**Unit 1**- Numbers - Percentages

## Mixed practice

**1** 2

**2** $x = \frac{360°}{7} = 51.4$

**3** $\frac{7}{13}$

**4** 4 hours

**5** 3 hours

**6** 4 mg

**7** 47.5%

**8** 12 hours

**9** $\frac{5}{6}$ of the catalogue

**10** **a** after 5 months **b** 330 hamsters

**11** 36 apples

**12** 510 000 Euros

## Review in context

**1** **a** **i** 128 grains of rice
**ii** 32 768 grains of rice
**iii** $9.22 \times 10^{18}$ grains of rice
**b** **i** 2.56 $cm^2$
**ii** 655.36 $cm^2$
**iii** 167 772.16 $cm^2$
**c** 16.78 $m^2$
**d** 18 446 744.07 $km^2$
**e** **i** 255 grains of rice
**ii** 65 535 grains of rice
**iii** 16 777 215 grains of rice
**iv** $1.845 \times 10^{19}$ grains of rice

**2** **a** **i** 7 moves
**ii** 15 moves
**iii** 31 moves
**b** **i** 7 seconds
**ii** 31 seconds
**iii** 63 seconds = 1 minute 3 seconds
**c** **i** 1023 seconds = 17 min 3 seconds
**ii** 1 048 575 seconds = 12 days 3 h 16 min 15 s

**3** **a** Student's own answer
**b** $2\pi r$
**c** $2\pi(r + 1 \text{ inch}) = 2\pi r + 2\pi$ inches
**d** $2\pi$ inches
**e** No, the size of the sphere does not matter. The circumference increases by $2\pi$ inches independently of the radius $r$.

There may be more solutions to each question than provided here.

**4** **a** $(7 + 1) \times (2 + 1) = 24$ **b** $(2 + 2 + 4) \times 3 = 24$
**c** $(2 + 3 \times 6) + 4 = 24$ or $(3 - 2) \times 4 \times 6 = 24$
**d** $(12 + 7 \times 2) - 2 = 24$

## Mixed practice

**1** All answers correct at time of going to press.

**a** {Europe, Asia, Africa, North America, South America, Oceania, Antarctica}

**b** {Everest, K2, Kangchenjunga}

**c** {Burj Khalifa, Shanghai Tower, Abraj Al-Bait Clock Tower}

**d** {20, 25, 30, 35, 40, 45, 50}

**2** **a** infinite **b** infinite **c** finite, 5 **d** finite, 6

**3** **a** $\{x \mid x \in \mathbb{Z},\ x > 0\}$

**b** $\{x \mid x \in \mathbb{N},\ x = 3n,\ 1 \leq n \leq 7\}$

**c** $\{x \mid x \in \mathbb{Z},\ x \text{ is a square number}\}$

**d** $\{x \mid x \in \mathbb{Z}^+,\ x \text{ is a cube number} \leq 1000\}$

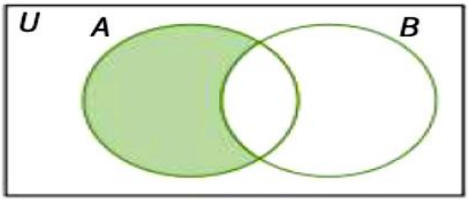
**4** **a** {7, 14}

**b** {11, 13, 17, 19}

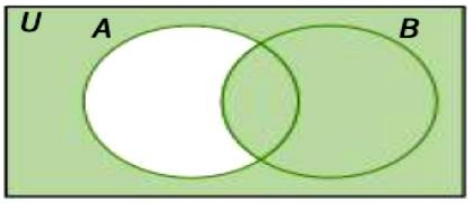
**c** {even multiples of 7: 14, 28, 42, ...}

**d** $\{x \mid x \in \mathbb{N},\ x \neq 7\}$

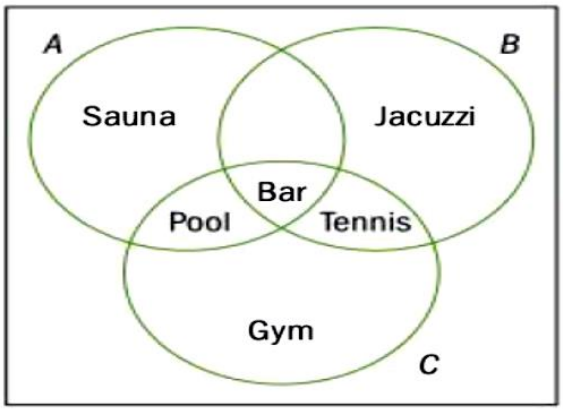
**5** **a**



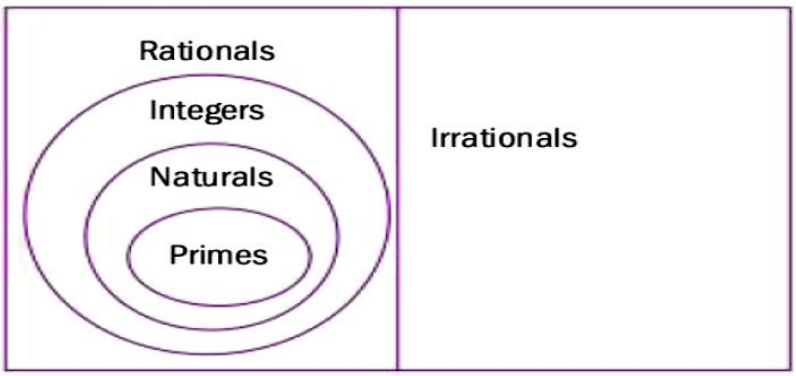

**b**



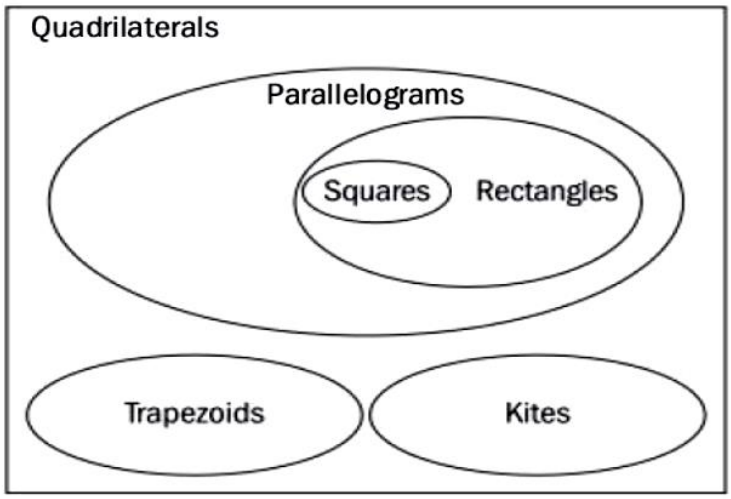

**6**




**7** Real Numbers



**8**




**9** **a** {0}
**b** {−10, 6, 7, 8, 9, 10}
**c** {−5, −4, −3, −2, −1, 0, 1, 2, 3, 4, 5}
**d** {−9, −8, −7, −6, −5, −4, −3, −2, −1}
**e** {0, 1, 2, 3, 4, 5}

**10** **a** True **b** False: $2 \in \{\text{primes}\}$
**c** True **d** True

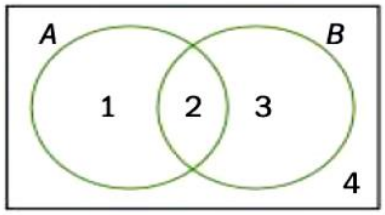
**11** 13

**12** **a** 6 **b** 3 **c** 5 **d** 21

## Review in context

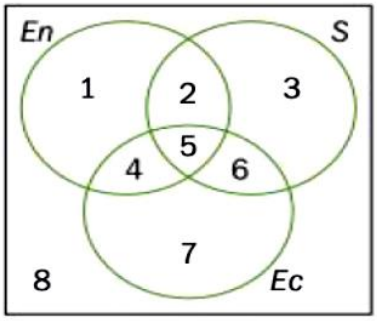
**1** **a** 464, 1101, 3154 **b** 14
**c** Student's own answers

**2** **a**




A: Truths; B: Beliefs
Region 2 defines Knowledge

**b**




Region 5: Sustainable
Regions 5 and 2: Bearable
Regions 5 and 4: Viable
Regions 5 and 6: Equitable

**3** **a** 10 660 **b** 18 402
**c** Mouse: 15 213, Chicken: 11 705, Zebrafish: 12 897
**d** Mouse: 82.7%, Chicken: 63.6%, Zebrafish: 70.1%
**e** Mouse

# Mixed practice

**1 a** A function, because each input has a unique output.
**b** A function, because each input has a unique output.
**c** A relation, because some inputs have more than one output.
**d** A relation, because the input 3 has more than one output.
**e** A function, because each input has a unique output.
**f** A relation, because some inputs have more than one output.
**g** A function, because each input has a unique output.
**h** Not a function, as e.g. $x = 0$ maps to 3 and $-3$. Also, the graph does not pass the vertical line test.
**i** Not a function, as $x = 1$ maps to all values between 0 and 1. Also, the graph does not pass the vertical line test.
**j** A function, as e.g. $x = 1$ maps to 5, not 10 as the open circle shows the value is not included. Also, the graph passes the vertical line test.

**2 a** Domain = $\{-2, 1, 2\}$, Range = $\{-4, 1, 4\}$
**b** Domain = $\{3, 4, 5\}$, Range = $\{5, 6\}$
**c** Domain = $\{-3, -2\}$, Range = $\{-3, -2, 5\}$
**d** Domain = $\{1, 2, 5\}$, Range = $\{1, 3, 8\}$

**3 a** The domain is $x \in \mathbb{R}$.
The range is $f(x) \in \mathbb{R}$.
**b** The domain is $\{x \mid x \in \mathbb{R}, x \geq 0\}$
The range is $\{f(x) \in \mathbb{R} \mid f(x) \geq 0\}$

**c** The domain is $x \in \mathbb{R}$.
The range is $f(x) \in \mathbb{R}$.

**d** The domain is $\{x \mid x \in \mathbb{R}, x \neq 0\}$
The range is $\{f(x) \in \mathbb{R} \mid f(x) \neq 0\}$

**e** The domain is $\{x \mid x \in \mathbb{R}, x \neq 4\}$
The range is $\{f(x) \in \mathbb{R} \mid f(x) \neq 0\}$

**f** The domain is $x \in \mathbb{R}$.
The range is $\{f(x) \in \mathbb{R} \mid f(x) \geq -1\}$

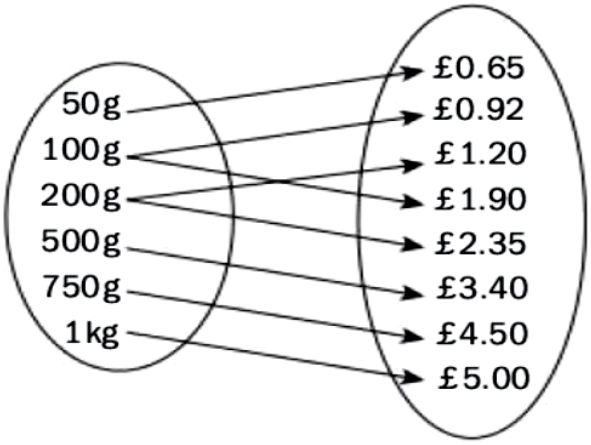
**4 a** **i** $-2$ **ii** 0 **iii** $-2$
**b** **i** 28 **ii** 20 **iii** 4
**c** **i** 0 **ii** 2
**iii** undefined for real numbers
**d** **i** 11 **ii** $8x + 3$ **iii** $7 - 2x$

**5 a** **i** $x = 5$ **ii** $x = 0.5$ **iii** $x = 1$
**b** **i** $x = 5$ **ii** $x = -4$ **iii** $x = 0.5$
**c** **i** $-\sqrt{5}$ **ii** 1 **iii** 3

**6 a** Because a word only ever has one amount of letters in it.
**b** $p$(word) = number of letters
**c** **i** 5 **ii** 11 **iii** 2
**d** **i** Student's own 3-letter word
**ii** Student's own 8-letter word
**e** 5 **f** 4

**7 a** Each value $n$ maps to one and only one value $T(n)$.
**b** Domain = $\{-3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$ (ground floor is zero, so the 9 floors above ground are 0 to 8)
**c** Student's suggestions for values of $T(n) \geq 0$
**d** Range $T(n) \geq 0$ with maximum value and suitable justification. E.g. $0 \leq T(n) < 1440$ because there are 1440 minutes in 24 hours and the lift will not return to a floor in less than one minute.

