

UNIT 2 ANSWERS

UNIT 2: NUMBER 2

EXERCISE 1

- 1** ▶ 4.56×10^2 **2** ▶ 6.78×10^1
3 ▶ 1.2345×10^2 **4** ▶ 6.7×10^7
5 ▶ 5.68×10^2 **6** ▶ 3.84×10^1
7 ▶ 7.0605×10^2 **8** ▶ 1.23×10^8
9 ▶ 4000 **10** ▶ 56 000
11 ▶ 4 090 000 **12** ▶ 678 900
13 ▶ 560 **14** ▶ 65 000
15 ▶ 7 970 000 **16** ▶ 987 600
17 ▶ 1000 **18** ▶ 10 000
19 ▶ 8.4×10^9 **20** ▶ 1.4×10^2
21 ▶ 5×10^1 **22** ▶ 2.75×10^5

EXERCISE 1*

- 1** ▶ 4.5089×10^4 **2** ▶ 8.705×10^4
3 ▶ 2.983×10^7 **4** ▶ 7.654×10^7
5 ▶ 1×10^3 **6** ▶ 1×10^6
7 ▶ 1×10^5 **8** ▶ 1×10^1
9 ▶ 1×10^{21} **10** ▶ 1×10^8
11 ▶ 1×10^0 or 1 **12** ▶ 1×10^6
13 ▶ 6.16×10^6 **14** ▶ 2.7×10^8
15 ▶ 4×10^1 **16** ▶ 7.083×10^4
17 ▶ 9.1125×10^{16} **18** ▶ 2.43×10^{42}
19 ▶ 2.5×10^4 **20** ▶ 3.46×10^8
21 ▶ 9.653×10^8 **22** ▶ 4×10^3
23 ▶ 1×10^{10} **24** ▶ 1000
25 ▶ Saturn 10 cm, Andromeda Galaxy 1 million km, OQ172 1000 million km

EXERCISE 2

- 1** ▶ 1×10^{-1} **2** ▶ 1×10^{-2}
3 ▶ 1×10^{-3} **4** ▶ 1×10^{-4}
5 ▶ 1×10^{-3} **6** ▶ 1×10^{-2}
7 ▶ 1×10^1 **8** ▶ 1×10^0
9 ▶ 0.001 **10** ▶ 0.000 01
11 ▶ 0.0012 **12** ▶ 0.87
13 ▶ 0.000 001 **14** ▶ 0.0001
15 ▶ 0.0467 **16** ▶ 0.000 34
17 ▶ 5.43×10^{-1} **18** ▶ 7.08×10^{-2}
19 ▶ 7×10^{-3} **20** ▶ 9×10^{-4}
21 ▶ 6.7×10^{-1} **22** ▶ 7.07×10^{-4}
23 ▶ 1×10^2 **24** ▶ 1×10^3
25 ▶ 100 **26** ▶ 100
27 ▶ 10 000 **28** ▶ 1 000 000
29 ▶ 128 **30** ▶ 0.03

EXERCISE 2*

- 1** ▶ 10 **2** ▶ 0.001
3 ▶ 0.011 **4** ▶ 0.099
5 ▶ 0.01 **6** ▶ 0.0001
7 ▶ 0.0011 **8** ▶ -0.099
9 ▶ 1×10^3 **10** ▶ 1×10^4
11 ▶ 1×10^1 **12** ▶ 1×10^{-1}
13 ▶ 1×10^4 **14** ▶ 1×10^{-4}
15 ▶ 1×10^2 **16** ▶ 1×10^{-3}
17 ▶ 6.25×10^{-6} **18** ▶ 1.6×10^{-3}
19 ▶ 6.9×10^7 **20** ▶ 5×10^{-2}
21 ▶ 4×10^{-6} **22** ▶ 2.5×10^{-3}
23 ▶ 4.8×10^5 **24** ▶ 3×10^{10}
25 ▶ 5000 viruses **26** ▶ 66 000 viruses
27 ▶ 4.7×10^{10} **28** ▶ 2×10^7
29 ▶ $(3.4 \times 10^{23}) + (0.34 \times 10^{23}) = 3.74 \times 10^{23}$
30 ▶ **a** 1×10^{27} , 27 zeros
 b $\sqrt[3]{1 \times 10^{-27}} = 1 \times 10^{-9}$
 c 1×10^7
 d 2×10^{23}
 e 2×10^{16} cm
 f $(2 \times 10^{16}) \div (4 \times 10^9) \approx 5 \times 10^6$ times!

EXERCISE 3

- 1** ▶ 20% **2** ▶ 12.5%
3 ▶ 5% **4** ▶ 4%
5 ▶ 5.5 km/h **6** ▶ 12°C
7 ▶ 126 m² **8** ▶ 16.8 hrs
9 ▶ +25% **10** ▶ -25%

EXERCISE 3*

- 1** ▶ 5% **2** ▶ 16.7%
3 ▶ 2.5% **4** ▶ 2.5%
5 ▶ 21.6 cm² **6** ▶ 1468.8 cm³
7 ▶ 2500 m³ **8** ▶ 810 db
9 ▶ +0.04% **10** ▶ **a** -11.3%
 b -22.9%

EXERCISE 4

- 1** ▶

Original value	Percentage increase	Multiplying factor	New value
20	5	1.05	21
180	95	1.95	351
360	30	1.30	468
2500	70	1.70	4250

2 ▶

Original value	Percentage decrease	Multiplying factor	New value
20	5	0.95	19
180	95	0.05	9
360	30	0.70	252
2500	70	0.30	750

3 ▶ a \$1515 b \$2985 c \$1650 d \$2850

4 ▶ a 495 kg b 5 kg c 450 kg d 50 kg

5 ▶ 68 kg 6 ▶ 624 kg

7 ▶ \$13 440 8 ▶ \$39 600

9 ▶ €129 600 10 ▶ €2300

EXERCISE 4*

1 ▶

Original value	Percentage increase	Multiplying factor	New value
60 secs	25	1.25	75 secs
50 kg	60	1.60	80 kg
100 km/h	25	1.25	125 km/h
1250 m	20	1.20	1500 m

2 ▶

Original value	Percentage decrease	Multiplying factor	New value
75 secs	20	0.80	60 secs
80 kg	37.5	0.625	50 kg
120 km/h	40	0.60	72 km/h
1500 m	20	0.80	1200 m

3 ▶ \$24.48 4 ▶ \$39.60

5 ▶ £6762 6 ▶ £5940

7 ▶ 39.6°C 8 ▶ 120 db

9 ▶ 554 cm² 10 ▶ 22.8 cm

EXERCISE 5

REVISION

1 ▶ 2.75×10^5 2 ▶ 2.75×10^{-2}

3 ▶ 3500 4 ▶ 0.0035

5 ▶ \$64 800 6 ▶ 2%

7 ▶ $33\frac{1}{3}\%$ 8 ▶ +5%

9 ▶ \$411.25 10 ▶ \$288.75

EXERCISE 5*

REVISION

1 ▶ 22 500 000 2 ▶ 1.23×10^{-1} 3 ▶ 58 300 4 ▶ 5×10^{11} 5 ▶ 19.2 m 6 ▶ $1.16 \times 10^{-3}\%$ 7 ▶ +10% 8 ▶ $\frac{y-x}{x} \times 100\%$

