

Luke Robinson
Sam Stevenson

CCEA GCSE

MATHEMATICS

M2 M6

ANSWERS

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Colourpoint House
Jubilee Business Park
21 Jubilee Road
Newtownards
County Down
Northern Ireland
BT23 4YH

Tel: 028 9182 0505

E-mail: sales@colourpoint.co.uk

Web site: www.colourpoint.co.uk

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Chapter 1: Working With Integers

Exercise 1A

- There are 6: -2, -1, 0, 1, 2, 3
- (a) -10 (b) 6 (c) -2 (d) -8
 (e) 10 (f) 20 (g) -21 (h) -8
 (i) 6

Exercise 1B

- (a) 3, 6, 9, 12, 15 (b) 4, 8, 12, 16, 20 (c) 8, 16, 24, 32, 40 (d) 9, 18, 27, 36, 45
- (a) 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (b) 6, 12, 18, 24, 30
 (c) The multiples of 6 can be found by taking every second multiple of 3.
- (a) 21, 28 (b) 60, 72, 84, 96 (c) 18, 24, 30, 36, 42, 48
- Any three from: 6, 3, 2 or 1
- (a) $3 \times 4 + 2 \times 10 = 12 + 20 = 32$ (b) $(5 \times 2) \times (2 \times 6) = 10 \times 12 = 120$
 (c) $6 \times 4 - 2 \times 3 = 18$ (d) $(8 \times 6) \div (6 \times 2) = 48 \div 12 = 4$
- (a) 30, 60, 15, 12, 6, 9, 45, 18, 27, 24, 21 (b) 60, 8, 12, 4, 28, 24
 (c) 30, 25, 60, 15, 45, 10, 5 (d) 30, 15, 12, 45, 24
 (e) 60
- (a) 10 times (b) 7 times (c) 2 times
- (a) 15 (b) 20 (c) 60

9.

×	2	3	5	7
3	6	9	15	21
5	10	15	25	35
7	14	21	35	49
8	16	24	40	56

- 3 possible answers: 28, 56 and 84
- (a) 30 (b) 6
- (a) 35 seconds (b) Reuben 5 laps, Clare 7 laps

Exercise 1C

- A prime number has no factors other than 1 and itself. For example, 7 is a prime number because its only factors are 1 and 7.
- 5, 19, 31
- There is only one even prime number: 2
- (a) 7 (b) 13 (c) 29 (d) 37
- (a) 28 has factors 2, 4, 7 and 14 (b) 21 has factors 3 and 7
 (c) 77 has factors 7 and 11
- (a) $10 = 3 + 7$ (b) $16 = 3 + 13$ (c) $20 = 7 + 13$
- (a) Not prime: 63 has factors of 3, 7, 9 and 21.
 (b) Not prime: since 200 ends in a 0, it is a multiple of 10.
 (c) Not prime: 685 ends in a 5, so it is a multiple of 5.
 (d) Not prime: the digits in 243 add up to 9. Since 9 is a multiple of 3, so is 243.

Answers: Exercise 1D

Exercise 1D

- (a) Yes: $1=1^2$ (b) No (c) Yes: $4=2^2$ (d) No
(e) Yes: $16=4^2$ (f) No
- (a) (i) 1, 4, 9, 16, 25, 36, 49, 64 (ii) 1, 8, 27, 64
(b) 24, 40 (c) 1, 64
- (a) 8 and -8 (b) 4
- Yes, 16 is a square number, because $16=4^2$. 4 is also a square number because $4=2^2$. So 16 is the square of a square number.
- Two: 4 and 9.
- (a) Andrea should say that the **square root** of 100 is 10, not the square.
(b) Finn should remember that 25 has two square roots: 5 and -5 .

Exercise 1E

- (a) 4, 8, 12, 16, 20, 24, 28, 32, 36, 40
(b) 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
(c) 20
- (a) 12 (b) 12 (c) 24
- (a) 1, 2, 4, 5, 10, 20 (b) 1, 2, 3, 4, 6, 8, 12, 24 (c) 4
- Patrick is not right. The LCM of 10 and 15 is 30.
- (a) 60 (b) 42 (c) 12
- (a) 4 (b) 252
- 7 times (9:14, 9:38, 10:02, 10:26, 10:50, 11:14, 11:38)
- LCM = 24. So both alarms sound together at 7:39 a.m.
- 5700 ml
- 12 cm

Exercise 1F

- (a) $2^2 \times 3^3$ (b) $2^3 \times 3 \times 5$
- $120 = 2^3 \times 3 \times 5$; $990 = 2 \times 3^2 \times 5 \times 11$; $240 = 2^4 \times 3 \times 5$; $7425 = 3^3 \times 5^2 \times 11$
- (a) $45 = 3^2 \times 5$ (b) $150 = 2 \times 3 \times 5^2$ (c) $48 = 2^4 \times 3$ (d) $126 = 2 \times 3^2 \times 7$
(e) $243 = 3^5$
- (a) Yes, as 2 is a prime factor of 462 (b) Yes, as 3 is a prime factor of 462
(c) Yes, as 6 is 2×3 which are prime factors of 462
(d) Yes as 7 is a prime factor of 462 (e) No, as 13 is not a prime factor of 462
- (a) No, as 3 is not a prime factor of 875 (b) Yes, as 5 is a prime factor of 875
(c) Yes, as 7 is a prime factor of 875 (d) Yes, as $25 = 5^2$, which are prime factors of 875
(e) No, as 11 is not a prime factor of 875 (f) No, as $49 = 7^2$ which is not a prime factor of 875
- (a) $2^3 \times 3^2 \times 5$ (b) 2×5^3 (c) $2^5 \times 3^3 \times 5^2$

Chapter 2: Working With Decimals

Exercise 2A

1.

	Hundreds	Tens	Units	.	Tenths $\frac{1}{10}$	Hundredths $\frac{1}{100}$	Thousandths $\frac{1}{1000}$
(a)			3	.	5		
(b)		8	5	.	3	8	
(c)			5	.	8	5	1
(d)			7	.	2	5	
(e)		1	5	.	0	8	
(f)	7	0	5	.	0	6	

2. (a) $\frac{4}{10}$ (b) 8 (c) 2 (d) 50
 (e) $\frac{9}{100}$ (f) $\frac{5}{1000}$ (g) $\frac{9}{100}$ (h) $\frac{2}{10}$
 (i) $\frac{5}{1000}$ (j) $\frac{0}{100}$, which is 0

Exercise 2B

1. (a) 3, 3.02, 3.2, 3.22 (b) 7, 7.04, 7.4, 7.44 (c) 9, 9.01, 9.1, 9.11
 (d) 0.04, 0.044, 0.4, 0.404, 0.44 (e) 5, 5.06, 5.066, 5.606, 5.666
 (f) 1.001, 1.01, 1.011, 1.1, 1.11
2. (a) 4.75, 4.7, 4.25, 4.2 (b) 13.65, 13.6, 13.15, 13.1
 (c) 6.44, 6.4, 6.04, 6 (d) 5.611, 5.61, 5.601, 5.6, 2.7
 (e) 9.777, 9.707, 9.077, 9.07, 9 (f) 1.63, 1.603, 1.6, 1.333, 1.33
3. 2.6 m, 2.65 m, 4.35 m, 4.4 m
4. 9.66 s, 9.7 s, 10.15 s, 10.35 s, 10.4 s
5. 1.22 litres, 1.202 litres, 1.2 litres, 1.02 litres
6. 0.58 m, 0.585 m, 0.8 m, 0.85 m, 0.858 m, 0.88 m

Exercise 2C

1. (a) 5.8 (b) 5.9 (c) 2.9 (d) 7.6 (e) 19.8
2. (a) 10.64 (b) 15.17 (c) 62.21 (d) 12.93
 (e) 5.11 (f) 1.36
3. (a) 10.8 (b) 28.54 (c) 28.38 (d) 8.58
 (e) 5.68 (f) 0.27
4. $142.88 + 9.02 = 151.9$ (not 161);
 $142.88 + 99.02 = 241.9$ (not 251);
 $142.88 - 99.02 = 43.86$ (not 23.86)
5. (a) 12.16 (b) 79.06 (c) 94.17 (d) 3.91
 (e) 17.89 (f) 0.01

Answers: Exercise 2D

6. (a) Andrew has subtracted; he should have added.
 (b) Andrew hasn't lined the decimal points up correctly. Also, he has not put a decimal point in the answer line.
7. (a) 0.33 m^2
 (b) The three triangular cards have a total area of 0.18 m^2 . The square card has an area of 0.09 m^2 . So the total area of the triangular cards is greater by 0.09 m^2 .
 (c) 0.1 m^2
8. (a) $+ 10.77$ (b) $+ 10.77$ and $- 1.5$
9. (a) 5.9 km (b) 9.8 km
10. (a) 6.37 L (b) B, D, E (c) 0.26 L
11. No. The combined weight is 99.84 kg .

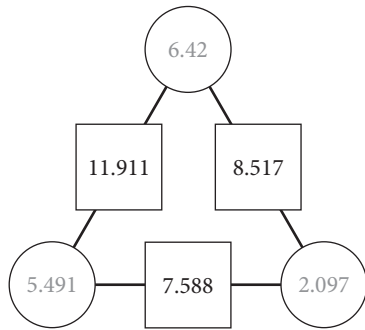
12. (a)

$$\begin{array}{r} 6\ 3\ 1\ .\ 2\ 9 \\ +\ 3\ 1\ 1\ .\ 3\ 2 \\ \hline 9\ 4\ 2\ .\ 6\ 1 \end{array}$$

(b)

$$\begin{array}{r} 9\ 5\ 3\ .\ 4\ 7 \\ -\ 2\ 2\ 2\ .\ 8\ 5 \\ \hline 7\ 3\ 0\ .\ 6\ 2 \end{array}$$

13.



Exercise 2D

1. (a) 830 (b) 190.35 (c) 5700 (d) 640.13
2. (a) 2430 (b) 661.3 (c) 54 640 (d) 2722.3
3. (a) 5596 (b) 6.6 (c) 213 740 (d) 19 800
4. (a) 5.6 (b) 9.8156 (c) 56.4 (d) 3.4007
5. (a) 0.423 (b) 0.05797 (c) 4.642 (d) 0.52069
6. (a) 0.021613 (b) 0.0000016 (c) 0.46521 (d) 0.00987
7. (a) 864 (b) 16.1 (c) 3.15 (d) 646
 (e) 7.92 (f) 0.01492
8. Ian has moved the digits the wrong way. He has divided by 100.
9. (a) 17.5 is the only possible output. (Multiplying by 10 gives a 4-digit number ending in zero. Then dividing by 100 gives a number with 2 digits before the decimal point.)
 (b) The input number is 175.
10. (a) $5.4 \times 10 = 54$; $54 \div 10 = 5.4$; $5.4 \div 10 = 0.54$; $0.54 \div 10 = 0.054$
 (b) Penny must move the decimal point 2 places, so she must use a number of steps that is a multiple of 2.
11. $5 \div 10 = 0.5$ (not 0.05); $50 \div 10 = 5$ (not 0.5)

Answers: Exercise 2E

12. $\times 1000$	51 000	2 000 000	572 000	175 000	9 400 000
$\times 100$	5100	200 000	57 200	17 500	940 000
$\times 10$	510	20 000	5720	1750	94 000
Original number	51	2000	572	175	9400
$\div 10$	5.1	200	57.2	17.5	940
$\div 100$	0.51	20	5.72	1.75	94
$\div 1000$	0.051	2	0.572	0.175	9.4

13. (a) $4.8 \times 10 \times 10 = 480$ (b) $6.2 \div 10 \div 10 = 0.062$
 (c) $0.26 \times 10 \div 10 = 0.26$ (d) $10.6 \div 10 \times 10 \div 10 = 1.06$

Exercise 2E

1. (a) (i) 1.5 (ii) 1.5 (b) (i) 1.2 (ii) 1.2
 2. (a) (i) 0.9 (ii) 0.9 (b) (i) 2 (ii) 2 (c) (i) 1.8 (ii) 1.8 (d) (i) 3 (ii) 3

3.

Thousands	Hundreds	Tens	Units	.	Tenths $\frac{1}{10}$	Hundredths $\frac{1}{100}$	Thousandths $\frac{1}{1000}$
		2	4	.			
			2	.	4		
	3	1	5	.	1	5	
		3	1	.	5	1	5

4. (a) 1.9 (b) 1.7 (c) 3.5 (d) 2.2
 5. Three
 6. (a) 0.04 (b) 0.16 (c) 0.001 (d) 0.008 (e) 0.064

7.

\times	0.2	0.04	0.01	4
0.3	0.06	0.012	0.03	1.2
4	0.8	0.16	0.04	16
6	1.2	0.24	0.06	24
20	4	0.8	0.2	80

Exercise 2F

1. (a) 18 (b) 1.8

2.

TTh	Th	H	T	O	.	t	h	th
			1	7	.			
		1	7	0	.			
		4	0	2	.	0	7	8
	4	0	2	0	.	7	8	

3. (a) (i) 0.7 (ii) 7 (b) (i) 0.7 (ii) 70

Answers: Exercise 2G

4. (a) (i) 90 (ii) 9 (b) (i) 60 (ii) 6 (c) (i) 0.3 (ii) 3 (d) (i) 60 (ii) 6
5. 0.8 m
6. (a) $18 \div 6 = 3$ (b) $18 \div 0.6 = 30$ (c) $0.18 \div 0.6 = 0.3$ (d) $0.018 \div 0.6 = 0.03$
7. (a) $0.6 \div 4 + 1.7 = 1.85$ (b) $6 \div 0.1 + 2.1 = 62.1$ (c) $9 - 4.5 \div 3 = 7.5$
8. Sharon takes 5 turns, Pete takes 4.

Exercise 2G

1. £17.60
2. (a) 25 (b) 150 (c) 200
3. £1.90
4. 4 packets
5. (a) £44.15 (b) £5.85
6. (a)

3 large bottles of milk at £1.45 each	£4.35
2 bags of flour at 95p each	£1.90
1 bag porridge oats	£3.75
4 bread rolls at 42p each	£1.68
1 box of 6 eggs	£1.36
Order total	£13.04
Delivery charge	£2.50
Total amount to pay	£15.54

- (b) £4.46
7. (a) £9.45 (b) £23.15
8. £124.02

Chapter 3: Rounding

Exercise 3A

1. (a) 500 (b) 30 (c) 8000
 2. (a) 0.7 or $\frac{7}{10}$ (b) 0.06 or $\frac{6}{100}$ (c) 2

Exercise 3B

1. (a) 6 (b) 10 (c) 3 (d) 3 (e) 90
 (f) 57 (g) 28 (h) 12 (i) 39 (j) 14
 2. (a) Lisburn 4 m, Dunmurry 3 m (b) Dundonald 3 km, Comber 3 km
 (c) Drogheda 11 km, Dublin 152 km, Cork 308 km

Exercise 3C

1. (a) (i) 70 (ii) 690 (iii) 6920
 (b) (i) 0 (ii) 20 (iii) 160
 (c) (i) 10 (ii) 60 (iii) 610
 2. (a) (i) 100 (ii) 800 (iii) 7500
 (b) (i) 0 (ii) 200 (iii) 2100
 (c) (i) 300 (ii) 2700 (iii) 26 500
 3. (a) (i) 1000 (ii) 8000 (iii) 83 000
 (b) (i) 0 (ii) 5000 (iii) 47 000
 (c) (i) 1000 (ii) 9000 (iii) 94 000
 4. (a) (i) 450 ml (ii) 500 ml (iii) 0 ml
 (b) (i) 730 ml (ii) 700 ml (iii) 1000 ml
 (c) (i) 4110 ml (ii) 4100 ml (iii) 4000 ml

Exercise 3D

1. (a) (i) 20.2 (ii) 20.25 (iii) 20.247 (b) (i) 458.2 (ii) 458.24 (iii) 458.235
 (c) (i) 134.3 (ii) 134.26 (iii) 134.259 (d) (i) 0.5 (ii) 0.47 (iii) 0.472
 (e) (i) 988.6 (ii) 988.57 (iii) 988.566 (f) (i) 392.7 (ii) 392.70 (iii) 392.700
 (g) (i) 30.0 (ii) 29.98 (iii) 29.979
 2. (a) (i) 3.5 cm (ii) 3.55 cm (b) (i) 2.8 cm (ii) 2.79 cm
 (c) (i) 5.0 cm (ii) 4.97 cm (d) (i) 3.9 cm (ii) 3.89 cm

3. (a)

Item	Price per kilogram	Calculation	Cost
Sausages	£8.52	$2.5 \times £8.52$	£21.30
Apples	£1.97	$0.5 \times £1.97$	£0.99
Carrots	£0.65	$0.75 \times £0.65$	£0.49
Onions	£1.05	$1.5 \times £1.05$	£1.58

- (b) £24.36

Answers: Exercise 3E

Exercise 3E

- (a) (i) 500 (ii) 490 (iii) 493
(c) (i) 600 (ii) 630 (iii) 632
(e) (i) 800 (ii) 810 (iii) 811

(b) (i) 100 (ii) 99 (iii) 99.4
(d) (i) 2 (ii) 1.8 (iii) 1.82
- (a) Larne vs Cliftonville
(c) (i) Po v Gl 1000, Cr v Co 2000, La vs Cl 3000, Li vs CR 2000
(ii) Po v Gl 1200, Cr v Co 1600, La vs Cl 2700, Li vs CR 1900
(iii) Po v Gl 1170, Cr v Co 1610, La vs Cl 2710, Li vs CR 1870

(b) Portadown vs Glenavon
- (a) 3 000 000 (b) 2 500 000 (c) 2 520 000
- (a) 0.006 kg (b) 0.0062 kg (c) 0.00618 kg
- (a) 6 750 000, 6 810 000 (b) 3.14, 3.14
(c) 1.63, 1.62 (d) 102, 102 (e) 54 000, 54 000
(f) 20.0, 20.0; The two numbers do not round to the same value in parts (a) and (c).

Exercise 3F

- 4 cups
- (a) 18 (b) 1 egg
- (a) 19 full boxes (b) 20 boxes
- 12 coaches
- (a) 8 full piles (b) 4 gemstones
- 6 tins
- (a) 3 full laps (b) 1.1 km
- (a) There are 6 players and they must each have the same number of cards. So the number of cards dealt must be a multiple of 6. The number of cards dealt is 48, since this is the closest multiple of 6 that is lower than 52.
(b) Each player gets 8 cards.
(c) There are 4 cards left over.

Chapter 4: Working With Fractions

Exercise 4A

1. (a) $\frac{10}{13}$ (b) $\frac{3}{13}$
 2. (a) 8 (b) 5
 3. (a) $\frac{1}{4}$ (b) $\frac{5}{6}$

Exercise 4B

1. (a) 1 (b) 1 (c) 5
 (d) 4 (e) 35 (f) 150
 2. (a) $\frac{3}{4}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{5}{6}$
 (e) $\frac{1}{3}$ (f) $\frac{2}{3}$ (g) $\frac{1}{4}$ (h) $\frac{7}{9}$
 3. $\frac{3}{4}$
 4. (a) $\frac{3}{4}$ (b) $\frac{3}{8}$ (c) $\frac{1}{3}$
 5. (a) $\frac{1}{12}$ (b) $\frac{1}{6}$ (c) $\frac{1}{3}$

Exercise 4C

1. (a) $\frac{7}{20}$ (b) $\frac{4}{5}$ (c) $\frac{3}{4}$ (d) $\frac{2}{5}$ (e) $\frac{1}{3}$
 2. (a) $\frac{1}{7}$ (b) $\frac{2}{5}$ (c) $\frac{7}{8}$ (d) $\frac{7}{10}$ (e) $\frac{5}{8}$
 (f) $\frac{5}{12}$
 3. (a) $\frac{3}{5}, \frac{5}{8}, \frac{7}{10}$ (b) $\frac{7}{4}, \frac{9}{5}, \frac{13}{3}$ (c) $\frac{9}{8}, \frac{3}{2}, \frac{5}{3}$ (d) $\frac{10}{7}, \frac{9}{4}, \frac{5}{2}$
 (e) $\frac{1}{5}, \frac{3}{10}, \frac{1}{2}$ (f) $\frac{2}{3}, \frac{5}{6}, \frac{11}{12}$ (g) $\frac{1}{4}, \frac{1}{3}, \frac{3}{8}$ (h) $\frac{1}{4}, \frac{7}{12}, \frac{5}{6}$
 4. (a) $\frac{1}{3}, \frac{1}{2}, \frac{3}{5}$ (b) $\frac{1}{4}, \frac{4}{7}, \frac{5}{8}$ (c) $\frac{1}{2}, \frac{3}{5}, \frac{8}{9}$ (d) $\frac{3}{7}, \frac{2}{3}, \frac{5}{6}$
 (e) $\frac{3}{8}, \frac{2}{3}, \frac{5}{6}$ (f) $\frac{1}{7}, \frac{1}{4}, \frac{7}{9}$ (g) $\frac{5}{19}, \frac{3}{11}, \frac{7}{9}$
 5. Wheat: $\frac{7}{12} = \frac{21}{36}$; Barley: $\frac{11}{18} = \frac{22}{36}$. The farmer sows a slightly greater area with barley.

Exercise 4D

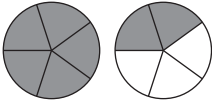
1. (a) 4 (b) 12 (c) 11 (d) 33 (e) 32
 (f) 24 (g) 40 (h) 21
 2. (a) £7 (b) £21 (c) 363 miles (d) 40 km (e) 77 litres
 (f) 13.5 metres (g) 103.5 cm (h) 6.5 lb (i) £11.55
 3. (a) 2 (b) 6 (c) 4
 4. (a) 95 (b) 100
 5. (a) 150 (b) 45 (c) 245
 6. 150

Answers: Exercise 4E

Exercise 4E

- | | | | | |
|-----------------------|---------------------|---------------------|---------------------|---------------------|
| 1. (a) $\frac{4}{11}$ | (b) $\frac{15}{17}$ | (c) $\frac{8}{9}$ | (d) $\frac{9}{10}$ | (e) $\frac{2}{3}$ |
| 2. (a) $\frac{1}{3}$ | (b) $\frac{1}{5}$ | (c) $\frac{2}{5}$ | (d) $\frac{1}{11}$ | (e) $\frac{1}{3}$ |
| (f) $\frac{1}{5}$ | | | | |
| 3. (a) $\frac{8}{9}$ | (b) $\frac{41}{42}$ | (c) $\frac{19}{21}$ | (d) $\frac{7}{10}$ | (e) $\frac{17}{18}$ |
| (f) $\frac{62}{63}$ | (g) $\frac{23}{28}$ | (h) $\frac{13}{14}$ | (i) $\frac{24}{35}$ | (j) $\frac{29}{36}$ |
| 4. (a) $\frac{1}{6}$ | (b) $\frac{1}{10}$ | (c) $\frac{29}{42}$ | (d) $\frac{4}{21}$ | (e) $\frac{4}{21}$ |
| (f) $\frac{1}{4}$ | (g) $\frac{17}{56}$ | (h) $\frac{17}{63}$ | (i) $\frac{7}{30}$ | (j) $\frac{1}{2}$ |
| 5. $\frac{7}{12}$ | | | | |
| 6. $\frac{11}{40}$ | | | | |
| 7. $\frac{3}{40}$ | | | | |

Exercise 4F

- | | | | | |
|---|--------------------|---------------------|--------------------|--------------------|
| 1. (a) 3 | (b) 6 | (c) 4 | (d) 8 | |
| 2.  | | | | |
| 3. (a) $\frac{3}{2}$ | (b) $\frac{11}{8}$ | (c) $\frac{11}{6}$ | (d) $\frac{8}{3}$ | (e) $\frac{7}{2}$ |
| (f) $\frac{44}{9}$ | (g) $\frac{19}{2}$ | | | |
| 4. (a) $1\frac{3}{8}$ | (b) $2\frac{1}{2}$ | (c) $2\frac{3}{4}$ | (d) $2\frac{3}{5}$ | (e) $1\frac{2}{3}$ |
| (f) $1\frac{7}{10}$ | (g) $1\frac{4}{9}$ | (h) $1\frac{9}{10}$ | | |

Exercise 4G

- | | | | | |
|-------------------------|---------------------|---------------------|----------------------|---------------------|
| 1. (a) $1\frac{4}{7}$ | (b) $1\frac{2}{11}$ | (c) $1\frac{2}{15}$ | (d) $1\frac{1}{3}$ | (e) $1\frac{1}{5}$ |
| (f) $1\frac{5}{12}$ | (g) $1\frac{3}{10}$ | (h) $1\frac{5}{14}$ | (i) $1\frac{11}{30}$ | |
| 2. (a) $4\frac{2}{3}$ | (b) $5\frac{1}{7}$ | (c) $\frac{2}{3}$ | (d) $7\frac{1}{6}$ | (e) $4\frac{1}{12}$ |
| (f) $3\frac{13}{18}$ | (g) $\frac{1}{2}$ | (h) $6\frac{1}{8}$ | | |
| 3. (a) $2\frac{2}{7}$ | (b) $1\frac{3}{5}$ | (c) $3\frac{3}{5}$ | (d) $1\frac{4}{7}$ | (e) $4\frac{1}{2}$ |
| (f) 5 | | | | |
| 4. (a) $2\frac{17}{35}$ | (b) $1\frac{1}{6}$ | (c) $\frac{4}{21}$ | (d) $\frac{5}{8}$ | (e) $5\frac{1}{20}$ |

Answers: Exercise 4H

5. $5\frac{3}{4}$

6. $1\frac{3}{4}$

Exercise 4H

1. (a) $\frac{1}{4}$ (b) $\frac{10}{27}$ (c) $\frac{3}{28}$ (d) $\frac{1}{6}$ (e) $\frac{4}{21}$

(f) $\frac{6}{19}$ (g) $\frac{16}{33}$

2. (a) $9\frac{1}{2}$ (b) $4\frac{1}{2}$ (c) $1\frac{23}{25}$ (d) $3\frac{1}{2}$ (e) $\frac{2}{5}$

(f) $2\frac{1}{7}$ (g) $7\frac{1}{3}$ (h) $4\frac{1}{2}$

3. $5\frac{1}{4}$ kg

4. $1\frac{3}{8}$ years

5. $20\frac{1}{2}$ kg

6. $\frac{9}{10}$ m²

7. $12\frac{2}{3}$ kg

8. 420 cm³

Exercise 4I

1. (a) $\frac{1}{4}$ (b) 7 (c) $1\frac{1}{4}$ (d) $\frac{7}{10}$ (e) 2

(f) $\frac{4}{3}$ (g) $\frac{2}{5}$

Exercise 4J

1. (a) 9 (b) $\frac{5}{6}$ (c) $1\frac{2}{5}$ (d) $1\frac{3}{11}$ (e) $\frac{99}{112}$

(f) $1\frac{1}{11}$

2. (a) $16\frac{1}{2}$ (b) $11\frac{2}{3}$ (c) $\frac{6}{7}$ (d) $1\frac{1}{20}$ (e) $\frac{3}{16}$

(f) $\frac{10}{13}$ (g) $1\frac{4}{5}$

3. Platform 6

4. 18 legs

5. 30 times

6. 25 milkshakes

Answers: Exercise 4K

Exercise 4K

1. (a) 21 kg (b) £16 (c) £11.75 (d) 99 inches (e) 13 litres
(f) 18 m (g) 8 cm (h) £21.06 (i) 45 gallons (j) 750 tons
2. 33
3. £15 600
4. 8.75 cm
5. (a) 21 (b) 525 g

Exercise 4L

1. (a) $1\frac{34}{105}$ (b) $\frac{22}{49}$ (c) $7\frac{1}{3}$ (d) $4\frac{1}{2}$ (e) $\frac{15}{32}$
(f) $1\frac{1}{34}$ (g) $\frac{9}{14}$ (h) $1\frac{1}{6}$ (i) $4\frac{3}{8}$ (j) $\frac{13}{24}$
(k) $5\frac{1}{4}$ (l) $\frac{3}{16}$ (m) $\frac{3}{5}$

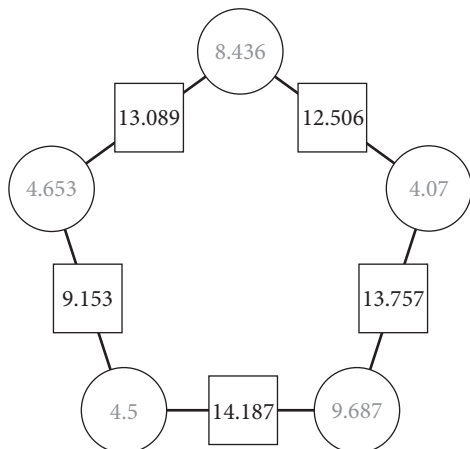
Exercise 4M

1. (a) $0.\dot{8}$ (b) $0.\dot{7}9$ (c) $0.i2\dot{4}$ (d) $0.\dot{5}$
2. (a) 0.777 ... (b) 0.626262 ... (c) 0.613613 ... (d) 0.2888 ... (e) 0.4555 ...
(f) 3.142857142857 ...
3. Parts (a), (c) and (e) can be written as recurring decimals; (b) and (d) as terminating decimals.
4. (a) 0.5 (b) 0.666 ... (c) 0.75 (d) 0.8 (e) 0.8333 ...
(f) 0.375 (g) 0.125 (h) 0.3 (i) 0.777 ... (j) 0.9
5. (a) $\frac{5}{9}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $\frac{28}{99}$ (e) $\frac{715}{999}$

Progress Review

Progress Review (Chapters 1–4)

1. (a) 20 (b) 30 (c) 60
2. 120
3. 1, 2, 3, 4, 6, 12
4. 9, 18, 27, 36, 45
5. Yes, 4 is a factor of 8 and a factor of 24, so it is a common factor.
6. 40 is a multiple of 8, but not a multiple of 12, so it is not a common multiple.
7. (a) 4 (b) 40 (c) $\frac{3}{100}$ (d) 2 (e) $\frac{3}{10}$
(f) $\frac{6}{1000}$
8. (a) 17, 17.05, 17.5, 17.55 (b) 10.001, 10.01, 10.011, 10.1, 10.11
(c) 33, 33.04, 33.4, 33.44 (d) 2.9, 2.901, 2.91, 2.911
(e) 15, 15.07, 15.077, 15.707, 15.777 (f) 0.03, 0.033, 0.3, 0.303, 0.33
9. (a) 4200 (b) 400.91 (c) 29 230 (d) 5446.5 (e) 113 960
(f) 21 700 (g) 40.9 (h) 1.007 (i) 9.002 (j) 0.457
(k) 0.46521 (l) 0.00987
10. (a) 0.03
(b) The first and last numbers add up to 1. The 2nd and 6th also add up to 1. The 3rd and 5th also add up to 1. The 4th is 0.5 so the sum is 3.5
11. (a) 612.027 (b) 6626.429 (c) 20 (d) 24.682 (e) 887.88
(f) 0.747
12. (a) $1 + 0.26 + 0.28 = 1.54$ (b) $10.6 + 0.26 + 0.26 + 0.26 = 11.38$
(c) $3 + 0.22 + 0.24 + 0.26 + 0.28 = 4$ (d) $8.8 + 0.22 + 0.22 + 0.22 + 0.22 = 9.68$
- 13.



14. 3.65 m
15. (a) 6 (b) 0.6
16. (a) (i) 1.5 (ii) 15 (b) (i) 6.3 (ii) 0.63 (c) (i) 2.7 (ii) 2.7 (d) (i) 1.3 (ii) 130
17. 4
18. (a) 0.09 (b) 0.027
19. $96 \div 12 = 8$; $96 \div 1.2 = 80$; $9.6 \div 1.2 = 8$; $0.96 \div 1.2 = 0.8$

Answers: Progress Review (Chapters 1–4)

20. (a) (i) 80 (ii) 750 (iii) 7500 (iv) 75 040
 (c) (i) 10 (ii) 120 (iii) 1240 (iv) 12 420
21. (a) (i) 100 (ii) 700 (iii) 6500
 (b) (i) 0 (ii) 300 (iii) 2900 (iv) 29 100
22. (a) (i) 1000 (ii) 10 000 (iii) 96000
 (b) (i) 0 (ii) 2000 (iii) 25 000
23. (a) 35 (b) 11 (c) 38 (d) 4 (e) 32
24. (a) 450 g (b) 500 g (c) 0 g
25. (a) 2.9181 2.9 2.92 2.918
 (b) 53.2598 53.3 53.26 53.260
 (c) 737.985 738.0 737.99 737.985
 (d) 38.5504 38.6 38.55 38.550
26. (a) 0.061777674 0.06 0.062 0.0618
 (b) 11.91786667 10 12 11.9
 (c) 0.593682187 0.6 0.59 0.594
 (d) 74.23349641 70 74 74.2
 (e) 900.6731736 900 900 901

27.

Number	Accuracy
1615	Nearest 10
0.9876	Two decimal places
5.93	One significant figure
5 896 842	Nearest thousand
97814	Three significant figures
37.042	One decimal place

Jack's answers	Sara's answers	Correct answer
1620 ✓	1610 ✗	1620
1.00 ✗	0.99 ✓	0.99
5.9 ✗	6 ✓	6
5 897 000 ✓	5 896 800 ✗	5 897 000
978 ✗	98 000 ✗	97800
37 ✗	37.0 ✓	37.0

28. (a) $\frac{3}{4}$ (b) $\frac{2}{3}$ (c) $\frac{3}{8}$ (d) $\frac{1}{3}$ (e) $\frac{3}{4}$
29. (a) $\frac{1}{10}$ (b) $\frac{1}{5}$ (c) $\frac{3}{10}$
30. (a) $\frac{1}{3}$ (b) $\frac{1}{2}$ (c) $\frac{2}{3}$
31. (a) $\frac{17}{20}$ (b) $\frac{5}{12}$ (c) $\frac{7}{10}$ (d) $\frac{11}{24}$ (e) $\frac{31}{35}$
 (f) $\frac{3}{7}$ (g) $\frac{5}{8}$ (h) $\frac{7}{8}$ (i) $\frac{3}{5}$ (j) $\frac{3}{7}$
32. (a) $\frac{7}{9}, \frac{5}{6}, \frac{11}{12}$ (b) $\frac{2}{3}, \frac{3}{4}, \frac{4}{5}$ (c) $\frac{1}{2}, \frac{7}{12}, \frac{2}{3}$ (d) $\frac{1}{4}, \frac{3}{8}, \frac{2}{5}$ (e) $\frac{7}{12}, \frac{2}{3}, \frac{3}{4}$
 (f) $\frac{11}{20}, \frac{7}{10}, \frac{4}{5}$
33. (a) $\frac{2}{7}, \frac{1}{3}, \frac{1}{2}$ (b) $\frac{1}{2}, \frac{3}{5}, \frac{5}{6}$ (c) $\frac{1}{4}, \frac{1}{2}, \frac{3}{5}$ (d) $\frac{1}{3}, \frac{4}{9}, \frac{1}{2}$ (e) $\frac{2}{5}, \frac{2}{3}, \frac{3}{4}$
34. (a) 8 (b) 8 (c) 27 (d) 12 (e) 350
 (f) 40
35. (a) £35 (b) 224 kg (c) £5 (d) 27 m (e) 27 litres
 (f) £4.50 (g) 7.8 miles (h) 0.5 km (i) 10.2 cm
36. (a) $\frac{7}{9}$ (b) $\frac{9}{11}$ (c) $\frac{16}{19}$ (d) $\frac{1}{5}$ (e) $\frac{7}{13}$
 (f) $\frac{5}{17}$ (g) $\frac{1}{3}$ (h) $\frac{3}{17}$ (i) $\frac{1}{11}$ (j) $\frac{2}{19}$

Answers: Progress Review (Chapters 1–4)

37. $\frac{7}{8}$

38. (a) $\frac{5}{3}$

(b) $\frac{7}{5}$

(c) $\frac{15}{8}$

39. (a) $2\frac{2}{3}$

(b) $2\frac{2}{7}$

(c) $3\frac{2}{7}$

40. (a) $1\frac{1}{7}$

(b) 4

(c) $4\frac{5}{8}$

(d) $\frac{19}{30}$

(e) $1\frac{1}{6}$

(f) $3\frac{1}{5}$

(g) $5\frac{3}{4}$

41. (a) $2\frac{7}{10}$

(b) $6\frac{1}{6}$

(c) $3\frac{11}{63}$

(d) $\frac{7}{15}$

(e) $\frac{5}{8}$

(f) $\frac{5}{24}$

(g) $\frac{9}{14}$

(h) $8\frac{1}{2}$

(i) $6\frac{1}{4}$

(j) $6\frac{29}{30}$

42. (a) $\frac{3}{10}$

(b) $\frac{1}{3}$

(c) $\frac{1}{7}$

(d) $\frac{1}{10}$

(e) $\frac{15}{44}$

(f) $\frac{4}{13}$

(g) $\frac{4}{9}$

43. (a) 1

(b) $1\frac{7}{48}$

(c) $1\frac{11}{27}$

(d) $\frac{9}{13}$

(e) $1\frac{3}{4}$

(f) $4\frac{1}{2}$

44. (a) $\frac{9}{14}$

(b) $2\frac{1}{4}$

(c) $8\frac{2}{3}$

(d) $1\frac{7}{8}$

(e) $1\frac{3}{11}$

45. 28 cm^3

46. 24

47. $4\frac{1}{2}$

48. \$714

49. 72

50. (a) $\frac{6}{11}$

(b) $2\frac{13}{18}$

(c) $5\frac{1}{2}$

(d) $\frac{8}{35}$

(e) $\frac{5}{24}$

(f) $\frac{11}{56}$

(g) $1\frac{1}{14}$

(h) $\frac{53}{56}$

(i) $\frac{7}{24}$

(j) $9\frac{5}{6}$

(k) $5\frac{3}{4}$

(l) $\frac{1}{6}$

(m) $4\frac{1}{10}$

51. (a) $\frac{1}{2}$

(b) 11

(c) $11\frac{1}{9}$

(d) 4

Chapter 5: Working With Percentages

Exercise 5A

- (a) 19% (b) 42% (c) 80% (d) 52% (e) 9%

(f) 96.5% (g) 102%
- (a) $\frac{9}{25}$ (b) $\frac{43}{100}$ (c) $\frac{2}{25}$ (d) $\frac{9}{10}$ (e) $\frac{21}{500}$
- (a) (i) 29% (ii) 6% (iii) 170%

(b) (i) 75% (ii) 30% (iii) 40%

(c) (i) 0.72 (ii) 0.045 (iii) 1.3

(d) (i) $\frac{2}{3}$ (ii) $\frac{31}{200}$ (iii) $1\frac{4}{5}$ or $\frac{9}{5}$
- 33%

Exercise 5B

- (a) 0.6, 65%, $\frac{2}{3}$ (b) $\frac{1}{99}$, 99%, 0.999 (c) 4%, $\frac{1}{4}$, 0.4 (d) $\frac{15}{10}$, 155%, 1.59
- Darkside School: $\frac{135}{250} = \frac{27}{50} = 54\%$
 Alliance Academy: 55%
 Alliance Academy's pupils performed slightly better.

Exercise 5C

- (a) 40 (b) 54 (c) 1520

(d) 40 (e) 7.2 kg (f) 3 cm
- (a) 87.5 (b) 516.6 (c) 457.6 lb
- (a) 17 is **17%** of 100 (b) 20 is **10%** of 200 (c) 26 is **25%** of 104

(d) 80 cm is **40%** of 200 cm (e) 32 g is **80%** of 40 g
- (a) 30% (b) 22
- 735

Exercise 5D

- (a) 25% (b) $66\frac{2}{3}\%$ (c) 75% (d) $133\frac{1}{3}\%$
- 80%
- (a) 80% (b) 125%
- (a) 35% (b) 65%
- (a) 45% (b) 55% (c) 37.5%

Answers: Exercise 5E

Exercise 5E

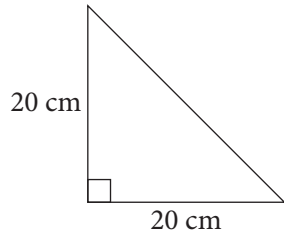
1. (a) 44 (b) 50 (c) 52 (d) 32.4 (e) 0
2. (a)

Number	10%	5%	20%
80	8	4	16
24	2.4	1.2	4.8
360	36	18	72
4200	420	210	840

- (b) 10% of 80 is 8
80 increased by 10% is $80 + 8 = 88$
- (c) (i) 26.4 (ii) 396 (iii) 414 (iv) 68 (v) 5040 (vi) 3570
3. 21 m

Exercise 5F

1. (a) 5% increase (b) 10% increase (c) 4% decrease (d) $33\frac{1}{3}\%$ decrease
(e) 40% increase (f) 75% decrease (g) 25% decrease (h) 0.5% decrease
2. (a)



- (b) 100% (c) 50 cm^2 (d) 200 cm^2 (e) 300%
3. (a) 40% (b) $66\frac{2}{3}\%$
4. (a) 60 km (b) 2.2 km (c) 33 (d) 72.6 km (e) 21%
5. (a)

Food	2022 price	2023 price	Price increase	Increase or decrease	As a percentage
500 g sausages	£3.70	£4.40	£0.70	$\frac{70}{370} = 0.189$	18.9%
400g jar of coffee	£4.10	£5.00	£0.90	$\frac{90}{410} = 0.220$	22.0%
1 kg potatoes	£1.50	£1.80	£0.30	$\frac{30}{150} = 0.200$	20.0%
12 eggs	£1.30	£1.50	£0.20	$\frac{20}{130} = 0.154$	15.4%

- (b) 20%
6. (a) £42 000 (b) 10% (c) 40% (d) 10%

Chapter 6: Finance

Exercise 6A

- £6250
- (a) £4500 (b) £22 500
- £144
- 2575 Australian dollars
- £1362.50
- £32 000

Exercise 6B

- (a) £78.40 (b) 28%
- £5250
- (a) £37 500 (b) £11 500

Exercise 6C

- (a) £15 (b) £80 (c) £49.50 (d) £21
- (a) £1100 (b) £371 (c) £1263 (d) £741
- £8.75
- 4.9% of £4000 = $0.049 \times £4000 = £196$
 She receives £196 interest per year.
 After 3 years she receives $3 \times £196 = £588$
 The balance of her account is $£4000 + £588 = £4588$
 The balance on Shená's account does not reach £5000

Exercise 6D

- (a) £347.29 (b) £1560.60 (c) £922.92 (d) £607.75
- Joanna's interest: $\frac{£3000 \times 2 \times 4}{100} = £280$
 Joanna's closing balance: $£3500 + £280 = £3780$
 David's closing balance: $£3500(1.02)^4 = £3788.51$
 David has more at the end of 4 years.
- (a) Niamh should choose the Bouncing Tiger Savings Account. It has the lower interest rate, but she can withdraw the money at short notice.
 (b) 5.54% of £10 000 = £554
- $A = P \left(\frac{100 + R}{100} \right)^n = £350 \left(\frac{100 + 5.54}{100} \right)^3 = £411.82$
 Charlie does not have enough for the scooter.
- \$6691.13
- £16 486
- (a) $5500 \times 1.0195^{15} = £7348.03$
 Lewis will have enough money.
 (b) Lewis does not withdraw any of the money during these 15 years. The price of the cruise does not change.