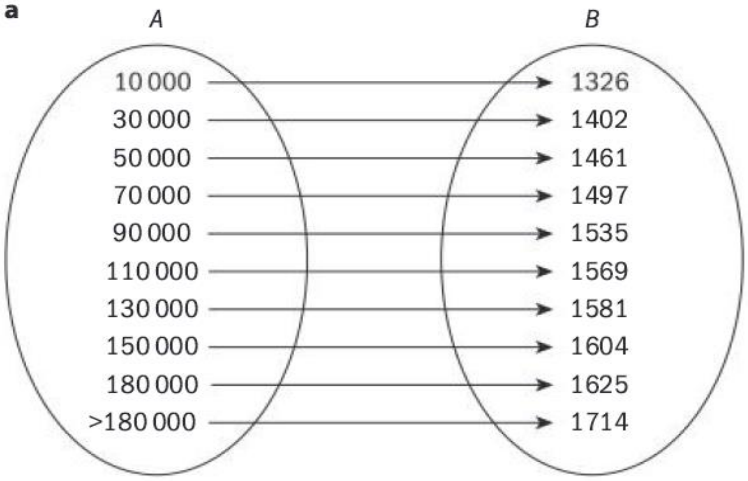
**a, b** Weight determines price




**c** Not a function, because e.g. 100 g maps to two possible prices.

## Review in context

**1 a**




**b** Yes, it is a function.

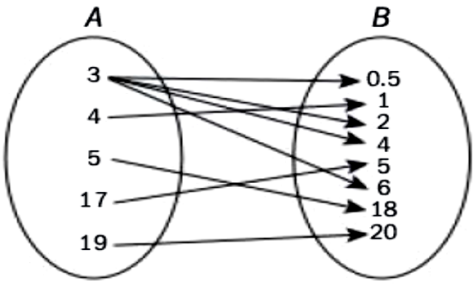
**c** Higher income may enable the student to have access to tutoring or better books etc. or the higher income may be a result of higher intelligence.

**d** Student's own decision and explanation.

**2 a** Input = Percentage of world population,
Output = Percentage of world's resources used.
Domain = $\{x \mid x \in \mathbb{R}, 0 \leq x \leq 100\}$
Range = $\{y \mid y \in \mathbb{R}, 0 \leq y \leq 100\}$

**b** No, because the input value 3, for percentage of world population, has multiple output values.

**c**




**d** Student's own opinion.

**e** Student's own opinion.

**3 a** $C = 24\,000 - 1000a$

**b** $C(18)$ represents the average cost of car insurance for an 18 year old male.
$C(18) = \$6000$

**c** Yes

**d** Student's own explanation.

**e** $C(21)$ represents the cost of car insurance for an 21 year old male.
$C(21) = \$3000$

**f** Because otherwise it would have a negative cost over the age of 24.

# UNIT 3: GEOMETRY & TRIGONOMETRY- COORDINATE GEOMETRY

## Mixed practice

**1** **a** 13 **b** 5 **c** 6 **d** 25

**2** **a** 7.81 **b** 11.4 **c** 6.45

**3** **a** $\sqrt{80}$ **b** $\sqrt{185}$ **c** $\sqrt{117}$

**4** **a** (5, 7) **b** (1, 3.5) **c** (−5.5, −9.5)

**d** (−0.65, 8.55) **e** $\left(\frac{7}{24}, \frac{5}{12}\right)$

**5** Distance (0, 0) to (6, 0) = 6
Distance (0, 0) to (3, 4) = 5
Distance (3, 4) to (6, 0) = 5
Two sides are the same length, therefore it is an isosceles triangle.

**6** Distance $AB = \sqrt{50}$

Distance $BC = \sqrt{40}$

Distance $AC = \sqrt{50}$

Two sides are the same length, therefore $ABC$ is an isosceles triangle.

**7** 3.6 units (1 d.p.)

**8** $B$

**9** Midpoint of $AB$, $M = \left(\frac{a+c}{2}, \frac{b+d}{2}\right)$

Midpoint of $AM$ divides $AB$ in the ratio 1 : 3

Midpoint of $AM = \left(\frac{a+\frac{a+c}{2}}{2}, \frac{b+\frac{b+d}{2}}{2}\right) = \left(\frac{3a+c}{4}, \frac{3b+d}{4}\right)$

**10** **a** $M = \left(\frac{a+c}{2}, \frac{b+d}{2}\right)$

**b** $AB = \sqrt{(c-a)^2 + (d-b)^2}$

**c, d** $AM = \frac{1}{2}\sqrt{(c-a)^2 + (d-b)^2}$

**11** **a** $AC = 8$, $AB = 9.85 = BC$

**b** Midpoints: (5, 0), (3, 4.5), (7, 4.5)

**c** Distance (3, 4.5) to (7, 4.5) = 4 units
Distance (5, 0) to (3, 4.5) = 4.92 = distance (5, 0) to (7, 4.5)

**d** Triangle has base 4 and perpendicular height 4.5, area = 9

**12** **a** The 4th column needs to contain a 2 and a 1, but only the 3rd row doesn't include 2 and 1 already.

**b** **i** The only number missing from the top row is 2.

**ii** Student's explanation

| | | | |
|---|---|---|---|
| 1 | 4 | 3 | **2** |
| | **2** | | 4 |
| | | **2** | |
| 2 | 1 | | |

**iii**

| | | | |
|---|---|---|---|
| 1 | 4 | 3 | **2** |
| **3** | **2** | **1** | 4 |
| **4** | **3** | **2** | **1** |
| 2 | 1 | **4** | **3** |

**13** (11, 3)

## Review in context

**1** (9, 9)
**2** (9.5, 4)
**3** (12, 12)
**4** The crown is at Mermaid Pool.
This is because the distance from Falling Palms to Grey Cliffs is $\sqrt{7^2+1^2} = \sqrt{50} \approx 7.07$ leagues.
The distance from Kaspar's cave to Mermaid Pool is $\sqrt{5^2+5^2} = \sqrt{50} \approx 7.07$ leagues.
Drawing a circle centered on Kaspar's Cave and passing through Mermaid Pool only gives one location, so there are no others the same distance from the cave.
**5** The midpoint between Kaspar's Cave and the Grey Cliffs is $\left(\frac{7+3}{2}, \frac{7+10}{2}\right) = (5, 8.5)$.
The midpoint between (5, 8.5) and Pirates' Port is (12, 8.5).
**6** **a** 5 leagues
**b** 5 leagues
**c** Since it has two sides of equal length, it is isosceles.
**d** Since isosceles triangles have a line of symmetry through the vertex, the point on the base that is closest to the vertex is the midpoint of the base.
**e** (2.5, 6.5)

# UNIT: STATISTICS AND PROBABILITY -1

## Mixed practice

**1** **a** Qualitative **b** Quantitative
**c** Quantitative **d** Quantitative

**2** **a** Continuous **b** Discrete
**c** Continuous **d** Continuous

**3** **a**

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

Key: 4 | 6 represents 46

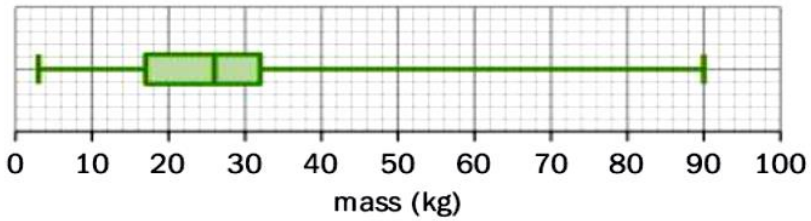
**b** 4 **c** 61 kg **d** 36 kg

**4** **a** 39 min **b** 16 min **c** 32 min

**5** **a** $r = 10, s = 13$ **b** 18

**6 a** 3, 17, 26, 32, 90

**b**




**7 a** 18 **b** $a = 10, b = 44$ **c** 40

**8 a** Film A had on average older people watching and a greater spread of ages.

**b** A: Young and old people attended.

**9 a** £132 000 **b** £560 000

**c** £559 000, included since a possible value

**d** Median: £85 000, not affected by outliers.

**10 a**

| Farm A | | Farm B |
|---|---|---|
| 9 | 1 | |
| | 2 | |
| | 3 | |
| 9 9 8 8 5 3 | 4 | 9 9 |
| 7 6 5 5 | 5 | 0 4 4 6 7 |
| 5 4 4 3 0 | 6 | 2 4 6 8 8 |
| | 7 | 0 0 1 2 |

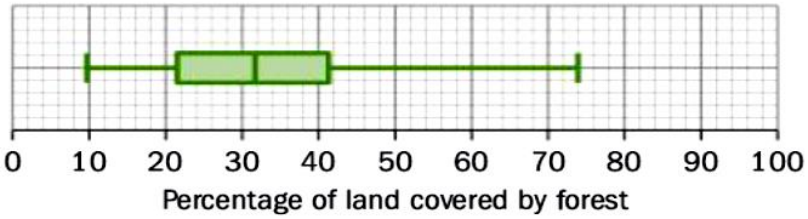
Key: 3 | 4 | 9 represents 43 for Farm A and 49 for Farm B

**b** Farm B had a higher average and greater spread.

**c** Both look like Average/good hill because the range of values fits that profile.

## Review in context

**1 a**




**b** Finland is a possible outlier.

**2** 2012 had a slightly lower average and values generally lower overall. Suggests forest areas reduced.

**3** Student's own answers

## UNIT: STATISTICS AND PROBABILITY -2

# Mixed practice

**1 a**

| Mass (grams) | Frequency |
|---|---|
| $250 \le x < 300$ | 5 |
| $300 \le x < 350$ | 7 |
| $350 \le x < 400$ | 6 |
| $400 \le x < 450$ | 4 |
| $450 \le x < 500$ | 10 |
| $500 \le x < 550$ | 3 |

Other intervals are acceptable.

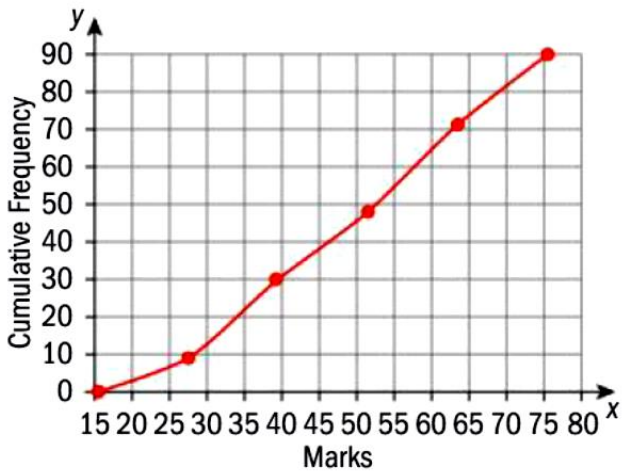
**b** $450 \le x < 500$ **c** $350 \le x < 400$ **d** 398

**2 a** 60

**b**

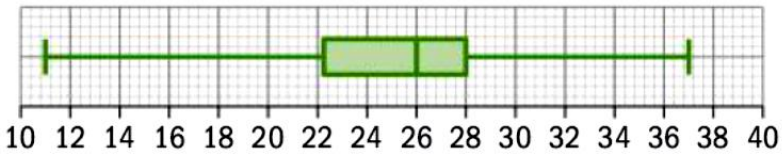
| Mark | Frequency | Cumulative Frequency |
|---|---|---|
| $16 \le x \le 27$ | 9 | 9 |
| $28 \le x \le 39$ | 21 | 30 |
| $40 \le x \le 51$ | 18 | 48 |
| $52 \le x \le 63$ | 23 | 71 |
| $64 \le x \le 75$ | 19 | 90 |

**c**

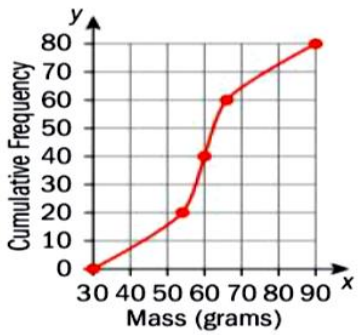



**3 a** 26 cm **b** About 5.75 cm

**c**



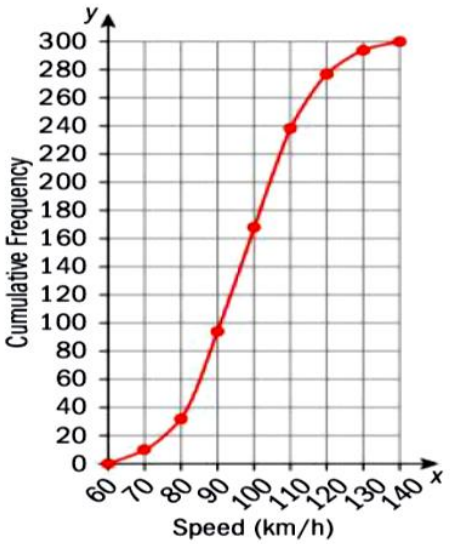
**4**




**5** **a** 98.0 km/h to 1 d.p.

**b** $a = 167$ and $b = 277$

**c**




**d** 108 km/h

**6** **a** **i** 72 grams **ii** 76 grams

**b** $x = 82$

**7** **a** 24.2 cm

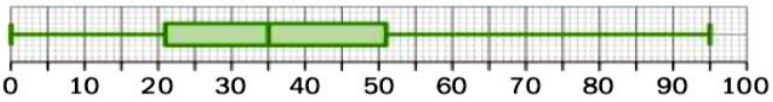
**b** About 11 cm

**c** 62 fish

**d** 76 small fish, 62 large fish

**e** About $1076

**8** Any sensible comparisons.
e.g. the distributions are very similar.
The two box and whisker plots are the same.

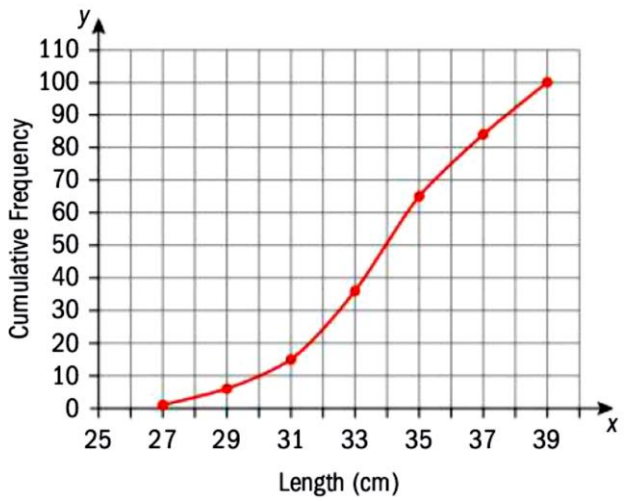



## Review in context

**1** **a**

| Length $L$ cm | Frequency | Cumulative Frequency |
|---|---|---|
| $25 < L \leq 27$ | 1 | 1 |
| $27 < L \leq 29$ | 5 | 6 |
| $29 < L \leq 31$ | 9 | 15 |
| $31 < L \leq 33$ | 21 | 36 |
| $33 < L \leq 35$ | 29 | 65 |
| $35 < L \leq 37$ | 19 | 84 |
| $37 < L \leq 39$ | 16 | 100 |

