the stems. However, the smaller interval and the decimal nature of the data mean that when you look at IQR, there is not such a massive difference in consumption given that the difference between the two IQRs is only 0.375.

Exercise 12.6

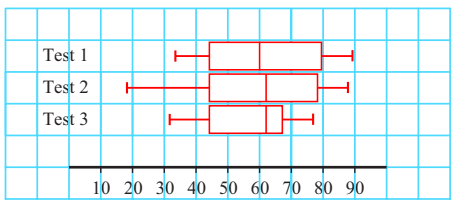
1



2



3 **a**



b Interpretations will vary, but generally the students performed worst on Test 3.

4 **a** 25 km **b** 47.5 km
c 75% **d** 50%
e 10 km
f The data is evenly distributed about the mean as its in the middle of the box part of the diagram.

5 **a** 34 **b** 30
c Team B **d** Team B
e Team A's median is higher and their IQR is overall higher.

6 Shamila spent 30 minutes or more studying every day. For 75 percent of the days, she studied for more than 45 minutes and on half the days she studied for 50 minutes or more. Malika studied for less than 30 minutes on half the days. She only studied for 45 minutes or more on 25% of the days, suggesting she studied for a shorter time over the period. This could be because she found the work easy and didn't need to study so much, or that she just doesn't like to study.

7 Reports will vary, but if you draw vertical lines on the graphs to show the tolerances (at 16.95 and 16.75) you can see that machines B and C produce bars outside the tolerances. Machine C produces the smallest rods, 75% of them are below the given diameter. Machine A is the most consistent with all rods within the given limits.

Examination practice

Past paper questions*

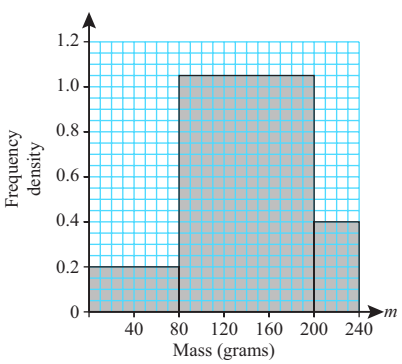
1 **a** $35 < t \leqslant 40$
b 37.3

2 78, 78, 76, 68

3 **a** 137 g (3sf)
b **i**

Mass (m grams)	Frequency
$0 < m \leqslant 80$	16
$80 < m \leqslant 200$	126
$200 < m \leqslant 240$	16

ii



c 135 g

Examination practice

Structured questions for Units 1–3

Answers for these questions are available in the Teacher's Resource.

Unit 4

Chapter 13

Exercise 13.1

1 **a** 4000 g **b** 5000 m
c 3.5 cm **d** 8.1 cm
e 7300 mg **f** 5.760 t
g 210 cm **h** 2000 kg
i 1.40 m **j** 2.024 kg
k 0.121 g **l** 23 000 mm
m 35 mm **n** 8036 m
o 9.077 g

2 $32.4\,\text{cm} < 3.22\,\text{m} < 3\frac{2}{9}\,\text{m}$

3 $125\,\text{ml} < \frac{1}{2}\,\text{litre} < 0.65\,\text{litres} < 780\,\text{ml}$

4 60

5 **a** 14230 mm, 0.01423 km
b 19 060 mg, 0.00001906 t
c 2750 ml, 275 cl
d 4 000 000 mm^2, 0.0004 ha
e 1300 mm^2, 0.000 000 13 ha
f 10 000 mm^3, 0.000 01 m^3

6 **a** 27 m^3 **b** 27 000 000 cm^3
c $2.7 \times 10^{10}\,\text{mm}^3$

7 **a** $1.09 \times 10^{12}\,\text{km}^3$
b $1.09 \times 10^{21}\,\text{m}^3$
c $1.09 \times 10^{30}\,\text{mm}^3$

8 **a** $1.13 \times 10^{2}\,\text{cm}^3$
b $1.13 \times 10^{5}\,\text{cm}^3$
c $1.13 \times 10^{-13}\,\text{km}^3$

9 **a** 6 **b** 20 g

10 **a** No **b** No **c** Yes

Exercise 13.2

1 3 h 39 min

2 **a** 22.30 to 23.30
b 09.15 to 10.45
c 19.45 to 21.10

3 **a** 300 km **b** 120 km/h

4 9 min 47 s

5 Monday 10 February 02.30

6 **a**

Day	Mon	Tues	Wed	Thurs	Fri
Total time worked	7h 55min	7h 55min	7h 25min	7h 53min	8h 24min

b 39 h 32 min **c** $223.36

Exercise 13.3

1 **a** 20.02 **b** 45 min **c** 23 min

2 **a** 1 h 7 min
b

Aville	11:10
Beeston	11:45
Crossway	11:59
Darby	12:17

c 14:25

3 **a** 00:17 **b** 12 h 40 min
c 5 h 46 min
d **i** 01:29 or 13:34
ii Unlikely to be 01:29 because it is in the middle of the night – in the dark.

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e **i** 1–6 February (Wed–Mon)
ii 1–4 February (Wed–Sat)

Exercise 13.4

1 **a** $11.5 \leqslant 12 < 12.5$
b $7.5 \leqslant 8 < 8.5$
c $99.5 \leqslant 100 < 100.5$
d $8.5 \leqslant 9 < 9.5$
e $71.5 \leqslant 72 < 72.5$
f $126.5 \leqslant 127 < 127.5$

2 **a** $2.65 \leqslant 2.7 < 2.75$
b $34.35 \leqslant 34.4 < 34.45$
c $4.95 \leqslant 5.0 < 5.05$
d $1.05 \leqslant 1.1 < 1.15$
e $-2.35 \leqslant -2.3 < -2.25$
f $-7.25 \leqslant -7.2 < -7.15$

3 **a** $131.5 \leqslant 132 < 132.5$
b $250 \leqslant 300 < 350$
c $402.5 \leqslant 405 < 407.5$
d 14.5 million $\leqslant$ 15 million $<$ 15.5 million
e $32.25 \leqslant 32.3 < 32.35$
f $26.65 \leqslant 26.7 < 26.75$
g $0.45 \leqslant 0.5 < 0.55$
h $12.335 \leqslant 12.34 < 12.345$
i $131.5 \leqslant 132 < 132.5$
j $0.1335 \leqslant 0.134 < 0.1345$

4 250 kg $\leqslant$ 300 kg $<$ 350 kg

5 **a** 99.5 m $\leqslant$ 100 m $<$ 100.5 m
b 15.25 seconds $\leqslant$ 15.3 seconds $<$ 15.35 seconds

6 4.45 m $\leqslant L <$ 4.55 m

Exercise 13.5

1 **a** $30.8 \leqslant a^2 < 31.9$
b $13900 \leqslant b^3 < 14100$
c $5.43 \leqslant cd^3 < 5.97$
d $609 \leqslant (a^2 + b^2) < 615$
e $0.248 < \frac{c}{b^2} < 0.251$
f $2.66 < \frac{ab}{cd} < 2.82$
g $-43.5 < \frac{c}{a} - \frac{b}{d} < -46.5$
h $2.66 < \left(\frac{a}{d} \div \frac{c}{b}\right) < 2.82$
i $48.9 < \left(dc + \sqrt{\frac{a}{b}}\right) < 50.7$
j $47.9 < \left(de - \sqrt{\frac{a}{b}}\right) < 49.7$

2 **a** 78.5 cm **b** 79.5 cm

3 37 kg $\leqslant$ mass left $<$ 39 kg

4 **a** 3.605 cm $\leqslant$ Length $<$ 3.615 cm; 2.565 cm $\leqslant$ Width $<$ 2.575 cm
b 9.246825 cm^2 $\leqslant$ area $<$ 9.308625 cm^2
c 9.25 cm^2 $\leqslant$ area $<$ 9.31 cm^2

5 **a** 511105787 km^2 $\leqslant$ Surface area $<$ 511266084 km^2
b $1.08652572 \times 10^{12}$ km^3 $\leqslant$ Volume of Earth $< 1.087036906 \times 10^{12}$ km^3

6 The smallest number of cupfuls is 426.4, and the largest is 433.6.

7 maximum gradient = 0.0739(3sf)
minimum gradient = 0.06

8 **a** 8.1 cm^2 $\leqslant$ area of $\Delta <$ 8.5 cm^2
b 5.76 cm $\leqslant$ hypotenuse $<$ 5.90 cm

9 $63.4° \leqslant x° < 63.6°$

10 $45.2\% \leqslant \left(\frac{45}{98} \times 100\right) < 46.7\%$

11 332 kg $\leqslant$ mean mass $<$ 335 kg (3sf)

12 $117.36 \leqslant$ number of 5s, < 117.84

13 **a** Max = 232.875
Min = 128.625
b **i** Max 5.32 and min 4.86
ii Only 1 can be used. The value of a is 5 to 1 sf. If we find the maximum and minimum values to 2 sf we get 5.3 and 4.9. This doesn't tell us any more than the answer is 5 to 1 sf.

Exercise 13.6

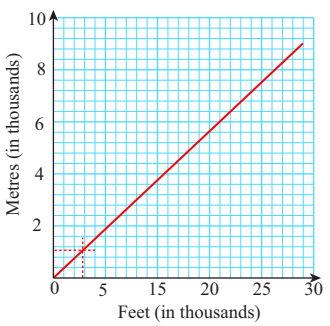
1 **a** 140 °F **b** 60 °F
c −16 °C **d** 38 °C

2 **a** 4 lb **b** 4 kg
c 36 kg **d** 126 lbs
e **i** correct
ii 18 lb = 8 kg
iii 60 lb = 27 kg
iv correct

3 **a** \$40 **b** \$84
c £50 **d** £40

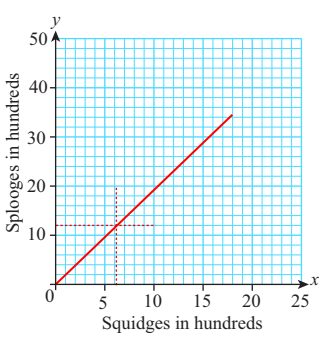
4 **a** 165 min **b** 4.8 kg
c $(40m) + 30 = 25$
$\Rightarrow m = -0.125$ kg
You cannot have a negative mass of meat. As the graph assumes it will always take at least 30 minutes to cook any piece of meat, you cannot use this graph for meat with a very small mass that will take less than 30 minutes to cook.

5 **a**



b 3600 ft (answer may vary +/− 100 foot.)
c 1050 m (answer may vary slightly if answer to (b) varies from that shown.)

6 **a**



b 625 *Squidges* (answer may vary)
c 224 000 *Ploggs* (answer may vary: 220, 000 – 228, 000)

Exercise 13.7

1 \$18.50
2 \$4163.00
3 £8520
4 \$384.52
5 \$2505.80

Examination practice

Exam-style questions

1 **a** 4.116×10^3 cm^3 $\leqslant$ Volume of cube $< 4.038 \times 10^3$ cm^3

b $4.116 \times 10^6 \text{mm}^3 \leqslant$ Volume of cube $< 4.038 \times 10^6 \text{mm}^3$

2 **a** 104 km/h
b 69 mph

3 **a** $129 \leqslant (a + b) < 130$
b $801 \leqslant ab < 808$
c $0.0529 \leqslant \left(\frac{a}{b}\right) < 0.0534$
d $122 \leqslant \left(b - \frac{1}{a}\right) < 123$

Past paper questions*

1 $249.5 \leqslant j < 250.5$

2 \$2.20

3 6.1 cm

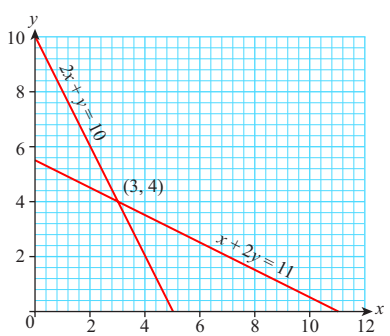
4 $95.5 \leqslant l < 96.5$

5 10

Chapter 14

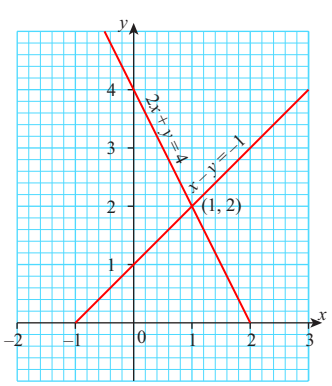
Exercise 14.1

1 **a**



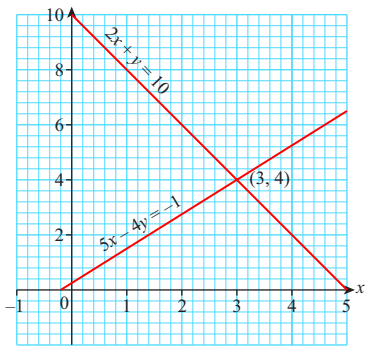
Solution is $x = 3$ and $y = 4$

b



Solution is $x = 1$ and $y = 2$

c



Solution is $x = 3$ and $y = 4$

2 **a** $x = -2, y = -2$ **b** $x = 3, y = 3$
c $x = 3, y = -2$ **d** $x = -1, y = 6$
e $x = \frac{1}{7}, y = -2$ **f** $x = \frac{4}{3}, y = \frac{4}{3}$

3 **a** $x = \frac{9}{11}, y = \frac{-1}{11}$ **b** $x = \frac{5}{4}, y = \frac{-3}{4}$
c $x = \frac{7}{4}, y = 1$ **d** $x = \frac{25}{17}, y = \frac{22}{17}$

4 **a** The scale can sometimes make it difficult to read off certain values, such as fractions, accurately.
b The equations must be solved algebraically.

Exercise 14.2

1 **a** $x = 2, y = 5$ **b** $x = 3, y = -2$
c $x = -10, y = 6$ **d** $x = \frac{4}{3}, y = \frac{-10}{3}$
e $x = -2, y = 4$ **f** $x = -\frac{11}{3}, y = 17$
g $x = \frac{1}{2}, y = \frac{1}{2}$ **h** $x = \frac{19}{17}, y = \frac{10}{17}$

2 **a** $x = 4, y = 4$ **b** $x = 2, y = 6$
c $x = 1, y = 2$ **d** $x = 5, y = -1$
e $x = 3, y = 4$ **f** $x = 1, y = 3$
g $x = 6, y = 3$ **h** $x = 5, y = 4$
i $x = 4, y = 3$ **j** $x = 4, y = 6$
k $x = 6, y = 6$ **l** $x = 4, y = 2$

3 **a** $x = 2, y = 4$ **b** $x = 4, y = 3$
c $x = -5, y = -10$ **d** $x = 5, y = 5$
e $x = \frac{7}{4}, y = \frac{9}{4}$ **f** $x = 5, y = 3$
g $x = \frac{6}{5}, y = \frac{9}{10}$ **h** $x = \frac{7}{3}, y = \frac{-6}{13}$
i $x = \frac{-118}{55}, y = \frac{-5}{11}$ **j** $x = \frac{29}{4}, y = \frac{35}{12}$
k $x = 1, y = -4$ **l** $x = -1, y = -4$
m $x = 5, y = -7$ **n** $x = \frac{-7}{3}, y = \frac{3}{2}$
o $x = \frac{3}{5}, y = \frac{29}{5}$

4 **a** $x = 3, y = 4$ **b** $x = 2, y = 4$
c $x = -3, y = 5$ **d** $x = 6, y = 3$
e $x = 3, y = 5$ **f** $x = 3, y = -4$
g $x = 5, y = 3$ **h** $x = 2, y = 4$
i $x = 2, y = 3$ **j** $x = -2, y = 1$
k $x = -3, y = -2$ **l** $x = \frac{1}{2}, y = 2$
m $x = \frac{-1}{2}, y = 3$ **n** $x = -3, y = 4$
o $x = 5, y = 8$

5 **a** $x = \frac{209}{12}, y = \frac{-301}{80}$
b $x = -17.08, y = -65.05$ (3dp)
c $x = 0.015, y = -0.006$ (3dp)
d $x = \frac{112}{25}, y = \frac{504}{25}$
e $x = 3, y = -2$
f $x = -8, y = -2$
g $x = 6, y = -18$
h $x = -0.739, y = -8.217$
i $x = 5.928, y = -15.985$ (3dp)

6 **a** 90 and 30
b −14.5 and −19.5
c 31.5 and 20.5
d 14 and 20

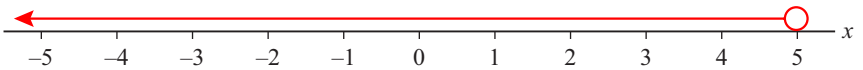
7 Pen drive \$10 and hard drive \$25

8 48 blocks (36 of 450 seats and 12 of 400 seats)

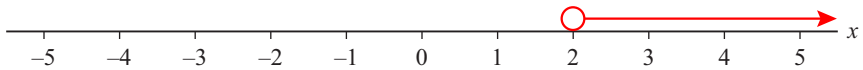
** Cambridge International Examinations bears no responsibility for the example answers to questions taken from its past question papers which are contained in this publication.*

Exercise 14.3

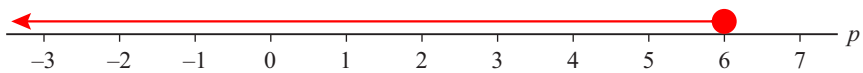
1 **a**



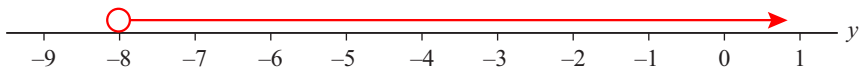
b



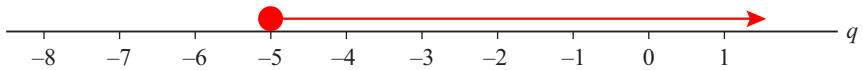
c



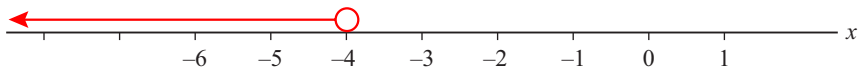
d



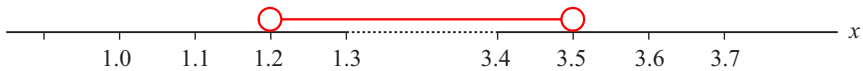
e



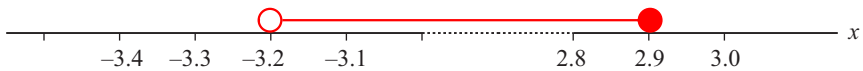
f



g



h



i

2 **a** {4, 5, …… 31, 32} **b** {8, 9, …… 18, 19} **c** {18, 19, …… −26, 27}
d {−3, −2, −1} **e** {−3, −2, − 1, 0} **f** {3, 4, …… 10, 11}
g {−6, −5, −4} **h** {4, 5, 6} **i** {3, 4}

Exercise 14.4

1 **a** $x < 2$ **b** $x > 3$ **c** $y \leqslant \frac{14}{15}$ **d** $y > -2$
e $c \geqslant 2$ **f** $x < 4$ **g** x < 6 **h** p > 3
i $x > -15$ **j** $g \geqslant 4$ **k** $w < 8$ **l** $k < \frac{7}{10}$

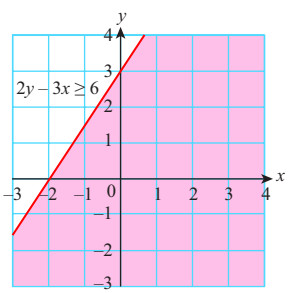
2 **a** $y > 30$ **b** $q < 12$ **c** $g \leqslant \frac{11}{2}$ **d** $h < 19$
e $y \leqslant 30$ **f** $x \leqslant -1$ **g** $h \geqslant -\frac{3}{2}$ **h** $y \geqslant \frac{-44}{3}$
i $n < 48$ **j** $v \leq \frac{-13}{6}$ **k** $z > 62$ **l** $k > 33$
m $e > \frac{31}{28}$

3 **a** $t > 9\frac{1}{4}$ **b** $t > \frac{109}{4}$
c $t > \frac{763}{4}$ **d** $r < \frac{10}{3}$
e $d \geqslant -\frac{305}{444}$

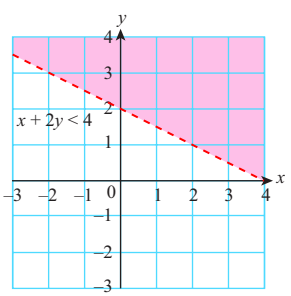
4 Both give the answer 0.42

Exercise 14.5

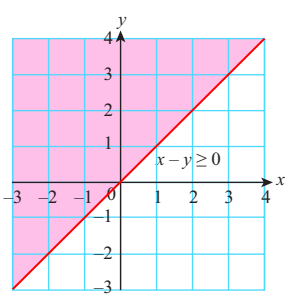
1



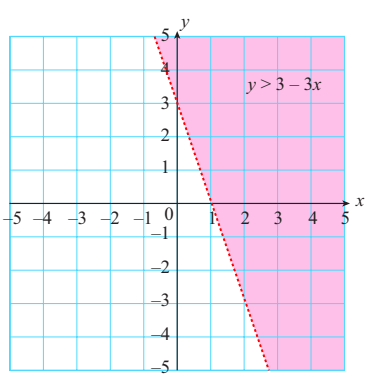
2



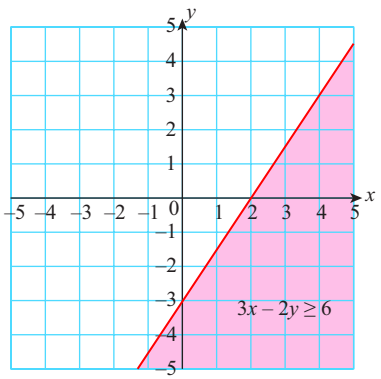
3



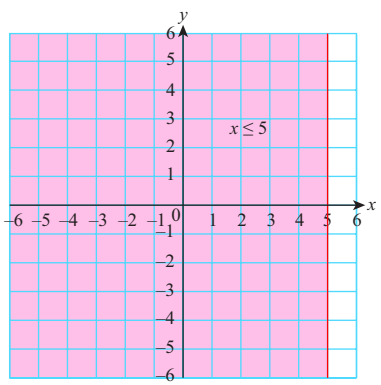
4 **a**



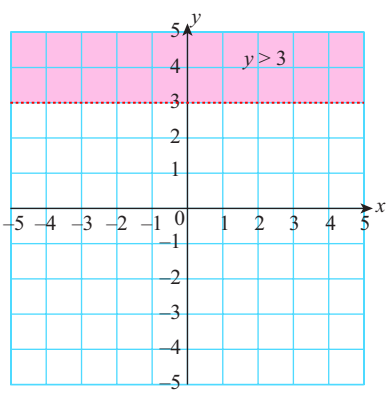
b



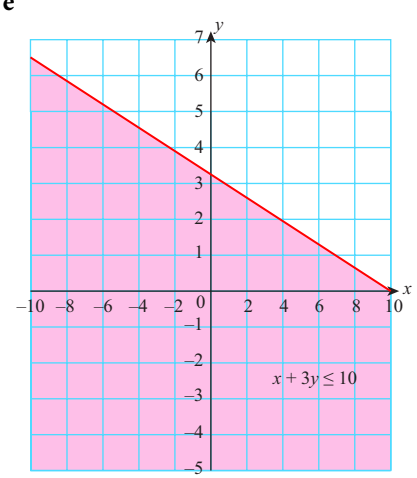
c



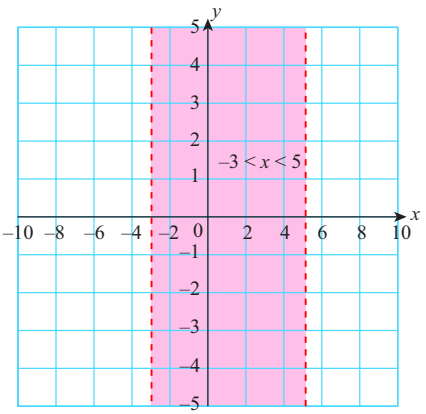
d



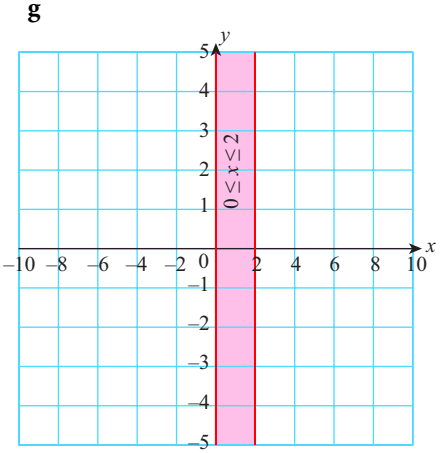
e



f



g

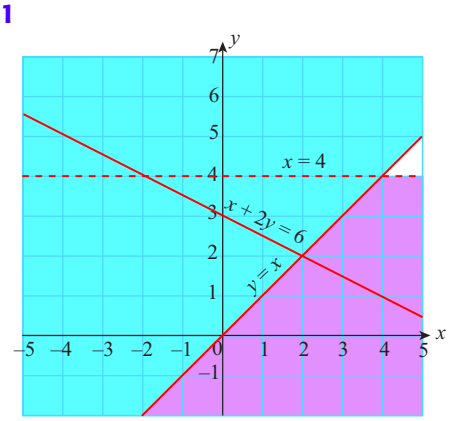


5 **a** above **b** below
c above and below

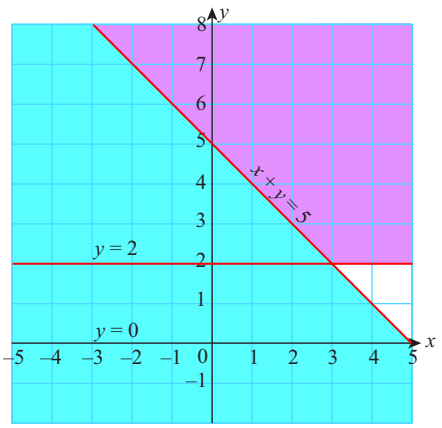
6 **a** $y \leqslant 4x + 5$ **b** $x + y < 3$
c $y \geq \frac{1}{3}x + 1$ **d** $y \leq \frac{-3}{2}x$

