Unit 1

NUMBER 1

EXERCISE 1

1	$\frac{2}{3}$	**2**	$\frac{2}{3}$	**3**	$\frac{1}{3}$	**4**	$\frac{2}{3}$
5	$\frac{1}{2}$	**6**	$\frac{1}{3}$	**7**	$\frac{3}{4}$, 75%	**8**	$\frac{1}{5}$, 20%
9	$\frac{1}{4}$, 0.25	**10**	$\frac{1}{8}$, 0.125	**11**	0.15, 15%	**12**	0.075, 7.5%
13	$\frac{7}{20}$, 35%	**14**	$\frac{3}{8}$, 37.5%	**15**	$2\frac{2}{3}$	**16**	$3\frac{1}{4}$
17	$3\frac{2}{5}$	**18**	$2\frac{5}{7}$	**19**	$\frac{7}{3}$	**20**	$\frac{18}{5}$
21	$\frac{11}{6}$	**22**	$\frac{41}{7}$				

EXERCISE 1*

1	$\frac{2}{7}$	**2**	$\frac{2}{3}$	**3**	$\frac{1}{6}$	**4**	$\frac{7}{11}$
5	$\frac{1}{2}$	**6**	$\frac{3}{8}$	**7**	$\frac{3}{40}$	**8**	$\frac{1}{15}$
9	$\frac{5}{6}$	**10**	$\frac{5}{6}$	**11**	$\frac{2}{3}$	**12**	$\frac{4}{5}$
13	$\frac{4}{9}$	**14**	$\frac{3}{8}$	**15**	$\frac{7}{40}$	**16**	$\frac{3}{40}$
17	680	**18**	910	**19**	0.765	**20**	0.095
21	39	**22**	3.1	**23**	24	**24**	18
25	26.25	**26**	42.84	**27**	41.86	**28**	49.88

EXERCISE 2

1	5	**2**	−8	**3**	13	**4**	−17
5	13	**6**	−20	**7**	−3	**8**	−10
9	−12	**10**	28	**11**	−6	**12**	−6
13	−2	**14**	−5	**15**	3	**16**	3
17	10	**18**	4				

EXERCISE 2*

1	−2	**2**	6	**3**	23	**4**	5
5	18	**6**	10	**7**	18	**8**	10
9	12	**10**	$2\frac{2}{3}$	**11**	12	**12**	18
13	36	**14**	13	**15**	49	**16**	74
17	144	**18**	196				

EXERCISE 3

1	1.8	**2**	0.272 km	**3**	5.52 m	**4**	1.38 cm
5	0.684	**6**	12.6 litres	**7**	£31.80	**8**	£64.80
9	£45.50	**10**	£71.20	**11**	15%	**12**	6%
13	10%	**14**	15%	**15**	5%	**16**	5.94 m

17 Percentage increase in value $= \frac{468}{7800} \times 100 = 6\%$

18 $12\,000 \times 0.24 = 2880$
$12\,000 - 2880 = 9120$

19 €688

20 1960 to 1980 = 2.70% increase
1980 to 2000 = 3.95% increase

EXERCISE 3*

1	0.75	**2**	21 kg	**3**	$171	**4**	11.7 km
5	52.5	**6**	106.25	**7**	68.005 km	**8**	86.1 kg
9	$80.04	**10**	$89.18	**11**	13.04%	**12**	$836

13 Profit = €4.25; percentage profit $= \frac{4.25}{34} \times 100 = 12.5\%$

14 $\frac{\$374.40}{\$960.00} \times 100 = 39\%$

15	0.0402%	**16**	33.3%	**17**	250%

18 11.1% cheaper in US; 12.5% more expensive in Europe

19 There are 500 million telephones in the world, 60 000 in Ethiopia. Population of Ethiopia is 30 million.

20

	1976	1986	1996
Largest tin (p/g)	0.0359	0.0607	0.0738
Smallest tin (p/g)	0.0493	0.1	0.16

	% increase in cost '76–'86	% increase in cost '86–'96
Largest tin	69.1	21.6
Smallest tin	102.8	60

Inflation was much higher between 1976 and 1986. If the larger tin were bought in 1976 you would get 37.3% more for your money. In 1986 you would get 64.7% more for your money and in 1996 you would get 117% more.

ACTIVITY 1

Neurons: 10^{11}
Connections: 10^{15}
Connections per second $\approx 10^{15} \div (60 \times 60 \times 24 \times 365 \times 75) \approx$ half a million

EXERCISE 4

1	1×10^5	**2**	1×10^5	**3**	1×10^{10}	**4**	1×10^{10}
5	1×10^3	**6**	1×10^7	**7**	1×10^{13}	**8**	1×10^{11}
9	1×10^2	**10**	1×10^5	**11**	1×10^3	**12**	1×10^2
13	1×10^3	**14**	1×10^8	**15**	1×10^1	**16**	1×10^2
17	4.56×10^2	**18**	6.78×10^1	**19**	1.2345×10^2		
20	6.7×10^7	**21**	5.68×10^2	**22**	3.84×10^1	**23**	7.0605×10^2
24	1.23×10^8	**25**	4000	**26**	56 000	**27**	4 090 000
28	678 900	**29**	560	**30**	65 000	**31**	7 970 000
32	987 600	**33**	1000	**34**	10 000	**35**	8.4×10^9
36	1.4×10^2	**37**	5×10^1				

EXERCISE 4*

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, Quasar 1000 million km

EXERCISE 5

1	800	**2**	90 000	**3**	3740	**4**	80 300
5	0.44	**6**	0.56	**7**	0.506	**8**	0.105
9	34.78	**10**	0.65	**11**	3.0	**12**	9.1
13	1×10^5	**14**	1.1×10^5	**15**	1×10^5	**16**	9.9×10^4

EXERCISE 5*

1	10	**2**	5000	**3**	45.7	**4**	89 500
5	0.069	**6**	0.0069	**7**	0.049 5	**8**	0.000 568
9	9.00	**10**	2.08	**11**	7.0	**12**	78.2
13	1.06×10^5	**14**	1.057×10^5	**15**	9.88×10^4	**16**	9.877×10^4

REVISION EXERCISE 6

1	1×10^5	**2**	1×10^2	**3**	4570	**4**	4.57×10^3
5	3700	**6**	$\frac{12}{25}$	**7**	0.48	**8**	$\frac{21}{8}$
9	2.625	**10**	$\frac{1}{3}$	**11**	$\frac{1}{30}$	**12**	$\frac{7}{9}$
13	$\frac{1}{16}$	**14**	4.2	**15**	420	**16**	4
17	14.4	**18**	0.05	**19**	0.046	**20**	0.046
21	9.2×10^8	**22**	5×10^4	**23**	2.04	**24**	45.12 km

25 Profit = \$0.60; percentage profit = $\frac{0.6}{12} \times 100 = 5\%$

26 Loss = €72, percentage loss = $\frac{72}{480} \times 100 = 15\%$

REVISION EXERCISE 6*

1	$\frac{1}{4}$	**2**	$\frac{3}{7}$	**3**	$\frac{5}{12}$	**4**	8.1×10^3
5	8.10×10^3	**6**	0.0456	**7**	45 600	**8**	1×10^{12}
9	1×10^2	**10**	1×10^8				

11 1.586×10^8 **12** 5.28×10^7 **13** 8×10^2

14 To increase 80 by 10% = 88.
To decrease 120 by 30% = 84. ∴ the first by 4.

15 Profit = £162 000; percentage profit = $\frac{162\,000}{900\,000} \times 100 = 18\%$

16 $0.04 \times 13.50 = 0.54$; $13.50 - 0.54 = 12.96$

17 \$42 928.40 **18** 2 cents loss

ALGEBRA 1

ACTIVITY 2

6. Half number added.

INVESTIGATE

Substituting any value of x gives the same values for both expressions.

EXERCISE 7

1	$4ab$	**2**	$3uv$	**3**	$7xy$	**4**	$8ab$
5	$-3pq$	**6**	$-3xy$	**7**	$y - xy$	**8**	$a - ab$
9	$2 - 6x$	**10**	$-3y - 4$	**11**	$2cd$	**12**	ab
13	$-4xy$	**14**	$-3pq$	**15**	$2ab + 5bc$		

16	$2ab + 3bc$	**17**	0	**18**	0	**19**	$2gh - 5jk + 7$
20	$3ab - 3bc + 2$	**21**	$-3p^2 - 2p$	**22**	$p^3 + 7p^2$	**23**	$5x^2y - 3xy^2$
24	$3ab^3 - 2ab^2$						

EXERCISE 7*

1	$-xy$	**2**	$-2xy$	**3**	$4ab - b$	**4**	$11xy - x$
5	$6ab$	**6**	$4xy$	**7**	0	**8**	0
9	$3ab + 3bc$	**10**	$2fg + 11gh$	**11**	$3q^2$	**12**	$2r^4$
13	$x + 1$	**14**	$x^4 + 3$	**15**	$a^3 + 2a^2 + a = a(a^2 + 2a + 1)$		
16	$x^5 - 7x^3 + 2$	**17**	$h^3 + h^2 + 3h + 4$	**18**	$2h^3 - 2h^2 + 2$		
19	$7a^2b - 3ab$	**20**	$3fg - 8fg^2$	**21**	$a^2b^3c - 0.6a^3b^2c + 0.3$		
22	0	**23**	$4pq^2r^5 - 2pq^2r^4$	**24**	$4f^2g^2h^2 + 9f^2g^2h^3 - 2f^2g^3h^2$		

EXERCISE 8

1	$6a$	**2**	$28x$	**3**	$2x^2$	**4**	$3y^2$
5	$3x^3$	**6**	$2a^4$	**7**	$15a^5$	**8**	$8b^6$
9	$6st$	**10**	$20rt$	**11**	$4rs^2$	**12**	$3de^3$
13	$2a^2b^2$	**14**	$9u^2v^2$	**15**	$4y^3$	**16**	$24r^3$
17	$12x^3$	**18**	$3y^5$	**19**	$20a^3$	**20**	$27b^3$

EXERCISE 8*

1	$8a^3$	**2**	$3x^4$	**3**	$15x^4y^2$	**4**	$8xy^6$
5	$6a^7$	**6**	$30b^7$	**7**	$18y^3$	**8**	$32a^4$
9	$36x^5y^3$	**10**	$24x^4y^7$	**11**	$30a^3b^3c^5$	**12**	$24a^2b^5c^6$
13	$56xy^4$	**14**	$135x^4y$	**15**	$10x^3y^3$	**16**	$9x^2y^5$
17	$3x^3y^4 - 2x^3y^2 = x^3y^2(3y^2 - 2)$			**18**	$5x^6y^2 + 3x^5y^2 = x^5y^2(5x + 3)$		
19	$14a^4b^6$	**20**	$2x^6y^5$				

EXERCISE 9

1	$10 + 15a$	**2**	$12 + 21x$	**3**	$2b - 8c$	**4**	$6v - 30w$
5	$-6a - 24$	**6**	$-27g - 45$	**7**	$4x - 12$	**8**	$7y - 28$
9	$2b - a$	**10**	$5y - x$	**11**	$5a + 4b$	**12**	$7x + 2y$
13	$3t - 18$	**14**	$5v - 17$	**15**	$6x + y$	**16**	$10a - 2b$
17	$1.4x + 0.3y$	**18**	$0.5b$	**19**	$2.1a - 11.7$	**20**	$4.3t + 9.1$

EXERCISE 9*

1	$12m - 8$	**2**	$10n - 30$	**3**	$2x - 2y + 2z$		
4	$3a + 3b - 3c$	**5**	$15a + 5b - 20c$	**6**	$15a - 6b - 9c$		
7	$2x - 3y + 4$	**8**	$5x + 3y - 4$	**9**	$3y - x$		
10	$x + 12y$	**11**	$-1.4x - 2.2$	**12**	$-1.1 - 1.6z$		
13	$-6x - 3y$	**14**	$-8q$	**15**	$4.6x - 6.2y - 0.4z$		
16	$0.8x + 1.8y - 0.4z$			**17**	$-0.6a - 4.2b + 0.7$		
18	$0.3a - 0.1b - 0.1c$			**19**	$-0.44x^2 - 3.8xy - 1.2y^2$		
20	$a^2 - 0.61ab - 1.1b^2$						

EXERCISE 10

1	4	**2**	12	**3**	15	**4**	−33
5	25	**6**	39	**7**	100	**8**	108
9	12	**10**	$\frac{1}{4}$	**11**	15	**12**	−33
13	2.4	**14**	6.5	**15**	13.5	**16**	19.5
17	26.6	**18**	21.6	**19**	1.4	**20**	−4.8
21	0.985	**22**	−10.1	**23**	6.8	**24**	6.3

EXERCISE 10*

1	99.9	**2**	−133.3	**3**	5.13 (to 2 d.p.)
4	10.68 (to 2 d.p)	**5**	40.664	**6**	4.587

7 580.39 **8** 32.364 **9** 8.49 (to 2 d.p)
10 0.0468 **11** 38.84 **12** −90.9433

EXERCISE 11

1 $x = 3$ **2** $x = 4$ **3** $x = -1$ **4** $x = -3$
5 $x = -2$ **6** $x = -2$ **7** $x = 2$ **8** $x = 4$
9 $x = 8$ **10** $x = 9$ **11** $x = 1$ **12** $x = 6$
13 $x = -6$ **14** $x = -10$ **15** $x = 1$ **16** $x = 1$
17 $x = -2$ **18** $x = -1$ **19** $x = \frac{2}{3}$ **20** $x = \frac{1}{5}$
21 $x = \frac{5}{9}$ **22** $x = \frac{5}{8}$ **23** $x = \frac{4}{3}$ **24** $x = 1$
25 $x = -1$ **26** $x = -\frac{2}{7}$ **27** 238, 239 **28** 72, 73, 74
29 $x = 10$; 40°, 80°, 60° **30** $x = 25$; 75°, 50°, 55°
31 $b = 4$ **32** $b = 2.4$ **33** $C = -15$ **34** $d = 0.5$

EXERCISE 11*

1 $x = 4$ **2** $x = 3$ **3** $x = 11$ **4** $x = 10$
5 $x = -2$ **6** $x = 2$ **7** $x = -5$ **8** $x = -4$
9 $x = -4$ **10** $x = -6$ **11** $x = 5$ **12** $x = 2$
13 $x = 0$ **14** $x = 1$ **15** 72, 74, 76
16 123, 125, 127, 129
17 Sonia = 11 kg, Amelia = 44 kg, John = 67 kg
18 14 **19** $x = -50$ **20** $x = 2.44$ (to 2 d.p)
21 45 m (2 s.f.) **22** 4.20 cm **23** $1\frac{2}{3}$ km

EXERCISE 12

1 $x = 1$ **2** $x = 4$ **3** $x = 2$ **4** $x = 5$
5 $x = 4$ **6** $x = 3$ **7** $x = -3$ **8** $x = -2$
9 $x = 1$ **10** $x = 2$ **11** $x = -1$ **12** $x = -2$
13 $x = 0$ **14** $x = 0$ **15** $x = -\frac{1}{2}$ **16** $x = -\frac{1}{3}$
17 $x = 2$, perimeter = 38 **18** $x = 2$, perimeter = 16
19 9 **20** 13

EXERCISE 12*

1 $x = 4$ **2** $x = 3$ **3** $x = -2$ **4** $x = -1$
5 $x = 1\frac{1}{2}$ **6** $x = \frac{2}{5}$ **7** $x = \frac{4}{5}$ **8** $x = \frac{3}{4}$
9 $x = \frac{7}{9}$ **10** $x = \frac{2}{3}$ **11** $x = 3$ **12** $x = 4$
13 $x = 5$ **14** $x = 4$ **15** $x = -9$ **16** $x = -10$
17 $x = 0.576$ (3 s.f.) **18** $x = 0.277$ (3 s.f.)
19 $x = 1.28$ (3 s.f.) **20** $x = -1.22$ (3 s.f.)
21 $x = 30$ **22** 42 years

EXERCISE 13

1 $x = 13$ **2** $x = 4$ **3** $x = 3$ **4** $x = 7$
5 $x = 2$ **6** $x = 6$ **7** $x = 4$ **8** $x = 4$
9 $x = .\frac{5}{2}.$ **10** $x = -\frac{5}{3}$

EXERCISE 13*

1 $x = 8$ **2** $x = 5$ **3** $x = 5$ **4** $x = 1$
5 $x = 4$ **6** $x = 3$ **7** $x = 9$ **8** $x = 5$
9 $x = \frac{3}{4}$ **10** $x = \frac{3}{5}$ **11** 6 hits **12** 15
13 4

REVISION EXERCISE 14

1 $3x - 2$ **2** ab **3** $6a$ **4** $2a^2$
5 a^3 **6** $2a^4$ **7** $4a^4$ **8** $-5a - 4ab$
9 $x + 7y$ **10** $x = 7$ **11** $x = 4.8$ **12** $x = 2$
13 145, 146, 147
14 **a** $4x + 12 = 54$ **b** 10.5, 16.5

REVISION EXERCISE 14*

1 $4xy^2 - 3x^2y$ **2** $2x^3y^3$ **3** 1 **4** $2x^3y + xy^3 + x^4$
5 $x = 20$ **6** $x = 1.25$ **7** $x = -6$ **8** $x = 2$
9 $x = 4$ **10** 72 m² **11** 11 years old **12** 6 m/s
13 \$98

GRAPHS 1

INVESTIGATE

Gradient of AB = 0.1
Closer to zero. Gradient AC = 0
Larger and larger. Gradient BC is infinite.

EXERCISE 15

1 1 **2** 1 **3** 0.5 **4** 0.5
5 3 **6** 2 **7** $\frac{1}{4}$ **8** $\frac{1}{3}$
9 $-\frac{1}{4}$ **10** −1 **11** 10 m **12** 45 m
13 1.5 m **14** 10 km **15** 2.325 m **16** 2 m
17 **a** 14 m **b** $\frac{1}{30}$ **18** **a** −2 **b** 159 m

EXERCISE 15*

1 $\frac{3}{8}$ **2** $\frac{5}{4}$ **3** $-\frac{3}{4}$ **4** $-\frac{6}{7}$ **5** 52
6 5 **7** No **8** No **9** Yes **10** Yes
11 **a** $\frac{1}{6}$ cm **b** 0.1 cm **12** 26 m **13** $p = -2$ **14** $q = 10.4$

ACTIVITY 3

x	−2	0	2	Gradient	y intercept
$y = x + 1$	−1	1	3	1	1
$y = -x + 1$	3	1	−1	−1	1
$y = 2x - 1$	−5	−1	3	2	−1
$y = -2x + 1$	5	1	−3	−2	1
$y = 3x - 1$	−7	−1	5	3	−1
$y = \frac{1}{2}x + 2$	1	2	3	$\frac{1}{2}$	2
$y = mx + c$				m	c

EXERCISE 16

1 3, 5 **2** 4, 1 **3** 1, −7 **4** 2, −3
5 $\frac{1}{3}$, 2 **6** $\frac{1}{2}$, 4 **7** $-\frac{1}{2}$, 5 **8** $-\frac{1}{4}$, 3
9 $-\frac{1}{3}$, −2 **10** $-\frac{1}{5}$, −1 **11** −2, 4 **12** −1, 5
13 0, −2 **14** 0, 3 **15** $y = 3x - 2$ **16** $y = -x + 4$
17 $y = \frac{x}{3} + 10$ **18** $y = -0.2x - 5$ **19** $y = 2x + 4$ **20** $y = -x - 1$
21 $y = -5x - 1$ **22** $y = 3x$

23 For example
a $y = x - 1$ **b** $y = -\frac{1}{2}x + 2$ **c** $y = 1$
24 **b** 9°C **c** $t = 0.6m + 9$ **d** 35 min
e 117 °C, no, over boiling point, $0 \leqslant t \leqslant 30$ seems sensible.

EXERCISE 16*

1 5, $\frac{1}{2}$ **2** $-4, -\frac{3}{4}$ **3** $0, -\frac{3}{4}$ **4** 0, 2.5 **5** −3, 2.5
6 $\frac{4}{3}, \frac{2}{3}$ **7** $6, -\frac{3}{2}$ **8** $\frac{5}{4}, \frac{2}{3}$ **9** ∞ **10** ∞
11 $-\frac{2}{3}, -\frac{5}{3}$ **12** $-\frac{3}{4}, \frac{5}{4}$ **13** $y = 2.5x - 2.3$
14 $y = -\frac{3}{5}x + 6.3$ **15** $y = \frac{x}{4} + 1$ **16** $y = -0.7x - 3.3$
17 $y = 2.5x - 3.5$ **18** $y = 8x + 8.4$ **19** **a** $7x + 6y = 84$
20 $9x - 5y = 96$
21 For example
a $x = 2$ **b** $2x + y = 2$ **c** $y = \frac{1}{2}x - 1$
22 **b** $h = 0.3t - 0.5$ **c** −0.2 m, no, $t > 2$
d 335 hours, steady growth **e** $h = 0.6t - 7.7$
Beanstalk is 6.7 m at noon on 2 April. Has to grow another 93.3 m.
$93.3 = 0.6t - 7.7$ gives $t \approx 168$ hours = 7 days
i.e. at noon on 9 April.

ACTIVITY 4

A baked bean tin or a cardboard tube is ideal.

$\pi = \frac{22}{7} = 3.142...$

EXERCISE 17

1 (3, 0), (0, 6) **2** (9, 0), (0, 3) **3** (4, 0), (0, 6)
4 (2, 0), (0, 4) **5** (5, 0), (0, 4) **6** (8, 0), (0, 3)
7 (4, 0), (0, −2) **8** (9, 0), (0, −3) **9** (−8, 0), (0, 6)
10 (−2, 0), (0, 5)
11 **b** £10 **c** 42 000 **d** £0; no, not a sensible value

EXERCISE 17*

1 (6, 0), (0, 12) **2** (14, 0), (0, 8) **3** (3.5, 0), (0, 5.25)
4 (1.5, 0), (0, 2.4) **5** (7.5, 0), (0, −6) **6** (6.4, 0), (0, −4)
7 (−10.5, 0), (0, 3) **8** (−3, 0), (0, 2.4) **9** (−3.5, 0), (0, 3)
10 (−6.75, 0), (0, 3)
11 **b** ≈23 **c** $-\frac{3}{25}$, 23; about $25H + 3W = 575$
d 92 weeks; no, longer, unlikely to continue linear.

ACTIVITY 5

Gradient of AB is 0.5. AB extended intercepts the y axis at (0, 2.5).

The equation of the line through AB is $y = \frac{1}{2}x + 2.5$.

$y = 3x + 7$; $y = -\frac{1}{3}x + 3$; $y = \frac{2}{3}x + \frac{1}{3}$

REVISION EXERCISE 18

1 **a** 2 **b** −1
2 4.5 m
3 **a** 3, −2 **b** −2, 5
4 **a** $y = 2x - 1$ **b** $y = -3x + 2$
5 **a** Gradient 2, intercept −3 **b** Gradient −1, intercept 4
c Passes through (5, 0) and (0, 2)
6 $y = 2x + 4$ and $4x = 2y + 7$; $x - 3y = 1$ and $9y = 3x + 4$;
$4x - 3y = 12$ and $3y = 4x - 1$;
$3x - 4y = 12$ and $4y = 3x + 7$
7 **b** 27 °C; −30 °C; 77 °F **c** −40
8 $y = x + 2$, $y = x - 2$, $x + y = 2$, $x + y = -2$
9 $y = x$, $y = -x$, $x = 3$, $x = -3$, $y = 3$, $y = -3$

REVISION EXERCISE 18*

1 **a** $-\frac{1}{3}$ **b** 2
2 5 m
3 **a** Gradient 3, intercept −2 **b** Gradient −2, intercept 3
c Gradient $-\frac{1}{2}$, intercept 2.5 **d** Passes through (2, 0) and $(0, \frac{10}{3})$
4 Gradient of BC = gradient of AD = $-\frac{5}{6}$
5 $b = \pm 1.5$
6 $3y = x + 6$
7 **a** $F = 20P + 20$; $S = 35P + 35$ **c** 3 h 48 min; 2 h 40 min
d 10.25 pounds **e** about 1.15 pm
8 **b** $35h + 3t = 105$ **c** 11.7 s
d −2.14 m, Not sensible, $0 \leqslant t \leqslant 35$
e 28 s, assume continues linear.