**b**



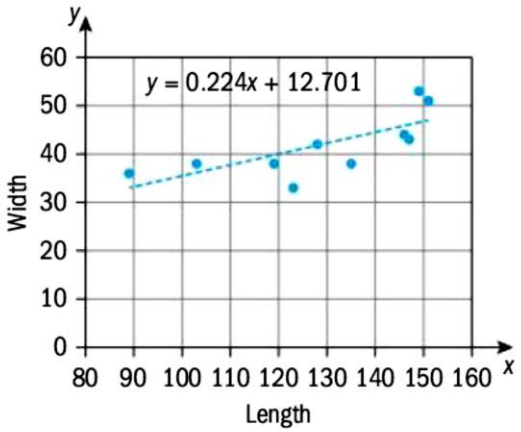

**c** 25, 32, 34, 36, 39 **d** 32 cm

**e** **i** About 70%
**ii** About 56%
**iii** About 63%

## UNIT: STATISTICS AND PROBABILITY – 3

### Mixed practice

**1 a c**




**b** Moderate positive correlation

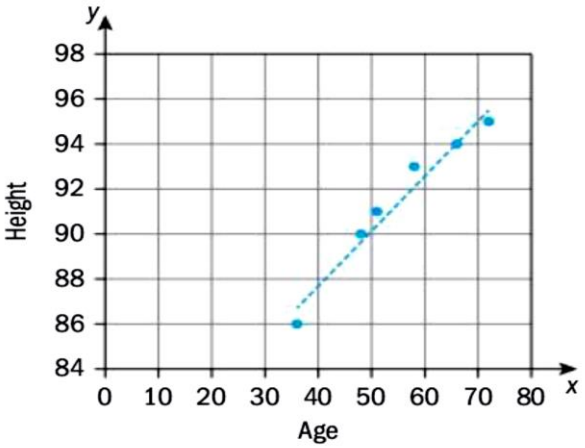
**2 a** You cannot correlate non-numerical data – here 'correlation' is used informally at best.

**b** This could be correct since they both have risen – the correlation is, however, spurious.

**c** This should be *negative* correlation.

## Review in context

**1 a**




**b** 88.2 cm

**c** No – outside the range of data – relationship may not continue

**2 a** Moderate negative correlation **b** 48 min

**c** No – outside the scope of the data – relationship unlikely to continue that far out.

## UNIT: STATISTICS AND PROBABILITY – 4

# Mixed practice

**1 a** (P, A) (P, B) (P, C) (P, F) (F, A) (F, B) (F, C) (F, F)

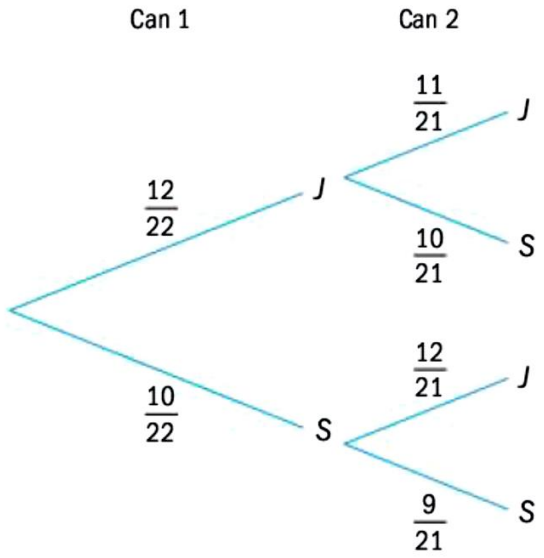
| | A | B | C | F |
|---|---|---|---|---|
| P | P,A | P,B | P,C | P,F |
| F | F,A | F,B | F,C | F,F |

**b i** $\frac{3}{8}$ **ii** $\frac{1}{2}$ **iii** $\frac{1}{8}$

**2 a** A+, A−, B+, B−, AB+, AB−, O+, O−

**b** $\frac{1}{8}$ **c** $\frac{2}{8} = \frac{1}{4}$ **d** $\frac{1}{2}$ **e** $\frac{1}{2}$

**3**

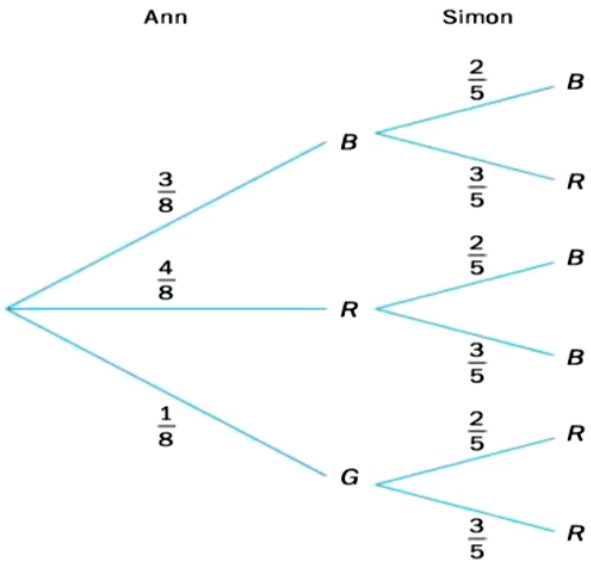



**a** $\frac{2}{7}$ **b** $\frac{37}{77}$

**c** $\frac{40}{77}$ **d** $\frac{15}{77}$

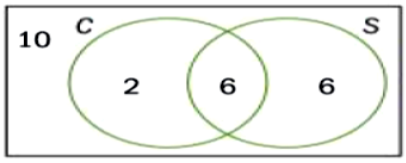
**4** **a** 1 2 **b** $\frac{1}{4}$ **c** $\frac{1}{6}$ **d** $\frac{1}{6}$

**5** **a**



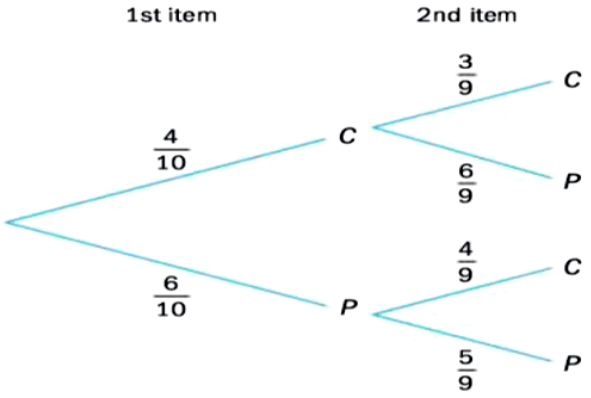

**b** $\frac{3}{20}$ **c** $\frac{11}{20}$

**6** **a**




**b** $\frac{6}{24}=\frac{1}{4}$ **c** $\frac{2}{24}=\frac{1}{12}$ **d** $\frac{10}{24}=\frac{5}{12}$

**7** **a**




**b** $\frac{8}{15}$

**8** **a** As above but second level probabilities are $\frac{4}{10}, \frac{6}{10}, \frac{4}{10}, \frac{6}{10}$

**b** $\frac{12}{25}\left(\text{down by } \frac{4}{75}\right)$

**9** **a**

| | More | Right | Less | |
|---|---|---|---|---|
| M | 60 | 4 | 8 | 72 |
| F | 20 | 4 | 24 | 48 |
| | 80 | 8 | 32 | 120 |

**b** $\frac{8}{120}=\frac{1}{15}$ **c** $\frac{8}{120}=\frac{1}{15}$ **d** $\frac{20}{48}=\frac{5}{12}$

**10** **a** $\frac{23}{50}$ **b** $\frac{11}{50}$ **c** $\frac{40}{50}=\frac{4}{5}$ **d** $\frac{17}{50}$

## Review in context

**1 a** 15.8%
**b** The risk increases
**c** About 5 times less
**d** Student's own answers

**2 a** 0.003375 **b** 0.06075 **c** 0.614125

**3 a**

| | | | Mother | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | MM | | Mm | | mm | |
| | | | M | M | M | m | m | m |
| Father | MM | M | MM | MM | MM | Mm | Mm | Mm |
| | | M | MM | MM | MM | Mm | Mm | Mm |
| | Mm | M | MM | MM | MM | Mm | Mm | Mm |
| | | m | mM | mM | mM | mm | mm | mm |
| | mm | m | mM | mM | mM | mm | mm | mm |
| | | m | mM | mM | mM | mm | mm | mm |

**b** $\frac{9}{36} = \frac{1}{4}$ **c** $\frac{27}{36} = \frac{3}{4}$

**d**

| | |
|---|---|
| MM | Mm |
| mM | mm |

¼

**e** $\frac{6}{16}$ **f** $\frac{9}{16}$ **g** Mm and mm

# UNIT: NUMBERS – CURRENCY CONVERSION

## Mixed practice

**1 a** 1045 USD **b** 2500 EUR

**2 a** 242 USD **b** 2.42 USD **c** 239.58 USD

**3** 1128.96 GBP

**4 a** 148120 RUB **b** 13.23 GBP

**5** $p = 0.79$, $q = 0.65$

**6 a** 3847 THB
**b** 0.2990 USD
**c** 0.04090 NZD
**d** 0.1368 NZD

**7 a** 560 EUR **b** 767.12 AUD **c** 32.88 AUD

**8 a** 274.40 CHF **b** 70 GBP

**9** 483.74 EUR

**10 a** 38 860 THB **b** 818.00 NZD **c** 1 NZD = 18.25 CZK

## Review in context

**1 a** 2732.40 SGD **b** s = 2.07(b – 10) **c** The British bank

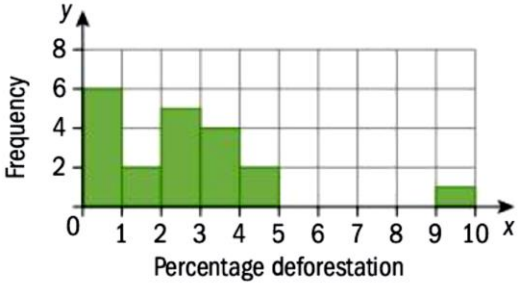
**2 a** 3960 CHF, 7500 BRL, 21750 SEK
**b** 4082.47 USD, 4934.21 USD, 3398.44 USD
**c** 4658.82 USD, 2279.64 USD, 2338.71 USD

## Review in context

**1 a** $(0 \times 4) + (1 \times 10) + (2 \times 7) + (3 \times 3) + (4 \times 1) = 37$; $\frac{37}{25} = 1.48$

**b** More children on average in Australia; Bigger spread of children in Australia. Both distributions unimodal and skewed slightly to the left.

**2 a**




**b** Skewed to the left **c** 9.2%

## Review in context

**1 a** 57, 3951057 **b** 0.00 %, 0.287 %

**c** Percentage errors are very small because the population is extremely large. However an absolute error of 3.95 million represents quite a large number of people, even though the percentage error is less than 0.5 %.

**d** 24 768 881

**e** 1 351 280 062 to 1 400 817 824

**f** If the government claims the official figure may be inaccurate by 1.8% (which is 24.7 million people), then 1.4 billion is good estimate since the absolute error (24 million) is within the acceptable range, and gives an idea of the size of the total population.

**g** **United States:**
Absolute error: 5 785 956, Reliable Value: 320 million (320 million has a smaller percentage error than 1.8%, but 300 million has a larger percentage error than 1.8%)
**Germany:**
Absolute error: 1 452 394, Reliable Value: 80 million (rounded to the nearest 10 million; 80 million has a smaller percentage error than 1.8%)
**Malaysia:**
Absolute error: 545 958, Reliable Value: 30 million (30 million has a smaller percentage error than 1.8%)
**Australia:**
Absolute error: 431 442, Reliable Value: 24 million (24 million has a smaller percentage error than 1.8%, but 20 million has a larger percentage error than 1.8%)
**Monaco:**
Absolute error: 679, Reliable Value: 38 000 (38 000 has a smaller percentage error than 1.8%, but 40 000 has a larger percentage error than 1.8%)

**2** **a** 403 597 **b** 23.9%
**c** 263 757 **d** an increase
**e** Student's own answer. Ideas include the aging of the population (increase in percentage of population over 65) and the increase in the total population.