9 ▶ €445.50

10 ▶ a 20% profit b 20% loss

EXAM PRACTICE: NUMBER 2

1 ▶ a 4.5×10^3 b 3×10^6
c 7.5×10^{-3} d 2.5×10^{-1} 2 ▶ a 1200 b 5 800 000
c 0.45 d 0.00933 ▶ a 4.25×10^7 b 3.48×10^3
c 8.03×10^5

4 ▶ 45 kg

5 ▶ a 17.5% b 6.61%

6 ▶ 21%

7 ▶ 2 hrs 15 mins 25 secs

UNIT 2: ALGEBRA 2

EXERCISE 1

1 ▶ 4 2 ▶ $3y$ 3 ▶ 2 4 ▶ $\frac{3a}{b}$ 5 ▶ $\frac{b}{2}$ 6 ▶ $\frac{3a}{b}$ 7 ▶ $4c$ 8 ▶ $\frac{a}{2}$ 9 ▶ $\frac{4}{x}$ 10 ▶ $2b$ 11 ▶ $\frac{1}{5b^2}$ 12 ▶ $\frac{a}{4}$

EXERCISE 1*

1 ▶ $\frac{1}{2}$ 2 ▶ $\frac{2}{b}$ 3 ▶ $\frac{x}{4}$ 4 ▶ $\frac{a}{2}$ 5 ▶ $\frac{2}{b}$ 6 ▶ $\frac{6}{b^2}$ 7 ▶ $\frac{a}{2b}$ 8 ▶ $\frac{3}{abc}$ 9 ▶ $\frac{a}{4b^2}$ 10 ▶ $\frac{1}{a^2b^2}$ 11 ▶ $\frac{3a}{8b}$ 12 ▶ $\frac{3z^2}{10x^2}$

EXERCISE 2

1 ▶ $\frac{5x^2}{4}$ 2 ▶ $\frac{x^3z}{y}$ 3 ▶ 1 4 ▶ $\frac{4c^2}{5}$ 5 ▶ 6 6 ▶ $\frac{ab}{2}$ 7 ▶ $\frac{b}{6}$ 8 ▶ 19 ▶ $\frac{2}{y}$ 10 ▶ $\frac{b}{2c}$

EXERCISE 2*

1 ▶ $2a^3$ 2 ▶ $\frac{3x}{z}$ 3 ▶ $\frac{9pq^2}{10}$ 4 ▶ $\frac{1}{2x}$ 5 ▶ $\frac{5xy^3}{z^2}$ 6 ▶ y 7 ▶ $\frac{3x^4}{8y}$ 8 ▶ $\frac{1}{2a^2b^2}$

EXERCISE 3

1 ▶ $\frac{7x}{12}$ 2 ▶ $\frac{a}{12}$ 3 ▶ $\frac{4a+3b}{12}$ 4 ▶ $\frac{5x}{12}$ 5 ▶ $\frac{a}{2}$ 6 ▶ $\frac{3a+4b}{12}$ 7 ▶ $\frac{a}{6}$ 8 ▶ $\frac{3a+8b}{12}$

EXERCISE 3*

1 ▶ $\frac{7x}{18}$ 2 ▶ $\frac{5a}{21}$ 3 ▶ $\frac{14x+20y}{35}$ 4 ▶ $\frac{a}{4}$ 5 ▶ $\frac{17}{6b}$ 6 ▶ $\frac{2d+3}{d^2}$ 7 ▶ $\frac{7-3x}{10}$ 8 ▶ $\frac{y-2}{30}$ 9 ▶ $\frac{3x+5}{12}$ 10 ▶ $\frac{2a-1}{a(a-1)}$

EXERCISE 4

- 1 ► $x = \pm 3$ 2 ► $x = \pm 6$
 3 ► $x = \pm 4$ 4 ► $x = \pm 8$
 5 ► $x = \pm 3$ 6 ► $x = \pm 1$
 7 ► $x = 13$ 8 ► $x = \pm 4$
 9 ► $x = 16$ 10 ► $x = 81$

EXERCISE 4*

- 1 ► $x = \pm 5$ 2 ► $x = \pm 7$
 3 ► $x = \pm 9$ 4 ► $x = 0$
 5 ► $x = 7$ 6 ► $x = \pm 4$
 7 ► $x = \pm 5$ 8 ► $x = 10$ or $x = -16$
 9 ► $x = \pm 3$ 10 ► $x = 1$ or $x = 97$

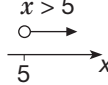
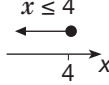
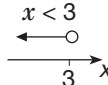
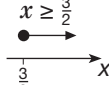
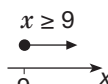
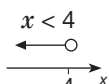
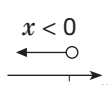
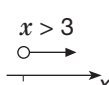
EXERCISE 5

- 1 ► $2^{10} = 1024$ 2 ► $4^7 = 16384$
 3 ► $2^6 = 64$ 4 ► $7^3 = 343$
 5 ► $2^{12} = 4096$ 6 ► $6^8 = 1679616$
 7 ► a^5 8 ► c^4 9 ► e^6 10 ► a^9
 11 ► c^5 12 ► $12a^6$ 13 ► $6a^5$ 14 ► $2e^8$

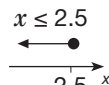
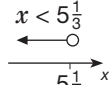
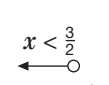
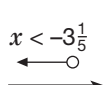
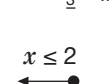
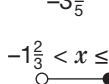
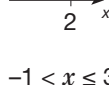
EXERCISE 5*

- 1 ► $6^{12} \approx 2.18 \times 10^9$ 2 ► $7^6 \approx 1.18 \times 10^5$
 3 ► $8^{12} \approx 6.87 \times 10^{10}$ 4 ► $4^{17} \approx 1.72 \times 10^{10}$
 5 ► a^{12} 6 ► $3c^6$
 7 ► $5e^8$ 8 ► $8g^{12}$
 9 ► $48j^{12}$ 10 ► $24m^7$
 11 ► $27a^6$ 12 ► 2
 13 ► $8b^4$ 14 ► 6

EXERCISE 6

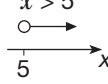
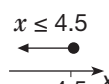
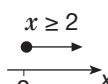
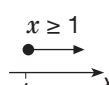
- 1 ► $<$ 2 ► $<$ 3 ► $>$ 4 ► $<$
 5 ► $x \leq 0, x > 2$ 6 ► $-3 < x \leq 3$
 7 ► $x > 5$