SHAPE AND SPACE 1

ACTIVITY 6

	□	□	▱	▱	⌂	⏢	◇
Diags equal	Y	Y	N	N	N	N	N
Diags bisect each other	Y	Y	Y	Y	N	N	N
Diags perpendicular	Y	N	Y	N	Y	N	Y
Diags bisect angles	Y	N	Y	N	N	N	N
Opp. angles equal	Y	Y	Y	Y	N	N	N

EXERCISE 19

1 $a = 102°$, $b = 78°$ **2** $a = 34°$, $b = 146°$ **3** $a = 65°$
4 $a = 37°$ **5** $a = 73°$, $b = 34°$ **6** $a = 36°$, $b = 72°$
7 $a = 57°$, $b = 123°$ **8** $a = 44°$, $b = 112°$ **9** $a = 31°$, $b = 31°$
10 $a = 50°$ **11** $a = 124°$, $b = 56°$ **12** $a = 42°$, $b = 138°$
13 $a = 58°$, $b = 32°$ **14** $a = 55°$, $b = 15°$
15 **a** 45° **b** 135° **c** 1080°
16 **a** 900° **b** $128\frac{4}{7}°$
17 9 sides **18** 12 sides **19** $x = 74°$; 74° and 148
20 **a** 15 **b** 2340°

EXERCISE 19*

1 $a = 137°$, $b = 43°$ **2** $a = 153°$, $b = 27°$, $c = 63°$ **3** $a = 36°$
4 $a = 20°$ **5** $a = 17°$ **6** $a = 39°$
7 $180° - 2x$ **8** $180 - 2y$ **9** $x = 50°$
10 $x = 36°$ **11** $a = 56°$, $b = 34°$ **12** $a = 73°$
13 $a = 40°$, $b = 113°$ **14** $a = 56°$, $b = 38°$ **15** 20 sides
16 6 sides

EXERCISE 20

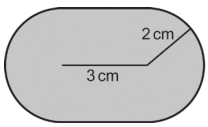
1 5.86 cm **2** 3.62 cm **3** 4.2 cm, 14.7 cm^2

4 JK = 9.2 cm, JM = 6.7 cm

5 **c** PS = QS = RS = 4.7 cm; all equal, on a circumcircle

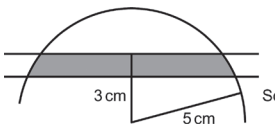
6 5.3 cm

7



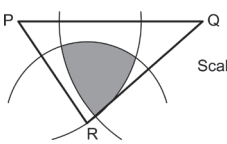
Scale 1 cm:10 m

8



Scale 1 cm:2 m

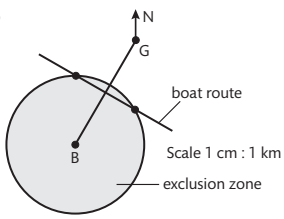
9 **a**



Scale: 1 cm:50 km

b 180 km

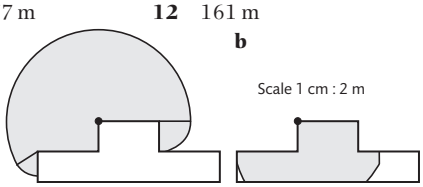
10 **a** and **b**



c 3.9 km

11 577 m **12** 161 m

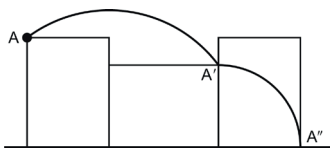
13 **a** **b**



EXERCISE 20*

1 5.4 cm **2** 6.5 cm **3** 6.8 cm **4** 8.5 cm

5



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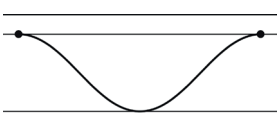

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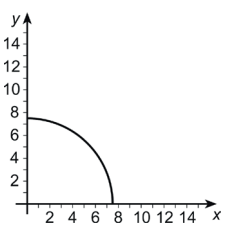
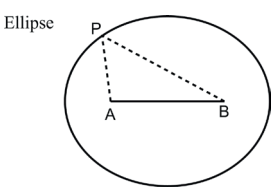
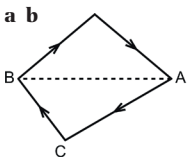


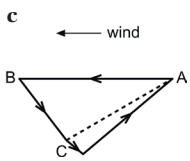
8



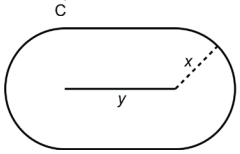
9 **a** **b**



c



10



$\pi x + y = 200$

REVISION EXERCISE 21

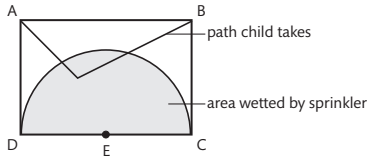
1 $a = 52°$ $b = 128°$ $c = 76°$

2 **a** 40° **b** 140° **c** 1260°

3 **a** 12 sides **b** 30° **4** $a = 40°$, $b = 70°$

5 $a = 210°$, $b = 20°$ **6** 9.5 cm, 38 cm^2

7 **a** **b**



c 14 m

REVISION EXERCISE 21*

1 $a = 40°$, $b = 100°$, $c = 40°$, $d = 260°$ **2** $x = 150°$

3 **b** 6.5 cm **c** 30 cm^2

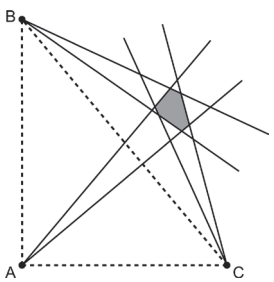
4 **a** Hexagon **b** Equilateral triangle

5 $\angle LKJ = 15°$, $\angle HKL = 45°$ $\therefore \angle JKH = \angle LKJ + \angle HKL = 60°$

6 $22\frac{1}{2}°$

7 **d** 5.2 cm

8 91 km, 69 km



SETS 1

EXERCISE 22

1 **a** Any two vegetables **b** Any two colours
c Any two letters **d** Any two odd numbers

2 **a** Any two fruits **b** Any two items of clothing
c Any two mathematical symbols **d** Any two even numbers

3 **a** {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}
b {1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
c For example, {Mathematics, Science, English, ...}
d {2, 3, 5, 7, 11, 13, 17, 19}

4 **a** {Africa, Antarctica, Asia, Australia, Europe, North America, South America}
b {3, 5, 7, 9}
c For example, {*Coronation Street*, *Neighbours*, ...}
d {1, 2, 3, 4, 6, 12}

5 **a** {the first four letters of the alphabet}
b {days of the week beginning with T}
c {first four square numbers}
d {even numbers}

6 **a** {last six letters of the alphabet} **b** {months beginning with J}
c {first five natural numbers} **d** {prime numbers}

7 **a** False **b** False
c False **d** True

8 **a** False **b** True
c False **d** True

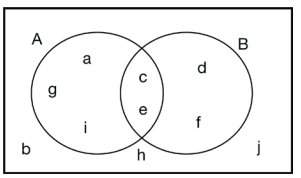
9 **b** and **c**
10 **a** and **c**

EXERCISE 22*

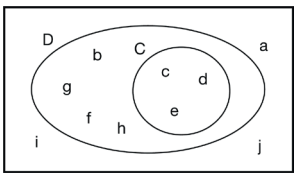
1 **a** Any two planets **b** Any two polygons
c Any two elements **d** Any two square numbers
2 **a** Any two sports
b Any two three-dimensional shapes
c Any two symbols on the buttons of a calculator
d Any two triangle numbers
3 **a** {2, 3, 4} **b** {1, 4, 6}
c {1, 5, 7, 35}
d {1, 10, 100, 1000, 10 000, 100 000}
4 **a** {SET, STE, EST, ETS, TSE, TES} **b** $\{x, x-1, x+1\}$
c {1, 2, 3, 5, 8, 13} **d** {3, 6, 9, 12}
5 **a** {seasons of the year} **b** {conic sections}
c {first five powers of 2} **d** {Pythagorean triples}
6 **a** {colours in traffic lights}
b {first five letters of the Greek alphabet}
c {fifth row of Pascal's triangle}
d {all arrangements of the digits 1, 2, 3}
7 **a** True **b** False **c** True **d** False
8 **a** True **b** False **c** False **d** False
9 **a** and **d**
10 **a** (*'queueing'* has five consecutive vowels)

EXERCISE 23

1 **a** 16 **b** $n(T) = 14$; 14 pupils like toffee
c $n(C \cap T) = 12$; 12 pupils like both chocolate and toffee
d 21
2 **a** 50 **b** 25
c $n(B \cap S) = 2$; there are two black sheep in the field
d 17
3 **a**



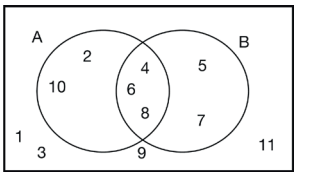
b {c, e}, 2
c Yes **d** No, d∈B but d∉A, for example
4 **a**



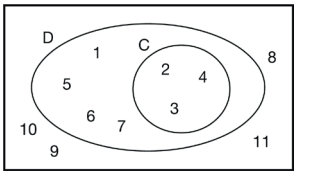
b {c, d, e}, {c, d, e}
c Yes
d Yes; every member of C is also a member of D.
5 **a** Pink Rolls-Royce cars
b There are no pink Rolls-Royce cars in the world.
6 **a** Yellow jeans
b The shop has got some yellow jeans.
7 **a** 35 **b** 3 **c** 11 **d** 2 **e** 64
8 **a** 39 **b** 22 **c** 8
d 12 **e** 7 different types of ice-cream

EXERCISE 23*

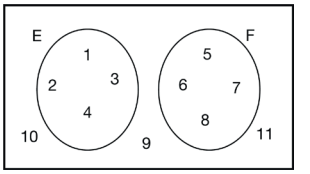
1 **a**



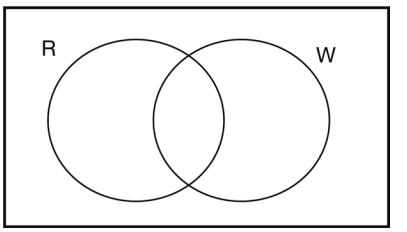
b {4, 6, 8}, 3 **c** Yes
d {1, 2, 3, 5, 7, 9, 10, 11} **e** Yes
2 **a**



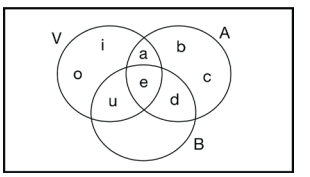
b {2, 3, 4}, {2, 3, 4} **c** Yes
d Yes **e** Yes
3 **a**



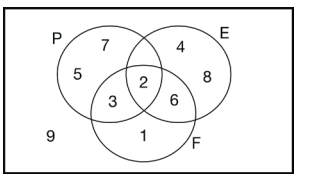
b { } or ∅ **c** The sets don't overlap (*disjoint*).
4 **a**



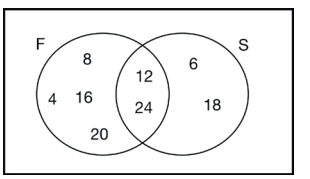
b White roses **c** The shop has no white roses.
5 **a**



b $V \cap A = \{a, e\}$, $V \cap B' = \{a, i, o\}$, $A' \cap B = \{u\}$
c {e}
6 **a**



b $P' \cap E = \{4, 6, 8\}$, $E \cap F = \{2, 6\}$, $P \cap F' = \{5, 7\}$
c The even prime factors of 6
7 **a**

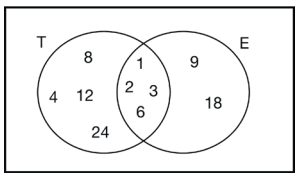


b {12, 24} **c** 12

d LCM is 12. It is the smallest member of F ∩ S.

e **(i)** 24 **(ii)** 40

8 **a**



b {1, 2, 3, 6} **c** Highest Common Factor

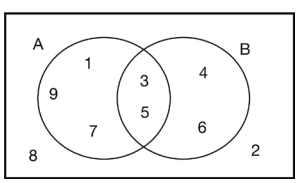
d **(i)** 16 **(ii)** 5

9 2^n

10 A ∩ B ∩ C gives multiples of 30, so $\mathscr{E}$ must be a set that includes one and only one multiple of 30.

EXERCISE 24

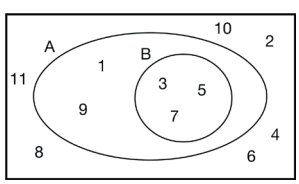
1 **a** $\mathscr{E}$



b {1, 3, 4, 5, 6, 7, 9}, 7 **c** Yes

d {2, 8} **e** No

2 **a** $\mathscr{E}$

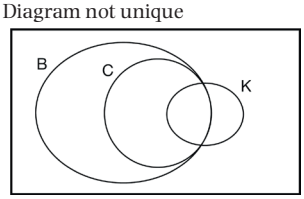


b A ∪ B = {1, 3, 5, 7, 9}, B ∪ A = {1, 3, 5, 7, 9}

c Yes **d** Yes **e** Yes

3 **a** Diagram not unique

$\mathscr{E}$

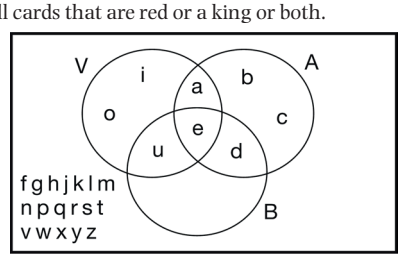


b All cards that are black or a king or both.

c All cards that are black, a club or a king or all three.

d All cards that are red or a king or both.

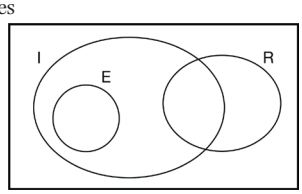
4 **a** $\mathscr{E}$



b {a, e, i, o, u, b, c, d} **c** Consonants

d Yes

5 **a** $\mathscr{E}$

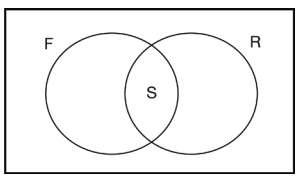


b An isosceles right-angled triangle.

c I ∪ E = Isosceles triangles, I ∪ R = triangles that are isosceles or right-angled or both.

d Equilateral triangles, ∅

6 $\mathscr{E}$

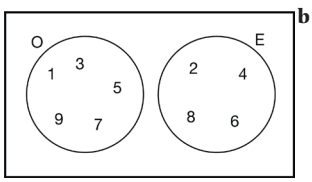


a Note S = F ∩ R **b** F ∩ R = {squares}

c S ∪ F = F, S ∪ R = R **d** S ∩ F = F ∩ R = {squares}

EXERCISE 24*

1 **a**



b {1, 2, 3, 4, 5, 6, 7, 8, 9}

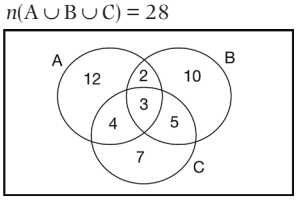
c E ∩ O = ∅ **d** E ∪ O = $\mathscr{E}$

2 **a** Pizzas containing ham or cheese or both.

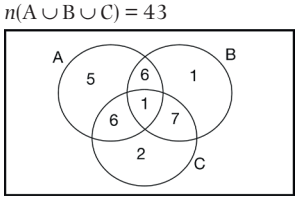
b Pizzas containing both ham and cheese.

c All the pizzas contain ham or cheese or both.

3 $n(A \cup B \cup C) = 28$



4 $n(A \cup B \cup C) = 43$



5 B ⊂ A or B = ∅

6 Yes

REVISION EXERCISE 25

1 **a** Any spice **b** Any pet or animal

c Any fruit **d** Any colour

2 **a** {4, 9, 16, 25} **b** {1, 2, 3, 4, 6, 8, 12, 24}

c {a, e, i}

d {April, June, September, November}

3 **a** {first four prime numbers}

b {even numbers between 31 and 39}

c {days of the week beginning with S} or {days of the weekend}

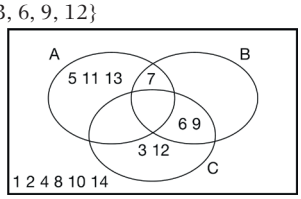
d {vowels}

4 **a** False (51 = 3 × 17) **b** False (2 ∉ O)

c True **d** True

5 **a** {3, 6, 9, 12}

b $\mathscr{E}$



c {5, 6, 7, 9, 11, 13}

d {6, 9}

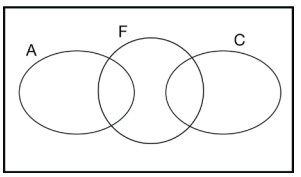
e ∅

6 **a** {female members born in Africa}

b ∅

c Amy was born either in Africa or in China

d $\mathscr{E}$

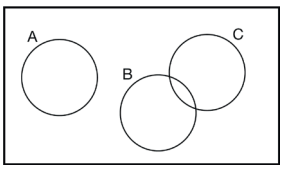


REVISION EXERCISE 25*

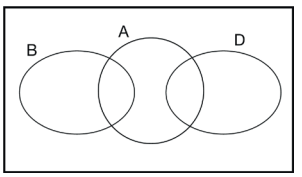
1 **a** {4, 8, 12, 16}
b {red, orange, yellow, green, blue, indigo, violet}
c {CAT, CTA, ACT, ATC, TCA, TAC}
d {2, 3, 6}

2 **a** {factors of 12} **b** {first five Fibonacci numbers}
c {suits in a pack of cards} **d** {five regular solids}

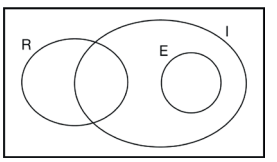
3 **a** 9
b $\mathscr{E}$



4 **a** {ace of diamonds} **b** ∅
c {diamonds plus aces of hearts, clubs and spades}
d 2
e



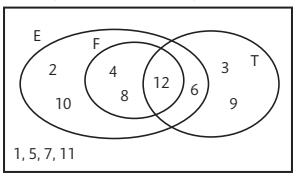
5 **a** Isosceles right-angled triangles **b** E
c ∅
d $\mathscr{E}$



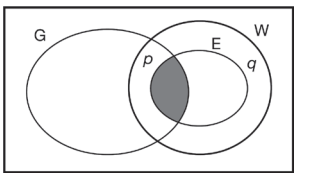
6 **a** {20} **b** 12 or 24
c Yes. The first integer that is a multiple of both 5 and 6 is 30.

EXAMINATION PRACTICE 1

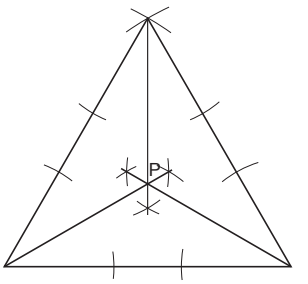
1 **a** $7a^2 + 4a^3$ **b** $2a^3$ **c** $12x - 15$
2 **a** $x = 9$ **b** $x = 40$ **c** $x = 15$
3 **a** 10^{14} **b** 1×10^{14}
4 **a** 3×10^{10} **b** 440 000
5 **a** 92.78 **b** 182.8 **c** 70.75
6 20%
7 **a** 38 **b** −8 **c** 64
8 **a** −2 **b** 4 **c** $y = -2x + 4$
9 $y = 3x + 2$ and $y = 3x - 3$
10 **a** $x = 6$ **b** $x = -10.5$ **c** $x = -2$
11 **a** 0.2 **b** 68 **c** 0.2
12 **a** 8.0×10^9 **b** 7.5×10^4 **c** 9.5×10^0
13 **a** $3a^2b + a$ **b** $4a^3$ **c** $4c + 4$
14 12%
15 1:3 by 11%
16 **a** −18 **b** 1 **c** 39
17 **a** E′ = {1, 3, 5, 7, 9, 11}, E ∩ T = {6, 12}, F ∩ T = {12}
b E′ = {odd integers less than 13},
E ∩ T = {multiples of 6},
F ∩ T = {multiples of 12}.
$\mathscr{E}$



18 **a** All houses with electricity have mains water. E ⊂ W
b House *p* has mains water and gas but no electricity.
c and **d**
$\mathscr{E}$



19 **a** $y = -\frac{2}{3}x + 2$ or $2x + 3y = 6$ **b** $y = -\frac{2}{3}x - 1$
20 **a** $3(x + 2) = 2x + 10$ **b** 4
21 **a** $20x - 10(30 - x) = 180$ **b** 16
22 **a** $3x + 5(x - 10) + 2(x + 20) = 890$
b 90 cents
23 interior angle = 150°, exterior angle = 30°
24 112°, 29°
25



Unit 2

NUMBER 2

ACTIVITY 7

Decimal form	Multiples of 10 or fraction form	Standard form
0.1	$\frac{1}{10}$	1×10^{-1}
0.01	$\frac{1}{100}=\frac{1}{10^2}$	1×10^{-2}
0.001	$\frac{1}{1000}=\frac{1}{10^3}$	1×10^{-3}
0.000 1	$\frac{1}{10\,000}=\frac{1}{10^4}$	1×10^{-4}
0.000 01	$\frac{1}{10\,000}=\frac{1}{10^5}$	1×10^{-5}

ACTIVITY 8

Mouse = 10 g = 10^1 g; pigmy shrew = 1 g = 10^0 g;
grain of sand = 0.000 1 g = 10^{-4} g; 10; 10 000; house mouse; grain of sand;
grain of sand, *staphylococcus*; 10, *staphylococcus*

EXERCISE 26

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** 0.001 2 **12** 0.87
13 0.000 001 **14** 0.000 1 **15** 0.046 7 **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^{-3} **23** 1×10^{2} **24** 1×10^{3}
25 100 **26** 100 **27** 10 000 **28** 1 000 000
29 128 **30** 0.03 **31** 30 **32** 3.6
33 0.018 **34** 30

EXERCISE 26*

1 10 **2** 0.001 **3** 0.011 **4** 0.099
5 0.01 **6** 0.000 1 **7** 0.001 1 **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** 2×10^{0}
25 5000 viruses **26** 66 000 viruses **27** 6×10^{10}
28 2×10^{7} **29** $(3.4\times10^{23})+(0.34\times10^{23})=3.74\times10^{23}$
30 **a** 1×10^{27}, 27 zeros
b $\sqrt[3]{(1\times10^{-27})}=1\times10^{-9}$
c 1×10^{7}
d 2×10^{23}, 2×10^{16} cm, $(2\times10^{16})\div(4\times10^{9})\approx5\times10^{6}$ times!

EXERCISE 27

1 $\frac{6}{7}$ **2** $\frac{5}{9}$ **3** $\frac{2}{5}$ **4** $\frac{1}{2}$ **5** $1\frac{2}{9}$
6 $1\frac{1}{4}$ **7** $\frac{1}{2}$ **8** $\frac{1}{4}$ **9** $\frac{23}{24}$ **10** $\frac{1}{12}$
11 $4\frac{5}{12}$ **12** $2\frac{1}{10}$ **13** $\frac{5}{18}$ **14** $\frac{3}{14}$ **15** $\frac{6}{7}$
16 $\frac{3}{8}$ **17** $\frac{3}{5}$ **18** $3\frac{1}{3}$ **19** $\frac{3}{25}$ **20** 8
21 3 **22** $1\frac{1}{2}$ **23** $1\frac{1}{2}$ **24** $2\frac{7}{10}$ **25** $4\frac{7}{12}$
26 $8\frac{1}{8}$ **27** $2\frac{3}{4}$ **28** $3\frac{19}{24}$ **29** $4\frac{4}{5}$ **30** $7\frac{1}{2}$
31 $\frac{3}{10}$ **32** 6

EXERCISE 27*

1 $\frac{3}{4}$ **2** $\frac{7}{10}$ **3** $\frac{3}{5}$ **4** $\frac{7}{12}$ **5** $\frac{19}{20}$
6 $\frac{3}{8}$ **7** $\frac{3}{4}$ **8** $\frac{3}{10}$ **9** $\frac{1}{5}$ **10** $\frac{3}{4}$
11 $\frac{7}{10}$ **12** $\frac{16}{25}$ **13** $\frac{2}{9}$ **14** $\frac{1}{3}$ **15** $\frac{3}{8}$
16 $\frac{9}{25}$ **17** $7\frac{2}{3}$ **18** $13\frac{11}{15}$ **19** $6\frac{1}{2}$ **20** $1\frac{4}{9}$
21 $6\frac{7}{9}$ **22** $1\frac{23}{60}$ **23** $1\frac{7}{15}$ **24** $11\frac{2}{3}$ **25** $2\frac{2}{3}$
26 6 **27** $\frac{5}{6}$ **28** $\frac{2}{9}$ **29** $4\frac{1}{2}$ **30** $1\frac{7}{8}$

EXERCISE 28

1 \$168, \$224 **2** 182 m, 455 m **3** 94 kg, 658 kg
4 108 miles, 135 miles
5 574, 410 **6** 315, 90 **7** 8.1, 5.4 **8** 3.2, 2.4

EXERCISE 28*

1 \$45 : \$75 **2** €50 : €300 **3** 111 ml **4** 519 g
5 117 : 234 : 351
6 256 tonnes : 192 tonnes : 128 tonnes
7 \$32 **8** 1 mg

EXERCISE 29

1 $2^4=16$ **2** $3^5=243$ **3** $2^5=32$ **4** $5^4=625$
5 $2^2=4$ **6** $4^2=16$ **7** $5^3=125$ **8** $8^3=512$
9 $3^6=729$ **10** $6^3=216$ **11** $2^{10}=1024$ **12** $2^8=256$
13 $(0.1)^3=0.001$ **14** $(0.2)^3=0.008$ **15** $2.1^2=4.41$
16 $1.3^2=1.69$ **17** $4^4=256$ **18** $7^3=343$
19 $20^4=160\,000$ **20** $30^4=810\,000$

EXERCISE 29*

1 $8^3=512$ **2** $9^3=729$ **3** $7^3=343$ **4** $4^4=256$
5 $5^3=125$ **6** $4^3=64$ **7** $6^1=6$ **8** $2^1=2$
9 $5^3=125$ **10** $10^1=10$ **11** $10^6=1\,000\,000$
12 $2^9=512$ **13** $2^0=1$ **14** $3^1=3$ **15** $5^3=125$
16 $2^1=2$ **17** 9 **18** 100 **19** 10 000
20 $2^{21}=2\,097\,152$; $2^{19}=524\,288$
21 $8^{10}=2^{30}$ and $4^{14}=2^{28}$ ∴ $8^{10}>4^{14}$
22 $3^{27}>9^{13}$
23

No. times done	No. of sheets in pile	Height of pile
3	8	0.8 mm
5	32	3.2 mm
10	1024	0.102 m
50	1.13×10^{15}	1.13 billion km

42 times

EXERCISE 30

1 £1 = Yen 180 **2** £1 = US\$1.7 **3** £1 = Aus\$2.38
4 £1 = US\$1.86 **5** £1 = NZ\$2.75 **6** £1 = Can\$2.25
7 **a** £8.40 **b** £75.60

8 **a** US$11.25 **b** US$78.75
9 **a** 105 mm/h **b** 1.75 mm/min
10 **a** 11 tonnes **b** 660 tonnes
11 **a** 1.1 s **b** 66.7 l
12 **a** 2 740 000 miles per day **b** 114 000 miles per hour

EXERCISE 30*

1 **a** \$15 **b** 2667 Yen
2 **a** 520 kJ **b** 6 g
3 2.3 million
4 **a** 1×10^9 **b** $\frac{1}{11}$ g/cm^3
5 ≈ 12 miles
6 ≈ 50
7 **a** 0.0825 s **b** 12.1 litres/s
8 **a** 125 s **b** 8.00 litres/s
9 **a** 94.4 m/s **b** 0.001 06 s
10 52.5 almudes

REVISION EXERCISE 31

1 $2^8 = 256$ **2** $7^2 = 49$ **3** $3^6 = 729$ **4** $5^2 = 25$
5 1×10^{-3} **6** 3.69×10^{-2} **7** 100 **8** 0.001
9 0.11 **10** $2\frac{13}{20}$ **11** $\frac{2}{3}$ **12** $\frac{1}{4}$
13 \$110, \$165
14 1 Swiss Franc = BD1.3; 15 Swiss Franc = BD19.5
15 1000 gallons/s
16 12 minutes