Answers: Exercise 6E

Exercise 6E

1. Vanadium card
2. (a) £200 000 (b) £12 000 (c) £10 000 (d) £198 000
3. (a)

Month	Opening balance	Payment	Balance after payment	Interest	Closing balance
July	£500	£100	£400	1.5% of £400 = £6	£406
August	£406	£100	£306	1.5% of £306 = £4.59	£310.59
September	£310.59	£100	£210.59	1.5% of £210.59 = £3.16	£213.75
October	£213.75	£100	£113.75	1.5% of £113.75 = £1.71	£115.46
November	£115.46	£100	£15.46	1.5% of £15.46 = £0.23	£15.69
December	£15.69	£15.69	£0		

- (b) Lorraine's credit card bill will be paid off in December.
 (c) It is assumed that Lorraine doesn't make any more purchases using her credit card between July and December.
4. (a) £5250 (b) £3600 (c) £148.50 (d) 18 months ($1\frac{1}{2}$ years)

Exercise 6F

1. (a) £100 (b) £375 (c) £520 (d) £45
2. (a) £3550 (b) £450
3. All Ireland News £7.65
 What's Going On? £7.80
 All Ireland News is cheaper with the discount.
4. (a) £370 (b) £20
5. (a) £479 (b) £99

Exercise 6G

1. 10 weeks
2. £135
3. The couple can save £150 per week (the difference between their weekly income and expenditure).
 Two months is roughly 8 weeks. To save £1500, they must save $£1500 \div 8 = £187.50$ per week.
 $£187.50 - £150 = £37.50$
 The couple must reduce their weekly expenditure by £37.50 per week.
4. (a) (i) £18 000 (ii) £5750 (iii) £39 750
 (b) There are no other items of income or expenditure between now and the election.

Answers: Exercise 6H

Exercise 6H

- 10%
- (a) £15 (b) 37.5%
- (a) £24.50 (b) 55.1%
- (a) 125% (b) 20% (c) 24.9% (d) 50%
- (a) 33.3% (b) 64% (c) 25%
- 40%
- 36.2%
- (a) 31.25% (b) 7.78%

Exercise 6I

- £51.75
- (a) £640 (b) £665.60
- (a) £1200 (b) £300 (c) £13.92

Chapter 7: Brackets

Exercise 7A

1. (a) $7x$ (b) $5p - 6q$ (c) $x^2 + y^2 + 3x - 2y$
(d) $4ab - 4a + 5b$ (e) $-5wz + 4w - 3z$ (f) $-2g^2 + 35f + 12g$

Exercise 7B

- $6 + 16 = 22$
- $32 - 20 = 12$
- $63 + 27 = 90$
- $315 - 90 = 225$
- $-57 + 21 = -36$
- $408 - 216 = 192$
- $3x + 15$
- $7x + 28$
- $6x + 30$
- $12x - 72$
- $15x - 45$
- $-18 + 3x$
- $6x - 16$
- $27x - 18$
- $88 - 11x$
- $28x - 210$
- $260 - 40x$
- $32 - 40x$
- $6 - 3x + 3y$
- $12x + 18y - 48$
- $35 - 14x - 21y$
- $19x - 38y + 38$
- $16 - 24x - 32y$
- $-18x + 36y + 54$
- $-8y + 12x + 28$
- $-12 - 3x - 9y$
- $132x - 156y$
- $66x + 121y$
- $-63x + 117y$
- $196 - 210x$

Answers: Exercise 7C

Exercise 7C

1. (a) $2y + 2xy$ (b) $12x + 42x^2$ (c) $12p - 15py$ (d) $56y - 35xy$
(e) $24xy + 176px$ (f) $8pq - 20qt$ (g) $12x^2 + 21xy$ (h) $18xy - 48y^2$
(i) $-15x - 20x^2$ (j) $45px - 40x^2$ (k) $-14x + 6x^2$ (l) $-4x^2 - 16qx$
(m) $-8x^2 + 32x^2 = 24x^2$ (n) $-3y + 8p$ (o) $-18p^2 - 27p$ (p) $20tx - 12x^2$
(q) $-21px + 7pt$ (r) $20xy - 12x^2$ (s) $12t + 18ty - 36t^2$
(t) $-6x + 15y + 21$ (u) $35y^2 - 42xy + 7y^3$
(v) $15p^2 - 10px + 35p$ (w) $-18 - 12x - 54y$
(x) $10q - 2q^2 - 6q^3$ (y) $14x^2 - 7px + 35xy - 7x^4$
2. (a) $17x + 41$ (b) $3x - 24$ (c) $62q - 17t$ (d) $29x - 27w$
(e) $12x - 48xy - 21y - 28$ (f) $-26x$ (g) $25x^2 + 12xy - 21y$
(h) $28xy - 28tx + 32ty$ (i) $13xy + 8y + 27$ (j) $72 - 39x + 47y$ (k) $10p - 23t$

Chapter 8: Factorising

Exercise 8A

1. $4x + 20$
2. $-2y + 6$
3. $2a^2 + 3a$
4. $x^2y - 9xy$
5. $-3pq^2 - p^2q^3$

Exercise 8B

1. $3(x + 3y)$
2. $6(p + 2q)$
3. $4(2t - s)$
4. $5(3p + 5r)$
5. $18(2t + y)$
6. $48(q - 3p)$
7. $5(p + 5q)$
8. $7(x - 2y)$
9. $7(5f + 4g)$
10. $6(3m + 4n)$
11. $5(3q - 2p)$
12. $3(b + 3c)$
13. $15(3t - 2y)$
14. $4(3q + 4w)$
15. $6(2r - 3t)$
16. $4(f - 11g)$
17. $10(s + 2t)$
18. $13(r + 3t)$
19. $6(t - 2q)$
20. $9(f + 3g)$
21. $11(11x + y)$
22. $2(2m + n)$
23. $3(5m - 9n)$
24. $15(r + 2t)$
25. $2(4p - 3q)$
26. $27(3q - t)$
27. $24(6w - q)$
28. $7(8y - 7p)$
29. $9(7p - 9q)$
30. $9(2y - 9x)$

Answers: Exercise 8C

Exercise 8C

1. $3x(1 + 7x)$
2. $3p(3q - 1)$
3. $6y(3 - x)$
4. $5p^2(4 - 3p)$
5. $2y(3x - 2y)$
6. $6yz(5x + 8)$
7. $4x(3p + 7x)$
8. $36(2x^2 - 1)$
9. $5p(q - 3t)$
10. $12(7 - 2xy)$
11. $y^2(y - x)$
12. $4xy(x^2 - 5)$
13. $4xy(3 - 5x^2 + 2y)$
14. $pqr(p - q + r)$
15. $18(4qx - 2x^3 + 3q^2)$
16. $2(2x - y + 3x) = 2(5x - y)$
17. $4ty(10x - 9q)$
18. $3p^2(6p^2 + 5p - 4)$
19. $19(2p - t + 3r)$
20. $27pq(3p - q)$
21. $13x(1 - 4x^2)$
22. $26pq(1 - 2p)$
23. $4xy(xy + 9)$
24. $10x(100y + 10y^2 + 1)$

Progress Review

Progress Review (Chapters 5–8)

1. (a) 6% (b) 69.1% (c) $46\frac{2}{3}\%$ (d) 89% (e) 4%
 (f) 88.8% (g) 174%
2. (a) $\frac{7}{20}$ (b) $\frac{31}{50}$ (c) $\frac{2}{5}$ (d) $\frac{9}{100}$ (e) $\frac{83}{200}$
3. (a) (i) 8.5% (ii) 19.35% (b) (i) 140% (ii) 164%
 (c) (i) 3.31 (ii) 0.652 (d) (i) $\frac{153}{400}$ (ii) $\frac{9}{125}$
4. 75%
5. (a) 10%, 0.1025, $\frac{3}{20}$ (b) 2%, 0.2, $\frac{1}{2}$ (c) 0.6667, 67%, $\frac{6}{7}$ (d) 500%, $\frac{533}{100}$, 5.5
6. (a) 10 (b) 189 (c) 82 (d) 100 m (e) 3 litres
7. (a) 126.5 (b) 32.8 (c) 454.31 g
8. (a) 6 is 40% of 15 (b) 14 is 28% of 50 (c) 14 seconds is $33\frac{1}{3}\%$ of 42 seconds
 (d) £4 is 80% of £5 (e) 2.5 kg is 500% of 500 g
9. (a) 128 ml (b) 320 ml (c) 48 ml
10. (a) 70% (b) 80%
11. 60%
12. (a) 630 (b) 18 (c) 18 (d) 50 (e) 50
13. (a) £18 360 (b) £18 635.40
14. (a) 1900 (b) 1805
15. (a) £13.20 (b) £11.88
16. (a) 20% increase (b) 45% increase (c) 30% increase (d) 12% decrease
 (e) 55% decrease (f) 36% decrease (g) 20% decrease (h) 25% increase
17. (a) 4 (b) 6 (c) 30
18. £636.72
19. £2916
20. (a) $36y - 72$ (b) $108 + 3x$ (c) $20z + 360$ (d) $36 - 48w$ (e) $36p + 60$
 (f) $36q - 14$ (g) $36 - 36a$
21. (a) $8x + 20$ (b) $-6y - 38$ (c) $12z - 5$
22. (a) $x(x + 3)$ (b) $2ab(3 + 4b)$ (c) $6cd^2(4cd - 5)$
23. $3x + 1$
24. $9x^2$

Chapter 9: Function Machines

Exercise 9A

1. (a) 50 (b) 7

2.

IN	OUT
5	5
-5	0
7	6

3.

IN	OUT
6	15
0	-3
9	24

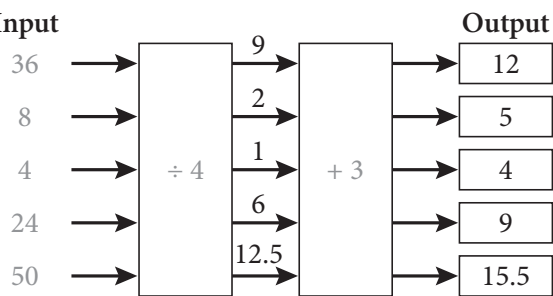
4.

IN	OUT
1	9.5
1.55	15
2	19.5

5. (a) 18 (b) 1.5

6. (a) 3 (b) 1

7. Input



8. (a) 7.25 (b) 9.25

9. Subtract 8

10. (a) 14 (b) -4 (c) -4

11. (a) 2.5 (b) 900

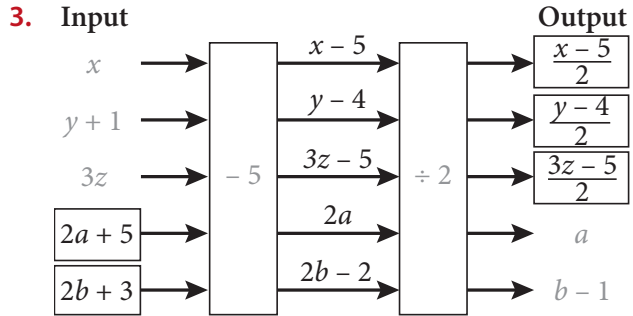
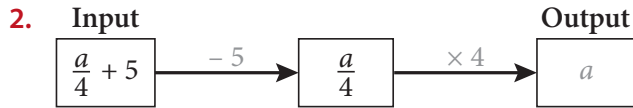
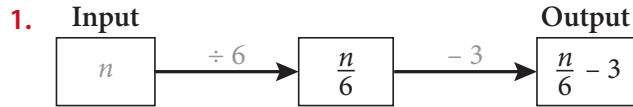
12. (a) 0.75 (b) 32

13. 1.66

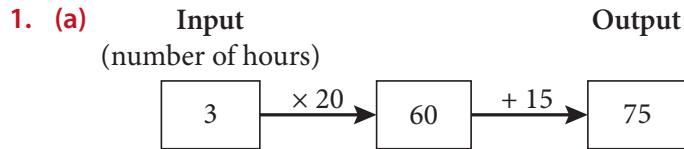
14. (a) 5670 is the only possible output. (b) 567

Answers: Exercise 9B

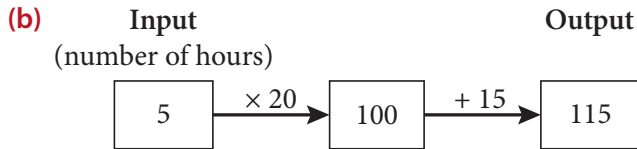
Exercise 9B



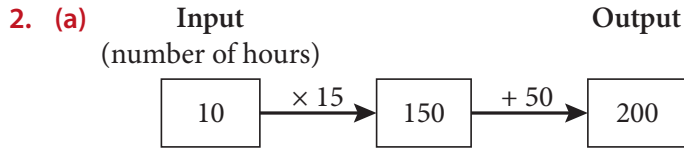
Exercise 9C



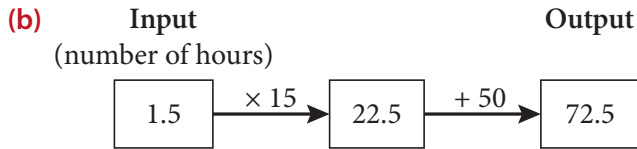
Answer: £75



Answer: 5 hours



Answer: He charges £200



Answer: The painter works for 1.5 hours

3. (a) £12.10 (b) 75 minutes

Chapter 10: Linear Equations

Exercise 10A

1. (a) $x - 1$ (b) $8p - 6r$ (c) $-3a$
 2. (a) $12x + 8$ (b) $12x - 6$
 3. (a) 5 (b) -5 (c) 19

Exercise 10B

1. (a) $x = 2$ (b) $x = 4$ (c) $x = 9$ (d) $x = 7$ (e) $x = 5$
 (f) $x = 3$ (g) $x = 11$ (h) $x = 13$ (i) $y = 4$ (j) $q = 5$
 (k) $p = 16$ (l) $x = 1$ (m) $q = 6$ (n) $w = 10$ (o) $x = 2$
 (p) $y = 6$ (q) $p = 5$ (r) $y = 7$ (s) $p = 7$ (t) $y = 18.5$

Exercise 10C

1. (a) $x = 26$ (b) $x = 4$ (c) $x = 5$ (d) $x = -3$ (e) $x = 4$
 (f) $x = 16.5$ (g) $x = 3$ (h) $x = 23$ (i) $x = 5$ (j) $x = 9$
 (k) $x = 7$ (l) $x = -8$ (m) $x = 0.5$ (n) $x = -0.6$ (o) $x = -1.6$
 (p) $x = -\frac{1}{16}$ (q) $x = \frac{24}{23}$ (r) $x = -\frac{5}{4}$ (s) $x = -\frac{9}{4}$ (t) $x = \frac{14}{13}$
2. (a) $a = 2$ (b) $b = 1$ (c) $c = 3$
 (d) $d = 1.8$ (e) $e = 2$ (f) $f = -1$

Exercise 10D

1. (a) $x = 42$ (b) $x = 99$ (c) $x = 49$ (d) $x = 91$ (e) $x = 10.5$
 (f) $x = \frac{33}{8}$ (g) $x = 39$ (h) $x = \frac{182}{3}$ (i) $x = 105$ (j) $x = 42$
 (k) $x = 144$ (l) $x = 55$ (m) $x = \frac{1}{3}$ (n) $x = \frac{9}{8}$ (o) $x = \frac{6}{11}$
 (p) $x = \frac{54}{7}$ (q) $x = -10$ (r) $x = 6$ (s) $x = \frac{81}{4}$ (t) $x = -11$
 (u) $x = \frac{32}{5}$ (v) $x = \frac{108}{5}$ (w) $x = -\frac{54}{7}$ (x) $x = -\frac{65}{2}$
2. (a) $x = -18$ (b) $x = 25$ (c) $x = 12$ (d) $x = -600$ (e) $x = \frac{272}{3}$
 (f) $x = -10$ (g) $x = 4$ (h) $x = 6$ (i) $x = 20$ (j) $x = 8$
 (k) $x = 24$ (l) $x = -48$ (m) $x = -56$ (n) $x = 20$ (o) $x = 36$
 (p) $x = -8$ (q) $x = \frac{330}{23}$ (r) $x = -\frac{990}{131}$ (s) $x = -12$ (t) $x = \frac{280}{11}$

Answers: Exercise 10E

Exercise 10E

- 40 cm
- 2.25 cm
- $42^\circ, 48^\circ$
- $170^\circ, 100^\circ$
- 192 cm
- 40 cm
- 21 cm
- 116°
- (a) $x + x + 4 = 18$ (b) $2x = 14 \Rightarrow x = 7$
- (a) 6 (b) 21 (c) 11 (d) 8 (e) 7
- (a) $a + 4a + a + 6 = 72$
 $6a + 6 = 72$
 $6a = 66$
 $a = 11$
(b) Kim £11; Quinn £44; Ruth £17
- (a) $6x + 5$ (b) $6x + 5 = 23$ (c) $3x = 9; 2x = 6; x + 5 = 8$
- 41°
- (a) $x = 6$ (b) 144 cm^2
- (a) $x + x + 7 + 2x = 67$ (b) 15

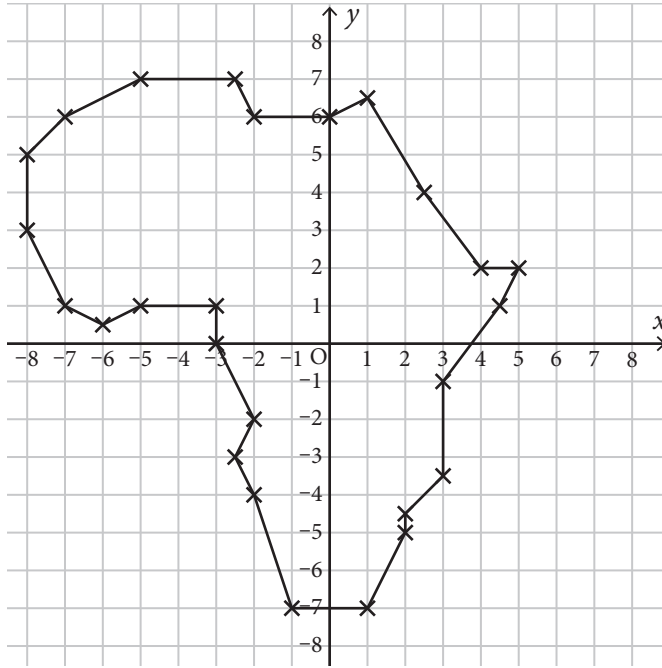
Exercise 10F

- (a) $d = 3$ (b) $h = 6$ (c) $x = 0$ (d) $x = 3$ (e) $b = 5$
- (a) $q = 2$ (b) $r = 10$ (c) $s = 3$ (d) $t = 3$ (e) $c = 4$
- (a) $d = \frac{3}{4}$ (b) $e = 2$ (c) $f = -1$ (d) $k = 4$ (e) $r = 1$
- (a) $w = \frac{3}{2}$ (b) $a = \frac{6}{5}$ or $1\frac{1}{5}$ (c) $x = \frac{26}{5}$ or $5\frac{1}{5}$ (d) $y = \frac{27}{5}$ or $5\frac{2}{5}$ (e) $z = \frac{14}{5}$ or $2\frac{4}{5}$
- (a) $b = 1$ (b) $x = 2$ (c) $a = 7$ (d) $p = 6$
(e) $q = 14$ (f) $x = 5$
- (a) $b = 1$ (b) $f = 6$ (c) $e = 7$ (d) $a = 1$ (e) $n = 2$
(f) $p = 3$ (g) $t = 10$ (h) $n = 1$ (i) $h = 6$ (j) $x = 7$
- (a) $g = 5$ (b) $k = 1$ (c) $r = -\frac{2}{7}$
- (a) $3(2x - 8) = 24$ (b) $x = 8$
- (a) $(5x + 10)^\circ$ (b) $5x + 10 = 180$ (c) $78^\circ, 82^\circ, 20^\circ$
- (a) Rectangle: $2(x + 35) + 2(x + 5) = 4x + 80$
Triangle: $(3x + 8) + (3x - 8) + 2x = 8x$
(b) $4x + 80 = 8x$ (c) $x = 20$
(d) Rectangle: Length 55 m, Width 25 m
Triangle: 68 m, 52 m and 40 m
(e) 160 m
- (a) 192 cm (b) 2160 cm^2
- (a) $20 - n$ (b) $6n$ (c) $8(20 - n)$ (d) $6n + 8(20 - n) = 136$
(e) $n = 12$, so there are 12 children and 8 adults

Chapter 11: Coordinates and Straight Lines

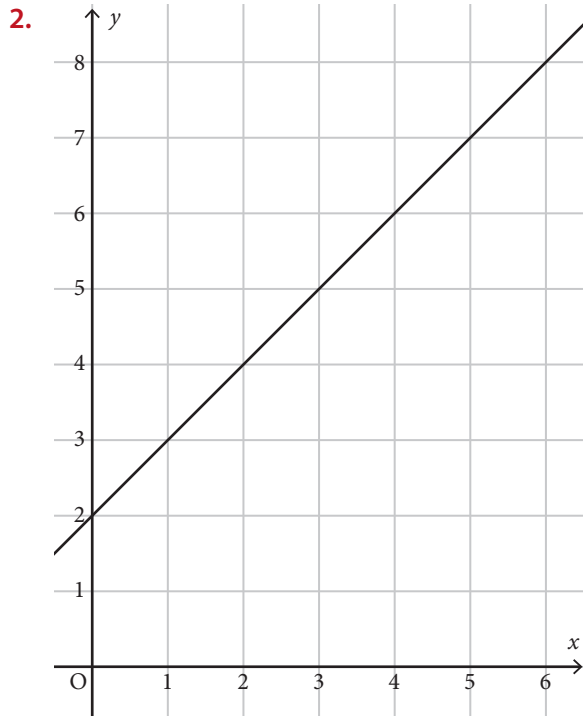
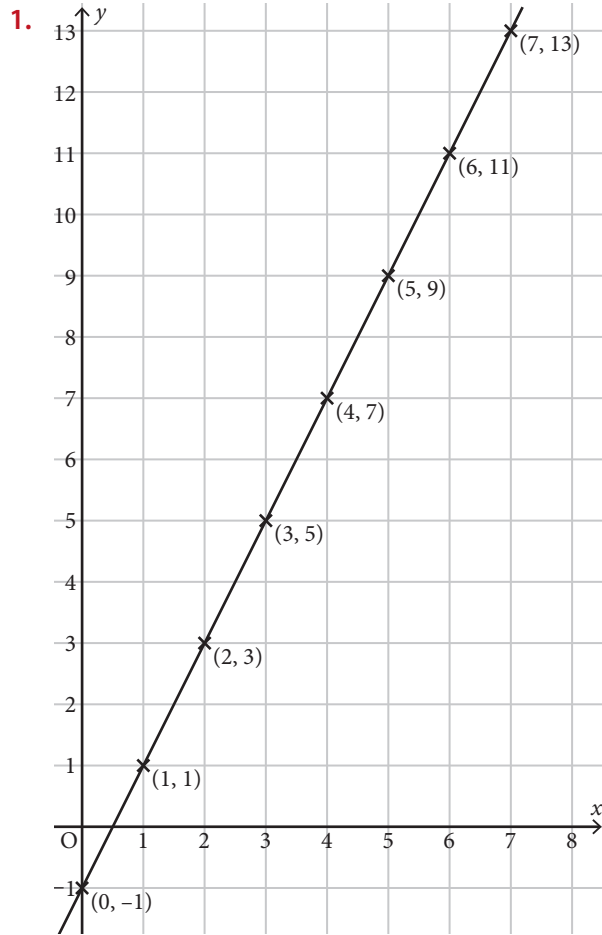
Exercise 11A

1. (a) (b)



(c) The plot represents Africa

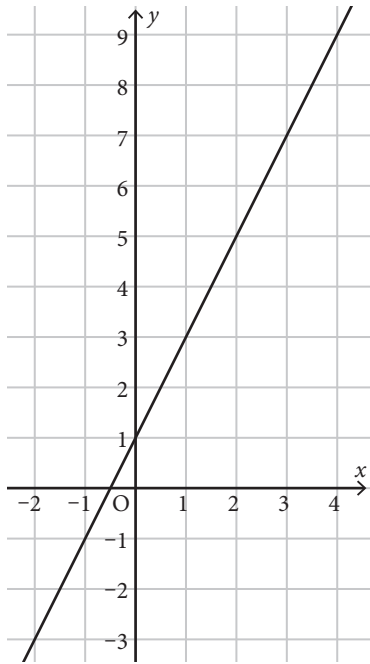
Exercise 11B



Answers: Exercise 11B

3.

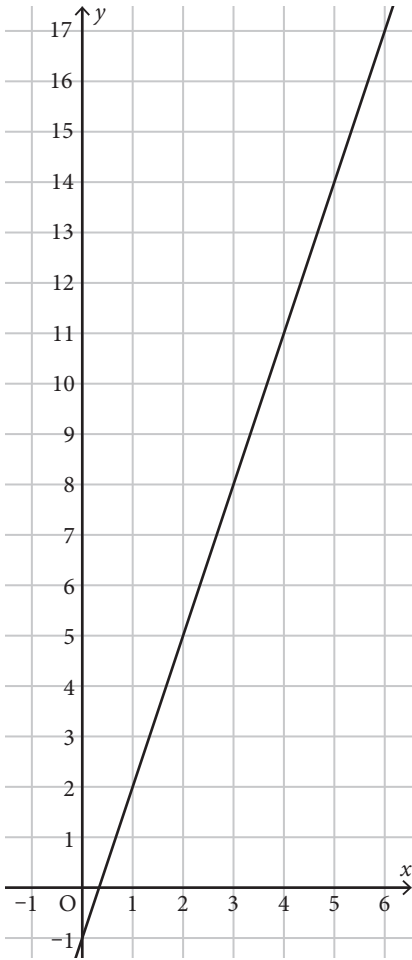
x	-2	-1	0	1	2	3	4
y	-3	-1	1	3	5	7	9



Answers: Exercise 11B

4.

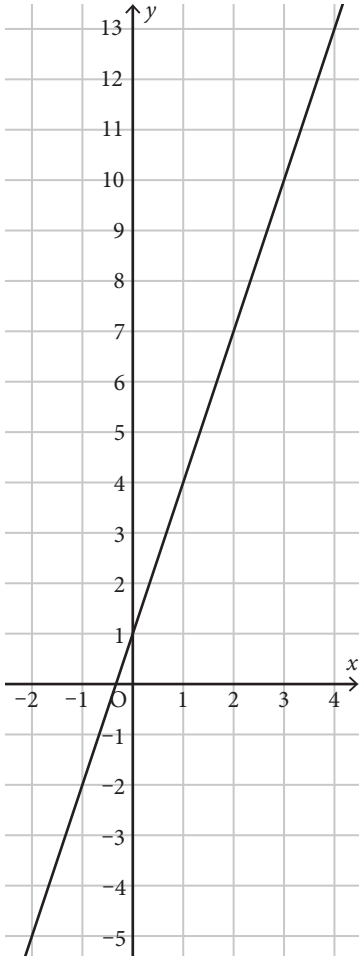
x	0	1	2	3	4	5	6
y	-1	2	5	8	11	14	17



Answers: Exercise 11B

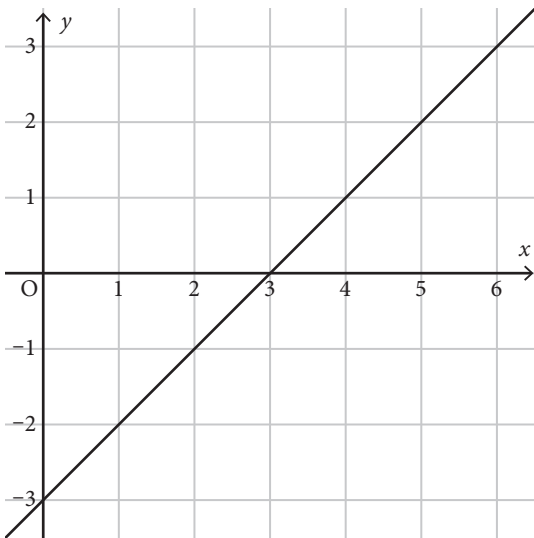
5.

x	-2	-1	0	1	2	3	4
y	-5	-2	1	4	7	10	13



6.

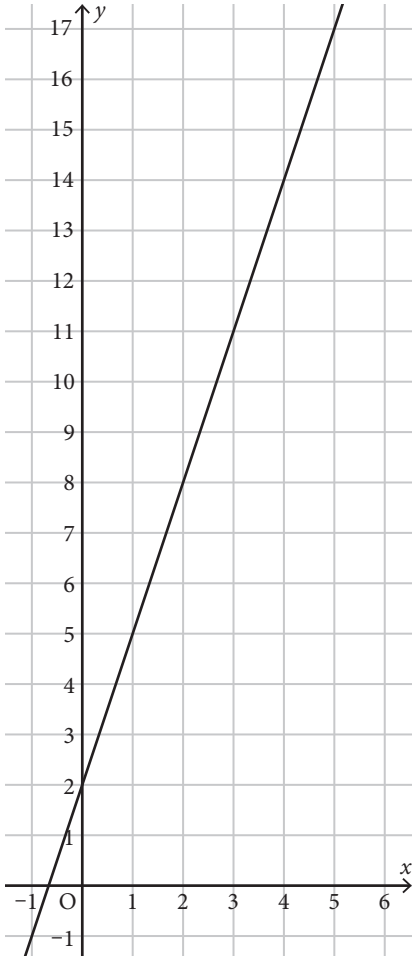
x	0	1	2	3	4	5	6
y	-3	-2	-1	0	1	2	3



Answers: Exercise 11B

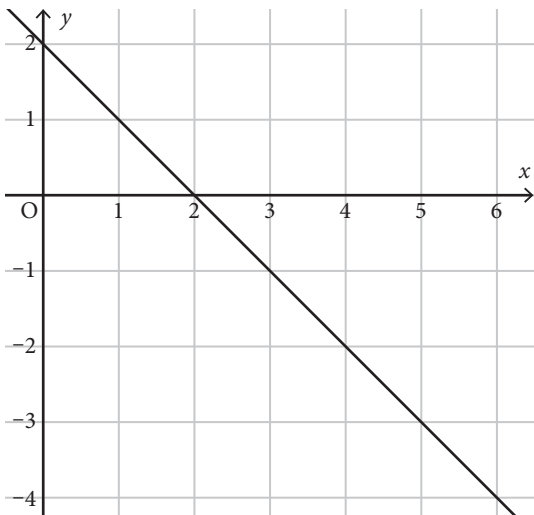
7.

x	-1	0	1	2	3	4	5
y	-1	2	5	8	11	14	17



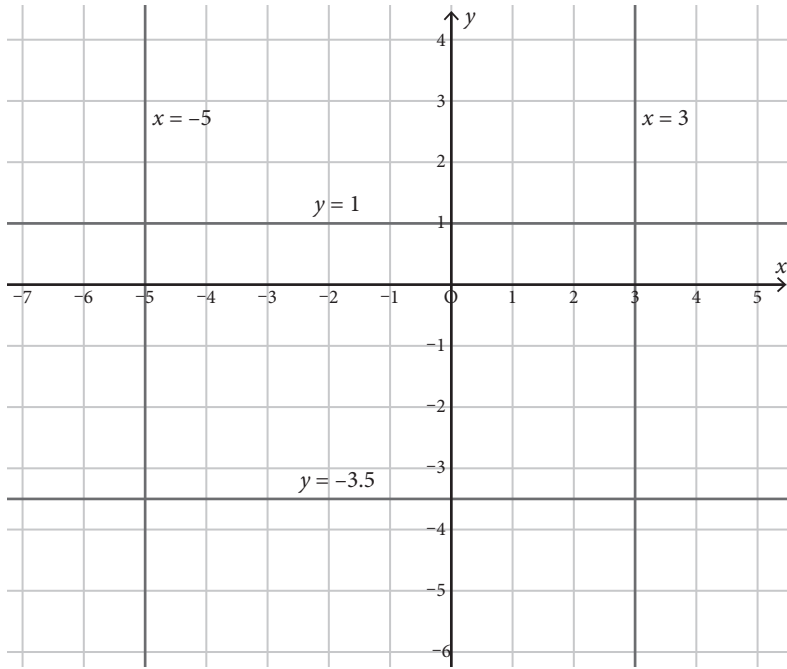
8.

x	0	1	2	3	4	5	6
y	2	1	0	-1	-2	-3	-4



Answers: Exercise 11C

9.



10. (a) $x = 2.5$ (b) $x = -10$ (c) $y = 1$ (d) $y = -5.5$
 11. (a) 5 (b) 10
 12. (a) 2 (b) 8 (c) -3 (d) 2

Exercise 11C

1. (a) (3, 5.5) (b) (9, 8) (c) (-0.5, 3) (d) (-2.5, 0)
 (e) (6, 6) (f) (-0.5, -0.5) (g) (7, 5.5) (h) (-5, 1)
 2. (1.5, 2.5)
 3. (4, -3)
 4. (10, 7)
 5. (9, -15)
 6. (-5, 0)
 7. (-1.7, -11.1)
 8. (a) 2 (b) 5 (c) 17 (d) 5
 (e) 13 (f) 17 (g) 10 (h) 29
 (i) 13 (j) 10 (k) 25

Exercise 11D

1. (a) 1 (b) 1.5 (c) 0.25 (d) $-\frac{7}{3}$ (e) 2
 2. (a) $\frac{4}{3}$ (b) -1 (c) -2 (d) 1.5 (e) 7
 3. (a) (i) 1 (ii) $x = 0$ (iii) $y = 0$ (b) (i) 2 (ii) $x = -1.5$ (iii) $y = 3$
 (c) (i) 2 (ii) $x = 0$ (iii) $y = 0$ (d) (i) 3 (ii) $x = \frac{4}{3}$ (iii) $y = -4$
 (e) (i) -2 (ii) $x = 3$ (iii) $y = 6$ (f) (i) -1 (ii) $x = 10$ (iii) $y = 10$
 (g) (i) 2 (ii) $x = 3$ (iii) $y = -6$ (h) (i) $-\frac{1}{2}$ (ii) $x = 14$ (iii) $y = 7$

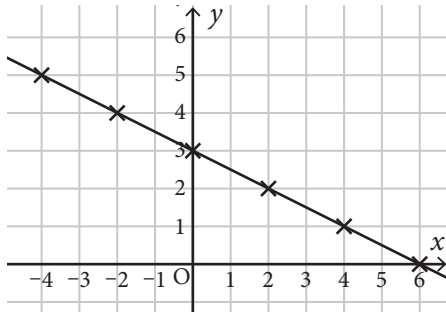
Chapter 12: Real-Life Linear Graphs

Exercise 12A

1. (a)

x	-4	-2	0	2	4	6
y	5	4	3	2	1	0

(b)



(c) $-\frac{1}{2}$

2. (a) $\frac{1}{2}$

(b) $\frac{1}{4}$

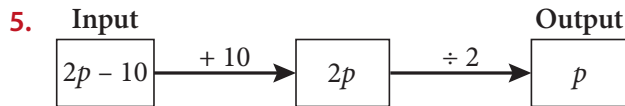
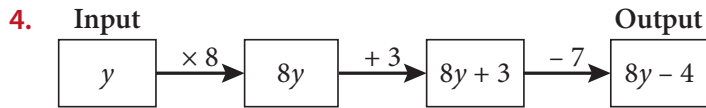
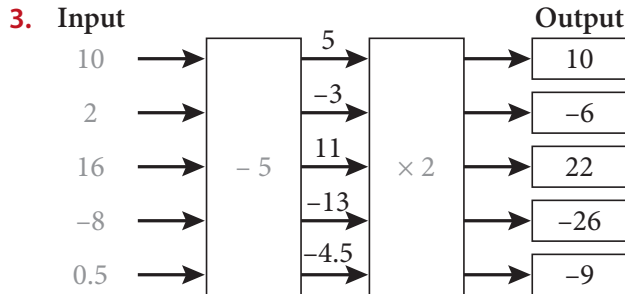
(c) $-\frac{1}{4}$

(d) 1

Progress Review

Progress Review (Chapters 9–12)

1. (a) 19 (b) 1
2. (a) 28 (b) 48



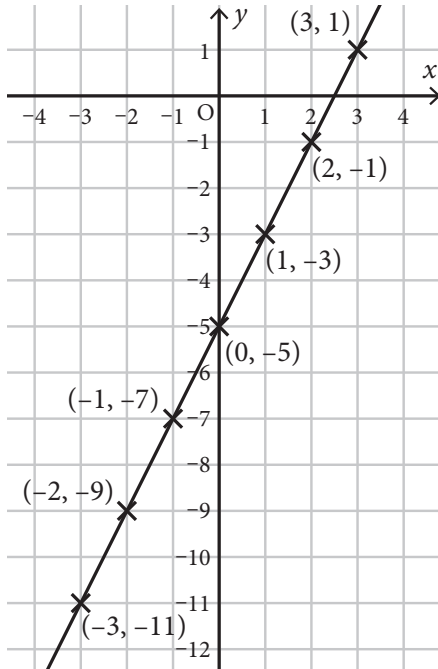
6. (a) £111 (b) 7.5 hours
7. Multiply by 4 ($\times 4$)
8. (a) $a = 5$ (b) $b = 6$ (c) $c = 1$ (d) $d = 4$ (e) $e = 1$
 (f) $f = 3$ (g) $g = 2$ (h) $h = 3$ (i) $i = 4$ (j) $j = 2$
 (k) $k = 1$ (l) $l = 3$ (m) $m = 4$ (n) $n = 3$ (o) $p = 5$
 (p) $q = 3$ (q) $n = 2$ (r) $p = 3$ (s) $r = 2$ (t) $b = 3$
 (u) $f = 1$ (v) $w = 1$
9. (a) $x = 2$ (b) $x = 20$ (c) $x = 20$ (d) $x = 19$ (e) $x = 21$
10. 8
11. $1 \times 60 + 0.5 \times n = 185 \Rightarrow 0.5n = 125 \Rightarrow n = 250$ miles
12. (a) $x = 3$ (b) $s = 10$ (c) $p = \frac{17}{10}$ (d) $x = -\frac{1}{2}$
13. (a) $x = -15$ (b) $y = 7$ (c) $e = 5$ (d) $e = -10$ (e) $n = 2$
 (f) $b = 1$ (g) $x = 2$ (h) $x = 7$ (i) $x = 0$ (j) $x = 7$
 (k) $x = -7$
14. (a) $5x + 4 = 2x + 13$ (b) $x = 3$
15. (a) $6x + 32 = 4x + 56$ (b) $x = 12$ (c) £1.04

Answers: Progress Review (Chapters 9–12)

16. (a)

x	-3	-2	-1	0	1	2	3
y	-11	-9	-7	-5	-3	-1	1

(b)



17. (a) 6

(b) -2

18. (1, 1)

19. (0.5, 0)

20. (4, -8)

21. 17

22. 5.4

23. (a) $y = \frac{1}{3}x + 3$

(b) $y = -\frac{1}{3}x + 3$

(c) $x = 3$

(d) $y = -1$

(e) $x = -3$

(f) $y = 2$

24. (a) Gradient 4, y -intercept 1, x -intercept $-\frac{1}{4}$

(b) Gradient 2, y -intercept -2, x -intercept 1

(c) Gradient 1, y -intercept -6, x -intercept 6

(d) Gradient -1, y -intercept 16, x -intercept 16

(e) Gradient $\frac{1}{4}$, y -intercept 3, x -intercept -12

(f) Gradient $-\frac{1}{2}$, y -intercept 2, x -intercept 4

(g) Gradient -6, y -intercept 1, x -intercept $\frac{1}{6}$

(h) Gradient 2, y -intercept -4, x -intercept 2

(i) Gradient -1.5, y -intercept 1, x -intercept $\frac{2}{3}$

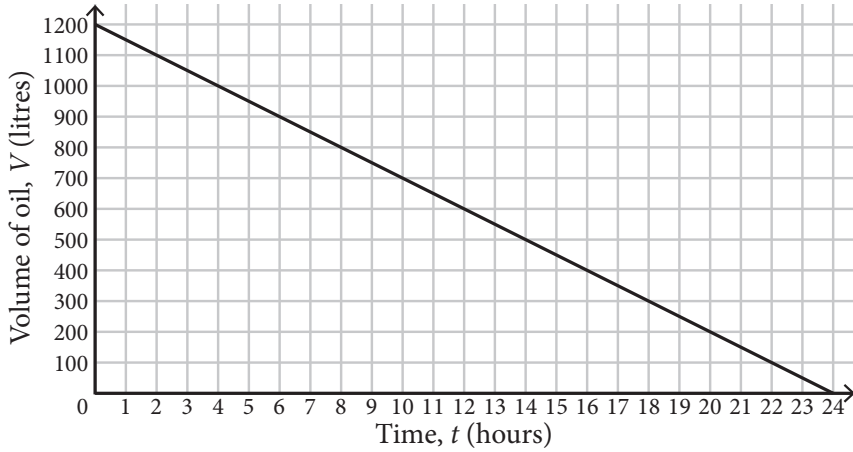
(j) Gradient $\frac{1}{3}$, y -intercept -2, x -intercept 6

Answers: Progress Review (Chapters 9–12)

25. (a)

Time (hours)	0	4	8	12	16	20	24
Volume of oil (litres)	1200	1000	800	600	400	200	0

(b)



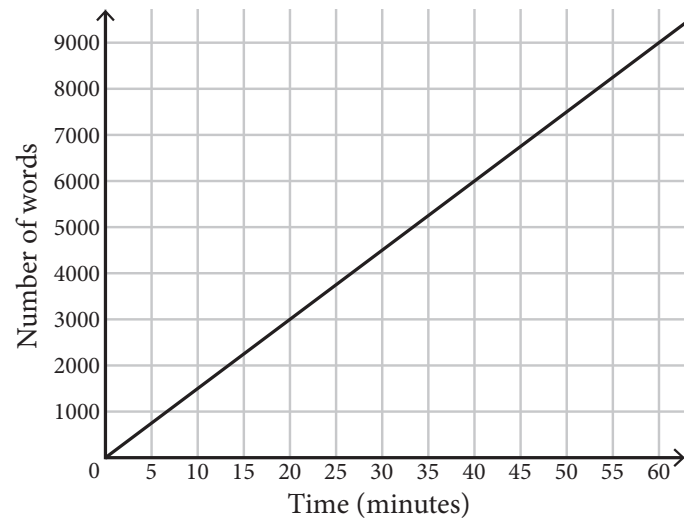
(c) 450 litres

(d) 10 hours

26. (a)

Time (minutes)	0	10	20	30	40	50	60
Total number of words spoken	0	1500	3000	4500	6000	7500	9000

(b)



(c) 150

(d) Mr Loquax can speak at a rate of 150 words per minute.