**3** **a** 4.45%
**b** To bias should let Felix know how the amount had been rounded and let Felix decide if it was reasonable.
**c** 13 cents; 4.45%
**d** The percentage errors are the same.

## Review in context

**1** **a** **i** 227.38 m **ii** 2331.72 m **iii** 128 720 km
**b** 7850 kg/m$^3$ **c** 278 377.48 m$^3$
**d** **i** 53.975 mm **ii** 32.725 mm

**2** **a** 1435 mm
**b** **i** 1422 mm **ii** 13 mm **iii** 2.4% error
**c** 3 ft 3 in
**d** Student's own answers, such as 'some trains travel from Spain to France.'

## UNIT: GEOMETRY – ARC LENGTH AND SECTOR

### Mixed practice

**1** **a** 2.09 mm **b** 8.78 mm **c** 5.17 $mm^2$

**2** **a** 62.31 km **b** 436.16 $km^2$

**3** **a** Perimeter = 25.07 feet, Area = 31.81 square feet.
**b** Perimeter = 67.48 feet, Area = 222.66 square feet.

**4** **a** 3.93 m **b** 13.93 m **c** 68.72 $m^2$

**5** **a** 120° **b** 16.76 cm
**c** 32.76 cm **d** 13.86 cm

**6** **a** 110° **b** 39.2 km **c** 16.38 km

**7** **a** Student's own diagram:
a correctly labelled rectangle.
**b** Student's own diagram,
with center of the circle at the center of the rectangle.
**c** 70.36 $m^2$
**d** 12 %

**8** 30 cm

### Review in context

**1** **a** 23.56 cm **b** 19.10°

**2** **a** 190.46 $m^2$ **b** 0.347 $m^2$ **c** 190.1 $m^2$

**3** **a** 12.86° **b** 16.16 $m^2$
**c** 23.64 m **d** 15.43 m

## UNIT: TRIGONOMETRY

### Mixed practice

**1** 17.0 m (3 s.f.)

**2** **a** 145 m (3 s.f.) **b** 13.5 cm (3 s.f)

**3** **a** 24.6° **b** $\sqrt{119}$ cm (10.9 cm to 3 s.f.)
**c** 3.9 cm **d** 5.9 cm
**e** 122.7° (1 d.p.)

**4** **a** 4.24 m (3 s.f.) **b** 5.15 m (3 s.f.)

**5** 35.1° **6** 73.9 m (3 s.f.)

### Review in context

**1** 29 000 feet (3 s.f.) **2** 12.6° (3 s.f.)

## UNIT: NUMBERS – PATTERNS

# Mixed practice

**1 a** $u_n = 4n + 2$
**b** $u_n = 49 - 7n$
**c** $u_n = n^2 + 1$
**d** $u_n = n^2 + 2n$
**e** $u_n = 4.5n - 2$
**f** $u_n = 2.5n^2 - 3n$
**g** $u_n = -2n^2 + 10n + 1$
**h** $u_n = -0.5n^2 + 2.5n + 4$

**2** 311

**3 a** 12, 7, 2, –3, –8
**b** $u_n = 17 - 5n$

**4 a** 15, 22, 29, 36, 43
**b** $u_n = 7n + 15$
$u_{10} = 7 \times 10 + 15 = 85$

**5** 1008

**6 a** $u_n = n^2 + 3n$
**b** 70
**c** $u_{20} = 20^2 + 3 \times 20 = 460$

**7 a** $u_n = \frac{1}{3}n^2 + n + \frac{2}{3}$

**b** $u_{20} = 154$

**8 a** 7 **b** 34

**9** 7.5

**10** 19

**11 a** 1230 **b** 1860 **c** $5n^2 + 605n$ **d** 22650 **e** 15

**12 a** constant difference of 6, therefore a linear sequence
**b** $T_n = 6n + 2$
**c** 9

# Review in context

**1 a** $u_n = 6n + 6$ **b** 186

**2 a** constant difference of 70, therefore a linear sequence
**b** $P_n = 70n - 30$
**c** 530
**d** e.g. Because a greater proportion of a one carriage train is taken up by the place where the driver sits, engine, or service areas.

**3 a** AB, BC, AC, BA, CB, CA
**b** AB, AC, AD, BC, BD, CD, BA, CA, DA, CB, DB, DC
12 journeys
**c** AB, AC, AD, AE, BC, BD, BE, CD, CE, DE, ED, EC, DC, EB, DB, CB, EA, DA, CA, BA
20 journeys
**d** $n^2 - n$ or $n(n - 1)$
**e** 2970
**f** 222

## Mixed practice

**1** **a** $(x+2)^2$ **b** $(x-4)(x-9)$
**c** $(x+7)(x-2)$ **d** $(x+9)^2$
**e** $(x-8)(x+1)$ **f** $(x-3)(x-8)$
**g** $(x-10)^2$ **h** $(x-20)(x+5)$
**i** $(x+1)(x+3)$ **j** $(x+14)(x-3)$
**k** $(x+12)(x-8)$ **l** $(x+1)(x+6)$
**m** $(x-7)(x-8)$ **n** $(x-15)(x+4)$

**2** **a** $(x+7)(x-7)$ **b** $(x+13)(x-13)$
**c** $(8+x)(8-x)$ **d** $(5x+2)(5x-2)$
**e** $(12x+9)(12x-9)$ **f** $(16x+13)(16x-13)$
**g** $(2x+y)(2x-y)$ **h** $(4x+3y)(4x-3y)$
**i** $(5x+17y)(5x-17y)$
**j** $(x^2+4)(x+2)(x-2)$
**k** $(4x^2+1)(2x+1)(2x-1)$
**l** $9(x^2+9y^2)(x+3y)(x-3y)$

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

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

**5** **a** $a(4a-3)$ **b** $7b(b+3)(b-8)$

**6** **a** $(a-9)(a+4)$ **b** $(4b+3)(4b-3)$
**c** $(c+8)(c+3)$ **d** $(4d+3)(d-5)$
**e** $e(4e-3)$ **f** $(f+8)(f-6)$
**g** $(3g-2)(g-7)$ **h** $(4h+1)(4h-1)$

**7** **a** $(n+4)^2-9$
**b** It factorizes to
$(n+4+3)(n+4-3)$
$=(n+7)(n+1)$
which are two integers with a difference of 6.

**8** **a** $x^2-8x+15=(x-3)(x-5)$
**b** $x^2+9x+20=(x+4)(x+5)$
**c** $x^2-8x-33=(x+3)(x-11)$
**d** $x^2-11x+30=(x-5)(x-6)$

**9** $(2n)^2-1=(2n+1)(2n-1)$
which is the product of two consecutive odd integers.

**10** **a** $2n^2+13n+15$
**b** Since it factorizes to give $(2n+3)(n+5)$, a rectangle with sides $(2n+3)$ and $(n+5)$ could be formed.

**11** $4n^2+28n+45=(2n+5)(2n+9)$
The pitch is 5 m by 9 m.

**12** **a**

| Sequence | 8 | | 45 | | 112 | | 209 | | 336 |
|---|---|---|---|---|---|---|---|---|---|
| First difference | | 37 | | 67 | | 97 | | 127 | |
| Second difference | | | 30 | | 30 | | 30 | | |

2nd difference is constant.

## Mixed practice

**1** **a** 466 $cm^2$, 576 $cm^3$ **b** 77.6 $cm^2$, 40 $cm^3$
**c** 118 $cm^2$, 84.8 $cm^3$ **d** 13.1 $cm^2$, 3.14 $cm^3$
**e** 845 $cm^2$, 2310 $cm^3$ **f** 452 $cm^2$, 905 $cm^3$

**2** **a** 393 $cm^2$, 407 $cm^3$ **b** 221 $cm^2$, 172 $cm^3$

**3** **a** 8.00 cm (3 s.f.) **b** 163 $cm^3$

**4** Yes the soccer ball satisfies the regulations.
It is 69.2 cm in circumference.

**5** **a** 3.00 cm **b** 56.7 $cm^3$

**6** 200 $cm^2$

## Review in context

**1** **a** 1.58… – pretty close
**b** 85 500 $m^2$
**c** Ratio is 1.61… pretty close
**d** 2 570 000 $m^3$
**e** 921.6 m and 914.2 m – they are very close

**2** **a** 3.90 $cm^2$, 49.7 $cm^2$
**b** 0.724 $cm^3$, 33.0 $cm^3$

**3** Circumference of the ball is 94.3 cm so it was a pretty tight fit!

**4** **a** The 215 cm tall tree has more area for decorations (4 720 000 $cm^2$; the 180 cm tree has area 3 520 000 $cm^2$).
**b** 8100 $ft^2$ is available for decorations.

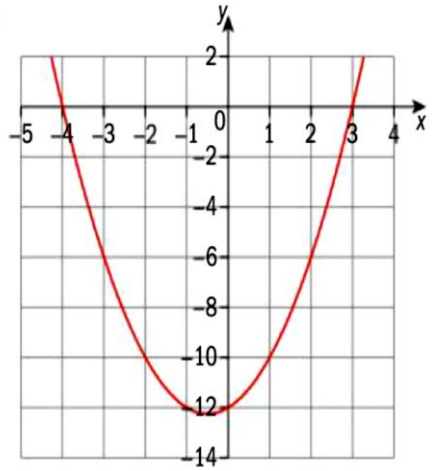
## UNIT: ALGEBRA – QUADRATIC EQUATION

# Mixed practice

**1 a i** vertex is (−0.5, −12.25)
$x$-intercepts are −4 and 3
$y$-intercept is −12

**ii** axis of symmetry is $x = -0.5$
It is concave up.

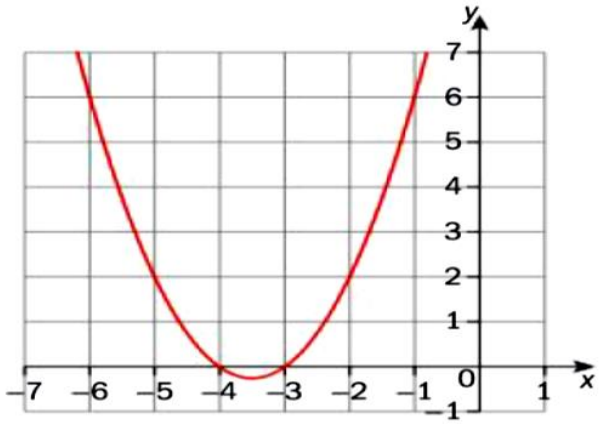
**iii**




**b i** vertex is (−3.5, −0.25)
$x$-intercepts are −4 and −3
$y$-intercept is 12

**ii** axis of symmetry is $x = -3.5$
It is concave up.

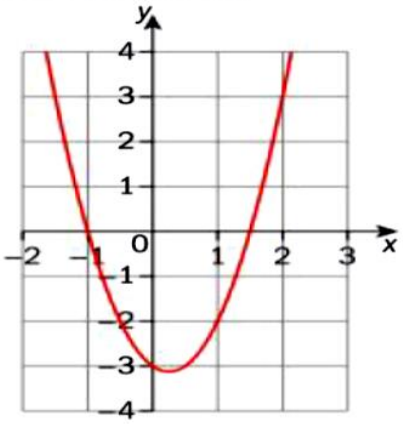
**iii**




**c i** vertex is (0.25, −3.125)
$x$-intercepts are −1 and 1.5
$y$-intercept is −3

**ii** axis of symmetry is $x = 0.25$
It is concave up.

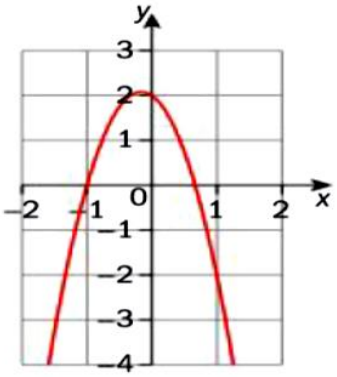
**iii**




**d i** vertex is $\left(-\frac{1}{6}, 2\frac{1}{12}\right)$
$x$-intercepts are −1 and $\frac{2}{3}$
$y$-intercept is 2

**ii** axis of symmetry is $x = -\frac{1}{6}$
It is concave down.

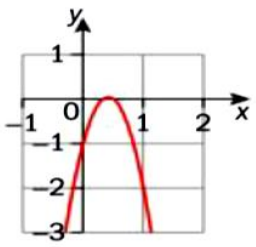
**iii**




**e i** vertex is $\left(\frac{5}{12}, \frac{1}{24}\right)$
$x$-intercepts are $\frac{1}{3}$ and $\frac{1}{2}$
$y$-intercept is −1

**ii** axis of symmetry is $x = \frac{5}{12}$
It is concave down.

**iii**




**f i** vertex is $(2.25, -15\frac{1}{8})$

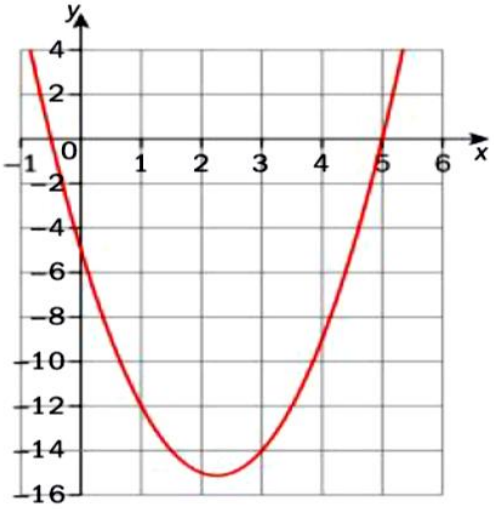
$x$-intercepts are $-0.5$ and $5$

$y$-intercept is $-5$

**ii** axis of symmetry is $x = 2.25$

It is concave up.