REVISION EXERCISE 31*

1 $20^3 = 8000$ **2** $1.2^2 = 1.44$ **3** $2^{10} = 1024$ **4** 1×10^{-6}
5 5×10^{-3} **6** $3\frac{11}{12}$ **7** $1\frac{1}{12}$ **8** $14\frac{7}{12}$
9 8 **10** \$208, \$312, \$416
11 1.01 **12** 9 metres behind the start line.
13 11.4 tonnes **14** 390 kg **15** 2.65 s

ALGEBRA 2

EXERCISE 32

1 4 **2** x **3** $3y$ **4** $2y$ **5** 2
6 2 **7** $\frac{3a}{b}$ **8** $\frac{3x}{y}$ **9** $\frac{b}{2}$ **10** $\frac{x}{2}$
11 $\frac{3a}{b}$ **12** $\frac{4x}{y}$ **13** $4c$ **14** $5y$ **15** $\frac{a}{2}$
16 $\frac{b}{3}$ **17** $\frac{4}{x}$ **18** $\frac{3}{a}$ **19** $2b$ **20** $4y^2$
21 $\frac{1}{5b^2}$ **22** $\frac{1}{6y^2}$ **23** $\frac{a}{4}$ **24** $\frac{y}{3x}$

EXERCISE 32*

1 $\frac{1}{2}$ **2** $\frac{1}{4}$ **3** $\frac{2}{b}$ **4** $\frac{3}{a}$ **5** $\frac{x}{4}$
6 $\frac{b}{4}$ **7** $\frac{a}{2}$ **8** $\frac{x}{5}$ **9** $\frac{2}{b}$ **10** $\frac{2}{xy}$
11 $\frac{6}{b^2}$ **12** $\frac{5a}{b^5}$ **13** $\frac{a}{2b}$ **14** $\frac{2x}{3y}$ **15** $\frac{3}{abc}$
16 $\frac{3}{4x}$ **17** $\frac{a}{4b^2}$ **18** $\frac{16x}{3y}$ **19** $\frac{1}{a^2b^2}$ **20** $\frac{c^3}{a^3}$
21 $\frac{3a}{8b}$ **22** $\frac{4c^2}{5a^2}$ **23** $\frac{3z^2}{10x^2}$ **24** $\frac{4ab}{169}$

EXERCISE 33

1 $\frac{5x^2}{4}$ **2** $\frac{2x^2}{3}$ **3** $\frac{x^3z}{y}$ **4** $\frac{y^4}{z}$ **5** 1
6 1 **7** $\frac{4c^2}{5}$ **8** $\frac{5d}{6}$ **9** 6 **10** 4
11 $\frac{ab}{2}$ **12** $\frac{3xy}{4}$ **13** $\frac{b}{6}$ **14** $\frac{2x}{7}$ **15** 1
16 1 **17** $\frac{2}{y}$ **18** $\frac{3}{a}$ **19** $\frac{b}{2c}$ **20** $\frac{3z}{y^2}$

EXERCISE 33*

1 $2a^3$ **2** $\frac{x^3}{2}$ **3** $\frac{3x}{z}$ **4** $\frac{4b^2c}{a}$ **5** $\frac{9pq^2}{10}$
6 $2ac$ **7** $\frac{1}{2x}$ **8** $\frac{y}{2x^2}$ **9** $\frac{5xy^3}{z^2}$ **10** $\frac{3x^2y^2}{z^3}$
11 y **12** a **13** $\frac{3x^4}{8y}$ **14** $\frac{5x^4}{2y^2}$ **15** $\frac{1}{2a^2b^2}$
16 $\frac{15}{2xy^4(y+x^2)}$

EXERCISE 34

1 $\frac{7x}{12}$ **2** $\frac{9a}{20}$ **3** $\frac{a}{12}$ **4** $\frac{x}{12}$ **5** $\frac{4a+3b}{12}$
6 $\frac{6x+5y}{30}$ **7** $\frac{5x}{12}$ **8** $\frac{11y}{20}$ **9** $\frac{a}{2}$ **10** $\frac{11b}{18}$
11 $\frac{3a+4b}{12}$ **12** $\frac{5x-2y}{10}$ **13** $\frac{a}{6}$ **14** $\frac{b}{2}$ **15** $\frac{3a+8b}{12}$
16 $\frac{x+6y}{9}$

EXERCISE 34*

1 $\frac{7x}{18}$ **2** $\frac{a}{15}$ **3** $\frac{5a}{21}$ **4** $\frac{26y}{45}$
5 $\frac{14x+20y}{35}$ **6** $\frac{30a-22b}{55}$ **7** $\frac{a}{4}$ **8** x
9 $\frac{17}{6b}$ **10** $\frac{31}{20c}$ **11** $\frac{2d+3}{d^2}$ **12** $\frac{1-2x}{x^2}$
13 $\frac{7-3x}{10}$ **14** $\frac{7x+7}{12}$ **15** $\frac{y-2}{30}$ **16** $\frac{15-5a}{14}$
17 $\frac{3x+5}{12}$ **18** $\frac{y+5}{30}$ **19** $\frac{2a-1}{a(a-1)}$ **20** $\frac{7x}{(x-4)(x+3)}$

EXERCISE 35

1 $x = \pm 3$ **2** $x = \pm 2$ **3** $x = \pm 6$ **4** $x = \pm 8$ **5** $x = \pm 4$
6 $x = \pm 8$ **7** $x = \pm 8$ **8** $x = \pm 7$ **9** $x = \pm 3$ **10** $x = \pm 5$
11 $x = \pm 1$ **12** $x = \pm 5$ **13** $x = 13$ **14** $x = 47$ **15** $x = \pm 4$
16 $x = \pm 9$ **17** $x = 16$ **18** $x = 144$ **19** $x = 81$ **20** $x = 12$

EXERCISE 35*

1 $x = \pm 5$ **2** $x = \pm 3$ **3** $x = \pm 7$ **4** $x = \pm 8$ **5** $x = \pm 9$
6 $x = \pm 4$ **7** $x = 81$ **8** $x = 0$ **9** $x = 7$ **10** $x = 36$
11 $x = \pm 4$ **12** $x = 81$ **13** $x = \pm 5$ **14** $x = 144$
15 $x = 10$ or $x = -16$ **16** $x = -5.5$ or $x = -2.5$ **17** $x = \pm 3$
18 $x = \pm 1.5$ **19** $x = 1$ **20** $x = 3.54$ or $x = 10.46$

CHALLENGE

Parallelogram: draw a diagonal. Area of each triangle = $\frac{1}{2}bh$. So area of parallelogram = bh.
Trapezium: draw a diagonal. Area of trapezium = $\frac{ah}{2} + \frac{bh}{2} = \frac{h}{2}(a+b)$

EXERCISE 36

1 4.5 cm **2** 7.2 cm **3** 44 cm; 154 cm^2
4 88 cm; 616 cm^2 **5** $h = 8$ cm **6** $b = 12$ cm

7 YZ = 4 cm **8** BC = 9 cm
9 **a** 7.07×10^{16} km **b** 8.1×10^{12} km/h
10 **a** 2.83×10^{19} km **b** 3.8×10^{13} km/h
11 $h = 4.7$ cm **12** $b = 3.9$ cm **13** 11.7 km
14 150 million km **15** 0.1 second

EXERCISE 36*

1 14 cm **2** 7 cm **3** AC = 12 cm; 4.2 cm
4 $x = 10$ cm **5** $h = 5.5$ cm **6** $a = 10.5$ cm
7 $\sqrt{9^2+12^2} > 14 \therefore no$
8 AP = 10 cm; PQ = 5 cm; area APQ = 25 cm^2
9 5.30 cm^2 **10** 5.83 units **11** 10.5 cm^2 for each
12 39 800 km **13** 15.9 km **14** 220 m
15 Obtuse **16** 3.71 cm **17** 8.37 cm
18 Area = $\frac{2r}{2\pi r} \times \pi r^2 = r^2$
19 **a** £1560 **b** £2120 **c** £2890

EXERCISE 37

1 $2^{10} = 1024$ **2** $3^9 = 19\,683$ **3** $4^7 = 16\,384$
4 $5^7 = 78\,125$ **5** $2^6 = 64$ **6** $3^{10} = 59\,049$
7 $7^3 = 343$ **8** $8^8 = 16\,777\,216$ **9** $2^{12} = 4096$
10 $3^9 = 19\,683$ **11** $6^8 = 1\,679\,616$ **12** $1^{100} = 1$
13 a^5 **14** b^7 **15** c^4
16 d^2 **17** e^6 **18** f^6
19 a^9 **20** b^{12} **21** c^5
22 d^2 **23** $12a^6$ **24** $12b^8$
25 $6a^5$ **26** $12b^7$ **27** $2e^8$
28 $3f^6$

EXERCISE 37*

1 $6^{12} = 2.18 \times 10^9$ **2** $7^{10} = 2.82 \times 10^8$ **3** $7^6 = 1.18 \times 10^5$
4 $8^7 = 2.10 \times 10^6$ **5** $8^{12} = 6.87 \times 10^{10}$ **6** $9^{15} = 2.06 \times 10^{14}$
7 $4^{17} = 1.72 \times 10^{10}$ **8** $5^{24} = 5.96 \times 10^{16}$
9 a^{12} **10** b^{14} **11** $3c^6$ **12** $8d^5$ **13** $2e^8$
14 $3f^6$ **15** $8g^{12}$ **16** $27h^9$ **17** $48j^{12}$ **18** $36k^8$
19 $24m^7$ **20** $36n^7$ **21** $27a^6$ **22** $3a^2$ **23** 2
24 a^7 **25** $8b^4$ **26** $8a^{16}$ **27** 6 **28** $8d^{15}$

EXERCISE 38

1 < **2** > **3** < **4** =
5 > **6** < **7** < **8** >
9 $x \leqslant 0, x > 2$ **10** $x < -1.5, x \geqslant 0.5$
11 $-3 < x \leqslant 3$ **12** $-1.5 < x \leqslant 4.5$

For Questions 13 to 28 the result should be shown on a number line.

13 $x > 5$ **14** $x > 3$ **15** $x \leqslant 4$ **16** $x \geqslant -2$ **17** $x < 3$
18 $x < -2$ **19** $x \geqslant 3$ **20** $x \geqslant -3$ **21** $x \geqslant 9$ **22** $x \leqslant -3$
23 $x < 4$ **24** $x > 4$ **25** $x < 0$ **26** $x \leqslant -1$ **27** $x > 3$
28 $x \geqslant 0$ **29** $x < -2$ **30** $x > 6$ **31** $x \geqslant -5$ **32** $x \leqslant -4$
33 $x < -1$ **34** $x \leqslant -\frac{1}{3}$ **35** $x \leqslant -2$ **36** $x \geqslant 1$ **37** $x \geqslant -\frac{2}{3}$
38 $x \geqslant -1.5$ **39** $x \geqslant -7$ **40** $x \geqslant -4$ **41** {5, 6} **42** {4, 5}
43 {3, 4} **44** {−3, −2, −1} **45** {0, 1}
46 {−4, −3, −2} **47** {1, 2, 3, 4} **48** {1, 2}
49 {2, 3} **50** {2, 3}

EXERCISE 38*

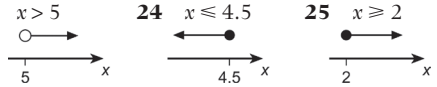
1 $x \leqslant 0$ or $x > 3$; $0 \geqslant x > 3 \rightarrow 0 \geqslant 3$ **2** $0 \leqslant x < 3$; 2

For Questions 3 to 14 the result should also be shown on a number line.

3 $x \leqslant 2.5$ **4** $x > -3\frac{2}{3}$ **5** $x < 5\frac{1}{3}$ **6** $x \geqslant 3\frac{2}{3}$
7 $x < 1.5$ **8** $x \leqslant -8\frac{1}{3}$ **9** $x < -3\frac{1}{5}$ **10** $x \leqslant 4.5$
11 $x \leqslant 2$ **12** $x > -3$ **13** $-1 < x \leqslant 3$ **14** $-1 < x \leqslant 4$
15 $x \leqslant 7$ {7, 6, 5, 4} **16** $x \leqslant -3.25$ {−4, −5, −6, −7}
17 23 **18** 13 **19** {1, 2, 3} **20** {−2, −1, 0, 1}

REVISION EXERCISE 39

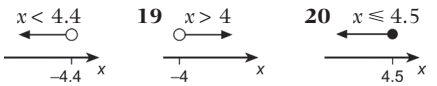
1 3 **2** x **3** $3x$ **4** 4 **5** a
6 $6x$ **7** $\frac{9y}{20}$ **8** $\frac{2x}{15}$ **9** $\frac{4a+b}{10}$ **10** ±4
11 ±6 **12** 20 **13** a^{10} **14** b^2 **15** c^{12}
16 5 cm **17** 12 cm **18** > **19** < **20** <
21 = **22** $\{-3 < x \leqslant 2\}$; −2
23 $x > 5$ **24** $x \leqslant 4.5$ **25** $x \geqslant 2$



26 $x \geqslant 1$ **27** {3, 4} **28** 3.24 cm **29** 11.34 km

REVISION EXERCISE 39*

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** ±3 **11** 2 **12** ±4
13 a^4 **14** $4b^6$ **15** $81c^7$ **16** 2.18 m
17 $-3 < x \leqslant 0$; −2
18 $x < 4.4$ **19** $x > 4$ **20** $x \leqslant 4.5$



21 37 **22** {−3, −2, −1, 0} **23** 50.1 cm
24 0.39 seconds **25** 4.07×10^6 km/hour

GRAPHS 2

ACTIVITY 9

Pineapple

Minutes online (t)	0	500	1000
Cost in cents (C)	999	1549	2099

Banana

Minutes online (t)	0	500	1000
Cost in pence (C)	495	1395	2295

720 minutes per month results in the same charge of $17.91.

EXERCISE 40

1

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

Intersection point is (3, 4).

2

x	0	2	4
$y = x - 1$	–1	1	3
x	0	2	4
$y = 6 - x$	6	4	2

Intersection point is (3.5, 2.5).

3 (2, 5) **4** (1, 0) **5** (3, 8) **6** (4, 13)
7 (1.5, 9) **8** (2.5, 5.5) **9** (2, 2) **10** (4, 2)

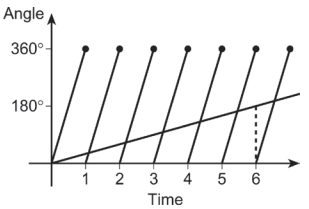
11 **a** $d = 35t$
b $d = 5 + 15t$; after 15 min at distance 8.75 km.

12 **a** Plan A: $C = 15 + 0.25t$; Plan B: $C = 100 + 0.14t$
c 773 min

EXERCISE 40*

1 (6, 13) **2** (5, 8) **3** (1.75, 4.25)
4 (2.67, 1.67) **5** (2.57, 0.29) **6** (1.89, 2.63)
7 $(0.5\dot{3}, -0.9)$ **8** $(1.\dot{6}\dot{3}, 3.\dot{0}\dot{9})$
9 (700, 2930), (7360, 2264)
10 Angles: 0°, 90°, 180°, 270°, 0°, 90°, 180°, 270°, 0°, 90°, 180°

b

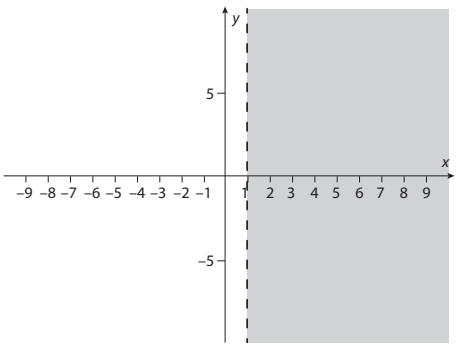


c 1 h 5.45 min; 2 h 10.9 min; 3 h 16.4 min; 4 h 21.8 min; 5 h 27.3 min

EXERCISE 41

1 $x \leqslant 2$ **2** $x > 5$ **3** $y > 4$ **4** $y \leqslant 3$
5 $y \leqslant -2$ **6** $x > -3$ **7** $x + y \geqslant 6$ **8** $x + 2y < 8$

9



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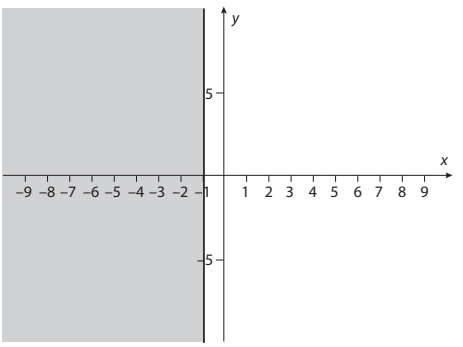

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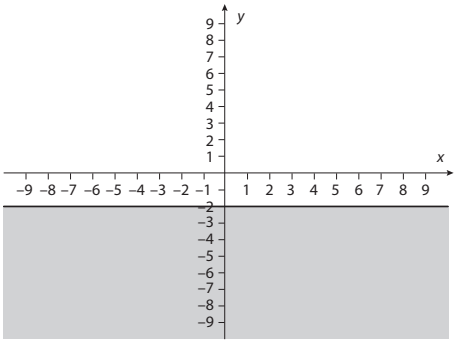

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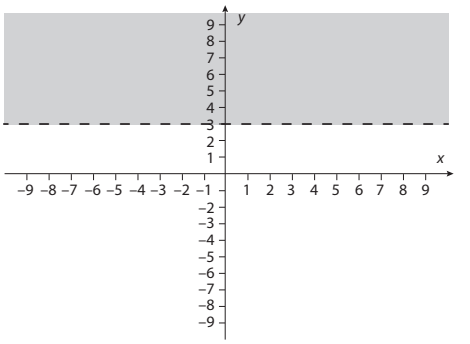

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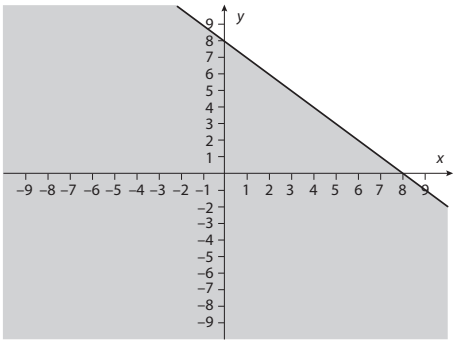

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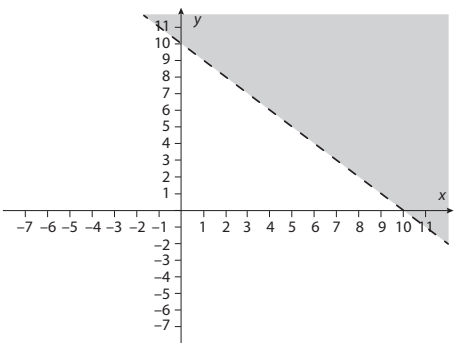

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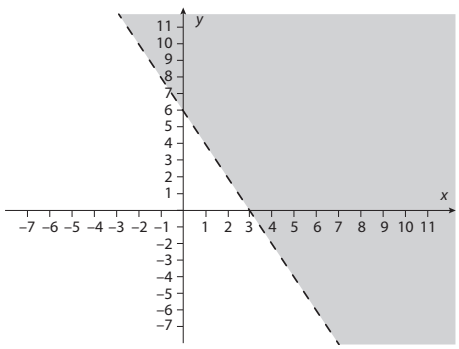

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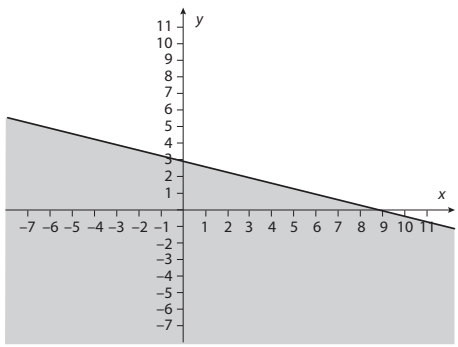
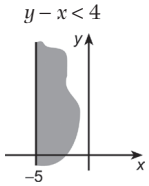


EXERCISE 41*

1 $y > -2$ **2** $x \leqslant -3$ **3** $2x + y \geqslant 6$ **4** $x + 3y < 12$
5 $y - x < 4$ **6** $y - 2x \geqslant 2$ **7** $2y + x \leqslant 4$ **8** $3y + x > 9$

9



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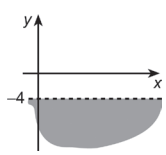

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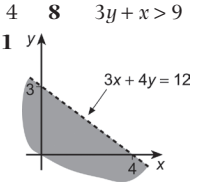

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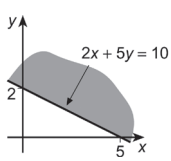

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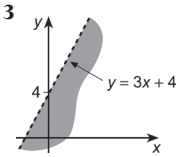

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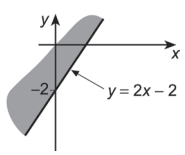

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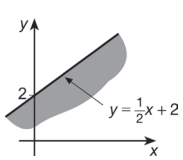

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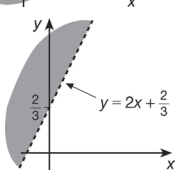


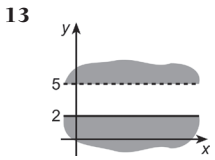
INVESTIGATE

The resultant graph would be very confusing.

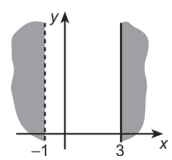
EXERCISE 42

1 $2 < x < 5$ **2** $-1 < x \leqslant 1$ **3** $-2 < y \leqslant 3$
4 $3 < y < 8$ **5** $x \geqslant 4$ or $x \leqslant -3$ **6** $x > 6$ or $x < 1$
7 $y \geqslant 9$ or $y < 3$ **8** $y \geqslant 4$ or $y < 2$
9 $x + y > 3$ and $x - y \leqslant 2$ **10** $x + 2y \leqslant 6$ and $2x - y \leqslant 2$
11 $y < x + 3$, $2y + x \leqslant 6$ and $y \geqslant 0$ **12** $x + y < 6$, $x - 2y \leqslant 4$ and $x \geqslant 0$

13



14



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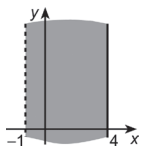

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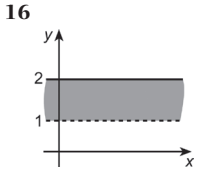

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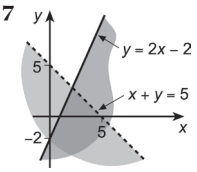

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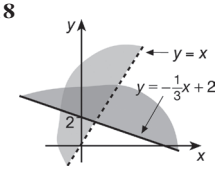
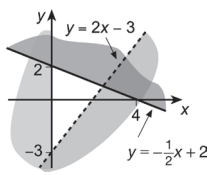


19



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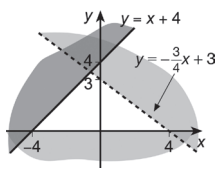
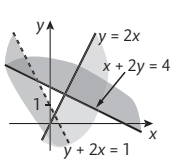


EXERCISE 42*

1 $-3 \leqslant x < 4$ **2** $y < 2$ or $y \geqslant 5$
3 $2y + x \geqslant 10$ or $2y + x \leqslant 4$ **4** $-2 \leqslant 2x - y \leqslant 2$
5 $4x + 3y \leqslant 12$, $y \geqslant 0$ and $y < 2x + 4$
6 $y > \frac{3x}{4} - 3$, $y \leqslant 0$ and $y \geqslant -\frac{3x}{2} - 3$
7 $x \geqslant 0$, $y \geqslant 0$, $y < -\frac{3x}{2} + 9$ and $y \leqslant -\frac{2x}{3} + 6$
8 $y \geqslant 0$, $y \leqslant x + 2$, $y \leqslant 2x - 2$ and $y \leqslant 18 - 2x$

9



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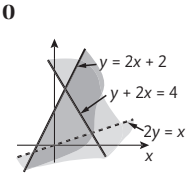

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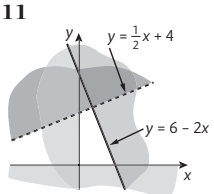

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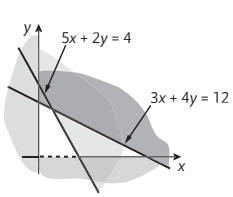
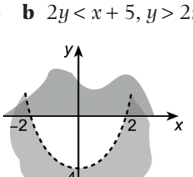
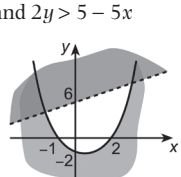


13 **b** $y < x + 2$, $y < -2x + 2$ and $2y + x > -2$ **c** $y = -1$
14 **b** $2y < x + 5$, $y > 2x - 2$ and $2y > 5 - 5x$ **c** $x = 1$

15



16



17

4, 10; 4, 11; 5, 8; 5, 9; 5, 10; 6, 7; 6, 8; 6, 9; 7, 7; 7, 8 and all negative pairs with $xy \leqslant 36$

18 Above the line.

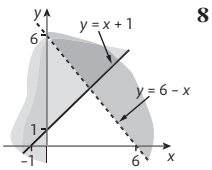
REVISION EXERCISE 43

1 (2, 1) **2** (4, 3) **3** (–1, 3) **4** (–2, –2)

5 A: $y > 2x$, $2y + x > 6$ B: $y < 2x$, $2y + x > 6$
C: $y < 2x$, $2y + x < 6$ D: $y > 2x$, $2y + x < 6$

6 A: $y > 4$, $y > 2x - 4$ B: $y > 4$, $y < 2x - 4$
C: $y < 4$, $y < 2x - 4$ D: $y < 4$, $y > 2x - 4$

7



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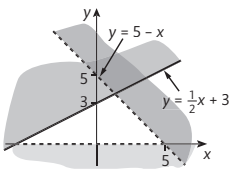


REVISION EXERCISE 43*

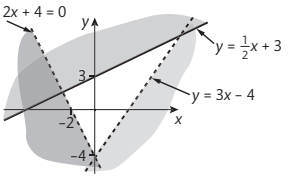
1 (2.29, 2.14) **2** (2.31, 3.23) **3** (–1.6, 1.2) **4** (–1.4, –0.8)

5 $y < 3x + 2$, $y < 7 - 2x$ and $2y > x - 1$

6 A: $y > 2x + 2$, $4y + 3x + 12 > 0$ B: $y < 2x + 2$, $4y + 3x + 12 > 0$
C: $y < 2x + 2$, $4y + 3x + 12 < 0$ D: $y > 2x + 2$, $4y + 3x + 12 < 0$

7 $\{y \geqslant 3$ and $2x + y \leqslant 6\}$

8



SHAPE AND SPACE 2

ACTIVITY 10

$\frac{o}{a} \approx 0.6$ for X, Y, Z

INVESTIGATE

x	0°	15°	30°	45°	60°	75°	89°	90°
tan x	0	0.268	0.577	1	1.73	3.73	57.3	∞

tan 89° is large because the opposite side becomes much larger compared with the adjacent side as the angle approaches 90°.