Exercise 14.6

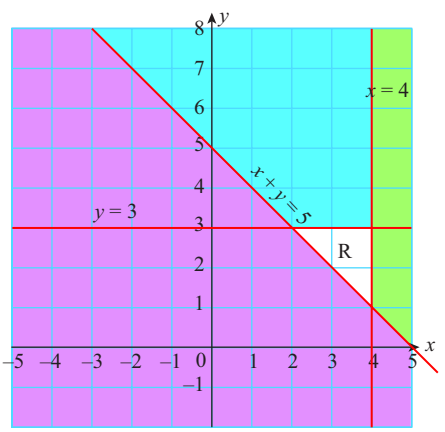
1



2



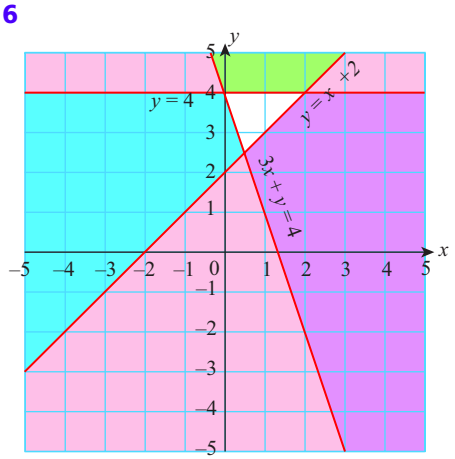
3



4 $y \leqslant -x + 4, y > 2x + 1, x \leqslant 2$

5 (3, 0), (2, 0), (2, 1), (1, 1), (1, 2), (1, 0), (0, 3), (0, 2)

6

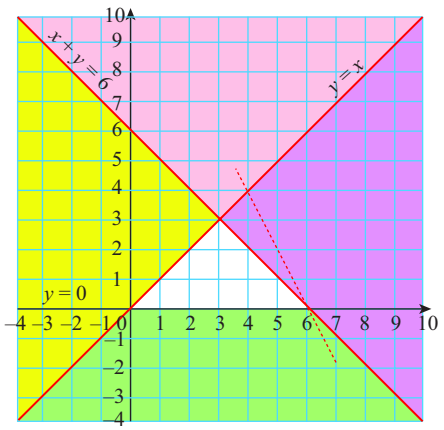


(0, 4) (1, 4) (2, 4) (1, 3)

Exercise 14.7

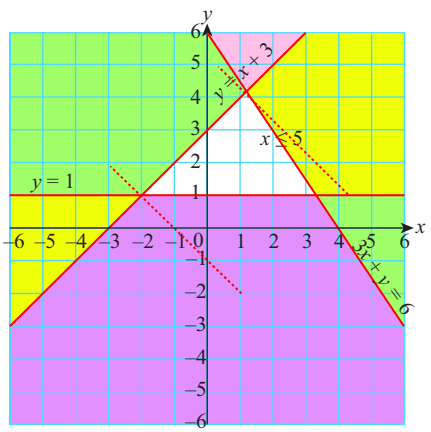
1 Greatest value: $3(6) + 2(6) = 30$
Least value: $3(-2) + 2(6) = 6$

2 **a**



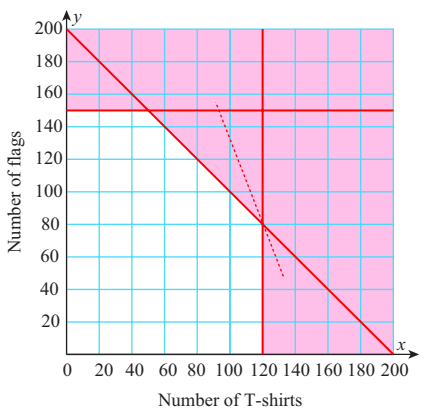
b $2(6) + 0 = 12$

3



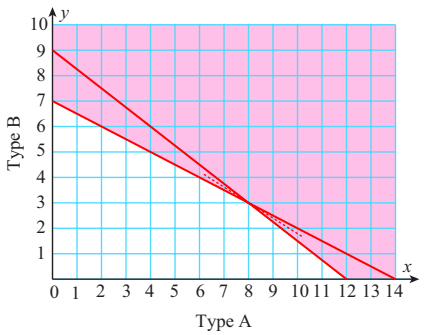
Greatest value = 5
Least value = −1

4



120 T-shirts and 80 flags will maximise income.

5



8 type A and 3 type B give 10 m^3 storage

Exercise 14.8

1 **a** $(x+3)^2 + 5$ **b** $(x+4)^2 - 15$
c $(x+6)^2 - 16$ **d** $(x+3)^2 - 4$
e $(x-2)^2 + 8$ **f** $(x-1)^2 - 18$
g $(x+\frac{5}{2})^2 - \frac{21}{4}$ **h** $(x+\frac{7}{2})^2 - \frac{57}{4}$
i $(x-\frac{3}{2})^2 - \frac{21}{4}$ **j** $(x+\frac{7}{2})^2 - \frac{81}{4}$
k $\left(x-\frac{13}{2}\right)^2 - \frac{165}{4}$
l $(x-10)^2 + 300$

2 **a** $x = 0.74$ or -6.74
b $x = -0.54$ or -7.46
c $x = 3.41$ or 0.59
d $x = 1.14$ or -6.14
e $x = 2$ or 1
f $x = 11.92$ or 0.08

3 **a** $x = 3.70$ or -2.70
b $x = 1.37$ or -4.37
c $x = 0.16$ or -6.16
d $x = 1.77$ or -2.27
e $x = 1.89$ or 0.11
f $x = 5.37$ or -0.37
g $x = 1.30$ or -2.30
h $x = 3$ or -1
i $x = 1.62$ or -0.62

Exercise 14.9

1 **a** $x = -3$ or -4
b $x = -6$ or -2
c $x = -7$ or -4
d $x = -5$ or 1
e $x = -8$ or 2
f $x = 8$ or -20
g $x = 4$ or 2
h $x = 7$ or -4
i $x = 8$ or -3
j $x = 8$ or 4
k $x = 11$ or -9
l $x = 12$ or -3
m $x = 6$ or 4
n $x = 5$ or 7
o $x = -3$ or 12

2 **a** $x = 0.162$ or -6.16
b $x = -1.38$ or -3.62
c $x = -2.38$ or -4.62
d $x = -0.586$ or -3.41
e $x = 3.30$ or -0.303
f $x = 3.41$ or 0.586
g $x = 7.16$ or 0.84
h $x = 2.73$ or -0.732
i $x = 6.61$ or -0.606
j $x = 8.24$ or -0.243
k $x = 8.14$ or -0.860
l $x = -0.678$ or -10.3

3 **a** $x = 1.71$ or 0.293
b $x = 1.26$ or -0.264
c $x = 0.896$ or -1.40
d $x = -0.851$ or 2.35
e $x = -1.37$ or 0.366
f $x = 0.681$ or -0.881

4 **a** $x = 2.28$ or 0.219
b $x = 0.631$ or 0.227
c $x = 0.879$ or -0.379
d $x = 1.35$ or -2.95
e $x = -2.84$ or -9.16
f $x = 6.85$ or 0.146

5 $x = 1.61$ cm (-5.61 is not a solution because length cannot be negative)

6 **a** 4.53 metres **b** 248 months

Exercise 14.10

1 **a** $(3x+2)(x+4)$
b $(2x+3)(x-1)$
c $(3x+2)(2x-1)$
d $(3x+8)(x+2)$
e $(2x-5)(x+2)$
f $(4x-1)(4x+9)$
g $(3x+1)(x+5)$
h $(4x-1)(2x+1)$
i $(2x+3)(x-2)$
j $(2x+3)(x+3)$
k $(3x+8)(x-2)$
l $(5x-3)(2x+1)$
m $(5x+1)(x+1)$
n $(2x-1)(x-9)$
o $(6x-5)(2x+3)$

Exercise 14.11

1 As Exercise 14.10

2 **a** $(3x-7)(2x+3)$
b $-(2x+3)(x+5)$
c $(2x+3y)(2x+3y)$
d $(3x+y)(2x-7y)$
e $(x^2-9)(x^2-4)=(x-3)(x+3)(x-2)(x+2)$
f $2(3x-4y)(x-5y)$
g $(3x+2)(2x+1)$
h $(3x-4)(x-3)$
i $3(x-5)(x-8)$
j $(x-1)(x-2)$
k $4(x-2)(x-1)$
l $(2x)(6x+13)$

Exercise 14.12

1 **a** $\frac{x}{2}$ **b** $\frac{y}{4}$
c 5 **d** 10
e $\frac{t}{6}$ **f** $\frac{u}{3}$
g $\frac{t}{10}$ **h** $\frac{y}{2}$
i $\frac{3z}{4}$ **j** $\frac{4t}{3}$

2 **a** $\frac{xy}{3}$ **b** $\frac{x}{4y}$
c $\frac{1}{2}$ **d** $\frac{y}{2}$
e $5x$ **f** $3b$
g $\frac{2x}{3y}$ **h** $3b$
i $\frac{2}{3de}$ **j** $\frac{1}{4b^2}$

3 **a** $\frac{a}{5b}$ **b** ab
c $\frac{b}{2}$ **d** $\frac{ac}{4}$
e $\frac{abc}{2}$ **f** $\frac{9b}{4c}$
g $(abc)^2$ **h** $\frac{3y}{4x}$
i $\frac{4x^2z}{3y}$ **j** 9

4 **a** $\frac{18}{17z^3}$ **b** $\frac{x^3z}{2y}$
c $\frac{3v}{7u^2w^4}$ **d** $\frac{x+3}{x+4}$
e $\frac{x}{x+4}$ **f** $\frac{y^3}{y+1}$
g $\frac{x-6}{x-4}$ **h** $\frac{x+5}{x-3}$
i 8 **j** $\frac{3x+2}{3x-2}$
k $\frac{x+3}{x+8}$ **l** $\frac{2x-3}{x+1}$
m $\frac{7x-1}{x-4}$ **n** $\frac{5y-4}{y-7}$
o $\frac{3x-7}{5x-4}$

5 **a** $\frac{3x-4}{7x+1}$ **b** x^2+y^2
c $\frac{1}{x}$ **d** x^2+1
e 1 **f** $\sqrt{x^3+y^3}$

Exercise 14.13

1 **a** $\frac{x^2}{4}$ **b** $\frac{3y^2}{14}$
c $\frac{3z^2}{14}$ **d** $\frac{t^2}{3}$
e 1 **f** $\frac{1}{6}$
g $\frac{3f}{2e}$ **h** $\frac{gh^2}{32}$
i 2 **j** $\frac{1}{2y^2}$
k $\frac{2d}{7c}$ **l** $\frac{r}{2pq}$

2 **a** $\frac{3z^2t^2}{x^3}$ **b** $\frac{2xt}{3}$
c $\frac{3}{4xy}$ **d** $\frac{64t^4y^4}{27}$
e $\frac{3}{4(x+y)^5(x-y)}$ **f** $\frac{1}{4(a-b)}$
g $\frac{\left(\sqrt{z^2+t^2}\right)^3}{144\,(x^2+y^2)}$ **h** $\frac{z-t}{z-y}$

Exercise 14.14

1 **a** $\frac{3y}{4}$ **b** $\frac{8t}{15}$
c $\frac{12u}{35}$ **d** $\frac{z}{14}$
e $\frac{5(x+y)}{12}$ **f** $\frac{3x}{2}$
g $\frac{11y}{8}$ **h** $\frac{a}{40}$
i $\frac{a}{2}$ **j** $\frac{7x+18y}{63}$

2 **a** $\frac{19(x+1)^2}{56}$ **b** $\frac{29pqr}{136}$
c $\frac{93p}{70}$ **d** $\frac{71x}{84}$
e $\frac{62x^2}{63}$ **f** $\frac{33-5x}{18}$

3 **a** $\frac{x+3}{a}$ **b** $\frac{23}{12a}$
c $\frac{19x}{6y}$ **d** $\frac{3a+2}{a^2}$
e $\frac{17}{6x}$ **f** $\frac{7}{5e}$

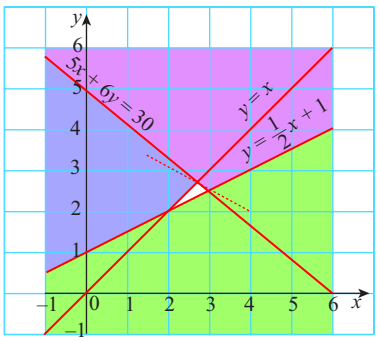
4 **a** $\frac{2x+5}{(x+1)(x+4)}$ **b** $\frac{5x-7}{(x-1)(x-2)}$
c $\frac{7x+39}{(x+2)(x+7)}$ **d** $\frac{5}{2x}$
e $\frac{7}{6xy}$ **f** $\frac{2+x^2}{x}$
g $\frac{x^2+2x+5}{2(x+1)}$
h $\frac{(x^2-1)(27y-14)}{63y^2}$
i $\frac{2y-x^3}{2x^2y}$
j $\frac{4x^2y+4xy-yz^2-z^3}{12xyz^2}$
k $\frac{1}{x+3}$ **l** $\frac{2}{x+2}$

Examination practice

Exam-style questions

1 **i** $\sqrt{37}$
ii 5

2 **a**



b Greatest value for $x+2y=8\frac{2}{11}$

(occurs at intersection of $x=y$ and $5x+6y=30$)

Past paper questions*

1 $x > -9$

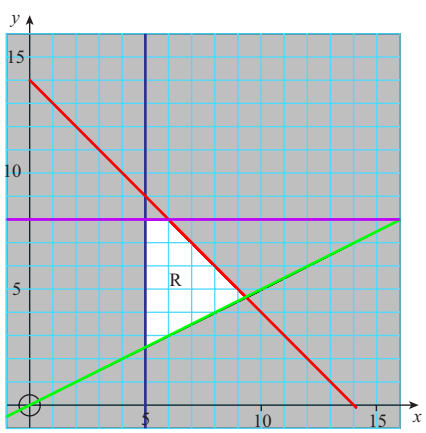
2 (8, 2)

3 1, 2, 3, 4

4 $\frac{23-2x}{12}$

5 **a** **i** $x \geqslant 5, y \leqslant 8, x+y \leqslant 14, y \geqslant 0.5x$

ii



b **i** \$480

ii 6 small boxes, 8 large boxes

6 $\frac{h+4}{h+5}$

7 $\frac{(x-1)}{3}$

8 $\frac{(x+7)}{(2x-1)(x+2)}$

9 $x = 1.58$ or $x = -0.380$

10 $a=\frac{7}{2}$ $b=\frac{-69}{4}$

11 $x=4$ $y=0.5$

Chapter 15

Exercise 15.1

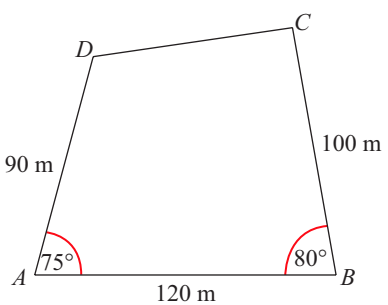
1 6.8 m × 5.2 m

2 **a** 3 cm **b** 2.4 cm

3 **a** 5.6 cm **b** 15°

Exercise 15.2

1 **a**



b BCD = 92°; ADC = 113°

c 80 m

2 **a** 20° **b** 3.4 m

3 **a** 20 m **b** 34.8 m **c** 35°

Exercise 15.3

1 **a** 270° **b** 135° **c** 045°

2 **a** 262° **b** 135°

3 **a** 110° **b** 050° **c** 230°
d 025° **e** 280°

4 **a** 108° **b** 288° **c** 147 km

5 **a** 9.6 km **b** 090°

Exercise 15.4

1

	Hypotenuse	Opposite A	Adjacent A
a	c	a	b
b	y	z	x
c	p	q	r
d	l	n	m
e	c	d	e
f	e	f	g

2 **a** opp (30°) = 5.7 cm

b opp(40°) = x cm
adj(50°) = x cm

c opp(65°) = q m or adj(25°)
opp(25°) = p m or adj(65°)
hypotenuse = r m

Exercise 15.5

1 **a** 0.700 **b** 1.04
c 0.325 **d** 1
e 0.279 **f** 0.323
g 0.00873 **h** 0

2 **a** $\tan A=\frac{1}{2}$ **b** $\tan A=\frac{3}{2}$
c $\tan A=\frac{1}{4}$, $\tan B=4$ **d** $\tan x=\frac{3}{2}$
e $\tan x=\frac{n}{m}$, $\tan y=\frac{m}{n}$ **f** $\tan C=a$
g $\tan D=p^2$

3 **a** 5.20 cm **b** 4.62 m
c 35.7 m **d** 3.54 km
e 18 cm **f** 10.3 cm

4 **a** 20.8 cm **b** 16.1 cm
c 9.17 cm **d** 7.85 cm
e 40.6 cm **f** 115 m
g 2.61 m **h** 95.8 km
i 39.8 m

5 **a** 1.0724 **b** 32.2 m

6 32.3 m

7 **a** 1.73 **b** 2

8 0.45 m

9 Adi is not correct, the pole is 4.34 m tall.

Exercise 15.6

1 **a** 40.4° **b** 60.0°
c 74.3° **d** 84.3°

2 **a** 22° **b** 38°
c 38° **d** 70°

3 **a** $a = 35.0°$ **b** $b = 77.5°$
c $c = 38.7°$, $d = 51.3°$
d $e = 18.4°$ **e** $f = 30°$

4 71.8° (1dp)

5 21.2° (1dp)

6 **a** 13.3 (3sf) **b** 26.7 (3sf)

7 $AB = 6.32$ (3sf)
ACB = 64.6° (1dp)

Exercise 15.7

1

	a	b	c	d	e	f	g
$\sin A$	$\frac{4}{5}$	$\frac{7}{25}$	$\frac{12}{13}$	$\frac{20}{29}$	$\frac{8}{17}$	$\frac{4}{5}$	$\frac{13}{85}$
$\cos A$	$\frac{3}{5}$	$\frac{24}{25}$	$\frac{5}{13}$	$\frac{21}{29}$	$\frac{15}{17}$	$\frac{3}{5}$	$\frac{84}{85}$
$\tan A$	$\frac{4}{3}$	$\frac{7}{24}$	$\frac{12}{5}$	$\frac{20}{21}$	$\frac{8}{15}$	$\frac{4}{3}$	$\frac{13}{84}$

2 **a** 0.0872 **b** 0.9962
c 0.5000 **d** 0.8660
e 0.8660 **f** 0.5000
g 0.9962 **h** 0.0872

3 **a** $\cos 42° = \frac{g}{e}$ **b** $\sin 60° = \frac{c}{a}$
c $\cos 25° = \frac{RQ}{RP}$ **d** $\sin\theta = \frac{y}{r}$
e $\cos 48° = \frac{q}{r}$ **f** $\sin 30° = \frac{e}{f}$
g $\cos 35° = \frac{HI}{JI}$ **h** $\cos\theta = \frac{x}{r}$

4 **a** 0.845 m **b** 4.50 m
c 10.6 km **d** 4.54 cm
e 10.6 cm **f** 9.57 cm
g 14.1 cm **h** 106 cm
i 4.98 cm **j** 42.9 m
k 2.75 m **l** 137 m

5 **a** 81.9° **b** 57.1°
c 22.0° **d** 30°

6 **a** 25.9° **b** 44.9°
c 69.5° **d** 79.6°
e 26.9° **f** 11.5°

7 1.93 m (2 d.p.)

8 **a** 10.1 km (3sf)
b 14.9 km (3sf)

9 **a** 14.1 m (3sf)
b 5.13 m (3sf)

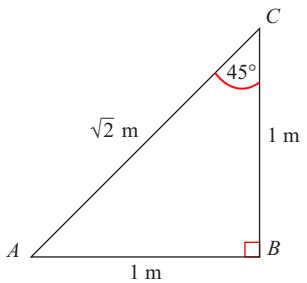
10 552 m (3sf)

11 **a** $x = 14.81$ cm
b $y = 10.09$ cm
c $A\Delta = 44.99$ m
d $a = 29.52$ cm
$b = 52.80$ cm

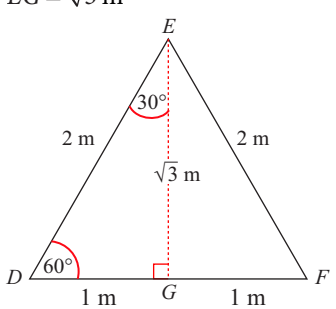
12 **a** **i** 0.577 **ii** 0.577
b **i** 1.11 **ii** 1.11
c **i** −1.73 **ii** −1.73
d **i** 0.249 **ii** 0.249
$\therefore \tan x = \frac{\sin x}{\cos x}$

13 **a** 1 **b** 1 **c** 1
d $\sin^2 x + \cos^2 x = 1$

14 **a** $ACB = 45°$ **b** $\sqrt{2}$ m
c



d $\sin 45° = \frac{1}{\sqrt{2}}$
$\cos 45° = \frac{1}{\sqrt{2}}$
$\tan 45° = 1$
e $y = 60°$ **f** $z = 30°$
g $EG = \sqrt{3}$ m
h



i $\sin 30° = \frac{1}{2}$
$\cos 30° = \frac{\sqrt{3}}{2}$
$\tan 30° = \frac{1}{\sqrt{3}}$
$\sin 60° = \frac{\sqrt{3}}{2}$
$\cos 60° = \frac{1}{2}$
$\tan 60° = \sqrt{3}$

j

Angle x	$\sin x$	$\cos x$	$\tan x$
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
45°	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1

Exercise 15.8

1 **a** $ABC = 16.2°$
b $BC = 17.9$ m

2 $AB = 13.856$ cm (3dp)

3 **a** $ABC = 59.0°$
b $AB = 1.749$ (3dp)
c Capacity $= 4.05$ m^3

4 $ABC = ACB = 38.9°$ and $BAC = 102.1°$

5 **a** 020° **b** 281.9 m
c 98 668 m^2

6 **a** 3.5 m (1dp)
b $DE = 6.1$ m (1dp)

7 $QT = 16$ cm

8 **a** $AOE = 72°$
b $AOM = 36°$
c $OM = 1.376$ cm (3dp)
d 0.688 cm^2
e 6.882 cm^2 (3dp)

9 77.255 cm^2

10 $6.882a^2$ cm^2

11 $\frac{na^2}{\tan\left(\frac{360°}{2n}\right)}$

Exercise 15.9

1 **a** $-\cos 60°$ **b** $\sin 145°$
c $-\cos 44°$ **d** $\sin 10°$
e $-\cos 92°$ **f** $\cos 40°$
g $\sin 59°$ **h** $\sin 81°$
i $\cos 135°$ **j** $\cos 30°$

2 **a** 30, 150 **b** 90
c 45, 315 **d** 78.7, 258.7
e 150, 210 **f** 191.5, 348,5
g 109.5, 250.5 **h** 60, 240
i 104, 284

3 **a** 45 **b** 120
c 55 **d** 45
e 270 **f** 120
g 270 **h** 90
i 696, 384

4 30, 150, 210, 330

5 41.4, 60, 300, 318.6

Exercise 15.10

1 **a** 11.2 **b** 8.58
c 25.3 **d** 38.8°

2 **a** 10.6 cm **b** 5.73 cm
c 4.42 cm **d** 5.32 cm
e 6.46 cm **f** 155 mm

3 **a** 54.7° **b** 66.8° or 113.2°
c 69.8° or 110.2° **d** 25.3° or 154.7°
e 52.7° or 127.3° **f** 50.5°

4 $C = 63°$
$AC = 15.9\,\text{cm}$
$CB = 21.3\,\text{cm}$

5 $F = 25°$
$DE = 9.80$
$EF = 14.9\,\text{cm}$

6 $R = 32.2°$
$P = 27.8°$
$QR = 7.0\,\text{cm}$

7 **a** Y is opposite a side shorter than X, so $Y < X$ and therefore $<40°$.
b $Y = 30.9°$ and $Z = 109.1°$
c $XY = 22.1\,\text{cm}$

8 **a** $ACB = 51°$
b $ABC = 52°$
c $AC = 32.26\,\text{mm}$

Exercise 15.11

1 $AC = 8.62\,\text{cm}$

2 $DE = 22.3\,\text{cm}$

3 $P = 53.8°$

4 **a** 18.7 m
b $U = 32.1°$ **c** $T = 52.9°$

5 **a** $X = 60°$ **b** $Y = 32.2°$
c $Z = 87.8°$

6 **a** Return = 14.4 km **b** 296°

7 51.2m on a bearing of 273

Exercise 15.12

1 **a** $10.0\,\text{cm}^2$
b $15.0\,\text{cm}^2$
c $52.0\,\text{cm}^2$
d $17.2\,\text{cm}^2$
e $22.7\,\text{cm}^2$
f $24.2\,\text{cm}^2$

2 $108\,\text{cm}^2$

3 $0.69\,\text{m}^2$

4 $42.1\,\text{cm}^2$

5 **a** $30.6\,\text{cm}^2$
b $325.9\,\text{cm}^2$
c $1.74\,\text{m}^2$

6 **a** $174\,\text{cm}^2$
b 8.7 cm and 21.5 cm

7 **a** $Q = 22.6°$ **b** $P = 53.1°$

Exercise 15.13

1 **a** $AC = 25\,\text{cm}$ **b** $EC = 13.0\,\text{cm}$
c 27.5°

2 **a** $EG = \sqrt{50}\,\text{m}$ **b** $AG = \sqrt{75}\,\text{m}$
c $AGE = 35.3°$

3 **a** $AC B = 53.1°$
b $BC = 5\,\text{m}$
c $CD = 4.2\,\text{m}$
d $BM = 4.5\,\text{m}$
e $BCD = 65°$

4 **a** 14.9 cm **b** 15.2 cm
c $\theta = 11.4°$

5 **a** $AC = \sqrt{AB^2 + BC^2}$
b $DA = \sqrt{DC^2 - AC^2}$
c $DC = \sqrt{AD^2 + AC^2}$
d $DAB = 90°$
e $BDC = \cos^{-1}\left(\dfrac{BD^2 + DC^2 - BC^2}{2 \times BD \times DC}\right)$
f $ADC = \cos^{-1}\left(\dfrac{AD}{CD}\right)$ or $\sin^{-1}\left(\dfrac{AC}{CD}\right)$

Examination practice

Exam-style questions

1 $AC = 9.8\,\text{m}$, $BC = 6.9\,\text{m}$

2 $DAB = 47.9°$

3 9.9 m

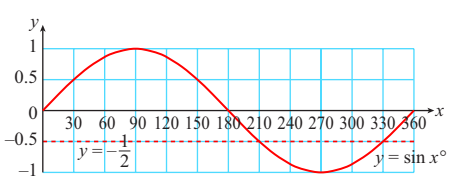
4 **a** $X = 10.1\,\text{m}$ (to 3sf) **b** $y = 20.6°$

5 **a** **i** $QX = 60 \tan 4° = 50.3\,\text{m}$
ii 78.3 m
b **i** 250.3 m **ii** 257.4 m
iii 077°

6 **a** 5.16 m **b** $3.11\,\text{m}^2$

7 **a** 7 cm **b** 51.1°

8 **a** (90°, 1) **b** −1
c



d 2 solutions

9 **a** **i** $AB = 107.3\,\text{km}$
ii $PAB = 66.6°$ **iii** 143.4°
b **i** 5 h **ii** 12 km/h

Past paper questions*

1 6.6 m

2 7.06

3 **a** 37.2°
b $11.7\,\text{cm}^2$

4 **a** 12.7 cm
b 28.2°

5 **a** **i** 14.6 km
ii

iii 260-264°

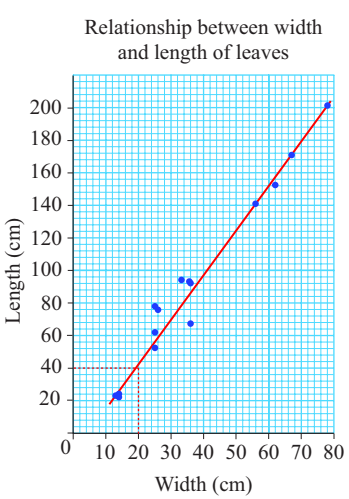
6 13.5

Chapter 16

Exercise 16.1

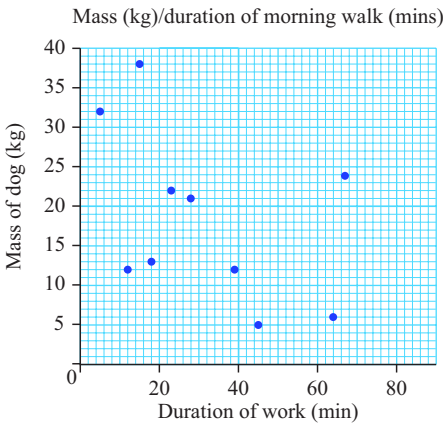
1 **a** Positive; weak
b No correlation
c Negative; weak
d Negative; strong

2 **a** + **c**
Relationship between width and length of leaves



b Strong positive correlation.
d 40 cm

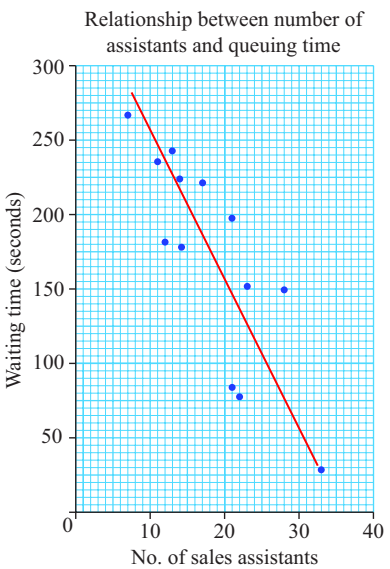
3 **a** Relationship between mass of dog and duration of morning walk



b No correlation

c The dogs are not a specific breed.