 8 ► $x \leq 4$

 9 ► $x < 3$

 10 ► $x \geq \frac{3}{2}$

 11 ► $x \geq 9$

 12 ► $x < 4$

 13 ► $x < 0$

 14 ► $x > 3$

 15 ► $x < -2$ 16 ► $x \geq -5$
 17 ► $x < -1$ 18 ► $x \leq -2$
 19 ► $x \geq -\frac{2}{3}$ 20 ► $x \geq -7$
 21 ► $\{5, 6\}$ 22 ► $\{3, 4\}$
 23 ► $\{0, 1\}$ 24 ► $\{1, 2, 3, 4\}$
 25 ► $\{2, 3\}$

EXERCISE 6*

- 1 ► $x \leq 0$ or $x > 3$; $0 \geq x > 3 \Rightarrow 0 \geq 3$
 2 ► $x \leq 2.5$

 3 ► $x < 5\frac{1}{3}$

 4 ► $x < \frac{3}{2}$

 5 ► $x < -3\frac{1}{5}$

 6 ► $x \leq 2$

 7 ► $-1\frac{2}{3} < x \leq 4\frac{1}{3}$

 8 ► $-1 < x \leq 3$

 9 ► 23
 10 ► $\{1, 2, 3\}$ 11 ► $x \leq 7$; $\{7, 6, 5, 4\}$

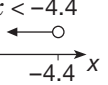
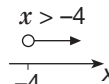
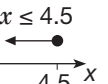
EXERCISE 7

REVISION

- 1 ► 3 2 ► x 3 ► $3x$ 4 ► 4
 5 ► a 6 ► $6x$ 7 ► $\frac{9y}{20}$ 8 ► $\frac{2x}{15}$
 9 ► $\frac{4a+b}{10}$ 10 ► $x = \pm 4$ 11 ► $x = \pm 6$
 12 ► $x = 20$ 13 ► a^{10} 14 ► b^2 15 ► c^{12}
 16 ► $>$ 17 ► $<$ 18 ► $<$ 19 ► $=$
 20 ► $-3 < x \leq 2$; -2 21 ► $x > 5$

 22 ► $x \leq 4.5$

 23 ► $x \geq 2$

 24 ► $x \geq 1$

 25 ► $\{3, 4\}$

EXERCISE 7*

REVISION

- 1 ► $\frac{4a}{b}$ 2 ► $\frac{5x}{y}$ 3 ► $\frac{b}{4a}$
 4 ► $\frac{b}{2}$ 5 ► $\frac{5}{xy}$ 6 ► $\frac{18b}{a}$
 7 ► $\frac{8a}{5}$ 8 ► $\frac{7}{12b}$ 9 ► $\frac{2x+6}{21}$
 10 ► $x = \pm 3$ 11 ► $x = 2$ 12 ► $x = \pm 4$
 13 ► a^4 14 ► $4b^6$ 15 ► $81c^7$
 16 ► $-3 < x \leq 0$; -2 17 ► $x < -4.4$

 18 ► $x > -4$

 19 ► $x \leq 4.5$

 20 ► 37 21 ► $\{-3, -2, -1, 0\}$

EXAM PRACTICE: ALGEBRA 2

1 ▶ $4y^2$

2 ▶ $\frac{y}{3x}$

3 ▶ 1

4 ▶ $\frac{3}{y}$

5 ▶ $\frac{x}{12}$

6 ▶ $\frac{7x}{9}$

7 ▶ $x = \pm 5$

8 ▶ $x = \pm 9$

9 ▶ $x = 12$

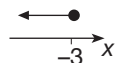
10 ▶ a $3q^6$

b p^2

c x^{20}

11 ▶ $x \leq -3$

12 ▶ 1, 2



UNIT 2: GRAPHS 2

EXERCISE 1

1 ▶ $y = x + 1$

2 ▶ $y = 0.5x - 1$

3 ▶ $y = -2x + 3$

4 ▶ $y = -x$

5 ▶ $y = x + 1$

6 ▶ $y = x + 3$

7 ▶ $y = 2x - 3$

8 ▶ $y = \frac{1}{3}x$

9 ▶ $y = -x + 4$

10 ▶ $y = -2x - 1$

EXERCISE 1*

1 ▶ $y = 3x + 12$

2 ▶ $y = -0.5x$

3 ▶ $y = \frac{5}{2}x - 3.5$

4 ▶ $y = \frac{9}{5}x - 12$

5 ▶ $y = 3x + 7$

6 ▶ $y = -\frac{1}{3}x + 3$

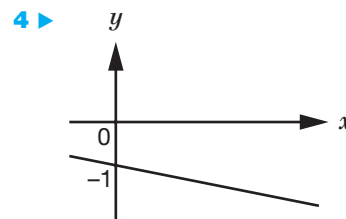
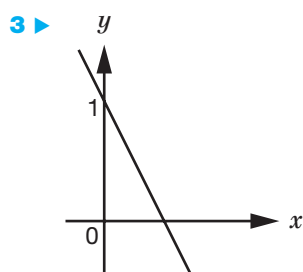
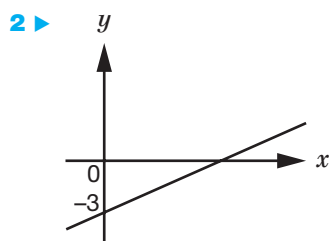
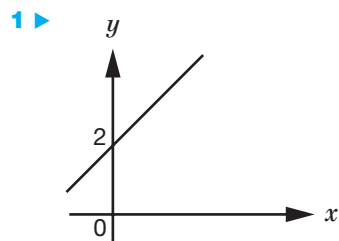
7 ▶ $y = 1$

8 ▶ a $y = -0.5x$ b Collinear

9 ▶ a $y = \frac{1}{2}x + 3$ b $y = \frac{1}{2}x + 3$ c Collinear

10 ▶ $y = -3x + 3, y = \frac{1}{2}x - \frac{1}{2}$

EXERCISE 2



5 ▶ 3, 5

6 ▶ 1, -7

7 ▶ -2, 3

8 ▶ $-\frac{1}{2}, -1$

9 ▶ Crosses axes at (2, 0) and (0, 3)

10 ▶ Crosses axes at (4, 0) and (0, -2)

11 ▶ Crosses axes at (-3, 0) and (0, 4)

12 ▶ For example

a $y = x - 1$

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

c $y = 1$

EXERCISE 2*

1 ▶ $5, \frac{1}{2}$

2 ▶ -2, 4

3 ▶ 2, 2.5

4 ▶ -3, 2.5

5 ▶ 3.5, -7

6 ▶ -2, 10

7 ▶ Crosses axes at $(\frac{1}{2}, 0)$ and $(0, -\frac{1}{3})$

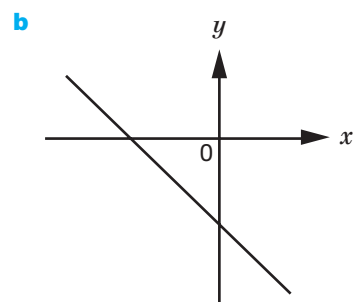
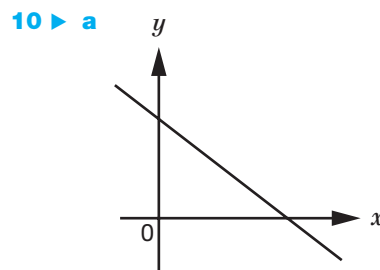
8 ▶ Crosses axes at $(\frac{3}{2}, 0)$ and $(0, -\frac{3}{4})$