**iii**




**2 a** $y = (x - 2)^2 + 2$
$(2, 2)$

**b** $y = (x + 3)^2 - 1$
$(-3, -1)$

**c** $y = (x + 1)^2 - 10$
$(-1, -10)$

**d** $y = (x - 1)^2 + 6$
$(1, 6)$

**e** $y = (x + 0.5)^2 - 5.25$
$(-0.5, -5.25)$

**f** $y = (x - 0.5)^2 + 6.75$
$(0.5, 6.75)$

**3 a** Area $= 300x - 3x^2$ **b** 50 m **c** 7500 m$^2$

**4** 10 m by 10 m

**5 a** 176.32 months **b** 12913

**c** During the 361st month

**6** $y = -(x - 2)^2 + 9$ or $y = 5 + 4x - x^2$

## Review in context

**1** Student's own work.

**2 a** Answers will vary, e.g. $y = -0.408(x - 4.9)^2 + 9.8$

**b** A rectangle.

**c** 8 meters at the very most.

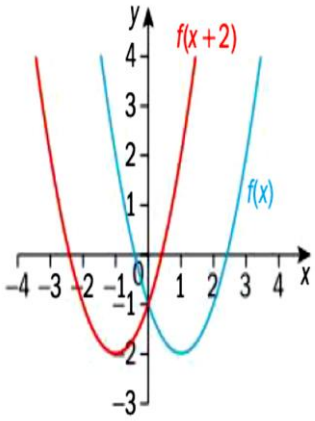
**d** Student's own explanation.

**e** 3.13 m

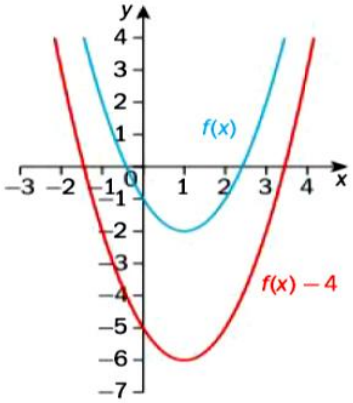
**UNIT: FUNCTIONS – TRANSFORMATION**

## Mixed practice

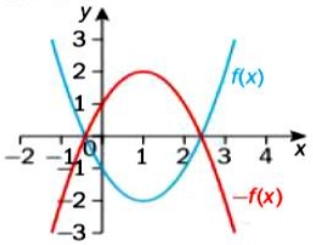
**1 a** (−1, −2)



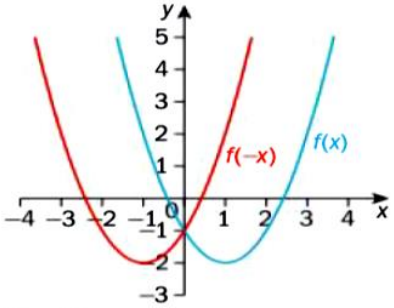

**b** (1, −6)



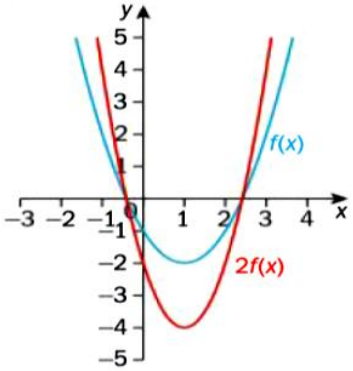

**c** (1, 2)



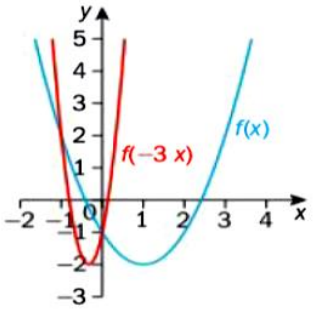

**d** (−1, −2)



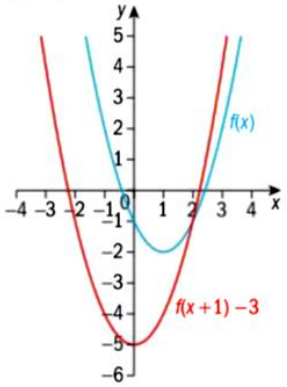

**e** (1, −4)



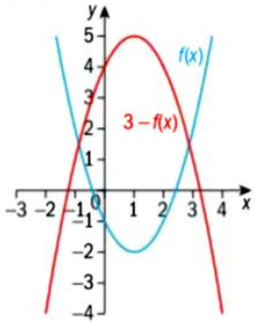

**f** $-\frac{1}{3}, -2$



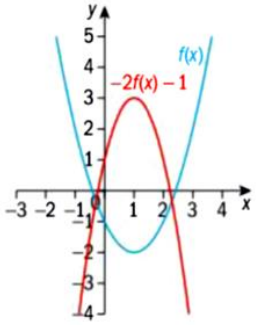
**g** (0, −5)



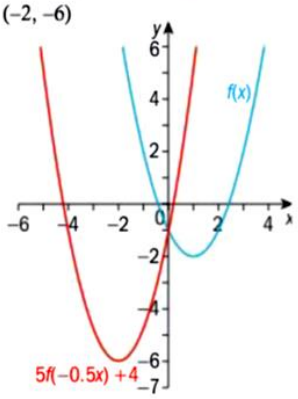

**h** (1, 5)




**i** (1, 3)




**j** (−2, −6)




**2 a** Dilation scale factor $\frac{1}{2}$ parallel to the $x$-axis and vertical translation of −8 units OR dilation scale factor 2 parallel to the $y$-axis and vertical translation of −8 units

**b** Dilation scale factor 3 parallel to the $x$-axis, reflection in the $y$-axis and vertical translation of 8 units OR dilation scale factor $\frac{1}{3}$ parallel to the y-axis and reflection in the $x$-axis

**c** Dilation scale factor $\frac{1}{2}$ parallel to the $y$-axis and vertical translation of 3.5 units OR Dilation scale factor 2 parallel to the $x$-axis and vertical translation of 1 unit

**d** Horizontal translation of 2 units and vertical translation of −5 units

**e** Horizontal translation of −3 units and vertical translation of −3 units

**f** Dilation scale factor $\frac{1}{2}$ parallel to the $y$-axis and vertical translation of 2 units

**3 a** Reflection in the $y$-axis: $f_2(x) = f_1(-x)$

**b** Horizontal dilation scale factor 2: $f_2(x) = f_1\left(\frac{x}{2}\right)$

**c** Horizontal translation −3 units: $f_2(x) = f_1(x + 3)$

**d** Reflection in the $x$-axis: $f_2(x) = -f_1(x)$

**e** Vertical dilation scale factor $\frac{1}{2}$: $f_2(x) = 0.5f_1(x)$

**f** Horizontal dilation scale factor $\frac{1}{2}$: $f_2(x) = f_1(2x)$

**4 a** Reflection in the $x$-axis and vertical translation of 3 units $f_2(x) = -f_1(x) + 3$ or reflection in the $y$-axis and vertical translation of 5 units: $f_2(x) = f_1(-x) + 5$

**b** Reflection in the $x$-axis and vertical translation of −1 unit $f_2(x) = -f_1(x) - 1$

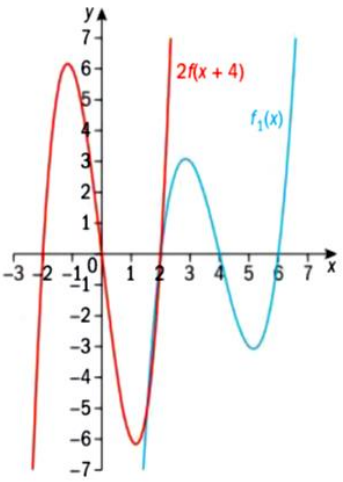
**c** Reflection in the $x$-axis and horizontal translation of −6 units $f_2(x) = -f_1(x + 6)$

**d** Vertical translation of 4 units and horizontal translation of 4 units $f_2(x) = f_1(x - 4) + 4$

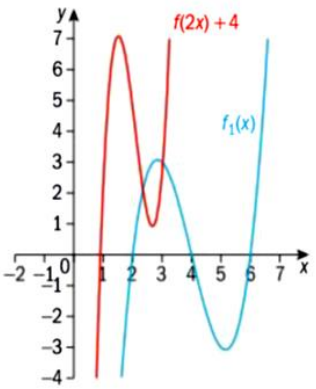
**e** Vertical dilation of scale factor 2 and horizontal translation of 3 units $f_2(x) = 2f_1(x - 3)$

**f** Reflection in the $x$-axis and vertical translation of −2 units $f_2(x) = -f_1(x) - 2$

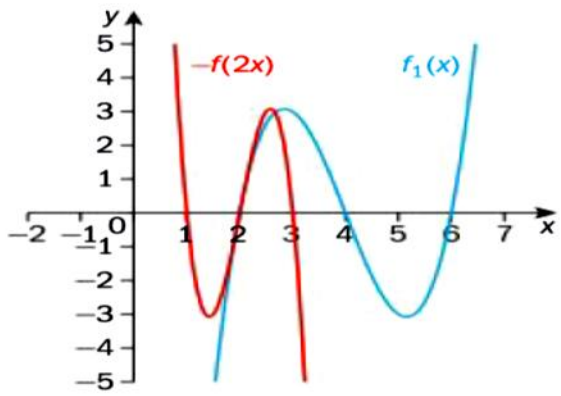
**5 a**



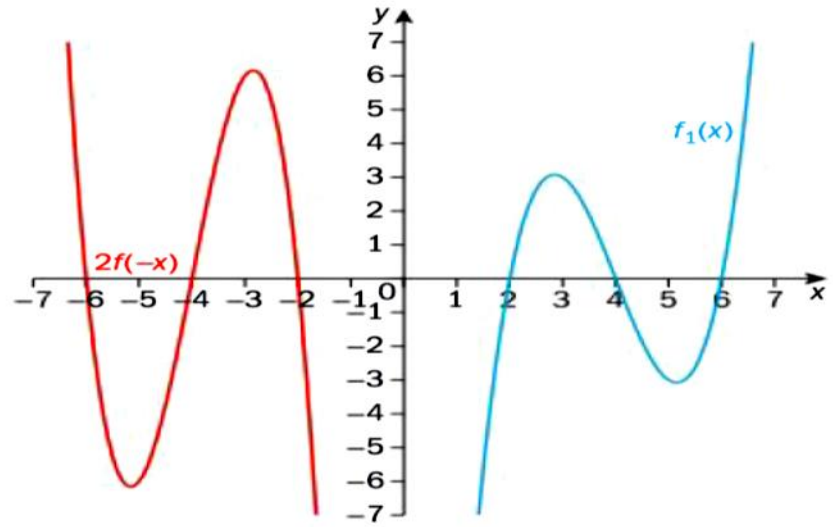

**b**



**c**

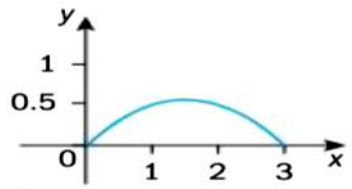



**d**




## Review in context

**1 a**




**b** 3 m

**c** **i** It would reach the same height but it would only travel half as far horizontally.

**ii** It would reach a greater maximum height, 0.675 m, and a greater overall distance, 4.29 m.

**iii** The frog has jumped to the left, not to the right.

**d** Because this would suggest that the frog has jumped downwards, then returned back upwards to its initial starting height.

**2 a** It translates the graph upwards – the ball would have been thrown from a greater height.

**b** It stretches the graph horizontally – the ball would have been thrown at a greater speed.

**3 a** **i** Horizontal translation of 10 units, reflect in the $x$-axis, dilate by a scale factor of $\frac{1}{20}$ in the $y$ direction and translate by 5 units in the $y$ direction.

**ii** $-\frac{1}{20}(0-10)^2+5=-\frac{1}{20}\times 100+5=-5+5=0$.

**iii** Minimum point starts at (0,0) and is mapped to a maximum point at (10,5).
It would hit the ceiling.

**b** The coordinates of the maximum point are (10, 2.5).
With a maximum height of 2.5 m, the ball would not hit the ceiling.