4 **a + c**



b Strong negative correlation.

d Value is outside the range of the collected data and waiting time will be negative time!

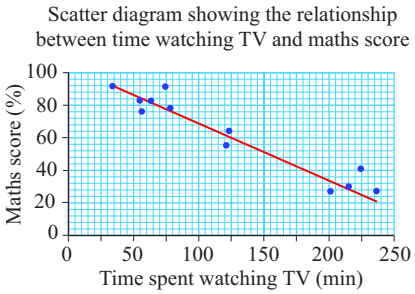
5 **a**

TV watching (min)	122	34	215	54	56	78
Maths score (%)	64	92	30	83	76	78

224	236	121	74	63	200
41	28	55	91	83	27

b Strong negative correlation.

c



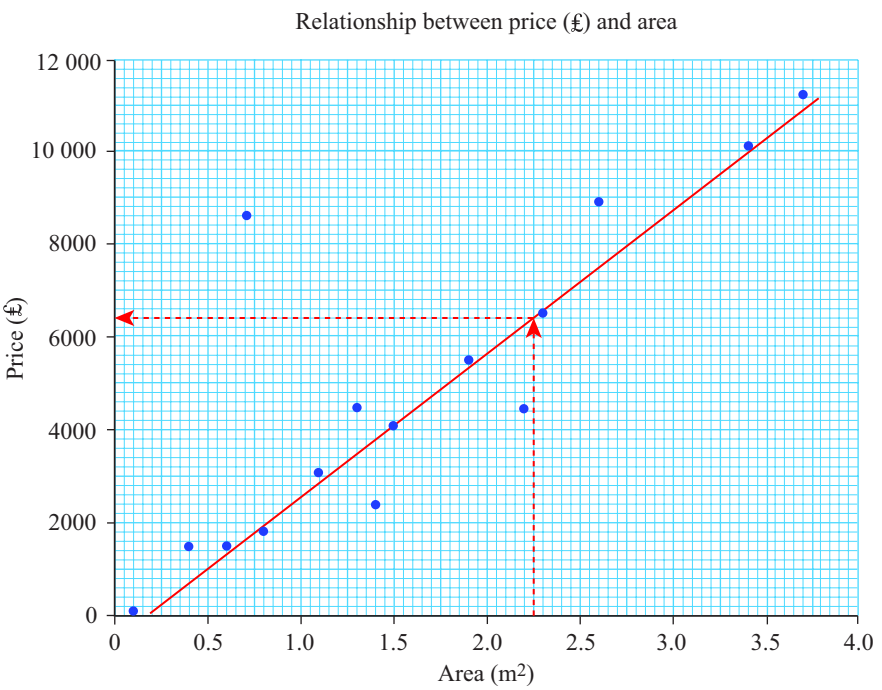
d 105 mins

e No way of knowing how accurate the estimate is as performance in test is affected by many factors.

Examination practice

Exam-style questions

1 **a + c**

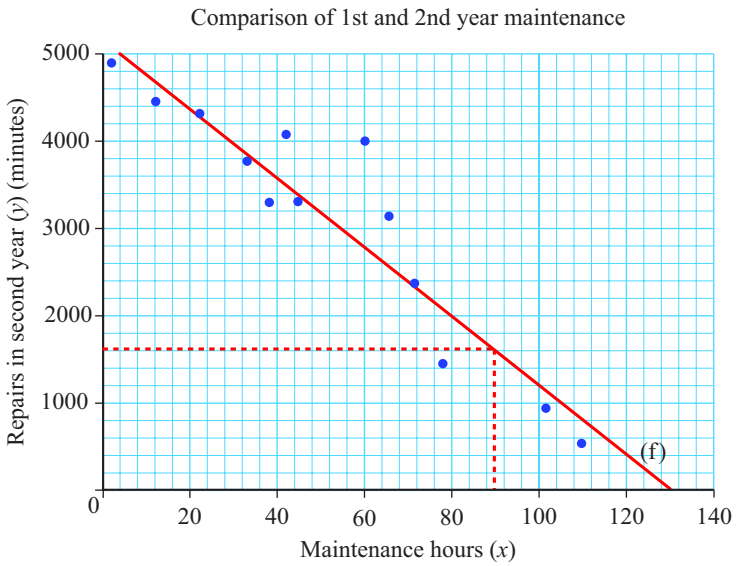


b Painting E because other paintings of a similar size are much cheaper.

d $6400

e Value is outside the range of the collected data.

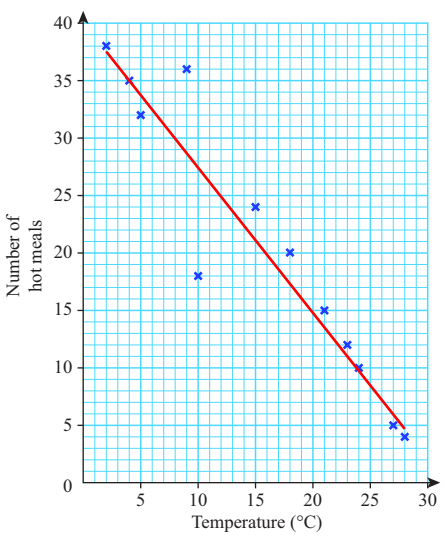
2 **a + c**



b Strong negative correlation.
d 1 600 minutes
e Repair time is a negative number – value is outside the range of the collected data.
f Approximately 130 hours – this is an extrapolated value so might not be accurate.

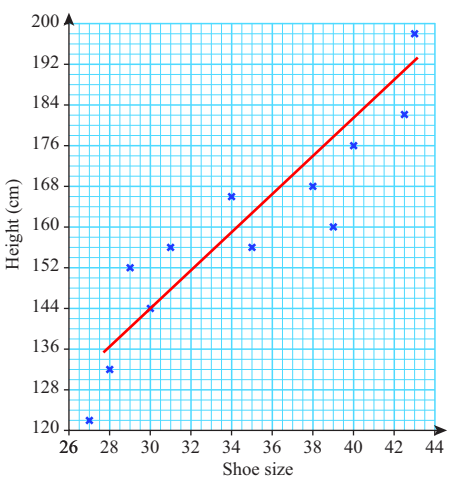
Past paper questions*

1 **a** and **b**



c strong negative

2 **a** and **b**



c strong positive

Unit 5

Chapter 17

Exercise 17.1

1 $49.50
2 $332.50
3 **a** $13.50 **b** $6.45
c 9.35 **d** $12.15
e $13.68
4 $2085.75
5 $474.30
6 $8250
7

Annie	$319.20
Bonnie	$315.00
Connie	$300.30
Donny	$403.20
Elizabeth	$248.85

8 All amounts in R million (3sf).

per year	per month a	35 % tax per year b	per month after tax c
87.9	7.33	30.8	4.76
86.1	7.18	30.1	4.66
85.1	7.09	29.8	4.61
66.9	5.58	23.4	3.62
66.8	5.57	23.4	3.62
59.5	4.96	20.8	3.22
51.9	4.33	18.2	2.81
51.5	4.29	18.0	2.79
49.9	4.16	17.5	2.70
49.7	4.14	17.4	2.69

d Bernard Fornas earned 4.48×10^{-2} million R (3sf) and Alan Clark earned 2.54×10^{-2} million R (3sf)

Exercise 17.2

1

Employee	a Net income ($)	b % $\left(\frac{\text{net}}{\text{gross}}\right)$
B Willis	317.00	47
M Freeman	158.89	35
J Malkovich	557.20	43
H Mirren	383.13	42
M Parker	363.64	43

2 **a** Mean weekly earnings: $836.63
b Median weekly earnings: $853.30
c Range of earnings: $832.50

3 **a** Difference between gross and net income:
M Badru: 3954.52
B Singh: 724.79
b Percentage of gross income that each takes home as net pay:
M Badru: 69.3%
B Singh: 57%

Exercise 17.3

1

Taxable income	Annual tax	Monthly tax
a $98 000.00	$17 640.00	$1470.00
b $120 000.00	$21 600.00	$1800.00
c $129 000.00	$23 220.00	$1935.00
d $135 000.00	$24 510.00	$2042.50
e $178 000.00	$35 260.00	$2938.33

2 **a** **i** Yes
ii No – he pays $6181.25
iii $6181.25 = $4681.25 + (40 000 – 34 000) × 0.25
b $67 616.75
c **i** She owes additional tax.
ii $238.25

3 **a** Value-Added-Tax:
VAT is paid at each step in the business chain. For the buyer it is the tax on the purchase price but for the seller it is the tax on the 'added value' part of the price. Rate/s at which charged vary from country to country.
b General sales tax:
Sales tax is paid only at the end of the consumer chain by the consumer. Rate/s at which charged vary from country to country.
c Customs and Excise duties:
Customs duties are taxes on imported goods. Excise duties are taxes on goods produced for sale, or sold, within a country. Rate/s at which charged vary from country to country.
d Capital Gains Tax:
Capital gains tax is paid on the profit made on the sale of assets. Rate/s at which charged vary from country to country.
e Estate duties:
These are taxes levied on people who inherit money, property, etc. Rate/s at which charged vary from country to country.

Exercise 17.4

1

Principal amount ($)	Interest rate (%)	Time invested	Interest earned ($)
500	1	3	15.00
650	0.75	2.5	12.19
1000	1.25	5	62.50
1200	4	6.75	324.00
875	5.5	3	144.38
900	6	2	108.00
699	7.25	3.75	190.04
1200	8	0.75	72.00
150 000	9.5	1.5	21 375.00

2

Principal amount ($)	Interest rate (%)	Time invested	Amount repay ($)
500	4.5	2	545.00
650	5	2	715.00
1000	6	2	1120.00
1200	12	1.5	1416.00
875	15	1.5	1071.88
900	15	3	1305.00
699	20	0.75	803.85
1200	21.25	0.67	1370.85
150 000	18	1.5	190 500.00

3 4 years
4 7% p.a.
5 33 years 4 months
6 **a** $32 **b** $96
c **i** $40.80 **ii** $136.80
7 **a** $11 700 **b** £3700
c 15.4% (1dp)

Exercise 17.5

1 **a** $100 **b** $60 **c** $460
2 $2850
3 **a** $141.83 **b** $2072
4 **a** £301 **b** 33.5% (1dp)
5 **a** $3657.80 **b** 13.09% (2dp)

Exercise 17.6

1 **a** $10 035.20 **b** $9920.00
2 **a** $4998.09 **b** $5077.92
3 $88 814.66
4 $380 059.62 (2 dp)

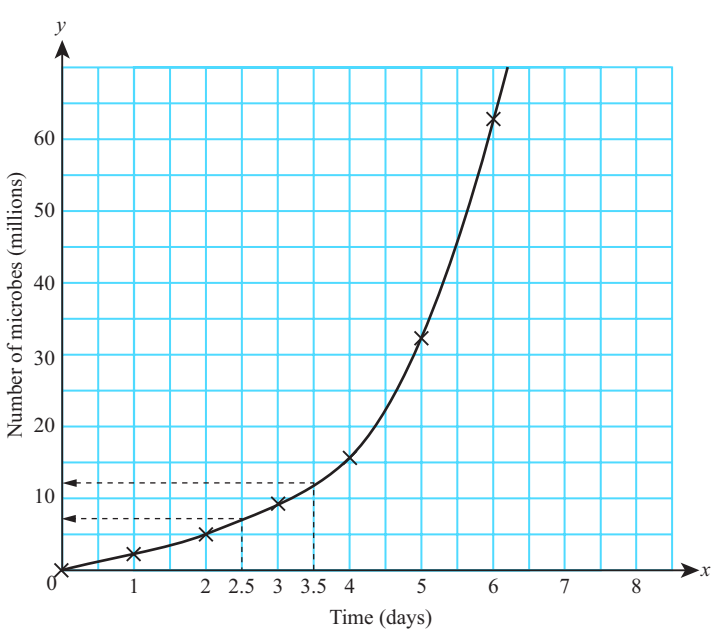
Exercise 17.7

1 **a** 7.255 billion
b 7.675 billion
c 8.118 billion
2 **a** 1724 pandas
b 1484 pandas

3 **a**

Time (days)	0	1	2	3	4	5	6	7	8
Total number of microbes (millions)	1	2	4	8	16	32	64	128	256

b



c **i** approximately 5.5 million **ii** approximately 12 million
d just over 4 days

4 **a** 6.5 minutes **b** 12 grams

5 $27 085.85

6 **a** $10 120 **b** $8565.57 **c** $5645.41 **d** $11 000(0.92)^n

7 $2903.70

8 **a** 7 137 564 **b** 10 years

9 15 hours

Exercise 17.8

1

	Cost price ($)	Selling price ($)	Profit ($)	Profit (%)
a	20.00	25.00	5.00	25.00
b	500.00	550.00	50.00	10.00
c	1.50	1.80	0.30	20.00
d	0.30	0.35	0.05	16.67

2

	Cost price ($)	Selling price ($)	Loss ($)	Loss %
a	400.00	300.00	100.00	25.00
b	0.75	0.65	0.10	13.33
c	5.00	4.75	0.25	5.00
d	6.50	5.85	0.65	10.00

3 Percentage profit = 66.67%

Exercise 17.9

1 **a** $108.33 **b** $256.00
c $469.41 **d** $1125.00

2 $840

3 $3225

4 $360

5 $220.80

6 $433.55 for 10 and $43.36 each

7 28%

8 **a** $67.38 **b** 60%

Exercise 17.10

1

Original price ($)	% discount	Savings ($)	Sale price ($)
89.99	5	4.50	85.49
125.99	10	12.60	113.39
599.00	12	71.88	527.12
22.50	7.5	1.69	20.81
65.80	2.5	1.65	64.16
10 000.00	23	2300.00	7700.00

2

Original price ($)	Sale price ($)	% discount
89.99	79.99	11
125.99	120.00	5
599.00	450.00	25
22.50	18.50	18
65.80	58.99	10
10 000.00	9500.00	5

Examination practice

Exam-style questions

1 **a** $366.56 **b** 9 hours

2 **a** $12 **b** $14.40

3 7.5%

4 $33.60

5 $635

6 **a** $30 000.00 **b** $2 977.53
c $2 307.59

7 28.07%

8 11%

Past paper questions*

1 $3826.38

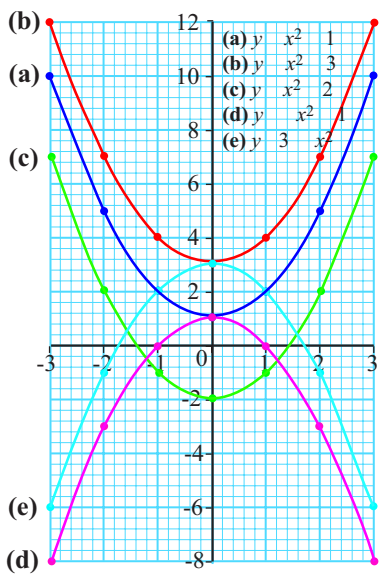
2 $460

Chapter 18

Exercise 18.1

1

	x	−3	−2	−1	0	1	2	3
a	$y = x^2 + 1$	10	5	2	1	2	5	10
b	$y = x^2 + 3$	12	7	4	3	4	7	12
c	$y = x^2 - 2$	7	2	−1	−2	−1	2	7
d	$y = -x^2 + 1$	−8	−3	0	1	0	−3	−8
e	$y = 3 - x^2$	−6	−1	2	3	2	−1	−6



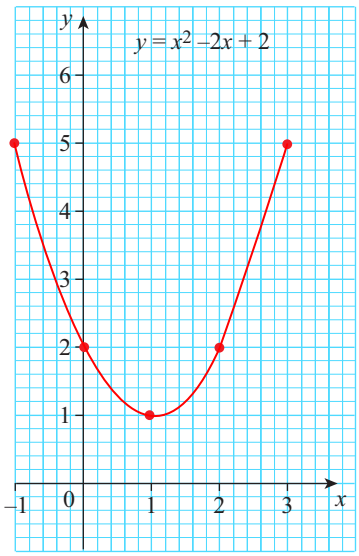
f When the value of the constant term changes the graph moves up or down the y-axis.

2 **a** *C* **b** *B*
c *A* **d** *D*
e *E*

Exercise 18.2

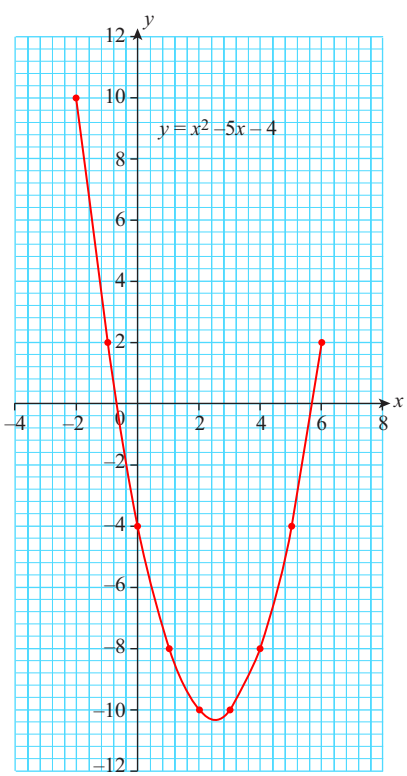
1

x	−1	0	1	2	3
$y = x^2 - 2x + 2$	5	2	1	2	5



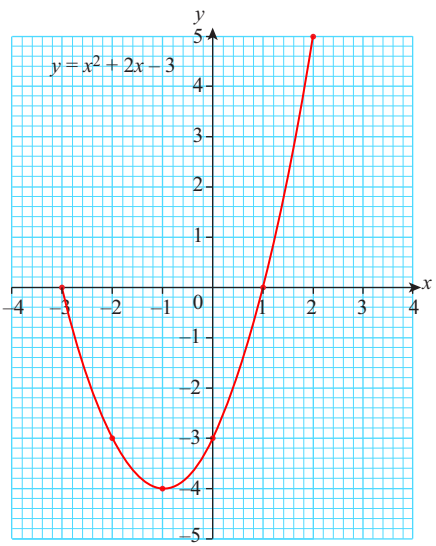
2

x	−2	−1	0	1	2	3	4	5	6
x^2	4	1	0	1	4	9	16	25	36
$-5x$	10	5	0	−5	−10	−15	−20	−25	−30
-4	−4	−4	−4	−4	−4	−4	−4	−4	−4
$y = x^2 - 5x - 4$	10	2	−4	−8	−10	−10	−8	−4	2



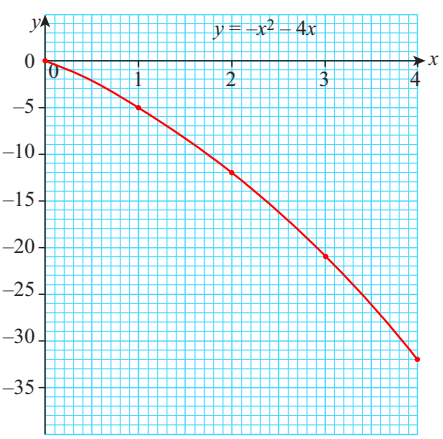
3

x	−3	−2	−1	0	1	2
$y = x^2 + 2x - 3$	0	−3	−4	−3	0	5



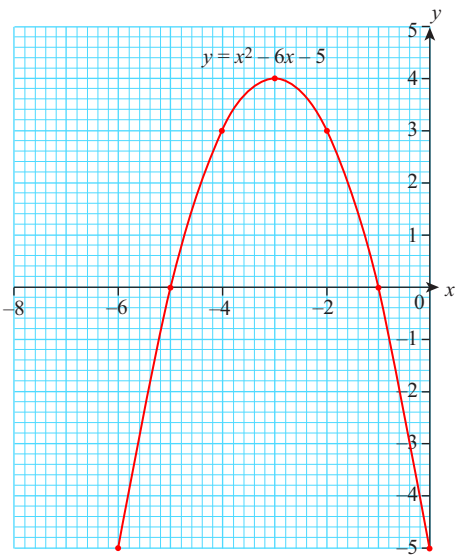
4

x	0	1	2	3	4
$y = -x^2 - 4x$	0	−5	−12	−21	−32



5

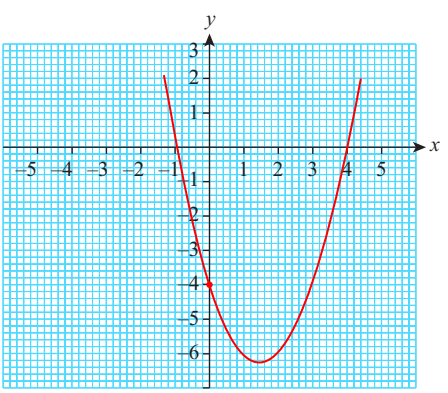
x	−6	−5	−4	−3	−2	−1	0
$y = -x^2 - 6x - 5$	−5	0	3	4	3	0	−5



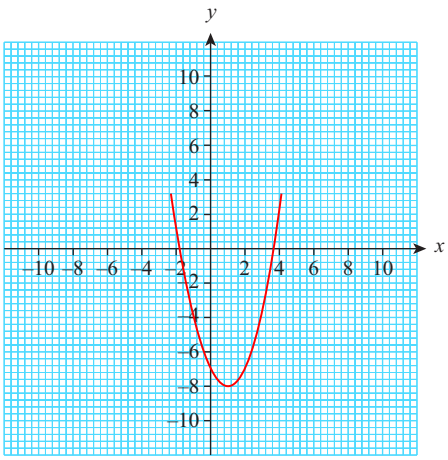
6 **a** 6 m
b 2 seconds
c 3 seconds
d 4.5 m
e The water surface is at $h = 0$.