Chapter 13: Compound Measure

Exercise 13A

1. (a) 10 (b) -30 (c) 4 (d) 15 (e) 10
(f) 2 (g) 32
2. (a) 120 minutes (b) 90 seconds (c) 5 hours 15 minutes
(d) 5 minutes 45 seconds (e) $1\frac{3}{4}$ or 1.75 hours

Exercise 13B

1. 70 km/h
2. 4 seconds
3. 8 metres
4. 45 minutes
5. 252 km
6. (a) 12 m/s (b) 43.2 km/h
7. 60 lengths of the pool
8. (a) 30 km/h (b) 15 km/h (c) 12.5 km/h
9. 45 mph
10. 7.5 m/s
11. 1500 m
12. (a) 10 m/s (b) 36 km/h
13. (a) 0.25 metres per minute (b) 0.417 cm/s
14. (a) 64 km/h (b) 64.8 km/h (c) Della, by 0.8 km/h (d) 8.33 seconds

Answers: Exercise 13C

Exercise 13C

1. (a) 11 g/cm^3 (b) 1 g/cm^3 (c) 0.92 g/cm^3 (d) 0.714 g/cm^3
2. (a) $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$ (b) $\text{Mass} = \text{Density} \times \text{Volume}$
3. (a) 1.2 g/cm^3 (b) 1.5 g/cm^3 (c) 0.908 g/cm^3
4. (a) 0.75 g/cm^3 (b) 6 kg
5. (a) 20 cm^3 (b) 300 g
6. (a) 2.68 g (b) 2000 cm^3
7. (a) Density 0.92 g/cm^3 – floats (b) Density 920 kg/m^3 – floats
(c) Density 755 kg/m^3 – floats (d) Density 2.25 g/cm^3 – sinks
8. (a)

	Mass (g)	Volume (cm ³)
Fat Density 0.9 g/cm^3	13 248	14 720
Non-fat Density 1.1 g/cm^3	44 352	40 320
Totals	57 600	55 040

- (b) 1.05 g/cm^3
9. (a) 3.5 g/cm^3 (b) 2.25 g/cm^3
(c) The single pebble has the higher density. The jar of pebbles has a slightly lower density because some of its volume is the air between the pebbles.
10. (a) 5 g/cm^3 (b) (i) $36\,000\,000 \text{ g}$ (ii) $9\,000\,000 \text{ cm}^3$ (iii) 4 g/cm^3 (c) Metal A

Exercise 13D

1. Jake 120 bpm Ruari 102.9 bpm Finn 125 bpm Sue 100 bpm
2. (a)

	Smart Car	Large family car	Bus	Truck
Distance travelled (miles)	160	100	24	80
Amount of fuel used (gallons)	4	5	2	5
Miles per gallon	40	20	12	16

- (b) Even though the bus has a lower fuel economy, it is more environmentally friendly than a car because it can transport a larger number of people.
3. (a) $\text{Speed of rotation} = \frac{\text{Number of revolutions}}{\text{Time in minutes}}$
(b) (i) 45 rpm (ii) $33 \frac{1}{3} \text{ rpm}$ (iii) 78 rpm
4. Aramis 5 printer 650 dpi Briskprint 500C printer 300 dpi Cauldron 2000 printer 2000 dpi
The Cauldron 2000 printer gives the best quality

Chapter 14: Perimeter and Area

Exercise 14A

- Circumference 25.13 cm; Area 50.27 cm²
- (a) Perimeter 12 cm; area 9 cm² (b) Perimeter 14 cm; area 10 cm²
(c) Perimeter 12 cm; area 6 cm² (d) Perimeter 12.2 cm; area 5 cm²
- (a) 29.6 cm (b) 56 cm²

Exercise 14B

- (a) Area 6.28 m²; Perimeter 10.28 m (b) Area 9.82 m²; Perimeter 13.93 cm
(c) Area 9.62 cm²; Perimeter 12.50 cm (d) Area 16.36 cm²; Perimeter 18.09 cm
- (a) 23.1 m² (b) 18.8 m
- (a) 71.3 cm² (b) 34.3 cm
- 11.3 cm²
- (a) 9.57 m² (b) 22.28 m
- 27.5 m²

Exercise 14C

- (a) 24 cm² (b) 45 cm² (c) 32 cm² (d) 30 cm² (e) 42 cm²
(f) 80 cm² (g) 48 cm² (h) 42 cm² (i) 28 cm²
- (a) Perimeter 38 cm; area 56 cm² (b) Perimeter 58 cm; area 180 cm²
(c) Perimeter 40 cm; area 84 cm² (d) Perimeter 60 cm; area 196 cm²
(e) Perimeter 38 cm; area 66 cm² (f) Perimeter 34 cm; area 48 cm²
- 64 m²
- 7 cm
- 9 cm

Exercise 14D

- (a) 21 cm² (b) 15 cm² (c) 24 cm² (d) 14 cm² (e) 24 cm²
(f) 15 cm² (g) 52.5 cm² (h) 15 cm² (i) 91 cm²
- 16 cm
- 0.375 m²
- Total area = 12 cm², so each kite has area 3 cm².
Total width is 6 cm, so each kite has long diagonal of 3 cm.
If the shorter diagonal is x then $\frac{1}{2} \times 3 \times x = 3 \Rightarrow x = 2$ cm.
The diagonals are 2 cm and 3 cm.
- (a) 1.15 cm (b) 1.15 cm² (c) 2.31 cm² (d) 18.5 cm² (e) 21.2 cm

Answers: Exercise 14E

Exercise 14E

- (a) 37.5 cm^2 (b) 132 cm^2 (c) 80 cm^2 (d) 234 cm^2 (e) 76 cm^2
(f) 77 cm^2 (g) 125.375 cm^2 (h) 45 cm^2 (i) 78.75 cm^2
- 11.5 cm^2
- (a) 10.5 m^2 (b) 2 m^2 (c) 8.5 m^2 (d) $\text{£}73.30$
- 20 cm

Exercise 14F

- (a) Kite, parallelogram, trapezium
(b) Kite: 3 cm^2 , parallelogram: 2 cm^2 , trapezium: 6 cm^2
Total: 11 cm^2
- (a) Dark grey kite, red rhombus and light grey parallelogram
(b) 2.61 cm^2
(c) 5 cm
(d) Dark grey kite 1.74 cm^2 , Red rhombus 3.48 cm^2 , Light grey parallelogram 1.74 cm^2
(e) 18 cm

Chapter 15: Volume

Exercise 15A

1. 8 cm^3
2. 6.4 cm^3
3. 200 cm^3
4. 500 m^3

Exercise 15B

1. (a) 120 cm^3 (b) 105 cm^3 (c) 300 cm^3 (d) 200 cm^3 (e) 102 cm^3
2. 368 cm^3
3. 22.5 cm
4. 4 cm
5. (a) Hexagonal prism (b) 60 m^3 (c) 1.7 m
6. (a) 5100 cm^2 (b) $163\,200 \text{ cm}^3$ (c) 13 times
7. (a) 17.5 cm^2 (b) 87.5 cm^3
8. 36.75 m^3
9. 207.6 cm^3

Exercise 15C

1. 117.8 cubic feet
2. 75.4 cm^3
3. 107.4 cm^3
4. 226 cubic inches
5. 1425 cm^3
6. 35.3 cm^3
7. 302 cm^3

Chapter 16: Pythagoras' Theorem

Exercise 16A

- (a) 9 (b) 49 (c) 25 (d) 8
(e) 4 (f) 10
- (a) 5.1 (b) 6.3 (c) 11.0 (d) 2.1 (e) 100.1
- (a) $x = 6$ (b) $y = 15$ (c) $a = \pm 3$ (d) $b = \pm 8$
(e) $c = \pm 8.9$ (1 d.p.)

Pythagoras' Theorem Activity

- 5
- 9 cm^2 , 16 cm^2 , 25 cm^2
- The sum of the areas of the two smaller squares is equal to the area of the largest square.

Exercise 16B

- (a) 13 cm (b) 5 cm (c) 10.8 km (d) 8.4 m (e) 5.4 mm
(f) 45.1 m (g) 15.3 km (h) 2.8 inches (i) 1.1 cm (j) 8.1 m
- 6.5 cm
- $x^2 + y^2 = z^2$
- 15 units
- 10
- 26 mm
- 10.6 cm
- 18.6 cm
- 14.1 cm

Exercise 16C

- (a) 5.7 m (b) 2.8 cm (c) 14.1 m (d) 12 m (e) 13.4 cm
(f) 11.9 cm (g) 12.8 cm (h) 10.2 cm (i) 7.2 cm (j) 6.4 cm
- 8 units
- 12 cm
- 9 cm
- 24 units
- 15 cm

Answers: Exercise 16D

Exercise 16D

1. 12.8 m
2. 258 cm
3. 9.5 feet (1 d.p.)
4. Elsie's route is 100 m longer
5. 9.2 km
6. Student's own answers (depends on what book is measured).
7. (a) 8 m (b) 17 m
8. (a) 8.60 km (b) 8.01 km
9. 1.8 m

Progress Review

Progress Review (Chapters 13 to 16)

1. (a) $A = wh$ (b) $w = \frac{A}{h}$ (c) $h = \frac{A}{w}$
2. Speed = $\frac{\text{distance}}{\text{time}}$
3. 45 mph
4. 204 cm or 2.04 m
5. 40 seconds
6. Mass = Density \times Volume
 For the marble: Mass = $5 \times 1.5 = 7.5$ g
 For the rock: Mass = $10 \times 5 = 50$ g
 The rock weighs more.
7. (a) Homemade loaf: 0.6 g/cm^3 ; supermarket white bread: 0.75 g/cm^3 ; Rye bread: 1.67 g/cm^3
 (b) The rye bread sinks because its density is greater than the density of water.
8. 50
9. 70 beats per minute
10. 26 minutes
11. (a) (i) 168 cm^2 (ii) 54 cm (b) (i) 473.5 cm^2 (ii) 84.8 cm
12. (a) 25 m^2 (b) 58.9 m^2 (c) 83.9 m^2 (d) 33.6 m
13. (a) 28 cm^2 (b) 40 cm^2 (c) 36 cm^2 (d) 80 cm^2 (e) 42 cm^2
 (f) 30 cm^2 (g) 54 cm^2 (h) 30 cm^2 (i) 28 cm^2
14. (a) Area 30 cm^2 ; perimeter 26 cm (b) Area 25.5 cm^2 ; perimeter 25 cm
 (c) Area 56 cm^2 ; perimeter 34.5 cm (d) Area 84 cm^2 ; perimeter 48 cm
 (e) Area 40 cm^2 ; perimeter 29 cm (f) Area 154 cm^2 ; perimeter 52 cm
15. (a) 48 cm^2 (b) 25 cm^2 (c) 91 cm^2 (d) 14 cm^2
 (e) 24 cm^2 (f) 15 cm^2
16. (a) 103.5 cm^2 (b) 161 cm^2 (c) 290 cm^2 (d) 52 cm^2
 (e) 69 cm^2 (f) 162 cm^2
17. For a parallelogram: area = base \times perpendicular height
 So base = $\frac{\text{area}}{\text{perpendicular height}} = \frac{112}{14} = 8 \text{ cm}$
 Ella is right
18. 16 cm
19. Area 101.68 cm^2 ; perimeter 41.2 cm
20. 4 and 5; or 1 and 20
21. 22.05 m^3
22. 1.5 m
23. 15 m^3
24. $120\,000 \text{ cm}^2$ or 0.12 m^3
25. $22\,500 \text{ cm}^3$

Answers: Progress Review (Chapters 13 to 16)

26. (a) Octagonal prism (b) 2 m^3 (c) 0.8 m^3
27. 603 cubic inches
28. 1005 m^3
29. 15700 cm^3
30. 3079 cm^3
31. 2036 cubic feet
32. 7950 cm^3
33. 20.4 km
34. 9.0 m
35. $x = 4.47 \text{ cm}$; $y = 4.58 \text{ cm}$
36. (a) 4.12 m (b) 3.61 m (c) 3.54 m
37. (a) 10 cm (b) 15 cm (c) 168 cm^2
38. 11.2 km
39. $x = 24 \text{ m}$; $y = 51 \text{ m}$
40. (a) 6.32 km (b) 2.61 km

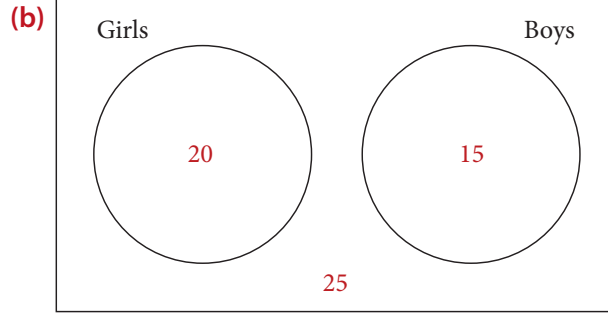
Chapter 17: Venn Diagrams

Exercise 17A

1. (a) 71 (b) 48
 2. (a) $25 - (6 + 3 + 9) = 7$ (b) $6 + 7 = 13$ (c) $25 - 6 = 19$ (d) $\frac{3}{25} = \frac{12}{100} = 12\%$

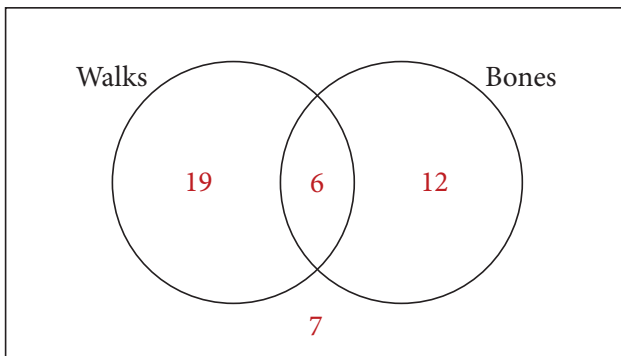
Exercise 17B

1. (a) 25

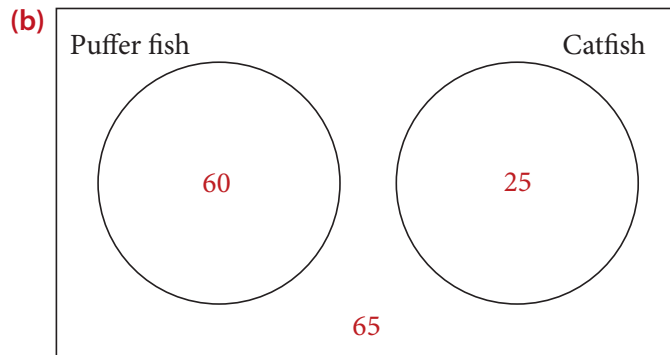


2. (a) 86 (b) 18 (c) 42 (d) 26

3. (a) (b) 44



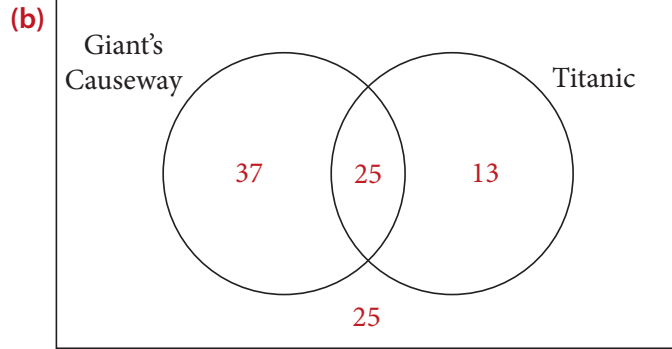
4. (a) 65



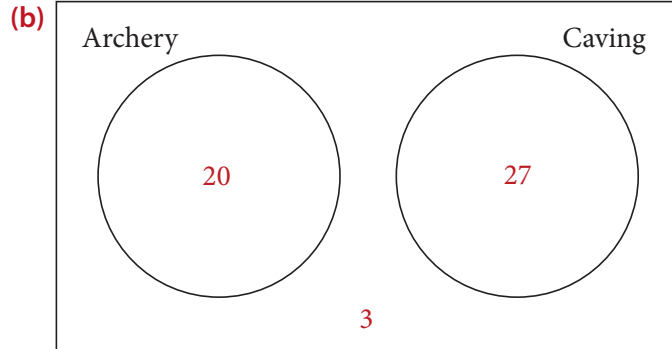
- (c) $\frac{60}{150} = \frac{6}{15} = \frac{2}{5} = 0.4 = 40\%$

Answers: Exercise 17B

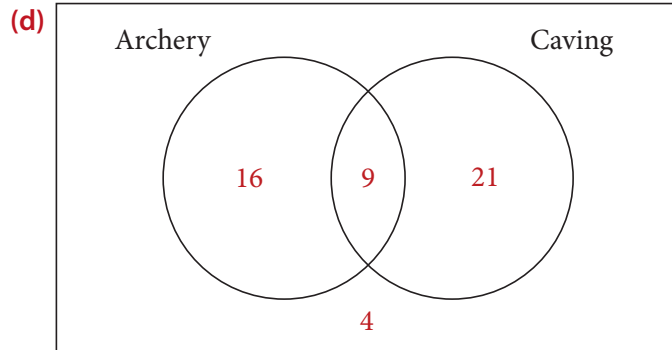
- 5. (a) 25
- (c) 38
- (d) 50%



- 6. (a) 3



- (c) 9

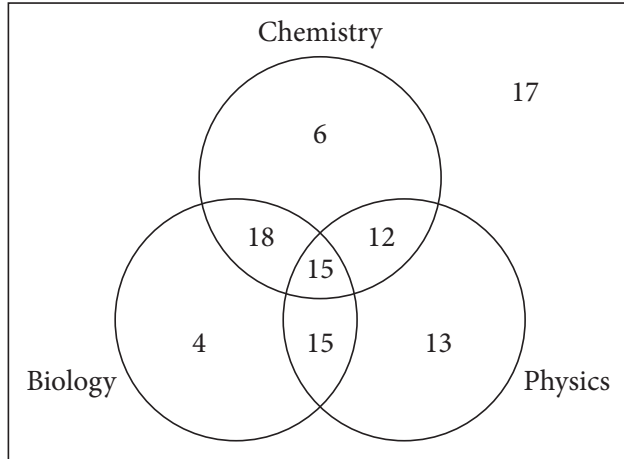


Answers: Exercise 17C

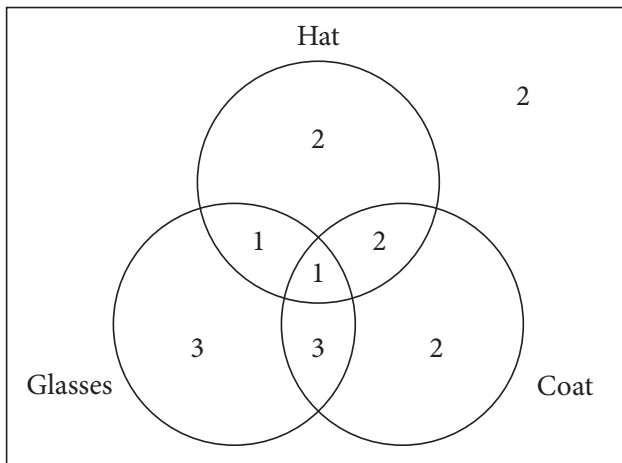
Exercise 17C

1. (a) 17

(b)

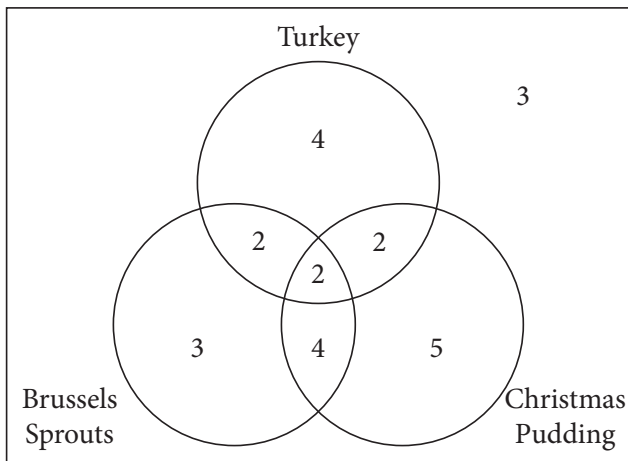


2. (a)



(b) 2

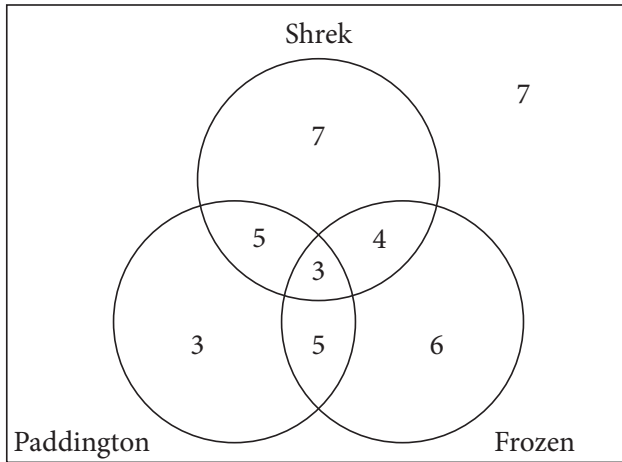
3. (a)



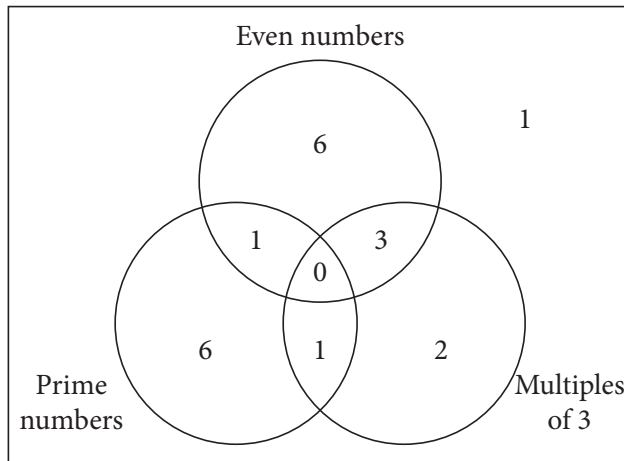
(b) 3

Answers: Exercise 17C

4. (a) – (d)



5. (a) 1 (the number 2) (b) 1 (the number 1)
(c) 1 (the number 1)



Chapter 18: Statistical Averages And Spread

Exercise 18A

- (a) 14 (b) £77
- 126 ml
- Jason is wrong because the weights must be put in order before the middle one is chosen. The correct median weight is 12.3 g
- (a) 6 kg (b) 9
- 3

Exercise 18B

- (a) (i) 3.6 (ii) 4 (iii) 4 (iv) 5 (b) (i) 3.9 (ii) 4 (iii) 6 (iv) 8
 (c) (i) 15.9 (ii) 15 (iii) 10 (iv) 25 (d) (i) 2.0 (ii) 2.0 (iii) 2.0 (iv) 0.5
 (e) (i) 2.12 (ii) 2.12 (iii) 2.13 (iv) 0.05
- (a) 1.8 (1 d.p.) (b) 2 (c) 1 (d) 6
- (a) 20 (b) 29 (c) 1.45 (d) 1
 (e) 0 and 1 (f) 5
- (a) 32 (b) 32 (c) 32 (d) 6
- (a) 39.8 (b) 40 (c) 40
- (a) 1 (b) 2 (c) 4 (d) 20%

Exercise 18C

- (a) 24.1 (b) $20 - 24$ (c) $20 - 24$
- (a) 31 (b) $20 \leq t < 30$ (c) $20 \leq t < 30$ (d) 23.7 minutes
- (a) 158.9 cm (b) $160 \leq t < 170$ (c) $150 \leq t < 160$
- (a) 25 (b) 17.7 minutes (c) $10 \leq t < 15$ (d) $15 \leq t < 20$
- (a) 8.2 (b) $8 \leq t < 9$
- (a) 10% (b) 29.5 mph (c) $30 \leq s < 40$ (d) $30 \leq s < 40$

Answers: Exercise 18D

Exercise 18D

1. (a) The mode, 51
(b) The mode can be misleading as an average when it is the lowest or the highest value.
2. The mode would be a sensible choice. They know that this is the size sold most frequently. Additionally, the mean and median may not be values that are in the list of sizes.
3. Mr Cameron should use the median score as the pass mark. By definition, half of the scores lie above the median, so half of the pupils will pass.
4. Pizza because this is the mode. It is not possible to work out the mean or median with non-numerical data.
5. 7
6. (a) £213 200 (b) £19 000
(c) The mean salary of £213 200 is very misleading.
It is distorted by the one very large salary of £1 000 000
Mrs Fisher should use the median salary of the workers. This is more representative of the salaries that most of the workers at the company are paid.
7. (a) $3\frac{1}{2}$
(b) He should use the mode, which is 6
The mean is $6\frac{1}{2}$ or 6.5 (to 2 d.p.)
The median is 6.25
8. 16 m^2
9. (a) 6 (b) 96 (c) 7.2
10. (a) 5 mm
(b) The mode is 0 mm. In this case, the mode is not a suitable average, because 0 mm is the lowest value in the dataset.
11. The data should be put in order from smallest to largest before the middle value is selected.

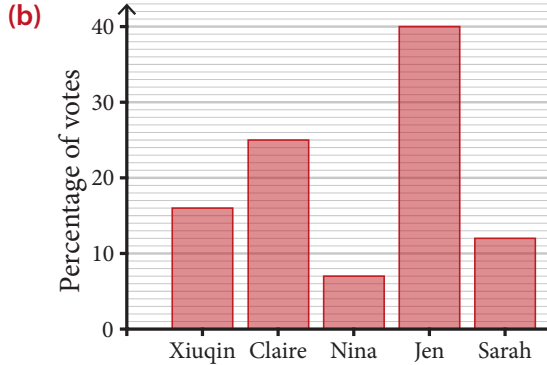
Chapter 19: Statistical Diagrams

Exercise 19A

1. (a) $250 \leq w < 255$ (b) $250 \leq w < 255$ (c) 253 g

Exercise 19B

1. (a) Xiuqin 16%; Claire 25%; Nina 7%; Jen 40%; Sarah 12%



2. (a) Walk
 (b) The bus bar has been drawn incorrectly. It currently has a height of 3.5. This should be a whole number as it is a frequency, or a number of pupils.
3. (a) Football (b) Hockey (c) 7
4. (a) 29 (b) 29
 (c) Class 11A did better. More pupils in class 11A get A or B grades, whereas more people in class 11B get D or E grades.
5. (a) £25 000 (b) 2022 (c) 2021
 (d) The staff section of the bar increases in size from 2020 to 2021, but then decreases in size in 2022.
6. (a) 4.5 p
 (b) The bar chart on the leaflet is misleading because the vertical axis does not start at zero. It has been designed to give the impression that Low Cost Oil is a lot cheaper than the competitors. In reality, the difference between the highest and lowest prices is only 4.5 p. The bar chart is designed to exaggerate this difference.

Answers: Exercise 19C

Exercise 19C

1. (a)

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

Key: 2 | 8 means 28

(b)

3	4 5
4	4
5	4 7
6	0
7	5
8	1 5
9	6

Key: 3 | 4 means 3.4

(c)

0.1	0 2 2 3 6
0.2	3
0.3	3 4 5 9
0.4	0 2
0.5	
0.6	0
0.7	0
0.8	0

Key: 0.2 | 3 means 0.23

2. (a) 24

(b) 15

(c) 28

(d) $\frac{1}{3}$

3. (a) 30

(b) 61

(c) 52

(d) $\frac{1}{10}$

4. (a) The median price in Belfast is £1.43, compared with £1.47 in Omagh, so overall Omagh has the higher prices. The ranges are as follows:

$$\text{Belfast } 156 - 128 = 28\text{p}$$

$$\text{Omagh } 163 - 134 = 29\text{p}$$

Omagh has a slightly larger range, so there is a slightly greater spread of prices there.

(b) It is possible to visualise both distributions. For example it can be seen that Omagh has slightly higher prices on average, since the numbers are in the '13' to '16' rows, compared with the '12' to '15' rows for Belfast.

5. (a)

0	6 7
1	1 2 6
2	3 3 5
3	2 2 8 8
4	1 1 2 5
5	0 1 3 3

(b) 35 minutes

Key: 1 | 2 means 12 minutes

6. (a) (i) 25 (ii) 35 (iii) 33

(b) The mode will stay the same. The median will increase. The range will increase.

7. (a)

76	4 9
77	
78	2 7 7 7 8
79	3 9
80	
81	
82	5
83	4 5
84	5
85	4 5

(b) (i) 79.3 (ii) 78.7 (iii) 9.1

(c) $\frac{2}{5}$

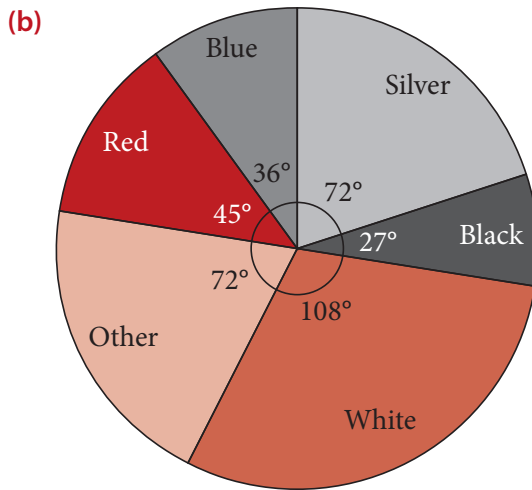
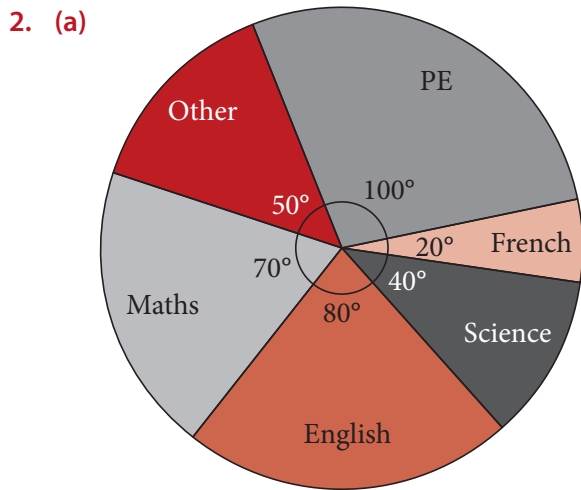
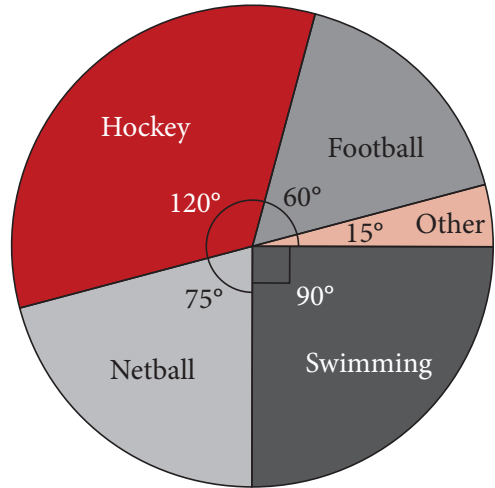
Key: 76 | 4 means 76.4 years

Answers: Exercise 19D

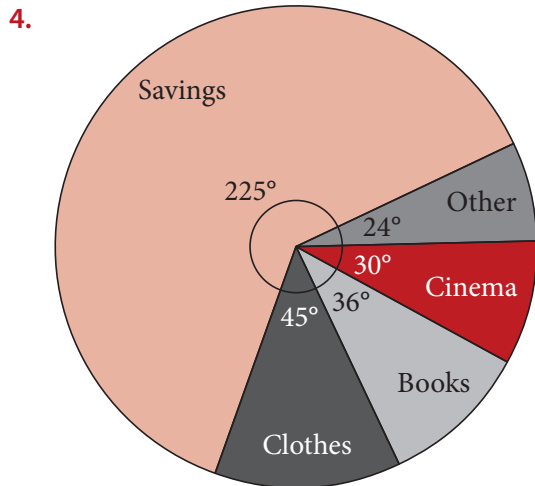
Exercise 19D

1.

Sport	Number of girls	Angle (°)
Hockey	16	120
Netball	10	75
Swimming	12	90
Football	8	60
Other	2	15

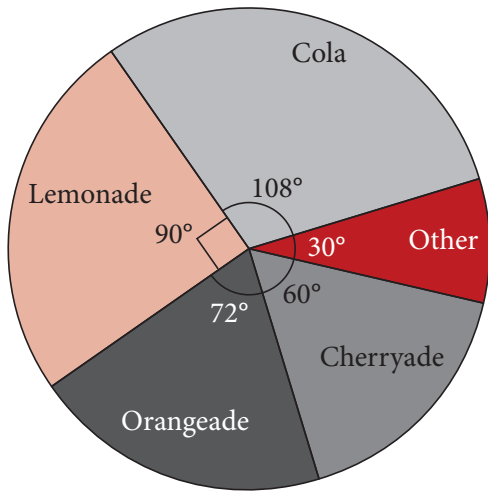


3. (a) 50 g (b) 35 g (c) 25 g (d) 50°



Answers: Exercise 19E

5.



Exercise 19E

1. (a) Clothing
 (b) Jenny is correct. The angle for the Clothing sector is twice as big as the angle for the Health and beauty sector (120° compared with 60°).
 (c) 20
2. (a) 37.5% (b) Stainberrys 8, Superstuff 8, Scounders 4, Scrimptons 12
3. (a) 5 (b) 5 (c) 3 (d) 7
4. (a) Other 10%, Coal and oil 5% (b) 38.9%
 (c) Joel is right.

Wind: $\frac{90}{360} \times 100 = 25\%$

Other renewables: $\frac{25}{360} \times 100 = 6.9\%$

Total from renewables: $25\% + 6.9\% = 31.9\%$

5. (a) 15° (b)

Food type	Cheese	Eggs
Water	39%	75%
Fat	25%	10%
Protein	22%	11%
Other	14%	4%

- (c) To work out the fat in 100 g of cheese: 25% of $100\text{ g} = \frac{25}{100} \times 100 = 25\text{ g}$

To work out the fat in 200 g of eggs: 10% of $200\text{ g} = \frac{10}{100} \times 200 = 20\text{ g}$

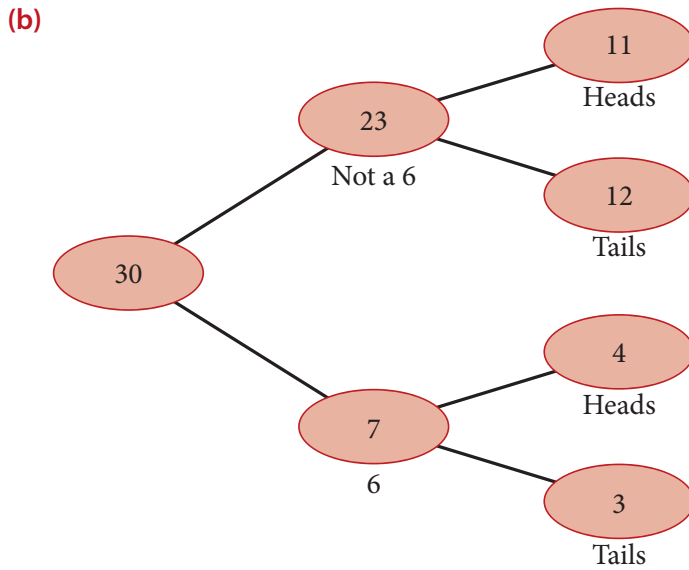
There is more fat in 100 g of cheese.

Answers: Exercise 19F

Exercise 19F

1. (a)

	Heads	Tails	Total
Not a 6	11	12	23
6	4	3	7

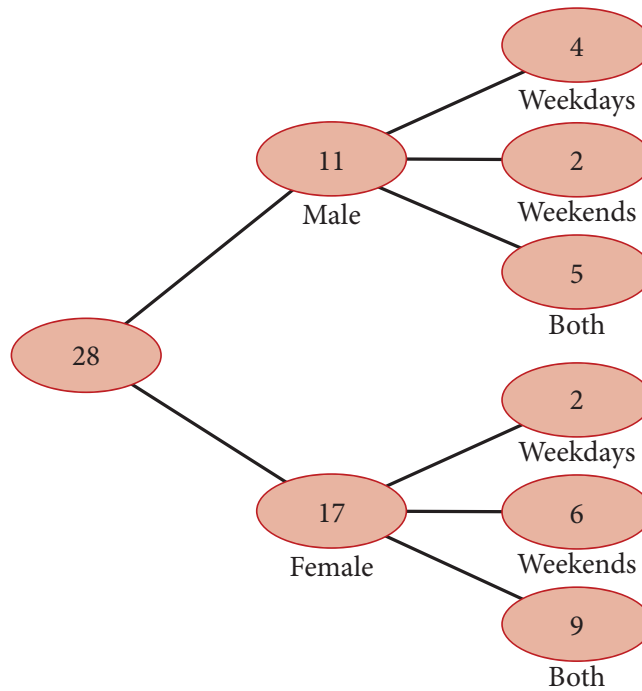


2. (a)

	Weekdays only	Weekends only	Both	Total
Male	4	2	5	11
Female	2	6	9	17
Total	6	8	14	28

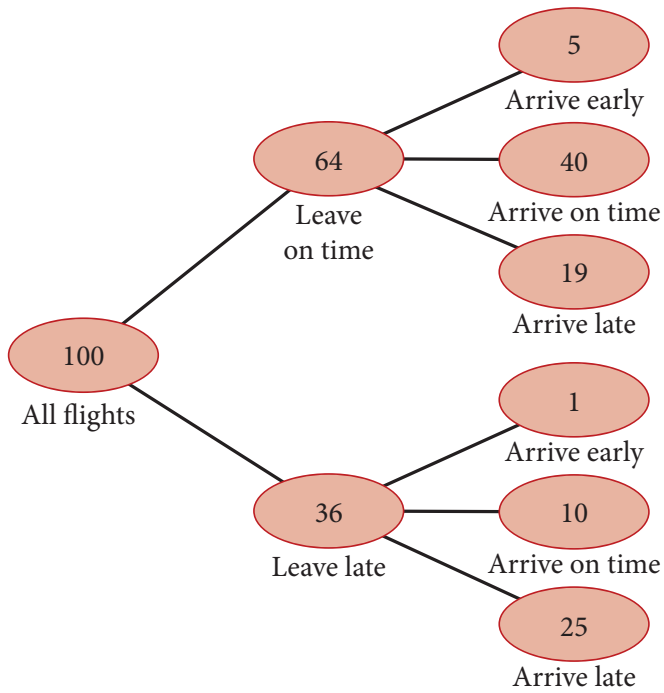
(b) 15

(c)



Answers: Exercise 19F

3. (a)



(b) 50

(c) 44%

(d)

	Arrive early	Arrive on time	Arrive late	Total
Leave on time	5	40	19	64
Leave late	1	10	25	36
Total	6	50	44	100

Answers: Exercise 19G

Exercise 19G

1. (a) 4 feet (b) 7 feet (c) 6 years after planting
 (d) Year 3 and Year 9 (e) During the 2nd year

2. (a) (ii) (b) (i) (c) (iii) (d) (iv)

3. (a)



- (b) November (c) August

- (d) Any two of:

- More people visit the hotel in the summer months.
- Fewer people visit during the winter.
- The peak time to visit is August, possibly because of school holidays.
- In the winter there is a peak in December, possibly because of Christmas holidays.
- There is another peak in April, possibly because of Easter holidays.

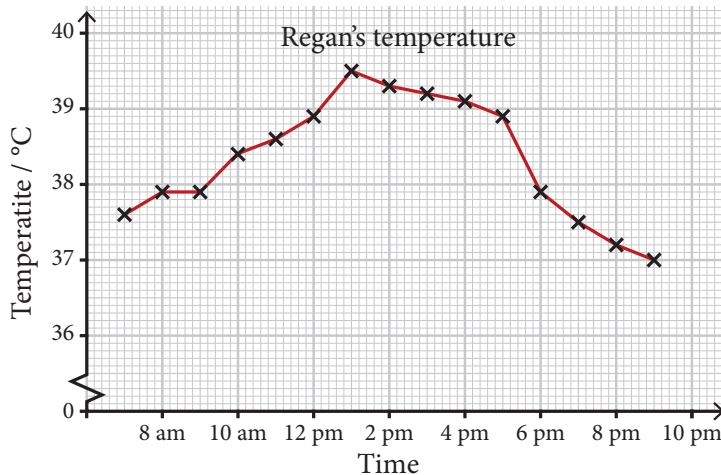
4. (a) 500 (b) 12:30 p.m. (c) 170 (d) 250

5. (a) £1000 (b) £0 (c) £3000

6. (a) June (b) 3 times (February, June and November)

- (c) He is wrong. The graph is misleading because the vertical axis does not start at zero.

7. (a)



- (b) 39.5°C

- (c) Accept 9:20 – 9:30 am and
5:45 – 5:55 pm

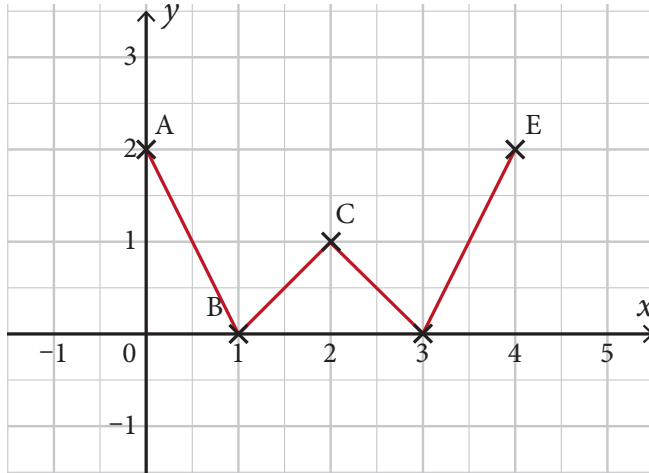
- (d) 8:30 pm

- (e) 9 pm

Chapter 20: Scatter Graphs

Exercise 20A

1. (a)



(b) W

2. (a) This line has a negative gradient as, from left to right, it slopes down the page. (b) -2

3. 5

Exercise 20B

1. (a) Positive correlation
 (c) Positive correlation
 (e) Positive correlation
 (g) Positive correlation

- (b) Negative correlation
 (d) No correlation
 (f) Negative correlation

2. (a) Graph 3 (b) Graph 1 (c) Graph 2

3. There is a negative correlation. As the age increases, the value decreases.

4. There is a positive correlation. High levels of sunshine in Alfreton occur at the same time as higher levels of sunshine in Belper. This may be because the two towns are close to each other.