**4 a** $b(t)=12\,000-150t$

## Mixed practice

**1** $r = \sqrt[3]{\frac{3V}{4\pi}}$

**2** $T = \frac{Pv}{500}$

**3** $r = \sqrt{\frac{Gm_1m_2}{F}}$

**4** $C = \frac{2W}{U^2}$

**5** $c = \sqrt{\frac{E}{m}}$

**6** $c = \frac{v\left(1+\left(\frac{v}{v_0}\right)^2\right)}{\left(\frac{v}{v_0}\right)^2-1} = \frac{v\left(v_0^2+v^2\right)}{v_0^2-v^2}$

**7** $\frac{x^3}{3}$; $x, y \neq 0$

**8** $\frac{5x^4-6x^2}{4} = \frac{x^2\left(5x^2-6\right)}{4}$; $x \neq 0$

**9** $\frac{x-7}{x-11}$; $x \notin \{-3, 11\}$

**10** $\frac{1}{x-4}$; $x \notin \{-4, 4\}$

**11** $\frac{10+xy}{5x}$; $x \neq 0$

**12** $\frac{6x^2y}{z^2}$; $z \neq 0$

**13** $\frac{x^3y^3}{x-y}$; $x \notin \{-y, 0, y\}$

**14** $\frac{x^2-10xy-4}{4x}$; $x \neq 0$

**15** $\frac{12x}{(x+5)(x-7)}$; $x \notin \{-5, 7\}$

**16** $\frac{6-5x}{(x+9)(x-8)} = \frac{-5x+6}{x^2+x-72}$; $x \notin \{-9, 8\}$

**17** $\frac{10x}{(x-1)(x+4)} = \frac{10x}{x^2+3x-4}$; $x \notin \{-4, 1\}$

**18** $\frac{13}{x^2-1} = \frac{13}{(x+1)(x-1)}$; $x \notin \{-1, 1\}$

**19** $\frac{12b+20a-ab(a+b)}{4ab}$; $a, b \neq 0$

**20** $\frac{x^3-7x^2+10x-24}{6x(x-2)}$; $x \notin \{0, 2\}$

## Review in context

**1 a** 830 km/h **b** 900 km/h **c** (870 + $x$) km/h

**d** (870 − $y$) km/h **e** $t = \frac{d}{V}$

**f** 6.39 hours = 6 hours 23 minutes 27 seconds

**g** 6.70 hours = 6 hours 42 minutes (6 hours 41 minutes 56 seconds)

**h** 6.18 hours = 6 hours 10 minutes (40 seconds)

**i** 70 km/h (headwind)

**j** 50.3 km/h (tailwind – 3 s.f.)

**2 a** $\frac{1}{x}+\frac{1}{x+4}+\frac{1}{2x+2} = \frac{5x^2+15x+8}{x(x+4)(2x+2)}$

**b** $\left(\frac{1}{x}+\frac{1}{x+4}+\frac{1}{2x+2}\right)+\frac{1}{2x+2} = \frac{3x^2+10x+4}{x(x+4)(2x+2)}$

**3 a** $I = \frac{V}{R+r}$ **b** $\frac{48r+72}{(6+r)(5+3r)}$

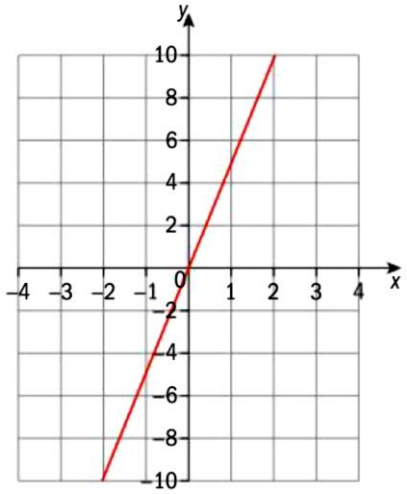
**4 a** 4 **b** Decreased 8 times

**c** Increased 96 times **d** It needs to double

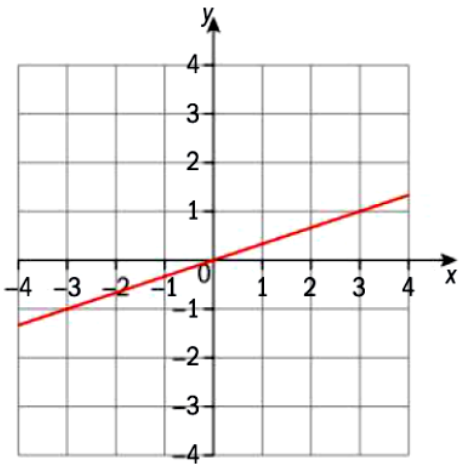
# UNIT: ALGEBRA – PROPORTION

## Mixed practice

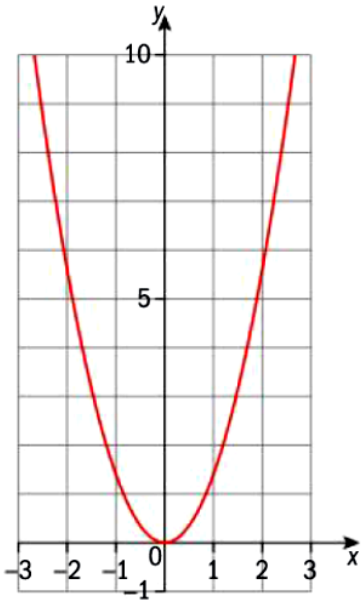
**1 a** direct relationship



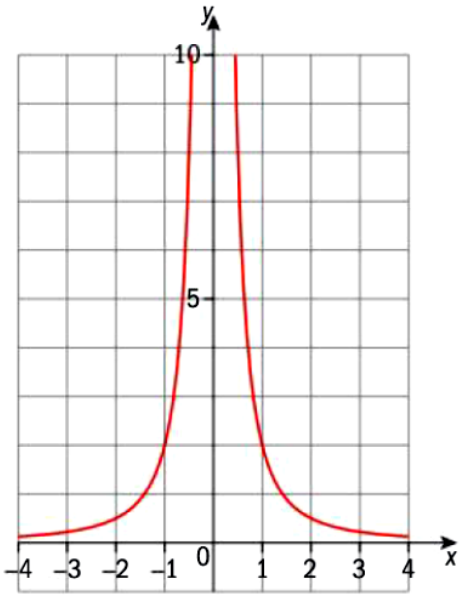

**b** direct relationship



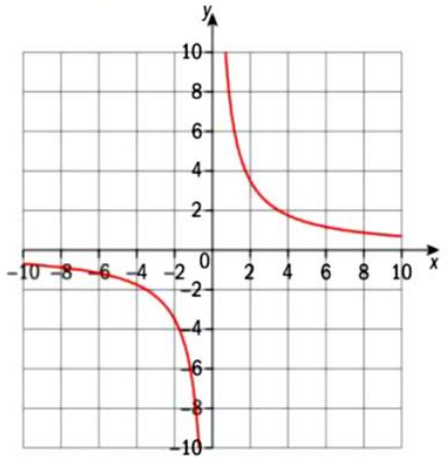

**c** direct relationship



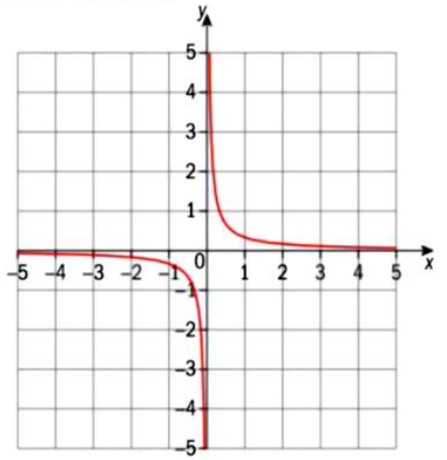

**d** inverse relationship



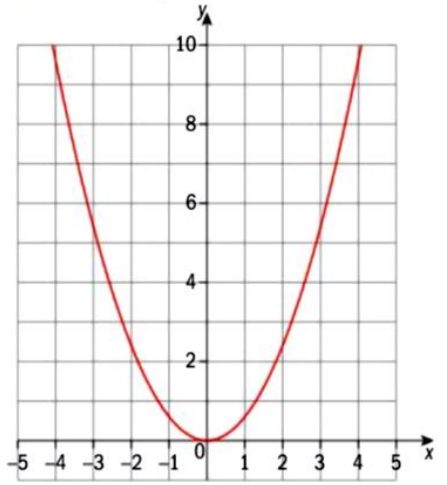
**e** inverse relationship



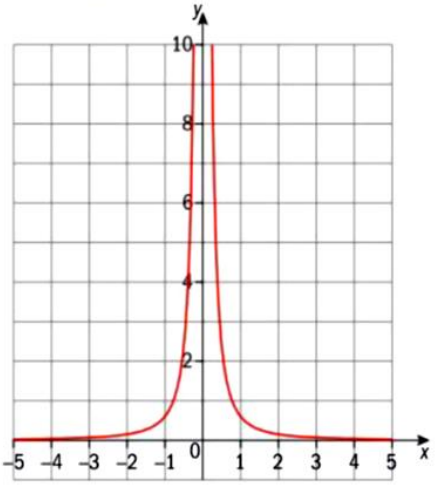

**f** inverse relationship




**g** direct relationship




**h** inverse relationship




**2 a** $k = 0.75$ **b** $x = 0.75t$ **c** $x = 6.15$

**3** $P = 2$ **4** $c = \pm 3.5$ **5** $p = 25, q = 0.02$

**6 a** $y = \frac{x^2}{4}$ **b** $y = -\frac{5}{x}$

**7 a** The more bottles are bought, the higher the cost.
Cost = 1.3 × number of bottles, direct proportion

**b** No, because the cost for 2 bottles or 3 bottles is the same, £2.60. The cost does not increase proportionally to the number of bottles bought.

**8** 360 N

**9** $N$ = the whole number part of $\frac{3k}{4\pi r^3}$

**10** 70.4 kg **11** 367.2 m **12** 500

**13 a** $V = kr^2$, $k = \pi h$ **b** $V = kh$, $k = \pi r^2$

## Review in context

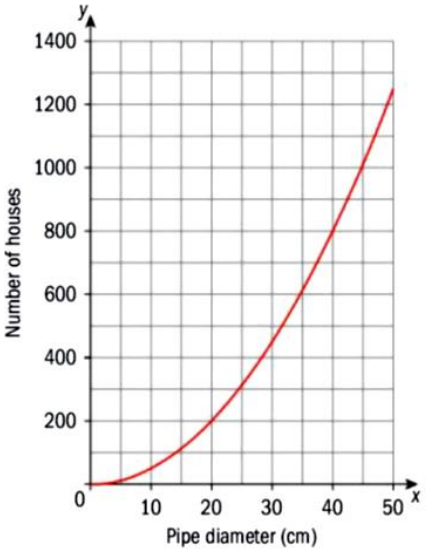
**1** Alphatown $62 500
Boomcity $125 000

**2 a**

| Pipe diameter (cm) | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| Number of houses | 50 | 200 | 450 | 800 | 1250 |

**b** Between 300 and 350 houses

**c**



**d** Between 310 and 340 houses
**e** 312 houses
**f** Student's own answer
**g** Student's own answer. A possible argument could be to find ways to reduce household consumption so that a pipe can serve more houses without needing to be enlarged.

**3** Moving the heater to B reduces the heat received by 36%.

**4** **a** Temperature change –0.71°C
**b** Diameter of trees 2.24 m

**5** **a** 1220 pairs of Classic jeans
**b** They should sell Classic jeans at $113 per pair to double their sales.

**6** **a** $2.5 \div 3^3 \neq 5 \div 5^3$, there is no constant proportion between the cube of the radius and the price.
**b** One large scoop would cost $11.57
**c** Student's own suggestions. Possible arguments could include that the price of an ice-cream should cover other costs, such as the salary of the waiter, the cost of the equipment to make ice-cream, etc. These costs can be covered in the first scoop or two, which will therefore be more expensive than each additional scoop.

## Review in context

**1** $38x + 5y = 550$; $56x + 60y = 1200$
13.5 ounces of milk and 7.4 ounces of orange juice.
This is realistic.

**2** $x + y = 8$; $0.12x + 0.32y = 1$
4.8 liters of 12% acid and 3.2 liters of 32% acid

**3** $x + y = 20$; $10.50x + 8.25y = 9(x + y)$
$6\frac{2}{3}$ kg of premium and $13\frac{1}{3}$ kg of standard

**4** Laser: $y = 150 + 0.015x$
Inkjet: $y = 30 + 0.06x$
For $x < 2666$, the inkjet printer is cheaper.
For $x > 2667$ the laser printer is cheaper.

## UNIT: ALGEBRA – FACTORISATION 2

### Mixed practice

**1** **a** 6, –4 **b** 9, –3 **c** $\frac{4}{3}, -\frac{1}{2}$

**d** $\frac{3}{2}$, 7 **e** $\frac{2}{5}$, 1 **f** 3, 1

**2** **a** $-3 \pm 2\sqrt{17}$ **b** $-6 \pm \sqrt{13}$ **c** $5 \pm \sqrt{7}$

**d** $\frac{-3 \pm \sqrt{30}}{3}$ **e** $\frac{4 \pm \sqrt{10}}{2}$ **f** $3, -\frac{1}{2}$

**3** **a** –1.54, –8.46 **b** 6.14, –1.14 **c** 1.26, –0.26
**d** 1.59, –1.26 **e** 0.12, –2.12 **f** No solutions

**4** **a** $1, \frac{1}{2}$ **b** No solutions **c** $2 \pm \sqrt{11}$

**d** $\frac{5}{3}$, –1 **e** $3 \pm \sqrt{3}$ **f** No solutions

**5** 9 cm by 12 cm

**6** 5 cm by 17 cm

**7** 5 cm by 6 cm

**8** 3.5 m

**9** 12 cm and 7 cm

**10** 15 cm, 8 cm and 17 cm

**11** 9 and 11

**12** 9 or –8

**13** 7 and 8

**14** **a** 5.04 seconds **b** 0.96 seconds **c** 3.08 seconds

**15** $8.01 or $25.99

**16** 18.9 cm

### Review in context

**1** 10.1 seconds (3 s.f.)

**2** **a** $h = -4.9t^2 + 24t + 30$
**b** **i** 59.4 meters (3 s.f.)
**ii** 2.45 seconds (3 s.f.)
**iii** 5.93 seconds (3 s.f.)