Exercise 18.3

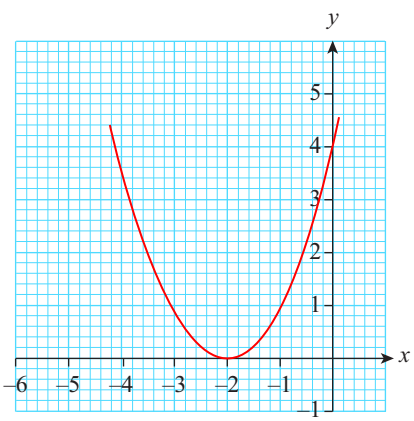
1 **a**



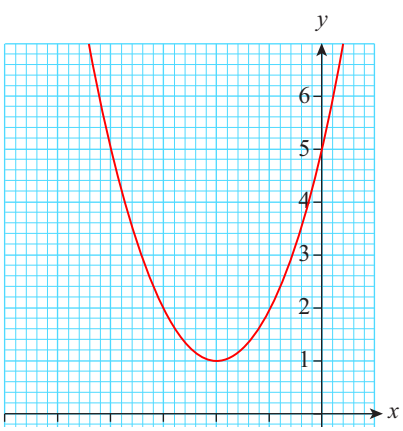
b



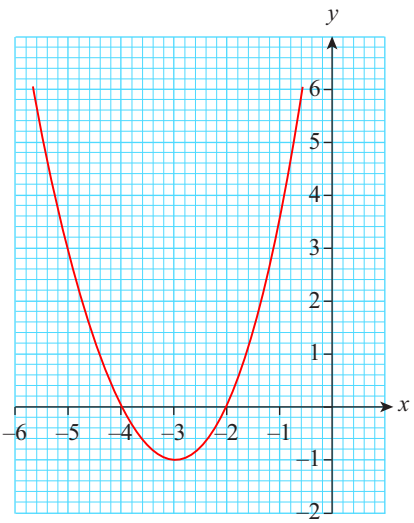
c



d



e



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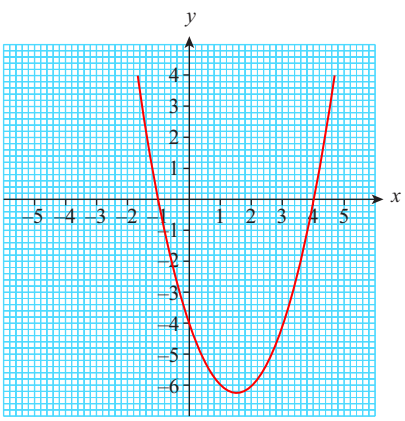
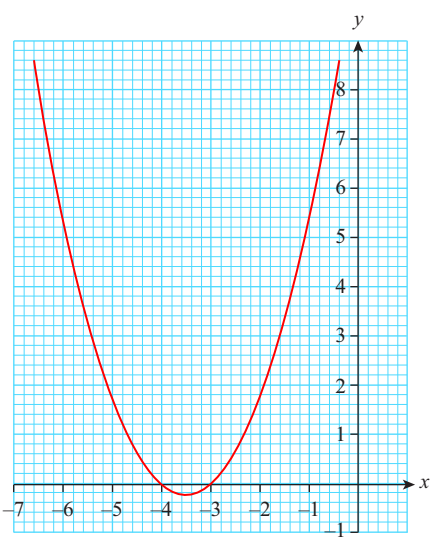
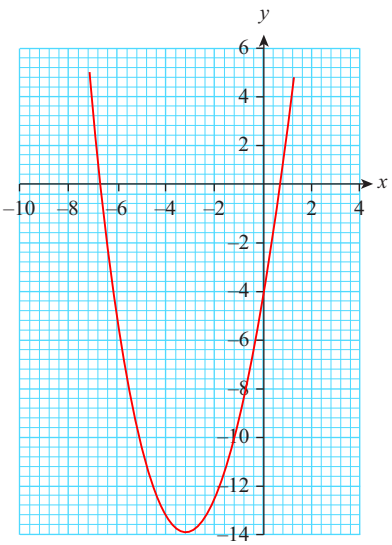


g

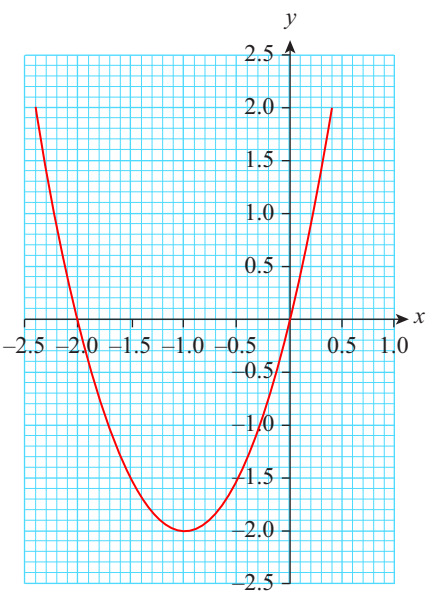


2 **a** $y = -x^2 - 4x + 5$
b $y = 4 - x^2$
c $y = x^2 - 3x - 4$
d $y = x^2 - 2x - 3$

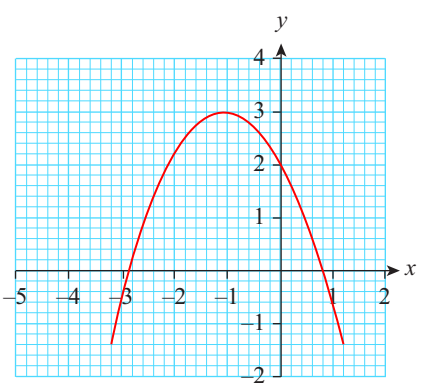
3 **a**



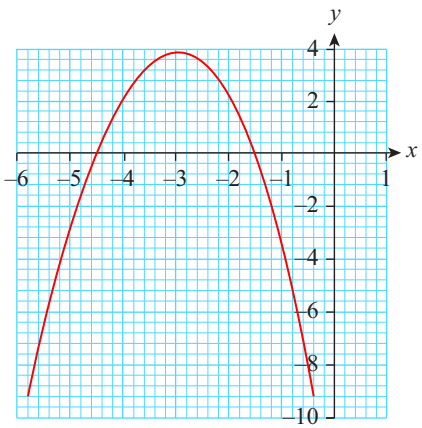
b



c



d



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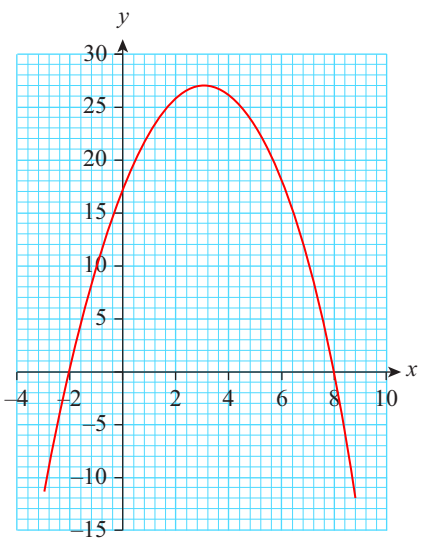

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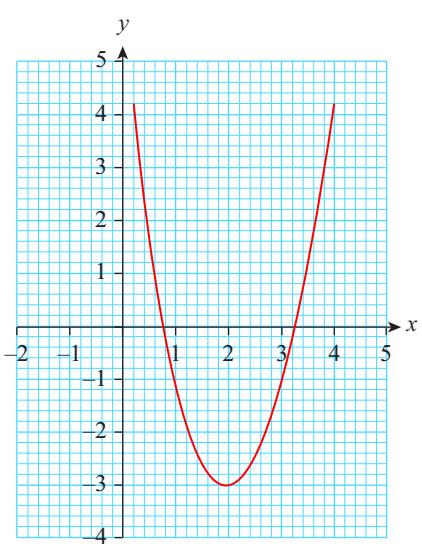
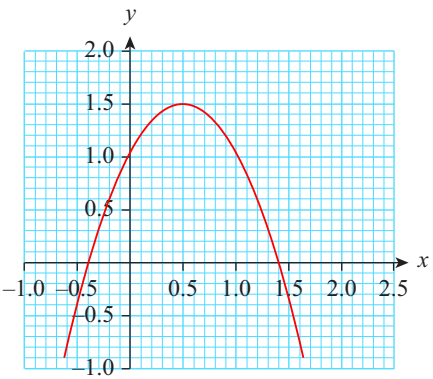
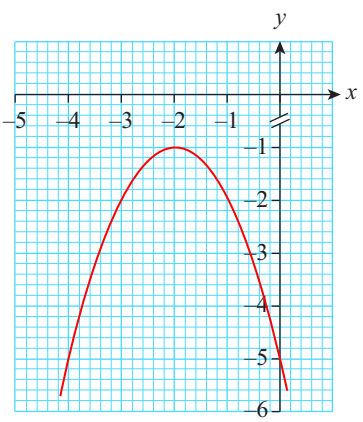


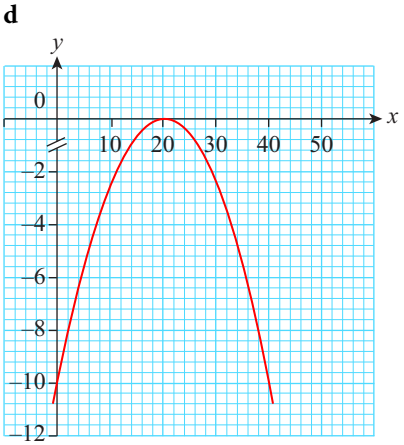
g



h



4 **a** (20, 0)
b $0 \leqslant x \leqslant 20$
c $-10 \leqslant h \leqslant 0$
d

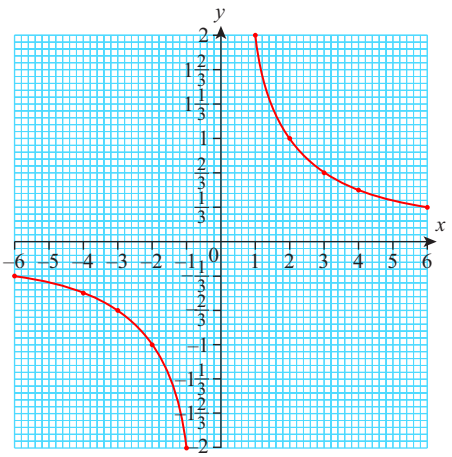


e width = 40 m
f max height = 10 m

Exercise 18.4

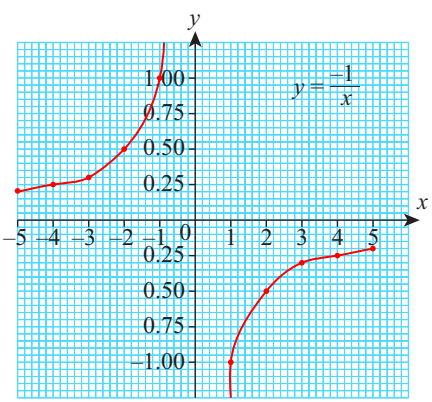
1 **a**

x	−6	−4	−3	−2	−1	1	2	3	4	6
$y = \frac{2}{x}$	$\frac{-1}{3}$	−0.5	$\frac{-2}{3}$	−1	−2	2	1	$\frac{2}{3}$	0.5	$\frac{1}{3}$



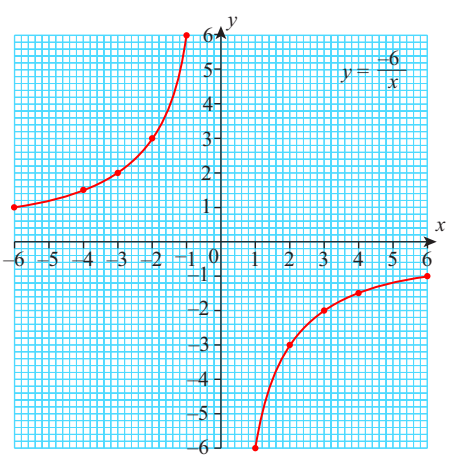
b

x	−5	−4	−3	−2	−1	1	2	3	4	5
$y = \frac{-1}{x}$	0.2	0.25	$\frac{1}{3}$	0.5	1	−1	−0.5	$\frac{-1}{3}$	−0.25	−0.2



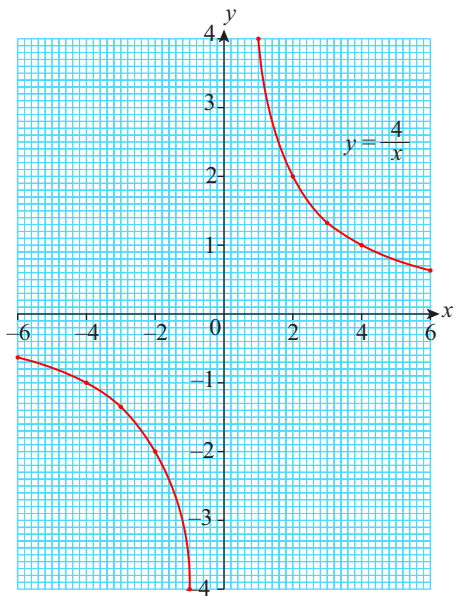
c

x	−6	−4	−3	−2	−1	1	2	3	4	6
$y = \frac{-6}{x}$	1	1.5	2	3	6	−6	−3	−2	−1.5	−1

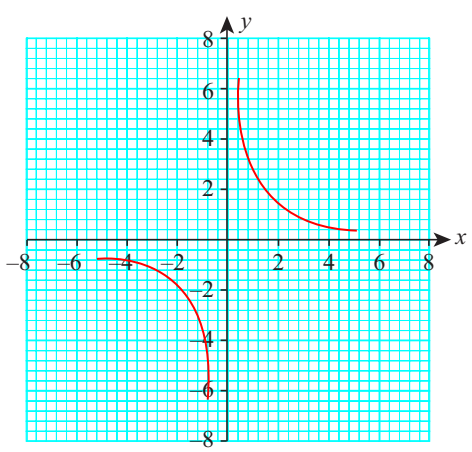


d

x	−6	−4	−3	−2	−1	1	2	3	4	6
$y=\frac{4}{x}$	$\frac{-2}{3}$	−1	$-1\frac{1}{3}$	−2	−4	4	2	$1\frac{1}{3}$	1	$\frac{2}{3}$



2 a



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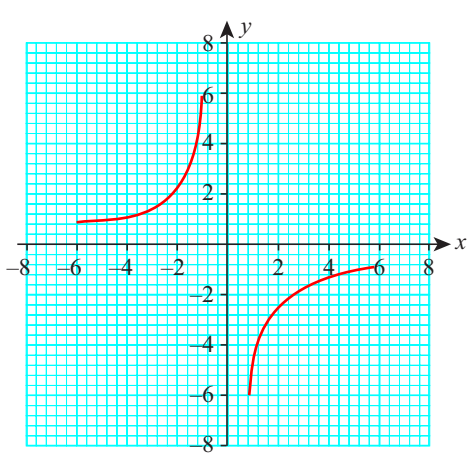
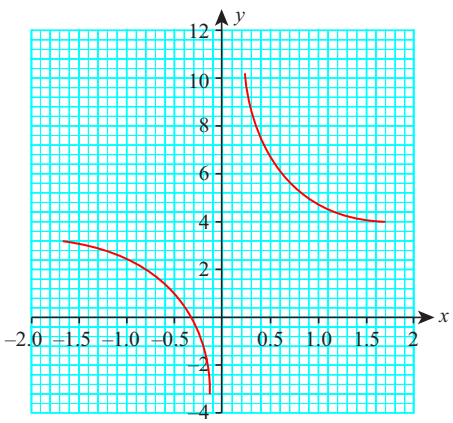
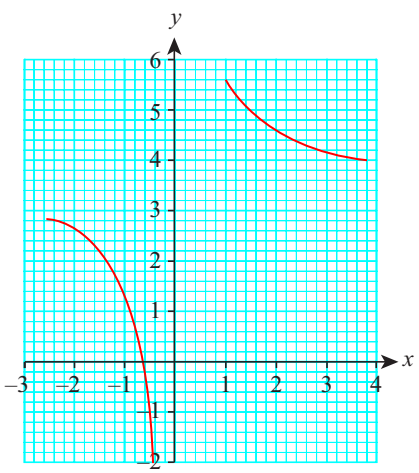


c



d



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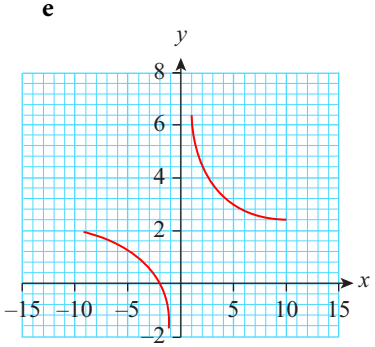
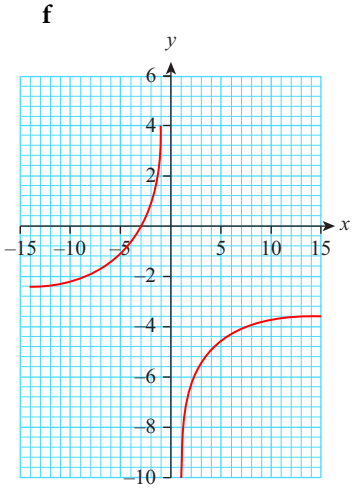


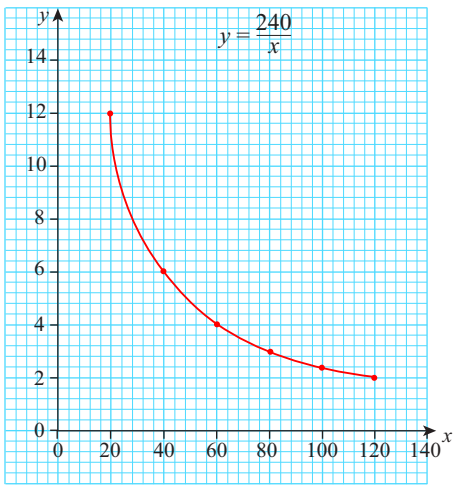
f



3 a

x	20	40	60	80	100	120
y	12	6	4	3	2.4	2

b

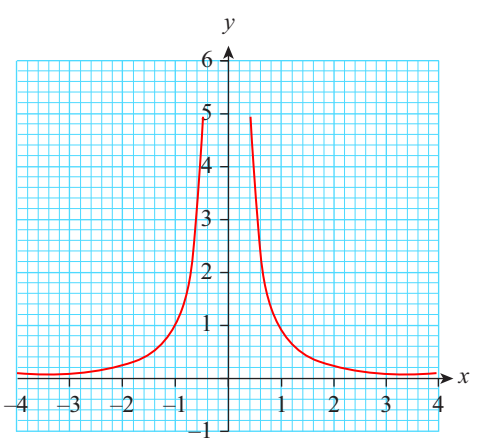


c $y=\frac{240}{x}$

4 a

x	−4	−3	−2	−1	$-\frac{1}{2}$	$\frac{1}{2}$	1	2	3	4
y	$\frac{1}{16}$	$\frac{1}{9}$	$\frac{1}{4}$	1	4	4	1	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{16}$

b



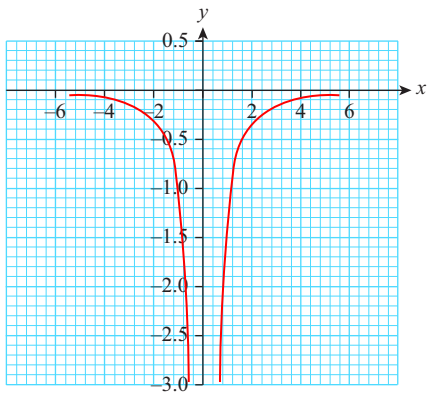
c Graph is still disjoint but both curves are above the x-axis on opposite sides of the y-axis.

d Division by 0 is meaningless

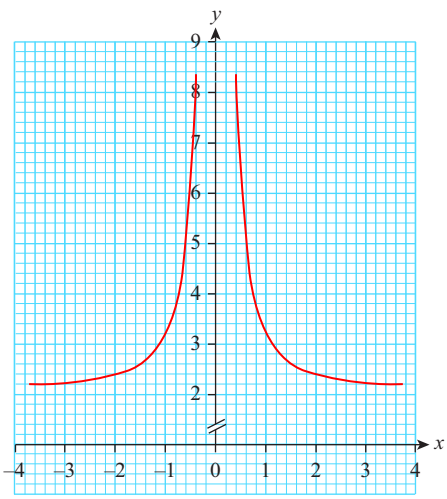
e $y = 0$ (the x-axis) and $x = 0$ (the y-axis)

f $x = 0$ and $y = 3$

g i



ii



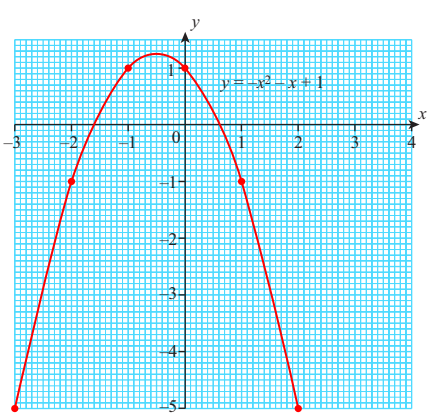
Exercise 18.5

1 **a** $x = -1$ and $x = 2$
b $x = -2.4$ and $x = 3.4$
c $x = -2$ and $x = 3$

2 **a**

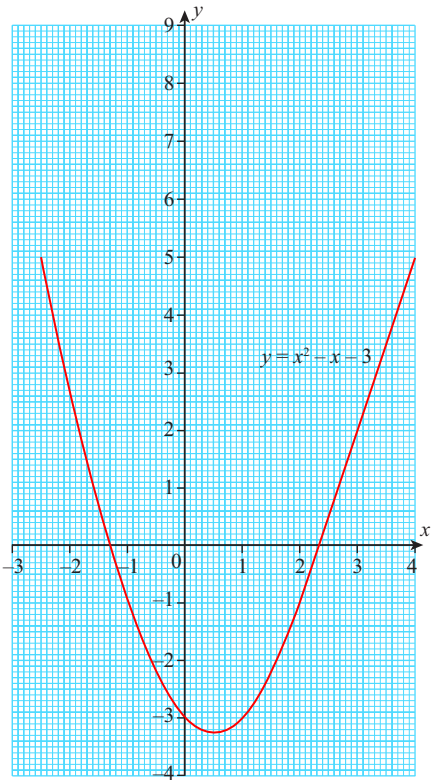
x	−3	−2	−1	0	1	2
$y = -x^2 - x + 1$	−5	−1	1	1	−1	−5

b

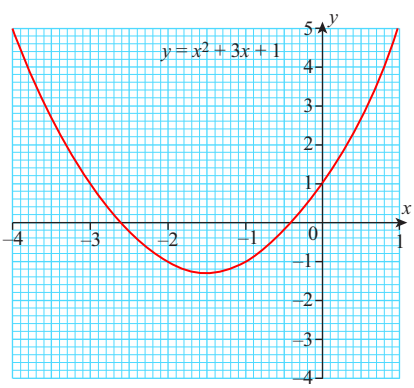


c $x = -1.6$ and $x = 0.6$

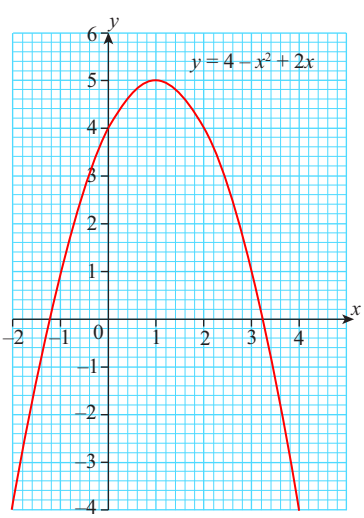
3 **a** $x = -1.3$ and $x = 2.3$



b $x = -2.6$ and $x = -0.4$

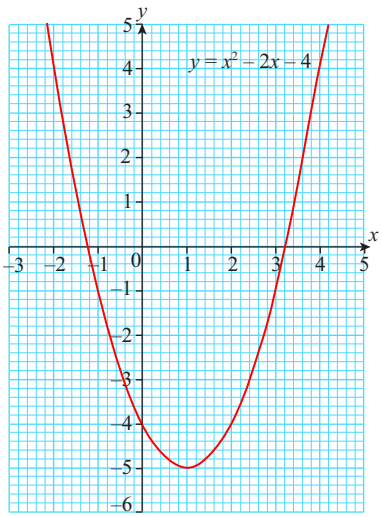


4 **a**



b **i** $x = -1.2$ and $x = 3.2$
ii $x = 0$ or $x = 2$

5 **a**



(Students, graph should also include the points (−3, 11) and (5, 11)

b **i** $x = -1.2$ and $x = 3.2$
ii $x = -1.8$ and $x = 3.8$
iii $x = -1$ and $x = 3$

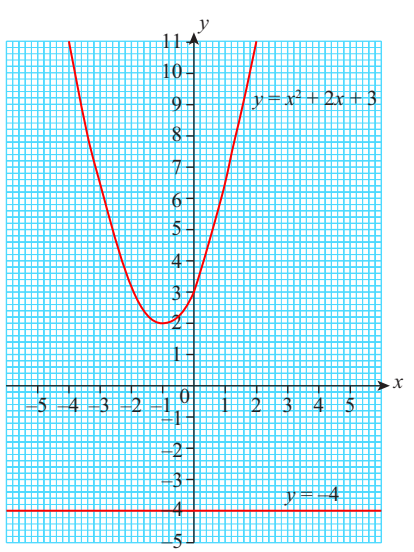
Exercise 18.6

1 **a** $x = 2$ and $x = -1$
b $x = 2$ and $x = -2$
c $x = -2$ and $x = 1$
d $x = 1.2$ and $x = -0.4$

2 Students' own graphs
a (0, 0) and (3, 9)
b (−1.4, −1.4) and (1.4, 1.4)
c (2, 0)

3 **a** $x = 9.1$ and $x = 0.9$
b $x = -2$ and $x = 4$
c $x = 3.8$ and $x = -1.8$

4



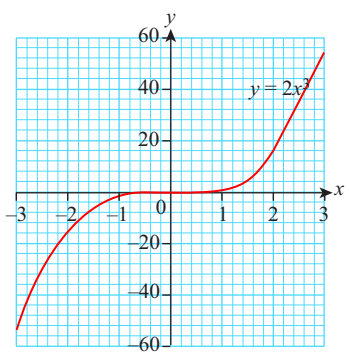
There are no points of intersection.