5. (a) No correlation, or little correlation

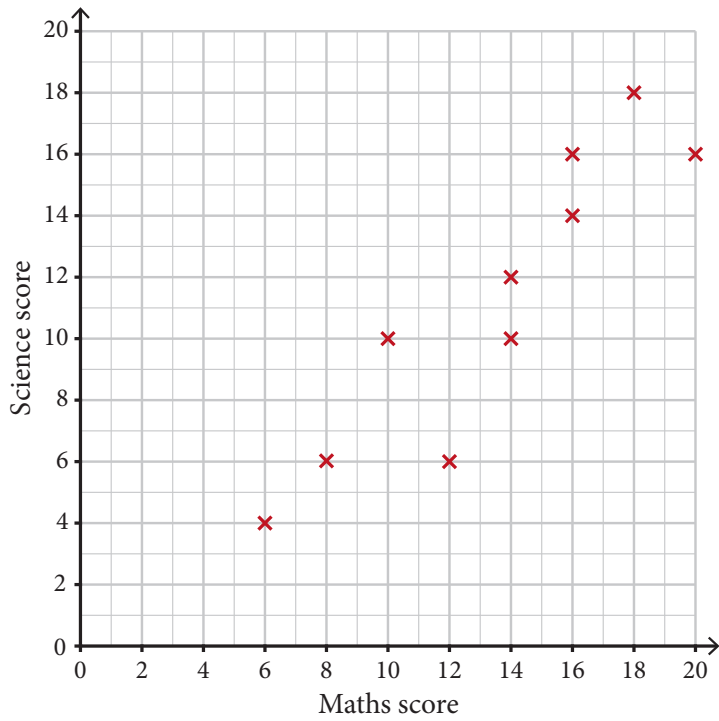
(b) Marie and John probably don't work together. If they did, they may attend the same meetings, and there would be a stronger correlation in the number of meetings they each attend.

6. (a) Little or no correlation

(b) Negative correlation

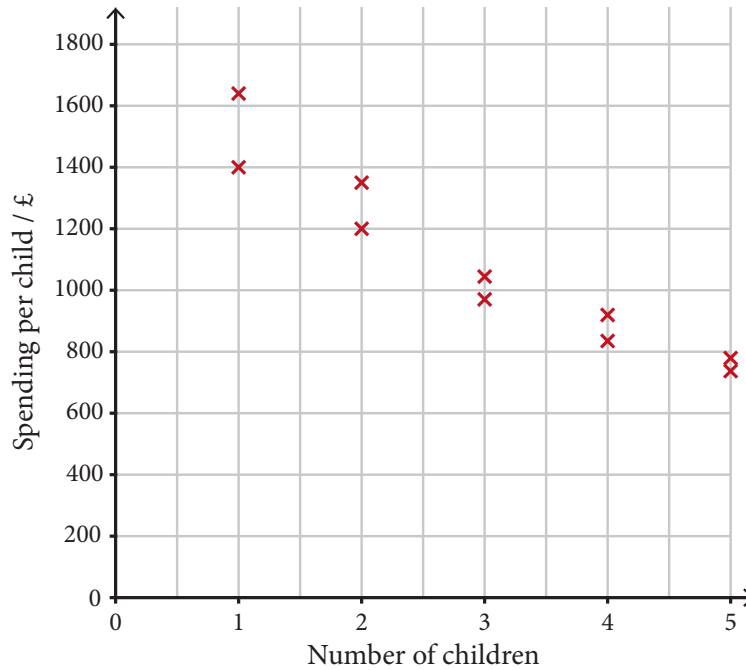
Answers: Exercise 20B

7. (a)



(b) Positive correlation

8. (a)

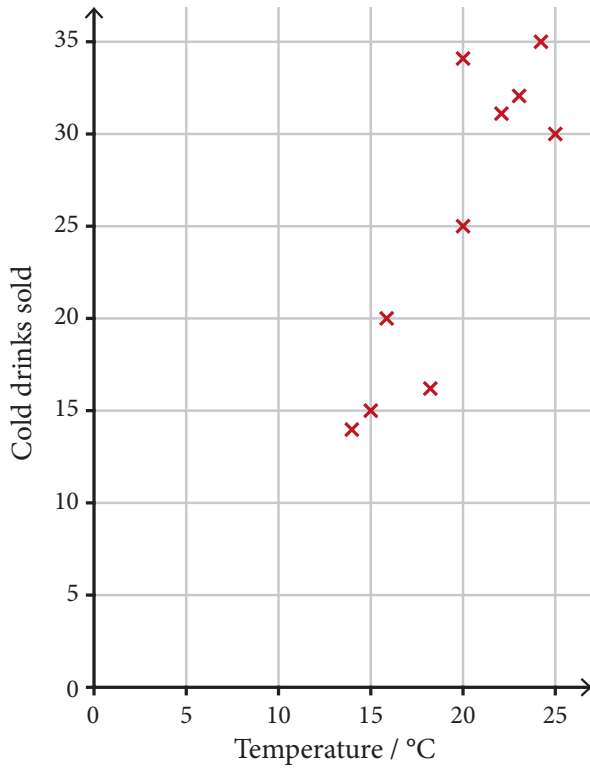


(b) Negative correlation

(c) In larger families, the younger children may re-use the uniforms of the older children, reducing the average spend per child.

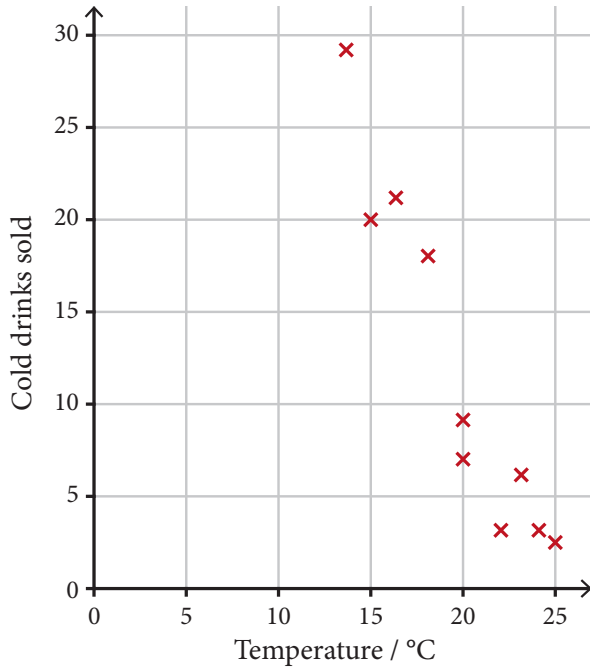
Answers: Exercise 20B

9. (a)



(b) Positive correlation

(c)



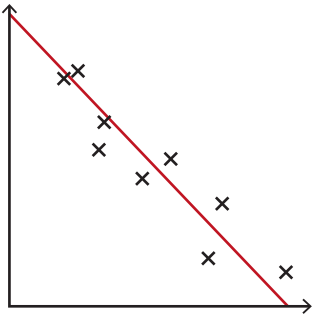
(d) Negative correlation

(e) (i) For the cold drinks: as temperature increases, more people order cold drinks to cool down.

(ii) For the hot drinks: as temperature increases, fewer people order hot drinks, preferring to order cold drinks.

Exercise 20C

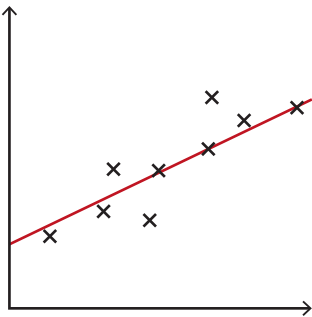
1. (a)



Negative correlation

(b) No correlation, so no line of best fit possible.

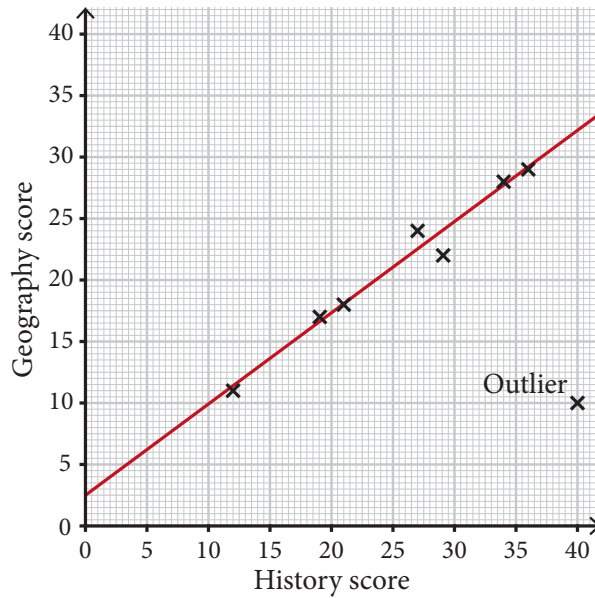
(c)



Positive correlation

(d) No correlation, so no line of best fit possible.

2. (a) – (c)



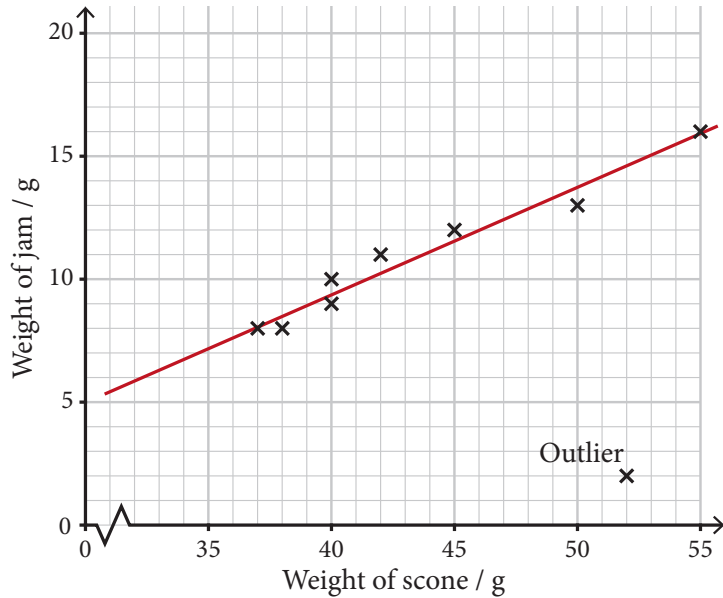
(d) Positive

(e) (i) 25 (ii) 5

(f) The estimate in part (i) is more reliable. The Geography scores used in the graph are between 10 and 29, so using a Geography score of 6 to estimate a History score is extrapolation.

Answers: Exercise 20C

3. (a) and (c)



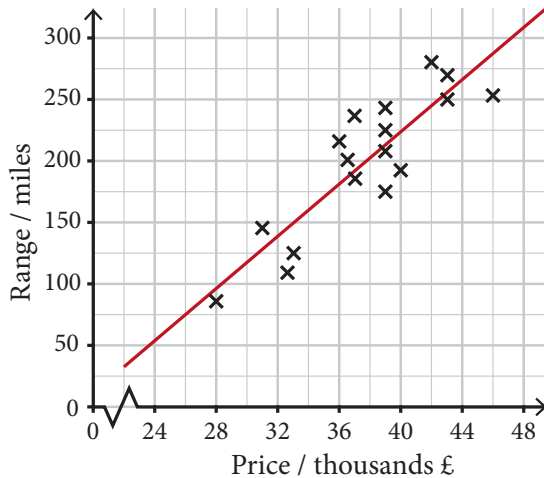
(b) Outlier is labelled on the graph. Reason for the outlier: Sam may have run out of jam.

(d) Positive

(e) (i) 7 g (ii) 53 g

(f) The estimate in part (ii) is more reliable. The weights of the scones used in the graph are between 37 g and 55 g, so using a weight of 35 g to estimate the amount of jam used is extrapolation and less reliable.

4. (a) – (b)



(c) Positive

(d) (i) 170 miles (ii) £47 000

(e) The estimate in (d)(i) is more likely to be reliable since £35 000 lies within the price range on the graph. (This is interpolation). In (d)(ii), 300 miles is bigger than the largest range value used, so this is extrapolation and less reliable.

Answers: Exercise 20D

Exercise 20D

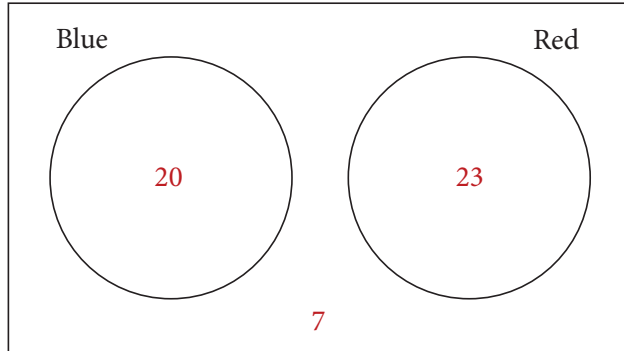
1.
 - (a) The larger a house the more it is likely to be worth.
 - (b) There is no causality. Instead, both variables are largely dependent on a third factor, the level of pollution in the river.
 - (c) An increase in the length of Mr Walker's walk will cause the time taken to increase.
 - (d) A child's increasing age will cause an increase in their height.
2. Probably. More hours spent on social media may cause fewer hours to be spent on homework.
3. There is a correlation between levels of atmospheric CO₂ and the level of obesity. However, there is no causation: higher obesity levels do not cause high levels of CO₂, or the other way round. Instead, there may be a third factor that causes both of these increases: since the 1950s people have become wealthier and this may be a cause of both the increases.
4.
 - (a) Positive correlation
 - (b) A higher number of colds causes a higher number of cold remedies to be taken. (It is not the case that a higher number of cold remedies causes a higher number of colds.)

Progress Review

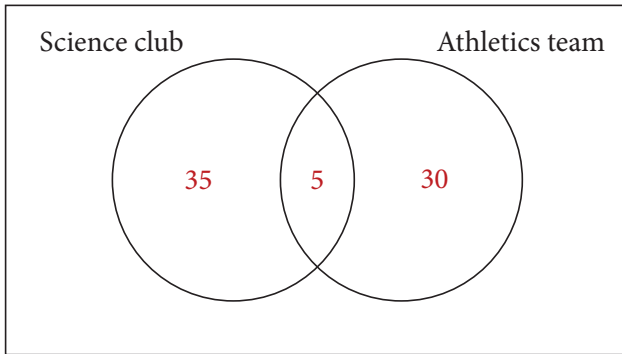
Progress Review (Chapters 17 to 20)

1. (a) 7

(b)



2. (a)



(b) 5

3. (a) 3

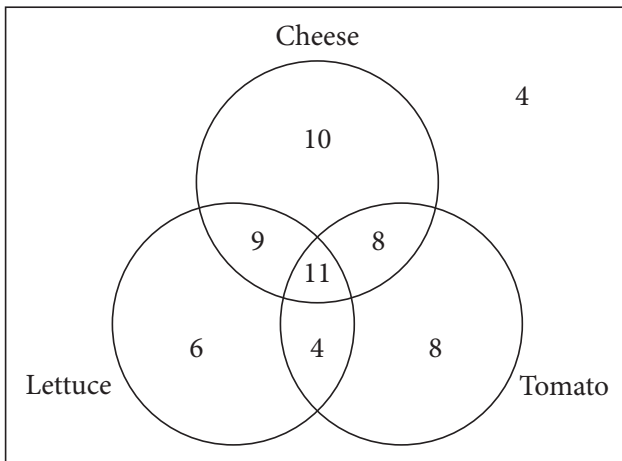
(b) 4

(c) 13

4. (a) 2

(b) 13

5. (a)



(b) 4

6. 75.4 cm

7. (a) 25.2 kg

(b) $15 \leq w < 25$

(c) $15 \leq w < 25$

8. (a) 19.3

(b) 19

(c) 19

9. (a) 6.6

(b) 8

(c) 6

10. 8.7 km

Answers: Progress Review (Chapters 17 to 20)

11. (a) 5.1 hours (1 d.p.)

(b) The modal class is $2 \leq s < 4$, since this is the class with the highest frequency.

$$n = 14 \Rightarrow \frac{n+1}{2} = 7.5$$

The 7th and 8th days both lie in the $4 \leq s < 6$ group, so this is the median class.

12. 20.6 minutes

13. (a) 10.6 cm (b) 11.2 cm

14. (a) 7 (b) 8.5 (c) 197 (d) 7.6

15. (a) 7 (b) 0.62 (c) 1.86

16. (a) 27.5 minutes (b) The times are grouped, so we do not know the exact time for each job.

17. (a) 30% (b) 25% (c) 10% (d) 20% (e) 10%

18. (a) 6 (b) 30 (c) 30 (d) 86

19. (a) 0 | 4 (b) 36

```

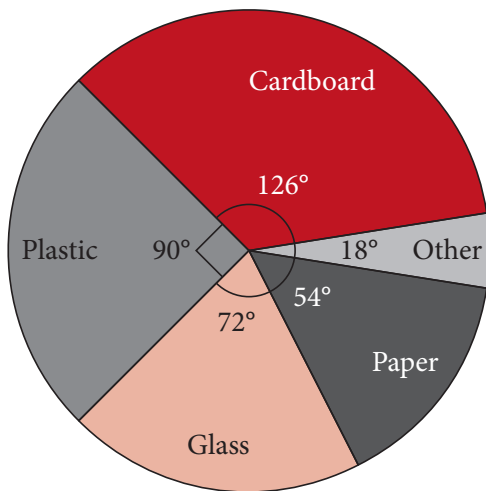
1 | 1 1 1 4 6
2 | 0 1 5 8
3 | 0 1 1 2 4 6 6 6 7 8
    
```

Key: 1 | 4 means 14

20. (a) 13 (b) 30

21. (a) (i) 18% (ii) 984 km² (b) (i) 12 567 km² (ii) Pasture

22.

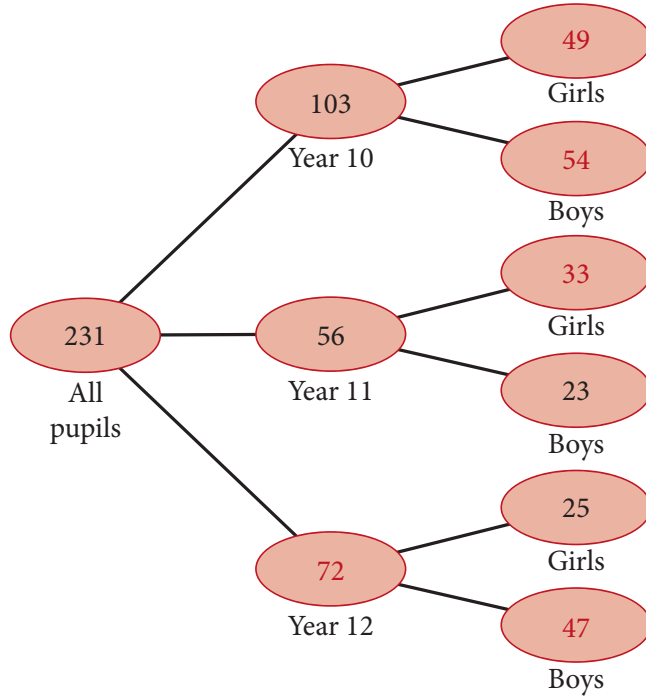


Answers: Progress Review (Chapters 17 to 20)

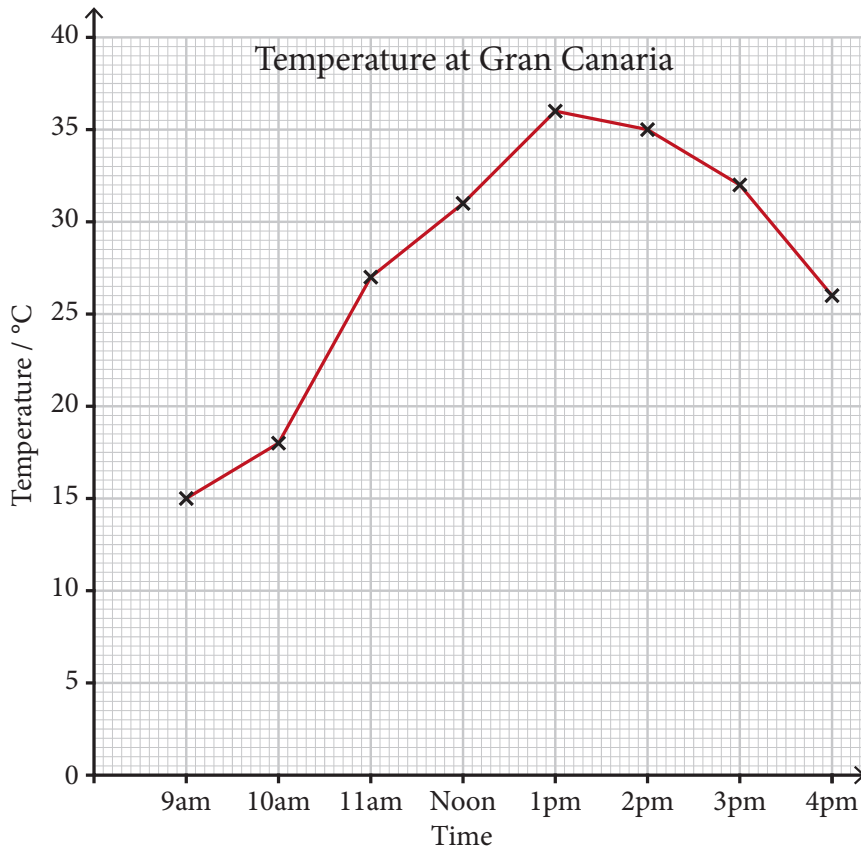
23. (a)

	Year 10	Year 11	Year 12	Total
Girls	49	33	25	107
Boys	54	23	47	124
Total	103	56	72	231

(b)

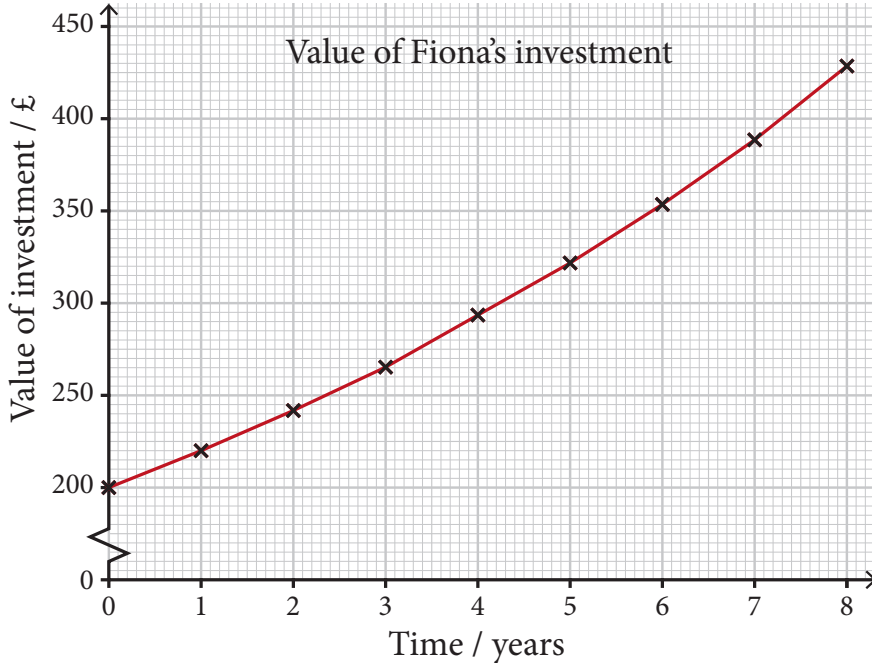


24. (a)



(b) 10 am – 11 am (c) 3 pm – 4 pm (d) 4 hours

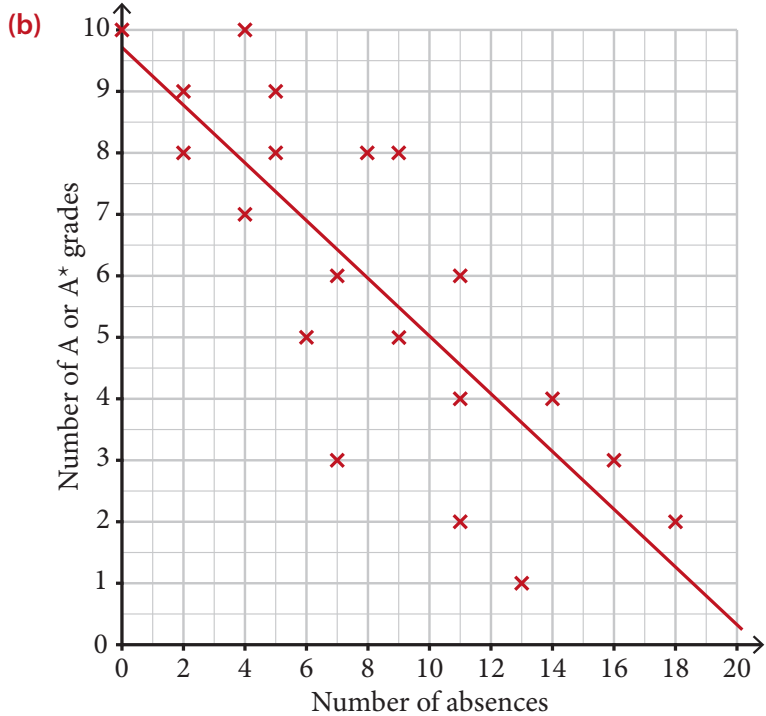
25. (a)



(b) Roughly £310 (c) Roughly 7.2 years

Answers: Progress Review (Chapters 17 to 20)

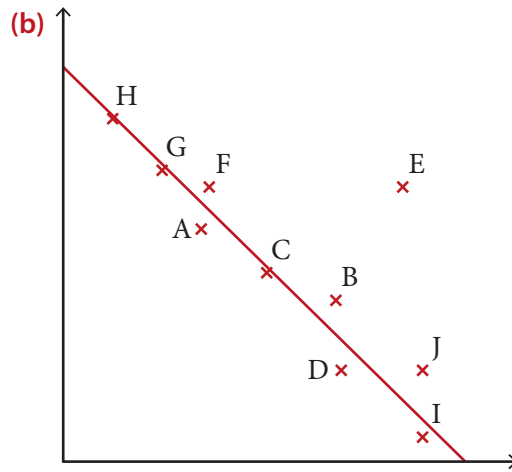
26. (a) Vienna and Bratislava (80 km) (b) 665 km
 27. $A = 6, B = 4$
 28. (a) Positive correlation (b) Negative correlation
 (c) Positive correlation (d) No correlation
 29. Positive correlation (The further the distance travelled, the higher the cost.)
 30. No correlation
 31. (a) Negative correlation



32. (a) 67%. This is fairly reliable since Joel's French score of 65% lies within the range of values used to plot the graph.
 (b) 83%. This is fairly reliable since Brídín's German score of 80% lies within the range of values used to plot the graph.
 (c) 85%. This may be unreliable, since Will's French score of 90% is outside of the range used to plot the graph.

Answers: Progress Review (Chapters 17 to 20)

33. (a) Point E



34. (a) There is no causality. Changes in both ice lolly sale and air conditioner sales are both driven by a third variable, temperature.
- (b) There is no causality. The size of an individual's home and their life expectancy are both linked to a third variable: the individual's wealth.
- (c) There is probably causality here: the longer a pupil spends on homework is likely to cause their test score to improve.

Chapter 21: Number Systems

Exercise 21A

1. (a) 256 (b) 2 (c) 32
 2. (a) 10 000 (b) 10 (c) 1000

Exercise 21B

1. (a) 7 units (b) 7 hundred (c) 7 tens or seventy
 (d) 7 tens or seventy (e) 7 units
 2. (a) 58 (b) 68 (c) 394 (d) 607 (e) 520
 3. (a) 127 (b) 208 (c) 85 (d) 480
 4. One thousand

Exercise 21C

1. (a) 1 unit (b) 2 thousandths (c) 3 hundred thousand
 (d) 4 hundredths (e) 5 hundreds (f) 6 tenths (g) 7 tens or seventy
 (h) 8 ten-thousands or 80 thousand (i) 9 million (j) 0 as zero thousands
 2. (a) 7 tens or seventy (b) 7 units (c) 7 hundredths (d) 7 million
 (e) 7 thousandths
 3. (a) 4 units (b) 4 thousandths (c) 4 hundredths (d) 4 tenths
 (e) 4 ten-thousands or 40 thousand
 4. (a) 5 tens or fifty (b) 5 tenths (c) 5 hundredths (d) 5 units
 (e) 5 hundred thousand

Exercise 21D

1. (a) 7 (b) 2 (c) 14 (d) 38 (e) 31
 2. (a) 3 (b) 10 (c) 29 (d) 86 (e) 124
 3. (a) 6 (b) 42 (c) 234 (d) 255 (e) 187

Exercise 21E

1. (a) 110 (b) 1100 (c) 10010 (d) 10111 (e) 11011
 2. (a) 175 (b) 153 (c) 45 (d) 51 (e) 170
 3. (a) 1011 (b) 100100 (c) 101101 (d) 111011 (e) 111101
 4. (a) 1111000 (b) 1101111 (c) 1100011 (d) 11011101 (e) 100001011
 5. (a) 3 (b) 15 (c) 63
 6. (a) 111 (b) 11111 (c) 1111111 (d) 11111111
 7. (a) 64, 16, 4, 1 (b) $2 \times 4 + 3 \times 1 = 11$ in decimal
 (c) We count in base ten, so $1 \times 16 + 2 \times 4 = 24$ planets

Chapter 22: Indices

Exercise 22A

- (a) 4×6 (b) 5×9 (c) 3×5 (d) 8×2
- (a) 4^2 (b) 3^3 (c) 11^2 (d) 13^3
- (a) $25 - 16 = 9$ (b) $9 - 8 = 1$ (c) $9 + 16 + 144 = 169$ (d) $27 - 25 = 2$

Exercise 22B

- (a) 2^5 (b) 8^6 (c) 9^4 (d) 12^7 (e) 6^5
- (a) $8 \times 8 \times 8$ (b) $4 \times 4 \times 4 \times 4 \times 4$ (c) $11 \times 11 \times 11 \times 11 \times 11 \times 11$
(d) $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ (e) $2 \times 2 \times 2 \times 2 \times 2 \times 2$
- (a) $216 - 64 = 152$ (b) $343 - 243 = 100$
(c) $9 + 64 + 625 = 698$ (d) $243 - 216 = 27$

Exercise 22C

- (a) r^2 (b) s^3 (c) p^4 (d) y^5 (e) t^7
- (a) q^9 (b) x^4 (c) p^7 (d) t^6 (e) k^8
- (a) $6xy$ (b) $15p^2$ (c) $21w^3$ (d) $24m^2n$ (e) $8r^2t^2$
- (a) $\frac{x^2}{y}$ (b) $\frac{5t}{q}$ (c) $\frac{6m}{3n} = \frac{2m}{n}$ (d) $\frac{60x^2}{4y} = \frac{15x^2}{y}$ (e) $\frac{48q^2}{12x^2} = \frac{4q^2}{x^2}$
- (a) $180p^2q^2$ (b) $\frac{8xy}{4xy} = 2$ (c) $\frac{28rt^2}{28rt} = t$ (d) $\frac{12w^2y^2}{3w^2} = 4y^2$
(e) $16mn + \frac{4n^2m}{n} = 20mn$

Exercise 22D

- (a) p^{12} (b) t^{11} (c) w^{11} (d) x^{16} (e) y^{13}
- (a) m^4 (b) r^9 (c) p^8 (d) 1 (e) $y^1 = y$
- (a) z^{18} (b) x^{14} (c) p^{45} (d) w^{21} (e) y^{28}
- (a) $6k^6p^4$ (b) $15t^3p^3$ (c) $48w^8x^5$ (d) $9x^3y^9$ (e) $5y^8$
- (a) $\frac{w^3}{3^2w^2} = \frac{w}{9}$ (b) $\frac{2y^5}{3^2y^2} = \frac{2y^3}{9}$ (c) $\frac{t^7}{2^3t^3} = \frac{t^4}{8}$ (d) $\frac{3y^3}{p^2}$ (e) $\frac{6x^4}{x^4} = 6$

Chapter 23: Trial and Improvement

Exercise 23A

- (a) 3 (b) 4 (c) 0 (d) 7
- (a) -3 (b) 4 (c) 10 (d) 28
- (a) 23 (b) 32 (c) 25 (d) 13

Exercise 23B

- (a) 7.7 (b) 3.2 (c) 9.5 (d) 8.5 (e) 10.5
- (a) 6.32 (b) 4.47 (c) 3.32
- 2.15

Exercise 23C

- (a) 3.4 (b) 2.3 (c) 6.4 (d) 4.4 (e) 7.1
- (a) 2.3 (b) 4.6 (c) 2.9 (d) 4.2 (e) 2.7
- (a) 3.65 (b) 3.07 (c) 6.20

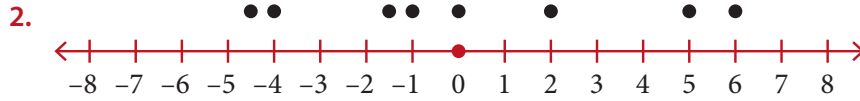
Exercise 23D

- 4.4 cm
- (a) 1.6 (you may also get -7.6) (b) 9.3 (you may also get -2.3)
- 3.92
- 7.4 cm
- 4.6 cm
- 1.9 feet

Chapter 24: Inequalities

Exercise 24A

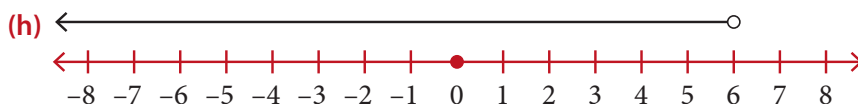
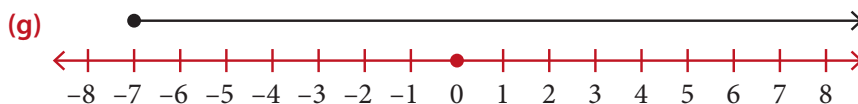
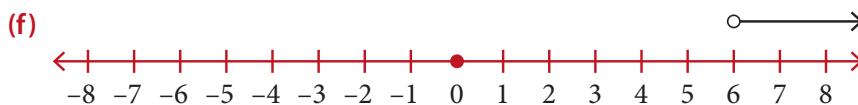
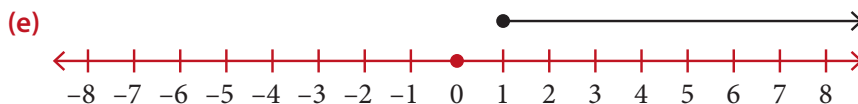
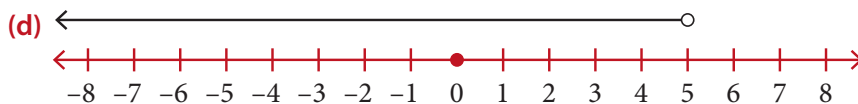
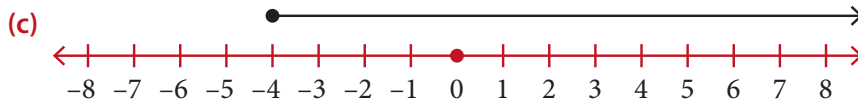
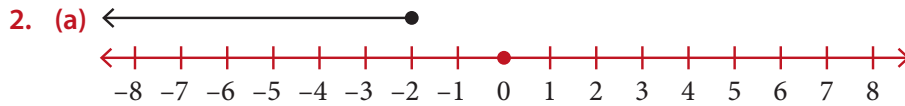
1. (a) $6 < 17$ (b) $8 < 12$ (c) $6 > 3$ (d) $20 = 20$ (e) $7 > -5$
 (f) $-3 > -8$ (g) $-2 < 0$ (h) $12 > -9$ (i) $-3 < 3$ (j) $-5 = -5$



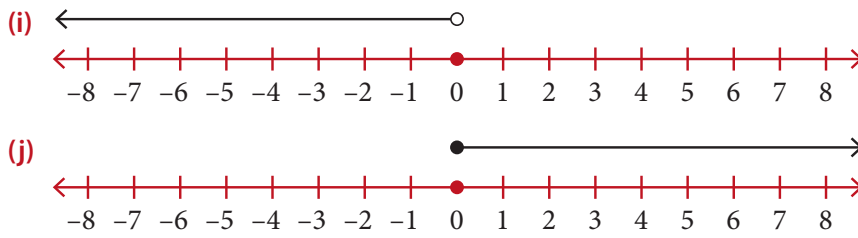
3. (a) 9 (b) 4.5 (c) 1.2 (d) 17 (e) 2
 (f) -8 (g) $\frac{4}{3}$ (h) $-\frac{59}{3}$

Exercise 24B

1. (a) $x \leq 4$ (b) $x \geq -8$ (c) $x > -5$ (d) $x < 0$ (e) $x < 7$
 (f) $x \leq 8$ (g) $x \geq 3$ (h) $x > 1$ (i) $x < -2$ (j) $x \leq -1$

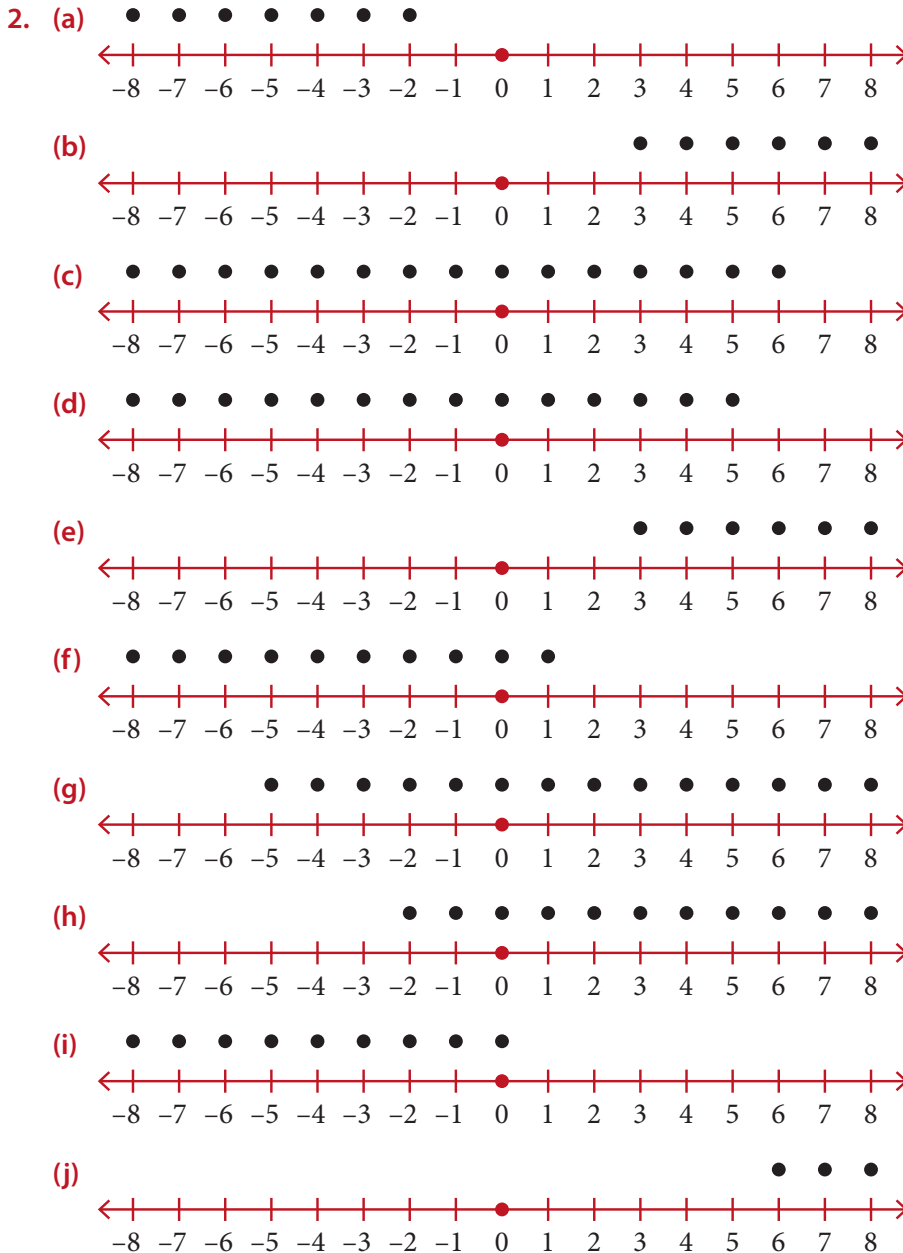


Answers: Exercise 24C



Exercise 24C

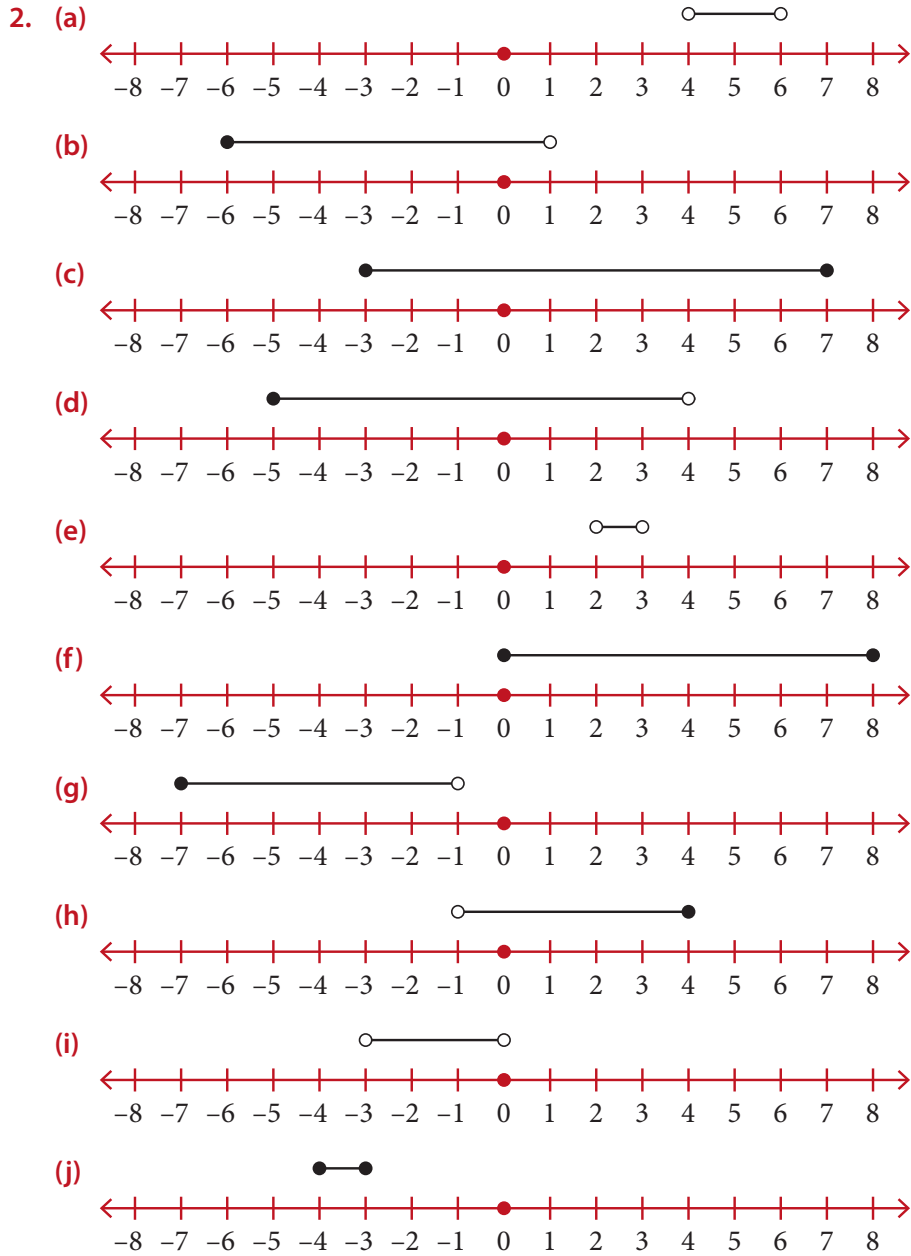
1. (a) $x \leq 2$ or $x < 3$ (b) $x \geq -1$ or $x > -2$ (c) $x \leq 5$ or $x < 6$ (d) $x \geq -5$ or $x > -6$
 (e) $x \leq -3$ or $x < -2$ (f) $x \geq 4$ or $x > 3$ (g) $x \geq -6$ or $x > -7$ (h) $x \geq -3$ or $x > -4$
 (i) $x \leq 7$ or $x < 8$ (j) $x \geq -7$ or $x > -8$



Answers: Exercise 24D

Exercise 24D

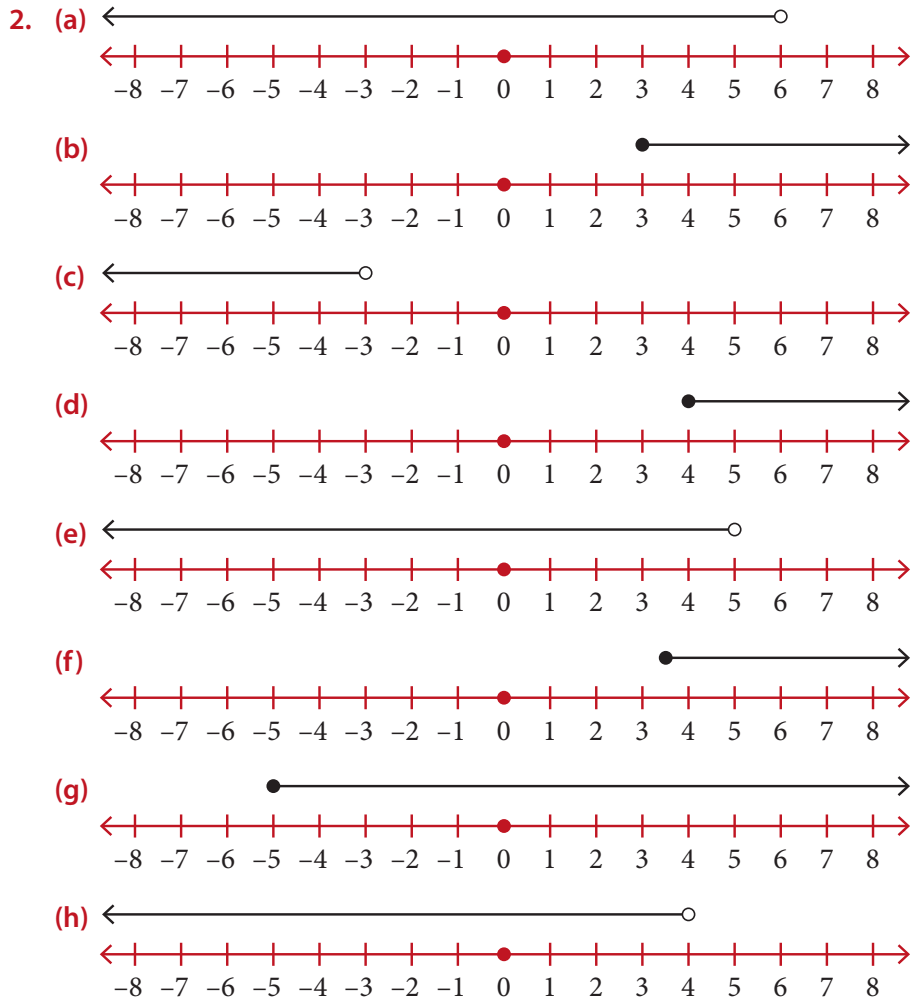
1. (a) $-6 \leq x \leq 4$ or $-7 < x < 5$ (b) $-2 < x \leq 7$ (c) $-7 \leq x \leq -4$ or $-8 < x < -3$
 (d) $-4 \leq x \leq 2$ (e) $-1 < x \leq 6$ (f) $0 \leq x \leq 5$ or $-1 < x < 6$
 (g) $-6 \leq x < 6$ (h) $0 < x \leq 5$ (i) $-1 \leq x \leq 7$ or $-2 < x < 8$
 (j) $-4 < x < 4$



Answers: Exercise 24E

Exercise 24E

1. (a) $x < 8$ (b) $x \geq 4$ (c) $x < 0.5$ (d) $x \leq 11$ (e) $x < 5$
 (f) $x \leq 7$ (g) $x < 7$ (h) $x \geq 6$ (i) $x < -2$ (j) $3 > x$ or $x < 3$



Progress Review

Progress Review (Chapters 21 to 24)

1. (a) Nine Hundred / 900 (b) Fifty / 50 (c) Ninety / 90
 (d) Five / 5 (e) Fifty / 50
2. (a) 34 (b) 870 (c) 515 (d) 607 (e) 25
3. (a) 119 (b) 126 (c) 81 (d) 410 (e) 257
4. (a) seven hundred thousand / 700 000 (b) five / 5 (c) three hundred / 300
 (d) forty million / 40 000 000 (e) twenty / 20
5. (a) thirty / 30 (b) three / 3 (c) three hundred thousand / 300 000
 (d) thirty / 30 (e) three hundred / 300
6. (a) two tenths / $\frac{2}{10}$ (b) two hundred / 200 (c) two ten thousandths / $\frac{1}{10\ 000}$
 (d) two hundred / 200 (e) two thousandths / $\frac{2}{1000}$

7.