EXERCISE 44

1 x: hyp, y: opp, z: adj **2** x: hyp, y: adj, z: opp **3** x: opp, y: adj, z: hyp

4 $\frac{3}{4}$ **5** $\frac{4}{3}$ **6** $\frac{5}{12}$ **7** 5.8

8 75 **9** 87 **10** 16 **11** 100

12 100 **13** 6.66 cm **14** 7.14 cm **15** 8.20 cm

16 4.04 cm **17** 11.3 cm **18** 2.58 cm **19** 87.5 m

20 87 m **21** 100 m²

EXERCISE 44*

1 14.4 cm **2** 3.99 m **3** $x = 200$ cm **4** 173 cm

5 8.46 m **6** 10.4 m **7** 100 m **8** 37.3 m

9 22.4 m **10** $x = 8.40$ cm, $y = 4.85$ cm

11 $x = 10.9$ cm, $y = 6.42$ cm

12 $x = 7.28$ cm, $y = 4.27$ cm

13 $x = 27.5$ cm, $y = 9.26$ cm

14 **a** 8.82 m **b** 6.350 km/h

15 BX = 2.66 m, BC = 4.00 m **16** 6.88 cm

EXERCISE 45

1 45° **2** 30° **3** 15° **4** 60.0° **5** 70.0°

6 75.0° **7** 45° **8** 60° **9** 75° **10** 36.9°

11 37.9° **12** 32.0° **13** 28.2° **14** 56.7° **15** 27.1°

16 $a = 27.2°$, $b = 62.8°$ **17** 23.4° **18** 15°

EXERCISE 45*

1 $a = 69°$, $b = 138°$ **2** 113° **3** 60°

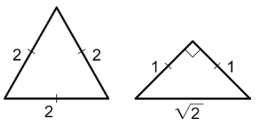
4 15° **5** 160°

6 **a** 125° **b** 305°

7 **a** 080.5° **b** 260.5° **c** 108.4° **d** 236.3°

8 13.9° **9** 101°

10 Hint



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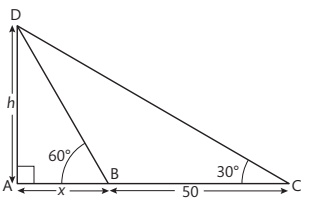


From △ABD $x = \frac{h}{\tan 60°} = \frac{h}{\sqrt{3}} = \frac{h\sqrt{3}}{3}$ ①

From △ACD $50 + x = \frac{h}{\tan 30°} = h\sqrt{3}$ ②

Sub ① into ② gives $50 + \frac{h\sqrt{3}}{3} = h\sqrt{3}$

$50 = h\sqrt{3} - \frac{h\sqrt{3}}{3}$

$50 = \frac{2\sqrt{3}}{3}h$

$h = 25 \times \frac{3}{\sqrt{3}}$

$h = 25\sqrt{3}$

REVISION EXERCISE 46

1 7.00 **2** 6.71 **3** 6.99 **4** 11.0 **5** 8.57

6 6.93 **7** 59.0° **8** 32.5° **9** 58.0° **10** 5.19 cm²

11 30°

REVISION EXERCISE 46*

1 549 m

2 **a** 063.4° **b** 243°

3 **a** 1.01 m

b Undesirable to have too large a blind distance.

4 Area $= x^2\sqrt{3}$

5 $\tan 30 = \sqrt{3}$, $\tan 45 = 1$

$\left(\frac{25 \div 1}{\sqrt{3}}\right) - (25 \div 1) = 25\sqrt{3} - 25$

$= 25(\sqrt{3} - 1)$

HANDLING DATA 2

EXERCISE 47

1

Score		Frequency
1	𝍸 ||||	9
2	𝍸 𝍸	10
3	𝍸 ||	7
4	𝍸	5
5	||||	4
6	𝍸	5
		Total = 40

The die appears to be biased towards 1,2 but the sample is too small to be sure.

2

Appointments		Frequency
0	|||	3
1		0
2	|	1
3	||	2
4	||	2
5	|||	3
6	|||	3
7	𝍸	5
8	||	2
		Total = 21

Median = 5, mode = 7.

3

Weight in kg		Frequency
$1.0 \leqslant w < 1.5$	||	2
$1.5 \leqslant w < 2.0$	𝍸	5
$2.0 \leqslant w < 2.5$	𝍸 ||||	9
$2.5 \leqslant w < 3.0$	𝍸 𝍸 ||	12
$3.0 \leqslant w < 3.5$	𝍸 ||||	9
$3.5 \leqslant w < 4.0$	𝍸 |||	8
$4.0 \leqslant w < 4.5$	||||	4
$4.5 \leqslant w < 5.0$	|	1
		Total = 50

$\frac{14}{25}$ of the babies weigh less than 3 kg.

4

Weight in g		Frequency
$54.0 \leqslant w < 55.0$	||	2
$55.0 \leqslant w < 56.0$	𝍸 |||	8
$56.0 \leqslant w < 57.0$	𝍸 𝍸|	11
$57.0 \leqslant w < 58.0$	𝍸 𝍸 |	11
$58.0 \leqslant w < 59.0$	|||	3
		Total = 35

55 g is a minimum weight.

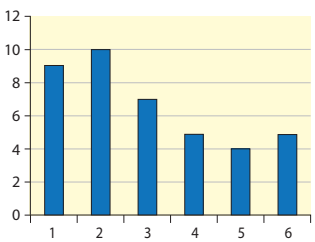
	mean	median	mode
5	10	12	14
6	1.46	1.4	0.8
7	15	16	4
8	1.25	1.0	–

EXERCISE 47*

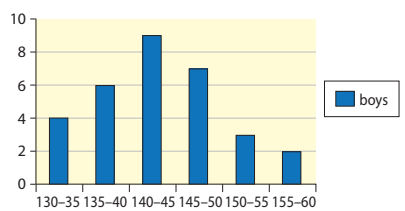
1 Mean = 48.9 s, median = 45 s.
2 Mean = 1.60 m, median = 1.59 m.
3 Mean 92, median 91, mode 91; therefore either median or mode.
4 Mean 4.9, median 5, mode 8; therefore the mode.
5 10.5 years
6 **a** 49.8% **b** 59.8%
7 For example: 1, 2, 3, 4, 5, 16; mean = 5.2
8 For example: 1, 2, 2, 2, 2, 2, 2, 2; mean = 1.875

EXERCISE 48

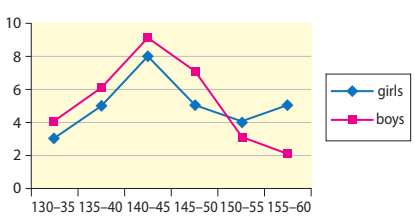
1 flour = 96°, almonds = 60°, caster sugar = 48°, semolina = 48°, butter = 108°
2 walk = 204°, cycle = 32°, car = 20°, bus = 56°, train = 48°; 29%
3 Frequencies: 9, 10, 7, 5, 4, 5



4 **a**

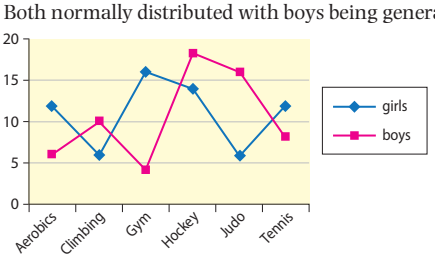


5 **a** and **b**



c Both normally distributed with boys being generally taller than girls.

6 **a**



7 7; 6.1 **8** 26

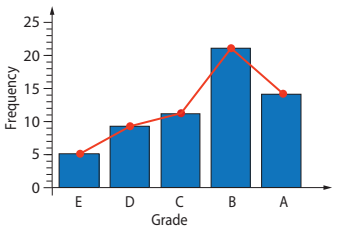
EXERCISE 48*

1 mean = 13.8, median = 13, mode = 17; mode much higher than mean or median.
2 **a** mean = 2.6; median = 2
2 **b** Children might not fill in details with accuracy or truth. Better to ask parents to fill in questionnaire.
3 720 pupils **4** 68% **5** 14 min 41 s

REVISION EXERCISE 49

1 Frequencies are Grade E = 5, Grade D = 9, Grade C = 11, Grade B = 21, Grade A = 14

2, 3



4 Angles Grade E = 30°, Grade D = 54°, Grade C = 66°, Grade B = 126°, Grade A = 84°

5 43.5 **6** 43

REVISION EXERCISE 49*

1 30

2 mean = 2.5, median = 2.5, mode = 1

3 mean = 15 min 55 s, median = 14 min

4

0–15	8
16–30	5
31–45	3
46–60	6
61–75	3
76–90	5

5 Sector angles = 0–15 = 96°, 16–30 = 60°, 31–45 = 36°, 46–60 = 72°, 61–75 = 36°, 76–90 = 60°

6 0–15

EXAMINATION PRACTICE 2

1 £1

2 Japan £200, France £225, Greece £250; so buy it in Japan!

3 **a** k^5 **b** p^4 **c** $3m$ **d** y^6

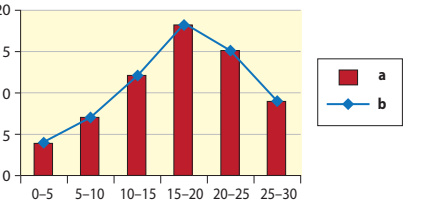
4 **a** 1.28×10^9 km **b** 71 min

5 $t = 2$ min 39 s

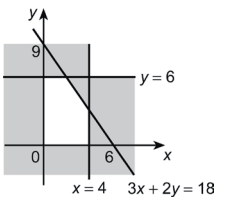
6 **a** 5.24×10^{12} m **b** 9.5×10^{15} m **c** 5.5×10^{-4} light years

7 $x = 3, y = 5$

8



9



10 **a** 15 **b** 9 **c** 10

11 2.5 cm

12 **a** 4000 **b** 120°

13 **a** 9.01 cm **b** 37.8 cm^2

14 73.7°

15 **a** 51.3° **b** 28.9 m, 8.9 m **c** 68.2°

16 **a** 1.28 **b** 1 **c** 0.9

Unit 3

NUMBER 3

ACTIVITY 11

£120 × 1.08 = £129.60; £120 × 0.92 = £110.40

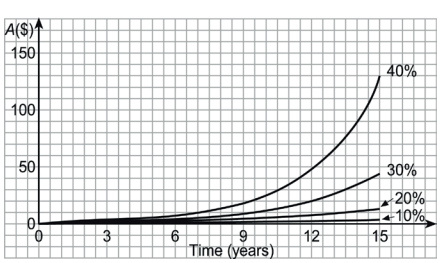
To increase by (%)	100% →	Multiply by
15	115%	1.15
70	170%	1.70
56	156%	1.56
2	102%	1.02
8	108%	1.08
80	180%	1.80

To decrease by (%)	100% →	Multiply by
15	85%	0.85
70	30%	0.30
20	80%	0.8
2	98%	0.98
8	92%	0.92
80	20%	0.20

ACTIVITY 12

Bread:

Time (years)	10%	20%	30%	40%
3	1.13	1.47	1.87	2.33
6	1.51	2.54	4.10	6.40
9	2.00	4.39	9.01	17.6
12	2.67	7.58	19.8	48.2
15	3.55	13.1	43.5	132



Fivefold increase: 40% ≈ 4.8 years (2 s.f.), 30% ≈ 6.1 years (2 s.f.), 20% ≈ 8.8 years (2 s.f.), 10% ≈ 17 years (2 s.f.)

Car: 13.5 years

INVESTIGATE

Peru: When $R = 6000$, the multiplying factor becomes 61. Therefore all prices are likely to increase by a factor of 61 times in a year. Using this figure, the cost of an item, after a chosen number of years, could be worked out.

If M% is the inflation rate per month and Y% is the inflation rate per year, then

$$Y = 100\left[\left(1+\frac{M}{100}\right)^{12}-1\right]$$

If the rate of inflation in country A is higher than the rate of inflation in country B, then exports from country A to country B will become more expensive and therefore less competitive. Conversely, exports from country B to country A will become cheaper and therefore more competitive. Therefore in an inflationary period there is a tendency for imports to increase and unemployment to rise as the country becomes less competitive. Pupils should illustrate this scenario by taking two different inflation rates, one in each country, and investigate what happens to the cost of imports and exports after a number of years. Graphs should be drawn to illustrate their findings.

EXERCISE 50

1 **a** 1.1 **b** 1.2 **c** 1.30 **d** 1.01 **e** 1.15 **f** 1.25
2 **a** 0.90 **b** 0.95 **c** 0.85 **d** 0.97 **e** 0.87 **f** 0.75
3 $440 **4** $480 **5** $520 **6** 202 km
7 230 km **8** 250 km **9** £270 **10** £285
11 £255 **12** £485 **13** £435 **14** £375
15 '... by 1.03 × 1.04'
16 '... by 0.92 × 0.93' **17** 660 pupils
18 262 g **19** '... by $(1.04)^5$' **20** '... by $(1.09)^6$'
21 €675 **22** $795 **23** $98 415, $804 262.23
24 $29 531.25, $5255.93

EXERCISE 50*

1 **a** 1.125 **b** 1.04 **c** 1.05
2 **a** 0.804 **b** 0.90 **c** 0.80
3 90 km **4** 804 kg **5** $437 **6** £288
7 Result is a multiplying factor of 1.2 × 0.8 = 0.96, that is 4% decrease. You do not get back to the original quantity because the 80% reduction is applied to the increased value.
8 Result is a multiplying factor of 0.8 × 1.2 = 0.96
9 €808 **10** $1224 **11** €10 100, €20 200, €40 700
12 £8870, £3940, £1750 **13** $4.39 million
14 £9410, £4430, £2080, £979 **15** SF22 800
16 £480 000 **17** P = $614 **18** P = $621 **19** R = 12.7%
20 R = 9.65% **21** n = 14.2 years **22** n = 7.27 years
23 How much slower, as a percentage, the women's record is:

	1965	1975	1985	1995	2005
100 m	11.6%	11.3%	8.4%	6.6%	7.4%
1500 m	20.1%	13.8%	10.8%	10.4%	11.9%

Since 1965 there have been more women participating in athletics, the media have given more attention to women's athletics and there has been more money in the sport.

EXERCISE 51

1 7, 14, 21, 28, 35 **2** 12, 24, 36, 48, 60
3 6, 12, 18, 24, 30 **4** 22, 44, 66, 88, 110
5 1, 2, 3, 4, 6, 12 **6** 1, 2, 3, 6, 9, 18
7 1, 2, 3, 5, 6, 10, 15, 30 **8** 1, 2, 4, 8, 16, 32
9 2 × 2 × 7 **10** 2 × 5 × 7
11 2 × 2 × 3 × 5 **12** 2 × 2 × 2 × 2 × 2 × 3
13 Yes **14** Yes
15 2 × 3 × 5 × 7 **16** 2 × 3 × 5 × 13
17 2 × 2 × 2 × 11 **18** 2 × 5 × 7 × 11
19 Divisible by 7 **20** Divisible by 3

EXERCISE 51*

1 No **2** Yes **3** 3, 7, 19 **4** 5, 11, 13
5 3, 7, 11 **6** 3, 11, 13 **7** 11 **8** 13
9 1, 3, 5, 15, 25, 75 **10** 1, 2, 4, 5, 8, 10, 20, 40
11 1, 2, 3, 6, 9, 18, 27, 54 **12** 1, 2, 3, 4, 6, 8, 12, 16, 24, 48
13 $3\times5\times11$ **14** $3\times5\times7\times11$
15 $3\times7\times19$ **16** $5\times11\times13$
17 59, 61 **18** 168
19 $2^3\times3^2\times7$ **20** $2^5\times5^2$ **21** $2^4\times3^2\times7$
22 2^{10}

EXERCISE 52

1 2 **2** 3 **3** 5 **4** 6 **5** 22
6 6 **7** 6 **8** 12 **9** 30 **10** 12
11 30 **12** 60 **13** $2x$ **14** $3a$ **15** $4y^2$
16 xy **17** $6ab$ **18** $12xy$ **19** $\frac{3}{4}$ **20** $\frac{3}{4}$
21 $\frac{4}{7}$ **22** $\frac{1}{5}$ **23** $\frac{1}{2}$ **24** $\frac{3}{4}$ **25** $\frac{3}{16}$
26 $\frac{6}{11}$ **27** $\frac{1}{5}$ **28** $\frac{5}{7}$ **29** $\frac{7}{24}$ **30** $\frac{7}{36}$
31 $\frac{17}{140}$ **32** $\frac{4}{5}$ **33** $\frac{11}{30}$ **34** $\frac{13}{36}$ **35** $\frac{7}{12}$
36 $\frac{13}{60}$

EXERCISE 52*

1 HCF = 6, LCM = 36 **2** HCF = 15, LCM = 225 **3** HCF = 15, LCM = 210 **4** HCF = 14, LCM = 210
5 HCF = y, LCM = $6xyz$ **6** HCF = b, LCM = $35abc$ **7** HCF = $2xy$, LCM = $12xy$ **8** HCF = $5ab$, LCM = $30ab$
9 HCF = xy, LCM = x^2yz **10** HCF = ab, LCM = a^2b^2 **11** HCF = xy, LCM = x^3y^4 **12** HCF = ab^2c, LCM = $a^2b^3c^2$
13 HCF = $3xyz$, LCM = $18x^2y^2z^2$ **14** HCF = $4ab^2c^2$, LCM = $24a^2b^3c^3$
15 $\frac{13}{24}$ **16** $\frac{31}{36}$ **17** $\frac{13}{36}$ **18** $\frac{31}{225}$ **19** $\frac{93}{140}$
20 $\frac{109}{210}$ **21** $\frac{29}{72}$ **22** $\frac{4}{15}$

ACTIVITY 13

$abc\ 7\times11\times13 = abcabc$ (because $7\times11\times13 = 1001$)

ACTIVITY 14

710.773 45, SHELL OIL; 710.0553, ESSO OIL

EXERCISE 53

1 6.96 **2** 17.3 **3** 3.35 **4** 6.61 **5** 6.96
6 17.3 **7** 3.35 **8** 6.61 **9** 134 **10** 9.59
11 0.384 **12** 0.495 **13** 12.9 **14** 2.61 **15** 16.1
16 0.371 **17** 2.58 **18** 6.83 **19** 14.6 **20** 14.3
21 2.69 **22** 1.87 **23** 7.16 **24** 10.2 **25** 11.3
26 1.31 **27** 1.22 **28** 2.49 **29** 625 **30** 1024
31 191 **32** 3.58 **33** 191 **34** 3.58 **35** 245 000
36 51 400 **37** 1.75×10^{10} **38** 5.71×10^{-11}

EXERCISE 53*

1 3.43 **2** 3.49 **3** 0.005 80 **4** 0.001 92
5 −1.01 **6** −10.1 **7** 12.4 **8** 10.2
9 −0.956 **10** 0.296 **11** 15.2 **12** 2.49
13 0.103 **14** 10 900 **15** 0.0454 **16** 0.006 21
17 3.60 **18** 4490 **19** $a^2+b^2 \neq (a+b)^2$
20 $6\times\frac{1}{6^3} = 0.0278$

REVISION EXERCISE 54

1 1.15 **2** 0.95 **3** $35.20
4 '... by $(1.07)^5$'
5 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47
6 5, 11 **7** 2, 5, 7 **8** 2, 3, 5
9 $168 = 7\times24$ **10** $175\div7 = 25$ **11** 2
12 3 **13** 10 **14** 15 **15** 12
16 18 **17** 42.6 **18** 50.4 **19** 9.56
20 3.71 **21** 1.09 **22** 583
23 £960, £1400, £2060 **24** £4440, £1970, £874
25 50%

REVISION EXERCISE 54*

1 406 kg **2** 497.5 km **3** 47, 53, 59, 61, 67
4 $2^2\times5\times17$ **5** $2^4\times7$ **6** $2^3\times3^3$
7 777 **8** $666\div18 = 37$ **9** 28
10 $3x$ **11** $3a^2$ **12** 210 **13** $12x^2y$
14 $30a^2b$ **15** 0.914 **16** 5.89 **17** −0.0851
18 280 **19** 1.02 **20** 1.49 **21** £2590
22 £86 billion

ALGEBRA 3

EXERCISE 55

1 $x(x+3)$ **2** $x(x+5)$ **3** $x(x-4)$
4 $x(x-7)$ **5** $5(a-2b)$ **6** $7(3a-b)$
7 $x(y-z)$ **8** $c(b-2d)$ **9** $2x(x+2)$
10 $3x(x+2)$ **11** $3x(x-6)$ **12** $4x(x-2)$
13 $ax(x-a)$ **14** $a^2x^2(1+ax)$ **15** $3xy(2x-7)$
16 $7ab(4b-3a)$ **17** $3pq(3p+2)$ **18** $2ab(2b^2+3a)$
19 $a(p+q-r)$ **20** $a(x+y+x^2)$

EXERCISE 55*

1 $5x^3(1+3x)$ **2** $9a^2(3a^2+1)$ **3** $3x^2(x-6)$
4 $6p^4(4-p)$ **5** $3x^2y^2(3x-4y^2)$ **6** $8xy(y^2-3x^2)$
7 $x(x^2-3x-3)$ **8** $a(5a+a^2-5)$ **9** $ab(c^2-b+ac)$
10 $ab^2c(a^2+ac-c^2)$ **11** $4pq(pqr^2-3r+4q)$ **12** $3ab(3b+5c-4a)$
13 $3x(10x^2+4y-7z)$ **14** $4a(6b^2-4ac+5ab^2)$
15 $0.1h(2h+g-3g^2h)$ **16** $0.7a^2b(b^2-3ab+2)$
17 $\frac{xy(2x^2-4y+xy)}{16}$ **18** $\frac{pq^2(6+p^2q-2p)}{18}$
19 $\pi r(r+2h)$ **20** $\frac{1}{3}\pi r^2(2r+h)$ **21** $4pqr(4pr^2-7-5p^2q)$
22 $8abc(3bc^2+4a^2b-6)$
23 $(a+b)(x+y)$ **24** $(a+b)^3$ **25** $(x-y)^2(1-x+y)$
26 $x^2(x+3)(x+5)$

EXERCISE 56

1 $x+1$ **2** $1-a^2$ **3** $\frac{(x+y)}{z}$ **4** $\frac{(a-b)}{c}$
5 2 **6** 5 **7** $\frac{(a-b)}{b}$ **8** $\frac{(x+y)}{y}$
9 $\frac{t}{r}$ **10** $\frac{a}{z}$ **11** $\frac{x}{z}$ **12** $\frac{a}{c}$

EXERCISE 56*

1	$x+y$	**2**	$3a+b$	**3**	$\frac{1}{z+1}$	**4**	$\frac{2}{m-2}$
5	$2+3x^2$	**6**	$a-3a^2$	**7**	$\frac{2}{3}(x-3y^2)$	**8**	$\frac{1}{2}(3y+x^2)$
9	y	**10**	a	**11**	$\frac{2x}{z}$	**12**	$2y$
13	1	**14**	$\frac{1}{y}$	**15**	$\frac{b}{a}$	**16**	$\frac{3x}{2y}$
17	5	**18**	$\frac{1}{3}$	**19**	$-x$	**20**	$-\frac{1}{y}$

EXERCISE 57

1	$x=8$	**2**	$x=6$	**3**	$x=-10$	**4**	$x=-21$
5	$x=2$	**6**	$x=10$	**7**	$x=0$	**8**	$x=0$
9	$x=-6$	**10**	$x=-10$	**11**	$x=5$	**12**	$x=7$
13	$x=-4$	**14**	$x=-5$	**15**	$x=6$	**16**	$x=15$
17	$x=14$	**18**	$x=10$	**19**	$x=3$	**20**	$x=7$
21	$x=0$	**22**	$x=0$	**23**	$x=10$	**24**	$x=37\frac{1}{2}$
25	6 km	**26**	90 cm				

EXERCISE 57*

1	$x=9$	**2**	$x=5$	**3**	$x=\frac{3}{5}$	**4**	$x=-\frac{5}{6}$
5	$x=9$	**6**	$x=10$	**7**	$x=-6$	**8**	$x=3$
9	$x=0$	**10**	$x=0$	**11**	$x=\frac{1}{9}$	**12**	$x=-4$
13	$x=3$	**14**	$x=-1$	**15**	$x=-1$	**16**	$x=5.6$
17	$x=-\frac{5}{13}$	**18**	$x=-\frac{5}{8}$	**19**	$x=7$	**20**	$x=10$
21	84 years	**22**	60 km, 3 hours				

EXERCISE 58

1	$x=2$	**2**	$x=7$	**3**	$x=-3$	**4**	$x=-5$
5	$x=\frac{3}{5}$	**6**	$x=\frac{2}{7}$	**7**	$x=-8$	**8**	$x=-15$
9	$x=10$	**10**	$x=16$	**11**	$x=-2.4$	**12**	$x=-10.5$
13	$x=50$	**14**	$x=30$	**15**	$x=-25$	**16**	$x=-6$
17	$x=\frac{5}{3}$	**18**	$x=\frac{6}{7}$	**19**	$x=\pm3$	**20**	$x=\pm5$

EXERCISE 58*

1	$x=4$	**2**	$x=5$	**3**	$x=-8$	**4**	$x=-2$
5	$x=\frac{1}{6}$	**6**	$x=\frac{1}{20}$	**7**	$x=-64$	**8**	$x=-121$
9	$x=4$	**10**	$x=6$	**11**	$x=\pm8$	**12**	$x=\pm9$
13	$x=\pm2$	**14**	$x=\pm3$	**15**	$x=0.32$	**16**	$x=0.14$
17	$x=\frac{5}{6}$	**18**	$x=\frac{7}{12}$	**19**	$x=\frac{(a+b)}{ab}$	**20**	$x=\frac{(b-a)}{ab}$

EXERCISE 59

1	(5, 3)	**2**	(1, 1)	**3**	(3, 2)	**4**	(2, 1)
5	(1, 2)	**6**	(−1, 3)	**7**	(1, 1)	**8**	(−2, 1)
9	(1, −1)	**10**	(−1, 2)				

EXERCISE 59*

1	(8, 3)	**2**	(2, −1)	**3**	(4, 5)	**4**	$(3, -\frac{1}{2})$
5	(1, 5)	**6**	(8, 5)	**7**	(0, −2)	**8**	(−7, 0)
9	(−1, 5)	**10**	(1, 1)				

EXERCISE 60

1	(2, 5)	**2**	(4, 1)	**3**	(5, 1)	**4**	(16, 3)
5	(1, 3)	**6**	(−2, 1)	**7**	(5, −1)	**8**	(3, −2)
9	(2, 1)	**10**	(1, 2)				

EXERCISE 60*

1	(3, −1)	**2**	(4, −2)	**3**	(1, 2)	**4**	(4, −3)
5	(−0.4, 2.6)	**6**	(1, 1)	**7**	(7, 3)	**8**	(4, −1)
9	(0.5, 0.75)	**10**	(0.2, −0.6)	**11**	(4, 6)	**12**	(−5, 4)
13	(−0.6, −0.8)	**14**	(0.6, −0.2)	**15**	(0.4, 0.5)	**16**	(4, −6)

EXERCISE 61

1	$x=3, y=1$	**2**	$x=2, y=1$	**3**	$x=1, y=4$
4	$x=2, y=4$	**5**	$x=1, y=6$	**6**	$x=2, y=5$
7	$x=-1, y=2$	**8**	$x=-2, y=2$	**9**	$x=3, y=-1$
10	$x=2, y=-2$				

EXERCISE 61*

1	$x=1, y=2$	**2**	$x=1, y=2$	**3**	$x=4, y=1$
4	$x=3, y=1$	**5**	$x=2, y=1$	**6**	$x=5, y=3$
7	$x=1, y=-2$	**8**	$x=4, y=5$	**9**	$x=-3, y=\frac{1}{2}$
10	$x=-2, y=1$				

EXERCISE 62

1	29, 83	**2**	43, 84	**3**	12, 16	**4**	20, 28
5	9, 4	**6**	5, 7	**7**	$x=2, y=3$, area = 180		
8	$x=4, y=2$, perimeter = 42			**9**	Burger 99p, cola 49p		
10	Dodgems £1.50, Big Wheel 90p			**11**	27 @ 20p, 12 @ 50p		
12	420	**13**	11	**14**	39		

EXERCISE 62*

1	(2, 3)	**2**	(1.5, 2)	**3**	$m=2, c=-1$		
4	$m=-1, c=3$	**5**	$\frac{12}{17}$	**6**	$\frac{14}{23}$		
7	1.5 m s^{-1}	**8**	16	**9**	7.5 km	**10**	150 km
11	37	**12**	84	**13**	50 m		
14	Urban 63 km, Motorway 105 km, total 168 km.						