**3** 6 seconds

**4** **a** 8.51 seconds (3 s.f.)
**b** 6 times as long
**c** Student's own answers

## Review in context

**1 a** His speed upstream will be 2 km/h less due to the current; likewise his speed downstream will be 2 km/h greater.

**b i** $\frac{15}{x-2}$ **ii** $\frac{15}{x+2}$

**c** $\frac{15}{x-2}+\frac{15}{x+2}=3$

**d** $(5+\sqrt{29})$ km/h [10.39 km/h (2 d.p.)]

**2 a** 16 and 48 ohms **b** 3 and 6 ohms
**c** 3, 5 and 6 ohms **d** 4 and 12 ohms

**3** 3 km/h

**4 a** 22.5 cm **b** 2 cm **c** 1.83 cm (3 s.f.)

**5** 48.5 km/h (3 s.f.)

# UNIT: ALGEBRA – SEQUENCES

## Mixed practice

**1 a** 18 **b** $u_{n+1}=u_n+18,\ u_1=7$ **c** $u_n=18n-1$
**d** 259 **e** 21st

**2 a** 38 **b** 139 **c** 531

**3 a** $31=a+2d;\ 52=a+5d$
**b** 17, 7, 80

**4** −13

**5 a** 30, 15 **b** No

**6 a** 6, 7 **b** $u_{n+1}=7u_n,\ u_1=6$ **c** $u_n=6\times 7^{n-1}$
**d** 14406 **e** 4 941 258 (8th term)

**7 a** 6, 0.5 **b** $u_{n+1}=0.5u_n,\ u_1=6$
**c** $u_n=6\times 0.5^{n-1}$ **d** 0.0117

**8 a** $4a,\ a+9$ **b** $4a=a+9,\ a=3$ **c** 5

**9 a** $r^2=\frac{48}{12}$ hence $r^2=4$ **b** 2, −2 **c** 384, −384

## Review in context

**1 a** 4, 6, 8 – sequence has a common difference
**b** $u_n=2n+2$
**c** 42
**d** 70

**2 a** Same scale factor means common ratio
**b** 232 831 (nearest person)
**c** 3 388 132 (nearest person)

**3** $183, $58

**4 a** Constant number of components = common difference
**b** 2400
**c** 31 200

## Mixed practice

**1** Tom's marks are more consistent, but the IQR tells us nothing about who has done better. Tom may be consistently bad.

**2 a** On average, students in the chess club are taller, but they are also more variable.

**b** The IQR is not affected by extreme values.

**c** There is simply not enough information about the clubs to attempt to make these sorts of inferences; the ages and genders of the students within the clubs will have a large effect. Furthermore, while physical attributes are unlikely to have much effect on progression from youth chess clubs to adult chess playing, adult ballet dancers are selected on athletic and physical grounds.

**3 a** Quota sampling

**b** He will catch fish and measure them until he has 20 salmon and 30 trout.

**4** e.g. The sample may be biased because the only people who will respond will be those who do not consider the survey 'unwanted'. People may have a similar attitude to surveys as they do to advertising. People who have strong feelings about unwanted advertising are likely to have asked to be removed from the directory.

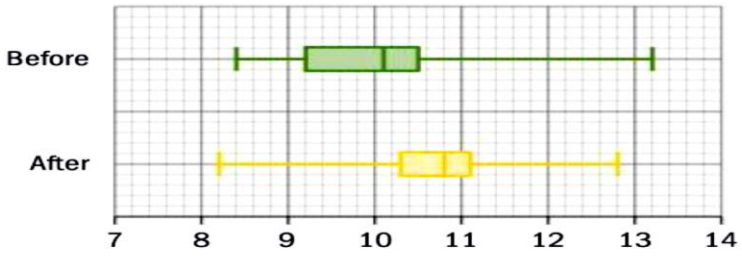
## Review in context

**1 a**


**b** On average, town B has higher household incomes. There is less variability though in town A.

**c** Different types of people were chosen for the same proportion as they appear in the population.

**2 a**



**b** Overall range similar; after data has smaller IQR so more consistent; after data has higher median.
**c** The intervention appears to have been effective.
**d** Small sample, limited age range covered.

**3 a, b** Student's own investigations.
**c** To take a census, you would use the data for every country in the world.

**4 a** The mean has increased from 5.6 to 6.4 hours, suggesting the scheme has been successful. Now, all residents report at least two hours of social contact, so everybody hits a minimum standard.
**b** Quota sampling.
**c** There are obvious flaws: those people using the bus already have a degree of mobility; just asking those who appear over 75 is not objective; asking if people would be interested is likely to bias the sample towards those who are likely to show improvement.
**d** e.g. To use a sampling frame from the electoral roll.

**5 a** e.g. People may not reliably remember what they donate to; people might be unwilling to share financial information.
**b** Create a stratified sample according to where the parents grew up.
**c** 40 local, 60 from elsewhere and 33 from different countries will make a stratified sample of 133.

## UNIT: GEOMETRY – CIRCLE PROPERTIES

# Mixed practice

**1 a** $a = 25°$, $b = 40°$ **b** $c = 84°$
**2 a** $a = 23°$ **b** $b = 132°$
**3 a** Converse: If $3a - 2 = 19$, then $a = 7$. Both statement and converse are true.
**b** Converse: If $a - b = 0$, then $a = b$. Both statement and converse are true.
**c** Statement is true (as wingless Moa bird is now extinct.) Converse: If it has wings, then it is a bird is false. (e.g. it could be an insect.)
**d** Converse: If a polygon is a square, then it has four sides i true. The statement is false (e.g. it could be a rectangle) b the converse is true.
**e** Converse: If $c^2 = 81$, then $c = 9$. The statement is true but the converse is false ($c$ could be –9).
**f** Converse: If a right-angled triangle's hypotenuse is the diameter of a circle, then its vertices will be on the circumference of the circle. Both statement and converse are true.

**4** $\angle ADC = 180° - \angle ABC$ (Opposite angles in a cyclic quadrilateral are supplementary)
Since $\angle ABC = \angle DAB$, $\angle DAB + \angle ADC = 180°$
Therefore $AB$ and $DC$ are parallel.
$\angle BAC = \angle ACD$ (alternate angles)
Therefore $AD = BC$ (Equal angles are subtended by equal chords)

**5** Draw in lines $OA$ and $OC$.
$\angle OCB = \angle OBC$ (Base angles in an isosceles triangle)
$\angle OAB = \angle OBA$ (Base angles in an isosceles triangle)
Since $\angle OBA = \angle OBC$, all four of these angles are equal.
$\angle OAC = \angle OCA$ (Base angles in an isosceles triangle)
So therefore the two base angles in triangle $ABC$ are equal, since $\angle OAC + \angle OAB = \angle OCA + \angle OCB$.
Therefore triangle $ABC$ is isosceles.

## Review in context

**1** 44°

**2** 4.94 m

## Mixed practice

**1 a** Student's own sketch
**b** $AX$ and $BX$ take values 1 and 10 or vice versa.
$CX$ and $DX$ take values 2 and 5 or vice versa.

**2 a** $x = 5$ **b** $x = 9$
**c** $x = 2$ **d** $x = 1, y = 4$
**e** $x = 18$ **f** $x = 5$

**3** $x = 8, y = 4.5, z = 7.5$

**4** $x = 3.6, y = 6.4$

**5** $x = 9, y = 12$

**6 a** Student's own demonstration. **b** $x = 4, y = 3$

## Review in context

**1 a** Student's own sketch.
**b** Student's own demonstration.
**c** 25.25 cm

**2 a** 370 m **b** 381 m
They are very similar.

## UNIT: EXPONENTIAL FUNCTIONS

# Review in context

**1** $N = N_0 \times 0.5^x$

**2** 7500

**3** 11 400

**4** 13.4%

**5** 23 136

**6** 1.42%

**7** 18 935 to 24 635

**8** The amount of carbon left is approximately 0.23%, a very small amount

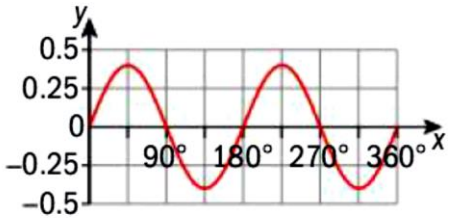
# Mixed practice

**1 a** Amplitude 4, Period 360°, Frequency 1, $y = 4\cos x$

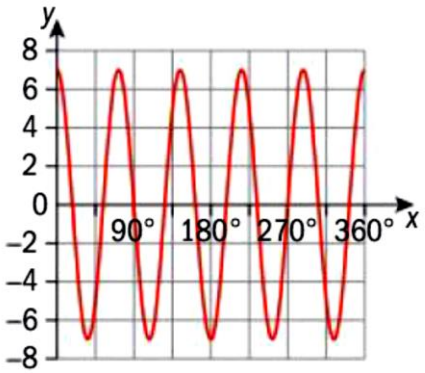
**b** Amplitude 2, Period 90°, Frequency 4, $y = 2\cos(4x)$

**c** Amplitude 0.5, Period 120°, Frequency 3, $y = 0.5\cos(3x)$

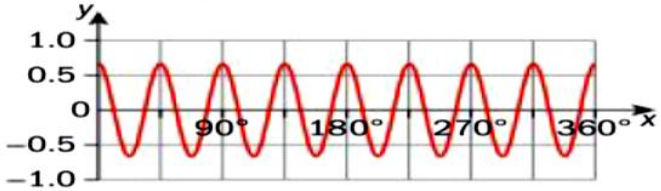
**2 a** Amplitude 0.4, period 180°



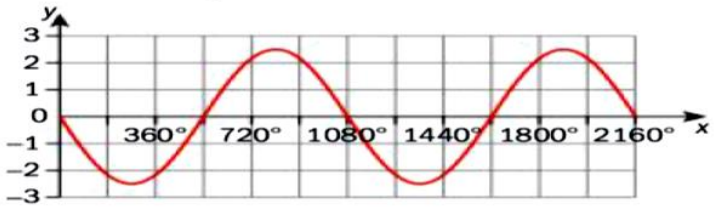

**b** Amplitude 7, period 72°



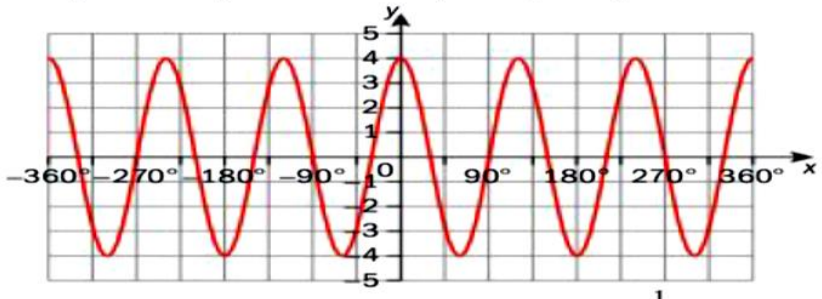
**c** Amplitude $\frac{2}{3}$, period 45°