Exercise 18.7

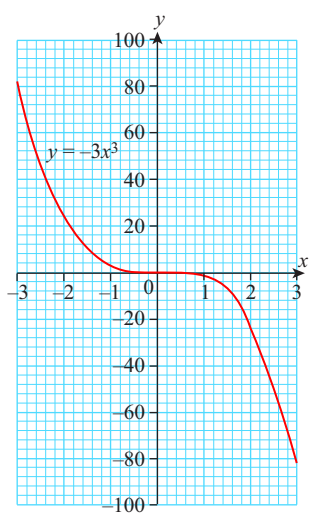
1

	x	−3	−2	−1	0	1	2	3
a	$y = 2x^3$	−54	−16	−2	0	2	16	54
b	$y = -3x^3$	81	24	3	0	−3	−24	−81
c	$y = x^3 - 2$	−29	−10	−3	−2	−1	6	25
d	$y = 3 + 2x^3$	−51	−13	1	3	5	19	57
e	$y = x^3 - 2x^2$	−45	−16	−3	0	−1	0	9
f	$y = 2x^3 - 4x + 1$	−41	−7	3	1	−1	9	43
g	$y = -x^3 + x^2 - 9$	27	3	−7	−9	−9	−13	−27
h	$y = x^3 - 2x^2 + 1$	−44	−15	−2	1	0	1	10

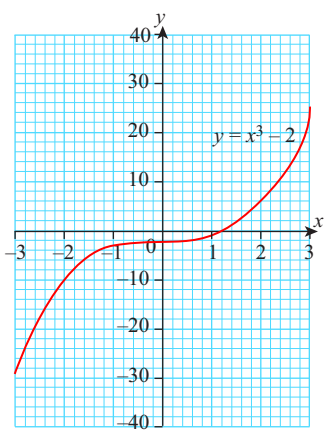
a



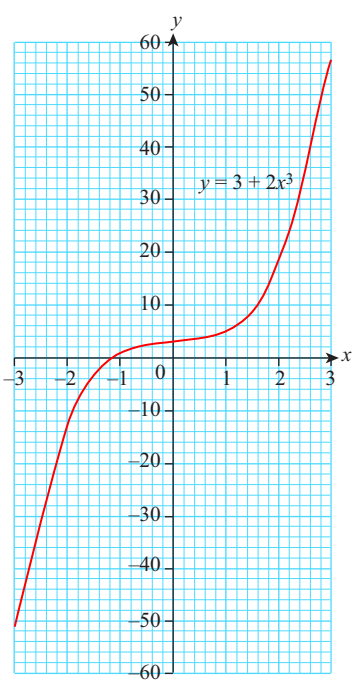
b



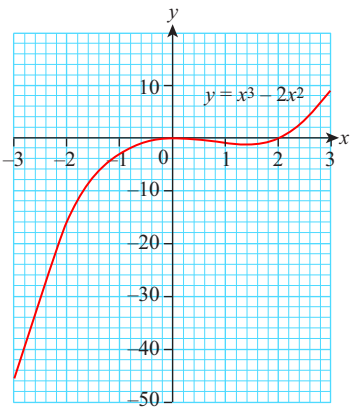
c



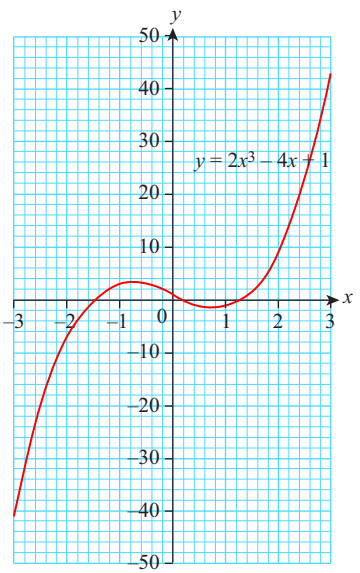
d



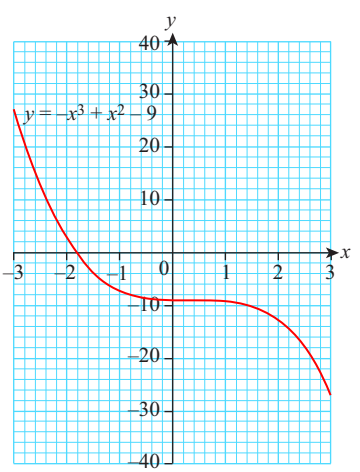
e



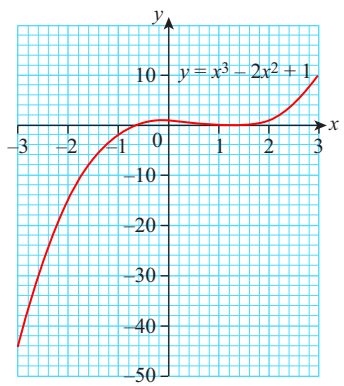
f



g



h

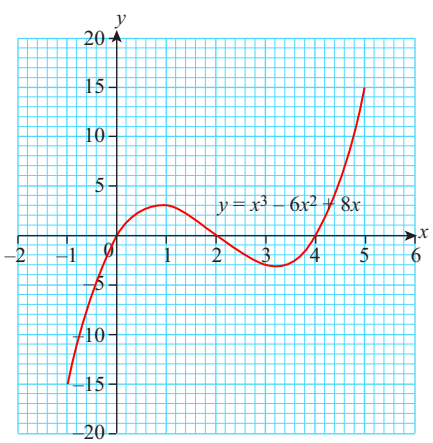


2 **a**

x	−1	−0.5	0	0.5	1
$y = x^3 - 6x^2 + 8x$	−15	−5.6	0	2.6	3

1.5	2	2.5	3	3.5	4	4.5	5
1.9	0	−1.9	−3	−2.6	0	5.6	15

b



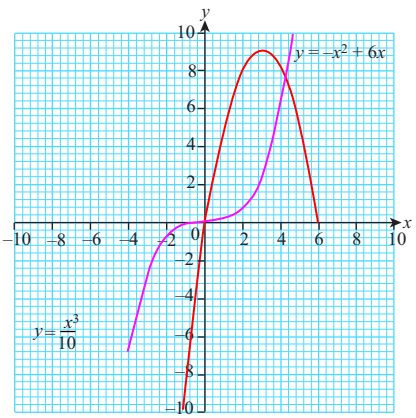
c **i** $x = 0$, $x = 2$ and $x = 4$

ii $x = 0.7$, 1, and $x = 4.3$

3 **a**

x	−4	−3	−2	−1
$y = \frac{x^3}{10}$	−6.4	−2.7	−0.8	−0.1
$y = 6x - x^2$	−40	−27	−16	−7

0	1	2	3	4	5	6
0	0.1	0.8	2.7	6.4	12.5	21.6
0	5	8	9	8	5	0



(Please note, only part of the graph is shown here).

b $x = 0$ and $x = 4.2$

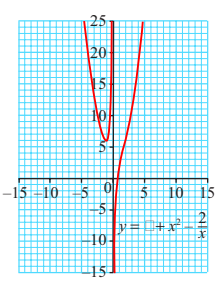
Exercise 18.8

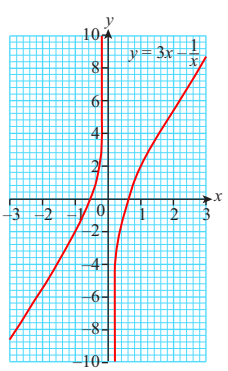
1

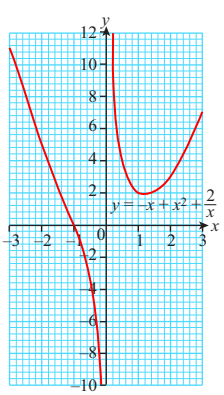
	x	−3	−2	−1	−0.5	−0.2	0	0.2	0.5	1	2	3
a	$y = 3 + x^2 - \frac{2}{x}$	12.7	8	6	7.3	13.0	N/A	−7.0	−0.8	2	6	11.3
b	$y = 3x - \frac{1}{x}$	−8.7	−5.5	−2	0.5	4.4	N/A	−4.4	−0.5	2	5.5	8.7
c	$y = -x + x^2 + \frac{2}{x}$	11.3	5	0	−3.3	−9.8	N/A	9.8	3.8	2	3	6.7
d	$y = -x^3 - 2x + 1$	34	13	4	2.1	1.4	1	0.6	−0.1	−2	−11	−32

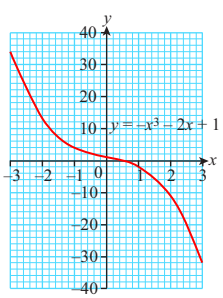
Note: The y-values are rounded to 1 decimal place.

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



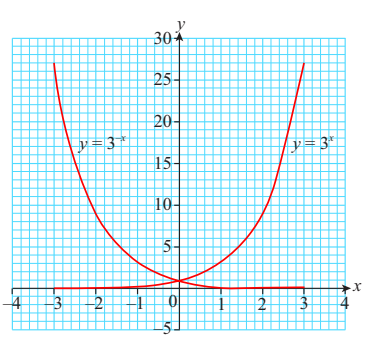






Exercise 18.9

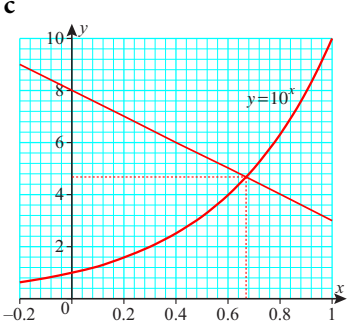
1 **a** **b**



c The two graphs are symmetrical about the y-axis.

2 **a** 2 **b** 0.8

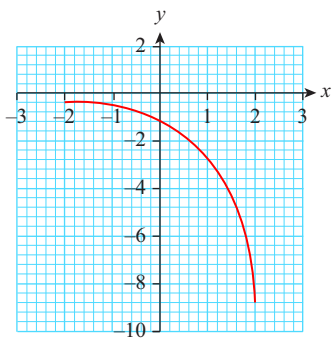
c



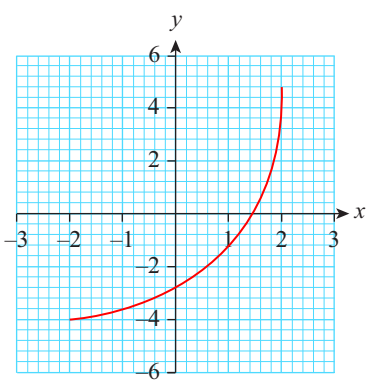
$10^x = 8 - 5x$ when $x = 0.67$
(0.66 – 0.68 also fine)

3 **a** Instructions will vary, but should include determine whether the graph is increasing or decreasing using the value of a. If a is positive the graph is decreasing, if a is negative, the graph is increasing. Use $a + q$ to determine the y-intercept. Work out the asymptote by finding the line $y = q$. If $a < 0$, the graph is below the asymptote and if $a > 0$, the graph is above the asymptote.

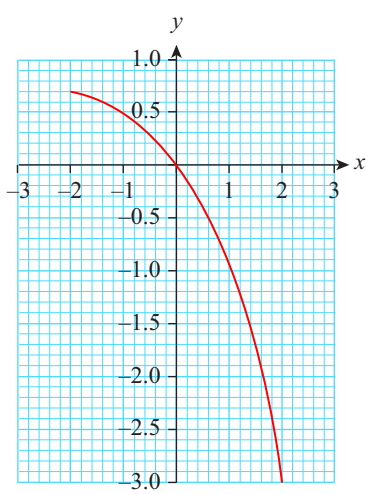
b **i**



ii

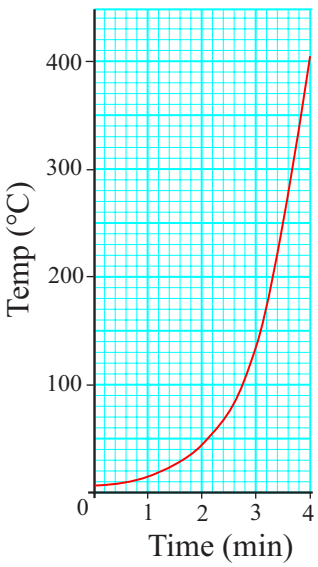


iii

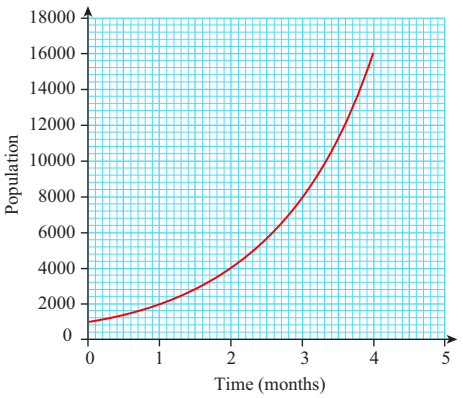


4 **a** 2 **b** 5.3 hours
c 64 **d** 20 hours

5



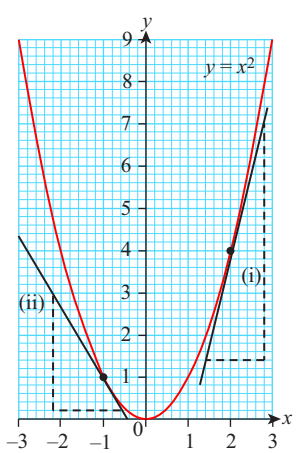
6 **a**



b 3.25 months
c 64 000

Exercise 18.10

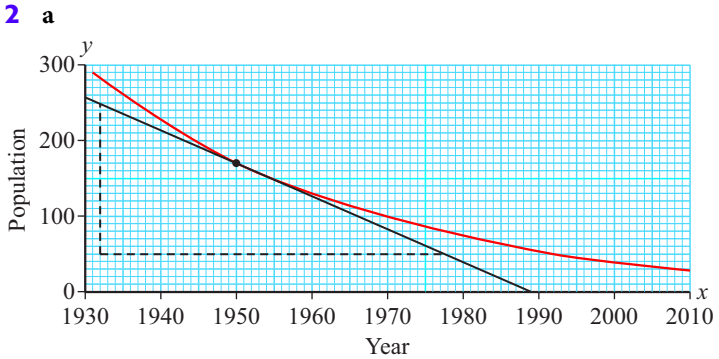
1 **a**



i 4 **ii** –1.75

b (–1.5, 2.25)

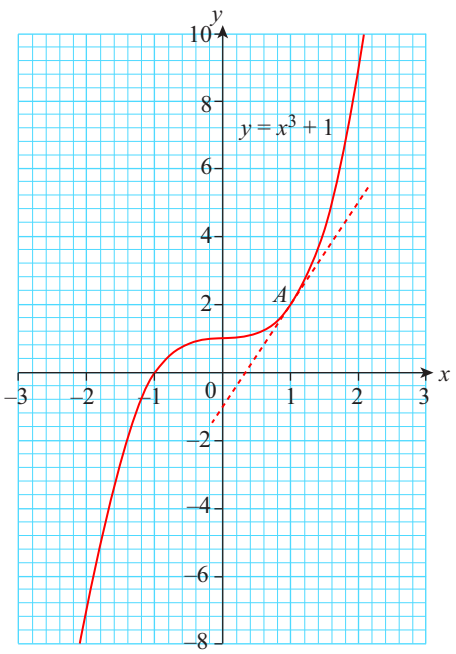
2 **a**



The gradient at point (1950, 170) is –4.4 people per year.

b Rate of change of population in the village in 1950.

3 **a**



b 3

Exercise 18.11

1 **a** $4x^3$ **b** $6x^5$
c $9x^8$ **d** $12x^2$
e $24x$ **f** $49x^6$
g $-16x^3$ **h** $84x^{11}$
i $-80x^4$

2 **a** 6 **b** 3
c 32 **d** −8
e −108 **f** 960

3 **(3, 27)**

Exercise 18.12

1 **a** $4x^3 + 5x^4$ **b** $9x^2 - 20x^3$
c $42x^5 + 18x$ **d** $x^2 - 28x^6$
e $30x^4 - \frac{32}{11}x^3$ **f** $-14x + 18x^5$
g $36x^2 + \frac{16}{3}x^7$ **h** $-120x^{11} - 80x^9$
i $8x - 36x^2 + 20x^3$
j $-\frac{32}{11}x^3 + \frac{6}{7}x^2 - \frac{3}{2}x$

2 **a** 93 **b** 52 **c** 12

3 (1, 5) and (−2, −4)

4 (0, 0) or $(\sqrt{3}, \frac{-9}{4})$

Exercise 18.13

1 **a** 5 **b** −4
c 0 **d** 7
e −3 **f** $8x - 4$
g $21x^2 + 2$ **h** $x^2 + x$
i m

2 **a** $2x + 2$ **b** $5x^4 + 8x^3$
c $2x - 1$ **d** $2x - 9$
e $16x^3 + 24x^2$ **f** $-10x + 20$
g $4x + 5$ **h** $6x - 7$
i $24x + 23$ **j** $12x - 13$
k $42x - 44$ **l** $2x + 6$
m $8x + 4$ **n** $18x - 12$
o $\frac{3}{5}x^2 + \frac{6}{5}x$ **p** $\frac{14}{3}x^6 + x^5$
q $10x - 20$ **r** $2x$

3 67

4 $\left(\frac{2}{3}, \frac{1}{3}\right)$

5 $\left(\frac{1}{3}, -3\right)$

6 (1,5) and (2, −4)

7 (2,11) and (−2,5)

8 $a = 2$, gradient at $x = 4$ is 92. $\frac{dy}{dx}$ at $x = -3$ is 50

Exercise 18.14

1 **a** $y = 6x - 9$
b $y = -4x - 4$
c $y = 56x - 144$
d $y = 18.25x - 19.25$
e $y = \frac{9}{20}x - \frac{1}{16}$

2 $\left(\frac{34}{19}, 0\right)$

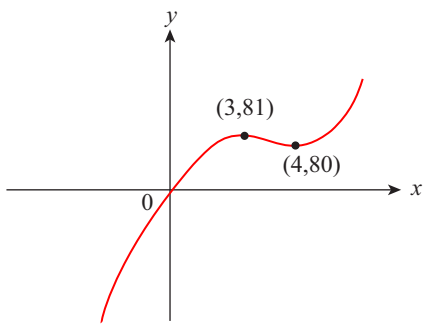
3 4

4 **a** $\left(\frac{26}{9}, 2\right)$

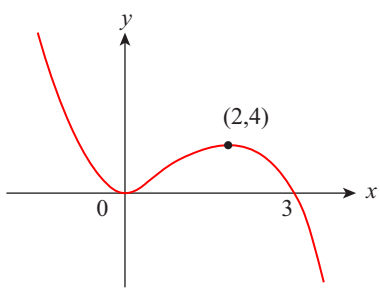
Exercise 18.15

1 **a** (2, −3) min **b** (−3, −13) min
c (4, 14) max **d** (2, −8) min
e (1, −1) max
f $\left(-\frac{3}{2}, -\frac{13}{4}\right)$ min
g $\left(\frac{3}{10}, \frac{89}{20}\right)$ max
h (−2, 15) max and (2, −17) min
i (0, 3) min and (4, 35) max
j (2, −4) min **k** (0, −25) min
l $\left(\frac{3}{4}, -\frac{9}{8}\right)$ min
m (3, 81) max and (4, 80) min
n (0, 0) min and (2, 4) max

2 **m**



n



3 **a** $\frac{dh}{dt} = 7 - 10t$
b 2.45m

4 **a** 54 thousand

5 **a** Length = $2 - 2x$ and
width = $1 - 2x$
V = length x width x
depth = $x(2 - 2x)(1 - 2x)$
b The width is only 1m and we are subtracting two lots of x from this length. So we can only subtract something less than 0.5
c $x = 0.211$, V = 0.192

Examination practice

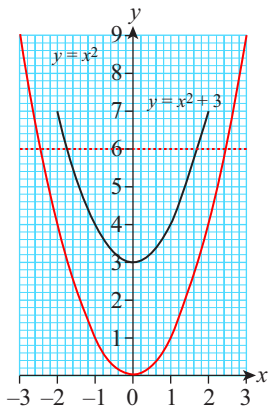
Exam-style questions

1 **a** A: $x = -2$
B: $y = -x$
C: $y = x^2 - 2$
D: $y = 2x + 1$
b **i** (−2, 2)
ii (3, 7) and (−1, −1)
c $\left(-\frac{1}{3}, \frac{1}{3}\right)$
d D **e** C

2 **a**

x	−2	−1.5	−1	−0.5	0	0.5	1	1.5	2
y	7	5.25	4	3.25	3	3.25	4	5.25	7

b



c No, x^2 will never equal $x^2 + 3$

d **i** $x = +2.4$ or -2.4

ii $x = +1.7$ or -1.7

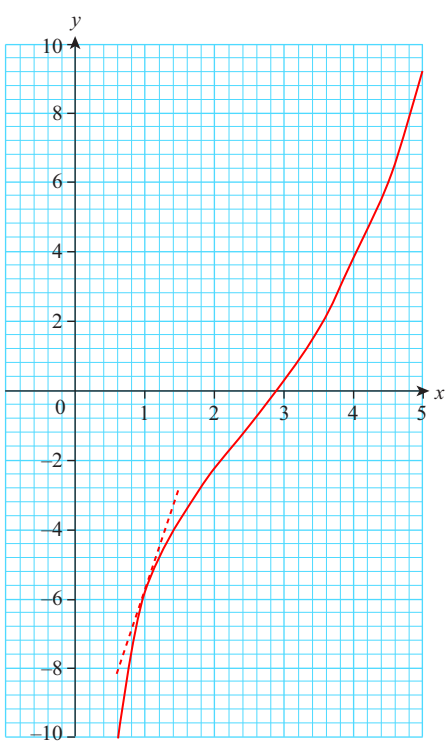
3 **a** **i** $p = -10$.

ii $q = 6.3$

iii $r = 9.2$

b

x	0.6	1	1.5	2	2.5	3	3.5	4	4.5	5
y	−10	−5.9	−3.7	−2.3	−1.1	0.3	1.9	3.8	6.3	9.2



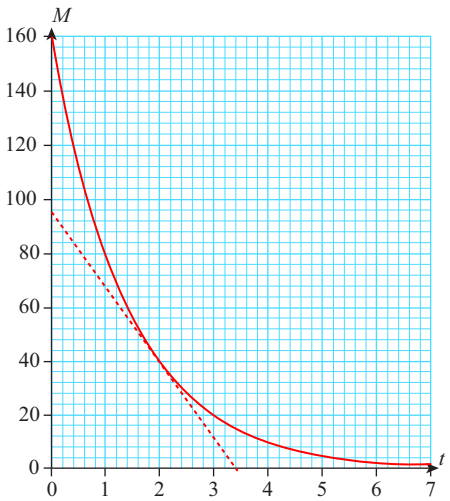
c $x = 2.9$ **d** Gradient = 6

4 **a** vi **b** ii

c i **d** iv

5 **a** **i** $p = 160$, $q = 10$, $r = 2.5$

ii



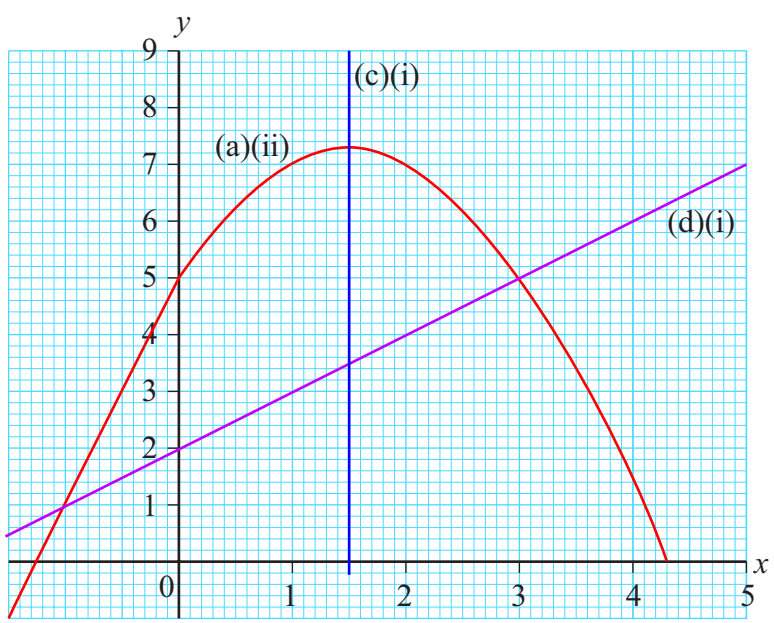
iii Rate of change = 28.2

b $t = 1$

Past paper questions

1 **a** **i**

x	−2	−1	0	1	2	3	4	5
y	−5	1	5	7	7	5	1	−5



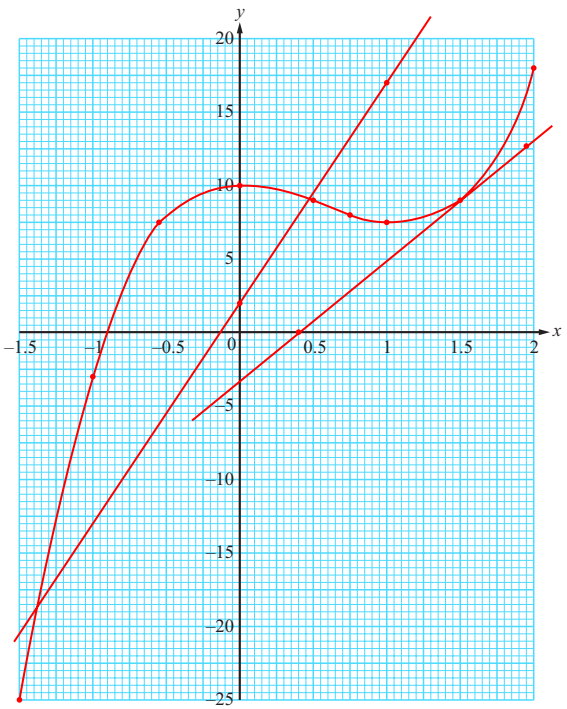
b $x = -1.2$, $x = 4.2$ **c** **ii** $x = 1.5$

d **ii** 1 **iii** $y = x + 2$

2 **a**

x	−1.5	−1	−0.5	0	0.5	0.75	1	1.5	2
$f(x)$	−24.9	−3	7.4	10	8.6	7.6	7	8.9	18

b

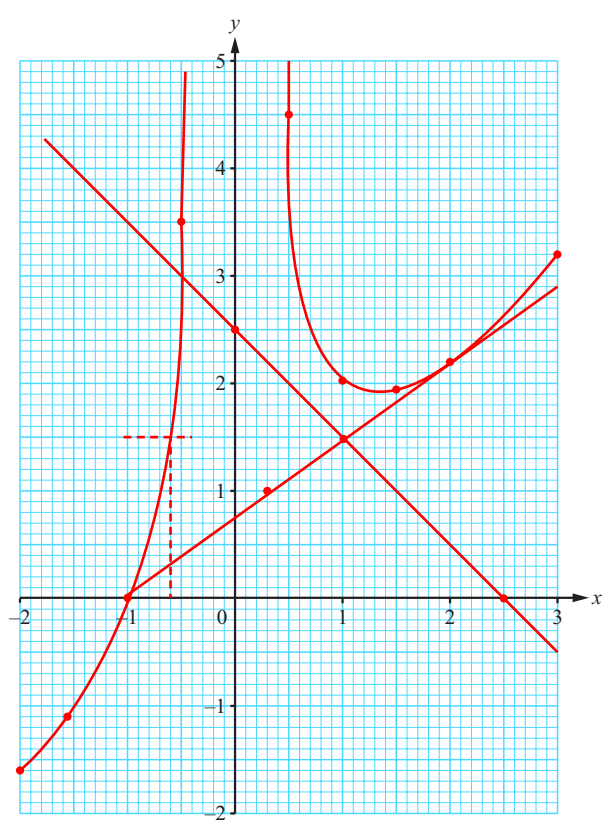


c **i** e.g. 5 or 0 or −5 **ii** e.g. 9
d $x = 0.445$ or $x = -1.35$ **e** 7.74

3 **a**

x	−2	−1.5	−1	−0.75	−0.5		0.5	0.75	1	1.5	2	3
y	−1.75	−1.06	0	1.03	3.5		4.50	2.53	2	1.94	2.25	3.11

b



c $x = -0.68$
d **i** $a = -1$ $b = 2.5$
ii $x = -0.5$
e 0.71

Chapter 19

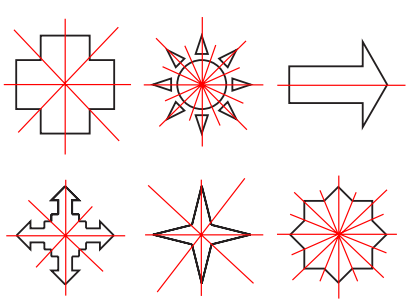
Exercise 19.1

1 **a** None
b *CD*, *HG*
c *CD*, *HG*
d *AB*
e *AB*, *EF*
f *AB*, *CD*
g *CD*
h *AB*, *CD*, *GH*

2

Shape	Number of lines of symmetry
Square	4
Rectangle	2
Equilateral triangle	3
Isosceles triangle	1
Scalene triangle	0
Kite	1
Parallelogram	0
Rhombus	2
Regular pentagon	5
Regular hexagon	6
Regular octagon	8

3



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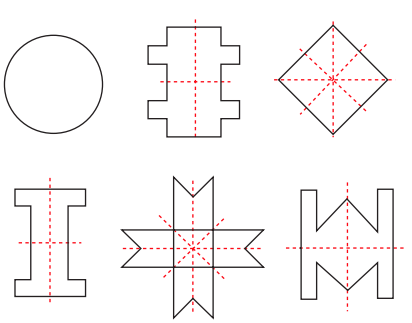


5 Students' own answers but might include names such as Audi, Citroën, Suzuki, Honda and Toyota.

Exercise 19.2

1 **a** 2
b 5
c 2
d 6
e 2
f 1
g 1
h 1

2 **b**

Regular polygon	Lines of symmetry	Order of rotational symmetry
Triangle	3	3
Quadrilateral	4	4
Pentagon	5	5
Hexagon	6	6
Octagon	8	8
Decagon	10	10

c Lines of symmetry = order of rotational symmetry in regular polygons

d Number of sides = lines of symmetry = order of rotational symmetry in regular polygons

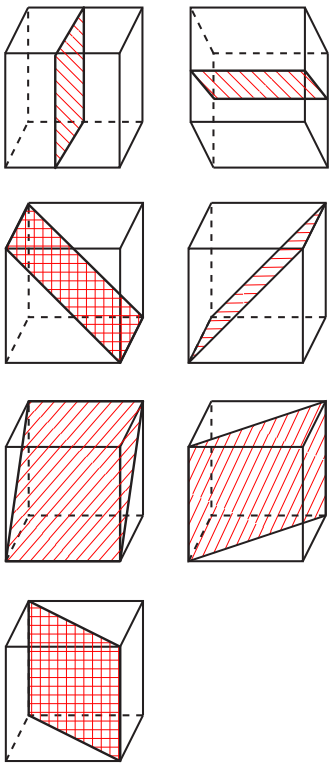
3 Audi = 1
Citroën = 1
Suzuki = 2
Honda = 1
Toyota = 1
Students' own answers, this is an example.