REVISION EXERCISE 63

1	$x(x-8)$	**2**	$3x(x+4)$	**3**	$6xy(y-5x)$
4	$3x(4x^2+3x-5)$	**5**	$x-1$	**6**	$\frac{(x+y)}{(x-y)}$
7	$x=4$	**8**	$x=6$	**9**	$x=-4$
10	$n=2$	**11**	24	**12**	(−1, 3)
13	(0, 3)	**14**	(2, 2)	**15**	(1, 3)
16	CD £7.50, Tape £3.50			**17**	19 @ 10p, 11 @ 20p

REVISION EXERCISE 63*

1	$3x^3(x-4)$	**2**	$\frac{2}{3}\pi r^2(2r+1)$	**3**	$6x^2y(4xy-3)$
4	$3a^2b^2c^2(5b-3a+7c)$				
5	$\frac{x}{y}$	**6**	x	**7**	$x=\frac{1}{3}$
8	$x=-4$	**9**	$x=6$	**10**	$x=\frac{1}{2}$
11	70 years	**12**	(2, 3)	**13**	(4, 1)
14	(4, 1.5)	**15**	$(3\frac{1}{3}, 2)$		
16	$a=\frac{3}{11}, b=\frac{2}{11}$	**17**	Mike is 38, Ben is 14		

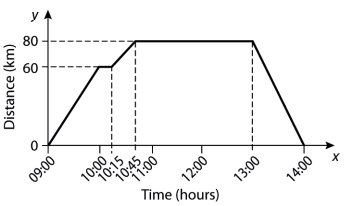
GRAPHS 3

EXERCISE 64

1 **a** 65 km/h **b** 50 km/h **c** 12:00 **d** 72.5 km
e 11:08 approx

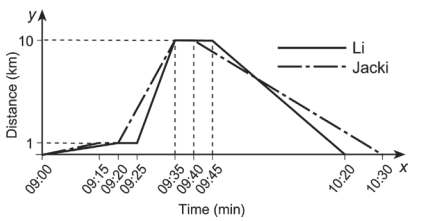
2 **a** 09:30 for half an hour **b** 09:00 and 10:54
c 20 miles **d** 80 mph yes! **e** 53.3 mph **f** 53.3 mph

3 **a**



b 14:00

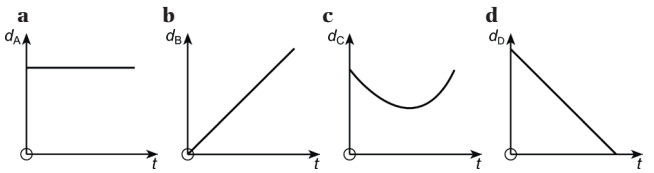
4 **a**



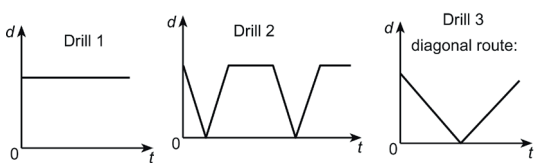
b Li at 10:20, Jacki at 10:30
c 09:20, 09:35–09:40, 09:57
d Li: 18.5 km/h, Jacki: 15 km/h

EXERCISE 64*

1 **a** **b** **c** **d**

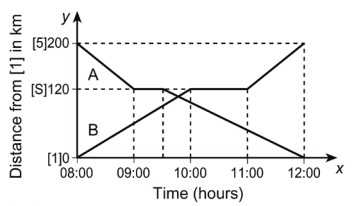


2



3 **a** **(i)** B & C joint 1st, A 2nd
(ii) C 1st, B 2nd, A 3rd
(iii) A 1st, B 2nd, C 3rd
b 28.5 s **c** B **d** **(i)** A **(ii)** C

4 **a**



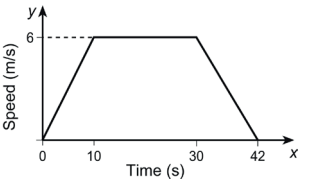
b 09:47
c A: 48 km/h, B: 80 km/h **d** A: 57 km/h, B: 67 km/h

EXERCISE 65

1 **a** 2 m/s² **b** 4 m/s² **c** 150 m **d** 10 m/s
2 **a** 3.5 km/h² **b** 7 km/h² **c** 10.5 km **d** 3.5 km/h
3 **a** 2 m/s² **b** 1 m/s² **c** 8000 m **d** 50 m/s
4 **a** 30 m/s **b** 10 s **c** 570 approx
d 23 m/s approx

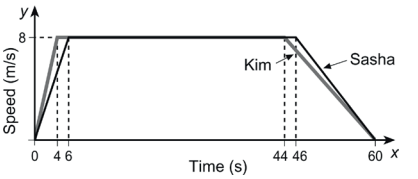
EXERCISE 65*

1 **a**



b 0.6 m/s² **c** −0.5 m/s² **d** 4.43 m/s (3 s.f.)
2 **a** S = 120 m/s **b** 9600 m **c** 80 m/s
3 **a** t = 10 s, so distance = 1900 m **b** −3 m/s²
c 47.5 m/s

4 **a**

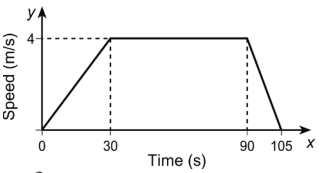


b Dead heat
c 6.67 m/s (to 3 s.f.) for both runners
d 400 m
e **(i)** Sasha reaches 100 m after 15.5 s. Kim reaches 100 m after 14.5 s. Kim is in the lead at 100 m.
(ii) Sasha reaches 300 m after 40.5 s. Kim reaches 300 m after 39.5 s. Kim is in the lead at 300 m.

5 Bee cannot have two speeds, or be at two different distances at any given time.

REVISION EXERCISE 66

1 **a** 20 min **b** 10:00 **c** 10 km/h **d** $3\frac{1}{3}$ km
2 **a** 0.4 m/s **b** 10 min **c** 0.2 m/s
3



a $\frac{2}{15}$ m/s² **b** 0 m/s² **c** $\frac{4}{15}$ m/s² **d** $3\frac{1}{7}$ m/s
4 **a** 400 m **b** 975 m **c** 9.75 m/s **d** 0.4 m/s²

REVISION EXERCISE 66*

1 **b** Elisa home at 12:00, Albert home at 12:00
c Elisa 1.48 m/s, Albert 2.22 m/s
2 **a** 50 m/s **b** 0.5 s at 30 m/s approx
3 **a** False; it is constant at $\frac{2}{3}$ m/s² **b** True
c True **d** False; it is 72 km/h
4 **a** 44 m **b** $\frac{2}{3}$ m/s² **c** 4.4 m/s

SHAPE AND SPACE 3

ACTIVITY 15

Triangle	Opposite	Adjacent	Hypotenuse
P	15 mm	27 mm	30 mm
Q	25 mm	43 mm	50 mm
R	19 mm	33 mm	38 mm

d	0°	15°	30°	45°	60°	75°	90°
sin d	0	0.259	0.5	0.707	0.866	0.966	1
cos d	1	0.966	0.866	0.707	0.5	0.259	0

EXERCISE 67

1 2.46 **2** 4.59 **3** 5.07 **4** 8.83 **5** 8.09
6 14.3 **7** 9.44 cm **8** 7.83 cm **9** 8.76 cm **10** 18.2 cm
11 10.1 m **12** 9.98 m **13** 1.61 m **14** 67.6 m

EXERCISE 67*

1 6.57 cm **2** 6.60 cm
3 **a** 2.5 m **b** 4.33 m **c** 20.6 m^2 **d** 31.7°
4 6.93 m^2
5 **a** 107 m **b** 79.5 m
6 155 m **7** 5.88 cm **8** 452 m

ACTIVITY 16

sin b	0	0.259	0.5	0.866	0.966	1
b	0°	15°	30°	60°	75°	90°
cos b	1	0.966	0.866	0.5	0.259	0

EXERCISE 68

1 48.6° **2** 41.4° **3** 46.1° **4** 71.2° **5** 19.5°
6 80.1° **7** 78.9° **8** 23.6° **9** 1.72° **10** 70.5°

EXERCISE 68*

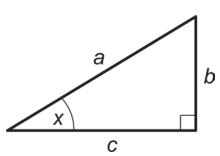
1 37.8° **2** 37.6° **3** 58.6° **4** 29.6° **5** 57.3°
6 29.0° **7** 014.9°; 194.9° **8** 72.7° **9** 33.6°
10 57.3°

INVESTIGATE

$(\sin x)^2 + (\cos x)^2 = 1$

$\left(\frac{b^2}{a^2}\right) + \left(\frac{c^2}{a^2}\right) = 1$

$\left(\frac{b^2 + c^2}{a^2}\right) = 1$



$b^2 + c^2 = a^2$ (Pythagoras' theorem)

$\sin x = \frac{b}{a}$, $\cos x = \frac{c}{a}$

$\frac{\sin x}{\cos x} = \frac{b}{a} \div \frac{c}{a} = \frac{b}{\cancel{a}} \times \frac{\cancel{a}}{c} = \frac{b}{c} \rightarrow \sin x \backslash \cos x = \tan x.$

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

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

EXERCISE 69

1 $x = 5$ **2** $x = 8.66$ **3** $x = 8.66$ **4** $x = 1.29$
5 $x = 5.18$ **6** $x = 49.2$ **7** $a = 30°$ **8** $a = 60°$
9 $a = 60°$ **10** $a = 30°$ **11** 9.24 **12** 5.45
13 32.2° **14** 18.4 **15** 49.7° **16** 60.9°
17 1.38 cm **18** 19.4 cm **19** 41.6° **20** 10.4 m
21 62.3° **22** 42.9° **23** 250 m **24** 10°
25 5.47 km **26** 63.6°

EXERCISE 69*

1 $x = 18$ **2** $x = 22$ **3** $x = 100$ **4** $x = 10$
5 $x = 20$ **6** $x = 200$ **7** $a = 45°$ **8** $a = 10°$
9 $a = 30°$ **10** $a = 30°$, $x = 8.7$, $y = 2.5$
11 **a** 4.66 km N **b** 17.4 km W
12 **a** 195 m **b** 442 m
13 $H = 22.2$ m **14** $d = 611$ m **15** 7.99 km **16** 1.5 m

INVESTIGATE

Prove that $h = x(1 - \cos a)$ and superimpose the three graphs for $x = 2$, $x = 3$ and $x = 10$ (metres).

Range for a is 0–90°.

The three parabolas all go through the origin and exist for $0° \leqslant a \leqslant 90°$. The steepest is for $x = 10$, second steepest for $x = 3$ and third steepest for $x = 2$. This does make sense when compared with the motion of a swing.

REVISION EXERCISE 70

1 $x = 14.1$ cm, $d = 70.5°$ **2** $x = 7.87$ m, $d = 10.2°$
3 $x = 16.8$ km, $d = 39.9°$ **4** $x = 11.7$ cm, $d = 31.2°$
5 $x = 2.38$ m, $d = 4.62°$ **6** $x = 14.3$ km, $d = 79°$
7 43.3 cm^2 **8** 33.7°
9 **a** 0.5 **b** $f = 30°$
10 **a** 20.5 m **b** 19.1 m **c** 20.7 m

REVISION EXERCISE 70*

1 Ascends in 3 min 52 s, so reaches surface with 8 seconds to spare.
2 **a** 17.2 km, 284° **b** 18:11:10
3 3.56 m
4 **a** 16.2 m **b** 16.2 s **c** 432 m
5 $p = 25$
6 $q = 5$

HANDLING DATA 3

ACTIVITY 17

Swimmers' times: exact group boundaries $55 \leqslant t < 60$ etc.; width = 5; mid-points are 57.5, 62.5, 67.5, 72.5

Earthworm lengths: exact group boundaries $2.5 \leqslant l < 5.5$ etc.; width = 3; mid-points are 4, 7, 10, 13

Noon temperatures: exact group boundaries $0 \leqslant t < 8$ etc.; width = 8; mid-points are 4, 12, 20, 28

Babies' weights: exact group boundaries $1 \leqslant w < 2$ etc.; width = 1; mid-points are 1.5, 2.5, 3.5, 4.5

Children's ages: exact group boundaries $2 \leqslant y < 4$ etc.; width = 2; mid-points are 3, 5, 7, 9

EXERCISE 71

1 **a**

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

b 2.9 **c** 2.5

2 **a**

Scores	Frequency
1	4
2	8
3	6
4	5
5	4
6	3

b 5.2 **c** 5

3 **a** 50 **b** 1.44 **c** 1
4 **a** 80 **b** 1.8 **c** 1
5 **a** 30 **b** 1.3 **c** 2
6 **a** 80 **b** 2.40 **c** 40%
7 **a** 35 **b** 167.5 **c** 184.5 cm
8 **a** 60 **b** 15 **c** 85 min

EXERCISE 71*

1 2.9 kg **2** 197 cm **3** 16 min **4** 91.5 s
5 24.65 years = 27 years 8 months
6 17.92 min = 17 min 55 s **7** 26.1 **8** 25.1

REVISION EXERCISE 72

1 **a**

Scores	Frequency
9	3
10	4
11	4
12	5
13	10
14	2

b \$11.75 **c** \$12

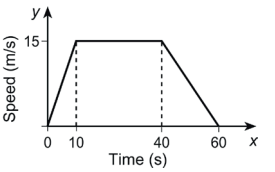
2 **a** 12.0 **b** £600

REVISION EXERCISE 72*

1 1670 cc
2 **b** 2165 min = 36 h 5 min **c** 31 min 23 s
d 69 min 50 s **e** \$12.32

EXAMINATION PRACTICE 3

1 **a** 3375 **b** 2×10^5 **c** 2 **d** 2
2 **a** **(i)** 3 **(ii)** 12
b **(i)** 24 **(ii)** 144
3 **a** **(i)** $x = 6$ **(ii)** $x = 12$
b **(i)** $x(x + 7)$ **(ii)** $xy(x + 2y + 3)$
4 **a**



b **(i)** 675m **(ii)** 1.5 m/s^2
(iii) 0.75 m/s^2 **(iv)** 40.5 km/h
5 177 cm
6 **a** 4.68 **b** 67.4 **c** 322 **d** 75.2
7 **a** Gain of £275 **b** 29.9% **c** £2.36 approx
8 **a** **(i)** $x = 5.5$ **(ii)** $x = \frac{7}{9}$
b **(i)** $5x^2y^2(2x - 3y)$ **(ii)** $4xyz(3yz^2 + 4x^2y - 6)$
c $x = 2$; 4 by 4 and 2 by 8
9 **a** 3358 ft **b** 4.6%
10 **a** 9.8 m/s **b** 35.3 km/h **c** 11.2 m/s **d** 2.2 m/s^2
11 **a** $x = 2, y = 5$ **b** $x = 3, y = -1$
12 **a** 4.91 m **b** 0.382 m
13 **a** 8.7 cm **b** 3.7 cm **c** 5 cm **d** 12.5 cm^2
14 **a** 6.24 km **b** **(i)** 51.3° **(ii)** 321.3° **(iii)** 141.3°
15 **a** **(i)** 4880 km **(ii)** 4090 km **(iii)** 38 200 km **(iv)** 123°
b Tangent is perpendicular to radius. Therefore the smallest possible value of angle ODS is 90°, since a smaller value would mean that the signal would pass back into Earth before reaching Delhi.
c 77 000 km
d 0.257s

Unit 4

NUMBER 4

EXERCISE 73

1	\$442	**2**	\$920	**3**	100%	**4**	200%
5	\$40	**6**	\$30	**7**	\$60	**8**	\$40
9	13.3%	**10**	16.7%	**11**	€76.20	**12**	€408
13	€74.10	**14**	€25 100	**15**	\$2430	**16**	12%
17	7%	**18**	0.559%				

EXERCISE 73*

1	\$44	**2**	\$23	**3**	\$180 000	**4**	\$3.50
5	\$60	**6**	\$400	**7**	11.1%	**8**	62.5 cm
9	€73 000	**10**	0.997%	**11**	34.4%	**12**	20%
13	£463	**14**	200%	**15**	400%		

16 **a** \$2.98, \$4.04, \$5.25, \$5.32, \$6.92

b Original price = $\frac{100}{114}$ × selling price

17	14.5%	**18**	116%	**19**	€3400

EXERCISE 74

1 230 m (to 10 m): 235 m; 225 m; (230 ± 5) m

2 70 kg (to 10 kg): 75 kg; 65 kg; (70 ± 5) kg

3 74 °F (to 1 °F): 74.5 °F; 73.5 °F; (74 ± 0.5) °F

4 19 m² (to 1 m²): 19.5 m²; 18.5 m²; (19 ± 0.5) m²

5	3.4 and 3.6	**6**	12.1 and 13.1	**7**	5.59 and 5.61
8	10.15 and 10.25	**9**	4.7 and 5.1	**10**	12.6 and 13.2
11	6.49 and 6.51	**12**	13.15 and 13.25	**13**	2.6 ± 0.1
14	12.25 ± 0.05	**15**	21.35 ± 0.05	**16**	8.2 ± 0.05
17	2.2 ± 0.1	**18**	12.8 ± 0.1	**19**	46.35 ± 0.05
20	9.4 ± 0.05				

EXERCISE 74*

1 5.5 and 6.5; 16.5 and 17.5; 122.5 and 123.5

2 6.5 and 7.5; 35 and 45; 650 and 750

3 2.25 and 2.75; 14.25 and 14.75; 145.75 and 146.25

4 45 and 55; 225 and 235; 4555 and 4565

5 0.1 and 0.3; 7.5 and 7.7; 12.3 and 12.5

6 0.335 and 0.344; 7.225 and 7.234; 12.885 and 12.894

7 42.5 kg and 43.4 kg

8 \$2.15 × 10⁷ and \$2.24 × 10⁷

9 Max length = 18.3 cm, min length = 17.9 cm
Min difference = 6.7 cm

10 Max perimeter = 38 m, min perimeter = 34 m
Max area = 89.25 m², min area = 71.25 m²

11 p(max) = 1.82, p(min) = 1.40

12 w(max) = 4.98, w(min) = 4.02

13 Radius = 1.54 cm, circumference = 9.61 cm

14 A_{max} = 33.6 cm²; d_{min} = 8.18 cm

ACTIVITY 18

Pupils' own estimates. These estimates should be checked against actual measurements.

EXERCISE 75

1	150	**2**	100	**3**	3	**4**	5
5	300	**6**	240	**7**	8	**8**	300
9	200	**10**	600	**11**	6×10^7	**12**	1.2×10^9
13	4×10^3	**14**	2×10^5	**15**	2.3×10^4	**16**	7.2×10^4
17	8.7×10^4	**18**	7.7×10^6	**19**	5×10^2	**20**	9×10^2
21	2×10^6	**22**	3×10^6	**23**	1×10^2	**24**	2×10^2
25	7×10^6	**26**	3×10^5	**27**	4×10^6	**28**	9×10^7
29	8×10^2	**30**	9×10^3				

EXERCISE 75*

1	4	**2**	1250	**3**	8	**4**	80
5	600 cm²	**6**	10 cm	**7**	100 cm²	**8**	68 cm²
9	1.2×10^9	**10**	2.4×10^3	**11**	2×10^3	**12**	5×10^{-3}
13	7.06×10^8	**14**	2.73×10^{-3}	**15**	50 000	**16**	2000
17	0.2	**18**	0.005	**19**	0.06	**20**	8000
21	\$6 000 000	**22**	10 000	**23**	2×10^6	**24**	2×10^2
25	3×10^{-1}	**26**	2×10^{-6}	**27**	2×10^7	**28**	7×10^5
29	1×10^{-3}	**30**	2×10^1				

REVISION EXERCISE 76

1	1.15	**2**	0.95	**3**	\$150	**4**	\$1200
5	4	**6**	600 cm²	**7**	5×10^{10}	**8**	2×10^4
9	4×10^5	**10**	9×10^2	**11**	33.5 and 34.4		
12	Max = 84 ml; min = 75 ml			**13**	Max = 17.24; min = 17.15		
14	Max = 18 906.25 m²; min = 17 556.25 m²						

REVISION EXERCISE 76*

1	406 kg	**2**	497.5 km	**3**	\$1125	**4**	\$800
5	95.3%	**6**	\$8200	**7**	$33\frac{1}{3}$	**8**	343 cm²
9	5×10^3	**10**	4×10^{-7}	**11**	2×10^{-2}	**12**	3×10^{-6}
13	3.3 ± 0.05	**14**	**a** 6.834	**b** 6.825			
15	Max radius = 3.8 cm, min circumference = 24 cm						
16	**a** 10.4 m			**b** 9.65 m			

ALGEBRA 4

EXERCISE 77

1	$a-2$	**2**	$b-4$	**3**	$5+p$	**4**	$3+a$
5	$c-a$	**6**	$p+q$	**7**	$\frac{b}{5}$	**8**	$\frac{q}{7}$
9	$\frac{(b-a)}{3}$	**10**	$\frac{(q+p)}{4}$	**11**	$\frac{(t-s)}{2}$	**12**	$\frac{(d-f)}{3}$
13	$\frac{(4-b)}{a}$	**14**	$\frac{(3+q)}{p}$	**15**	$\frac{(f+g)}{e}$	**16**	$\frac{(a-c)}{b}$
17	$\frac{c}{(a+b)}$	**18**	$\frac{q}{(r-s)}$	**19**	$\frac{(d-8b)}{c}$	**20**	$\frac{(5q-s)}{r}$
21	$\frac{(a-3b)}{3}$	**22**	$\frac{(d-2f)}{2}$	**23**	$\frac{(c-ab)}{a}$	**24**	$\frac{(f+hk)}{h}$
25	ab	**26**	qr	**27**	$\frac{qr}{p}$	**28**	$\frac{cd}{b}$
29	$r(p+q)$	**30**	$a(c-b)$	**31**	$cd+b$	**32**	$qr-p$

EXERCISE 77*

1	$x=\frac{c-b}{a}$	**2**	$x=\frac{d+\pi}{a}$	**3**	$x=cd+b$	**4**	$x=Qa-b$
5	$x=\frac{cd}{b}$	**6**	$x=\frac{Pd}{b}$	**7**	$x=\frac{e}{a}-c$	**8**	$x=\frac{f}{e}+s$
9	$x=\frac{P-b^2}{\pi}$	**10**	$x=a(e+b^2)$	**11**	$x=\frac{Td^2}{b}$	**12**	$x=ac+b^2$
13	$x=\pi-b$	**14**	$x=Q-TP$	**15**	$x=\frac{ab-c}{d}$	**16**	$x=\frac{b}{d}-P$

17 $\frac{a}{b}$ **18** $\frac{s}{t}$ **19** $\frac{(a+b)}{c}$ **20** $\frac{(p-q)}{r}$