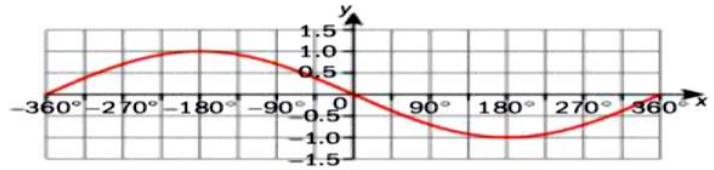

**d** Amplitude $\frac{5}{2}$, period 120°



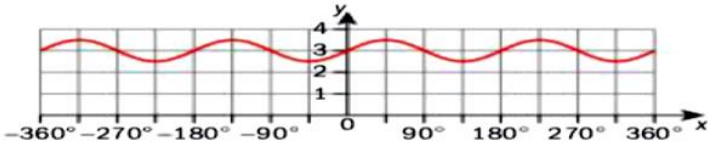

**3 a** Amplitude 4, Period 120°, Frequency 3



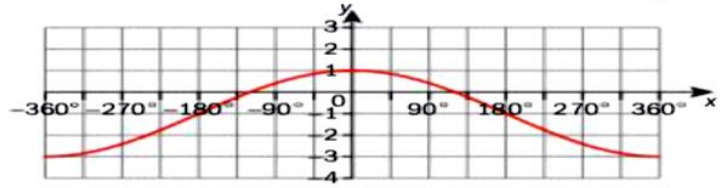

**b** Amplitude 1, Period 720°, Frequency $\frac{1}{2}$




**c** Amplitude 0.5, Period 180°, Frequency 2

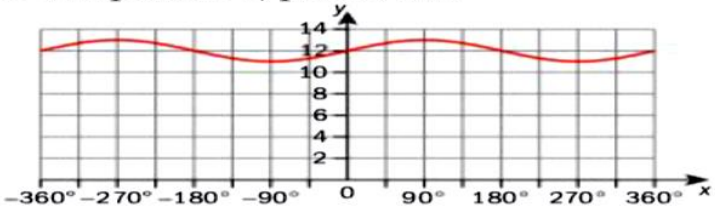



**d** Amplitude 3, Period 720°, Frequency $\frac{1}{2}$

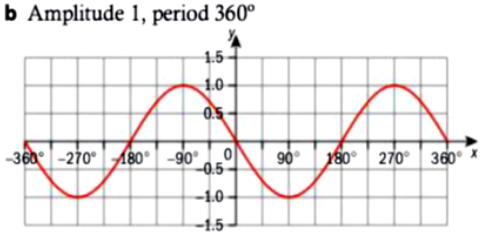



**4** $y = -2\sin\left(\frac{x}{2}\right)$

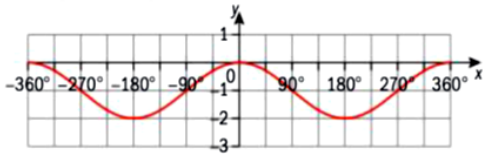
**5 a** Amplitude 1, period 360°



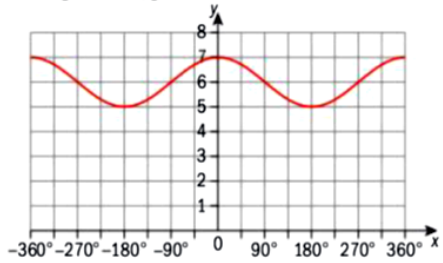
**b** Amplitude 1, period 360°




**c** Amplitude 1, period 360°




**d** Amplitude 1, period 360°

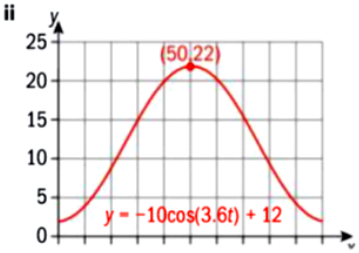



**6 a** Amplitude 1, Period 360° $y = \sin x + 3$
**b** Amplitude 1, Period 360° $y = \cos x - 3$
**c** Amplitude 1, Period 360° $y = -\cos x$
**d** Amplitude 1, Period 360° $y = \sin x - 1$

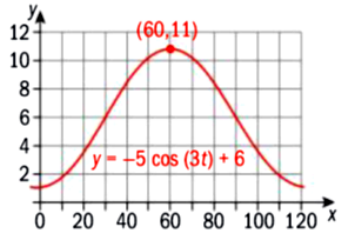
**7 a** Vertical dilation scale factor 3 and vertical translation 2 units in the positive direction
**b** Vertical dilation scale factor 2, reflection in the $x$-axis, and horizontal dilation scale factor $\frac{1}{4}$
**c** Horizontal dilation scale factor $\frac{1}{2}$, reflection in the $x$-axis, vertical translation 3 units in the negative direction
**d** Horizontal dilation scale factor $\frac{1}{2}$, vertical dilation scale factor $\frac{1}{2}$, and vertical translation 4 units in the negative direction
**e** Horizontal dilation scale factor $\frac{1}{3}$, and vertical dilation scale factor 3, reflection in the $x$-axis, and vertical translation 3 units in the positive direction
**f** Horizontal dilation scale factor $\frac{4}{3}$, vertical dilation scale factor $\frac{3}{4}$.

**8 a** $y = 2\sin x - 1$ **b** $y = -\cos(2x) - 2$
**c** $y = -\sin\left(\frac{x}{2}\right) + 1$ **d** $y = \sin(4x) + 1$
**e** $y = -2\cos(2x) - 2$

**9 a i** $y = -10\cos(3.6°t) + 12$
**ii**




**b i** $y = -5\cos(3°t) + 6$
**ii**

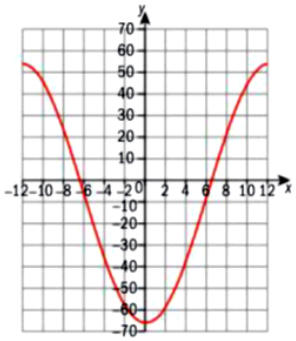



**iii** Children

**10 a** The period is 10 seconds – it is the time taken for the building to sway back to its original position.
**b** 20 cm
**c** $y = 20\sin(36t)$

**11 a** 180 cm – represents the distance travelled in one revolution
**b** 30 cm – represents the radius of the wheel
**c** 30 cm
**d** $y = -30\cos(2x) + 30$

**12 a**



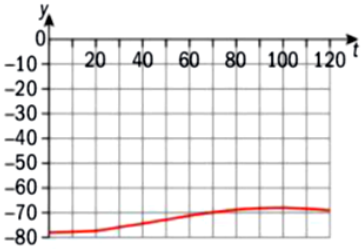

**b** Sunrise and sunset
**c** The sun is below the horizon – it is dark
**d** 37.4°, 47°
**e** 6:19 am

## Review in context

**1 a** $d = -10\sin\left(\frac{360x}{15}\right) + 9$

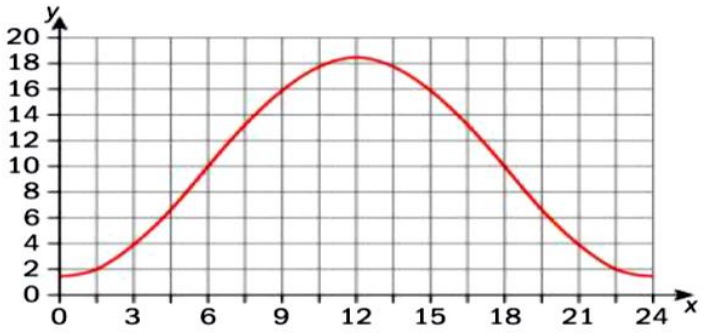
**b i** 4.9 m **ii** 0.40 m **iii** 9.3 m
**c** −1 m
**d** The shore waters would recede leaving the ocean floor exposed.

**2 a**




**b** $y = -4.5\cos(3x) - 73.5$
**c** −69.6°
**d** Horizontal dilation scale factor $\frac{1}{3}$, vertical dilation scale factor 4.5, reflection in the $x$-axis, and vertical translation 73.5 units in the negative direction
**e** No – it would travel linearly down the latitude

**3 a**

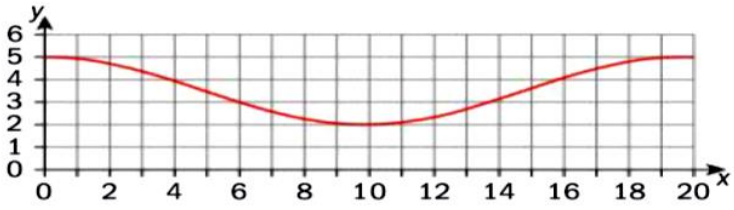



**b** $y = -8.5\cos(15°t) + 10$ **c** 4 m

**d** Midnight and midday

**e** Tides provide constant energy, whereas wind varies.

**4 a**

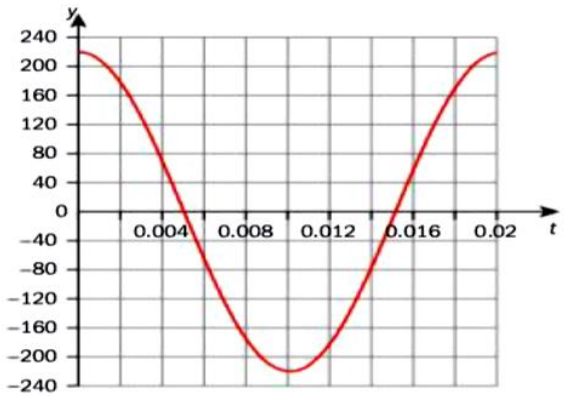



**b** 1.5 million, 20 days, freq 18

**c** More than half – is at 3.5 million (> 2.5 million)

**d** Before – the next low would happen sooner and be over quicker.

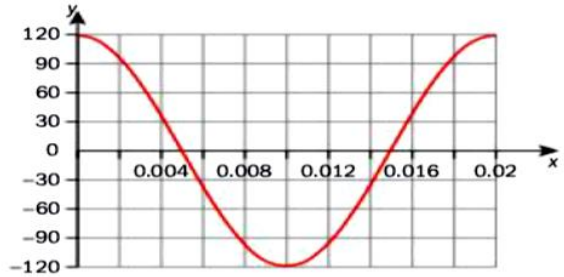
**5 a**




**b** frequency $= \frac{1}{50}$ seconds/cycle, hence period is $\frac{360°}{\left(\frac{1}{50}\right)} = 18\,000°$

**c** $y = 220\cos(18000°t)$

**d**




**e** $\frac{1}{60}$, 120, $y = 120\cos(21\,600°t)$

**f** Vertical dilation scale factor $\frac{6}{11}$ and horizontal dilation scale factor $\frac{5}{6}$

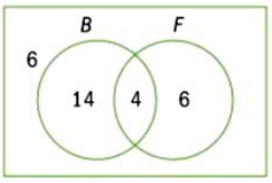
# UNIT : PROBABILITY 5

## Mixed practice

**1 a** i $\frac{18}{30}=\frac{3}{5}$ ii $\frac{24}{30}=\frac{4}{5}$ iii $\frac{10}{30}=\frac{1}{3}$ iv $\frac{26}{30}=\frac{13}{15}$

**b** $\frac{4}{30}=\frac{2}{15}$

**c**

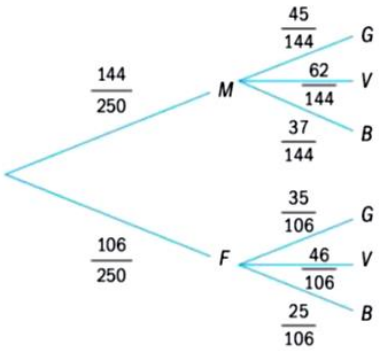



**d** $\frac{4}{18}=\frac{2}{9}$

**2 a** i Yes ii Yes

**b** $\frac{108}{250}=\frac{54}{125}$ **c** $\frac{35}{106}$ **d** $\frac{60}{142}=\frac{30}{71}$

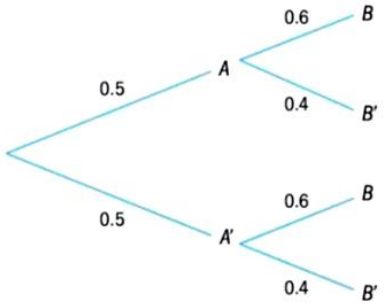
**e**




Yes

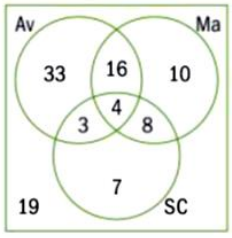
**3 a** 0.3

**b** 0.6




**c** Yes: $0.5 \times 0.6 = 0.3$

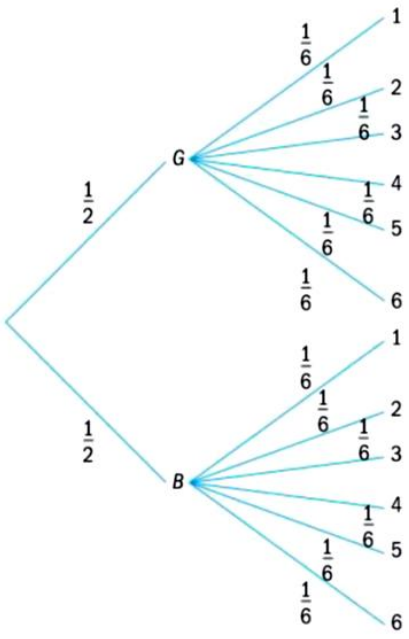
**4 a**




**b** 19 **c** No **d** $\frac{12}{22}=\frac{6}{11}$

**5 a** 0.2 **b** No **c** No

**6 a**




**b** $\frac{1}{6}$ **c** $\frac{2}{6}=\frac{1}{3}$ **d** $\frac{1}{4}$

**e** Yes $P(E) \times P(G) = P(E \cap G)$

**7 a** i $\frac{3}{50}$ ii $\frac{45}{50}=\frac{9}{10}$ iii $\frac{16}{18}=\frac{8}{9}$

**b** No, No

## Review in context

**1 a** i $\frac{32}{60}=\frac{8}{15}$ ii $\frac{28}{60}=\frac{7}{15}$ iii $\frac{8}{17}$

iv $\frac{49}{60}$ v $\frac{3}{25}$

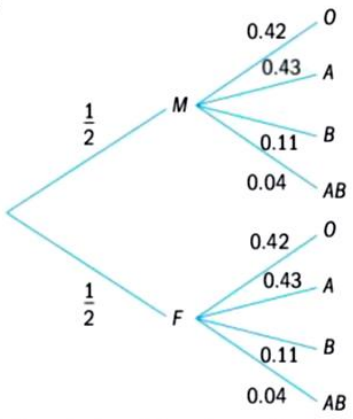
**b** i $\frac{14}{885}$ ii $\frac{253}{1770}$

**2 a** i 0.04 ii 0.96

**b** Yes **c** 0.54 **d** 0.53 **e** $\frac{42}{53}$

**3 a** No **b** i 0.5 ii 0.5

**c**




**d** E.g. $P(M) \times P(O) = P(M \cap O)$