4 ABCDEFGHIJKLMNOPQRST UVWXYZ
a ABCDEMUVWY
b HIOX
c HIOSX

5 Students' answers will vary.

Exercise 19.3

1



2 **a** 4
b infinite
c infinite
d 2 if base is a right-angled; isosceles triangle
e 2 **f** 2
g infinite **h** 7
i 2

Exercise 19.4

1 Each has a rotational symmetry of 2

2 **a** Infinite **b** 1
c 2 **d** 8
e Infinite **f** 1

Exercise 19.5

1 **a** $AB = 5$ cm **b** $AB = 30$ cm
c $AB = 2.4$ m

2 Join OP and construct a line at right angles to OP that will be the chord.

3 O is the centre of both concentric circles.
Construct OX perpendicular to AD.
$\therefore X$ is the mid-point of AD and BC
$\therefore BX = XC$ and $AX = XD$
$AB = AX - BX = XD - XC = CD$

4 **a** 17.3 cm **b** 4.25 m
c 31.1 mm

5 13.5 cm

6 $AO = 9$ cm
Area $AOCB = 108$ cm^2

7 $x = 43°$

Exercise 19.6

1 **a** $x = 43°$, $y = 43°$, $z = 94°$
b $x = 124°$, $y = 34°$
c $x = 35°$ **d** $x = 48°$

2 **a** $x = 41.5°$ **b** $x = 38°$

3 **a** Tangents subtended from the same point are equal in length.
b **i** $CAB = 70°$
ii $DAC = 20°$
iii $ADC = 70°$

Exercise 19.7

1 **a** $p = 50°$, $q = 65°$, $r = 65°$
b $b = 40°$
c $c = 30°$, $d = 55°$, $e = 45°$, $f = 45°$
d $p = 85°$, $q = 105°$
e $b = 60°$
f $x = 94°$, $y = 62°$, $z = 24°$
g $p = 85°$, $q = 65°$

2 **a** $AOB = 2x$ **b** $OAB = 90° - x$
c $BAT = x$

3 **a** $a = 70°$ **b** $b = 125°$
c $c = 60°$, $d = 60°$, $e = 80°$, $f = 40°$

4 **a** $90° - x$ **b** $180° - 2x$
c $2x - 90°$

5 **a** Length of side = 30 mm; area = 900 mm^2
b 193 mm^2

6 $10\sqrt{3} \approx 17.3$ cm

7 **a** Draw the chords AD and BC. ADX and BCX are angles in the same segment, so they are equal. Similarly angle DAX is the same as angle CBX. AXD and BXC are vertically opposite angles, so they are the same, too. This means that both triangles contain the same three angle and so they are similar.
b Using similarity $\frac{DX}{CX} = \frac{AX}{BX}$. You can then multiply through by CX and BX

Exercise 19.8

1 **a** 120° **b** 85°
c 80° **d** 120°
e 90° **f** 90°
g 30°

2 AngleBTC = 180°–30°–(180°–60°) = 30° because angles in a triangle add up to 180°

So angle TDC = 30° by the alternate segment theorem

CTD = 180°–60°–30° = 90° (angle sum in a triangle)

So CD is diameter because the angle in the segment is 90°

3 CTD = 90°

So TDC = 180°–90°–x = 90°–x

So by the alternate segment theorem CTB = 90°–x

But BCT = 180°–x
So $y + 180° - x + 90° - x = 180°$
So $2x - y = 90°$

5 103°

Examination practice

Exam-style questions

1 **a** and **e**

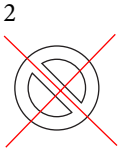
2 Order 3

3 $a = 90°$, $b = 53°$, $c = 90°$, $d = 53°$

Past paper questions*

1 **a** 2

b



2 8

3 52°

4 **a** **i** 43

ii $w = 62$ because YOZ is an isosceles triangle and YOZ + OYZ + YZO = 180° so YOZ = 180 − 2 × 28 = 124. Angle at centre is twice angle at circumference so $w = \frac{1}{2}$ of 124 = 62

iii $p = 30°$ because opposite sides in a cyclic quadrilateral add up to 180°

b **i** 1 : 2

ii OQ; $MQ = NQ$; $OM = ON$; O

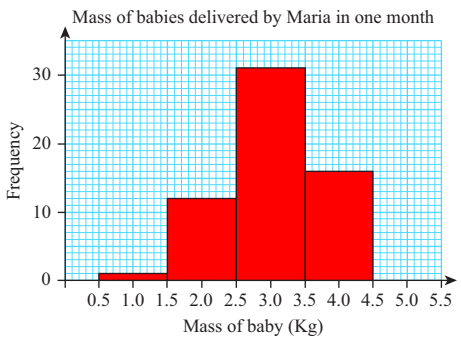
5 Parallelogram

Chapter 20

Exercise 20.1

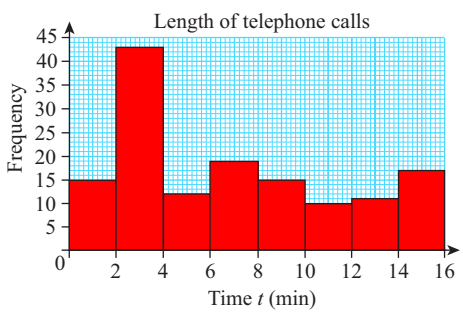
1 **a** $2.5 \leqslant m < 3.5$ **b** 13

c



2 **a** 142 **b** $2 \leqslant t < 4$ min

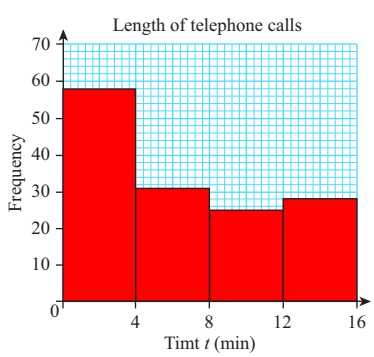
c



d

Class interval	$0 \leqslant t < 4$	$4 \leqslant t < 8$	$8 \leqslant t < 12$	$12 \leqslant t < 16$
Frequency	58	31	25	28

e

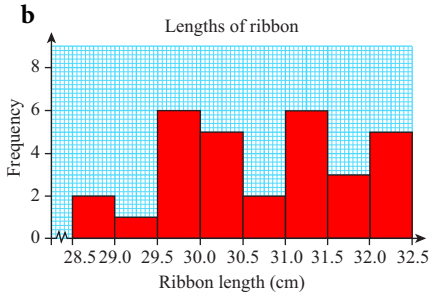


f The smaller the class intervals the more detailed the information represented.
The larger class intervals give a good general picture of the data.

3 **a**

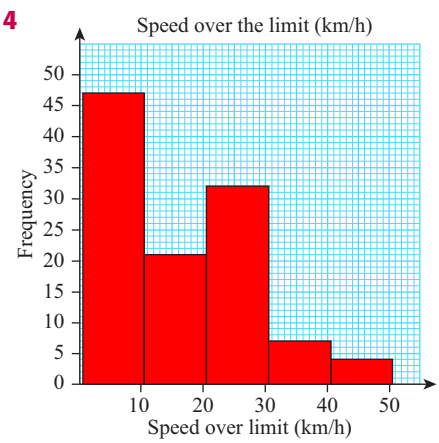
Class interval	Frequency
$28.5 \leqslant l < 29.0$	2
$29.0 \leqslant l < 29.5$	1
$29.5 \leqslant l < 30.0$	6
$30.0 \leqslant l < 30.5$	5
$30.5 \leqslant l < 31.0$	2
$31.0 \leqslant l < 31.5$	6
$31.5 \leqslant l < 32.0$	3
$32.0 \leqslant l < 32.5$	5

b

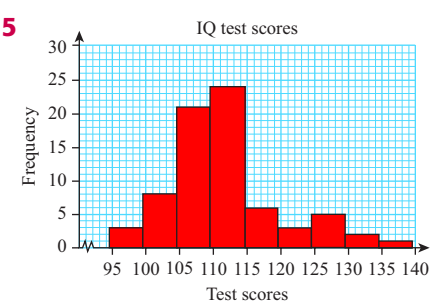


c Not very accurate; only 11 out of 30 were within 0.5 cm of 30 cm.

4



5

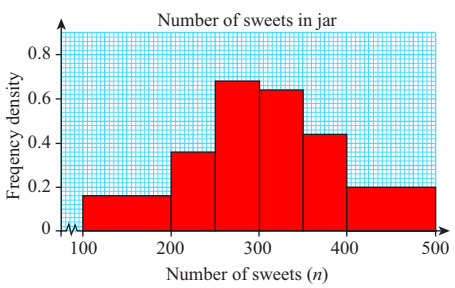


Exercise 20.2

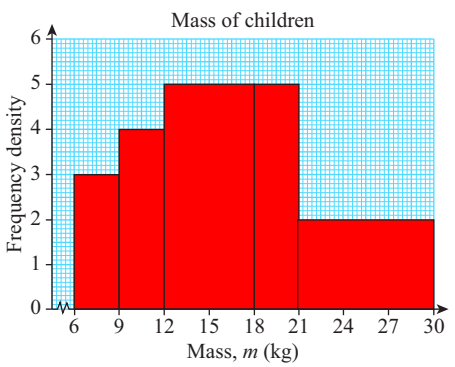
1 **a**

No. of sweets (n)	Frequency (f)	Class width	Frequency density
$100 \leqslant n < 200$	18	100	0.18
$200 \leqslant n < 250$	18	50	0.36
$250 \leqslant n < 300$	32	50	0.64
$300 \leqslant n < 350$	31	50	0.62
$350 \leqslant n < 400$	21	50	0.42
$400 \leqslant n < 500$	20	100	0.2

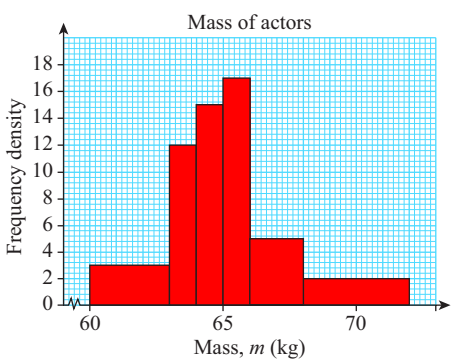
b



2



3



4 **a** 80 **b** 73 **c** 7

d Body fat is too low for intense physical activity.

e No – the expectation is that soldiers are physically active and therefore keep their body fat at a satisfactory level.

5 **a**

Age (a) in years	Frequency
$0 < a \leqslant 15$	12
$15 < a \leqslant 25$	66
$25 < a \leqslant 35$	90
$35 < a \leqslant 40$	45
$40 < a \leqslant 70$	60

b 156

6 **a** No – frequency density and not frequency given.

b Yes – one can see most of the bars are with the boundaries of the speed limits.

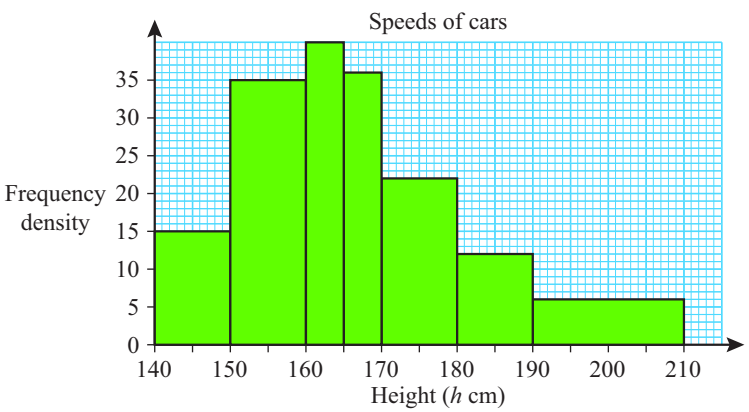
c **i**

Speed (km/h)	Frequency	Class width	Frequency density
$0 \leqslant s < 50$	240	50	4.8
$50 \leqslant s < 65$	320	15	21.3
$65 \leqslant s < 80$	500	15	33.3
$80 \leqslant s < 95$	780	15	52
$95 \leqslant s < 110$	960	15	64
$110 \leqslant s < 125$	819	15	54.6
$125 \leqslant s < 180$	638	55	11.6

ii 240 below the minimum speed limit

d 15%

7 **a**



b

Height (h cm)	Frequency
$140 \leqslant h < 150$	15
$150 \leqslant h < 160$	35
$160 \leqslant h < 165$	20
$165 \leqslant h < 170$	18
$170 \leqslant h < 180$	22
$180 \leqslant h < 190$	12
$190 \leqslant h < 210$	12

c 150 – 160 **d** 75.7

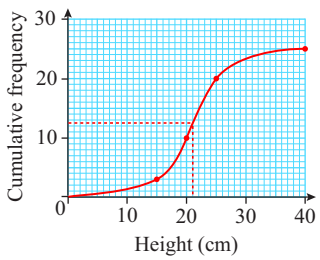
Exercise 20.3

1 **a**

Height in cm	6–15	16–20	21–25	26–40
Number of plants	3	7	10	5
Cumulative frequency	3	10	20	25

b 21–25 cm

c

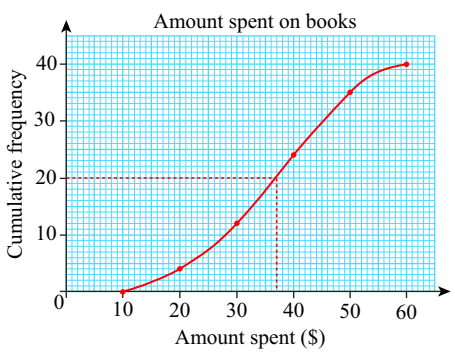


Median = 21 cm

2 **a** $36.25

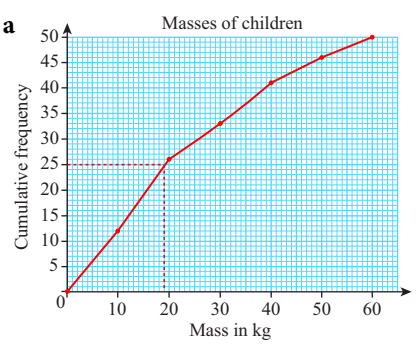
b $p = 12$, $q = 24$, $r = 35$

c



d Median amount spent $37

3 **a**



b 19 kg **c** 24

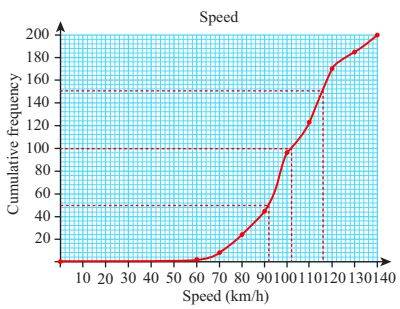
Exercise 20.4

1 **a** 30.0 cm **b** 27.5 cm **c** 33.5 cm
d 6 cm **e** 29.5 cm

2 **a** **i** Paper 1: 48% Paper 2: 60%
ii Paper 1: 28% Paper 2: 28%
iii Paper 1: 52% Paper 2: 66%
b Paper 1: >66% Paper 2: >79%

3 **a** **i** 45 kg **ii** 330 girls
b 10%

4 **a**



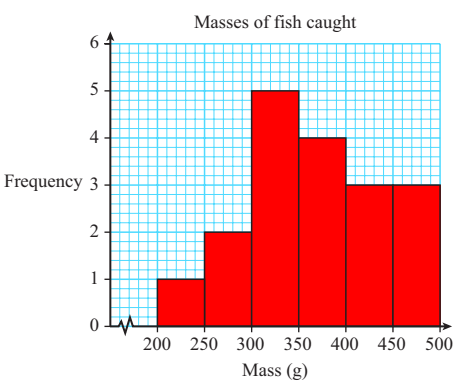
b Median = 102 km/h
$Q_1 = 92$ Speed km/h
$Q_3 = 116$

c IQR = 24 km/h **d** 14.5%

Examination practice

Exam-style questions

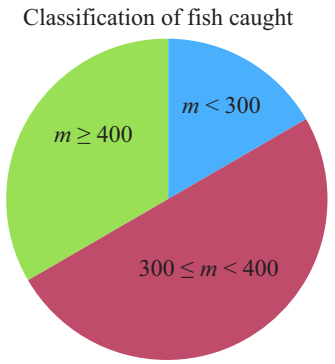
1 **a**



b

Mass (m) in grams	Number of fish	Classification
$m < 300$	3	Small
$300 \leqslant m < 400$	9	Medium
$m \geqslant 400$	6	Large

c



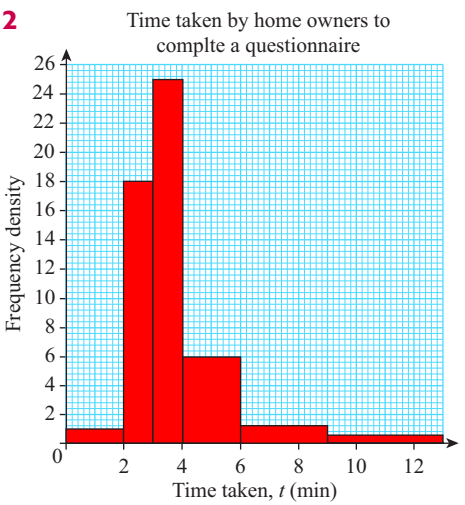
Total number of fish caught = 18

$$\frac{3}{18} \times 360° = 60°$$

$$\frac{9}{18} \times 360° = 180°$$

$$\frac{6}{18} \times 360° = 120°$$

2

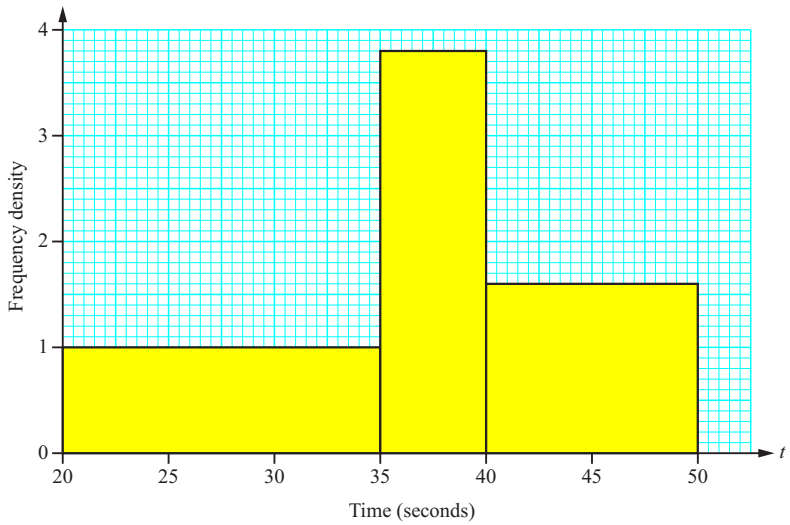


Past paper questions

1 **i**

Time (t seconds)	$20 < t \leqslant 35$	$35 < t \leqslant 40$	$40 < t \leqslant 50$
Frequency	15	19	16

ii



2 **a** 56
b **i** 63 **ii** 24

Unit 6

Chapter 21

Exercise 21.1

1 **a** 1 : 1 **b** 1 : 5 **c** 25 : 3
d 3 : 10 **e** 3 : 20 **f** 1 : 5

2 **a** 12 : 5 **b** 5 : 12

3 **a** 2 : 3 **b** 3 : 4
c 11 : 16 **d** 1 : 2

4 **a** 1 : 12 **b** 1 : 2 **c** 1 : 8
d 7 : 6 **e** 10 : 3 **f** 5 : 12

5 **a** 1 : 10 **b** 1 : 100
c 100 : 1 **d** 1 : 1 000
e 1 000 : 1 **f** 1 : 60

6 **a** 1 : 2 **b** 1 : 8
c 3 : 8 **d** 3 : 25
e 3 : 200 **f** 1 : 20
g 8 : 5 **h** 2 : 15

Exercise 21.2

1 **a** $x = 9$ **b** $y = 24$
c $y = 2$ **d** $x = 6$
e $x = 176$ **f** $y = 65$
g $x = 35$ **h** $y = 180$
i $y = 1400$ **j** $x = 105$
k $x = 1.25$ **l** $y = 4$

2 **a** $x = 15$ **b** $x = 8$
c $y = 20$ **d** $x = 2.4$
e $x = 0.6$ **f** $y = 3.25$
g $x = 5.6$ **h** $y = 7.2$

3 **a** false **b** true **c** false
d false **e** true

4 **a** 1 g **b** 1.33 g
c 7 : 5 **d** 3 : 5

5 **a** 18 : 25 : 5 **b** 1.67 g **c** 4.17 g

6 **a** 20 ml **b** 2.5 ml

7 15 750 kg

Exercise 21.3

1 **a** 40 : 160 **b** 1 200 : 300
c 15 : 35 **d** 12 : 48
e 150 : 450 **f** 22 : 16
g 220 : 80 **h** 230 : 460 : 1 610

2 0.31 = 300 ml

3 Josh gets 27 Ahmed gets 18

4 Annie gets $50, Andrew gets $66.67 and Amina gets $83.33

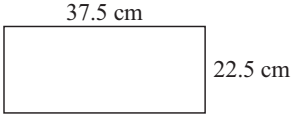
5 Students should draw a 16 cm line with 6 cm marked and 10 cm marked.

6

	N (kg)	P (kg)	K (kg)
a	0.25	0.375	0.375
b	1.25	1.875	1.875
c	5	7.5	7.5
d	6.25	9.375	9.375

7 1.8 m : 2.25 m : 1.35 m

8



9 1200 men

10 **a** $\pi r^2 : 2\pi r$
$= \pi r \times r : \pi r \times 2$
$= r : 2$

b $\frac{4}{3}\pi r^3 : 4\pi r^2$
$= 4\pi r^3 : 12\pi r^2$
$= 4\pi r^2 \times r : 4\pi r^2 \times 3$
$= r : 3$

Exercise 21.4

1

	(i)	(ii)
a	1 : 200	0.005 : 1
b	1 : 250	0.004 : 1
c	1 : 25 000	0.00 004 : 1
d	1 : 200 000	0.000 005 : 1
e	1 : 28.6	0.035 : 1
f	1 : 16 700 000	0.000 000 06 : 1

2 **a** 4 m **b** 6 m
c 14 m **d** 48 m

3 **a** 0.0012 m = 0.12 cm = 1.2 mm
b 0.0003 km = 300 mm
c 0.0024 km = 2400 mm
d 0.00151 km = 1510 mm

4 **a** 100 mm × 250 mm
d 80 mm × 200 mm

5 **a** 1740 km **b** 1640 km
c 1520 km

6 **a** 1 cm = 150 cm = 1.5 m
Answers will vary due to measuring variations.
b **i** 8.4 m
ii 5.85 m
iii 2.7 m
iv 3.15 m
c **i** 27.92 m^2
ii 20.88 m^2
iii 26.46 m^2
d 3.94 m^2
e $162.49

Exercise 21.5

1 **a** 2.4 kg/$ **b** 0.12 l/km
c $105/night **d** 0.25 km/min
e 27 students/teacher
f 3 hours/hole dug

2 **a** 9600 t **b** 48 000 t

3 **a** 120 l **b** 840 l

4 7.4 minutes

5 12.75 km

6 **a** 805 km **b** 76.67 km

7 **a** 312.5 km **b** 3000 km

8 110 km/h

9 18.7 km/h

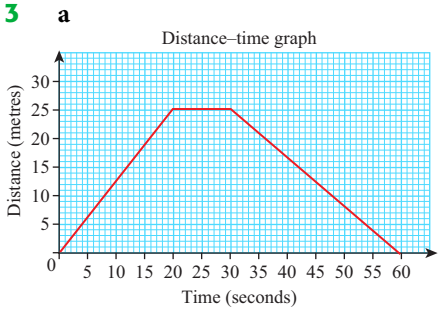
10 **a** 37.578 km/h **b** 40.236 s

Exercise 21.6

1 **a** 700 m **b** 7 min
c 09:07 and 09:21
d Going to the supermarket

2 **a** 45 min **b** 17:55 **c** 17:15

3 **a**



b 15 m **c** 5 m

Exercise 21.7

1 **a** and **b**
Answers will vary, examples: (from left to right)
- The object is moving in the direction of y at a constant speed. Example: a helium-filled children's balloon released in a large hall (with no breeze).
- The object is stationary. Example: a parked car.
- The object is moving in the direction of y at a constant speed, then suddenly changes direction, moving at a much faster speed. Example: a squash ball travelling towards the court wall, hitting it then bouncing back.
- The object is moving very quickly in the direction of y at a constant speed, then stops and is stationary for a while, then continues in the same direction at the same speed as before, then stops and is stationary again. Example: a train travelling from Valladolid to Madrid, stopping at Segovia on the way.
- The object travels slowly at first, then very quickly, then slowly again in the direction of y. Example: an Olympic runner doing interval training.
- The object is moving at a constant speed in the opposite direction to y then it suddenly changes direction and travels at a slightly faster speed in the direction of y.