21 $\frac{s}{(p-q)}$ **22** $\frac{v}{(t-s)}$ **23** $r=\frac{A}{2\pi}$ **24** $h=\frac{V}{\pi r^2}$

25 $h=\frac{3V}{\pi r^2}$ **26** $h=\frac{v^2}{2g}$ **27** $x=\frac{(y-c)}{m}$ **28** $t=\frac{(v-u)}{a}$

29 $s=\frac{(v^2-u^2)}{2a}$ **30** $y=\frac{(d-a^2x)}{b^2}$ **31** $a=2m-b$ **32** $h=\frac{A-\pi 2r^2}{2\pi r}$

33 $a=\frac{S(1-r)}{(1-r^n)}$ **34** $a=\frac{2(s-ut)}{t^2}$ **35** $a=\frac{S}{n}-\frac{(n-1)d}{2}$

EXERCISE 78

1 $x=\sqrt{\frac{b}{a}}$ **2** $x=\sqrt{\frac{c}{b}}$ **3** $x=\sqrt{ab}$

4 $x=\sqrt{wy}$ **5** $x=\sqrt{2D-C}$ **6** $x=\sqrt{3C+B}$

7 $x=\sqrt{a(c-b)}$ **8** $x=\sqrt{y(a+z)}$ **9** $x=\sqrt{\frac{c-2b}{a}}$

10 $x=\sqrt{\frac{r+q}{p}}$ **11** $x=\frac{t}{a+d}$ **12** $x=\frac{D}{b-c}$

13 $x=\frac{ab}{a-1}$ **14** $x=\frac{pq}{p-1}$ **15** $x=\frac{2b-a}{a-b}$

16 $x=\frac{bc+de}{c+d}$ **17** $r=\sqrt{\frac{A}{4\pi}}$ **18** $c=\sqrt{\frac{E}{m}}$

19 $v=\sqrt{ar}$ **20** $x=\sqrt{\frac{2El}{\lambda}}$ **21** $r=\sqrt[3]{\frac{3V}{4\pi}}$

22 $d=\sqrt[3]{\frac{3\pi F}{k}}$ **23** $l=\left(\frac{T}{2\pi}\right)^2$ **24** $x=\left(\frac{F}{4\pi}\right)^2$

EXERCISE 78*

1 $x=\sqrt{\frac{S}{R}}$ **2** $x=\sqrt{\frac{b}{c}}$ **3** $x=\sqrt{\frac{g-a}{c}}$

4 $x=\sqrt{a(b-c)}$ **5** $x=\frac{c}{b-a}$ **6** $x=\frac{q}{t-p}$

7 $x=\frac{c-f}{e+d}$ **8** $x=\frac{cd+ab}{a+c}$ **9** $x=\frac{\tan b+ac}{1-a}$

10 $x=\frac{\cos b}{c-a}$ **11** $x=t(p^2-s)$ **12** $x=(PR)^2-Q$

13 $x=\sqrt{Ab-Da}$ **14** $x=\sqrt{a(z-y)}$ **15** $x=\sqrt{\frac{3V}{\pi h}}$

16 $v=\sqrt{\frac{2E}{m}}$ **17** $v=\sqrt{2gh}$ **18** $r=\sqrt{\frac{GmM}{F}}$

19 $x=\sqrt{\frac{1}{y}-a^2}$ **20** $x=\sqrt{a^2\left(1-\frac{y^2}{b^2}\right)}$ **21** $a=b-\sqrt{12s}$

22 $d=\sqrt[3]{\frac{k}{F}}$ **23** $Q=\frac{1}{p}\left(\frac{S}{r}\right)^2$ **24** $l=g\left(\frac{T}{2\pi}\right)^2$

25 $d=\left(\frac{k}{F}\right)^3$ **26** $x=\left(\frac{q-1}{D}\right)^3+1$ **27** $x=\sqrt{\left(1-\frac{1}{y^2}\right)}$

28 $c=\frac{b^2-(2ax+b)^2}{4a}$ **29** $x=\frac{p(y+1)}{y-1}$ **30** $t=\frac{m-1}{a(m+1)}$

ACTIVITY 19

63.4 seconds; 0.25 m, 25 m, 895 m, 3.2×10^6 m, 1.9×10^9 m

ACTIVITY 20

Circumference of base = $2\pi r$ so curved surface area = $2\pi rh$

EXERCISE 79

1 **a** 155 min **b** 2 kg **2** **a** \$500 **b** 1750

3 **a** 18 **b** 10 **4** **a** 80 **b** 8 **c** 3

5 **a** 0.15 **b** 4.5×10^6 **6** **a** 0.72 **b** 15

7 **a** 2350 **b** 25 750 **8** **a** \$14.52 **b** 25.8 cm

9 $A=\frac{\pi r^2}{4}$, $P=r\left(2+\frac{\pi}{2}\right)$

a $A=19.6$ cm^2, $P=17.9$ cm **b** 11.28 **c** 14.0 **d** 4.55

10 $A=\frac{\pi r^2}{2}$, $P=r(2+\pi)$

a $A=157$ cm^2, $P=51.4$ cm **b** 5.64 cm **c** 14.6 **d** 3.27

EXERCISE 79*

1 **a** 22 **b** 400 **2** **a** 339 **b** 4

3 **a** 354 **b** 3.16 **4** **a** 53.75 m **b** 80 km/h

5 **a** 209 **b** 3 **c** 8

6 **a** 16 km **b** 195 m

7 **a** 27.3 **b** 12 **c** 6.63

8 **a** 6.67 **b** 20

9 $A=r^2\left(1+\frac{\pi}{4}\right)$, $P=r\left(4+\frac{\pi}{2}\right)$ **a** $A=28.6$ cm^2, $P=22.3$ cm

b 4.10 **c** 12.6 **d** 3.12

10 $A=r^2(1+\pi)$, $P=2r(2+\pi)$ **a** $A=265$ cm^2, $P=82.3$ cm

b 4.91 **c** 3.89 **d** 2.48

REVISION EXERCISE 80

1 $x=\frac{b}{a}$ **2** $x=ac$ **3** $x=\frac{a-c}{b}$ **4** $y=\sqrt{\frac{d}{b}}$

5 $y=\frac{b^2}{a}$ **6** $y=\frac{d}{a-c}$ **7** $y=\frac{bc}{c-1}$

8 **a** 35 km **b** 200 m **c** 23 km

9 **a** 26 **b** 100 **c** \$1800

10 **a** $A=\frac{\pi r^2}{2}$, $P=r(2+\pi)$

b $A=39.3$, $P=25.7$

c 3.57 **d** 11.7 **e** 3.27

REVISION EXERCISE 80*

1 $x=\frac{c-b}{a}$ **2** $x=\frac{b}{a-d}$ **3** $x=\frac{ab-\tan c}{a}$

4 $y=\sqrt{\frac{a}{b-c}}$ **5** $y=\frac{ac-d}{a-b}$ **6** $y=b-d(c-a)^2$

7 **a** $\frac{2}{3}$ **b** 3 s **c** 2.45 m

8 **a** $A=\frac{r^2}{2}(1+\pi)$

$P=r(2+\sqrt{2}+\pi)$

b $A=18.6$, $P=19.7$ **c** 2.41 **d** 5.19 **e** 3.16

9 3 : 1

10 **a** 0.75 **b** $\frac{m_1-t}{m_1t+1}$ **c** 1

GRAPHS 4

ACTIVITY 21

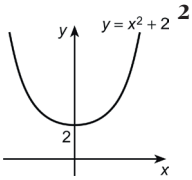
Distance travelled by a falling stone *vs* time ...

Speed of cyclist *vs* time ...

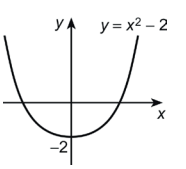
Sunshine intensity *vs* time in a day ... numerous other examples.

EXERCISE 81

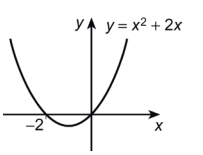
1

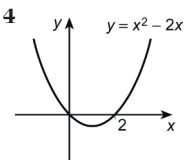


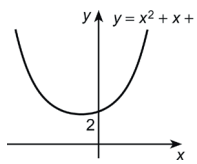
2

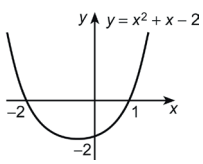


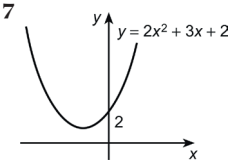
3

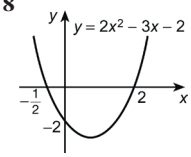


4 

5 

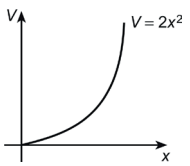
6 

7 

8 

9 b

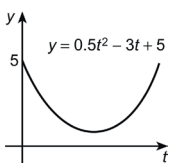
x	0	0.4	0.8	1.2	1.6	2.0
V	0	0.32	1.28	2.88	5.12	8



c 1.41 m × 1.41 m **d** 0.72 m³ **e** $1.23 \leqslant x \leqslant 1.8$

10 a

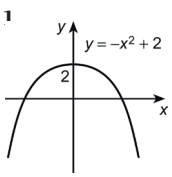
t	0	1	2	3	4	5	6
y	5	2.5	1	0.5	1	2.5	5

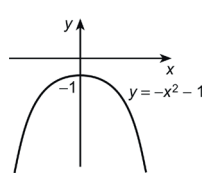


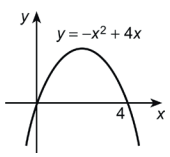
b 5 m **c** 0.5 m, 3 s **d** 0 m

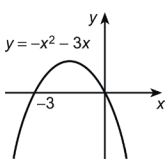
e $0 \leqslant t \leqslant 0.76$, $5.24 \leqslant t \leqslant 6$

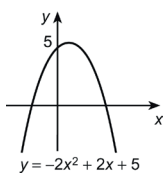
EXERCISE 81*

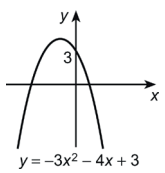
1 

2 

3 

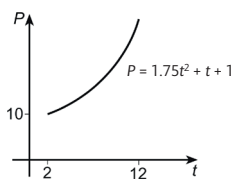
4 

5 

6 

7 a $k = 1.75 \rightarrow P = 1.75t^2 + t + 1$

t	2	4	6	8	10	12
P	10	33	70	121	186	265

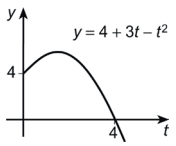
b 

c Accurate answer is 49 750 000. Only approximate answers will be available from the graph.

d 7.2 days approx.

8 a

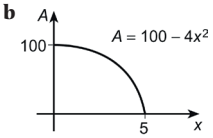
t	0	1	1.5	2	3	4
y	4	6	6.25	6	4	0



b 4 m **c** 4 p.m. **d** 6.25 m, 1.30 p.m.

e Between 12.23 p.m. and 2.37 p.m.

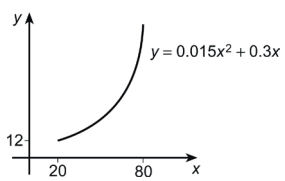
9 a $A = (10 - 2x)^2 + 4x(10 - 2x) = 100 - 4x^2$

b 

c $2.5 \leqslant x \leqslant 3.5$

10 a

x	20	30	40	50	60	70	80
y	12	22.5	36	52.5	72	94.5	120



b 61.9 m **c** 48.6 mph **d** 0.7 s

INVESTIGATE

$r = 46.6$ m when $H = 100$ m

1708 m²; 6831 m²

Try to steer the pupils to producing a general formula for various angles:

$A = \pi(\tan x)^2 \times H^2$ and draw a family of curves for $x = 20°, 30°, 40° \ldots 90°$

EXERCISE 82

1 $x = 3$ or $x = 2$ **2** $x = 1$ or $x = 5$ **3** $x = 1$ or $x = 3$

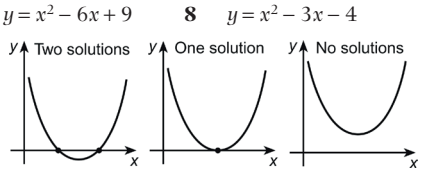
4 $x = 2$ or $x = 5$ **5** $x = 0$ or $x = 3$ **6** $x = 0$ or $x = 5$

EXERCISE 82*

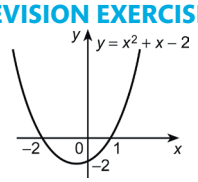
1 $x = \frac{1}{2}$ or $x = 2$ **2** $x = 1$ or $x = 2\frac{1}{2}$ **3** $x = \frac{2}{3}$ or $x = 2$

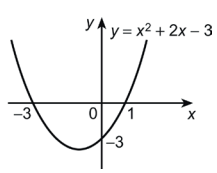
4 $x = \frac{1}{2}$ or $x = \frac{1}{2}$ **5** $y = x^2 - 6x + 5$ **6** $y = x^2 - 7x + 10$

7 $y = x^2 - 6x + 9$ **8** $y = x^2 - 3x - 4$

9 

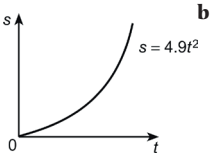
REVISION EXERCISE 83

1 

2 

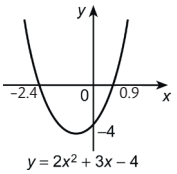
3 $x \approx 0.6$ or 3.4 **4** $x \approx -1.4$ or 3.4

5 a 4.9 cm² **b** 4.5 cm **c** 12.96 cm

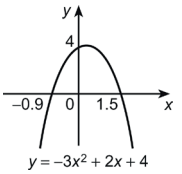
6 **a** 

b 30.6 m **c** 3.2 s

REVISION EXERCISE 83*

1 

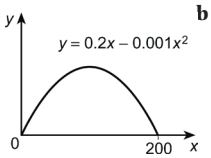
$y = 2x^2 + 3x - 4$

2 

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

3 $x \approx -2.6$ or 1.1 **4** $x \approx -2.6$ or 1.1

5 **b** 28.3 m

6 **a** 

b 10 m **c** $29 \leqslant x \leqslant 170$

SHAPE AND SPACE 4

ACTIVITY 22

	BAO	ABO	AOB	BOC	OCB + OBC	OBC	ABC
C_1	20°	20°	140°	40°	140°	70°	90°
C_2	30°	30°	120°	60°	120°	60°	90°
C_3	x	x	$180° - 2x$	$2x$	$180° - 2x$	$90° - x$	90°

EXERCISE 84

1 $a = 230°, b = 25°$ **2** $a = 248°, b = 34°$ **3** $a = 280°, b = 50°$
4 $a = 292°, b = 56°$ **5** $a = 100°, b = 260°$ **6** $a = 84°, b = 276°$
7 $a = 40°, b = 320°$ **8** $a = 72°, b = 288°$ **9** $a = 110°, b = 35°$
10 $a = 128°, b = 26°$ **11** $a = 60°, b = 60°$ **12** $a = 82°, b = 49°$
13 $a = 108°, b = 72°, c = 54°$ **14** $a = 48°, b = 132°, c = 24°$
15 $a = 62°, b = 62°, c = 28°$ **16** $a = 29°, b = 29°, c = 61°$
17 $a = 55°$ **18** $a = 24°$
19 $a = 45°$ **20** $a = 30°$
21 $a = 90°, b = 32°, c = 58°$ **22** $a = 90°, b = 132°, c = 66°$
23 $a = 50°$ **24** $a = 78°$
25 **a** 90° **b** 32° **c** 132° **d** 80°
26 **a** 90° **b** 54° **c** 126°
Isosceles trapezium; kites are all similar shapes

EXERCISE 84*

1 **a** 37° **b** 53°
c $\angle OBC = \angle OCB$; $\angle ABO = 90° - \angle OBC$
2 **a** 54° **b** 108° **c** 36°
d $\angle DEO = \angle ODE$; $\angle DOF = 180° - \angle DOE$; $\angle DFO = \dfrac{(180° - \angle DOF)}{2}$
3 **a** x **b** $2x$
c $\angle OGF = \angle OFG$; $\angle GOH = 180° - (180° - 2x)$
4 **a** $\angle PMO = y$; $\angle POM = 180° - 2y$; $\angle ROQ = 180° - 2y$; $\angle ORQ = y$
b $\angle PMO = \angle OPM$; $\angle POM = \angle ROQ$
5 **a** 22.5° **b** 45°
6 $\angle APB = 90°$; $\angle TPB = 90°$; $\angle TBP = 90° - x$
7 **a** $\angle OUT = x$; $\angle TOU = 180° - 2x$; $\angle TUV = 90° - x$
b $\angle OUT = \angle OTU$; $\angle OUV = 90°$
8 **a** $\angle XZW = 90° - y$; $\angle XZY = y$; $\angle WXY = 90°$
b $\angle XZW = 180° - 90° - y$; $\angle XZY = 90 - (90 - y)$;
$\angle COB = 180° - \angle AOB = 180° - 2x$
9 $\angle OBA = 90° - x$; $\angle AOB = 2x$, BD tangent at 90° to OB,
$\angle AOB = 180° - 2(90° - x)$
10 $\angle OFG = x$; $\angle EFO = 180° - x$; $\angle EOF = \dfrac{180° - x}{2}$; $\angle GOF = 180° - 2x$
11 **a** $AM = \sqrt{r^2 - x^2}$ **b** $BM = \sqrt{r^2 - x^2}$
12 **a** 5 cm **b** 24 cm^2 **c** 4.8 cm
13 **a** 12 cm **b** 54 cm^2 **c** 7.2 cm
14 **a** 4 cm **b** 27 cm^2
15 **a** 9 cm **b** 108 cm^2

ACTIVITY 23

	∠ORP	∠ORQ	∠RPO	∠POS
C_1	25°	30°	25°	50°
C_2	80°	25°	80°	160°
C_3	x	y	x	$2x$

	∠RQO	∠QOS	∠PRQ	∠POQ
C_1	30°	60°	55°	110°
C_2	25°	50°	105°	210°
C_3	y	$2y$	$x + y$	$2x + 2y$

EXERCISE 85

1 $a = 124°$ **2** $a = 98°$ **3** $a = 56°$
4 $a = 62.5°$ **5** $a = 102°$ **6** $a = 146°$
7 $a = 78°$ **8** $a = 37°$ **9** $a = 56°$
10 $a = 114°$ **11** $a = 36°, b = 36°$ **12** $a = 71°, b = 71°$
13 $a = 50°, b = 130°$ **14** $a = 65°, b = 65°$ **15** $a = 67°, b = 113°$
16 $a = 120°, b = 60°$ **17** $a = 100°, b = 160°$ **18** $a = 69°, b = 138°$
19 $a = 40°, b = 140°$ **20** $a = 100°, b = 80°$ **21** $a = 67°, b = 85°$
22 $a = 64°, b = 28°$ **23** $a = 105°$ **24** $a = 144°$

EXERCISE 85*

1 $\angle AOB = 180° - 48° - 48° = 84°$ (angles in a triangle),
$\angle BOC = 180° - 84° = 96°$ (angles on a straight line), $x = 96°$
2 $\angle ODE = \dfrac{180° - 70°}{2} = 55°$ (angles in an isosceles triangle),
$x = 90° - 55° = 35°$ (angles in a semi circle)
3 $\angle HOI = 360° - 260° = 100°$ (angles around a point), $x = \dfrac{100°}{2} = 50°$ (subtended angle)
4 $32° \times 2 = 64°$ (subtended angle), $360° - 64° = 296°$ (angles around a point)
5 $x = 126°$
6 $x = 128°$
7 $100° \times 2 = 200°$ (subtended angle), $360° - 200° = 160°$ (angles around a point), $x = 160°$
8 $360° - 166° = 194°$ (angles around a point), $\dfrac{194°}{2} = 97°$ (subtended angle), $x = 97°$
9 $x = 116°, y = 64°$
10 $x = 58°, y = 122°$
11 $x = 27°$

12 $x = 35°$

13 $\angle ABC = 90°$; $\angle OCB = 180° - 90° - 30° = 60°$ (angles in a triangle); $\angle OBC = \angle OCB = 60°$ (angles formed from radius in a triangle); $\angle COB = 180° - 60° - 60° = 60°$ (angles in a triangle)

14 $\angle OGF = 120°$ (vertically opposite angles); $\angle OFG = 20°$. Therefore DE and FO are parallel

15 $\angle VUW = 110°$ (opposite angles in cyclic quadrilateral); $\angle UVW = 180° - 35° - 110° = 35°$ (angles in a triangle)

16 $\angle POQ = 36°$ (z angles); $\angle PRQ = \frac{36^\circ}{2} = 18°$ (subtended angles); $x = 180° - 36° - 18° = 126°$ (angles in a triangle)

ACTIVITY 24

$\frac{AC}{DF} = 0.75$, $\frac{AB}{DE} = 0.75$, $\frac{BC}{EF} = 0.75$, $\frac{AB}{GH} = 0.67$, $\frac{AC}{GI} = 0.5$, $\frac{EF}{HI} = 0.69$

ACTIVITY 25

XRY = BRA (angle of incidence = angle of reflection)
XYR = BAR (90°) $\therefore$ RXY $\approx$ ABR
$\therefore$ $\triangle$s ABR and YXR are similar. $\frac{AB}{XY} = \frac{AR}{YR} = \frac{BR}{XR}$

EXERCISE 86

1 T_1, T_2 **2** T_1, T_3 **3** T_2, T_3 **4** T_1, T_3
5 T_1, T_3 **6** T_1, T_3 **7** T_1, T_2 **8** $x = 6$
9 $y = 22.5$ **10** $x = 5, y = 8$ **11** $v = 15, w = 26$
12 **a** 3 cm **b** 14 cm
13 **a** 7.5 cm **b** 10.5 cm
14 12.5 m **15** 1.5 m

EXERCISE 86*

1 E(4, 2), F(4, 4) **2** S(1, 7), T(7, 7)
3 **a** (3, 5) **b** P(1, 4) **c** Q(5, 6)
4 **a** (8.5, 2) **b** P(4, 5) **c** Q(10, 1)
5 **a** FJH = GIH, HFG = HGI, GHI = FHJ so triangles GHI and FHJ are similar.
b 16 cm **c** 15 cm
6 **a** BAC = DAE, ABC = ADE, ACB = AED so triangles ABC and ADE are similar.
b 11.25 cm **c** 3.75 cm
7 **a** 5.7 cm **b** $\frac{AC}{EF} = \frac{BC}{FG}$; 6.32 cm
8 **a** 5.4 cm **b** $\frac{XY}{RT} = \frac{XZ}{RS}$; 3.75 cm
9 PQS, RPS, RPQ
a PS = $\frac{20}{3}$, RS = $\frac{16}{3}$ **b** $\frac{50}{3}$
10 CD = $\frac{25}{3}$, BC = $\frac{8}{3}$
11 18 m **12** 15 m **13** 55 cubits
14 91.875 cubits **15** 2.5 m **16** 790 m
17 239 000 cm^3 **18** 135°

ACTIVITY 26

$(a + b)^2 = c^2 + 4(0.5ab)$
$a^2 + b^2 + 2ab = c^2 + 2ab$
$a^2 + b^2 = c^2$

EXERCISE 87

1 10.3 cm **2** 8.06 cm **3** 8.94 cm **4** 13.0 cm
5 11.8 m **6** 15.3 m **7** 70.7 m
8 29.2 km **9** 3.16 m **10** 10.4 m
11 **a** $\sqrt{y^2 - r^2}$ **b** $\sqrt{y^2 - r^2}$

EXERCISE 87*

1 12.4 cm **2** 4.90 cm **3** 8.77 m **4** 11.0 m
5 13.9 **6** 200 cm^2 **7** 17 : 28 : 12 **8** 11.6 cm
9 27.5 m **10** 3.92 m
11 **a** 48 m **b** 24 m

REVISION EXERCISE 88

1 $a = 52°$, $b = 128°$, $c = 76°$
2 $a = 73°$, $b = 73°$
$c = 17°$, $d = 17°$
3 $a = 80°$, $b = 50°$, $c = 130°$ **4** $a = 65°$, $b = 65°$, $c = 50°$, $d = 25°$
5 $a = 18°$ **6** $a = 105°$, $b = 75°$
7 PQ = 3.6 cm; AC = 6 cm
8 **a** 13.0 cm **b** 11.2 cm
9 44.7 cm
10 **a** 2.5 m **b** 6.5 m^2

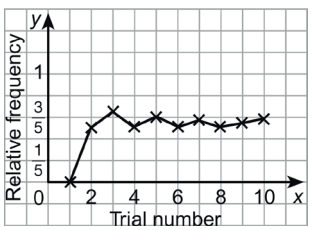
REVISION EXERCISE 88*

1 $a = 40°$, $b = 100°$, $c = 40°$, $d = 260°$
2 $x = 150°$
3 **a** 13 cm **b** 120 cm^2
4 $a = 32°$, $b = 64°$, $c = 26°$, $d = 58°$
5 **a** $\angle ACB = \angle DCE$ (vertically opposite angles); $\angle CAB = \angle CED$; $\angle CBA = \angle CDE$ (z angles)
b DE = 6 cm **c** AE = 10.4 cm
6 3.875 ft or 3 ft 10.5 in. **7** 2 m **8** 4.28 cm

HANDLING DATA 4

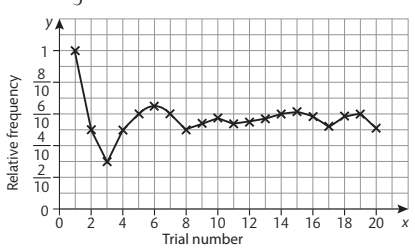
EXERCISE 89

1 **a**



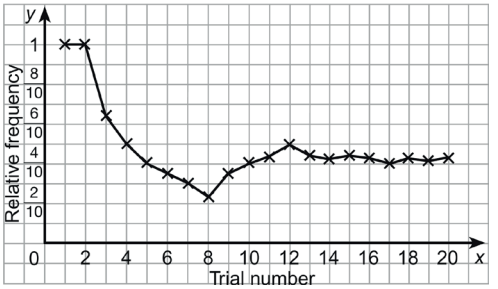
b p(biased) = $\frac{3}{5}$
Heidi's suspicion seems to be true. More trials would improve the experiment.