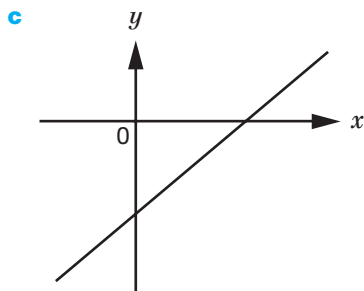
9 ▶ For example

a $x = 2$

b $2x + y = 2$

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





EXERCISE 3

1 ▶

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

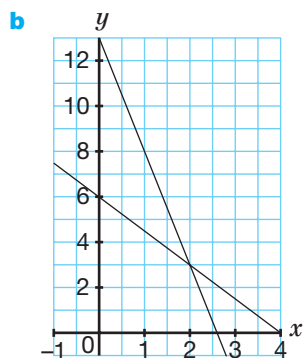
Intersection point is (3, 4)

2 ▶ (2, 5)

3 ▶ (3, 8)

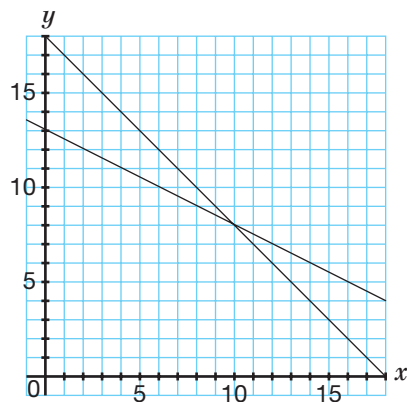
4 ▶ (2, 2)

5 ▶ a Logan: $3x + 2y = 12$ Max: $5x + y = 13$

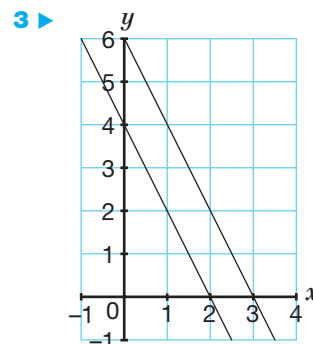


c Big Wheel \$2, Pirate Ship \$3

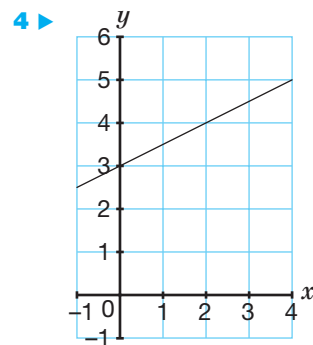
6 ▶ Numbers of coins: $x + y = 18$
Value: $\frac{1}{2}x + y = 13$



Freya has ten 50p coins (and eight £1 coins).



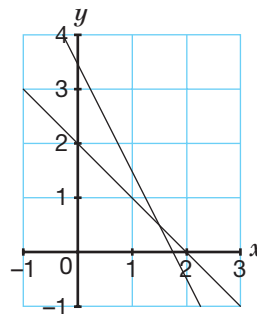
No solutions as lines are parallel and never cross.



Infinite number of solutions (e.g. (0, 3), (2, 4), $(p, \frac{1}{2}p + 3)$) as the lines are the same.

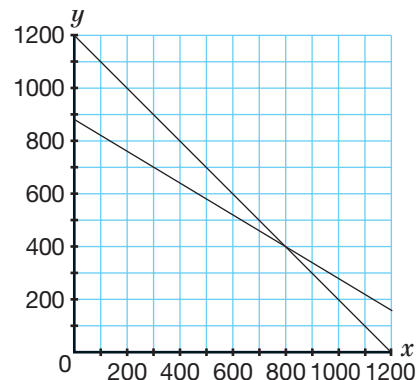
5 ▶ Approx (700, 2900) and (7400, 2300)

6 ▶ Equations are $4x + 2y = 7$ and $3x + 3y = 6$



Cat food £1.50, bag of treats £0.50

7 ▶ Let x be number of £60 tickets,
 y be number of £100 tickets.
Equations are $x + y = 1200$,
 $60x + 100y = 88\,000$ or $3x + 5y = 4400$



Number of £60 tickets is 800

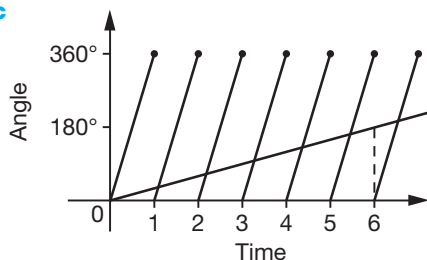
EXERCISE 3*

1 ▶ (6, 13)

2 ▶ (0.53, -0.9)

- 8 ▶ a Angles: $0^\circ, 90^\circ, 180^\circ, 270^\circ, 0^\circ, 90^\circ, 180^\circ, 270^\circ, 0^\circ, 90^\circ, 180^\circ$