2 **a** 6 min **b** 10 km/h
c 3 min **d** 3.33 m/s

3 **a** For the first 50 minutes the taxi travelled a distance of 10 km at 12 km/h, then was stationary for 50 minutes then took 20 minutes to return to starting point at 30 km/h. The taxi was then stationary for 40 minutes, then travelled 5 km in 40 minutes at a speed of 7.5 km/h and was then stationary for 40 minutes.
b 130 minutes – the graph is horizontal.
c 25 km
d **i** 12 km/h **ii** 10 km/h
iii 6 km/h **iv** 6.25 km/h

4 **a** Other questions are possible, these are just examples: What is the total time taken to attain a height of 16 m?
When was the helicopter descending?
When was the helicopter ascending?
During what time period was the vertical speed the greatest?
At what speed was the helicopter travelling between 2 and 4 seconds?

Exercise 21.8

1 **a** 1 500 m **b** 2 m/s
c He was stationary. **d** 0.5 m/s

2 **a** 2 m/s^2 **b** 35 m **c** 3.5 m/s

3 **a** 1 m/s^2 **b** 100 m **c** 15 m/s

Exercise 21.9

1 **a, c, d, e, f, h, i**

Exercise 21.10

1 $6.75

2 60 min

3 70 s

4 172.5 kg

5 10.5 km

6 **a** 320 g flour, 64 g sultanas, 80 g margarine, 99 ml milk, 32 g sugar, 16 g salt
b 4 : 1

7 250 g

8 **a** 550 km **b** 17.31

9 **a** 13 ft **b** 13.12 ft
c **i** 4 m **ii** 6.5 m
d **i** 30 ft **ii** 6.59 m
e 6.49 m

Exercise 21.11

1

Number of people	120	150	200	300	400
Days the water will last	40	32	24	16	12

2 **a** 8 days **b** 2 days

3 **a** 100 **b** 25
c 8 **d** 250 cm

4 722.86 km/h

5 3 h 36 min

Exercise 21.12

1 **a** $y = \frac{4.5}{x}$ **b** $y = \frac{62.5}{x}$
c $y = \frac{2}{x}$ **d** $y = \frac{0.28}{x}$
e $y = \frac{4.8}{x}$

2 **a** $k = 5120$ **b** $y = 10$
c $y = 23.70$ **d** $x = 5.98$

3

x	0.1	0.25	0.5	0.0625
y	25	4	1	64

4

x	25	100	3.70	1
y	10	5	26	50

5 **a** 2.5 **b** 1000 **c** 0.125

6 400

7 6.4

8 p and q are not inversely proportional because $p \times q$ is not constant.

9 60

10 **a** false **b** false **c** true

11 5 h

12 16 666.7N (16.7 kN to 3sf)

13 **a** 2 °C;
b As temperature varies inversely it will never reach −1 °C

14

m	3	5
P	24	40

n	2	8
P	24	6

Exercise 21.13

1 56

2 24

3 105

4 38

5 40 cm long and 25 cm wide

Examination practice

Exam-style questions

1 Sandra receives 12 marshmallows

2 Raja receives $40

3 300 cm = 3 m

4 **a** 1.6 kg raisins **b** 1.2 kg dates

5 960 males

6 9 cups

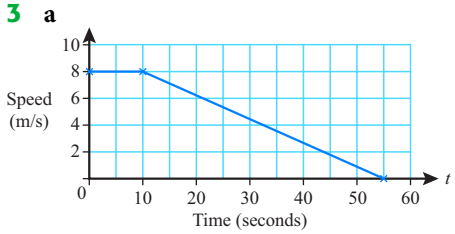
7 **a** 90 km/h **b** 18 km/h²
c 15 km **d** $2\frac{1}{2}$ min
e 18 km/h **f** 17.5 km

Past paper questions*

1 460

2 175

3 **a**



b 260

4 16 km

Chapter 22

Exercise 22.1

1 **a** $4x = 32$
$x = 8$
b $12x = 96$
$x = 8$
c $x + 12 = 55$
$x = 43$
d $x + 13 = 25$
$x = 12$
e $x - 6 = 14$
$x = 20$
f $9 - x = -5$
$x = 14$
g $\frac{x}{7} = 2.5$
$x = 17.5$
h $\frac{28}{x} = 4$
$x = 7$

2 **a** $y = 3$ **b** $y = 12$
c $y = 46$ **d** $y = 70$

3 **a** $x = 13$ **b** $x = 9$
c $x = 2$ **d** $x = 11$

Exercise 22.2

1 Daughter = 15.5 years and father = 46.5 years

2 Silvia has 70 marbles; Jess has 350 marbles.

3 Kofi has $51.25 and Soumik has $46.25

4 $250 and $500

5 9 years

6 Width = 15 cm and length = 22 cm

7 48 km

8 Pam = 12 years and Amira = 24 years

9 6.30 p.m.

10 50 km

Exercise 22.3

1 −8 and −5 or 5 and 8

2 $t = 2$ seconds

3 12

4 4 and 7

5 6 cm

6 8 cm

7 **a** 12 sides
b n not an integer when the equation is solved

8 **b** $x = 1.62$ or $x = -0.62$
c Negative solution can't work as a length must be positive
d perimeter = 5.24 cm

9 (0,1,2), (−7, −6, −5), (4, 5, 6)

10 7 or −2

11 3 cm by 8 cm

12 0.836 seconds

13 1.96 seconds

14 6 or −4

15 2.75 cm

16 7 and 8

Exercise 22.4

1 **a** $x = m - bp$ **b** $x = pr - n$
c $x = \frac{m}{4}$ **d** $x = \sqrt{\frac{c+b}{a}}$
e $x = \frac{d - 2b - c}{m}$
f $x = 3by$ **g** $x = \frac{p}{m}$
h $x = \frac{np}{m}$ **i** $x = \frac{mk}{2}$
j $x = \frac{20}{p}$

2 **a** $x = \frac{m - 3y}{3}$ **b** $x = \frac{4t - c}{4}$
c $x = \frac{y + 15}{3}$ **d** $x = \frac{5}{2}$
e $x = \frac{m}{4c} + y$ **f** $x = 2r - \frac{a}{\pi r}$

3 $m = \frac{E}{c^2}$

4 $\mathrm{R} = \frac{100\mathrm{I}}{\mathrm{PT}}$

5 $m = \frac{2k}{v^2}$

6 $b = \frac{2A}{h} - a$

7 $h = \frac{3V}{A}$

8 $h = \frac{3V}{\pi r^2}$

9 $B = 0.68$

10 $h = 3.07$

11 **a** 38 °C **b** 100 °C
c 0 °C

12 **a** 2.11 **b** 6.18
c 0.40

Exercise 22.5

1 **a** $x = \sqrt{\frac{m}{a}}$ **b** $x = \sqrt{m+y}$

c $x = \sqrt{n-m}$ **d** $x = \sqrt{ay}$

e $x = \sqrt{\frac{ac}{b}}$ **f** $x = \sqrt{a+b^2}$

g $x = \sqrt{\frac{n}{m}}$ **h** $x = \frac{m^2}{y}$

i $x = \frac{a^2}{5}$ **j** $x = y^2 + z$

k $x = (y+z)^2$ **l** $x = \left(\frac{c}{a-b}\right)^2$

m $x = \left(\frac{m-a}{-b}\right)^2$ **n** $x = \frac{y^2+1}{3}$

o $x = \frac{y-a^2}{2}$ **p** $x = \frac{a^2+by^2}{4y^2}$

2 **a** $a = \frac{b-x}{1-x}$ **b** $a = \frac{L}{B+1+C}$

c $a = \frac{5b}{b-1}$ **d** $a = \frac{x(y+1)}{y-1}$

e $a = \frac{3-y}{y-1}$ **f** $a = \sqrt{\frac{2}{m-n}}$

3 $c = \sqrt{\frac{E}{m}}$

4 $a = \sqrt{c^2 - b^2}$

5 $\frac{2y}{1-y}$

6 $s = \sqrt{A}$

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

c $\frac{4x+z}{3}$

d $y = \frac{2(b-a)}{3}$

8 **a** $E = 49$ **b** $v = \sqrt{\frac{2E}{m}}$

9 **a** $V = 2010619\,\text{cm}^3$

b $r = \sqrt{\frac{V}{\pi h}}$

10 **a** $A = 1.13\,\text{m}^2$ **b** $A = 1.13\,\text{m}^2$

c $d = \sqrt{\frac{4A}{\pi}}$

Exercise 22.6

1

	i f(2) =	ii f(−2) =	iii f(0.5) =	iv f(0) =
a	8	−4	3.5	2
b	8	−12	0.5	−2
c	3	−5	0	−1
d	11	11	3.5	3
e	0	8	−0.75	0
f	6	−10	−1.875	−2

2 **a** −5 **b** −1
c 5 **d** −17

3 **a** 0 **b** −4
c 5 **d** −3.9375

4 **a** 0 **b** −9
c −2 **d** 5

5 **a** 16 **b** 16 **c** 1

6 $x = \frac{4}{3}$

7 $x = \frac{1}{3}$

8 $x = 6$

9 **a** $x = -2$ or 3 **b** $x = -6$

10 **a** $2a$ **b** $2a + 4$
c $8a$ **d** $8a$

11 **a** 9 **b** $x = 2$

12 **a** 15 **b** 3 **c** 1

Exercise 22.7

1 **a** $\text{fg}(x) = x + 3$; $\text{gf}(x) = x + 3$
b $\text{fg}(x) = 50x^2 - 15x + 1$;
$\text{gf}(x) = 10x^2 - 15x + 5$
c $\text{fg}(x) = 27x^2 - 48x + 22$;
$\text{gf}(x) = 9x^2 - 12x + 4$

d $\text{fg}(x) = \frac{4x^2 - 36}{3}$;

$\text{gf}(x) = \frac{16x^2}{9} - 9$

2 **a** $-2x$ **b** −4
c 16 **d** −2

3 **a** $9x + 4$ **b** $18x^2 + 1$
c 3456 **d** 150

e $\frac{726}{25}$

4 **a** 26 **b** 7
c 26 **d** 29

5 $\text{gh}(4) = 5$ $\text{hg}(4) = \frac{4}{5}$

6 **a** $-56 + 16x^2 - x^4$
b $56 - 16x^2 + x^4$
c $-56 + 16x^2 - x^4$
d $56 - 16x^2 + x^4$

7 **a** −25 **b** $\frac{3}{2}$ **c** $-\frac{7}{34}$

d $\frac{1}{3}$ **e** −15

8 **a** $\left(x^2 + 36\right)^2$ **b** $\sqrt{x^8 + 36}$

c 0 **d** $\sqrt{76}$

9 $\text{hgf}(1) = \frac{1}{0}$ which is undefined.

10 **a**

$$ff(x) = \frac{\frac{x+1}{x-1} + 1}{\frac{x+1}{x-1} - 1}$$
$$= \frac{x+1+x-1}{x+1-(x-1)}$$
$$= \frac{2x}{2}$$
$$= x$$

b Same as f(x) as the function is self inverse. So $f^{-1}(x) = \frac{x+1}{x-1}$.

Exercise 22.8

1 **a** $\frac{x}{7}$ **b** $\sqrt[3]{\frac{1}{7x}}$ **c** $\sqrt[3]{x}$

d $\frac{x-3}{4}$ **e** $2(x-5)$ **f** $2x - 2$

g $\frac{x}{3} + 2$ **h** $\frac{2x-9}{2}$ **i** $\frac{4x-2}{2+x}$

j $\sqrt[3]{x-5}$ **k** $\frac{x^2-8}{3}$

l $f^{-1}(x) = \frac{x+1}{x-1}$

2 **a** $\text{f}^{-1}(x) = \text{g}(x)$
b $\text{f}^{-1}(x) = \text{g}(x)$
c $\text{f}^{-1}(x) \neq \text{g}(x)$
d $\text{f}^{-1}(x) = \text{g}(x)$

3 $g^{-1}(x) = 3(x + 44)$

4 **a** **i** $f^{-1}(x) = \frac{x}{5}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

b **i** $f^{-1}(x) = x - 4$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

c **i** $f^{-1}(x) = \frac{x+7}{2}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

d **i** $f^{-1}(x) = \sqrt[3]{x-2}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

e **i** $f^{-1}(x) = \frac{x^2+1}{2}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

f **i** $f^{-1}(x) = \frac{9}{x}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

g **i** $f^{-1}(x) = \sqrt[3]{x+1}$

ii $ff^{-1}(x) = x$

iii $f^{-1}f(x) = x$

5 **a** 8 **b** 20 **c** 11

6 **a** −10 **b** $\frac{5x+2}{20}$

c $x = 1.54$

d **i** $-56\frac{2}{5}$ **ii** 3

iii $-7\frac{4}{5}$

Examination practice

Exam-style questions

1 \$2

2 16 5c coins and 34 10c coins

3 $a = 3.64$

4 **a** false **b** true

c true **d** false

5 **a** 14 **b** $x = 1.26$ or -0.26

c $x = 1.76$ or -0.76

d $x = 1$ **e** $\frac{4-x}{3}$

6 **a** 7 **b** $\frac{3-x}{4}$ **c** 4

7 $-\frac{3}{4}$

Past paper questions*

1 $x = \pm\sqrt{y-4}$

2 $y = \pm\sqrt{\frac{\pi x^2 - A}{\pi}}$

or

$y = \pm\sqrt{x^2 - \frac{A}{\pi}}$

3 **a** **i** 8

ii 4

b 4 or −4

c 1.176 or −4.68

d $\frac{(x+2)}{5}$

e −2

4 **a** **i** 11

ii 256

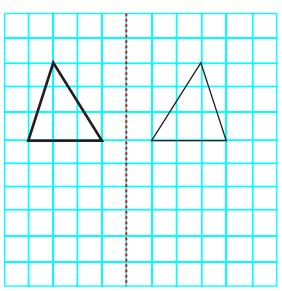
b $\frac{(x-5)}{2}$ **c** $19 - 6x$

d −1, 0, 1, 2

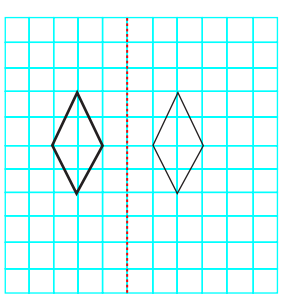
Chapter 23

Exercise 23.1

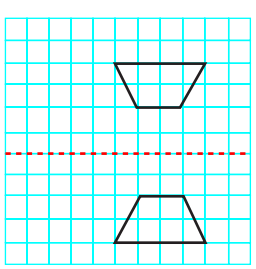
1 **a**



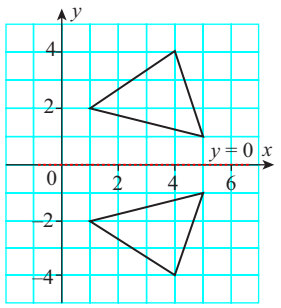
b



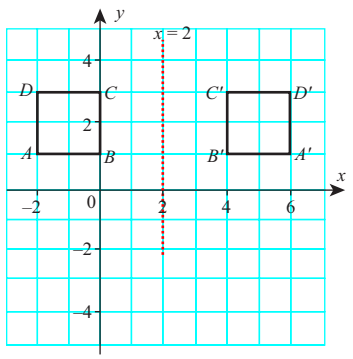
c



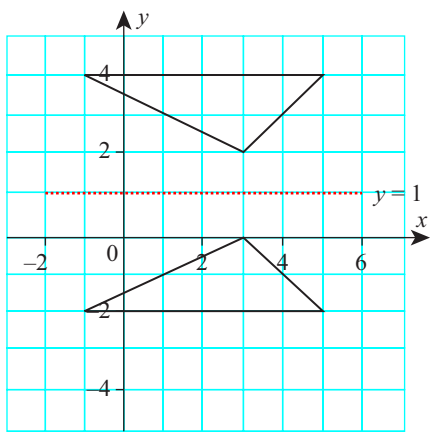
2 **a**



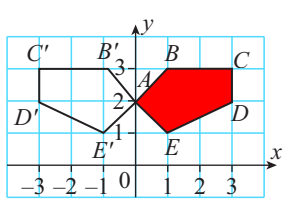
b



c



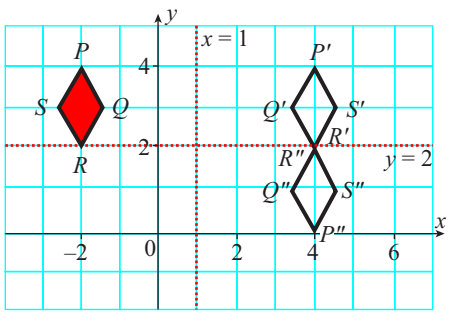
3 **a**



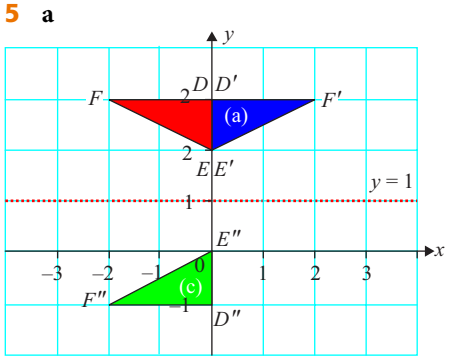
b $B' = (-1, 3)$

c A and A' are invariant – they are the same point.

4 **a** and **b**



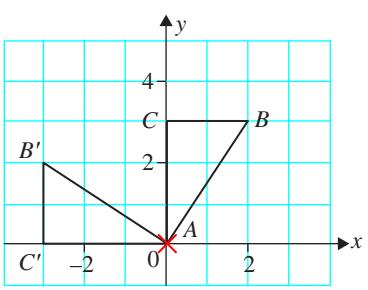
5 **a**



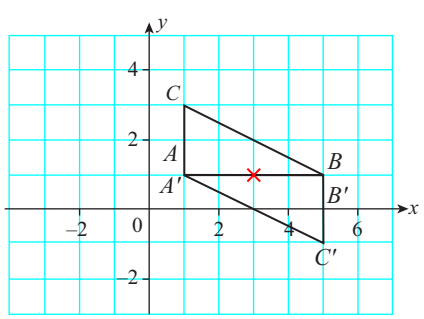
b F is at (–2, 3)
F' is at (2, 3)

Exercise 23.2

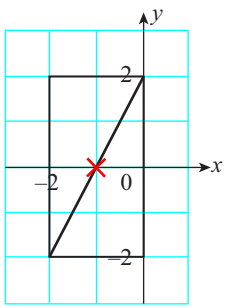
1 **a**



b



c

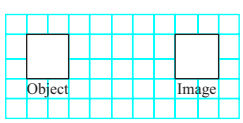


2 **a** Centre of rotation A; angle of rotation 90° clockwise.
b Centre of rotation point on line AC; angle of rotation 180°.
c Centre of rotation point on line AC; angle of rotation 90° clockwise.

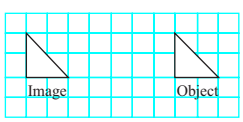
3 **a** no **b** no **c** yes

Exercise 23.3

1 **a**



b

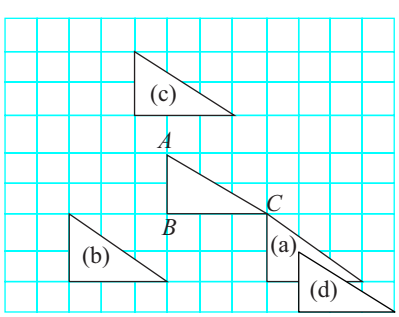


2 **a** $A \to B\begin{pmatrix}-6\\0\end{pmatrix}$ $A \to C\begin{pmatrix}3\\6\end{pmatrix}$

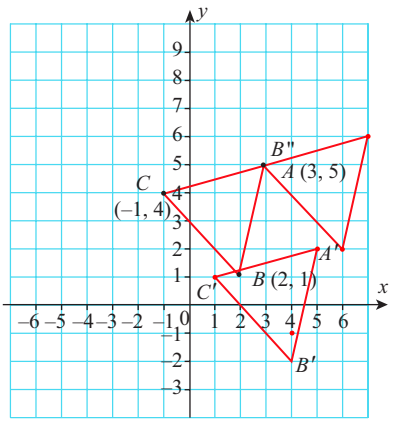
b $A \to B\begin{pmatrix}0\\-7\end{pmatrix}$ $A \to C\begin{pmatrix}-6\\1\end{pmatrix}$

c $A \to B\begin{pmatrix}0\\5\end{pmatrix}$ $A \to C\begin{pmatrix}6\\-3\end{pmatrix}$

3

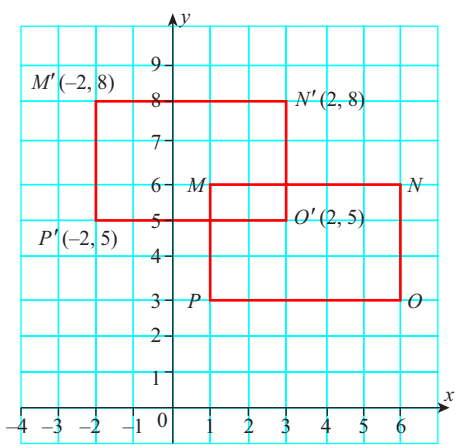


4 **a** and **b**



5 X' (7, –1)
Y' (6, 4)
Z' (3, –7)

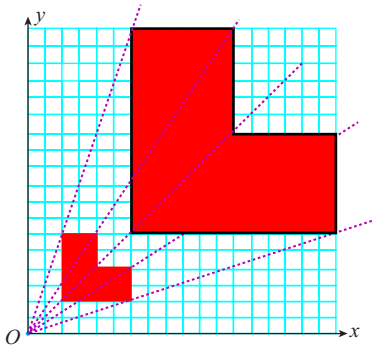
6 **a** and **b**



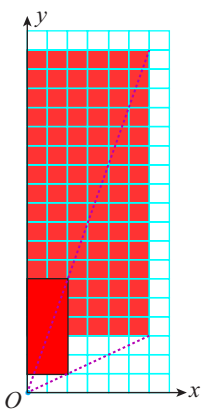
Exercise 23.4

1 **a** Scale factor 2; centre of enlargement = (8, 0)
b Scale factor 2; centre of enlargement = (3, –2)
c Scale factor 2; centre of enlargement (–3, 4)
d Scale factor $\frac{1}{2}$; centre of enlargement (0, 0)

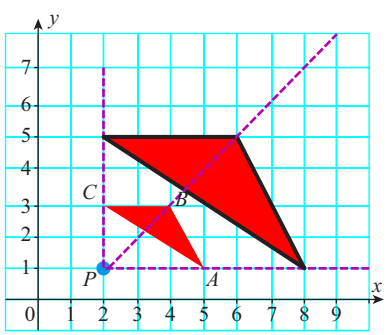
2 **a**



b



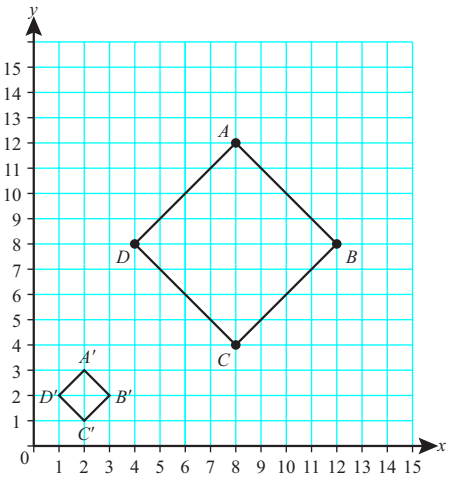
3



4 Scale factor $\frac{1}{2}$; centre of enlargement (0, −1)

5 Scale factor 1.5; centre of enlargement (4, 2)

6



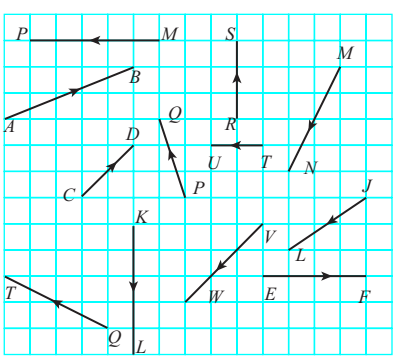
7 **a** 9.6 cm wide
b Length will be tripled.
c No; the image will not be in proportion.
d 2.5 cm long and 1.5 cm wide

8 **a** Scale factor is 0.75
b 1.78 times smaller

Exercise 23.5

1 **a** $\begin{pmatrix}4\\6\end{pmatrix}$ **b** $\begin{pmatrix}4\\2\end{pmatrix}$ **c** $\begin{pmatrix}-4\\2\end{pmatrix}$
d $\begin{pmatrix}-4\\2\end{pmatrix}$ **e** $\begin{pmatrix}6\\-4\end{pmatrix}$ **f** $\begin{pmatrix}0\\4\end{pmatrix}$
g $\begin{pmatrix}8\\4\end{pmatrix}$ **h** $\begin{pmatrix}4\\-2\end{pmatrix}$

2



3 **a** $\overrightarrow{AB} = \begin{pmatrix}4\\0\end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix}4\\0\end{pmatrix}$
b $\overrightarrow{BC} = \begin{pmatrix}1\\3\end{pmatrix}$ $\overrightarrow{AD} = \begin{pmatrix}1\\3\end{pmatrix}$
c They are equal.