2 **a** p(a) = $\frac{3}{5}$



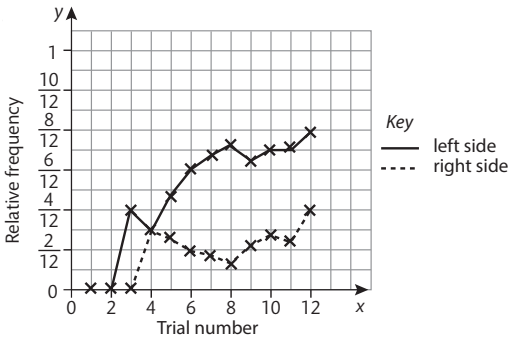
b More likely than not to rain in first 20 days of April.

3 p(vowel) = $\frac{9}{20}$



EXERCISE 89*

1



p(L) = $\frac{2}{3}$ p(R) = $\frac{1}{3}$

b Learning curve, so warm up before playing.
Practise more from RHS.

2 Work in pairs. p(A) $\rightarrow \frac{2}{\pi}$ as the number of trials increases.

3 **a** p(W) = $\frac{12}{20} = \frac{3}{5}$; p($P$) = $\frac{8}{20} = \frac{2}{5}$

b No. of W = $\frac{3}{5} \times 100 = 60 \rightarrow$ No. of P = 40

INVESTIGATE

$A = \frac{1}{2}$, $B = \frac{1}{4}$, $C = \frac{3}{4}$, D = almost zero, E = almost 1

EXERCISE 90

1 **a** p(g) = $\frac{4}{10} = \frac{2}{5}$ **b** p(a) = $\frac{3}{10}$ **c** p(t) = 0

d p($\bar{S}$) = $\frac{9}{10}$

2 **a** p(O) = $\frac{4}{14} = \frac{2}{7}$ **b** p(T) = $\frac{1}{14}$ **c** p(vowel) = $\frac{6}{14} = \frac{3}{7}$

d p(N or non-vowel) = $\frac{8}{14} = \frac{4}{7}$

3 **a** p(R) = $\frac{1}{2}$ **b** p(K) = $\frac{1}{13}$ **c** p(mult of 3) = $\frac{3}{13}$

d p(AJQK) = $\frac{4}{13}$

4 **a** $\frac{3}{10}$ **b** $\frac{2}{5}$ **c** $\frac{3}{10}$ **d** $\frac{9}{10}$

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

6 **a** $\frac{3}{50}$ **b** $\frac{43}{50}$ **c** $\frac{2}{25}$ **d** $\frac{19}{20}$

EXERCISE 90*

1 **a**

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

(i) $\frac{5}{36}$ **(ii)** $\frac{1}{12}$ **(iii)** $\frac{1}{12}$ **(iv)** $\frac{15}{36}$

b 7

2 **a**

		Red			
		2	**3**	**5**	**7**
Green	**11**	9	8	6	4
	13	11	10	8	6
	17	15	14	12	10
	19	17	16	14	12

(i) $\frac{1}{8}$ **(ii)** $\frac{5}{16}$ **(iii)** $\frac{7}{16}$ **(iv)** $\frac{3}{16}$

b 4, 9, 11, 15, 16, 17; all with probability $\frac{1}{16}$

3

		1st spin				
		1	**2**	**3**	**4**	**5**
2nd spin	**1**	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

a $\frac{9}{25}$ **b** $\frac{14}{25}$ **c** $\frac{6}{25}$ **d** $\frac{9}{25}$

4 **a** $\frac{10}{110} = \frac{1}{11}$ **b** $\frac{113}{130}$ **c** 850

5

		Die					
		1	**2**	**3**	**4**	**5**	**6**
Spinner	**2**	2	2	3	4	5	6
	4	4	4	4	4	5	6
	6	6	6	6	6	6	6

a $\frac{1}{2}$ **b** $\frac{3}{18} = \frac{1}{6}$ **c** $\frac{13}{18}$ **d** $\frac{5}{18}$

6 **a** $\frac{1}{5}$ **b** $\frac{1}{5}$ **c** $\frac{2}{15}$ **d** $\frac{1}{15}$

7 $f = 5$

8 **a** $\frac{\pi}{3\sqrt{3}}$ **b** Approx. 40 darts.

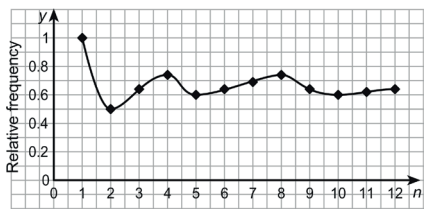
INVESTIGATE

Safest first (ratio of deaths per 5-year period per 1 million adults): golf (0.009), tennis (0.022), running (0.045), badminton (0.051), gymnastics (0.071), cricket (0.1), football (0.109), rugby (0.167), hockey (0.222),

swimming/diving (0.516), fishing (1.351), horse riding (1.59), boating/sailing (3), motor sports (5.909), mountaineering (8.5), air sports (51)

REVISION EXERCISE 91

1 $\frac{2}{3}$; More trials for a better estimate



2 $\frac{13}{15}$

3 **a** $\frac{7}{51}$ **b** $\frac{1}{17}$ **c** $\frac{1}{3}$ **d** 0

4 HH, HT, TH, TT **a** $\frac{1}{4}$ **b** $\frac{1}{2}$

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

6 $\frac{10}{494} = \frac{5}{247}$

REVISION EXERCISE 91*

1 **a** 2002, $\frac{7}{10}$; 2003, $\frac{6}{10}$; 2004, $\frac{4}{10}$

b Decrease in numbers from 2002 is suggested by the data

2 **a** $\frac{1}{12}$ **b** $\frac{3}{4}$ **c** $\frac{11}{36}$

3 **a** **(i)** $\frac{1}{11}$ **(ii)** $\frac{2}{11}$ **(iii)** 0

b Z or *U*, $\frac{2}{11}$

4 **a** $\frac{6}{25}$ **b** $\frac{19}{25}$ **c** $\frac{3}{25}$ **d** $\frac{9}{25}$

5 £45

6 HHH, HHT, HTH, HTT, THH, THT, TTH, TTT

a $\frac{1}{8}$ **b** $\frac{3}{8}$ **c** $\frac{1}{2}$

EXAMINATION PRACTICE 4

1 **a** **(i)** 0.6 **(ii)** 1×10^5

b **(i)** 0.177 886 **(ii)** 17 788.6

2 **a** 42% **b** £316.25 **c** £280

3 **a** 9.5 m by 29.5 m **b** 280.25 m^2

4 **a** **(i)** $s = 600$, $u = 10$, $v = 90$ **(ii)** 12

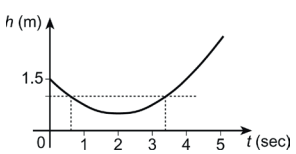
b 12.64 (2 d.p.), *s*, *u* and *v* have 2 d.p.

5 **a** $C = 15n + 4$ **b** $n = \frac{C-4}{15}$

6 39 000 feet

7 **a**

t	0	1	2	3	4	5
h	1.5	0.75	0.5	0.75	1.5	2.75



b 1.5 m **c** 0.5 m at 2 s **d** 0.6 s to 3.4 s

8 **a** 5500 litres **b** 10 apartments **c** $N = \frac{V-2500}{150}$

d 20 apartments

9 **a** £72.50 **b** 30 cm

10 **a** $p = 192°$, $q = 96°$ **b** $r = 72°$

11 **a** $a = 2$, $b = 4$

12 **(i)** $2x°$ **(ii)** $(180 - 6x)°$ **(iii)** $(90 - 3x)°$

13 **a** $\frac{5}{18}$ **b** $\frac{1}{12}$

14 **a** $\frac{1}{15}$ **b** $\frac{1}{3}$ **c** $\frac{2}{15}$ **d** $\frac{2}{15}$

15 **a** 150 cm **b** 24 cm **c** $-6\frac{2}{3}$

The last answer is not possible, as it is negative.

16 173 cm^2

17 10

18 1.414 m

Unit 5

NUMBER 5

ACTIVITY 27

Edible chicken (to 2 s.f.)

a Chicken breast 0.56 cents/g
b Boneless chicken breast 0.89 cents/g
c Whole chicken 0.48 cents/g
d Chicken leg 0.56 cents/g

The whole chicken is obviously the best buy, because it has not been prepared for cooking. However, it is not that much cheaper than the leg or the breast. The boneless breast is nearly twice as expensive as the other three cuts.

EXERCISE 92

1 X \$4.50/litre, Y \$4.20/litre. Y better value
2 P \$3.25/kg, Q \$3.30/kg. P better value
3 A \$6.50/m, B\$6.25/m. B better value
4 I ¢0.36/ml, II ¢0.32/ml. II better value
5 110 000 m, 3600 s; 30.6 m/s
6 6000 m, 3600 s; 1.67 m/s
7 2.74 litres/day **8** 43.5 miles, 160 000 mph (2 s.f.)
9 38.6 eggs/min **10** 2.22 **11** 28 cm
12 10 cm **13** 80 cm **14** 30 m **15** 1:100

ACTIVITY 28

Man: 0.22 m; greyhound: 4.1 m; bullet: 180 m; Earth: 90 m; thunderclap: 66 m; lightning: 6×10^7 m

EXERCISE 92*

1 Marble \$75/m^2, slate \$72/m^2, limestone \$72.22/m^2. Slate is cheapest.
2 1.5 m tree is \$30/m, 2 m is \$27.5/m, 3.5 m is \$31.43/m. The 2 m tree is best value.
3 0.694 mm/min
4 760 m/s
5 0.047 m^3/min
6 1520 g/s
7 9600 shilling
8 22.0 euros
9 Eurozone \$600, Malaysia \$590, UK \$580. UK cheapest.
10 550 real, 336 pounds, 16 072 rupees
11 **a** $1{:}2 \times 10^{10}$ **b** ≈ 500 000 km
12 ≈ 48 million years

ACTIVITY 29

Aluminium: 2.7 g/cm^3; brass: 8.5 g/cm^3; gold: 19 g/cm^3; platinum: 21 g/cm^3

Substance	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Aluminium	135	50	**2.7**
Brass	459	54	**8.5**
Platinum	**210**	10	21
Oak	46.2	55	**0.84**
Petrol	46.8	**65**	0.72
Air	1200	**10^6**	0.0012
Water	**any value**	**same value**	**1**
D	M	V	$\frac{M}{V}$

$D = \frac{M}{V}$

EXERCISE 93

1 156 g **2** 40 cm^3 **3** 208 g **4** 18 cm^3
5 84 joules **6** 6.84 kg **7** 1.5 m **8** 9 ohms

EXERCISE 93*

1 1900 cm^3 **2** 3.375 kg **3** 3.2 m **4** 3.5 g/cm^3
5 13 g/cm^3 **6** 120 kg **7** 2520 joules
8 cells at 156 cm; land animals at 492 cm; mammals at 513 cm; giant dinosaurs at 524 cm; man at 539.8 cm

EXERCISE 94

1 $\frac{1}{3}$ **2** $\frac{7}{9}$ **3** $\frac{621}{999} = \frac{23}{37}$ **4** $\frac{403}{999}$

5 Let $x = 0.\dot{8}\dot{1}$
so $100x = 81.\dot{8}\dot{1}$ now minus x
$99x = 81$
so $x = \frac{81}{99} = \frac{9}{11}$

6 Let $x = 0.\dot{1}\dot{5}$
so $100x = 15.\dot{1}\dot{5}$ now minus x
$99x = 15$
so $x = \frac{15}{99} = \frac{5}{33}$

EXERCISE 94*

1 $\frac{1}{90}$ **2** $\frac{53}{999}$ **3** $\frac{4321}{9999}$ **4** $\frac{9876}{9999}$

5 Let $x = 0.7\dot{3}$
so $10x = 7.\dot{3}$ now minus x
$9x = 6.6$ multiply by 10
$90x = 66$
so $x = \frac{66}{90} = \frac{11}{15}$

6 Let $x = 0.5\dot{8}$
so $10x = 5.\dot{8}$ now minus x
$9x = 5.3$ multiply by 10
$90x = 53$
so $x = \frac{53}{90}$

REVISION EXERCISE 95

1 Tin A 167 g/\$, tin B 176 g/\$. Tin B gives better value.
2 Shop X \$1 per day per DVD, shop Y \$1.20 per day per DVD. Shop X gives better value.
3 $\frac{56}{99}$ **4** $\frac{301}{999}$ **5** 25.6 km/h **6** 30 metres
7 7.22 m/s **8** 1.71 g/min **9** 79.8 grams **10** 44 ohms

REVISION EXERCISE 95*

1 \$775 **2** 60.8 **3** 2540 krone
4 \$30.9, 60.8 francs **5** $\frac{71}{90}$ **6** $\frac{52}{9000}$
7 1 kg; 1 tonne **8** 100 000 tonnes; 40 000 m^3
9 2730 m^3/s

ALGEBRA 5

ACTIVITY 30

$(x+5)(x+2) = x^2 + 7x + 10$
$(x+1)(x+1) = x^2 + 2x + 1$
$(x+2)^2 = x^2 + 4x + 4$
$(x-1)(x-6) = x^2 - 7x + 6$
$(x+2)(x-2) = x^2 - 4$
$(10+x)(x+7) = x^2 + 17x + 70$
$(x+2)^2 = x^2 + 2$ only when $x = 0$
$(x+4)(x-3) = x^2 + x - 12$
$(x-3)^2 = x^2 - 6x + 9$

EXERCISE 96

1	x^2+5x+4	**2**	$x^2+8x+12$	**3**	$x^2-4x-21$
4	x^2-x-20	**5**	$x^2-4x-12$	**6**	x^2+6x-7
7	$x^2-8x+15$	**8**	$x^2-10x+16$	**9**	x^2+6x+9
10	$x^2+10x+25$	**11**	$x^2-8x+16$	**12**	$x^2-14x+49$
13	x^2-25	**14**	x^2-16	**15**	$x^2-6x-16$
16	$3x^2-10x-8$	**17**	$15x^2-7x-2$	**18**	$12x^2+17x-5$
19	$x^3+2x^2-5x-10$	**20**	$x^3-4x^2+3x-12$		

EXERCISE 96*

1	$x^2+4x-21$	**2**	$x^2+7x-18$	**3**	x^2-9
4	x^2-36	**5**	$x^2+24x+144$	**6**	$x^2-18x+81$
7	$12x^2-25x+12$	**8**	$14x^2+41x+15$	**9**	$x^2+x(b-a)-ab$
10	x^2-a^2	**11**	$16x^2-40x+25$	**12**	$49x^2+56x+16$
13	$15x^3+21x^2+5x+7$	**14**	$20x^3-15x^2+8x-6$		
15	$8x+8=8(x+1)$	**16**	$-7x-22$	**17**	$\frac{a^2}{4}-\frac{ab}{5}+\frac{b^2}{25}$
18	$\frac{x^2}{16}+\frac{xy}{6}+\frac{y^2}{9}$	**19**	$10x^5+11x^4+3x^3$	**20**	$x^2-\frac{1}{x^2}$
21	4	**22**	$5x+2$	**23**	$x=-\frac{5}{3}$
24	$a=5$	**25**	$a=3, b=1$		

ACTIVITY 31

	x^2	$2x$	3
x	x^3	$2x^2$	$3x$
1	x^2	$2x$	3

So $(x^2+2x+3)(x+1)=x^3+3x^2+5x+3$

	x^2	$2x$	-3
x^2	x^4	$2x^3$	$-3x^2$
$-2x$	$-2x^3$	$-4x^2$	$6x$
3	$3x^2$	$6x$	-9

So $(x^2+2x-3)(x^2-2x+3)=x^4-4x^2+12x-9$

	x	y	3
x	x^2	xy	$3x$
$-2y$	$-2xy$	$-2y^2$	$-6y$

So $(x+y+3)(x-2y)=x^2-2y^2-xy+3x-6y$

EXERCISE 97

1	**a** x^2+3x+2	**b** $3x+2$	**c** $x=3$
2	**a** $\pi(x^2+8x+16)$	**b** $\pi(8x+16)$	**c** $x=2$
3	**a** $5x^2+25x+30$	**b** $2x^2+30x+62$	
4	**a** $7x^2+35x$	**b** $2x^2+66x+140$	
5	$x=6$		
6	**a** $(x+2)^2=(x+1)^2+49$		**b** $x=23$

EXERCISE 97*

1	**a** $\pi(x^2+12x+36)$	**b** $x=0.75$	
2	**a** $4x^2+37x+40$	**b** $x=1.5$	
3	$x=6$	**4** $x=2$	
5	**a** $2n$ is divisible by 2 and so is even; $2n+1$ is then odd.		
	b $(2n+1)(2m+1)=4mn+2n+2m+1$; $4mn$, $2n$ and $2m$ are even so this is odd.		
	c $(2n-1)(2n+1)+1=4n^2=(2n)^2$		
6	**a** $10-x$	**b** $5-x$	**c** $x=3.9$

INVESTIGATE

Order of brackets is not important because $ab=ba$.

$-3\times+3=-9$; this is always the connection.

x^2+9 cannot be factorised.

EXERCISE 98

1	$x(x-3)$	**2**	$x(x-1)$	**3**	$x(x+2)$
4	$x(x+4)$	**5**	$x(x-31)$	**6**	$x(x-17)$
7	$x(x+42)$	**8**	$x(x+38)$	**9**	$(x-4)(x+4)$
10	$(x-5)(x+5)$	**11**	$(x-7)(x+7)$	**12**	$(x-9)(x+9)$

EXERCISE 98*

1	$x(x-312)$	**2**	$x(x-273)$	**3**	$x(x+51)$
4	$x(x+74)$	**5**	$(x-8)(x+8)$	**6**	$(x-10)(x+10)$
7	$(x-11)(x+11)$	**8**	$(x-14)(x+14)$	**9**	$(x+15)(x-15)$
10	$(x+25)(x-25)$	**11**	$4(x+2)(x-2)$	**12**	$(5x+6)(5x-6)$

EXERCISE 99

1	$a=1$	**2**	$a=2$	**3**	$a=4$	**4**	$a=2$
5	$a=-1$	**6**	$a=-3$	**7**	$a=-2$	**8**	$a=-3$
9	$a=2$	**10**	$a=1$	**11**	$a=-1$	**12**	$a=2$

EXERCISE 99*

1	$a=3$	**2**	$a=3$	**3**	$a=4$
4	$a=-3$	**5**	$a=-7$	**6**	$a=-2$
7	$a=-3$	**8**	$a=6$	**9**	$a=-8$
10	$a=9$	**11**	$a=\frac{1}{2}$	**12**	$a=-\frac{1}{3}$

EXERCISE 100

1	$(x-2)(x-1)$	**2**	$(x+2)(x+2)$	**3**	$(x-1)(x-3)$
4	$(x-1)(x-4)$	**5**	$(x-4)(x-3)$	**6**	$(x+5)(x+2)$
7	$(x+4)(x+4)$	**8**	$(x+3)(x+3)$	**9**	$(x-1)(x-8)$
10	$(x-2)(x-5)$	**11**	$(x-1)(x-1)$	**12**	$(x-2)(x-2)$

EXERCISE 100*

1	$(x+7)(x+3)$	**2**	$(x+6)(x+3)$	**3**	$(x-2)(x-6)$
4	$(x-5)(x-6)$	**5**	$(x-8)(x-8)$	**6**	$(x-7)(x-7)$
7	$(x-6)(x-12)$	**8**	$(x-8)(x-11)$	**9**	$(x+9)(x+5)$
10	$(x+8)(x+12)$	**11**	$(x+12)(x+12)$	**12**	$(x+15)(x+15)$

EXERCISE 101

1	$(x+3)(x-2)$	**2**	$(x+4)(x-2)$	**3**	$(x+2)(x-5)$
4	$(x+1)(x-5)$	**5**	$(x+2)(x-6)$	**6**	$(x+2)(x-4)$
7	$(x+1)(x-10)$	**8**	$(x+2)(x-9)$	**9**	$(x+7)(x-2)$
10	$(x+5)(x-3)$	**11**	$(x+8)(x-1)$	**12**	$(x+5)(x-2)$

EXERCISE 101*

1	$(x+6)(x-5)$	**2**	$(x+9)(x-3)$	**3**	$(x+4)(x-6)$
4	$(x+4)(x-7)$	**5**	$(x+12)(x-5)$	**6**	$(x+10)(x-9)$
7	$(x+5)(x-14)$	**8**	$(x+5)(x-10)$	**9**	$(x+8)(x-15)$
10	$(x+4)(x-16)$	**11**	$(x-5)(x+15)$	**12**	$(x-6)(x+12)$

EXERCISE 102

1	$(x-1)(x-2)$	**2**	$(x+2)(x-3)$	**3**	$(x+3)(x-1)$
4	$(x+4)(x-3)$	**5**	$(x+1)(x+12)$	**6**	$(x+2)(x+1)$
7	$(x-2)(x-6)$	**8**	$(x-1)(x-5)$	**9**	$(x-4)(x-4)$
10	$(x-3)(x-3)$	**11**	$(x-4)(x+5)$	**12**	$(x-5)(x+2)$

EXERCISE 102*

1	$(x+10)(x-2)$	**2**	$(x+8)(x-2)$	**3**	$(x+2)(x-9)$
4	$(x+5)(x-7)$	**5**	$(x+9)(x+4)$	**6**	$(x+8)(x+5)$
7	$(x-4)(x-8)$	**8**	$(x+6)(x-8)$	**9**	$(x+12)(x-4)$
10	$(x-2)(x-24)$	**11**	$(3-x)(x+1)$	**12**	$(4+x)(2-x)$

INVESTIGATE

a and b (integers) are factors of 12: (12, 1), (6, 2), (4, 3), (3, 4), (2, 6), (1, 12), (–12, –1), (–6, –2), (–4, –3), (–3, – 4), (–2, –6) or (–1, –12).

EXERCISE 103

1 $x = -1$ or $x = -2$ **2** $x = -2$ or $x = -3$ **3** $x = -4$ or $x = 1$
4 $x = -5$ or $x = 4$ **5** $x = 7$ or $x = 2$ **6** $x = 5$ or $x = 3$
7 $x = -8$ **8** $x = 9$ **9** $x = 0$ or $x = 10$
10 $x = 0$ or $x = -7$

EXERCISE 103*

1 $x = -8$ or $x = 4$ **2** $x = -12$ or $x = 3$ **3** $x = -21$ or $x = 5$
4 $x = -6$ or $x = 9$ **5** $x = 0$ or $x = 8$ **6** $x = 0$ or $x = -10$
7 $x = -\frac{3}{2}$ or $x = \frac{3}{4}$ **8** $x = \frac{2}{3}$ or $x = -\frac{1}{5}$
9 $x = -1$ or $x = 1$ or $x = -\frac{5}{2}$ **10** $x = a$ or $x = b$ or $x = c$

EXERCISE 104

1 $x = 1$ or $x = 2$ **2** $x = 2$ or $x = 3$ **3** $x = -2$ or $x = 1$
4 $x = -1$ or $x = 3$ **5** $x = -2$ or $x = -4$ **6** $x = -1$ or $x = -2$
7 $x = 4$ or $x = -3$ **8** $x = 3$ or $x = -4$ **9** $x = 5$ or $x = 3$
10 $x = 4$ or $x = 6$ **11** $x = -4$ **12** $x = 5$

EXERCISE 104*

1 $x = 4$ or $x = 5$ **2** $x = 5$ or $x = 7$ **3** $x = -3$ or $x = 8$
4 $x = -4$ or $x = 7$ **5** $x = -9$ or $x = -12$ **6** $x = -11$ or $x = -10$
7 $x = 14$ or $x = 4$ **8** $x = 13$ or $x = 5$ **9** $x = -16$ or $x = -6$
10 $x = -18$ or $x = -5$ **11** $x = 3$ or $x = -1$ **12** $x = -7$ or $x = 2$
13 $x = -15$ or $x = 8$

EXERCISE 105

1 $x = 0$ or $x = 2$ **2** $x = 0$ or $x = 5$ **3** $x = 0$ or $x = -7$
4 $x = 0$ or $x = -3$ **5** $x = 0$ or $x = 25$ **6** $x = 0$ or $x = 17$
7 $x = 0$ or $x = -23$ **8** $x = 0$ or $x = -31$ **9** $x = -2$ or $x = 2$
10 $x = -6$ or $x = 6$ **11** $x = -5$ or $x = 5$ **12** $x = -4$ or $x = 4$

EXERCISE 105*

1 $x = 0$ or $x = 125$ **2** $x = 0$ or $x = 117$ **3** $x = 0$ or $x = -231$
4 $x = 0$ or $x = -321$ **5** $x = -8$ or $x = 8$ **6** $x = -9$ or $x = 9$
7 $x = -13$ or $x = 13$ **8** $x = -12$ or $x = 12$ **9** $x = -\sqrt{7}$ or $x = \sqrt{7}$
10 $x = -a$ or $x = a$ **11** No (real) solutions **12** $x = 0$ or $x = 34$

EXERCISE 106

1 3, –4 **2** 5, –6 **3** –4, 5 **4** –6, 7
5 5, –7 **6** –4, 6
7 **a** $x^2 + 3x$ **b** $x = 3$
8 **a** $x^2 + x$ **b** $x = 6$
9 10 cm by 4 cm **10** 8 cm by 5 cm **11** $x = 3$
12 $x = 2$

EXERCISE 106*

1 11, 13 or –13, –11 **2** 8, 12 or –12, –8
3 30 cm by 40 cm **4** 20 m by 100 m
5 1 s and 2 s **6** 2 s
7 8, 9 or –9, –8 **8** 7, 9 or –9, –7
9 20 **10** 18
11 4 cm **12** 20 cans

REVISION EXERCISE 107

1 $x^2 - 10x + 21$ **2** $x^2 + 4x + 4$ **3** $2x^2 - 7x - 15$
4 **a** $x^2 + 5x + 6$ **b** $5x + 6$ **c** $x = 4$
5 $(x - 6)(x + 6)$ **6** $(x + 3)(x + 1)$ **7** $(x + 4)(x - 2)$
8 $x = 6$ or $x = -2$ **9** $x = 0$ or $x = 5$ **10** $x = -6$ or $x = 6$
11 $x = -4$ or $x = 5$ **12** 20 cm by 30 cm

REVISION EXERCISE 107*

1 $x^2 - 3x - 108$ **2** $4x^2 - 12x + 9$ **3** $6x^2 + 7x - 3$
4 4.25 m **5** 27 cm **6** $x = -11$ or $x = 11$
7 $x = 0$ or $x = 7$ **8** $x = -7$ or $x = 8$ **9** $x = 9$ or $x = 6$
10 400 cm^2

SEQUENCE 5

(Note: this material is ideal for use with a spreadsheet.)