Decimal	Binary
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16	10000

8. (a) 10 (b) 25 (c) 21 (d) 31 (e) 19
9. (a) 45 (b) 51 (c) 46 (d) 62 (e) 63
10. (a) 11000 (b) 101001 (c) 111110 (d) 111001 (e) 11011
11. (a) 100101 (b) 100111 (c) 110111 (d) 111100 (e) 110001
12. Only (d) $10100 = 20$ can be divided by $101 = 5$
13. Only (c) $11100 = 28$ can be divided by $111 = 7$
14. (a) 4^{11} (b) 7^6 (c) $5^5 \times 6^5$ (d) $2^3 \times 3^4 \times 4^3$ (e) $9^6 \times 11^5$
15. (a) $8 \times 8 \times 8 \times 8 \times 8$ (b) $3 \times 3 \times 3$ (c) 12×12 (d) $13 \times 13 \times 13 \times 13 \times 13 \times 13 \times 13$
 (e) $9 \times 9 \times 9 \times 9 \times 9 \times 9$

Answers: Progress Review (Chapters 21 to 24)

- 16.** (a) 64 (b) 0 (c) 50 (d) 113 (e) 89
17. (a) q^7 (b) x^{10} (c) p^{11} (d) t^4 (e) k^5
18. (a) $35pq$ (b) $20x^2$ (c) $108w^3$ (d) $56m^2n$ (e) $40r^2t^2$
19. (a) x^3 (b) p^3 (c) $9x^3$ (d) $2y$ (e) $\frac{2}{3}r^3$
20. (a) $120x^2y^2$ (b) $7x^3y^4$ (c) $315x^5y^5$ (d) $9x^5y^2$ (e) $2y^2$

21. $(6x^2)^2 = 6x^2 \times 6x^2 = 36 \times x \times x \times x \times x = 36x^4$, so Harry is right. Tom and Dick are wrong.

22. The 3 laws of indices are:

(a) $x^p \times x^q = x^{(p+q)}$ (b) $x^p \div x^q = x^{(p-q)}$ (c) $(x^p)^q = x^{pq}$

- 23.** (a) x^9 (b) y^9 (c) p^9 (d) q^{11} (e) r^7
24. (a) x^5 (b) y^5 (c) p^4 (d) q (e) r^4
25. (a) x^6 (b) y^6 (c) p^{32} (d) q^{15} (e) r^{21}
26. (a) $18x^{10}$ (b) $48t^5$ (c) $96p^5$ (d) $18q^{16}$ (e) $7r^5$
27. (a) x (b) $5y^3$ (c) $2p^2$ (d) $54q$ (e) $4x^4$

28.

Guess	Square of guess	Too small / big?
6	36	Too small
6.7	44.89	Too small
6.8	46.24	Too big
6.75	45.56	Too big

Answer = 6.7 to 1 decimal place

29. (a)

Guess	Use the guess for x to evaluate the expression $x^2 + 4x$	Too small / big?
2	12	Too small
2.2	13.64	Too small
2.3	14.49	Too big
2.25	14.06	Too big

Answer = 2.2 to 1 decimal place

(b)

Guess	Use the guess for x to evaluate the expression $x^3 - x$	Too small / big?
3.2	29.57	Too small
3.3	32.64	Too big
3.25	31.08	Too big

Answer = 3.2 to 1 decimal place

Answers: Progress Review (Chapters 21 to 24)

(c)

Guess	Use the guess for x to evaluate the expression $x^2 - 2x$	Too small / big?
6	24	Too small
6.1	25.01	Too small
6.2	26.04	Too big
6.15	25.52	Too small

Answer = 6.2 to 1 decimal place

30. Triangle area = $\frac{1}{2}$ length \times perpendicular height

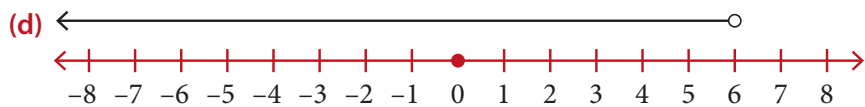
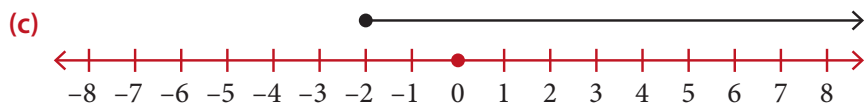
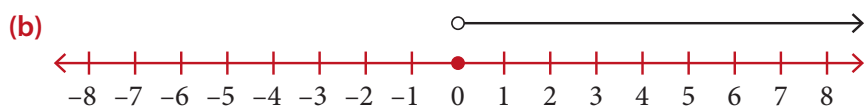
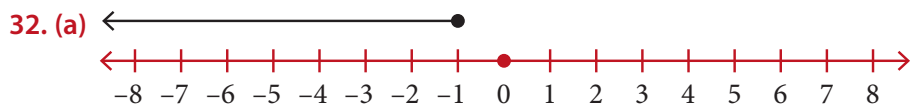
$$7 = \frac{1}{2}x(x - 3)$$

$$\text{So: } 14 = x^2 - 3x$$

Guess	Use the guess for x to evaluate the expression $x^2 - 3x$	Too small / big?
5	10	Too small
6	18	Too big
5.5	13.75	Too small
5.6	14.56	Too big
5.55	14.15	Too big

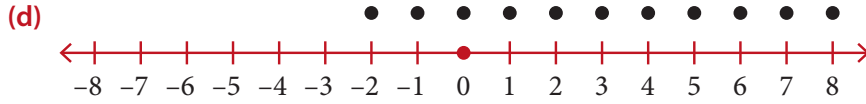
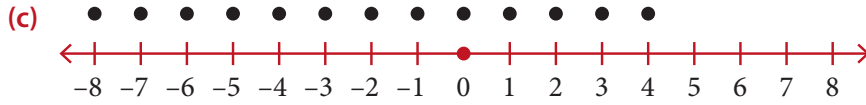
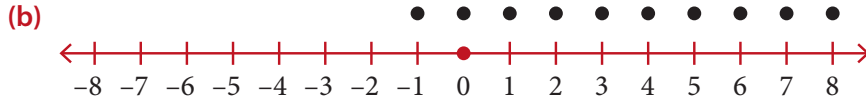
Answer = 5.5 cm to 1 decimal place

31. (a) $x \leq 0$ (b) $x \geq -3$ (c) $x > -7$ (d) $x < 4$



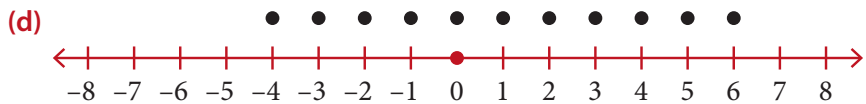
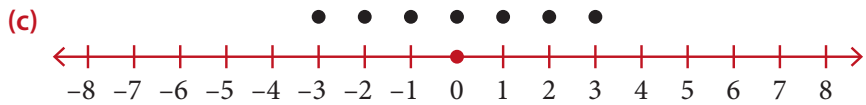
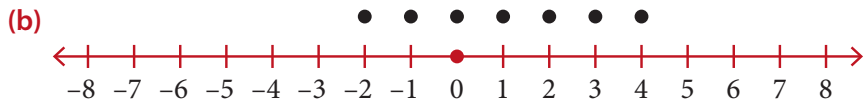
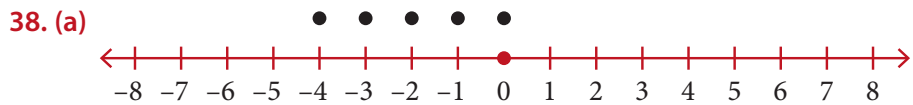
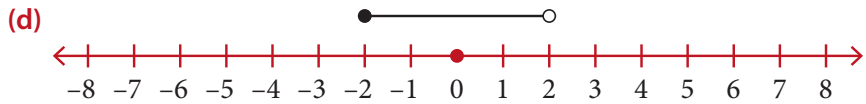
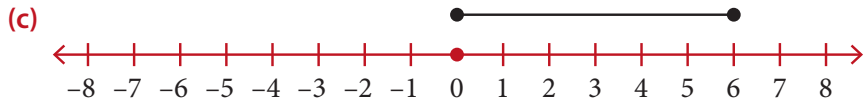
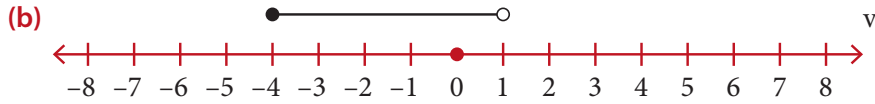
33. (a) $x \leq 1$ or $x < 2$ (b) $x \geq -1$ or $x > -2$ (c) $x \leq 7$ or $x < 8$ (d) $x \geq -3$ or $x > -4$

Answers: Progress Review (Chapters 21 to 24)



35. (a) $-3 \leq x \leq 5$ or $-4 < x < 6$ where x is an integer. (b) $-6 < x \leq 7$
 (c) $-2 \leq x \leq 3$ or $-3 < x < 4$ where x is an integer. (d) $-5 \leq x \leq 0$

36. (a) $-5 < x \leq 5$ (b) $0 < x \leq 5$ (c) $0 \leq x \leq 4$ or $-1 < x < 5$ where x is an integer.
 (d) $-3 < x < 2$



Answers: Progress Review (Chapters 21 to 24)

39. (a) $x < 4$

(b) $x \geq 4$

(c) $x < 14$

(d) $x \leq 4.4$

40. (a) $x < 11$

(b) $x \geq 11$

(c) $x > 3$

(d) $x \leq 12$

41. $x > 18$ m

42. $w < 705$ g

43. $p \leq 14$ passengers

Chapter 25: Formulae

Exercise 25A

1. (a) $C = 65n$ (b) $C = 55n + 20$
 2. (a) 8 miles (b) 25 miles

Exercise 25B

1. (a) $x = y - 6$ (b) $x = y + 11$ (c) $x = y - 3$ (d) $x = y - a$ (e) $x = y + b$
 (f) $x = c - y$ (g) $x = \frac{y}{3}$ (h) $x = \frac{y}{b}$ (i) $x = 5y$ (j) $x = py$
2. (a) $a = \frac{b-5}{2}$ (b) $a = \frac{c+4}{5}$ (c) $a = \frac{d-2}{3}$ (d) $a = \frac{f-h}{5}$ (e) $a = \frac{g-j}{3}$
 (f) $a = \frac{k-n}{m}$ (g) $a = \frac{p-q}{r}$ (h) $a = \frac{4-e}{6}$ (i) $a = \frac{5-s}{t}$ (j) $a = \frac{v-u}{w}$
3. (a) $y = \frac{a-6}{3}$ (b) $y = \frac{b-20}{4}$ (c) $y = \frac{c+12}{2}$ (d) $y = \frac{35-d}{5}$ (e) $y = \frac{e-7f}{f}$
 (f) $y = \frac{p-8g}{8}$ (g) $y = \frac{h+9j}{j}$ (h) $y = \frac{4m-k}{m}$
4. (a) $I = M + S$ (b) $S = I - M$
5. $n = \frac{C-2}{4}$
6. (a) $F = PA$ (b) $A = \frac{F}{P}$
7. $L = \frac{P}{4}$
8. (a) $P = 3L$ (b) $L = \frac{P}{3}$
9. (a) $P = 2L + 2W$ (b) (i) $L = \frac{P-2W}{2}$ (ii) $W = \frac{P-2L}{2}$
 (c) $A = LW$ (d) (i) $L = \frac{A}{W}$ (ii) $W = \frac{A}{L}$
10. (a) $C = 10L + 3P$ (b) (i) $L = \frac{C-3P}{10}$ (ii) $P = \frac{C-10L}{3}$

Chapter 26: Sequences

Exercise 26A

- (a) 7, 8 (b) 12, 14 (c) 13, 16 (d) 21, 23
- (a) 26, 25 (b) 15, 10 (c) 12, 10 (d) 37, 34
- (a) 28, 32, 36 (b) 36, 30, 24 (c) 30, 37, 44 (d) 45, 36, 27

Exercise 26B

- 1, 3, 5, 7, 9, 11, 13, 15
- 1, 3, 6, 10, 15, 21, 28, 36, 45, 55
- 1, 4, 9, 16, 25, 36, 49, 64, 81, 100
- 1, 8, 27, 64, 125, 216, 343
- 1, 1, 2, 3, 5, 8, 13, 21, 34, 55

Exercise 26C

- (a) 19, 23 (b) 30, 36 (c) 17, 21 (d) 60, 56 (e) 0, -1
(f) 49, 55 (g) 85, 81 (h) -13, -18
- (a) Step = 11 Terms = 5, 16, 27, 38 (b) 57, 55, 53, 51
(c) Step = -11 Terms = 85, 74, 63, 52 (d) 7, -1, -9, -17
- From 3 to 7 is 2 steps thus step = $4 \div 2 = 2$ Sequence = 3, 5, 7, 9 thus 4th term = 9

Exercise 26D

- (a) $61 + 4n$ (b) $23 + 11n$ (c) $156 - 12n$ (d) $-29 + 4n$ (e) $9.1 + 1.2n$
- (a) $80 - 7n$ (b) $5 - 2n$ (c) $56 - 8n$ (d) $13 - 5n$ (e) $7.5 - 2.1n$
- (a) $5n - 2$; 123 (b) $8 + 6n$; 158 (c) $13 + 10n$; 263 (d) $100 - 2n$; 50 (e) $16 + 9n$; 241
- 40th

Exercise 26E

- (a) 57, 257 (b) 80, 0 (c) 99, 2499 (d) 120, 2600 (e) 23, -97
(f) 98, 2498 (g) -13, -173 (h) 208, 2968
- (a) 29 (b) 225 (c) 100 (d) 55 (e) 82
(f) 3375 (g) 450 (h) 122
- 21st term
- 7th term
- 12th term

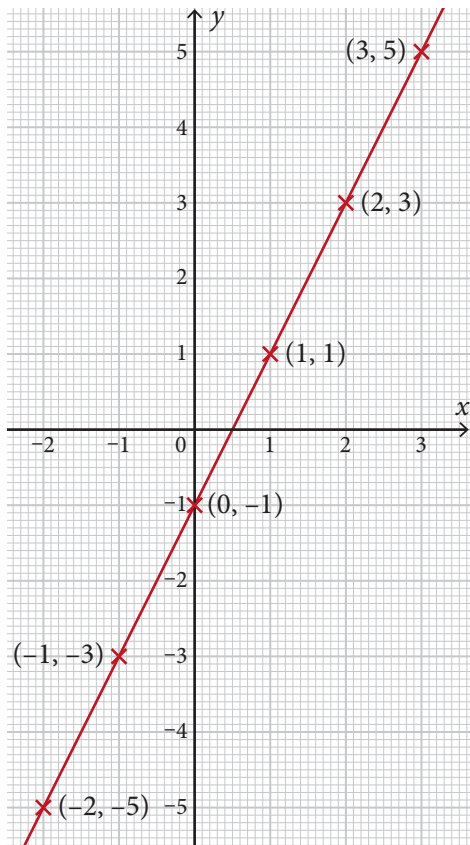
Chapter 27: Graphical Solutions

Exercise 27A

1. (a)

x	-2	-1	0	1	2	3	4
$y = 2x - 1$	-5	-3	-1	1	3	5	7

(b)



Answers: Exercise 27B

Exercise 27B

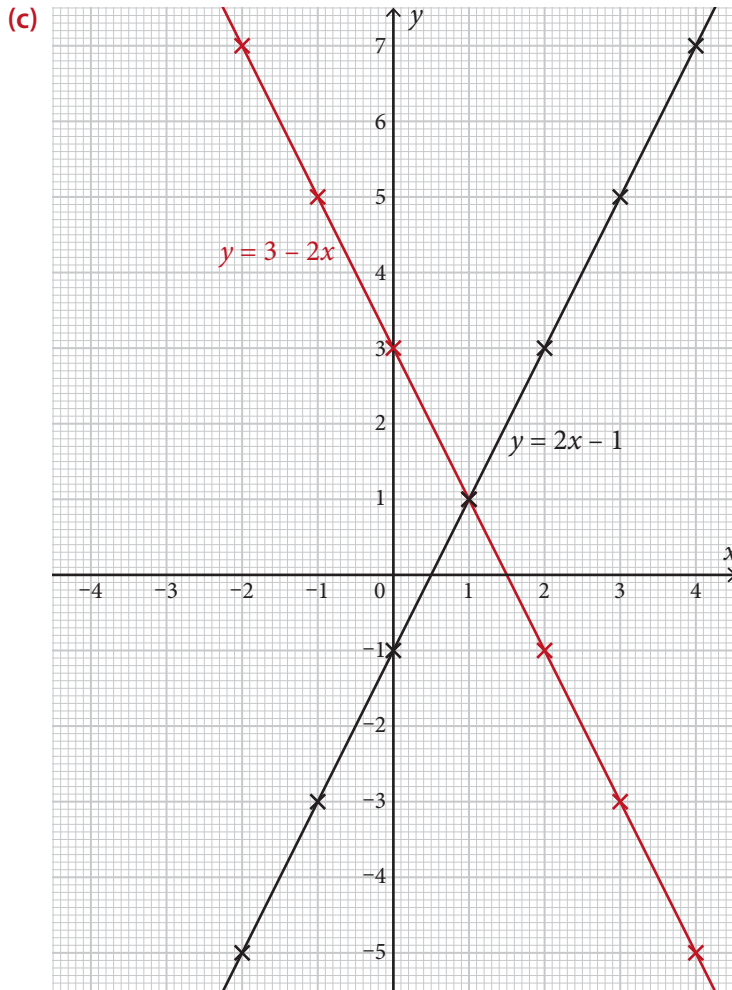
1. (a) $x = 1, y = -1$ (b) $x = 0, y = 1$ (c) $x = -4, y = 3$ (d) $x = -1, y = 3$
 2. The solutions to the simultaneous equations $y = -4x - 5$ and $y = 1.5x + 6$ are $x = -2$ and $y = 3$

3. (a)

x	-2	-1	0	1	2	3	4
$y = 3 - 2x$	7	5	3	1	-1	-3	-5

(b)

x	-2	-1	0	1	2	3	4
$y = 2x - 1$	-5	-3	-1	1	3	5	7



- (d) $x = 1, y = 1$

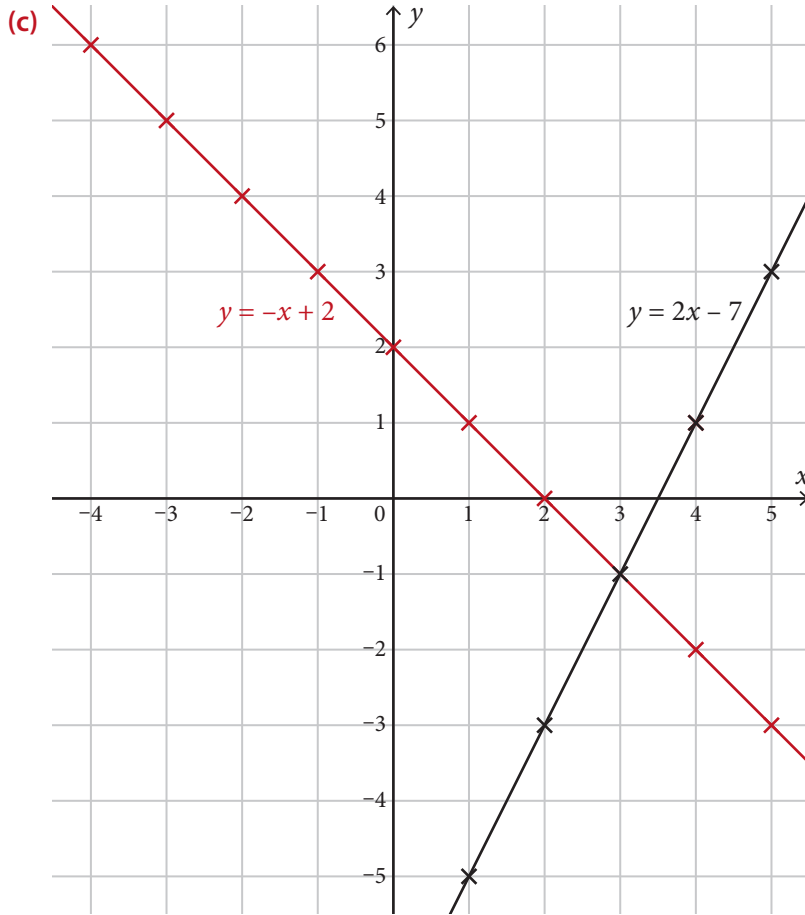
Answers: Exercise 27B

4. (a)

x	-4	-3	-2	-1	0	1	2	3	4	5
$y = -x + 2$	6	5	4	3	2	1	0	-1	-2	-3

(b)

x	1	2	3	4	5
$y = 2x - 7$	-5	-3	-1	1	3



(d) $x = 3, y = -1$

5. $x = 1, y = 3$

6. (a) $x = 2, y = -2$

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

(c) $x = 3, y = 3$

(d) $x = -1, y = 3$

(e) $x = 2, y = 3$

(f) $x = 2, y = 5$

(g) $x = -2, y = 1$

(h) $x = 4, y = 1$

(i) $x = -2, y = 4$

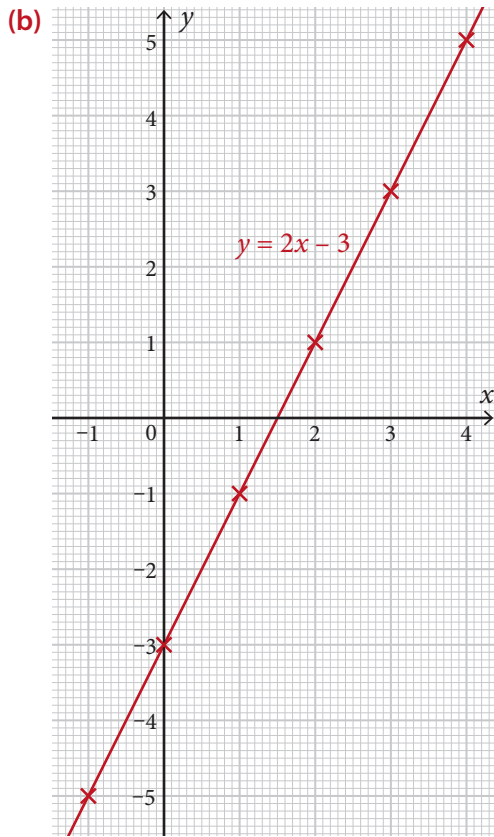
(j) $x = 0, y = -4$

Chapter 28: Quadratic Graphs

Exercise 28A

1. (a)

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



(c) 2

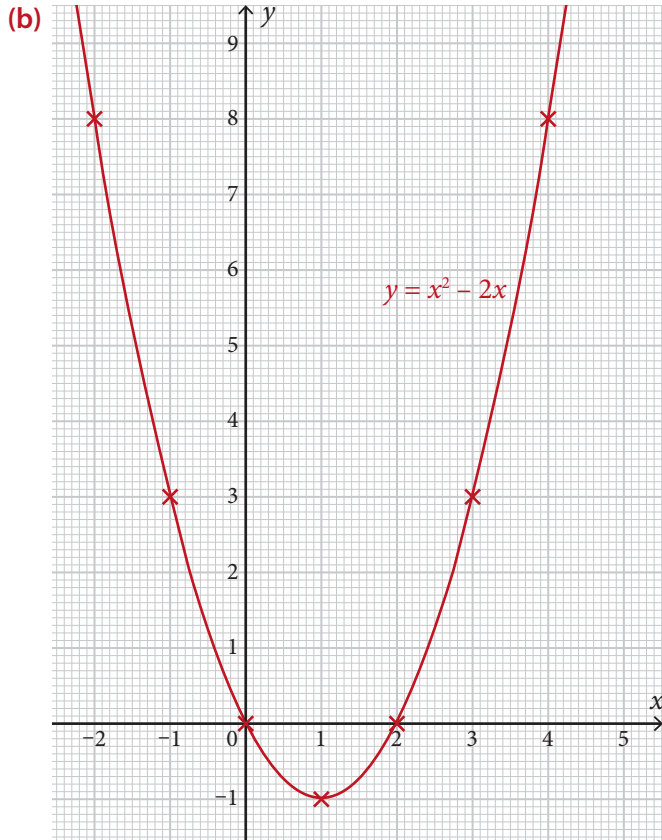
(d) 3.5

Answers: Exercise 28B

Exercise 28B

1. (a)

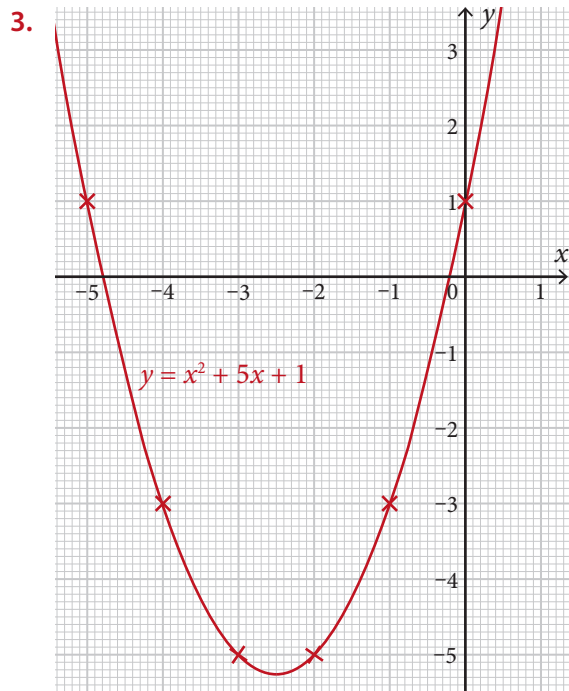
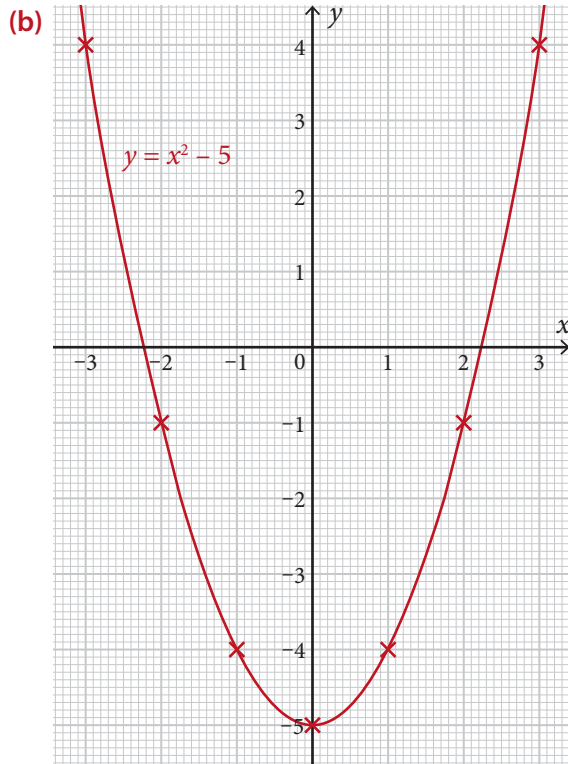
x	-2	-1	0	1	2	3	4
$y = x^2 - 2x$	8	3	0	-1	0	3	8



Answers: Exercise 28B

2. (a)

x	-3	-2	-1	0	1	2	3
$y = x^2 - 5$	4	-1	-4	-5	-4	-1	4

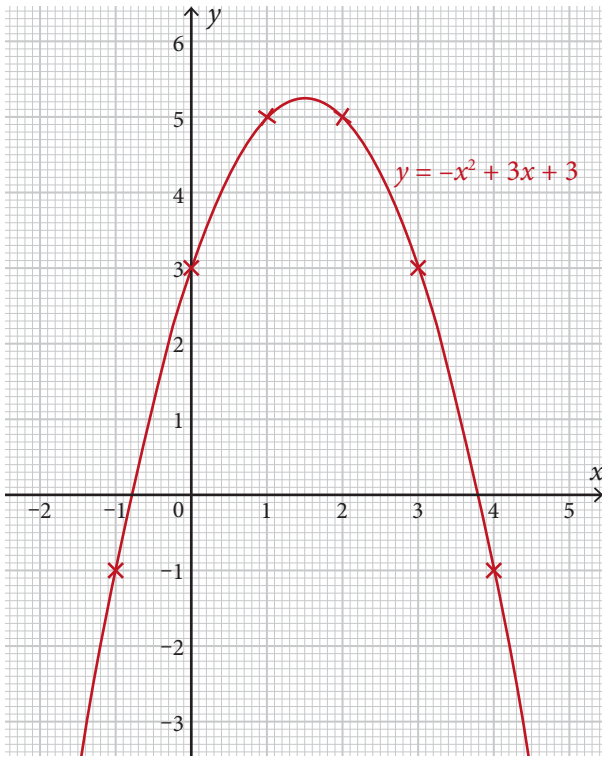


Answers: Exercise 28B

4. (a)

x	-1	0	1	2	3	4
$y = -x^2 + 3x + 3$	-1	3	5	5	3	-1

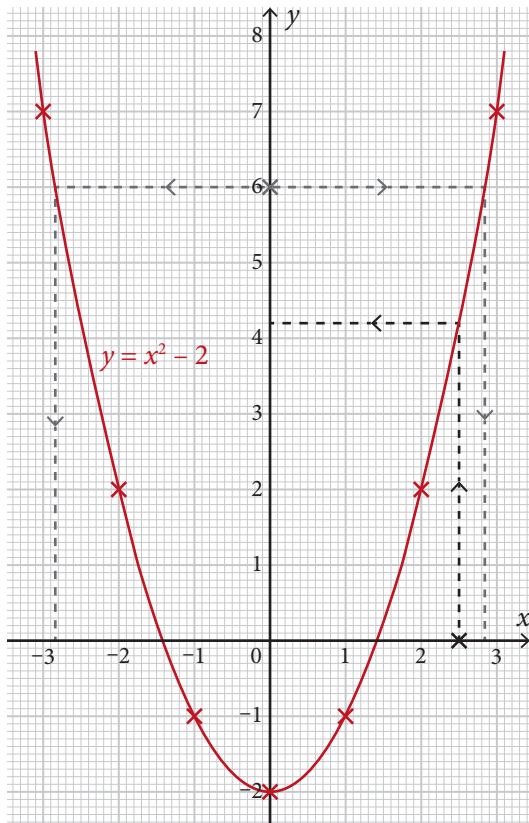
(b)



Exercise 28C

1. (a) -2.3 (accept -2.2) (b) ± 1.2

2. (a)



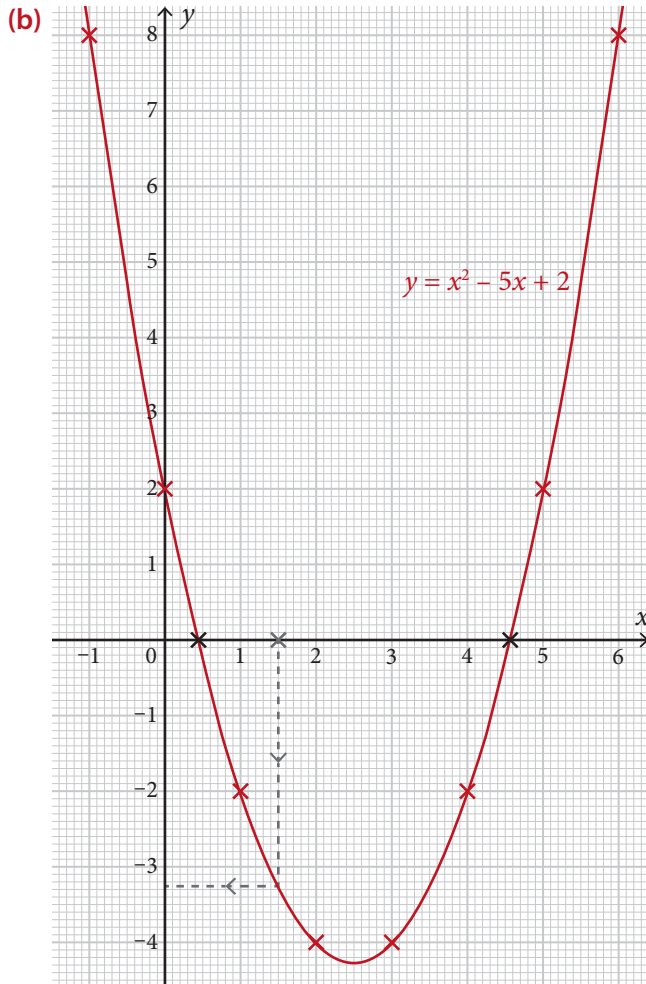
(b) 4.3

(c) ± 2.8

Answers: Exercise 28C

3. (a)

x	-1	0	1	2	3	4	5	6
$y = x^2 - 5x + 2$	8	2	-2	-4	-4	-2	2	8

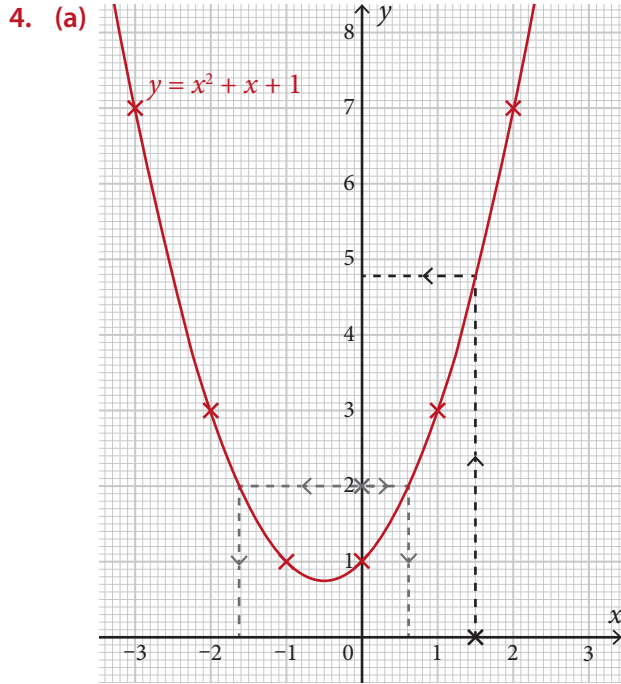


(c) -3.3 (accept -3.2)

(d) 0.4, 4.6

(e) -4.25 (accept answers between -4.2 and -4.3 inclusive)

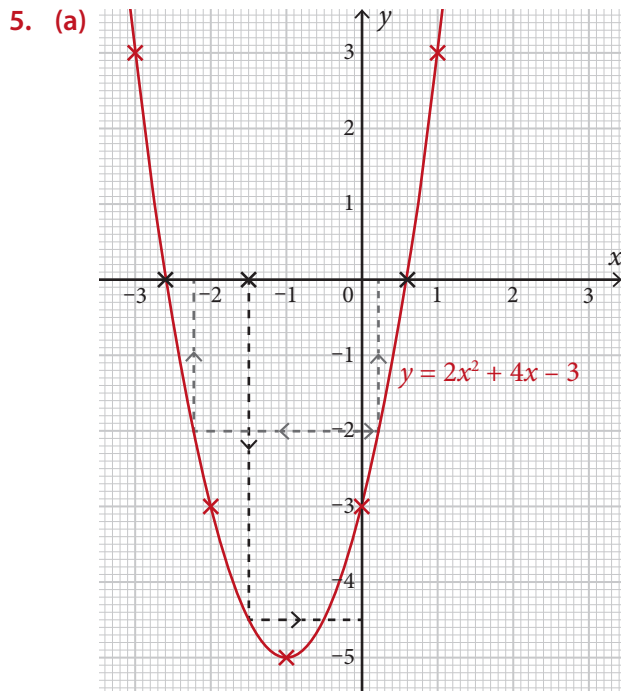
Answers: Exercise 28C



(b) 4.8 (accept 4.7)

(c) -1.6, 0.6

(d) The curve does not intersect the line (the x -axis).



(b) -4.5

(c) -2.2, 0.2

(d) -2.6, 0.6

Progress Review

Progress Review (Chapters 25 to 28)

1. (a) $x = y - 8$ (b) $x = y + 9$ (c) $x = y - 7$ (d) $x = y - p$ (e) $x = y + q$
 (f) $x = s - y$ (g) $x = \frac{y}{5}$ (h) $x = \frac{y}{t}$ (i) $x = 3y$ (j) $x = uy$
2. (a) $b = \frac{a-7}{2}$ (b) $b = \frac{k+9}{5}$ (c) $b = \frac{s-2}{10}$ (d) $b = \frac{q-r}{3}$ (e) $b = \frac{v-w}{8}$
 (f) $b = \frac{c-e}{d}$ (g) $b = \frac{m-n}{p}$ (h) $b = \frac{2-f}{11}$ (i) $b = \frac{15-t}{u}$ (j) $b = \frac{h-g}{j}$
3. (a) $z = \frac{m-6}{2}$ (b) $z = \frac{n-20}{5}$ (c) $z = \frac{p+12}{6}$ (d) $z = \frac{56-q}{7}$ (e) $z = \frac{r-9s}{s}$
 (f) $z = \frac{t-10u}{u}$ (g) $z = \frac{v+w}{w}$ (h) $z = \frac{14y-x}{y}$
4. $M = \frac{P-500}{1000}$
5. (a) $P = 5S$ (b) $S = \frac{P}{5}$
6. (a) $C = 3p + 2$ (b) $p = \frac{C-2}{3}$
7. (a) $T = 6l + 1.5$ (b) $l = \frac{T-1.5}{6}$
8. (a) 17, 20, 23 (add 3) (b) 160, 190, 220 (add 30) (c) 22, 20, 18 (subtract 2)
 (d) 6, 10, 14 (add 4) (e) -40, -46, -52 (subtract 6)
9. (a) 14 (b) 16 (c) -11 (d) 16.5 (e) -60
10. (a) $5n$ (b) $20n$ (c) $-4n$ (d) $1.5n$
11. (a) $6n - 1$ (b) $10n + 1$ (c) $13n - 1$ (d) $-6n + 1$ (e) $15n - 1$
12. (a) (i) Triangular numbers (ii) Square numbers (iii) Cube numbers
 (b) (i) 21 (ii) 36 (iii) 125
13. (a) $10n + 1 = 59 \Rightarrow 10n = 58 \Rightarrow n = 5.8$, which is not an integer, so 59 is not in the sequence.
 (b) $-7n + 1 = -83 \Rightarrow -7n = -84 \Rightarrow n = 12$, which is an integer, so -83 is the 12th term in the sequence.
14. (a) 9, 10, 11, 12, 13 (b) -6, -5, -4, -3, -2
15. (a) 24, 48 (b) 256, 1024 (c) -81, -243 (d) 2, 4 (e) 16, 8
16. (a) Add 3 (b) Divide by 2 (or halve, or multiply by 0.5)
 (c) Subtract 4 (d) Multiply by -2 (e) Subtract 2

17.