b, c



- d 1 h 5.45 min; 2 h 10.9 min; 3 h 16.4 min; 4 h 21.8 min; 5 h 27.3 min

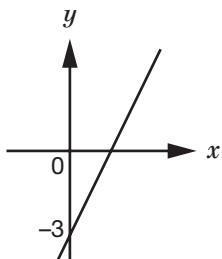
EXERCISE 4

REVISION

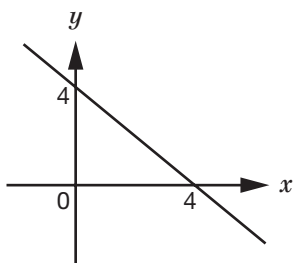
1 ▶ a $y = 2x$ b $y = -3x + 6$

2 ▶ a $y = 2x - 2$ b $y = -x + 1$

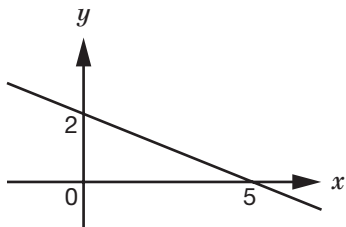
3 ▶ a



b



c

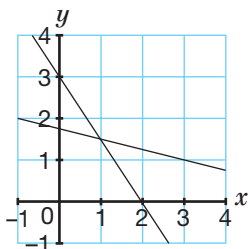


4 ▶ $x = 2, y = 1$

5 ▶ $x = -1, y = 3$

6 ▶ a Rahul: $3x + 2y = 6$, Mia: $x + 4y = 7$

b



c Banana \$1, Musedown \$1.50

EXERCISE 4*

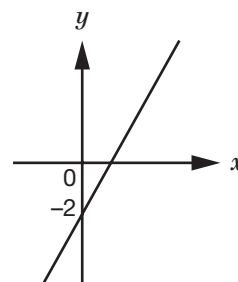
REVISION

1 ▶ $3y = x + 6$

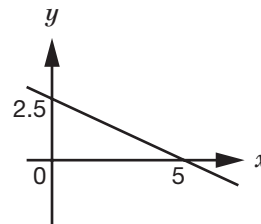
2 ▶ a $3y + x = -7$

b $y = 2x - 4$

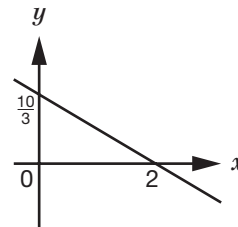
3 ▶ a



b

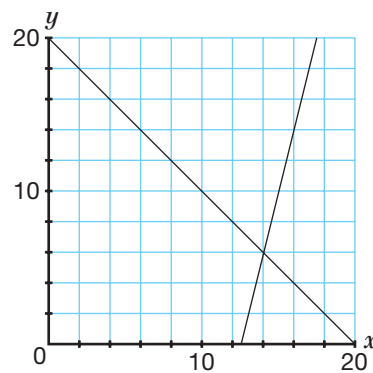


c



4 ▶ $x = -1.4, y = -0.8$

5 ▶ Let x be number correct, y be number wrong. Then $x + y = 20$ and $4x - y = 50$.



From graph number wrong is 6.

6 ▶ $y = 3x + 9 - 6p$

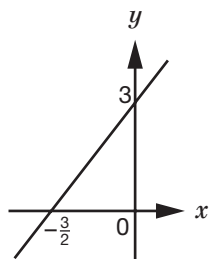
EXAM PRACTICE: GRAPHS 2

1 ▶ $y = 5x - 3$

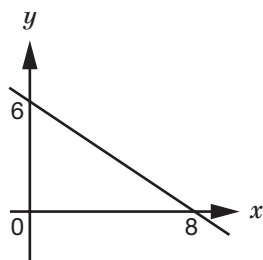
2 ▶ a $y = -\frac{1}{2}x$

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

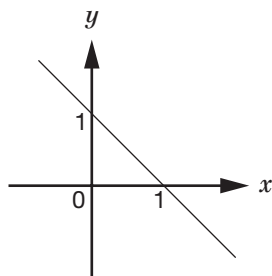
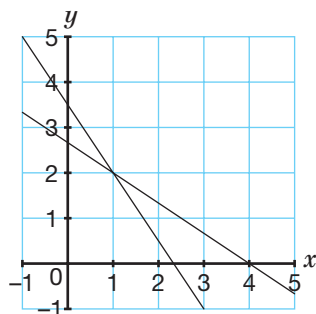
3 ▶ a



b



c

4 ▶ $x = 3, y = 5$ 5 ▶ Theo: $6x + 4y = 14$, Erin: $4x + 6y = 16$ 

a Apple costs \$1 b Avocado costs \$2

UNIT 2: SHAPE AND SPACE 2

EXERCISE 1

- 1 ▶ 10.3 cm 2 ▶ 8.06 cm
 3 ▶ 8.94 cm 4 ▶ 13.0 cm
 5 ▶ 11.8 cm 6 ▶ 15.3 cm
 7 ▶ 70.7 m 8 ▶ 69.2 km
 9 ▶ 3.16 m 10 ▶ 10.4 m

EXERCISE 1*

- 1 ▶ 12.4 cm 2 ▶ 4.90 cm
 3 ▶ 8.77 m 4 ▶ 11.0 m
 5 ▶ 13.9 6 ▶ 200 cm²
 7 ▶ 17:28:20
 8 ▶ a 75 m b 43.3 m

9 ▶ a $\sqrt{y^2 - r^2}$

b Both tangents to circle from same point

10 ▶ 11.6 cm 11 ▶ 27.5 m 12 ▶ 3.92 m

ACTIVITY 2

Circle Angle	BAO	ABO	AOB	BOC	OBC+OCB	OBC	ABC
C_1	25°	25°	130°	50°	130°	65°	90°
C_2	x°	x°	$180^\circ - x^\circ$	$2x^\circ$	$180^\circ - 2x^\circ$	$90^\circ - x^\circ$	90°

EXERCISE 2

- 1 ▶ $a = 50^\circ, b = 280^\circ$
 2 ▶ $a = 90^\circ, b = 30^\circ$
 3 ▶ $a = 70^\circ, b = 20^\circ$
 4 ▶ $a = 55^\circ, b = 70^\circ$
 5 ▶ $a = 25^\circ, b = 25^\circ, c = 65^\circ$
 6 ▶ $x = 30^\circ, 2x = 60^\circ$
 7 ▶ $a = 90^\circ, b = 30^\circ, c = 60^\circ$
 8 ▶ $a = 90^\circ, b = 130^\circ, c = 65^\circ$
 9 ▶ $a = 55^\circ$
 10 ▶ $a = 70^\circ$

EXERCISE 2*

- 1 ▶ $a = 60^\circ, b = 300^\circ$
 2 ▶ $a = 90^\circ, b = 45^\circ$
 3 ▶ $2a = 36^\circ, 3a = 54^\circ$
 4 ▶ $a = 55^\circ, b = 35^\circ$
 5 ▶ $a = 70^\circ, b = 70^\circ, c = 20^\circ, d = 20^\circ$
 6 ▶ $a = 70^\circ, b = 55^\circ, c = 125^\circ$
 7 ▶ $x = 130^\circ, y = 25^\circ, z = 65^\circ$
 8 ▶ $x = 70^\circ, y = 55^\circ, z = 35^\circ$
 9 ▶ $x = 124^\circ, y = 34^\circ, z = 62^\circ$
 10 ▶ $\angle OTP = 90^\circ$ (angle between tangent and radius is 90°)
 $\angle TOP = 180 - (90 + 32) = 58^\circ$ (angles in a triangle)
 $\angle SOT = 180 - 58 = 122^\circ$ (angles on a straight line)
 $OS = OT$ (radii of same circle)
 $x = (180 - 122) \div 2 = 29^\circ$ (angles in an isosceles triangle)