4 **a** $\begin{pmatrix}4\\2\end{pmatrix}$ **b** $\begin{pmatrix}5\\-1\end{pmatrix}$ **c** $\begin{pmatrix}6\\-1\end{pmatrix}$
d $\begin{pmatrix}0\\-3\end{pmatrix}$ **e** $\begin{pmatrix}-4\\3\end{pmatrix}$ **f** $\begin{pmatrix}5\\2\end{pmatrix}$

Exercise 23.6

1 **a** $\begin{pmatrix}9\\-21\end{pmatrix}$ **b** $\begin{pmatrix}\frac{3}{2}\\\frac{-7}{2}\end{pmatrix}$ **c** $\begin{pmatrix}-6\\14\end{pmatrix}$
d $\begin{pmatrix}-3\\7\end{pmatrix}$ **e** $\begin{pmatrix}\frac{-9}{4}\\\frac{21}{4}\end{pmatrix}$ **f** $\begin{pmatrix}4.5\\-10.5\end{pmatrix}$

2 **a** $\overrightarrow{DK} = 2\overrightarrow{JK}$ **b** $\overrightarrow{JQ} = \frac{1}{4}\overrightarrow{JF}$
c $\overrightarrow{HP} = \frac{1}{2}\overrightarrow{HF}$ **d** $2\overrightarrow{GO} = \frac{1}{2}\overrightarrow{GC}$
e $3\overrightarrow{DG} = 1\overrightarrow{CL}$ **f** $6\overrightarrow{BE} = 2\overrightarrow{CL}$

3 **a** $\begin{pmatrix}2\\8\end{pmatrix}$ **b** $\begin{pmatrix}9\\21\end{pmatrix}$
c $\begin{pmatrix}4.5\\10.5\end{pmatrix}$ **d** $\begin{pmatrix}0.75\\3\end{pmatrix}$
e $\begin{pmatrix}1.5\\6\end{pmatrix}$ **f** $\begin{pmatrix}-36\\-84\end{pmatrix}$
g $\begin{pmatrix}1.5\\6\end{pmatrix}$ **h** $\begin{pmatrix}-\frac{5}{3}\\-\frac{35}{9}\end{pmatrix}$

Exercise 23.7

1 **a** $\begin{pmatrix}12\\-6\end{pmatrix}$ **b** $\begin{pmatrix}3\\-5\end{pmatrix}$

2 $\begin{pmatrix}12\\-7\end{pmatrix}$

3 **a** $\begin{pmatrix}12\\8\end{pmatrix}$ **b** $\begin{pmatrix}8\\24\end{pmatrix}$
c $\begin{pmatrix}-4\\-12\end{pmatrix}$ **d** $\begin{pmatrix}2\\0\end{pmatrix}$

e $\begin{pmatrix}0\\12\end{pmatrix}$ **f** $\begin{pmatrix}16\\21\end{pmatrix}$

g $\begin{pmatrix}10\\9\end{pmatrix}$ **h** $\begin{pmatrix}-2\\-7\end{pmatrix}$

4 **a** $2\mathbf{a}+3\mathbf{b}$ **b** $\mathbf{a}+\frac{3\mathbf{b}}{2}$

c $\mathbf{b}$ **d** $\mathbf{a}+\frac{\mathbf{b}}{2}$

5 **a** $\mathbf{x}+\mathbf{y}$ **b** $\frac{3}{4}(x+y)$

c $-\frac{1}{4}\mathbf{x}+\frac{3}{4}\mathbf{y}$

6 **a** $2q-2p$ **b** $2p+q$ **c** $p-q$

Exercise 23.8

1 **a** 4.12 **b** 3.61 **c** 4.24

d 5 **e** 4.47 **f** 5

g 5.83

2 **a** 10.30 **b** 13.04

c 5 **d** 10

3 **a** 5 **b** 13 **c** 17

4 **a** $A(4, 2)$ $B(-1, 3)$ $C(6,-2)$

b $\overrightarrow{AB}=\begin{pmatrix}-5\\1\end{pmatrix}$ $\overrightarrow{CB}=\begin{pmatrix}-7\\5\end{pmatrix}$ $\overrightarrow{AC}=\begin{pmatrix}2\\-4\end{pmatrix}$

5 **a** $\frac{\mathbf{a}}{2}$ **b** $-\frac{\mathbf{b}}{2}$

c $\frac{\mathbf{a}-\mathbf{b}}{2}$ **d** $\frac{3\mathbf{a}+3\mathbf{b}}{4}$

6 **a** 10 **b** 8.60

7 100 km/h

8 6.71 km/h (3sf)

9 **a** b – a **b** 3

c $\overrightarrow{CD}=\overrightarrow{CA}+\overrightarrow{AD}$

So $CD = -2a + 3b - a = 3b - 3a = 3\overrightarrow{AB}$

So CD is parallel to AB, so the triangles are similar.

10 **a** $-\mathrm{p}+\mathrm{q}$ **b** $\frac{2}{3}(-\mathrm{p}+\mathrm{q})$

c $\frac{2}{3\mathrm{q}}+\frac{1}{3\mathrm{p}}$ **d** $\mathrm{q}+\frac{1}{2}\mathrm{p}$

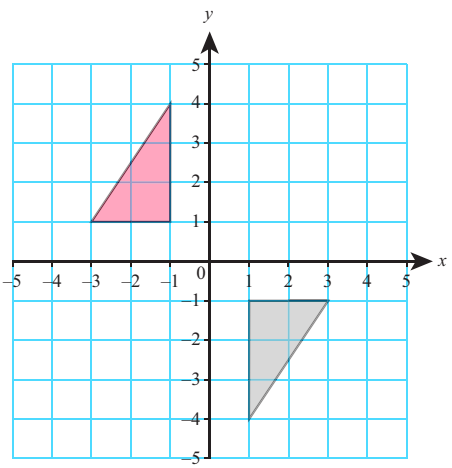
Exercise 23.9

1 **a** $y=-x$

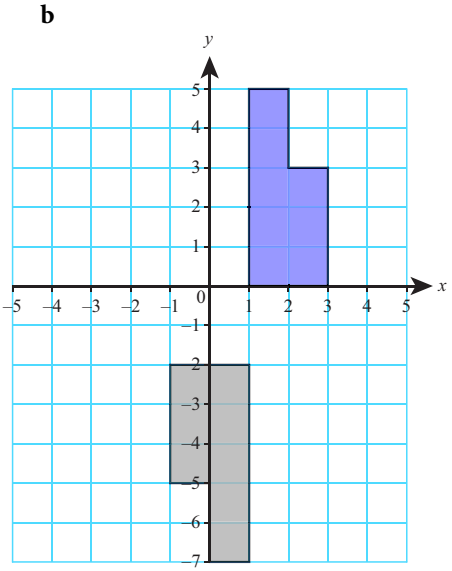
b $y=x-1$

c $y=2-x$

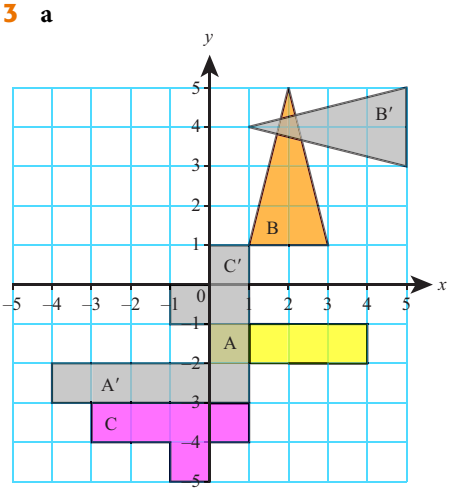
2 **a**



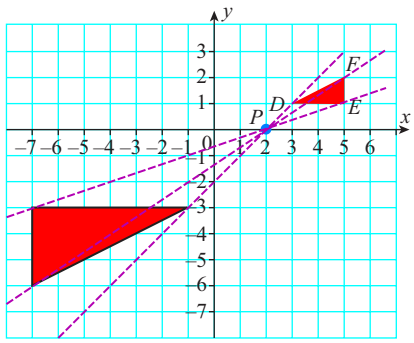
b



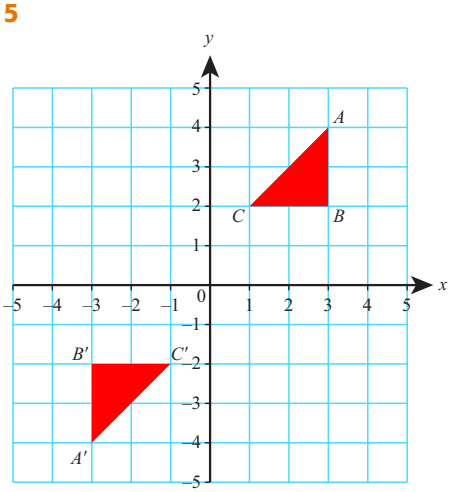
3 **a**



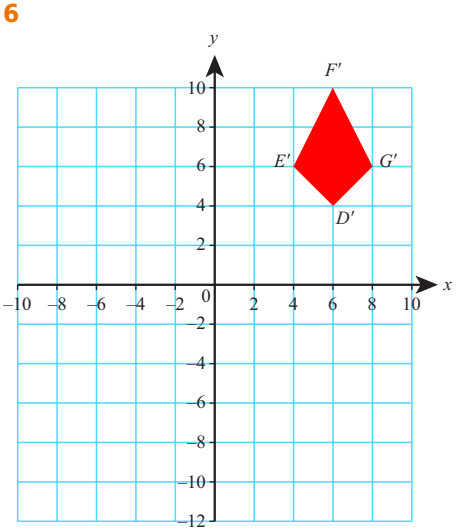
4



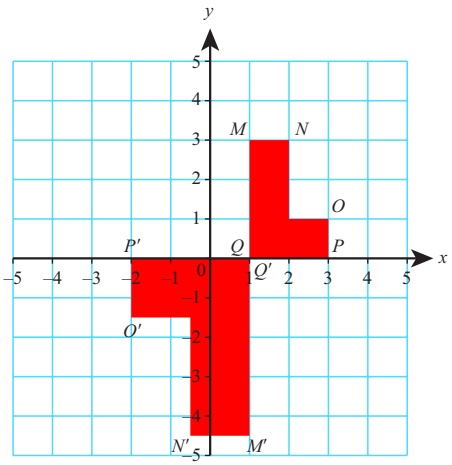
5



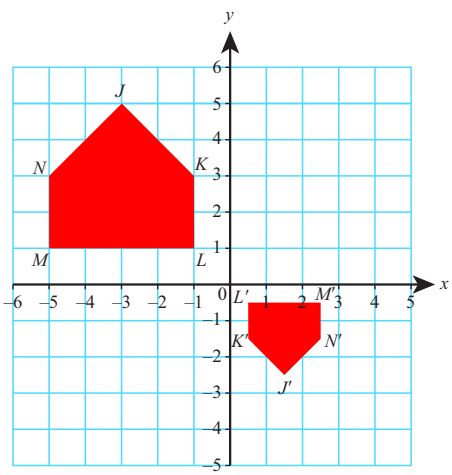
6



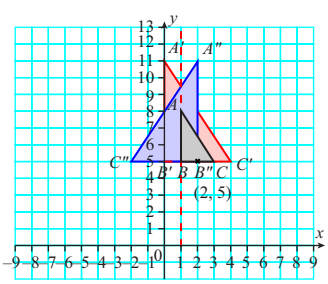
7



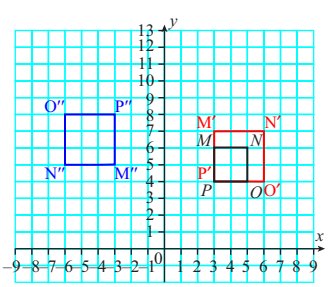
8



9



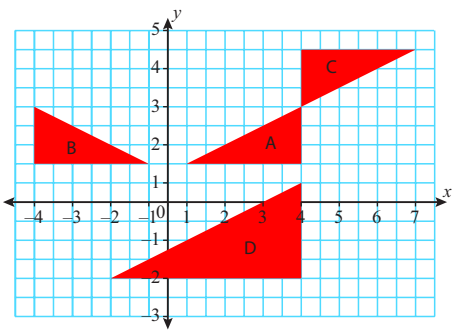
10



Examination practice

Exam-style questions

1 **a** NOT TO SCALE



2 *A*: reflection about $y = 0$ (x-axis).

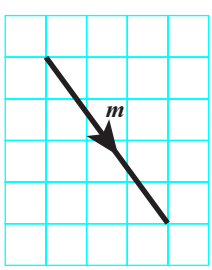
B: translation $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$.

C: enlargement scale factor 2 centre origin.

D: rotation + 90° about the origin.

3 **a** **i** $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$ **ii** $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$

b



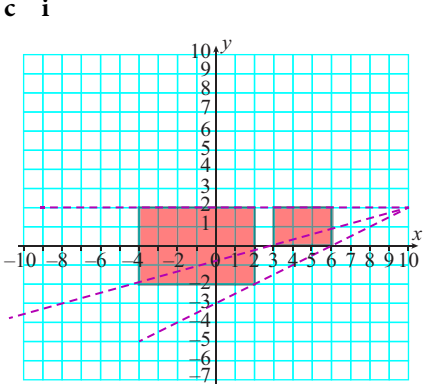
4 **a** (−1, 2)

b Scale factor −2

5 **a** $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

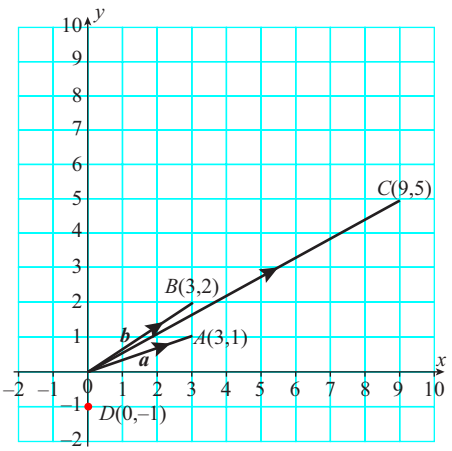
b Rotation 180° about centre (6, 0).

c **i**



ii 4 : 1

6 **a**



b **a** – **b** **c** $|\mathbf{a}| = 3.16$

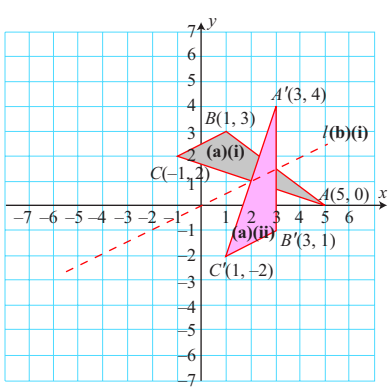
7 **a** **i** Translation $\begin{pmatrix} 7 \\ 3 \end{pmatrix}$

ii Enlargement scale factor 3 centre origin

iii Rotation 90° centre (2, 1) and translation $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$

b Shapes B, D

8



b **ii** $y = \frac{x}{2}$

Past paper questions*

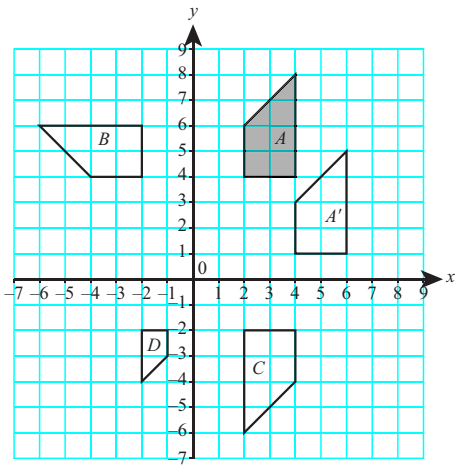
1 $\sqrt{34}$

2 **a** **i** Rotation, 90°, anticlockwise about (0, 2)

ii Reflection in the line $y = 1$

iii Enlargement, scale factor $-\frac{1}{2}$, centre (0, 0)

b



3 **a** **i** $-a+c$

ii $-\frac{1}{3}a+\frac{1}{3}c$

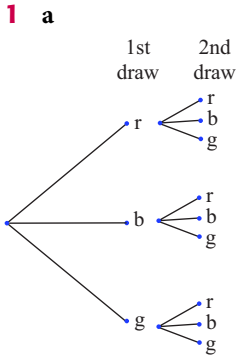
b $\overrightarrow{AX}=\frac{1}{3}(-a+c)=\frac{1}{3}\overrightarrow{AC}$

so $\overrightarrow{AX}$ and $\overrightarrow{AC}$ are parallel and pass through A therefore the points lie on a straight line.

Chapter 24

Exercise 24.1

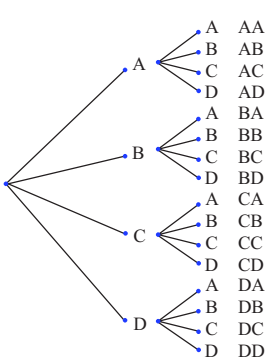
1 **a**



b 9 possible outcomes **c** 3

d 5 **e** 4

2 **a**

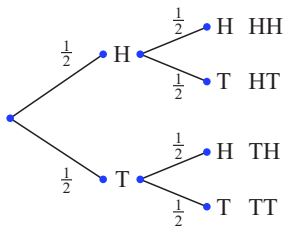


b 16

c $\frac{1}{16}$

Exercise 24.2

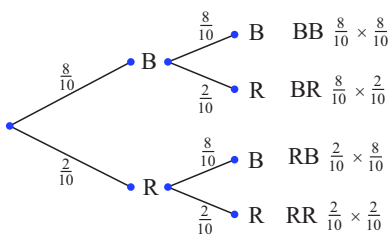
1



4 outcomes

P(TT or HH) = $\frac{2}{4}=\frac{1}{2}$

2 **a**

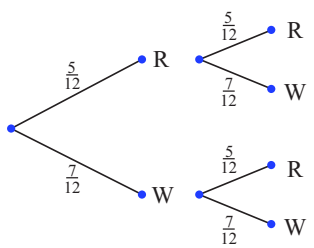


b **i** P(RR) = $\frac{1}{25}$

ii P(RB) + P(BR) = $\frac{8}{25}$

iii P(BB) = $\frac{16}{25}$

3 **a**



b **i** P(RR) = $\frac{25}{144}$

ii P(WW) = $\frac{49}{144}$

4 **a** 4

b $\frac{4}{9}$

c $\frac{1}{9}$

d He is equally likely either to buy two birds, or to buy one of each.

Exercise 24.3

1 **a** $\frac{1}{2}$

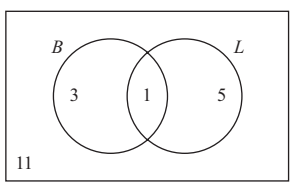
b $\frac{2}{3}$

c $\frac{1}{6}$

d $\frac{1}{3}$

e 1

2

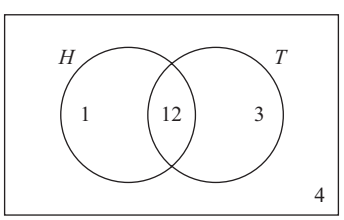


a $\frac{4}{5}$

b $\frac{1}{4}$

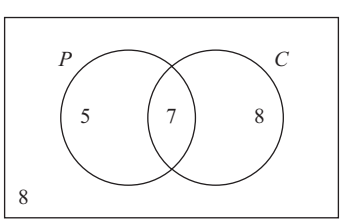
c $\frac{11}{20}$

3 **a**



b $\frac{3}{5}$

4 **a**

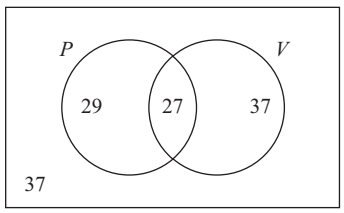


b **i** $\frac{5}{28}$

ii $\frac{5}{7}$

iii $\frac{1}{4}$

5 **a**



b **i** $\frac{32}{65}$

ii $\frac{93}{130}$

iii $\frac{27}{130}$

iv $\frac{37}{130}$

6 **a** 12

b 3

c 21

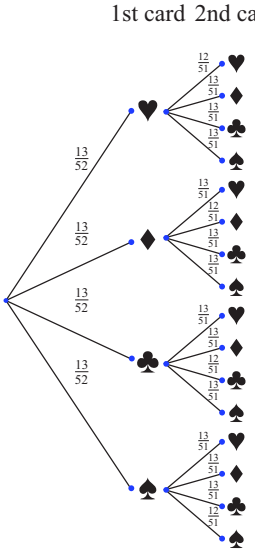
d 12

e $\frac{7}{12}$

f $\frac{12}{19}$

Exercise 24.4

1 **a**

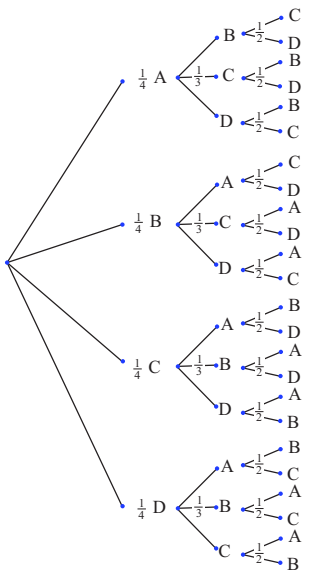


b **i** $P(\heartsuit\heartsuit) = \frac{13}{52} \times \frac{12}{51} = \frac{3}{51}$

ii $P(\clubsuit\clubsuit) = \frac{13}{52} \times \frac{12}{51} = \frac{3}{51}$

iii $P(\text{red, black}) = \frac{26}{52} \times \frac{26}{51} = \frac{13}{51}$

2 **a**

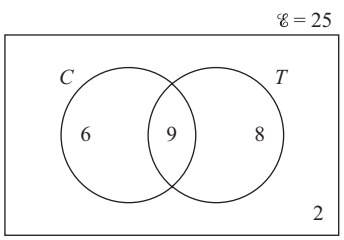


b **i** $\frac{1}{24}$ **ii** $\frac{1}{24}$

iii 0

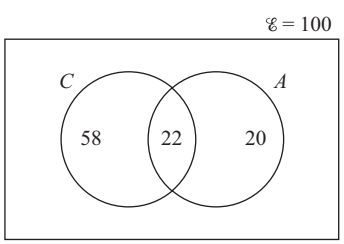
c $\frac{1}{4}$ **d** $\frac{1}{24}$

3



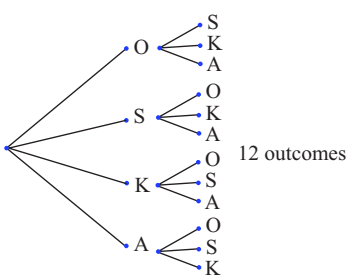
a $\frac{3}{5}$ **b** $\frac{9}{17}$

4



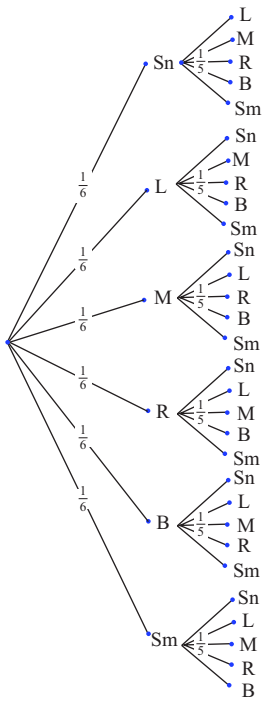
a **i** 0.58 **b** $\frac{11}{40}$ or 0.275

5 **a** 12 outcomes



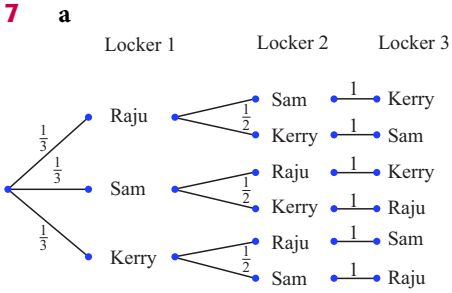
b $\frac{1}{12}$ **c** $\frac{1}{12}$

6 **a**



b $\frac{1}{30}$

7 **a**

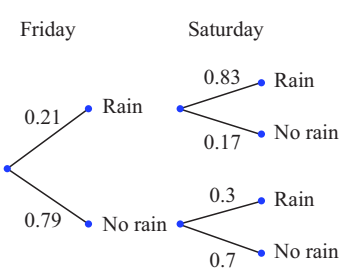


b Conditional – once the first name is chosen it cannot be chosen again, so the second choice depends on the first, and so on.

c 1 ways **d** 6 ways **e** $\frac{1}{6}$

8 $\frac{4}{15}$

9 **a**



b **i** 0.1743 **ii** 0.4113

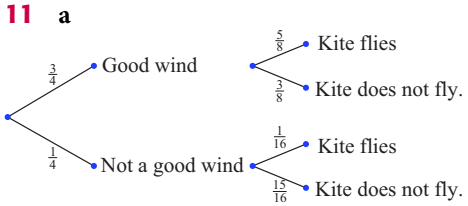
10 **a** weather forecast over the next 2 days

b $P(\text{rain both days}) = \frac{1}{50}$

$P(\text{sun both days}) = \frac{96}{125}$

$P(\text{1 fine day and 1 rain}) = \frac{53}{250}$

11 **a**

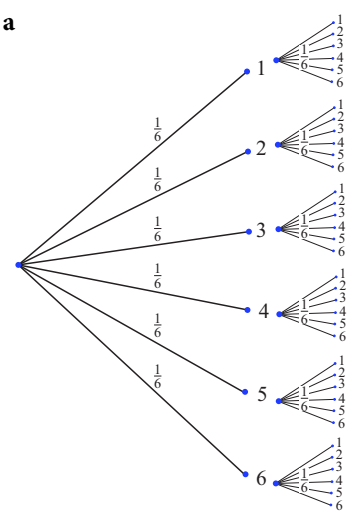


b $\frac{15}{32}$ **c** $\frac{33}{64}$ **d** $\frac{31}{128}$

Examination practice

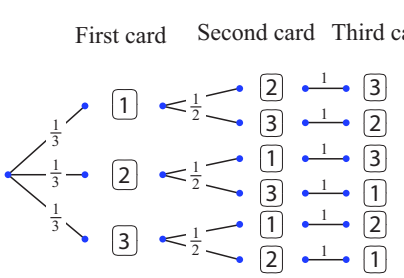
Exam-style questions

1 **a**



b **i** $\frac{5}{36}$ **ii** $\frac{1}{6}$

2 **a**



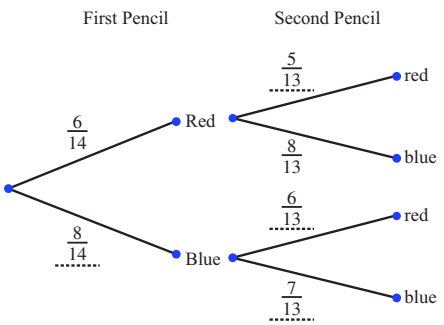
b 6

c **i** $\frac{1}{6}$ **ii** $\frac{2}{3}$

iii $\frac{1}{3}$ **iv** 1

Past paper questions*

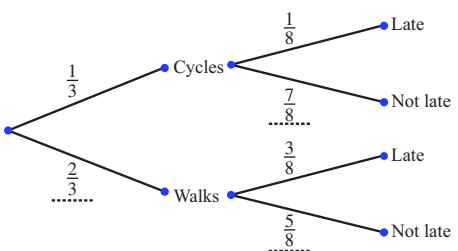
1 **a**



b **i** $\frac{15}{91}$ **ii** $\frac{9}{13}$

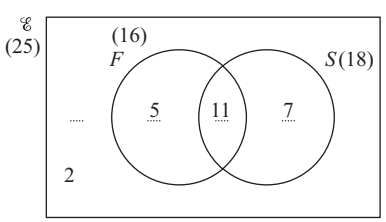
2 **a** $\frac{2}{3}$

b



c **i** $\frac{1}{24}$ **ii** $\frac{17}{24}$

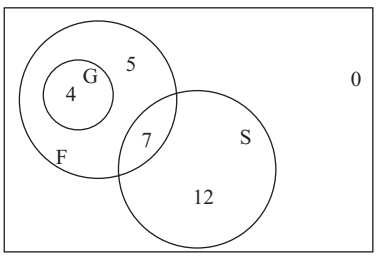
3 **a** **i**



ii 9 **iii** 14

iv $\frac{11}{25}$ **v** $\frac{7}{100}$

b **i**



ii 28

Examination practice

Structured questions for Units 4–6

Answers for these questions are available in the Teacher's Resource.

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