1, 3, 5, 7, 9, ...	$n^2 - 1$
$-\frac{1}{2}, -1, -1\frac{1}{2}, -2, -2\frac{1}{2}, \dots$	$2n - 1$
3, 6, 9, 12, 15, ...	$-\frac{1}{2}n$
0, 3, 8, 15, 24, ...	$n - 3$
-2, -1, 0, 1, 2, ...	$3n$

18. (a)

Number of hours	1	2	3	4	5
Cost C (£)	80	120	160	200	240

- (b) £320 (c) 9 hours (d) $C = 40n + 40$

Answers: Progress Review (Chapters 25 to 28)



(b)

Pattern number n	1	2	3	4
Number of matchsticks m	5	9	13	17

(c) 12 (d) $m = 4n + 1$

(e) $4n + 1 = 35 \Rightarrow 4n = 34 \Rightarrow n = 8.5$

Since 8.5 is not an integer, 35 is not a term in this sequence.

So, Laura cannot use all 35 matches for a pattern in this sequence.

20. (a) $x = -4, y = 3$

(b) The solutions to the simultaneous equations $y = 2x + 2$ and $y = -x - 1$ are $x = -1$ and $y = 0$

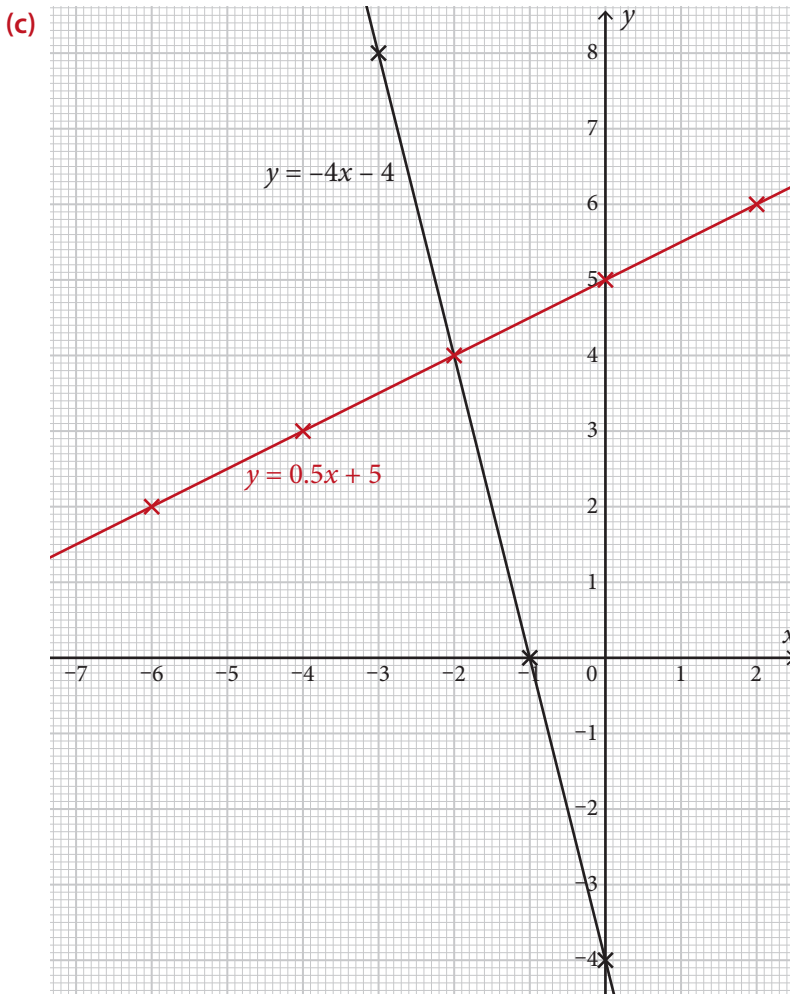
(c) The solutions to the simultaneous equations $y = 2x + 2$ and $y = -\frac{1}{4}x + 2$ are $x = 0$ and $y = 2$

21. (a)

x	-6	-4	-2	0	2
$y = \frac{1}{2}x + 5$	2	3	4	5	6

(b)

x	-3	-2	-1	0
$y = -4x - 4$	8	4	0	-4



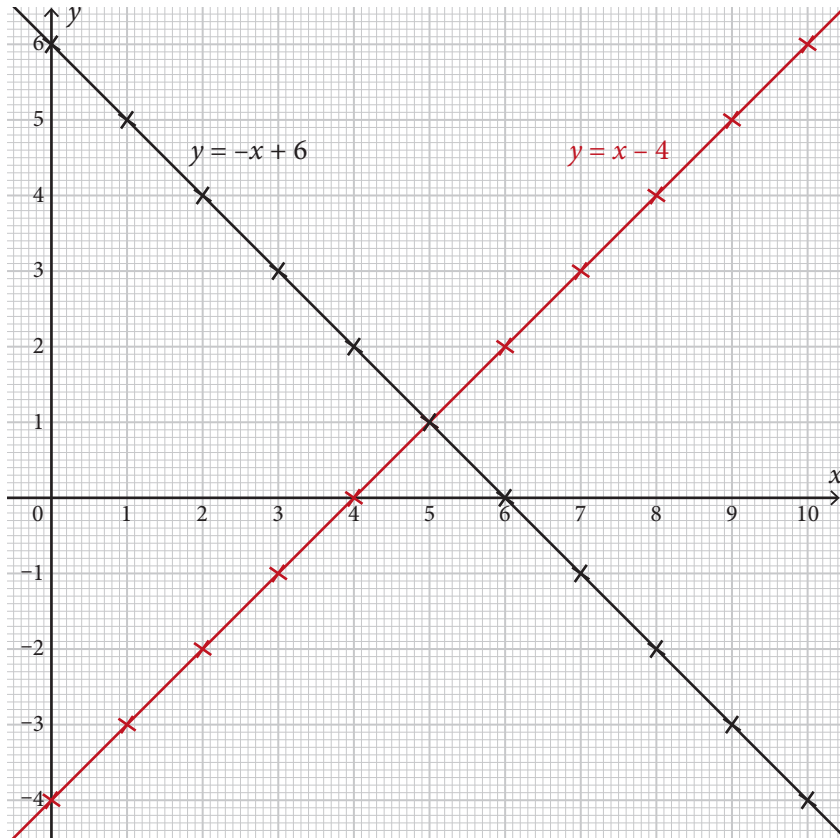
(d) $x = -2, y = 4$

Answers: Progress Review (Chapters 25 to 28)

22. (a)

x	0	1	2	3	4	5	6	7	8
$y = x - 4$	-4	-3	-2	-1	0	1	2	3	4
$y = 6 - x$	6	5	4	3	2	1	0	-1	-2

(b)



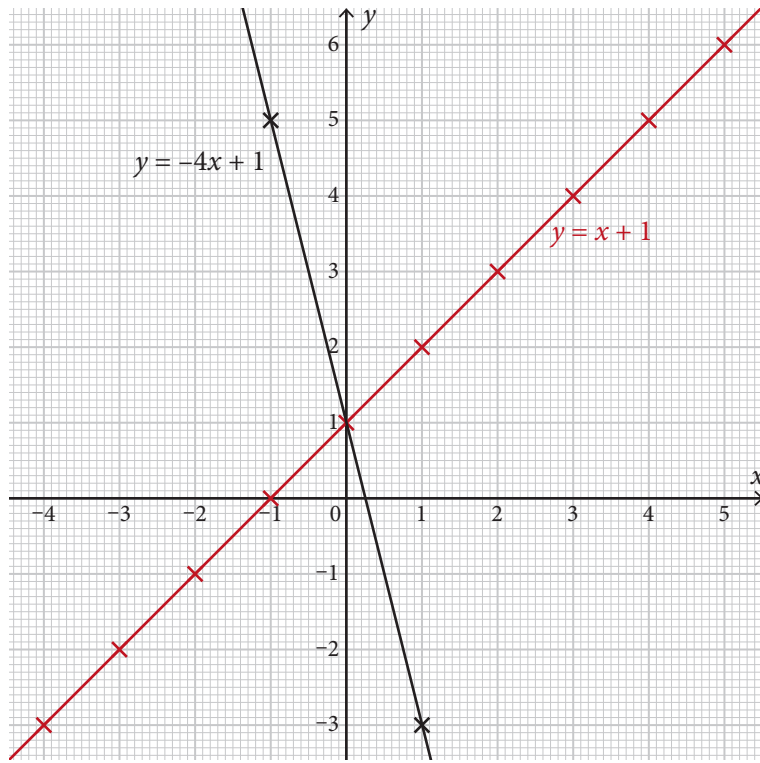
Solution: $x = 5, y = 1$

Answers: Progress Review (Chapters 25 to 28)

23. (a)

x	-3	-2	-1	0	1	2	3	4	5	6
$y = x + 1$	-2	-1	0	1	2	3	4	5	6	7
$y = 1 - 4x$	13	9	5	1	-3	-7	-11	-15	-19	-23

(b)



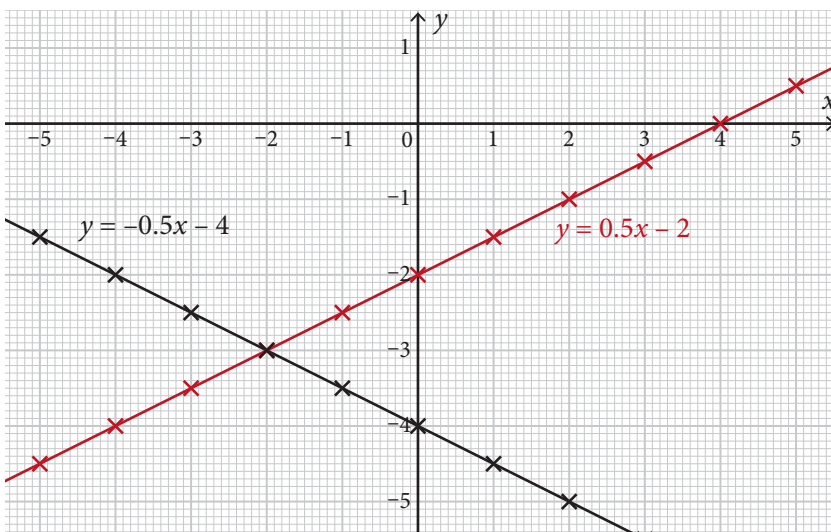
Solution: $x = 0, y = 1$

Answers: Progress Review (Chapters 25 to 28)

24. (a)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
$y = \frac{1}{2}x - 2$	-4.5	-4	-3.5	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5
$y = -\frac{1}{2}x - 4$	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5

(b)

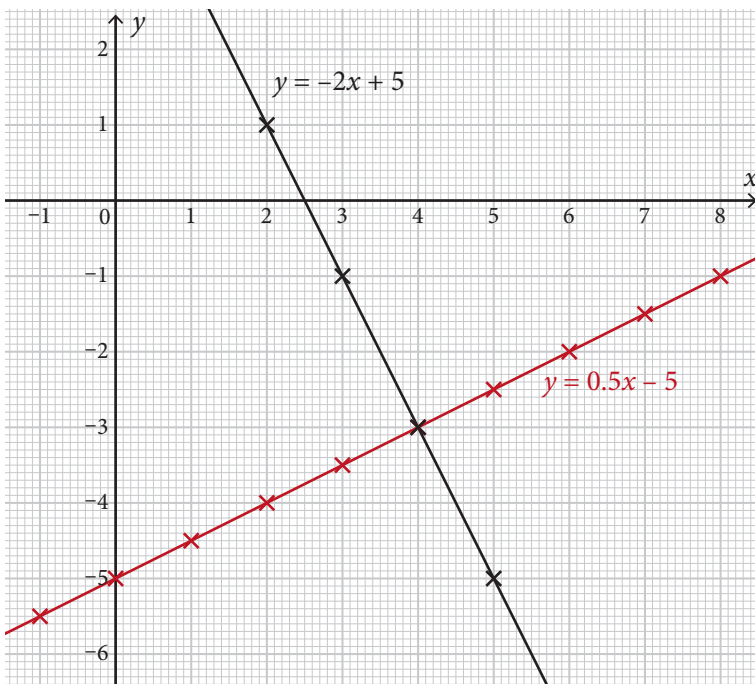


Solution: $x = -2, y = -3$

25. (a)

x	-1	0	1	2	3	4	5	6	7	8
$y = \frac{1}{2}x - 5$	-5.5	-5	-4.5	-4	-3.5	-3	-2.5	-2	-1.5	-1
$y = -2x + 5$	7	5	3	1	-1	-3	-5	-7	-9	-11

(b)

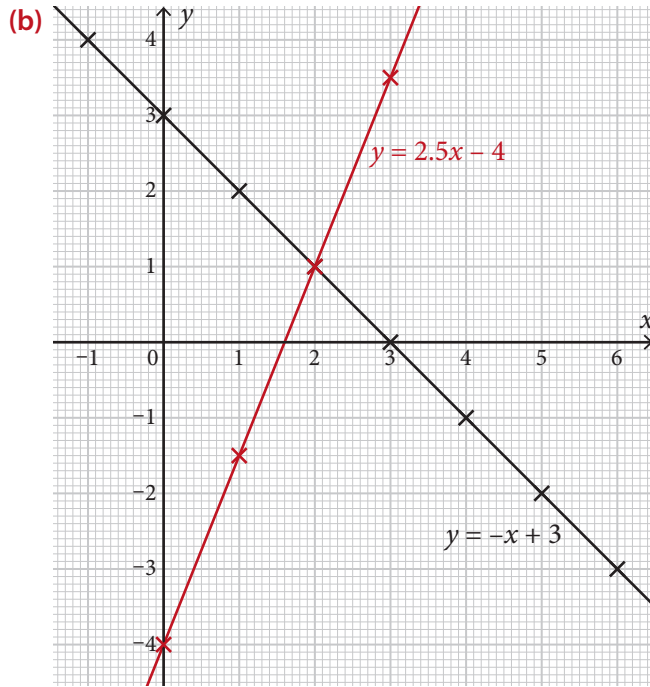


Solution: $x = 4, y = -3$

Answers: Progress Review (Chapters 25 to 28)

26. (a)

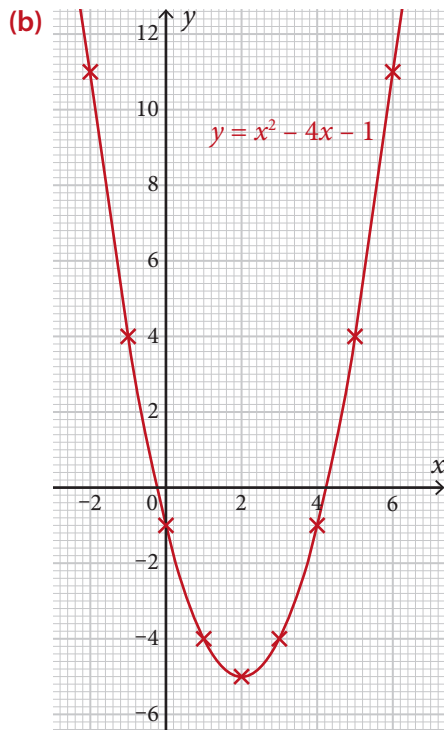
x	-1	0	1	2	3	4	5	6
$y = 2.5x - 4$	-6.5	-4	-1.5	1	3.5	6	8.5	11
$y = 3 - x$	4	3	2	1	0	-1	-2	-3



Solution: $x = 2, y = 1$

27. (a)

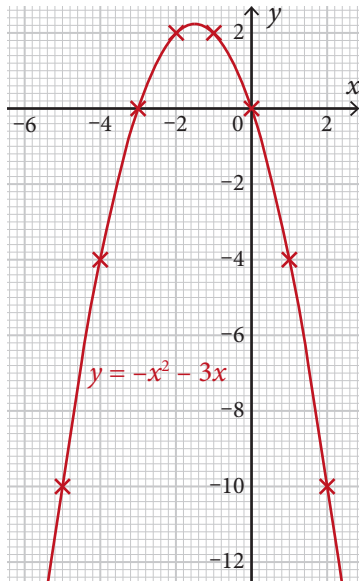
x	-2	-1	0	1	2	3	4	5	6
$y = x^2 - 4x - 1$	11	4	-1	-4	-5	-4	-1	4	11



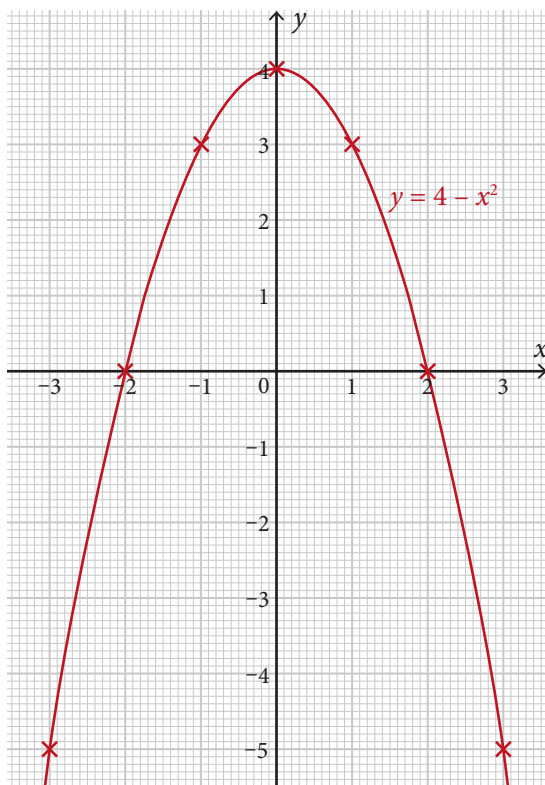
Answers: Progress Review (Chapters 25 to 28)

28.

x	-5	-4	-3	-2	-1	0	1	2
$y = -x^2 - 3x$	-10	-4	0	2	2	0	-4	-10



29. (a)



(b) 1.8

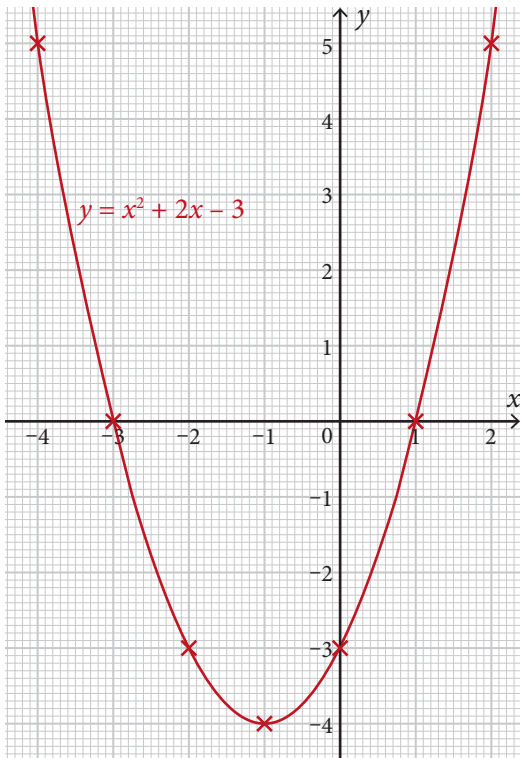
(c) ± 2.4 (accept ± 2.5)

Answers: Progress Review (Chapters 25 to 28)

30. (a)

x	-4	-3	-2	-1	0	1	2
$y = x^2 + 2x - 3$	5	0	-3	-4	-3	0	5

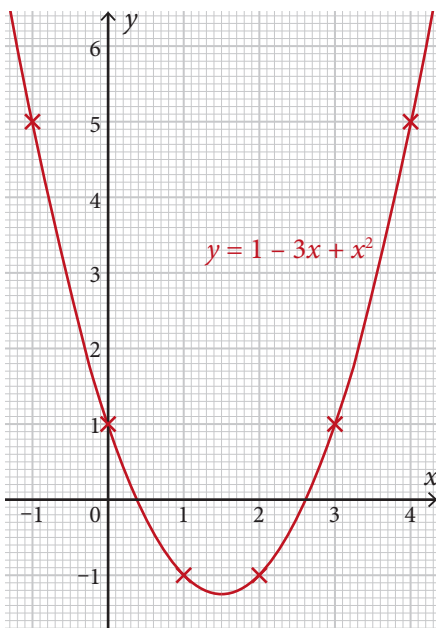
(b)



(c) -1.8 (accept -1.7)

(d) 1.2, -3.2

31. (a)

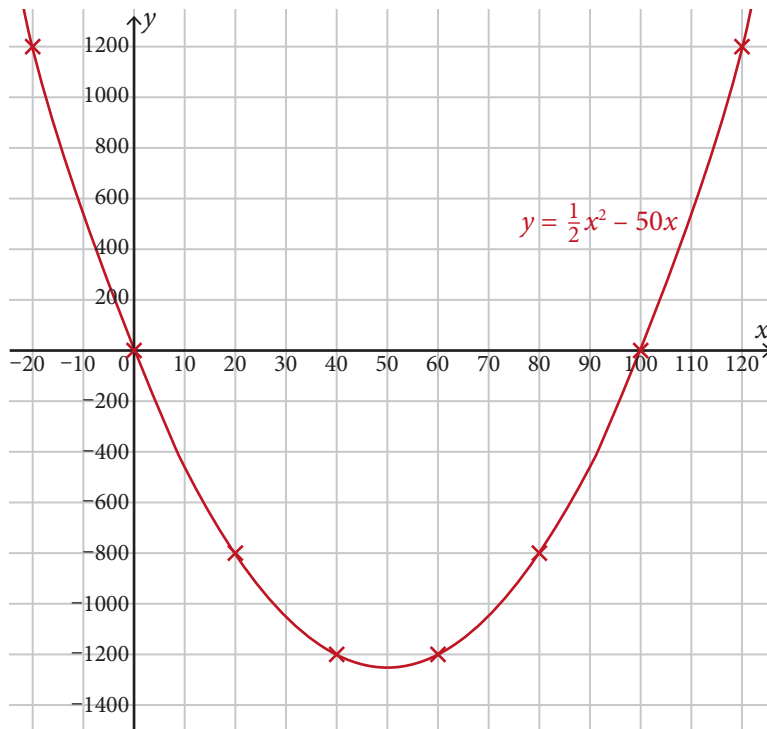


(b) 2.8

(c) $x = 0.4, 2.6$

(d) -1.25 (accept -1 to -1.5 exclusive)

32. (a)



(b) (i) -11, 111 (accept ± 3 for both) (ii) 11 and 89 (accept ± 3 for both)

Chapter 29: Bearings

Exercise 29A

1. (a) $x = 63^\circ$ (b) $x = 146^\circ$; $y = 34^\circ$

2.

	Original Direction	Action	Final Direction
(a)	W	$\frac{1}{4}$ turn clockwise	N
(b)	E	$\frac{1}{4}$ turn anticlockwise	N
(c)	NW	$\frac{1}{2}$ turn	SE
(d)	SE	$\frac{1}{4}$ turn clockwise	SW

3. $a = 57^\circ$ (alternate angles)
 $b = 123^\circ$ (angle on a straight line with , or supplementary with 57°)
 $c = 71^\circ$ (corresponding with 71°)
 $d = 28^\circ$ (vertically opposite)

4. (a) 5 km (b) 3 cm

Exercise 29B

1. (a) 082° (b) 114° (c) 122° (d) 209° (e) 283°
 (f) 255° (g) 215° (h) 085°
2. (a) 213° (b) 087° (c) 039° (d) 351° (e) 141°
 (f) 066° (g) 199° (h) 315° (i) 178° (j) 329°

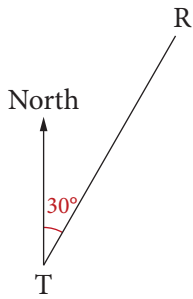
Exercise 29C

1. (a) Bearing 060° , Distance 30 km (b) Bearing 120° , Distance 20 km
 (c) Bearing 270° , Distance 80 km (d) Bearing 330° , Distance 30 km
 (e) Bearing 150° , Distance 35 km (f) Bearing 300° , Distance 15 km
2. (a) 045° (b) 030° (c) 297° (d) 236°

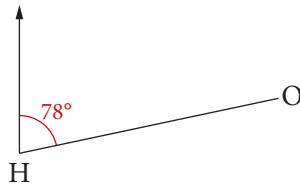
Answers: Exercise 29D

Exercise 29D

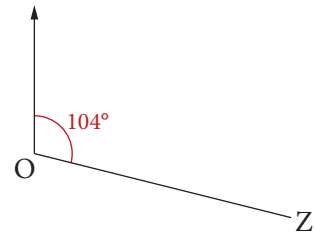
1. (a)



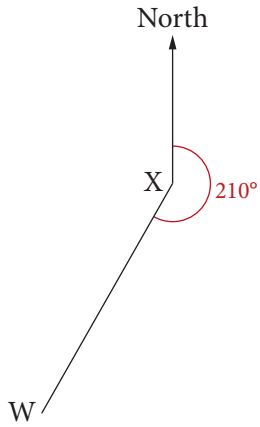
(b) North



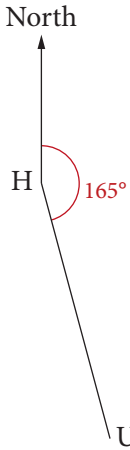
(c) North



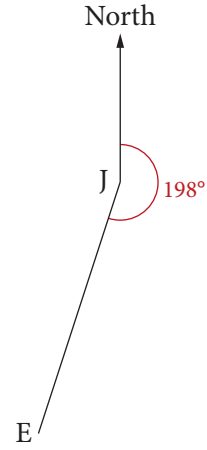
(d)



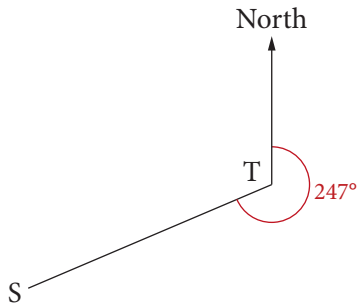
(e) North



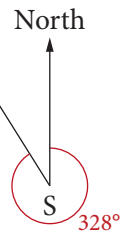
(f)



(g)

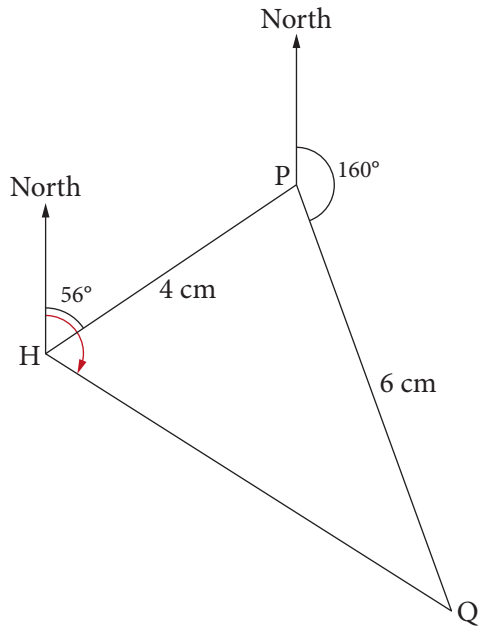


(h) Z



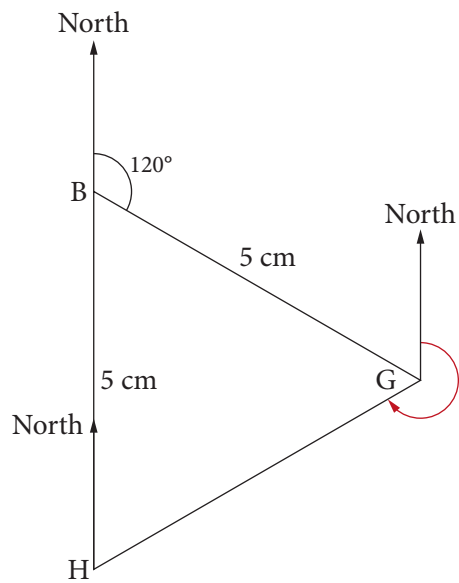
Answers: Exercise 29D

2. (a)



(b) (i) 63.6 km (to 1 d.p.) or 64 km (to nearest km) **(ii)** 122°

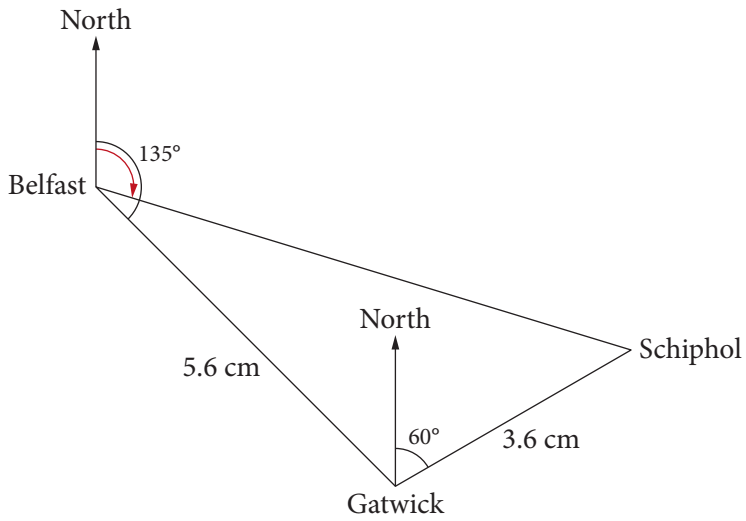
3. (a)



(b) (i) 5 km **(ii)** 240°

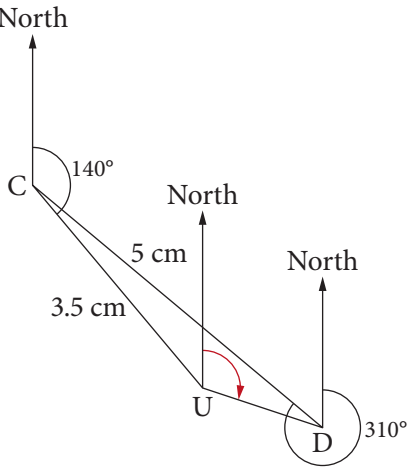
Answers: Exercise 29D

4. (a)



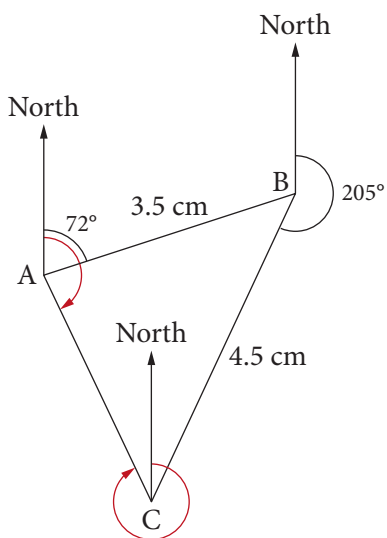
(b) (i) 740 km (ii) 107°

5. (a)



(b) 16.7 km (to 1 d.p.) or 17 km (to nearest km); 109°

6. (a)



(b) (i) 10 km (to nearest km) (ii) 155° (iii) 335°

Chapter 30: Polygons

Exercise 30A

- (a) 107° (b) 35° (c) 64° (d) 42° (e) 86°
- (a) 8 (b) 5 (c) 6 (d) 7 (e) 10
(f) 9
- $a = 38^\circ, b = 54^\circ, c = 126^\circ$

Exercise 30B

- (a) 4 (b) 720°
- (a) 2 (b) 360°
- (a) 6 (b) 1080°
- (a) Jake is not right. An 8-sided polygon can be divided into 6 triangles. The sum of the interior angles is $6 \times 180 = 1080^\circ$, which is not double 360°
(b) 10

Exercise 30C

- (a) 120° (b) 90° (c) 72° (d) 60°
- 36
- (a) 56° (b) 137° (c) 85° (d) 64°

Exercise 30D

- (a) 108° (b) 120° (c) 144° (d) 160°
- 9
- (a) 24° (b) 15
- (a) 3 (b) Equilateral triangle
- Yes. The exterior angle would be 45° $n = \frac{360}{45} = 8$, so the polygon has 8 sides. (It is a regular octagon.)
- No. The exterior angle would be 50° $n = \frac{360}{50} = 7.2$ It is not possible for a polygon to have 7.2 sides.
- (a) $90^\circ, 120^\circ, 140^\circ$ (b) No. $90 + 120 + 140 = 350^\circ$ not 360° , so there is a gap of 10°

Exercise 30E

- (a) 360° (b) 1080° (c) 1260° (d) 1440°
- 17
- 13
- 16
- 900°
- (a) 720° (b) 101°
- 18000°

Answers: Exercise 30F

Exercise 30F

- (a) $a = 82^\circ, b = 48^\circ, c = 34^\circ, d = 146^\circ$
(b) $a = 79^\circ, b = 72^\circ, c = 66^\circ, d = 73^\circ, e = 107^\circ$
(c) $a = 38^\circ, b = 137^\circ, c = 102^\circ, d = 101^\circ, e = 79^\circ$
(d) $a = 93^\circ, b = 66^\circ, c = 102^\circ$
(e) $a = 19^\circ, b = 55^\circ, c = 149^\circ, d = 43^\circ, e = 102^\circ, f = 78^\circ$
- 68°
- Regular octagon angle = 135°, regular pentagon angle = 108°
 $a = 117^\circ, b = 49^\circ$
- 384°

Chapter 31: Symmetry and Transformations

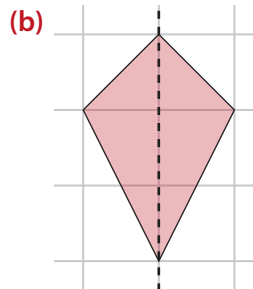
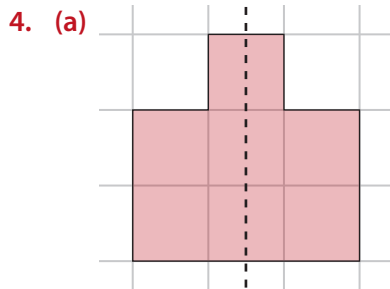
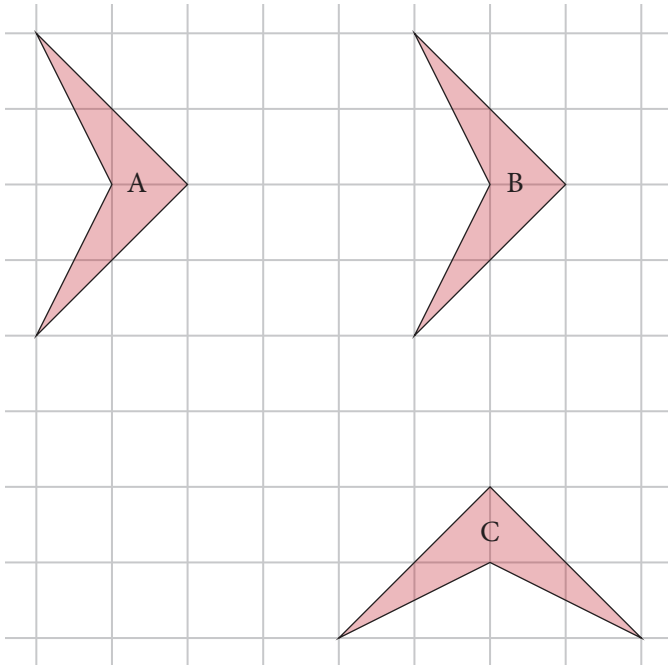
Exercise 31A



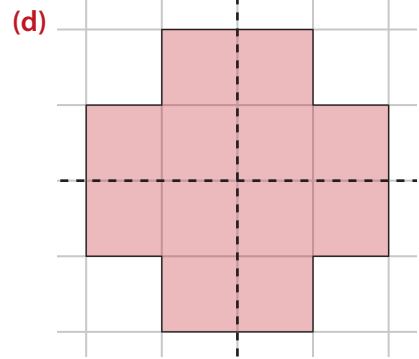
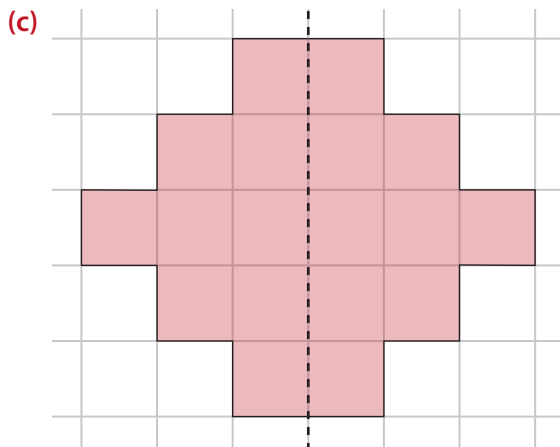
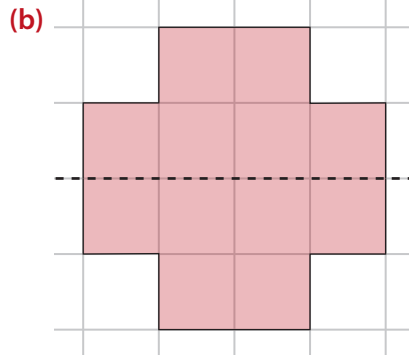
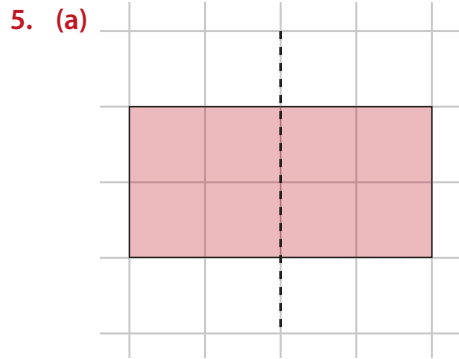
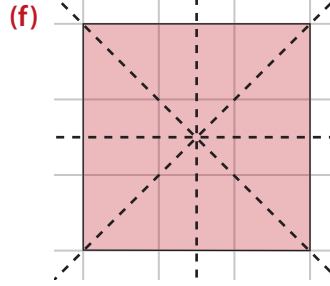
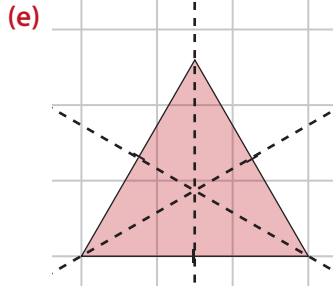
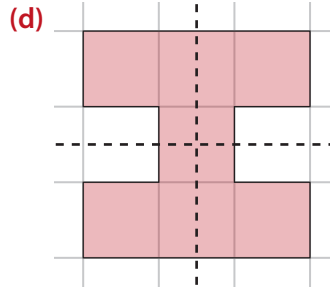
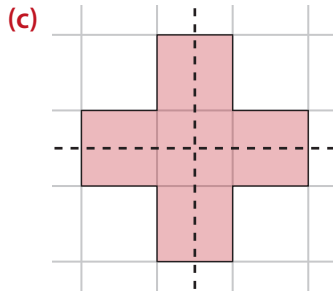
2. (a) (i) Yes (ii) Yes (b) 4

Exercise 31B

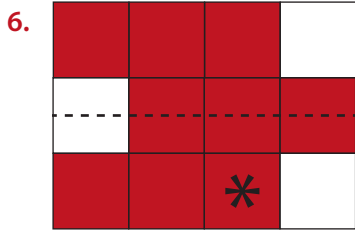
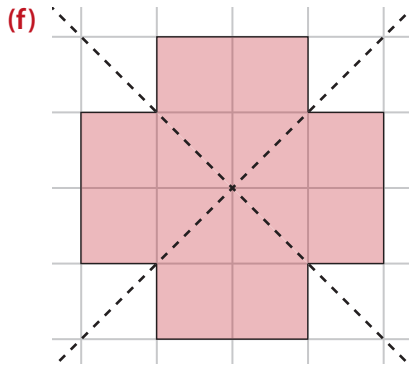
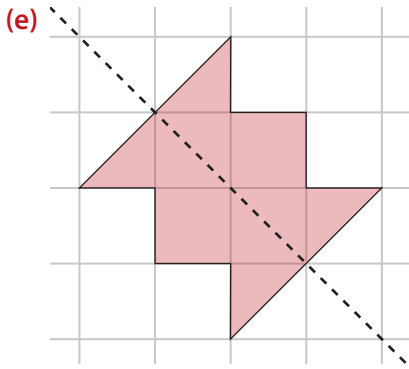
1. (a) Triangle A is congruent to triangle H (b) Triangle B is congruent to triangle D
 (c) Triangle C is congruent to triangle G (d) Triangle E is congruent to triangle F
2. (a) No (b) Yes (c) Yes (d) Yes (e) No
 (f) Yes
3. Example solution:



Answers: Exercise 31B



Answers: Exercise 31B

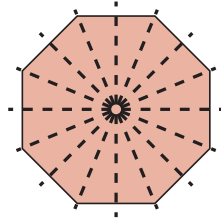
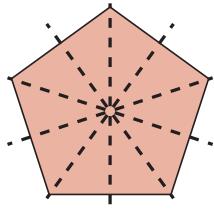
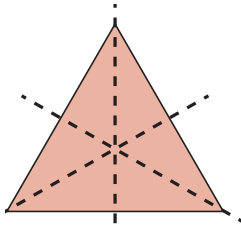


7. (a) 3

(b) 5

(c) 8

8.