ACTIVITY 3

Circle Angle	OCA	OCB	CAO	AOD	CBO	BOD	ACB	AOB
C_1	35°	40°	35°	70°	40°	80°	75°	150°
C_2	x°	y°	x°	$2x^\circ$	y°	$2y^\circ$	$x^\circ + y^\circ$	$2(x^\circ + y^\circ)$

$$k = 2$$

EXERCISE 3

- 1 ▶ $a = 60^\circ$
- 2 ▶ $a = 140^\circ$
- 3 ▶ $a = 50^\circ$
- 4 ▶ $a = 140^\circ$
- 5 ▶ $a = 40^\circ, b = 20^\circ$
- 6 ▶ $a = 120^\circ, b = 30^\circ$
- 7 ▶ $a = 65^\circ, b = 115^\circ$
- 8 ▶ $a = 50^\circ, b = 130^\circ$
- 9 ▶ $a = 72^\circ$ (opposite angles of a cyclic quadrilateral add to 180°)
 $b = 108^\circ$ (angles on a straight line add to 180°)
 $c = 93^\circ$ (angles in a quadrilateral add to 360°)
- 10 ▶ $k = 46^\circ$ and $m = 38^\circ$ (angles subtended by the same arc)
 $l = 54^\circ$ (angles in a triangle add to 180°)

EXERCISE 3*

- 1 ▶ $a = 100^\circ$
- 2 ▶ $a = 80^\circ$
- 3 ▶ $a = 290^\circ$
- 4 ▶ $a = 102^\circ$
- 5 ▶ $a = 40^\circ, b = 60^\circ$
- 6 ▶ $a = 35^\circ, b = 25^\circ$
- 7 ▶ $a = 110^\circ, b = 70^\circ$
- 8 ▶ $a = 60^\circ, b = 60^\circ$
- 9 ▶ $\angle ADC = \frac{y}{2}$ (angle at centre is twice the angle at the circumference)
 $\angle ABC = 180 - \frac{y}{2}$ (opposite angles in cyclic quadrilateral add to 180°)
- 10 ▶ Angle $TAO = 90^\circ$ (angle between tangent and radius = 90°)
 Angle $OAB = \text{angle } OBA = 32^\circ$ (base angles of isosceles triangle are equal)
 Angle $ABT = 81^\circ$ (angles in a triangle add to 180°)
 Angle $OBT = 32 + 81 = 113^\circ$

EXERCISE 4

REVISION

- 1 ▶ a 13.0 cm b 11.2 cm
- 2 ▶ 44.7 cm
- 3 ▶ a 2.5 m b 6.5 m^2
- 4 ▶ $a = 60^\circ$ (OBC is an equilateral triangle)
 $OA = OB$ so OAB is isosceles (radii same circle)
 $c = \angle OBA = 130^\circ - 60^\circ = 70^\circ$ (base angles of an isosceles triangle are equal)
 $b = 180 - 70 - 70 = 40^\circ$ (angles in a triangle add to 180°)
- 5 ▶ $\angle ABC = 90^\circ; \angle ACB = 36^\circ; \angle BAC = 54^\circ$

- 6 ▶ $OB = OC = OA$ (radii same circle)
 $\angle OAC = \angle OCA$ (base angles of isosceles triangle are equal)
 $\angle OCB = (180^\circ - 40^\circ - 70^\circ) \div 2 = 35^\circ$
 $\angle OBC = \angle OCB$ (base angles of isosceles triangle are equal)
 $\angle OCB = (180^\circ - 40^\circ) \div 2 = 70^\circ$
 $= 2 \times \angle ACO$
 Hence AC bisects $\angle OCB$
- 7 ▶ $\angle ODC = 66^\circ$ (opposite angles of a cyclic quadrilateral add to 180°)
 $OC = OD$ (radii same circle)
 $\angle ODC = \angle OCD$ (base angles of isosceles triangle are equal)
 $\angle COD = 180^\circ - 66^\circ - 66^\circ = 48^\circ$ (angles in a triangle add to 180°)
- 8 ▶ $\angle BCD = 30^\circ$ (opposite angles of a cyclic quadrilateral add to 180°)
 $\angle BOD = 60^\circ$ (angle at the centre is twice angle at the circumference when both are subtended by the same arc)
 $OB = OD$ (radii same circle)
 $\angle OBD = \angle ODB = (180^\circ - 60^\circ) \div 2 = 60^\circ$ (base angles of isosceles triangle are equal and angles in a triangle add to 180°)
 In triangle OBD all the angles are 60° so it is equilateral.

EXERCISE 4*

REVISION

- 1 ▶ 2 m
- 2 ▶ 3.71 cm
- 3 ▶ $OA = OB$ radii same circle.
 Angle $OAB = \text{angle } OBA$ (base angles of isosceles triangle are equal)
 Angle $OAB = (180^\circ - 124^\circ) \div 2 = 28^\circ$ (angles in a triangle add to 180°)
 Angle $OAT = 90^\circ$ (angle between tangent and radius is 90°)
 Angle $BAT = 90^\circ - 28^\circ = 62^\circ$
 (Note: these angles may be annotated on the diagram.)
- 4 ▶ Angle $BAD = 70^\circ$. Angle $BOD = 140^\circ$.
 Opposite angles of cyclic quadrilateral add to 180° and angle at centre equals twice angle at circumference when both are subtended by the same arc.
- 5 ▶ a Angle $BAD = 90^\circ$ (the angle in a semicircle is a right angle). Angle $ABD = 180 - 90^\circ - 19^\circ = 71^\circ$ (angles in a triangle add to 180°)
 b Angle $ACB = 19^\circ$ (angles subtended at the circumference by the same arc are equal)

- 6 ▶ Angle $ABC = 90^\circ$, $6y = 90^\circ$, angle $BAC = 75^\circ$
- 7 ▶ a Let angle $BAO = x$. Angle $CDO =$ angle $BAO = x$ (both subtended by arc BC)
 Angle $BOC = 2 \times$ angle $BAO = 2x$ (angle at centre $= 2 \times$ angle at circumference)
 So angle $BAO +$ angle $CDO = x + x = 2x =$ angle BOC
- b Angle $BAO =$ angle ABO (base angles of isosceles triangle OAB , equal radii)
 Angle $CDO =$ angle DCO (base angles of isosceles triangle OCD , equal radii)
 Since angle $BAO =$ angle $CDO = x$, all four angles $= x$
- 8 ▶ Angle $ABC = 180^\circ - x$ (angles on a straight line). Also angle $ABC = 180^\circ -$ angle ADC (opposite angles of a cyclic quadrilateral are supplementary). So angle $ADC = x$
 Angle $ADC +$ angle $CDT = 180^\circ$ (angles on a straight line). So $x + y = 180^\circ$

EXAM PRACTICE: SHAPE AND SPACE 2

- 1 ▶ 2.98 m
- 2 ▶ a $\alpha = b = 40^\circ$ (angles subtended by same arc)
 Angle adjacent to $35^\circ = 40^\circ$ (alternate angles)
 So $c = b + 75 = 115^\circ$ (exterior angle property)
- b Angle adjacent to $d = 74^\circ$ (opposite angles of a cyclic quadrilateral are supplementary)
 $d = 106^\circ$ (angles on a straight line)
 $e = 102^\circ$ (opposite angles of a cyclic quadrilateral are supplementary)
- c $f = 65^\circ$ (angles subtended by same arc)
 $g = 102 - f = 37^\circ$ (exterior angle property)
- 3 ▶ Angle $OBA = 90^\circ - 3x$ (angle between tangent and radius $= 90^\circ$)
 Angle $OAB = 90^\circ - 3x$ (base angle of isosceles triangle OAB , equal radii)
 Angle $OAC = x$ (base angle of isosceles triangle OAC , equal radii)
 Therefore
 angle $BAC = 90^\circ - 3x + x = 90^\circ - 2x$
 Angle $BOC = 2 \times$ angle $BAC = 180^\circ - 4x$ (angle at centre $= 2 \times$ angle at circumference)
 Angle $TBO =$ angle $TCO = 90^\circ$ (angles between tangent and radii)
 In quadrilateral $TBOC$,
 $y + 90 + 180 - 4x + 90 = 360^\circ$
 Therefore $y = 4x$ (There are at least four other ways to prove this result.)
- 4 ▶ 43.3 cm^2

UNIT 2: HANDLING DATA 1

EXERCISE 1

- 1 ▶ a Categorical
 b Discrete
 c Discrete
 d Continuous
 e Categorical
 f Continuous

2 ▶ a

Grade Rating	Tally	Frequency
A		9
B		5
C		2
D		6
E		8
	Total	30

- b 30
 c Students either loved or hated the event.

3–4 Students' own answers

EXERCISE 1*

- 1 ▶ a Continuous
 b Categorical
 c Discrete
 d Continuous
 e Categorical
 f Discrete

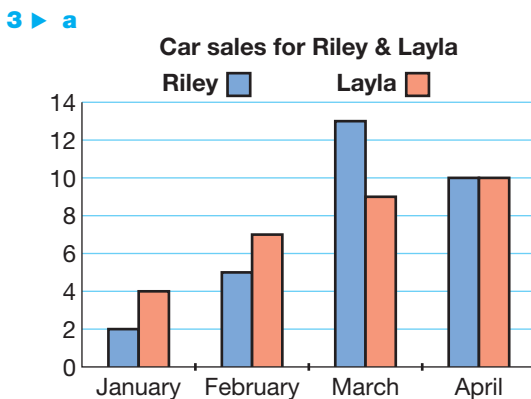
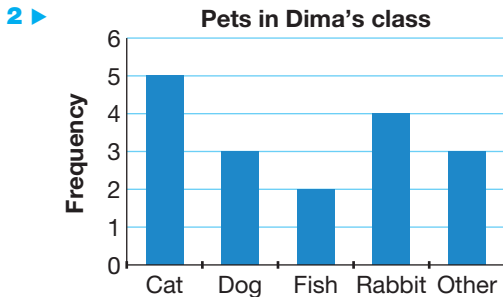
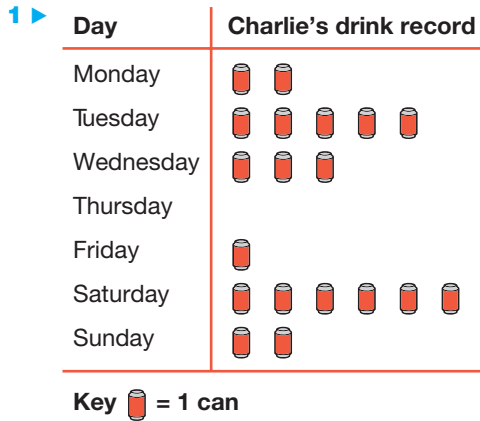
2 ▶ a

Score	Tally	Frequency
1		7
2		10
3		5
4		10
5		6
6		12
	Total	50

- b No clear bias. (Sample is too small to draw conclusions from)

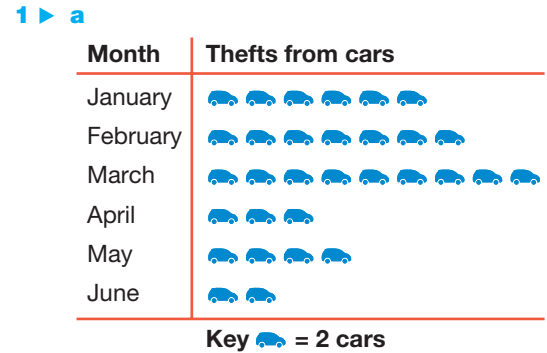
3–4 Students' own answers

EXERCISE 2

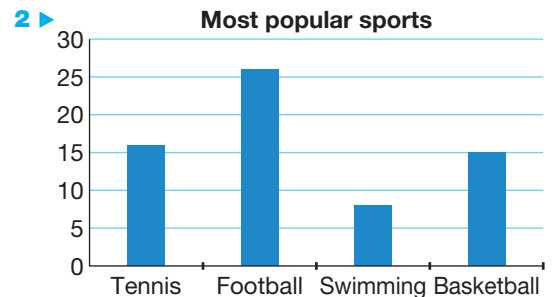


- b** Both have increasing sales, but Riley did very well in March.
- 4 ▶ a** Hot chocolate 80°, milkshake 60°, coffee 100°, tea 120°
- b** Accurate pie chart drawn with hot chocolate 80°, milkshake 60°, coffee 100°, tea 120°
- 5 ▶ a** Any suitable two-way table
- b** No since only 54% are in favour.

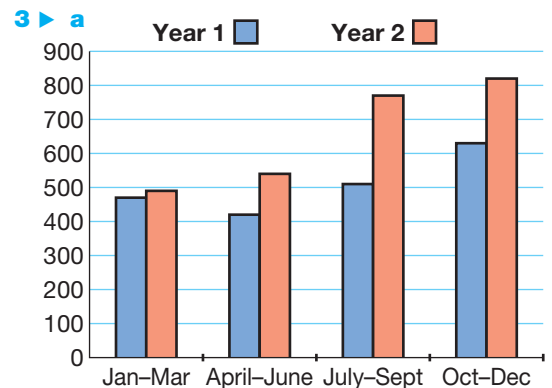
EXERCISE 2*



- b** Probably end of March, beginning of April



- b** 65



- b** Year 2 sales are better and are following the same trend as Year 1.

- 4 ▶** Accurate pie chart drawn with France 144°, Spain 108°, Germany 45°, Italy 63°

5 ▶ a

	No change	Improved	Much improved	Total
Drug A	10	45	5	60
Drug B	7	20	13	40
Total	17	65	18	100

- b** $\frac{2}{5}$

- c** Students' own answer, e.g. Drug B had a greater proportion much improved but Drug A had a greater proportion improved.