9. (a) None (or rotational symmetry order 1)

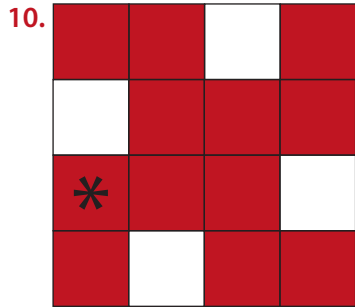
(b) None (or rotational symmetry order 1)

(c) Rotational symmetry order 4

(d) Rotational symmetry order 2

(e) Rotational symmetry order 3

(f) Rotational symmetry order 4



11. 11

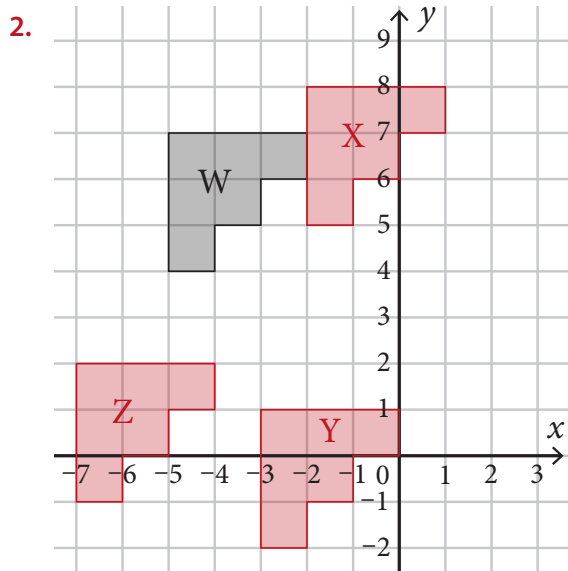
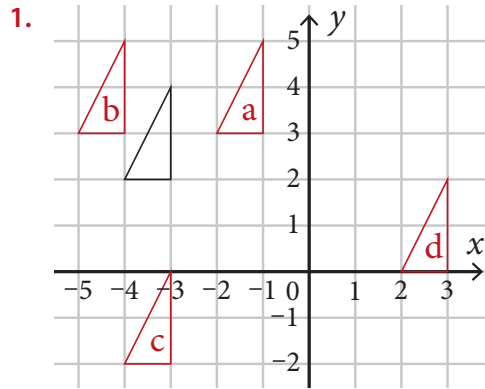
12. (5, 3.5)

13. (a) 3

(b) 5

(c) 8

Exercise 31C

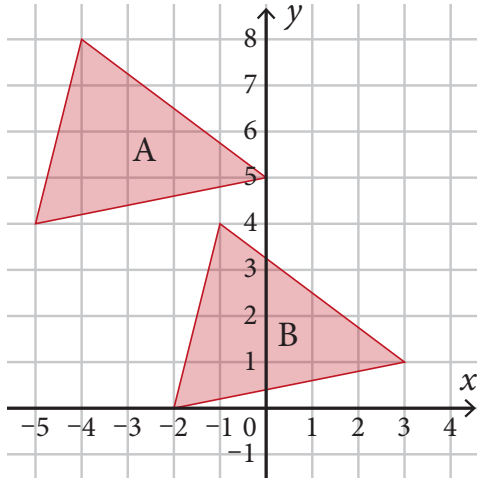


3.

Translation	Translation Vector
A → B	$\begin{pmatrix} 8 \\ 1 \end{pmatrix}$
A → C	$\begin{pmatrix} 2 \\ -6 \end{pmatrix}$
B → C	$\begin{pmatrix} -6 \\ -7 \end{pmatrix}$
B → A	$\begin{pmatrix} -8 \\ -1 \end{pmatrix}$
C → A	$\begin{pmatrix} -2 \\ 6 \end{pmatrix}$
C → B	$\begin{pmatrix} 6 \\ 7 \end{pmatrix}$

Answers: Exercise 31C

4. (a) and (b)



(c) Translation, vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$

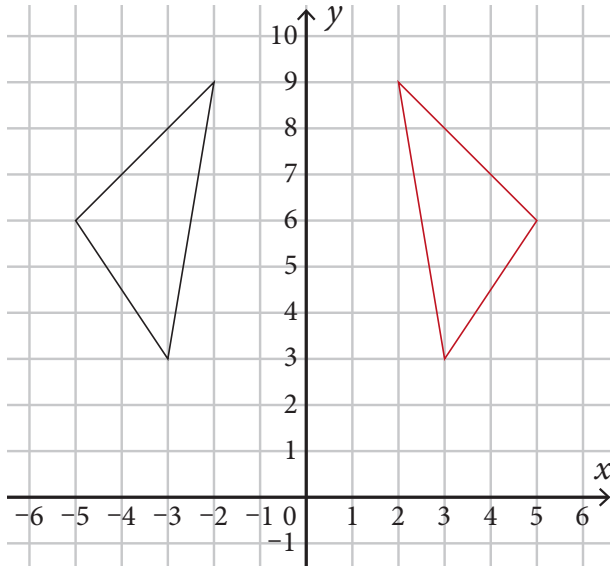
(d) Yes, shapes A and B are congruent. They are the same size and shape.

5. (a) $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

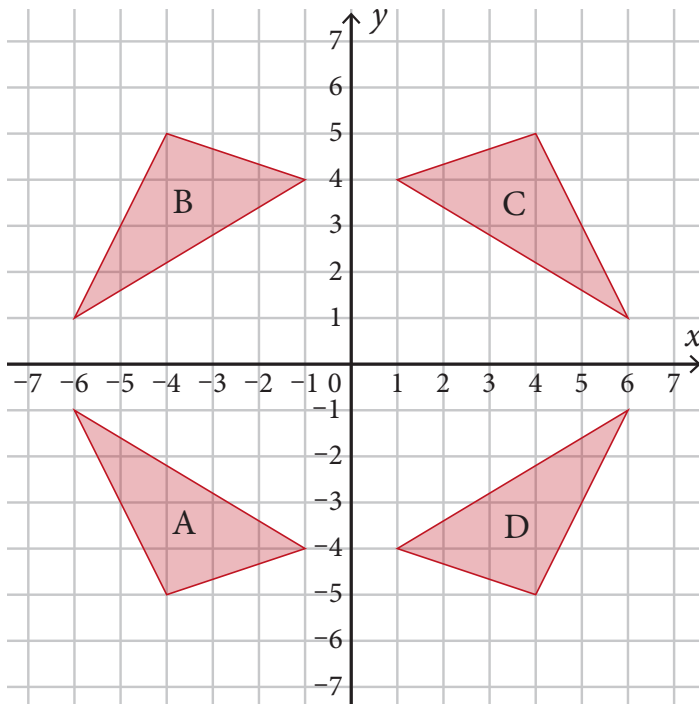
(b) Example answer: $\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \begin{pmatrix} -1 \\ -1 \end{pmatrix}$

Exercise 31D

1.



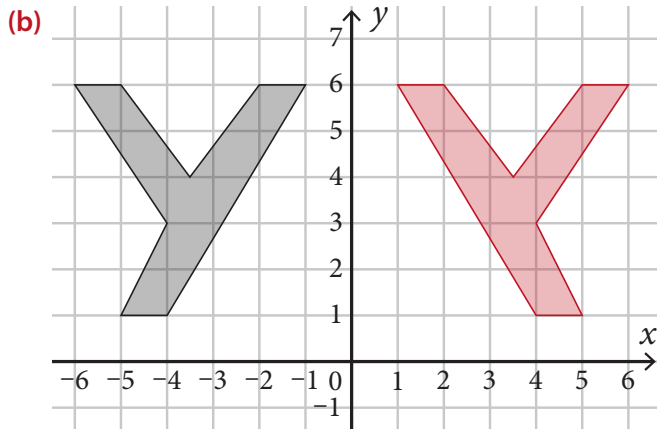
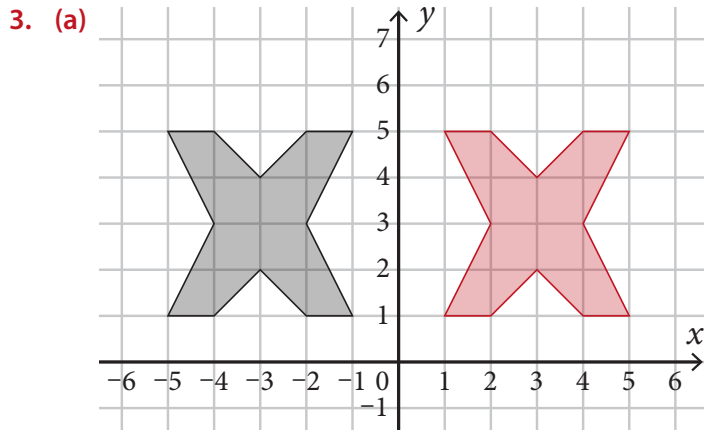
2. (a) to (d)



(e) Reflection in the y -axis

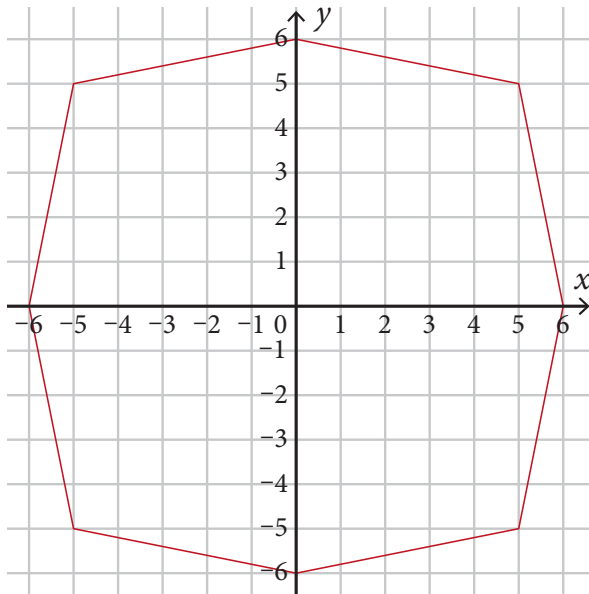
(f) Yes, shapes A and D are congruent. They are the same size and shape.

Answers: Exercise 31D



(c) The letter X is the right way round after the reflection because it has a vertical line of symmetry. The Y does not.

4. (a) and (b)



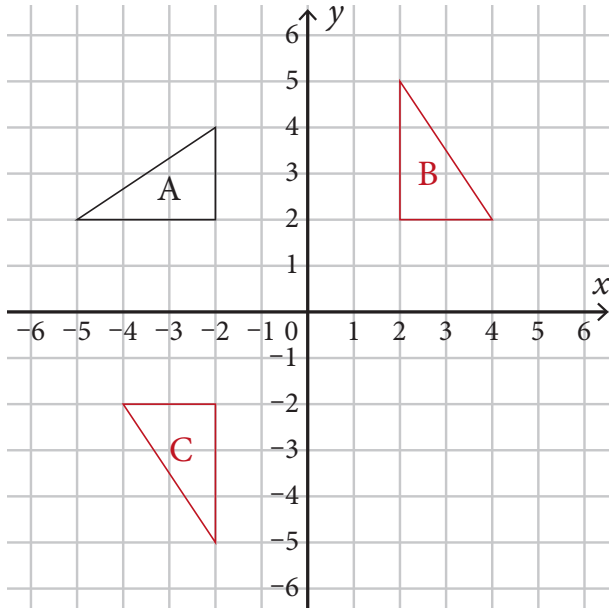
(c) Octagon

5. (a) They have a horizontal line of symmetry
 (b) It must have a vertical line of symmetry
 (c) Example answers: TOT, TUT, MUM

Answers: Exercise 31E

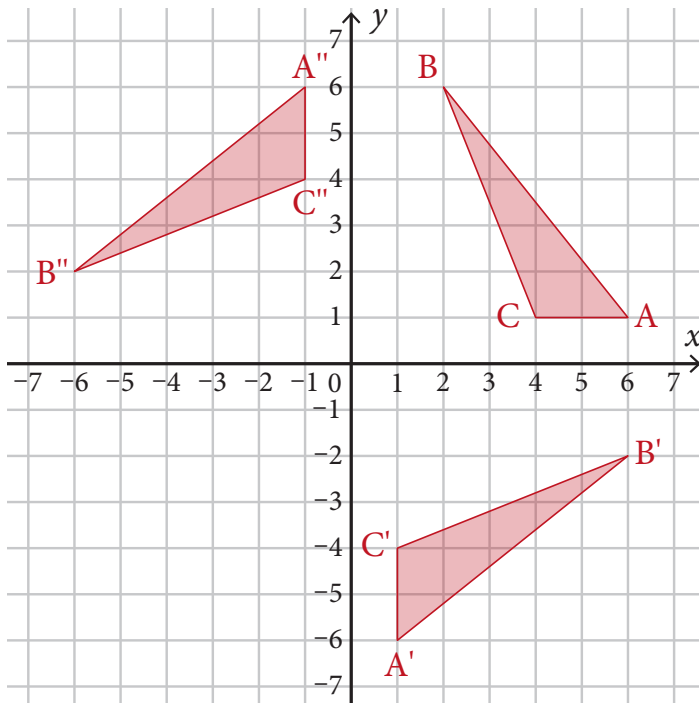
Exercise 31E

1. (a) and (b)



(c) Rotation 180° about the origin.

2. (a) to (c)

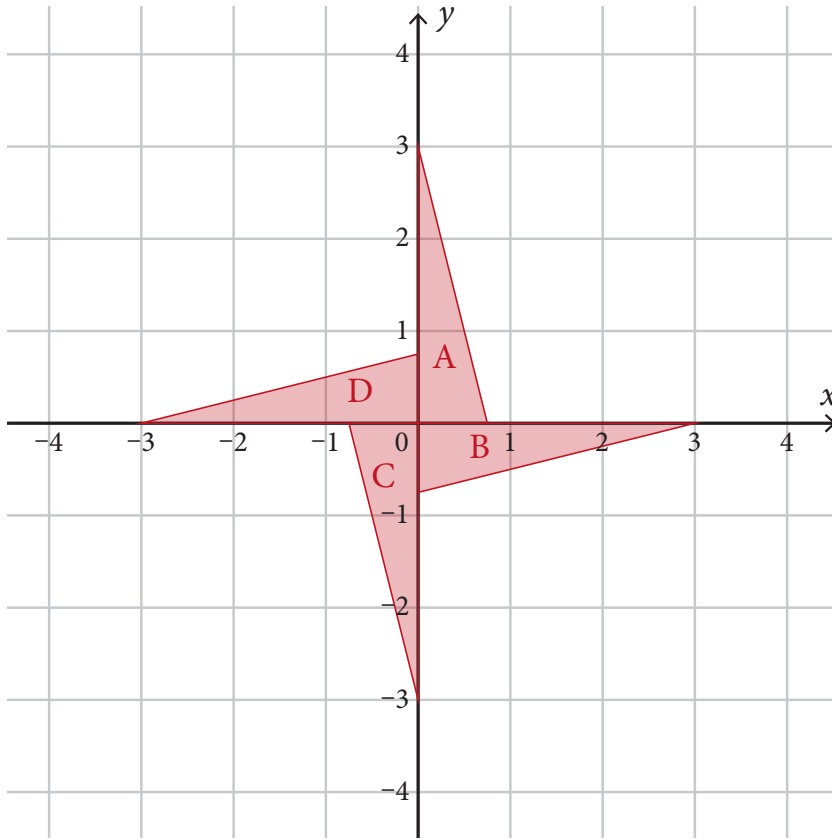


(b) $A'(1, -6)$, $B'(6, -2)$, $C'(1, -4)$

(c) $A''(-1, 6)$, $B''(-6, 2)$, $C''(-1, 4)$

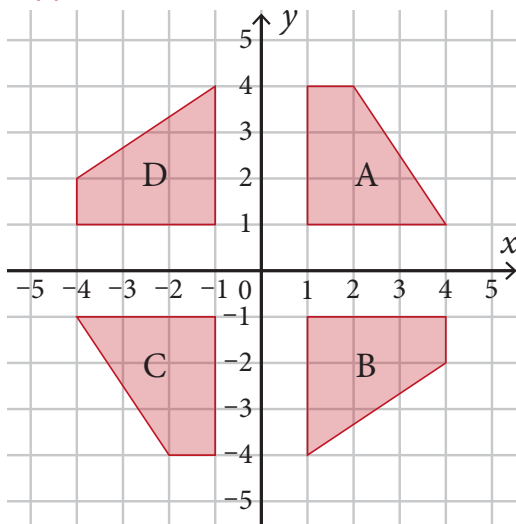
Answers: Exercise 31E

3. (a) to (d)



(e) The image is in the same position as the original.

4. (a) to (c)



(b) $(1, -1), (4, -1), (4, -2), (1, -4)$

(c) $(-1, -1), (-4, -1), (-2, -4), (-1, -4)$

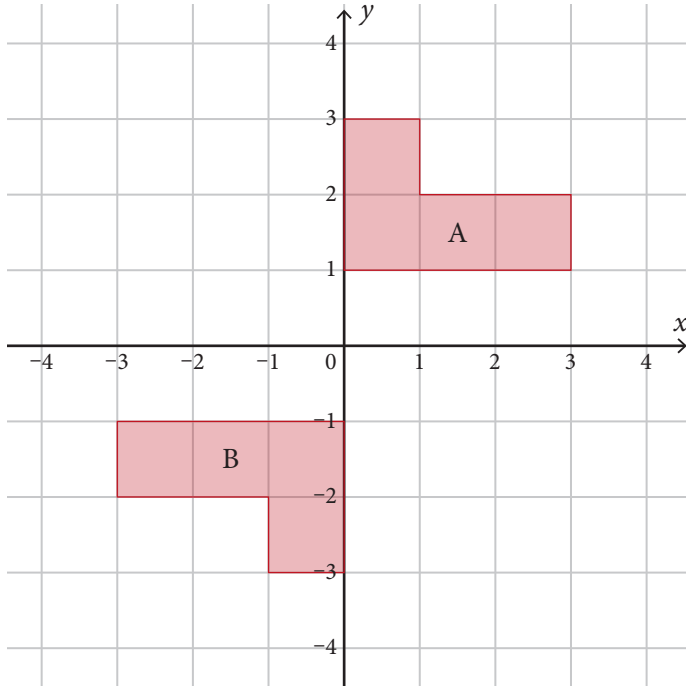
(d) Rotation 90° clockwise about the origin

(e) Yes, A and D are congruent. They are the same size and shape.

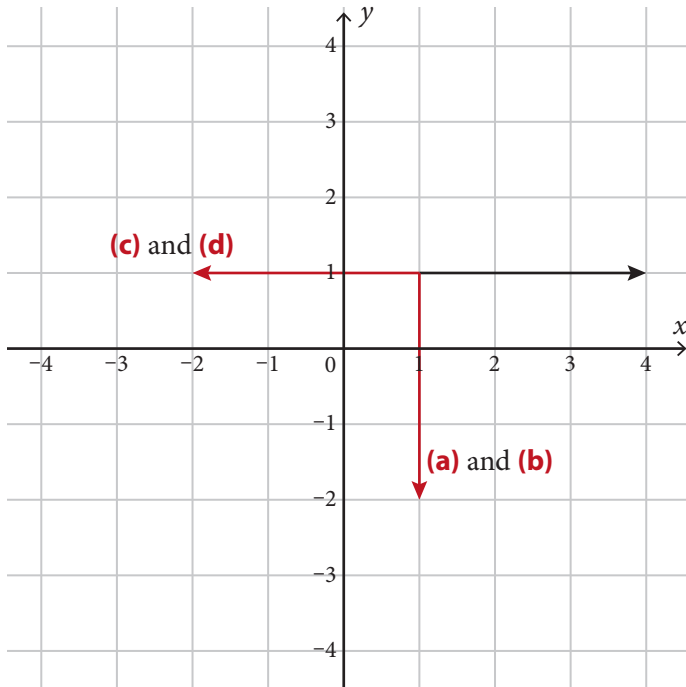
Answers: Exercise 31E

5. (a) (i) Rotation 90° clockwise about the origin
(ii) Rotation 90° anticlockwise about the origin (or 270° clockwise)
(iii) Rotation 90° anticlockwise about the origin (or 270° clockwise)

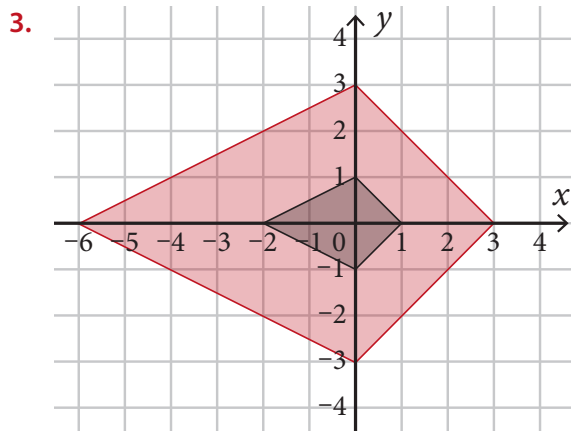
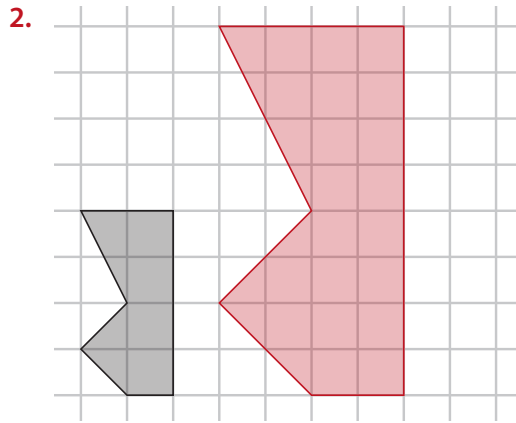
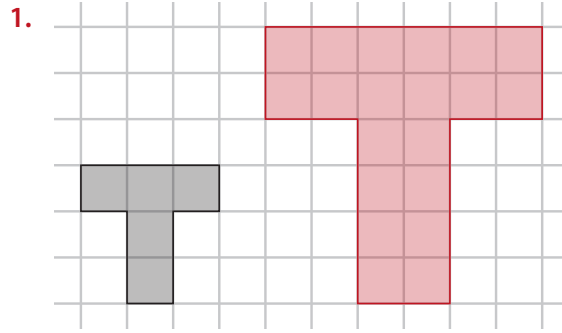
(b)



6.

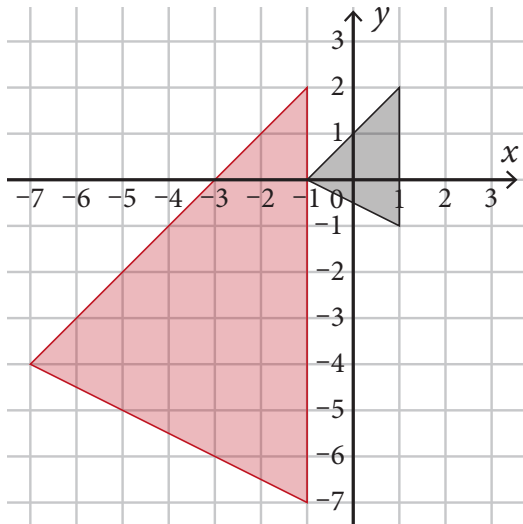


Exercise 31F



Answers: Exercise 31F

4.

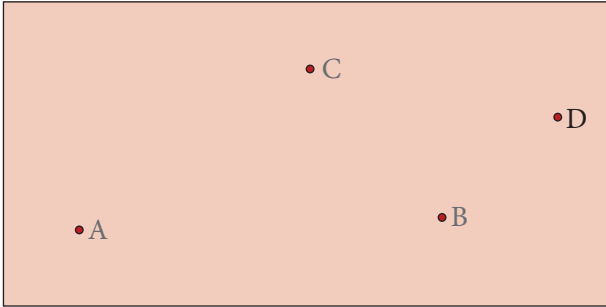


5. No. The lengths in the image are twice the size of the lengths in the original shape. Congruent shapes have the same shape and size.
6. 2
7. Scale factor 4, centre of enlargement $(-3, -1)$
8. Enlargement, scale factor 2, centre of enlargement $(-5, -4)$
9. (a) 12 cm (b) 4 cm (c) 112 cm^2
10. (a) 33 cm (b) 9 (c) 450 cm^2

Chapter 32: Constructions and Loci

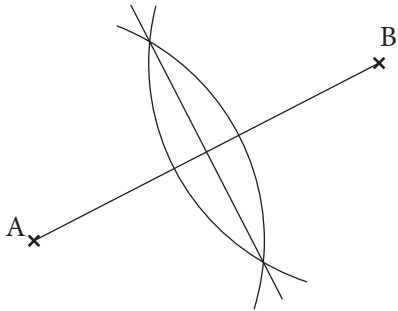
Exercise 32A

1. (a) 24 km (b) 055° (c) 318°
(d)

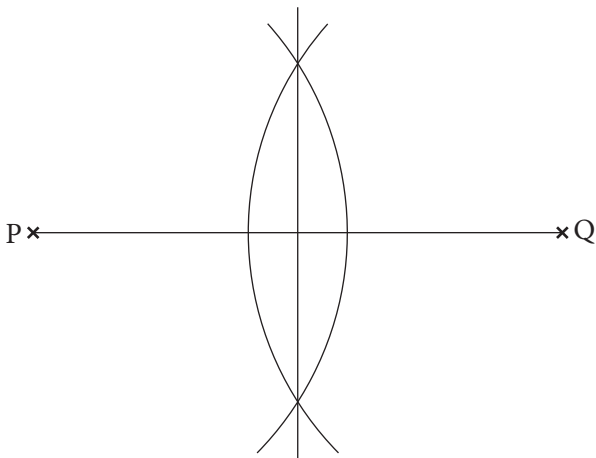


Exercise 32B

1.

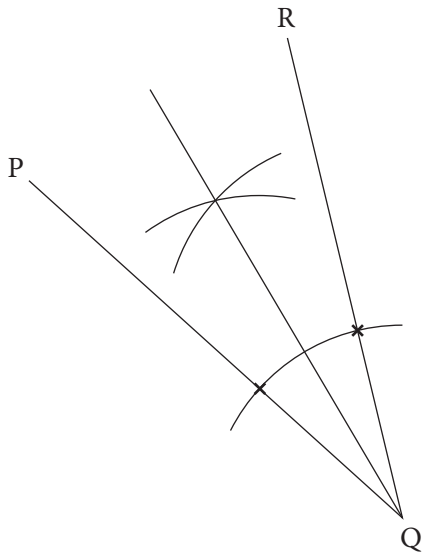


2.

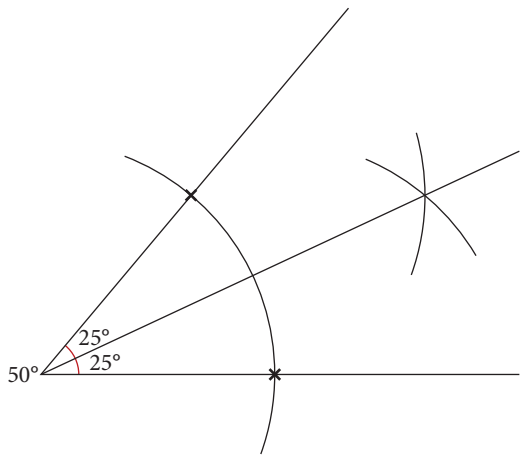


Answers: Exercise 32B

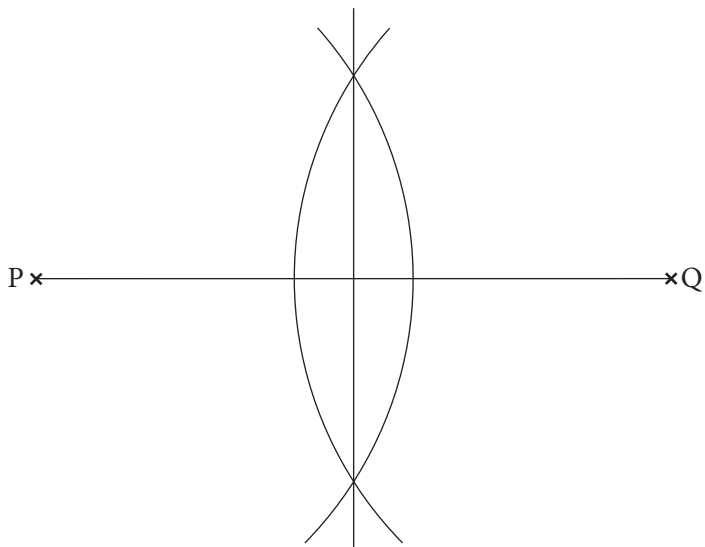
3.



4.

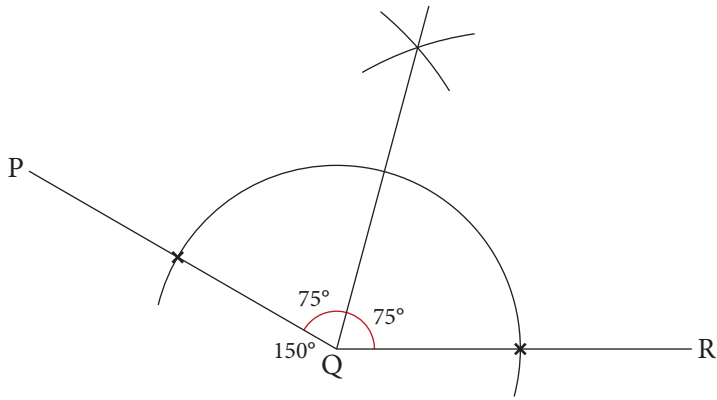


5.

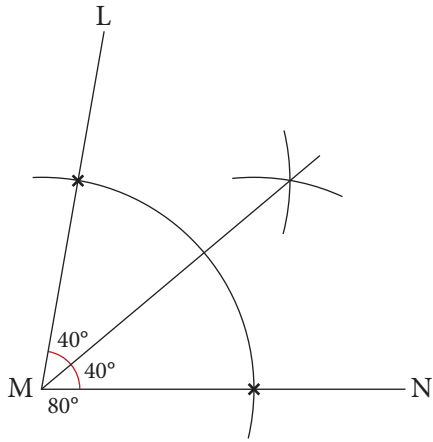


Answers: Exercise 32B

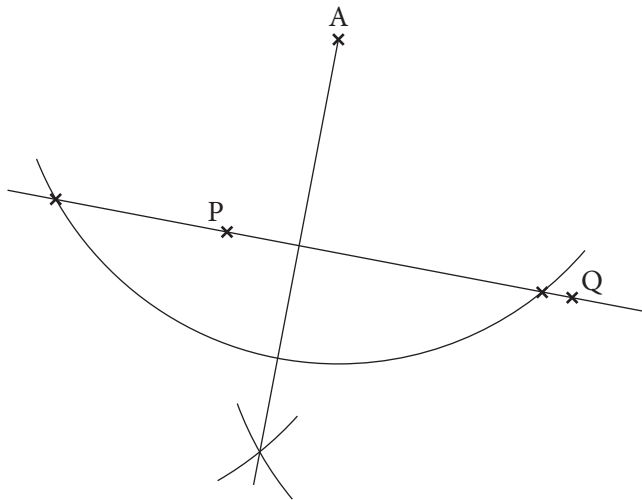
6.



7.

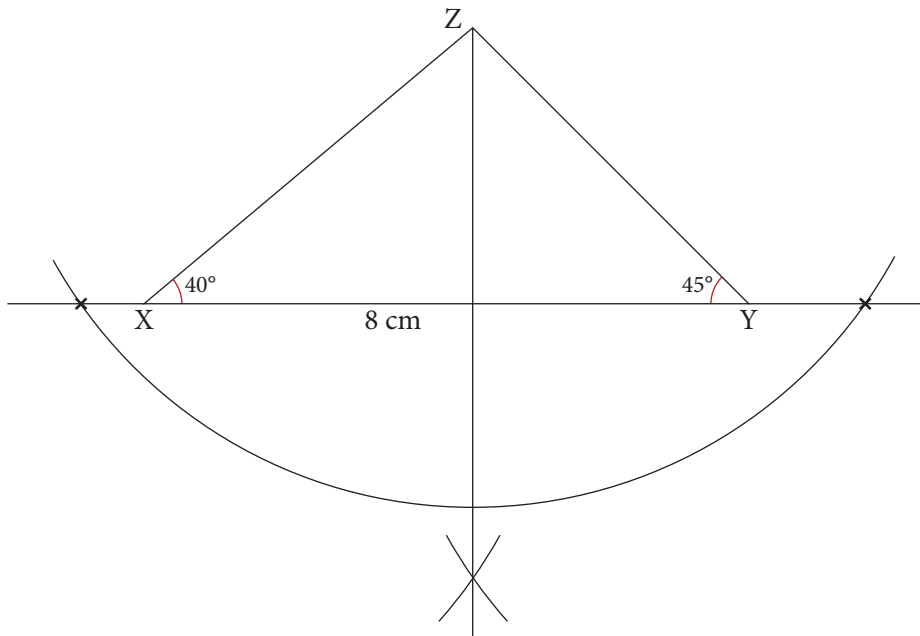


8.



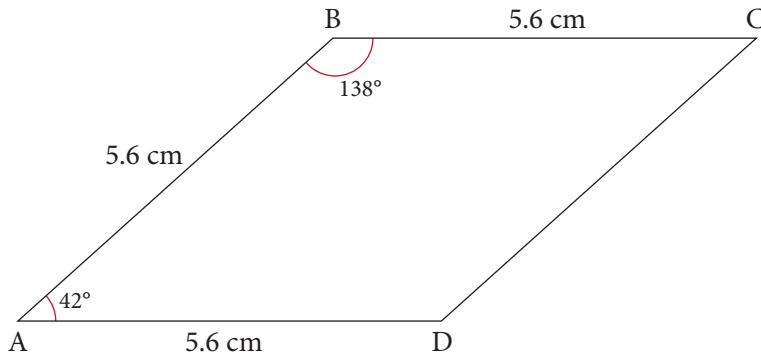
Answers: Exercise 32B

9.

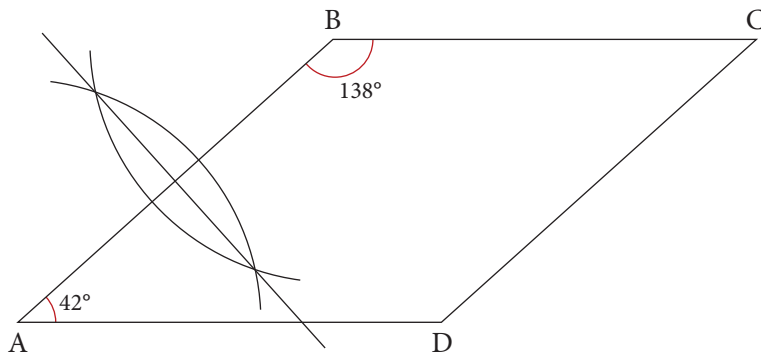


10. (a) One possible solution:

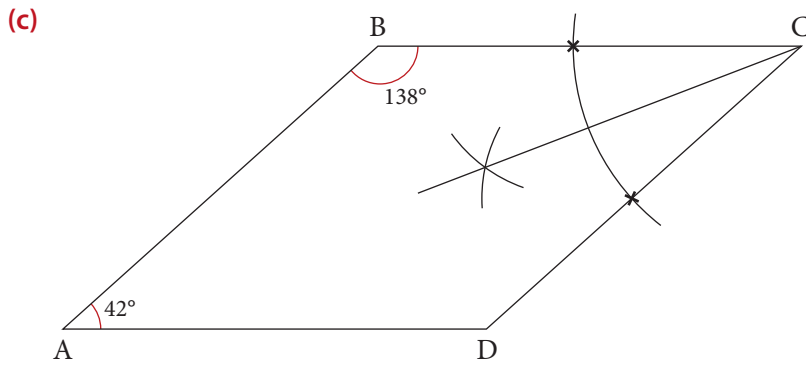
- Draw AD horizontally, 5.6 cm in length.
- Draw a line at an angle of 42° to AD at point A. Measure 5.6 cm along this line and label this point B.
- Draw a line at an angle of 138° to AB at point B. Measure 5.6 cm along this line and label this point C.
- Join the four points to make the rhombus.



(b)

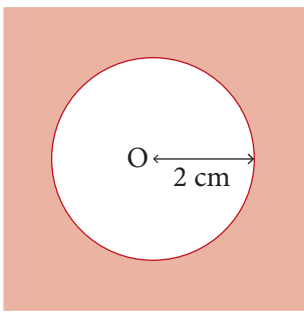


Answers: Exercise 32C

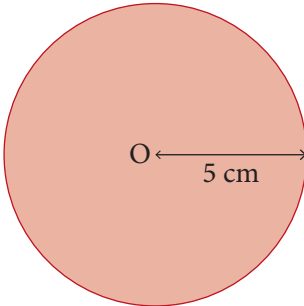


Exercise 32C

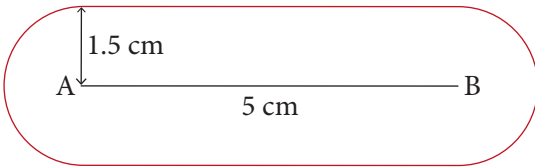
1.



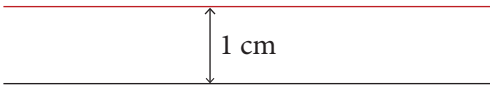
2.



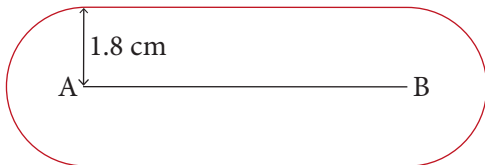
3.



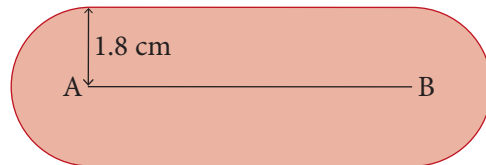
4.



5. (a)

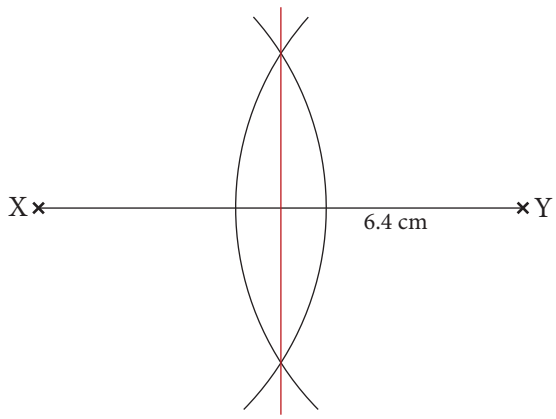


(b)

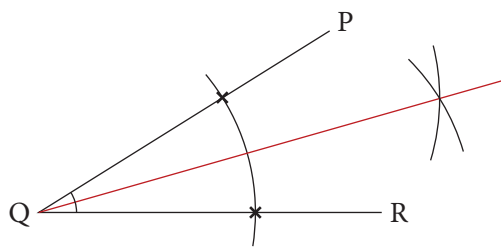


Answers: Exercise 32C

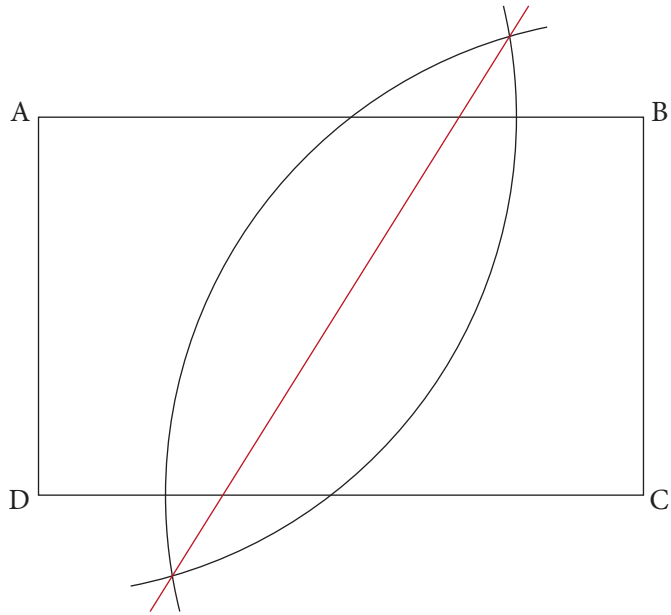
6.



7.

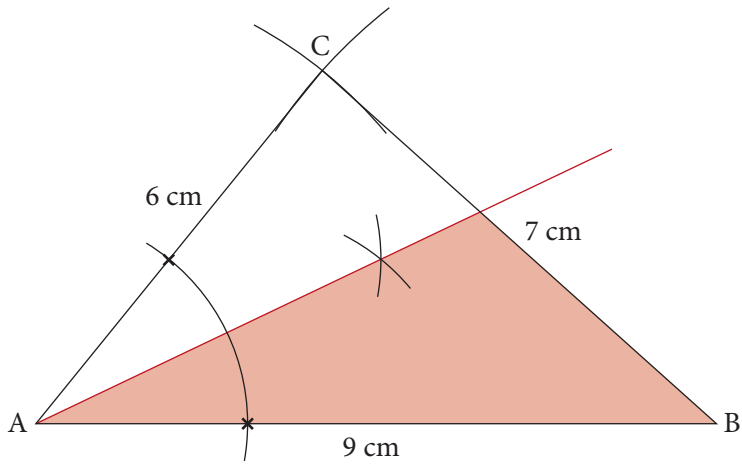


8.

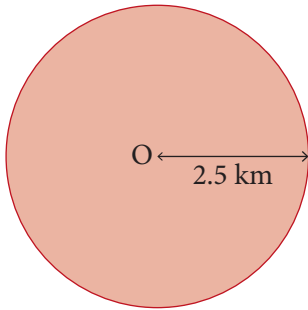


Answers: Exercise 32C

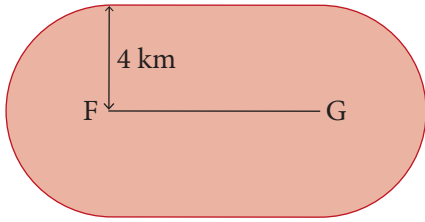
9.



10.

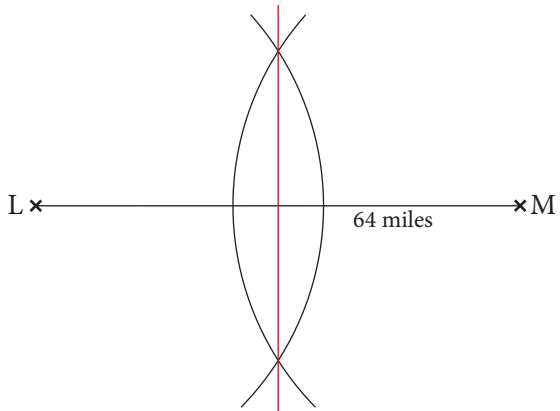


11.



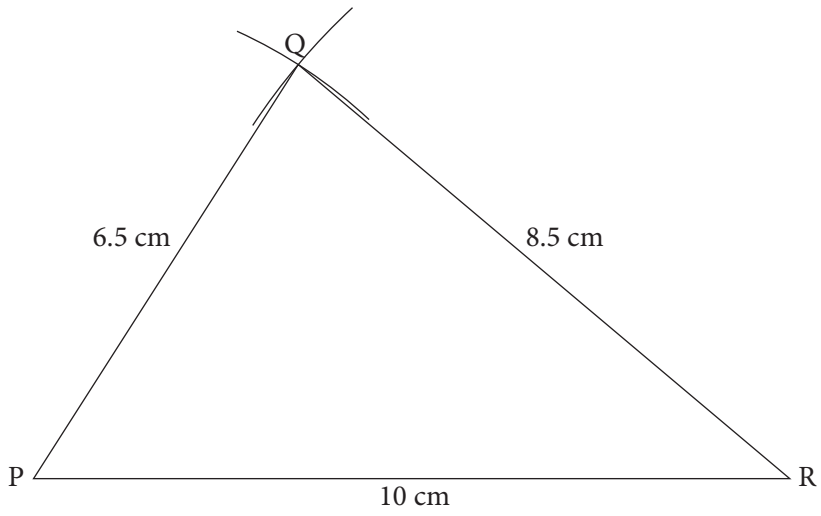
Note: This diagram is not drawn to scale.