EXERCISE 3

- 1 ▶ Mean = 4, median = 4, mode = 4
- 2 ▶ Mean = 5, median = 4, mode = none
- 3 ▶ Mean = 6, median = 4, mode = 0
- 4 ▶ Mean = 4.75, median = 5, mode = 7 and 9
- 5 ▶ Mean = 30.5, median = 31, mode = 31
- 6 ▶ 4
- 7 ▶ 43
- 8 ▶ 1

EXERCISE 3*

- 1 ▶ Mean = 3, median = 2, mode = 0
- 2 ▶ Mean = 66, median = 70.5, mode = 72
- 3 ▶ Mean = 82.375, median = 71, mode = none
- 4 ▶ Mean = 0.62, median = 0.575, mode = 0.46
- 5 ▶ Mean = 12.9, median = 12, mode = none
- 6 ▶ Mean = 92.9
- 7 ▶ 11 and 15, 12 and 14, or 13 and 13
- 8 ▶ $x = 3$, $y = 6$, $z = 9$

EXERCISE 4

- 1 ▶ a Mean £19 400, median £15 000, mode £12 000
b Median; mean is distorted by one high salary and mode is lowest salary so neither of these gives a typical salary.
- 2 ▶ a Median; the low value of 6 s distorts the mean, making it too low, and the mode gives the longest time so neither of these is typical.
b Mode; the data is qualitative so you cannot work out the mean or median.
- 3 ▶ a Mean = 14.2, median = 13, mode = 12
b Size 12; the most popular size is the one that is most likely to be purchased.
- 4 ▶ a Mean = 194, mode = 180, median = 180
b Mean. This takes into account lower and higher values throughout the week.

EXERCISE 4*

- 1 ▶ a Mean = 8.375, median = 7.75, mode = 7
b Mode; this is the most popular shoe size so it makes sense to order what customers are likely to want to buy. The values of mean and median aren't proper shoe sizes.
- 2 ▶ a Mean = 53, median = 47, mode = 47
b Mean. This is the highest therefore they will wish to work on a 'worst case scenario'. They will also want an excuse to charge more!

- 3 ▶ a Mean = £212, median = £190, mode = £180

b Mean, which takes into account all five values and could be used to work out the total bill.

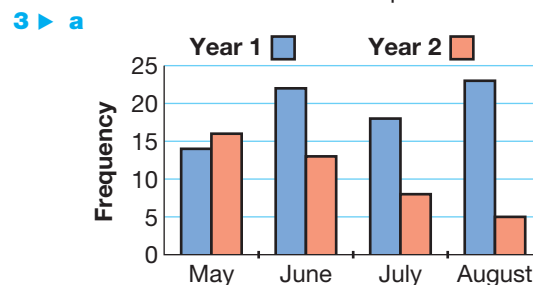
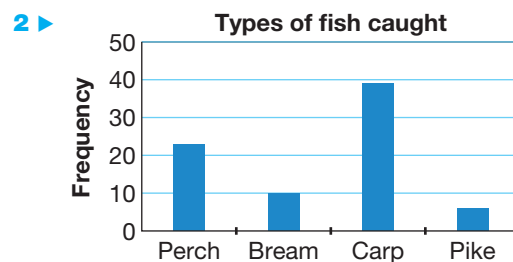
- 4 ▶ a Mode. Data is non-numerical.

b Median. The mean would not give a whole number and the mode is the lowest value so not representative of the data set.

EXERCISE 5

REVISION

- 1 ▶ Accurate pie chart drawn with strawberries 125°, banana 75°, yoghurt 100°, iced water 60°



- b Second year started with roughly the same number of sunny days, but then rapidly deteriorated.

4 ▶

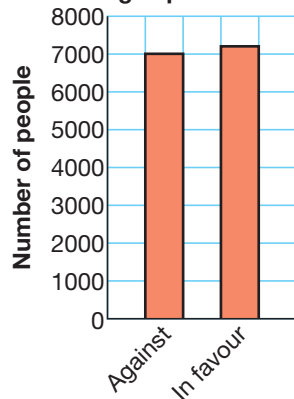
	French	German	Mandarin	Total
History	57	51	18	126
Geography	45	12	17	74
Total	102	63	35	200

- b 17.5%

c History

- 5 ▶ a The vertical scale does not start from zero. This makes a small difference look like a big difference.

b **High speed rail link**



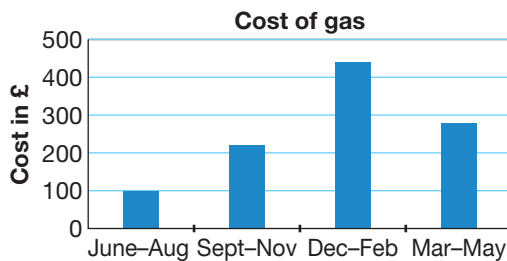
Very similar numbers in favour of and against the rail link.

- 6 ▶ Mean = 5, median = 6, mode = none
 7 ▶ a Mean = \$1150, mode = \$700, median = \$750
 b Median
 8 ▶ 36

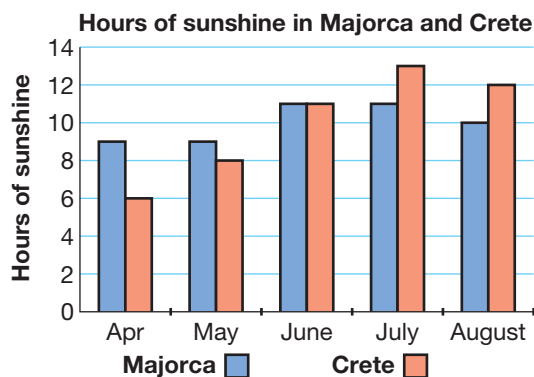
EXERCISE 5*

REVISION

- 1 ▶ 540
 2 ▶ a



- b £86.67
 3 ▶ a



- b Majorca is sunnier before June, Crete is sunnier after June.

4 ▶

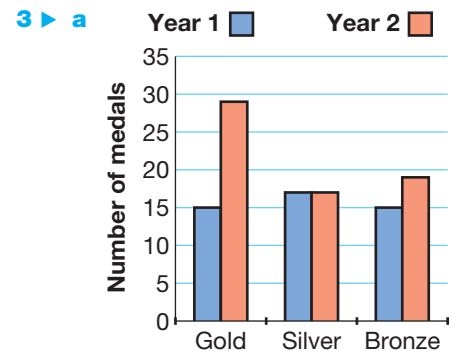
	Men	Women	Total
More spaces	23	42	65
Adequate spaces	37	18	55
Total	60	60	120

No, only 54% want more spaces.

- 5 ▶ The bar for 'Nutty Oats' is wider than the rest. The vertical axis has no scale or unit.
 6 ▶ a Mean = 47, mode = 70, median = 49
 b Mean or median
 7 ▶ 1.74 m
 8 ▶ 9.37 m (to 3 s.f.)

EXAM PRACTICE: HANDLING DATA 1

- 1 ▶ a 8 b 60°
 2 ▶ 14



- b Year 2 was much better, especially the number of gold medals won.

4 ▶

	Chicken	Vegetarian	Total
Cheese	15	8	23
Ice cream	22	5	27
Total	37	13	50

- 5 ▶ (1) The blocks have different widths. (2) The scale on the y -axis does not start at zero.
 6 ▶ Mean = 6, median = 6, mode = none
 7 ▶ 82
 8 ▶ $1.803... = 1.80$ (3 s.f.)