12.

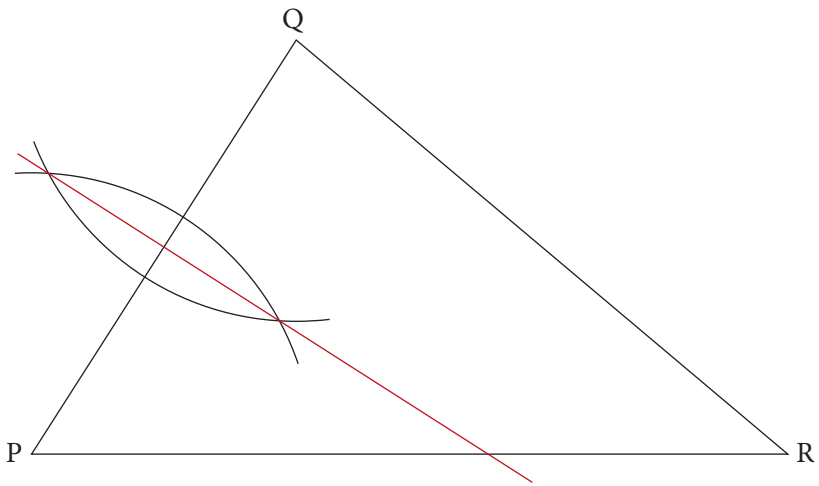


Answers: Exercise 32C

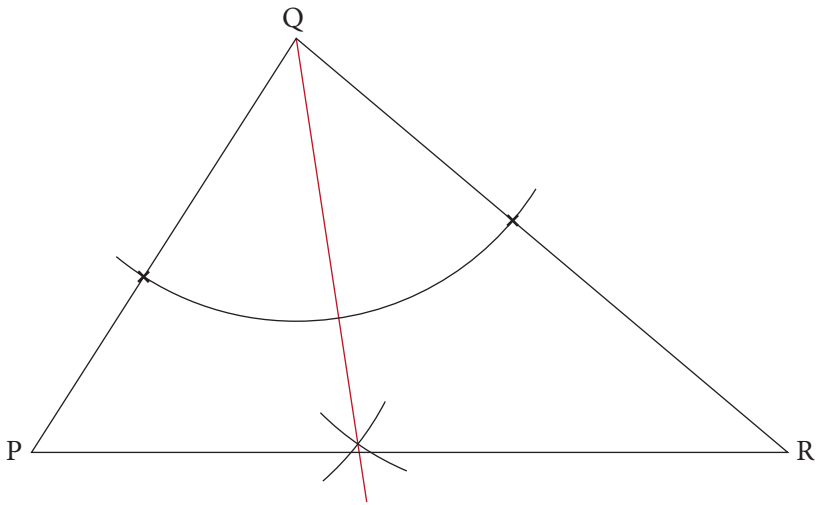
13. (a)



(b)

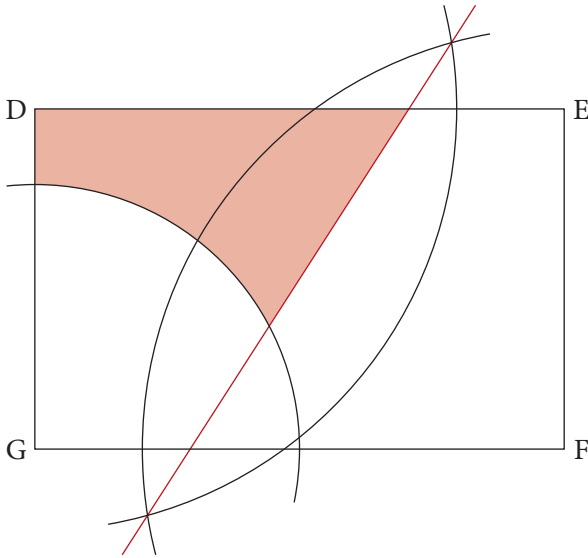


(c)

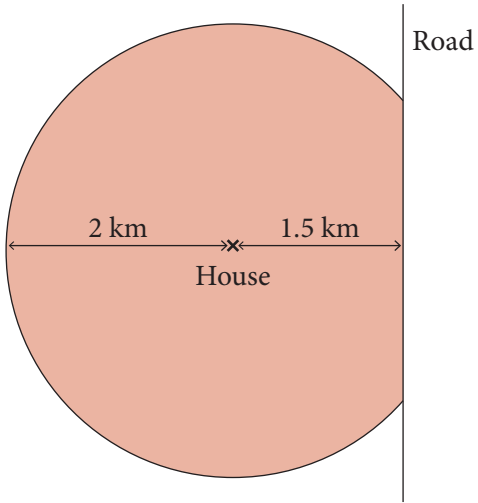


Answers: Exercise 32C

14.



15.



Chapter 33: Probability

Exercise 33A

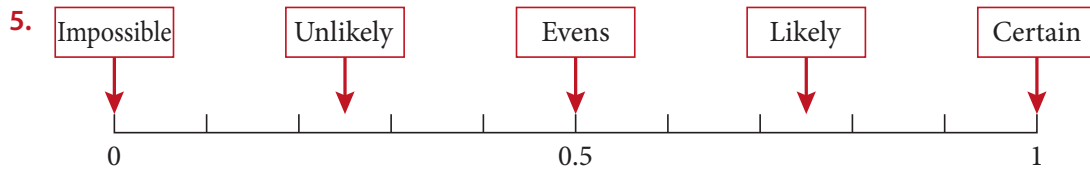
1. (a) A fair coin is one for which the probability of heads is equal to the probability of tails (0.5 for both).
 (b) The opposite of fair is **biased**. A biased coin could have a probability of heads of 0.6, for example.

2.

Event	Probability
A caterpillar turning into an elephant	Unlikely
Pressing the light switch in my bedroom and the light coming on	Impossible
Spring following winter	Certain
Meeting the Pope on the way to school	Likely

3. (a) (i) $\frac{2}{5}$ (ii) 0.2 (b) 80

4. 0.35



6. 0.32

7. (a) (i) 0.6 (ii) 0.4 (iii) 1 (iv) 0
 (b) White

Answers: Exercise 33B

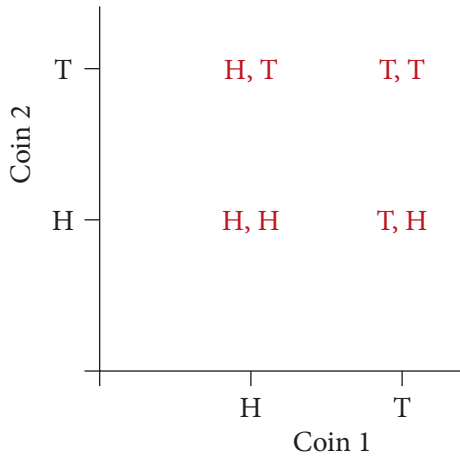
Exercise 33B

1. (a)

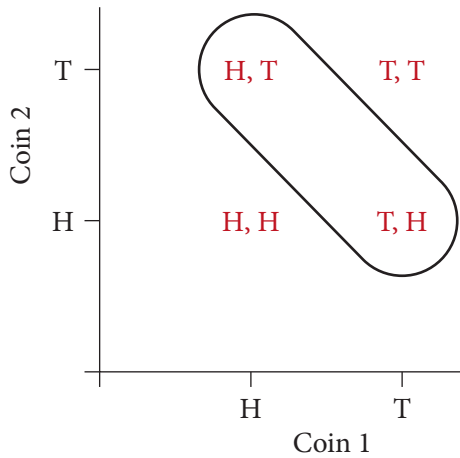
		Dice 1					
		1	2	3	4	5	6
Dice 2	+						
	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
6	7	8	9	10	11	12	

(b) $\frac{4}{36} = \frac{1}{9}$

2. (a)

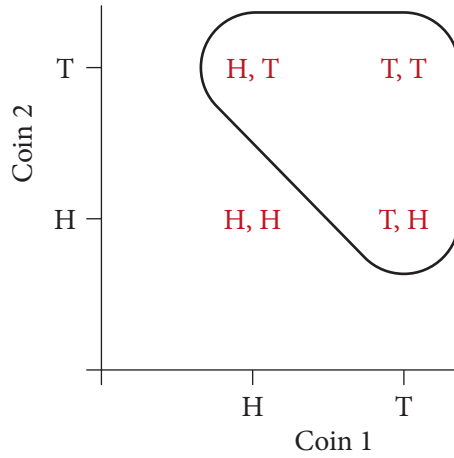


(b) (i)



$P(\text{one head and one tail}) = \frac{2}{4} = \frac{1}{2}$

(ii)



$P(\text{at least one tail}) = \frac{3}{4}$

Answers: Exercise 33B

3. (a) Cross Country Netball
 Cross Country Lifeguard Training
 Cookery Netball
 Cookery Lifeguard Training
 Hockey Netball
 Hockey Lifeguard Training
 Sewing Netball
 Sewing Lifeguard Training
 Football Netball
 Football Lifeguard Training
 Total: 10 combinations

(b) $\frac{1}{10}$ (c) 0.5

(d) 4 events on Monday and 3 events on Thursday gives $4 \times 3 = 12$

4. (a)

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

(b) $\frac{1}{12}$ (c) $\frac{1}{4}$

(d)

		Spinner	
		Pink	White
Coin	H	(Heads, pink)	(Heads, white)
	T	(Tails, pink)	(Tails, white)

5. (a)

		Dice 1					
		1	2	3	4	5	6
Dice 2	× 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) $\frac{1}{9}$ (c) $\frac{1}{36}$

(d) If the dice are rolled 120 times we expect $120 \times \frac{1}{12} = 10$

6. (a) 12 combinations:

Electric, black	Electric, silver	Electric, white	Electric, red
Petrol, black	Petrol, silver	Petrol, white	Petrol, red
Diesel, black	Diesel, silver	Diesel, white	Diesel, red

(b) 4 combinations:

Petrol, silver	Petrol, red	Diesel, silver	Diesel, red
----------------	-------------	----------------	-------------

(c) $\frac{1}{4}$

Answers: Exercise 33C

Exercise 33C

1. (a) 0.5
(b) The answer to part (a) is an estimate because:
– It is only based on 30 games. If we took a larger sample, we may get a better estimate.
– The next game may be affected by special circumstances. For example, the opposition may be a very strong team; there may be injured players, etc.

2. (a) 0.25 (b) 12

3. (a) Add the relative frequency for each number to another row in the table:

Number	1	2	3	4	5	6
Frequency	9	8	8	10	9	16
Relative frequency	0.15	0.133	0.133	0.167	0.15	0.267

- (b) 10
(c) This dice may be biased towards rolling a 6
After 60 rolls the number 6 was rolled far more than any other number. This dice is probably biased towards the number 6
(d) 267

4. (a)

Total number of draws	Number of times a red bead is withdrawn	Relative frequency
20	17	0.85
40	35	0.875
60	40	0.667
80	55	0.688
100	72	0.72

- (b) The best estimate of the probability of choosing a red bead is 0.72 because this value is based on the largest sample size (100 draws).
(c) 65 red beads; 25 black beads

5. (a)

Number of jumps	Number of successes	Relative frequency
5	3	0.6
10	7	0.7
15	9	0.6
20	13	0.65
25	17	0.68
30	21	0.7

- (b) The best estimate for the probability is 0.7, since this is the relative frequency that is based on the largest number of jumps.
(c) 14

Answers: Exercise 33C

6. (a) 189; 77

(b)

Name	Number of times coin tossed	Number of heads	Relative frequency
Shane	30	15	0.5
Cian	54	24	0.444
Jo	45	21	0.467
Clare	60	17	0.283
Total	189	77	0.407

(c) 0.407 because this is based on the largest number of trials, 189

(d) The coin is probably biased. The best estimate for the probability of getting heads is 0.407
For a fair coin, this would be 0.5

(e) 204

7. (a)

Question numbers	Number correct	Total correct so far	Relative frequency
1 – 10	5	5	0.5
11 – 20	4	9	0.45
21 – 30	5	14	$\frac{14}{30} = 0.467$
31 – 40	6	20	$\frac{20}{40} = 0.5$
41 – 50	5	25	$\frac{25}{50} = 0.5$
51 – 60	6	31	$\frac{31}{60} = 0.517$
61 – 70	8	39	$\frac{39}{70} = 0.557$
71 – 80	7	46	$\frac{46}{80} = 0.575$
81 – 90	6	52	$\frac{52}{90} = 0.578$
91 – 100	4	56	$\frac{56}{100} = 0.56$

(b) 0.56

(c) 22

8. (a) 160

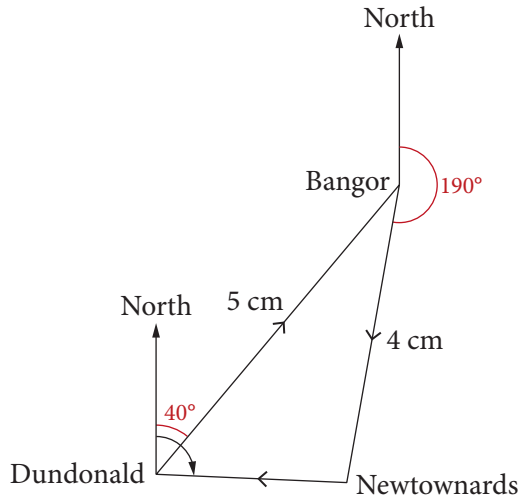
(b) Treadmill 0.344; Weights 0.219; Pool 0.263; Exercise bike 0.175

(c) 44

Progress Review

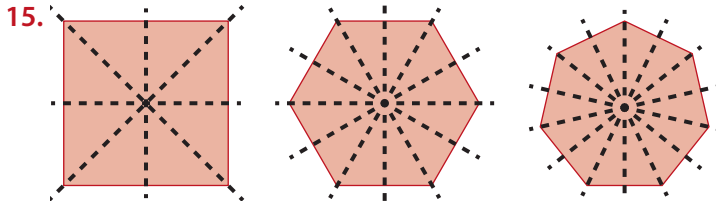
Progress Review (Chapters 29–33)

1. 283°
2. 162°
3. (a) 120° (b) 70 km
4. (a) (i) 20 m (ii) 120° (b) 256°
5. (a)



- (b) (i) 2.5 miles (accept 2.3 to 2.7 miles)
- (ii) 92° (accept 90° to 94°)
- (iii) 272° (accept 270° to 274°)
6. 540°
7. 150°
8. (a) 4 (b) Square
9. 18
10. Yes. The exterior angle would be $30 \frac{360}{30} = 12$, so the polygon has 12 sides.
11. No. The exterior angle would be 55° $n = \frac{360}{55} = 6.55$ (2 d.p.). It is not possible for a polygon to have 6.55 sides.
12. 11
13. 22
14. (a) 4 (b) (2.5, 1.5) (c) 4
- (d) Vertical: $x = 2.5$; horizontal: $y = 1.5$

Answers: Progress Review (Chapters 29–33)



16. (a) Translation, vector $\begin{pmatrix} -6 \\ -2 \end{pmatrix}$ (b) Reflection in line $x = 4$

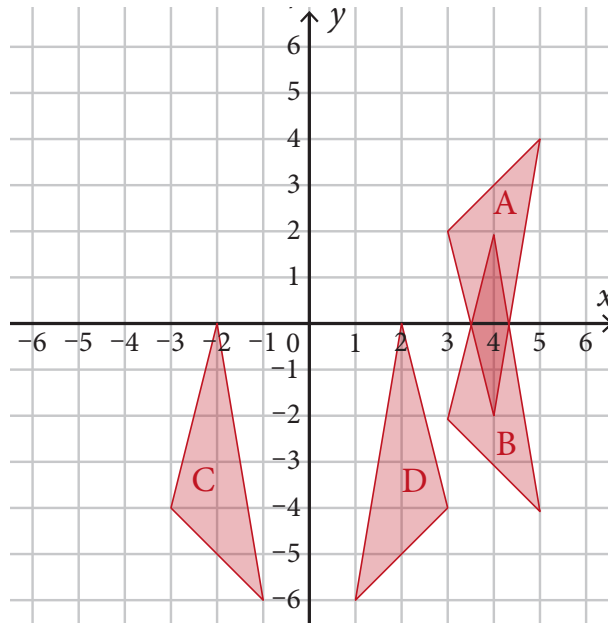
(c) Translation, vector $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ (d) Reflection in line $y = 1$

(e) Rotation 180° about $(3, 1)$

(f) There is no translation mapping A to C because a translation does not change the orientation of the original. Shapes A and C do not have the same orientation.

(g) Rotation 180° about $(0, 0)$

17. (a) (b) (d) (e)



(c) $(3, -2)$, $(5, -4)$, $(4, 2)$

(f) Rotation 180° about $(3, -1)$

18. (a) Reflection in y -axis (or Reflection in $x = 0$)

(b) Translation by vector $\begin{pmatrix} 0 \\ -5 \end{pmatrix}$

(c) Reflection in $y = 1$

19. (a) (i) Translation by vector $\begin{pmatrix} -4 \\ 0 \end{pmatrix}$ (ii) Translation by vector $\begin{pmatrix} 5 \\ -4 \end{pmatrix}$

(iii) Translation by vector $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ (iv) Translation by vector $\begin{pmatrix} -5 \\ 1 \end{pmatrix}$

(b) A translation gives an image that is the same size and shape as the original. A and E are not the same shape.

Answers: Progress Review (Chapters 29–33)

20. Mappings	Transformation
$A \rightarrow P$	Reflection in line $y = 3$
$A \rightarrow Q$	Translation by vector $\begin{pmatrix} 3 \\ 3 \end{pmatrix}$
$A \rightarrow R$	Reflection in line $x = 3$
$A \rightarrow S$	Rotation 180° about $(3, 3)$

21. (a) A vector describing the movement of the object.

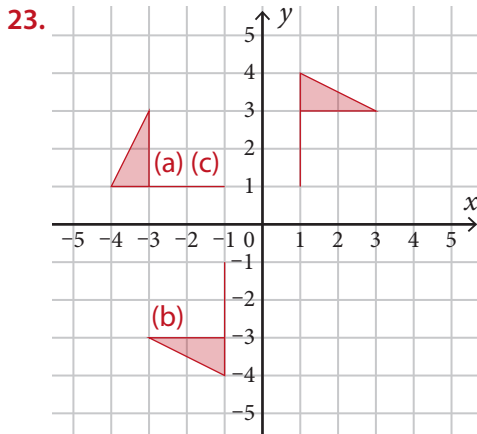
(b) Centre of rotation, angle, direction.

22. (a) (i) Translation by vector $\begin{pmatrix} -2 \\ 2 \end{pmatrix}$ (ii) Translation by vector $\begin{pmatrix} 6 \\ -6 \end{pmatrix}$

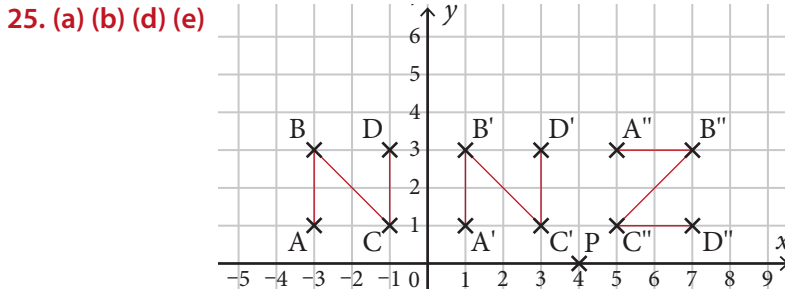
(iii) Translation by vector $\begin{pmatrix} 8 \\ -8 \end{pmatrix}$ (iv) Translation by vector $\begin{pmatrix} -8 \\ -4 \end{pmatrix}$

(b) (i) Rotation 90° clockwise about $(0, 0)$ (ii) Rotation 180° about $(0, 0)$

(iii) Rotation 180° about $(-1, 1)$ (iv) Rotation 90° anticlockwise about $(-2, 0)$



24. Rotation 180° about $(-2, 3)$



(c) Letter N

(f) Letter Z

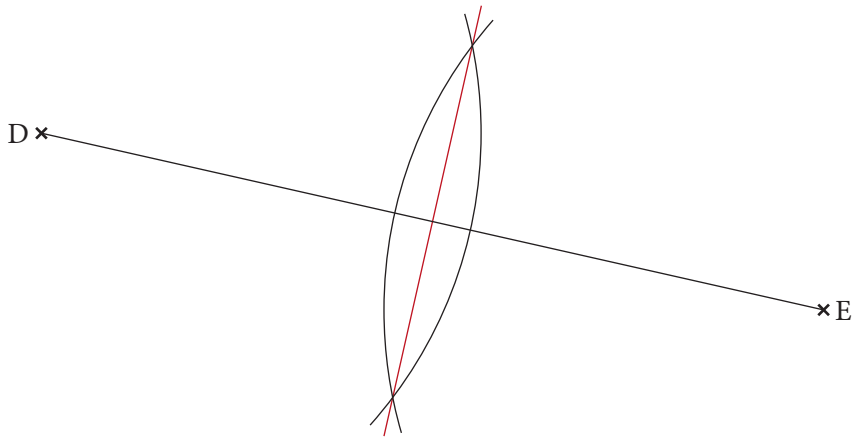
26. (a) 3 (b) $(7, -5)$

(c) Enlargement, scale factor 3, centre of enlargement $(7, -5)$.

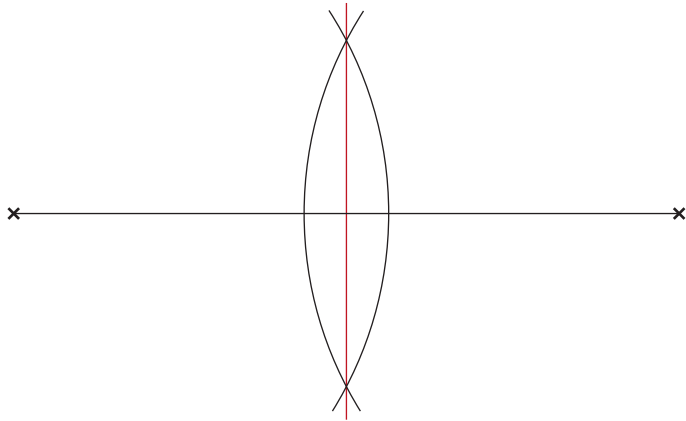
27. (a) 16 cm (b) 804 cm^2

Answers: Progress Review (Chapters 29–33)

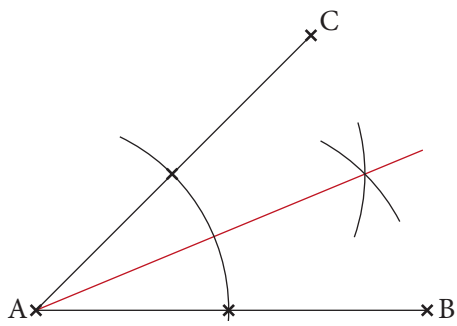
28.



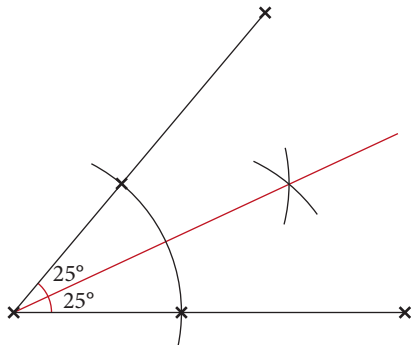
29.



30.

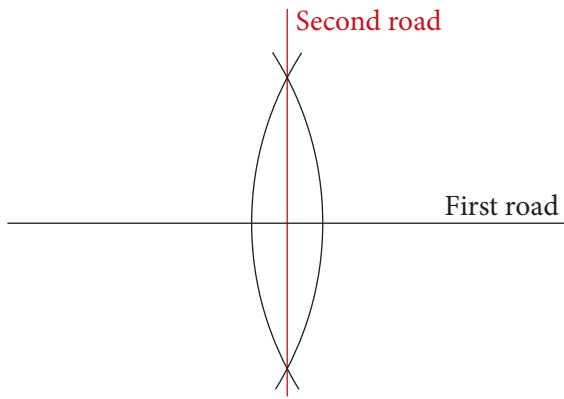


31.

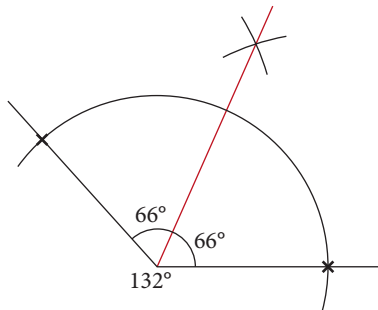


Answers: Progress Review (Chapters 29–33)

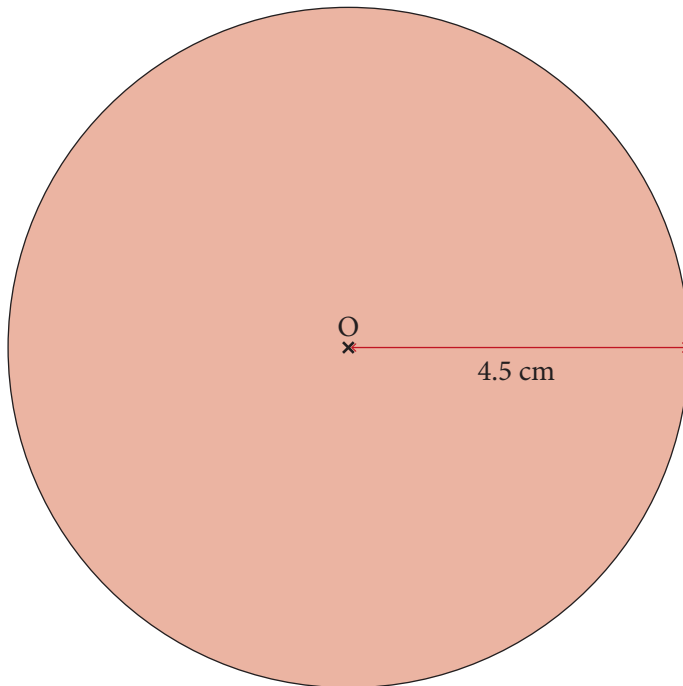
32.



33.

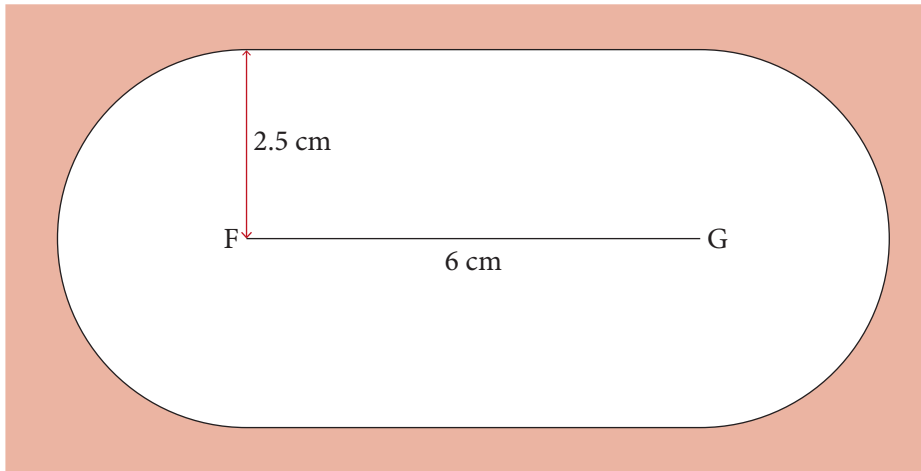


34.

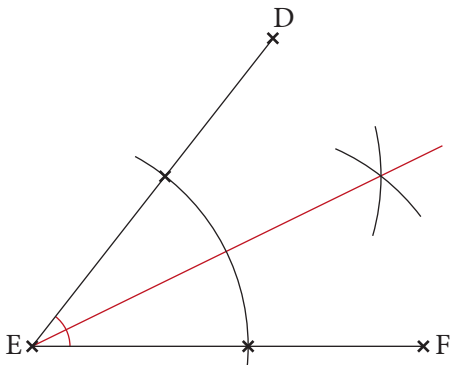


Answers: Progress Review (Chapters 29–33)

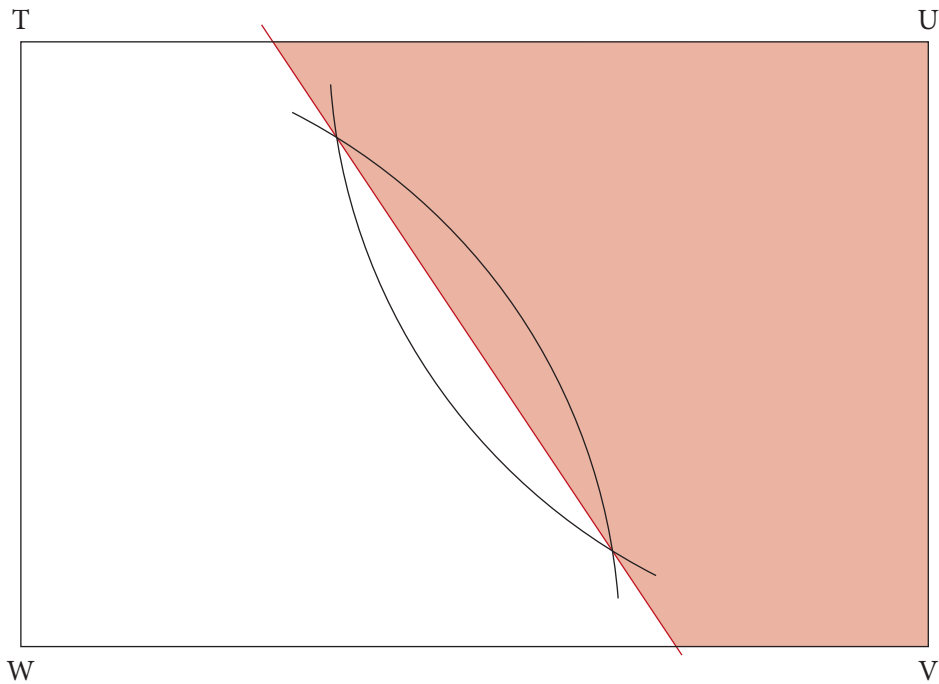
35.



36.

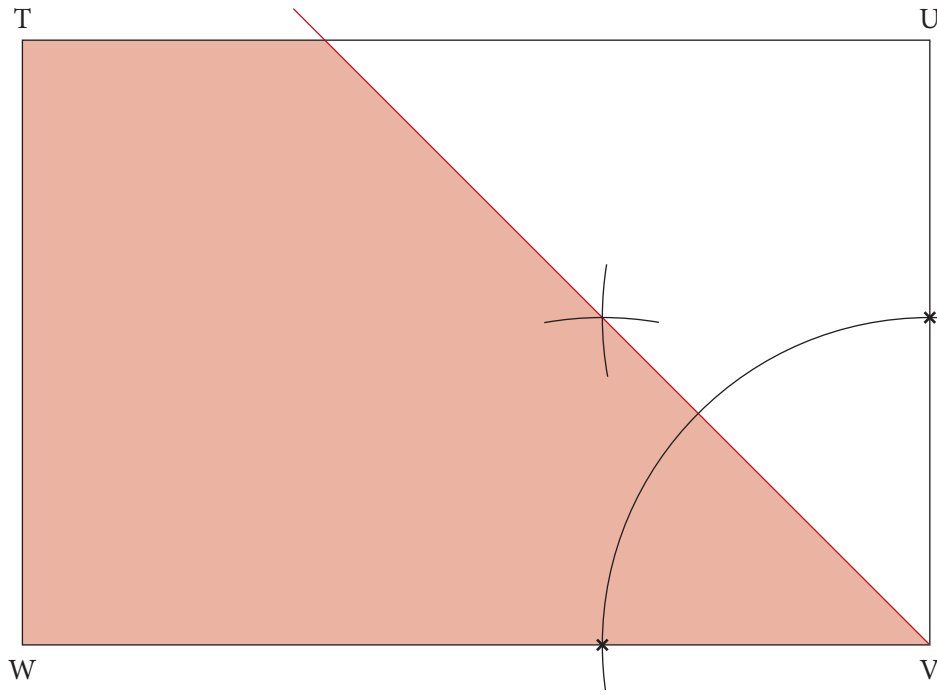


37. (a) (b) (i) T

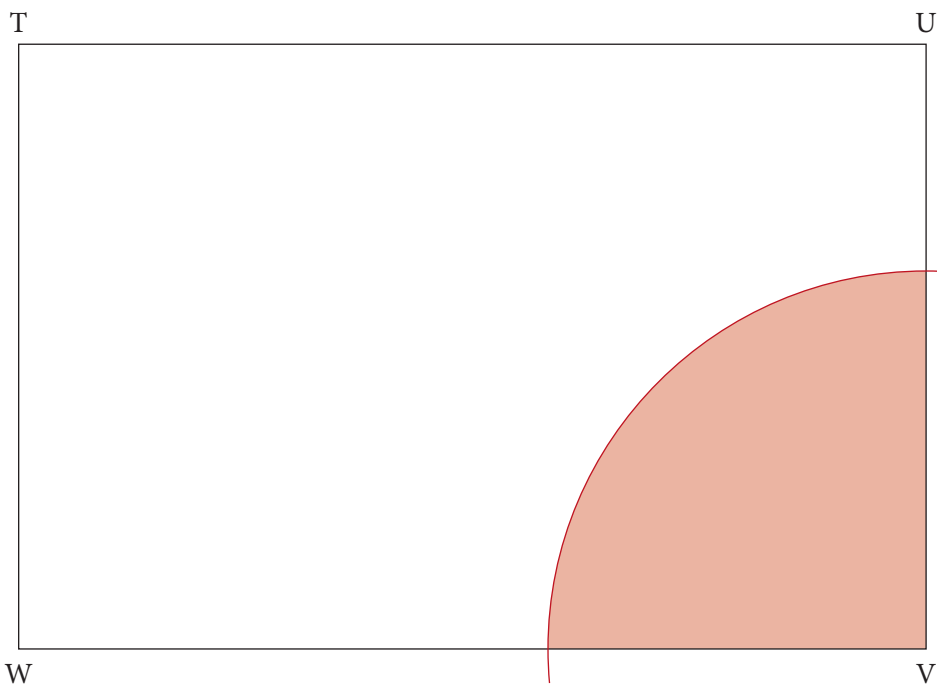


Answers: Progress Review (Chapters 29–33)

37. (b) (ii)

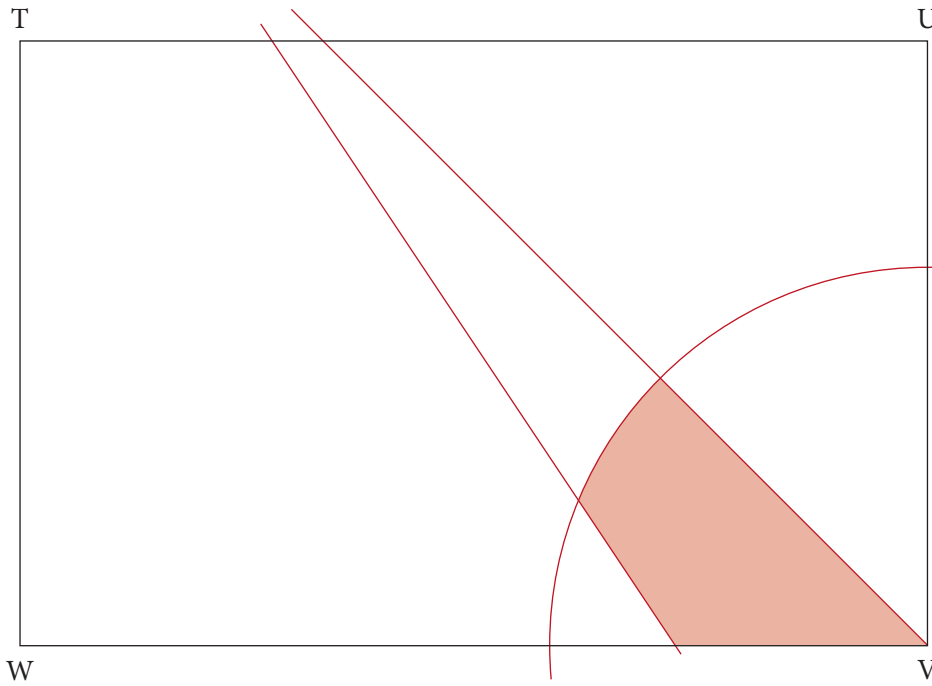


(b) (iii)

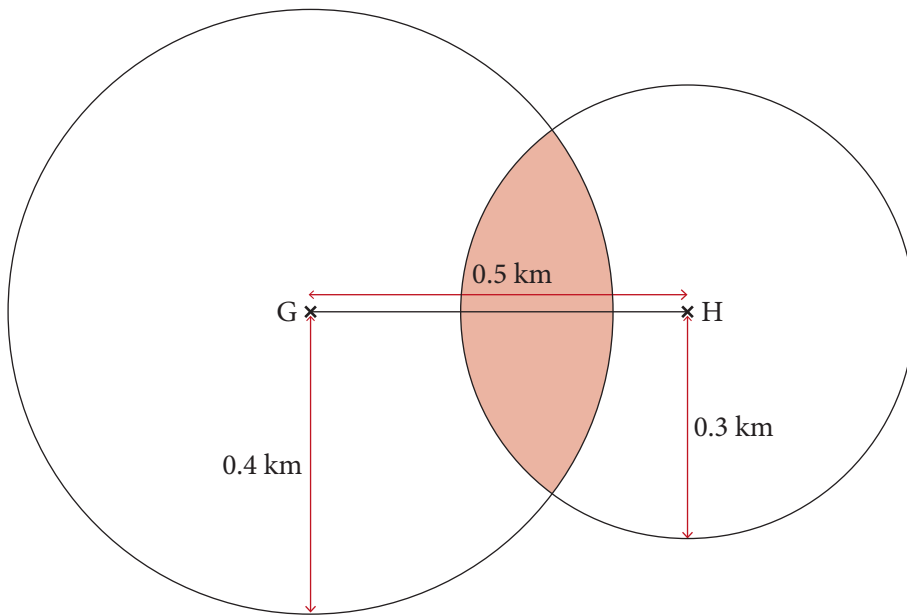


Answers: Progress Review (Chapters 29–33)

37. (c)

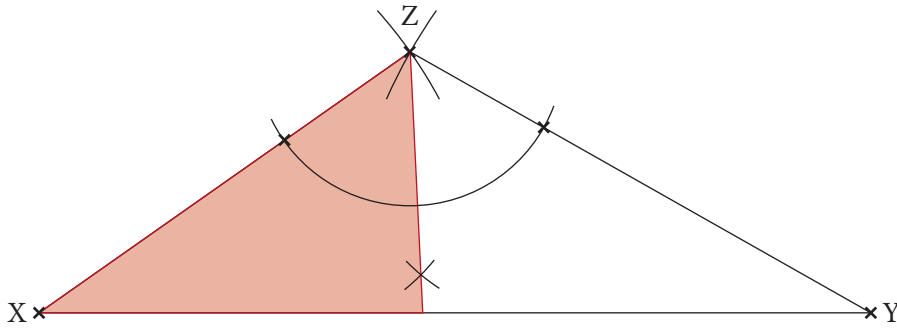


38.

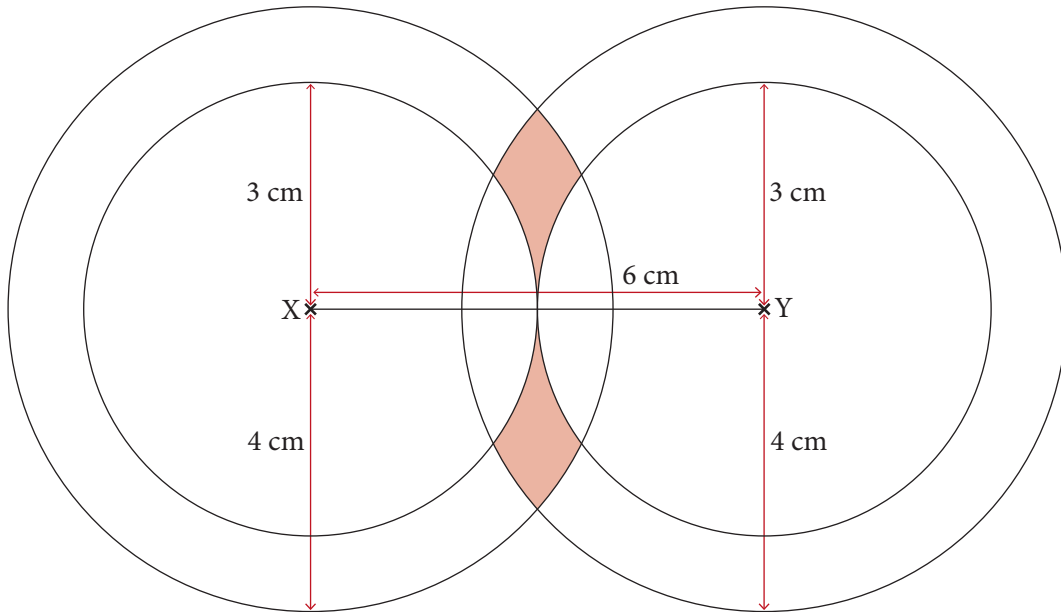


Answers: Progress Review (Chapters 29–33)

39.



40.



41. (a)

		Coin 1	
		H	T
Coin 2	H	(H, H)	(T, H)
	T	(H, T)	(T, T)

(b) $\frac{3}{4}$

42. (a)

		Dice 1					
		1	2	3	4	5	6
Dice 2	+						
	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) (i) $\frac{1}{4}$ (ii) $\frac{5}{12}$

Answers: Progress Review (Chapters 29–33)

43. $\frac{1}{28}$

44. (a) $\frac{5}{8}$

(b) Either of:

- The probability is only based on 40 games. A larger sample may give a more accurate probability.
- The probability of winning his next game depends on many factors, including the quality of his opponent.

45. (a) 36 250 (b) $\frac{24}{25}$ or 0.96 (c) 38 400

46. (a)

Number	1	2	3	4	5	6
Relative frequency	0.14	0.3	0.16	0.13	0.15	0.12

(b) 50

(c) The dice is probably biased towards 2 as either:

- the number of times 2 was rolled is 90, which is much greater than 50; or
- the relative frequency for 2 is 0.3, which is much greater than the other relative frequencies.

(d) 300

47. (a)

Total number of samples	Total number of times water quality is acceptable	Relative frequency
20	16	0.8
40	35	0.875
60	54	0.9
80	66	0.825
100	85	0.85

(b) 0.85

(c) The relative frequency of 0.85 is based on the largest number of samples.

(d) 170

48. (a) 6 (b) $\frac{1}{6}$ (c) 12 (d) $\frac{1}{12}$ (e) $\frac{1}{2}$