ACTIVITY 32

Triangular patterns: add on one more than before; 10, 15, 21, ...; $\frac{1}{2}n(n+1)$; 13 rows, 9 balloons left over

Pyramidal patterns: differences are the previous sequence; 20, 35, 56, ...; 9 layers with 35 balloons left over

EXERCISE 108

1 2, 4, 6, 8 **2** 1, 3, 5, 7 **3** –9, –6, –3, 0
4 –8, –4, 0, 4 **5** 15, 10, 5, 0 **6** 10, 7, 4, 1
7 2, 4, 8, 16 **8** 1, 3, 9, 27 **9** 12, 6, 3, 1.5
10 32, 16, 8, 4 **11** Add 4; 19, 23, 27 **12** Add 4; 21, 25, 29
13 Subtract 5; –7, –12, –17
14 Subtract 3; –7, –10, –13
15 Double; 48, 96, 192
16 Treble; 162, 486, 1458
17 Halve; 4, 2, 1 **18** Halve; 18, 9, $4\frac{1}{2}$ **19** Add 0.3; 1.4, 1.7, 2
20 Divide by 10; 0.0001, 0.000 01, 0.000 001

EXERCISE 108*

1 –1, 0.5, 2, 3.5 **2** –0.8, –0.6, –0.4, –0.2
3 3, 1.75, 0.5, –0.75 **4** 5, 2.5, 0, –2.5
5 1, 2.5, 6.25, 15.625 **6** 1, 1.5, 2.25, 3.375
7 3, –1, $\frac{1}{3}$, $-\frac{1}{9}$ **8** 1, $-\frac{1}{2}$, $\frac{1}{4}$, $-\frac{1}{8}$
9 1, 1, 2, 3, 5, 8 **10** 1, 2, 2, 4, 8, 32
11 Add $2\frac{1}{2}$; 13, $15\frac{1}{2}$, 18 **12** Subtract 0.2; 0.2, 0, –0.2
13 Divide by 3; 3, 1, $\frac{1}{3}$ **14** Divide by 2; $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$
15 Square; 65 536, 4.3×10^9, 1.8×10^{19}
16 Divide by 5; 0.064, 0.0128, 0.002 56
17 Multiply by $-\frac{1}{2}$; $\frac{1}{16}$, $-\frac{1}{32}$, $\frac{1}{64}$
18 Multiply by –3; –9, 27, –81
19 Double then add 1; 63, 127, 255
20 Add 1 then double; 94, 190, 382

EXERCISE 109

1 3, 5, 7, 9 **2** 5, 8, 11, 14 **3** 4, 9, 14, 19
4 1, 5, 9, 13 **5** 30, 27, 24, 21 **6** 26, 24, 22, 20
7 2, 5, 10, 17 **8** 0, 3, 8, 15 **9** 3, 6, 9, 12

10 2, 4, 6, 8 **11** 2, $\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{4}$ **12** 0, $\frac{1}{3}$, $\frac{2}{4}$, $\frac{3}{5}$

13 8 **14** 12 **15** 7

16 9 **17** 7 **18** 5

19 22 **20** 30

EXERCISE 109*

1 –1, 4, 9, 14 **2** –2, 4, 10, 16 **3** 97, 94, 91, 88

4 80, 76, 72, 68 **5** 1, $\frac{3}{2}$, 2, $\frac{5}{2}$ **6** $-\frac{1}{3}$, 0, $\frac{1}{3}$, $\frac{2}{3}$

7 3, 7, 13, 21 **8** 0, 1, 3, 6 **9** 3, 6, 11, 18

10 3, 10, 21, 36 **11** 3, $\frac{5}{3}$, $\frac{7}{5}$, $\frac{9}{7}$ **12** $\frac{1}{3}$, $-\frac{1}{4}$, $-\frac{3}{5}$, $-\frac{5}{6}$

13 8 **14** 7 **15** 12

16 14 **17** 10 **18** 11

19 51 **20** 17

INVESTIGATE

a gives the difference between the terms of the sequence.
$a + b$ gives the first term of the sequence.

EXERCISE 110

1 17, 20, 23 **2** 29, 34, 39 **3** –7, –10, –13

4 –9, –13, –17 **5** 56, 76, 99 **6** 52, 68, 86

7 0, 8, 19 **8** 4, 10, 18 **9** –4, –11, –20

10 3, 0, –4

EXERCISE 110*

1 58, 78, 101 **2** 74, 100, 130 **3** 1, –6, –15

4 8, 5, 1 **5** 1, 8, 17 **6** –6, –4, –1

7 71, 101, 139 **8** 150, 215, 297 **9** –6, –19, –38

10 –54, –90, –139

ACTIVITY 33

3, 5, 7, 9, 11, 13; $b = 2t + 1$; 201 balloons $b = 3s + 1$ (s = no. of squares)
$b = 7h + 5$ (h = no. of hexagons) $b = 5h + 1$ (h = no. of hexagons)

INVESTIGATE

10 pentagons needed using 40 balloons

ACTIVITY 34

4, 8, 12, 16, 20, 24; $4n$

INVESTIGATE

Triangular perimeter numbers: 3, 6, 9, 12, ... $3n$
Pentagonal perimeter numbers: 5, 10, 15, 20, ... $5n$
Hexagonal perimeter numbers: 6, 12, 18, 24, ... $6n$

EXERCISE 111

1 $\frac{1}{n}$ **2** $\frac{1}{n+2}$ **3** $\frac{1}{2n}$ **4** $\frac{1}{2n-1}$

5 $3n + 1$ **6** $2n + 3$ **7** $34 - 4n$ **8** $29 - 3n$

9 **a** 1, 3, 5, 7, 9, 11, ... **b** $c = 2l - 1$
c c is always odd, 50 layers.

10 **a** 8, 10, 12, 14, 16, 18, ... **b** $p = 2n + 6$
c 47th

EXERCISE 111*

1 $\frac{n+1}{n}$ **2** $\frac{n-1}{n+1}$ **3** $\frac{2n}{2n-1}$ **4** $\frac{2n-1}{2n+1}$

5 $4n - 1$ **6** $3n - 2$ **7** $9 - 3n$ **8** $13 - 4n$

9 **a** 6, 10, 14, 18, 22, 26, ... **b** $s = 4n + 2$
c 202

10 **a** 10, 16, 22, 28, 34, 40, ... **b** $p = 6n + 4$
c 32nd

REVISION EXERCISE 112

1 –2, 43, 493 **2** 5, 8, 11 **3** $\frac{n}{n+1}$ **4** $6n + 4$

5 **a** 1800 m **b** $800 + 200n$ **c** 36 days

6 **a** 1st; 300 **b** $4n - 1$

7 **a** Odd numbers **b** 4, 9, 16, 25 **c** 121
d n^2 **e** 29

8 **a** $n + n + 1$ **b** $2n + 1$ **c** $n + n + 1 = 2n + 1$
d $2n$ is always even, so $2n + 1$ is odd.

9 **a** n **b** n^2 **c** $n + n^2$
d 10 100

10 **a** 12, 20, 28, 36, 44, 52, ... **b** $w = 8c + 4$
c $c = 9 \rightarrow w = 76$, $c = 10 \rightarrow w = 84$

REVISION EXERCISE 112*

1 5, –58, –688 **2** –2, –5, –8 **3** $\frac{n}{2n-1}$

4 $18 - 5n$

5 **a** £2.90 **b** $50 + 20n$
c 12 years

6 **a** 17, 21, 25, 29 **b** 7, 13
c 1, 3, 7, 13, ...; 21st term

7 **a** $n(n + 1)$ **b** $n^2 + n$
c $n(n + 1) = n^2 + n$
d Either n or $n + 1$ is even, so their product is even.

8 **a** $n + 1$ **b** $n - 1$
c $(n + 1)(n - 1)$ **d** $(n + 1)(n - 1) = n^2 - 1$

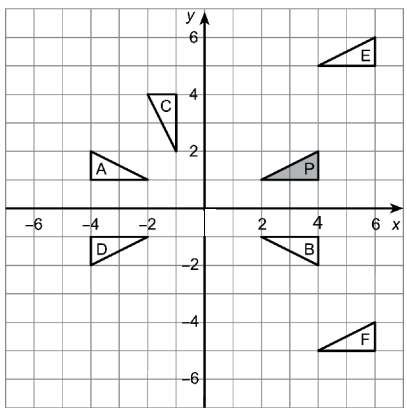
9 **a** 9, 19, 29, 39, 49, 59, ... **b** $n = 10b - 1$
c 99

10 **a** 1, 8, 21, 40, 65 **b** $p = 3m^2 - 2m$
c 15th

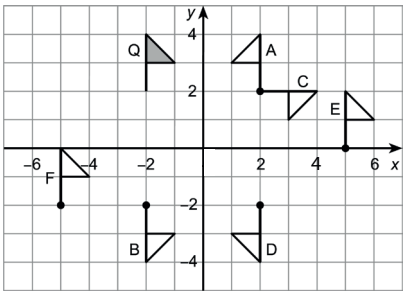
SHAPE AND SPACE 5

EXERCISE 113

1



2



3

Object	Reflection in line	Image
A	$x = 5$	B
F	$x = 5$	**G**
G	$\boldsymbol{x = 5}$	F
A	$x = 7$	**C**
D	$\boldsymbol{x = 12}$	B
G	$x = 9$	H
K	$\boldsymbol{x = 24}$	J
I	$x = 12$	G
H	$x = 18$	**K**
E	$x = 10$	A
J	$\boldsymbol{x = 15}$	G
D	$x = 17$	**E**

4

Object	Reflection in line	Image
B	$y = 0$	A
D	$y = 8$	**C**
B	$\boldsymbol{y = 6}$	E
A	$y = 4$	D
D	$\boldsymbol{y = 10}$	E
I	$y = 9$	**H**
H	$\boldsymbol{y = 5}$	G
G	$y = 1$	F
F	$\boldsymbol{y = 6}$	J
J	$x = 5$	**K**
H	$\boldsymbol{x = 4}$	C
C	$y = 4$	B

5

Object	Transformation		Image
B	Rotation	Centre (0, 0) ∠90°	A
A	Translation	Vector $\begin{pmatrix}3\\1\end{pmatrix}$	C
B	Rotation	Centre **(1, 2) ∠90°**	C
A	Rotation	Centre **(0, –1)** ∠90°	F
F	Translation	Vector $\begin{pmatrix}0\\2\end{pmatrix}$	**E**
A	Rotation	Centre (–1, 0) ∠90°	**E**
A	Rotation	Centre (0, 0) ∠180°	**G**
G	Translation	Vector $\begin{pmatrix}-2\\0\end{pmatrix}$	H
A	Rotation	Centre **(–1, 0) ∠180°**	H
B	Rotation	Centre **(–1, 1)** ∠–90°	H
H	Translation	Vector $\begin{pmatrix}2\\0\end{pmatrix}$	G
B	Rotation	Centre **(0, 0) ∠–90°**	G

6

Object	Transformation		Image
A	Rotation	Centre (0, 0) ∠–90°	D
D	Translation	Vector $\begin{pmatrix}2\\2\end{pmatrix}$	C
A	Rotation	Centre **(2, 0) ∠–90°**	C

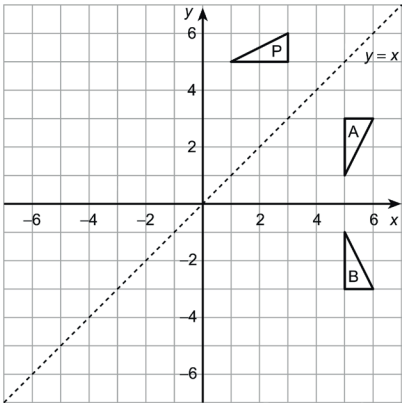
Object	Transformation		Image
H	Rotation	Centre (0, 0) ∠90°	**F**
F	Translation	Vector $\begin{pmatrix}6\\-2\end{pmatrix}$	**E**
H	Rotation	Centre (4, 2) ∠90°	**E**
D	Rotation	Centre **(0, 0) ∠–90°**	F
F	Translation	Vector $\begin{pmatrix}6\\-2\end{pmatrix}$	E
D	Rotation	Centre **(2, –4) ∠–90°**	E
F	Rotation	Centre (0, 0) ∠180°	**A**
A	Translation	Vector $\begin{pmatrix}-8\\-5\end{pmatrix}$	G
F	Rotation	Centre **(–4, –2.5) ∠180°**	G
H	**Translation**	**Vector** $\begin{pmatrix}7\\2\end{pmatrix}$	B
C	**Rotation**	**Centre (4.5, 2) ∠180°**	B

EXERCISE 113*

1 **a** (1, –2) **b** (1, 2) **c** (1, 10) **d** (1, 18)
e (4, 1) **f** (5, 2) **g** (6, 3) **h** (12, 9)

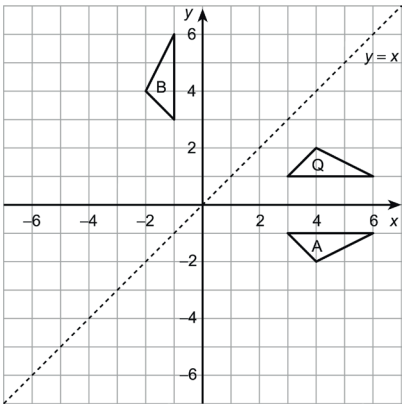
2 **a** (4, 2) **b** (6, 2) **c** (8, 2) **d** (18, 2)
e (6, 6) **f** (5, 5) **g** (2, 2) **h** (–8, –8)

3 **a**



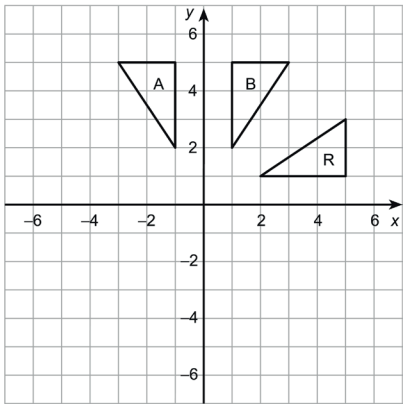
c Rotation – 90° about (0, 0)

4 **a**



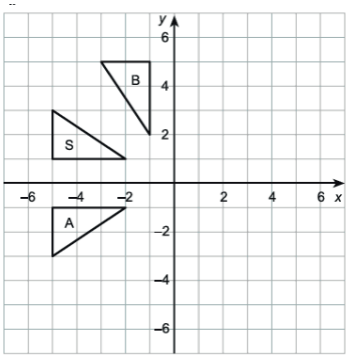
c Rotation 90° about (0, 0)

5 **a**



c Reflection in $y = x$

6 **a**



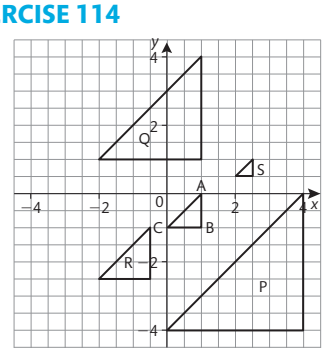
c Reflection in $x + y = 0$

ACTIVITY 35

T	2.5 cm	1.4 cm	2.9 cm
T_1	3.9 cm	2.3 cm	4.6 cm
Ratios	≈ 1.6	≈ 1.6	≈ 1.6
T_2	1.7 cm	1 cm	1.9 cm
Ratios	≈ 0.7	≈ 0.7	≈ 0.7

EXERCISE 114

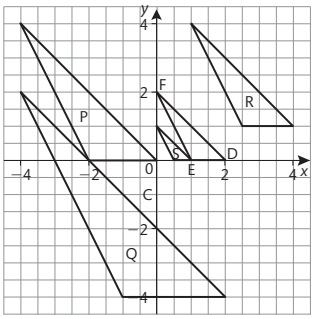
1–4



5 B to A: (10, 8) SF = 2; A to E: (8, 0) SF = $\frac{1}{2}$; D to B: (12, 4) SF = $\frac{3}{2}$; E to D: (14, 12) SF = $\frac{2}{3}$; D to C: (4, 4) SF = 2

EXERCISE 114*

1–4



5 A to C: (2, 11) SF = 2; A to D: (3, 11) SF = 4; C to D: (5, 11) SF = 2; C to E: (4, 10) SF = 3; B to C: (4, 5) SF = $\frac{1}{2}$; E to D: (1, 7) SF = $\frac{2}{3}$

EXERCISE 115

1 Reflection in $y = 2$; reflection in x-axis; translation $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$

2 Reflection in $x = 4$; reflection in y-axis; translation $\begin{pmatrix} -8 \\ 0 \end{pmatrix}$

3 Reflection in y-axis; reflection in $y = 2$; rotation 180° about (0, 2)

4 Reflection in $x = 4$; reflection in $y = 2$; rotation 180° about (4, 2)

5 Reflection in y-axis; reflection in $x + y = 0$; rotation 90° about (0, 0)

6 Reflection in y-axis; reflection in $x + y = 0$; rotation 90° about (0, 0)

7 Reflection in $x = -4$; reflection in $y = 2$; rotation 180° about (–4, 2)

8 Reflection in $y = -2$; reflection in y-axis; rotation 180° about (0, –2)

EXERCISE 115*

1 Reflection in $x + y = 6$; rotation –90° about (2, 4)

2 Rotation 90° about (– 3, – 1); translation $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$

3 Rotation 143° about (– 2, 2); reflection in $y = 2x + 6$

4 Reflection in $x + y = 8$; translation $\begin{pmatrix} -8 \\ -8 \end{pmatrix}$

INVESTIGATE

This table represents an 'unfolding' from A10 to A1

Size	Sheets in A0	Width	L = W $\sqrt{2}$	Area
A10	1024	1	$\sqrt{2}$	$1\sqrt{2}$
A9	512	$\sqrt{2}$	2	$2\sqrt{2}$
A8	256	2	$2\sqrt{2}$	$4\sqrt{2}$
A7	128	$2\sqrt{2}$	4	$8\sqrt{2}$
A6	64	4	$4\sqrt{2}$	$16\sqrt{2}$
A5	32	$4\sqrt{2}$	8	$32\sqrt{2}$
A4	16	8	$8\sqrt{2}$	$64\sqrt{2}$
A3	8	$8\sqrt{2}$	16	$128\sqrt{2}$
A2	4	16	$16\sqrt{2}$	$256\sqrt{2}$
A1	2	$16\sqrt{2}$	32	$512\sqrt{2}$
A0	1	32	$32\sqrt{2}$	$1024\sqrt{2}$

Ratio width:length = 1: $\sqrt{2}$ Volume ratio A7:A9 = 1:8

REVISION EXERCISE 116

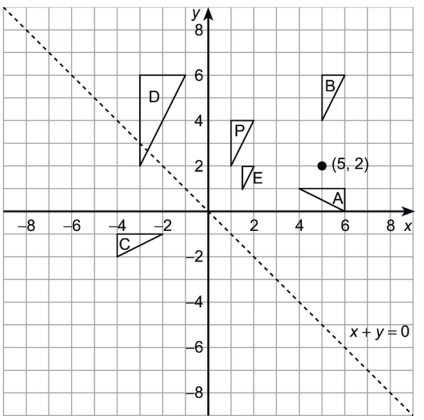
1 Reflection in y-axis
2 Reflection in $x = 1$
3 Reflection in x-axis
4 Reflection in $y = 2$
5 Rotation –90° about (0, 0)
6 Rotation 180° about (0, 0)
7 Rotation 90° about (0, 4)
8 Reflection in $y = x$
9 Enlargement (1, 5) SF = 2
10 Enlargement (– 6, 0) SF = 0.5

REVISION EXERCISE 116*

1 **a** (–5, 0) **b** (6, –1) **c** (–3, 1) **d** (1, 0) **e** (4, 1)

2 **a** Reflection in x-axis
b Reflection in y-axis
c Reflection in $y = x + 2$
d Reflection in $y = x - 2$
e Rotation 90° about (–2, 0)
f Rotation 90° about (0, –2)

3



HANDLING DATA 5

ACTIVITY 36

Classroom discussion should highlight the need for shape and spread of distributions as well as the average in decision-making.

EXERCISE 117

1 m = 3, $Q_1 = 2$, $Q_3 = 6$, R = 7, IQR = 4
2 m = 11, $Q_1 = 8$, $Q_3 = 15.5$, R = 15, IQR = 7.5
3 m = 4, $Q_1 = 2$, $Q_3 = 7$, R = 8, IQR = 5
4 m = 0.35, $Q_1 = 0.2$, $Q_3 = 0.55$, R = 0.7, IQR = 0.35

EXERCISE 117*

1 m = 27, $Q_1 = 19$, $Q_3 = 33.5$, IQR = 14.5, R = 31
2 m = 56.7, $Q_1 = 55.8$, $Q_3 = 57.5$, IQR = 1.7, R = 3.4
3 m = 3, $Q_1 = 2$, $Q_3 = 4$, R = 5, IQR = 2
4 m = 2, $Q_1 = 2$, $Q_3 = 3$, R = 4, IQR = 1

EXERCISE 118

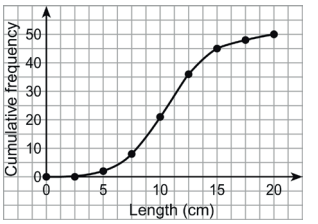
1 **a** m ≈ 332 g, $Q_1 \approx 306$ g, $Q_3 \approx 360$ g
b IQR ≈ 54 g
c Distribution is symmetric; median ≈ mean

2 **a** m ≈ 27.4 min, $Q_1 \approx 25.6$ min, $Q_3 \approx 29.0$ min
b IQR ≈ 3.4 min
c Median is better; shape of distribution is not smooth

3 **a** m ≈ £22 000, $Q_1 \approx$ £16 000, $Q_3 \approx$ £25 000
b IQR ≈ £9 000

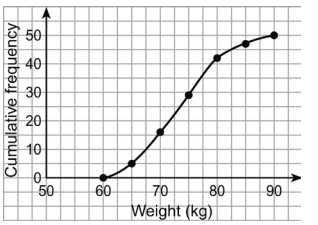
4 **a** m ≈ 186 cm, $Q_1 \approx 178$ cm, $Q_3 \approx 192$ cm
b IQR ≈ 14 cm

5 **a**



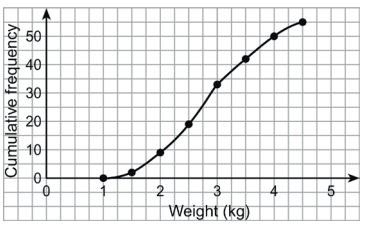
b m ≈ 10.75 cm, $Q_1 \approx 8.3$ cm, $Q_3 \approx 13.1$ cm
c IQR ≈ 4.8 cm

6 **a**



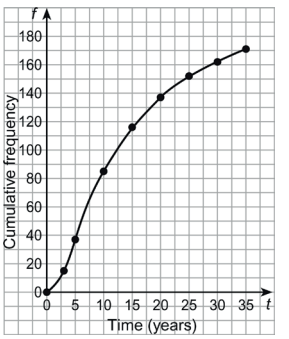
b m ≈ 73.7 kg, $Q_1 \approx 68.5$ kg, $Q_3 \approx 78.5$ kg
c IQR ≈ 10 kg

7 **b**



c m ≈ 2.8 kg, $Q_1 \approx 2.35$ kg, $Q_3 \approx 3.5$ kg

8 **b**



c m ≈ 10 years, $Q_1 \approx 5.6$ years, $Q_3 \approx 17.9$ years
d Median is best; distribution is skewed

EXERCISE 118*

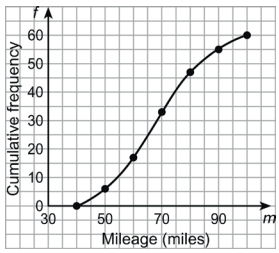
1 **a** m ≈ 45 years, IQR ≈ 47.5 – 37.5 = 10 years
b 30%

2 **a** m ≈ 29 years, $Q_1 \approx 25$ years, $Q_3 \approx 33$ years
b IQR ≈ 8 years
c Symmetric distribution; mean ≈ median

3 **a** m ≈ 49.5%, IQR ≈ 61 – 36 = 25%
b 17 candidates

4 **a** m ≈ 1.84 m, IQR ≈ 1.87 – 1.81 = 0.06 m
b ≈ 40%

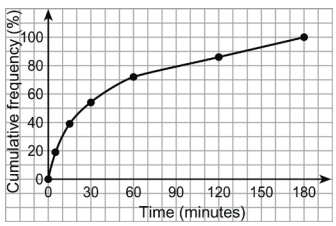
5 **b**



c m ≈ 67.6 m, IQR ≈ 78 – 58 = 20 m

d ≈ 51

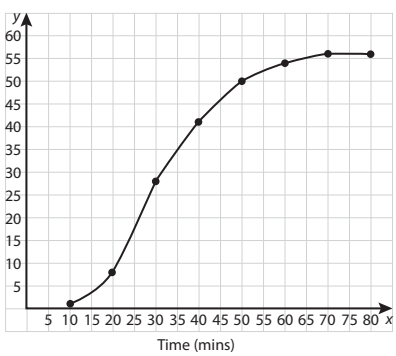
6 **a**



b m ≈ 26 min, IQR ≈ 73 – 8 = 65 min

c 37%

7 **a**

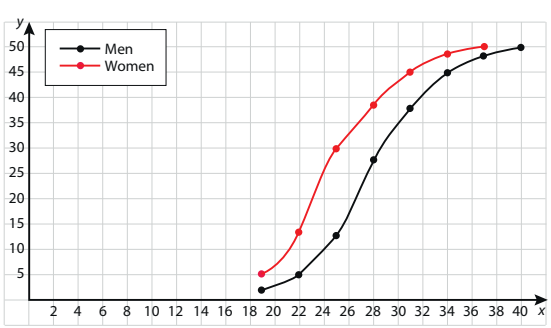


m ≈ 30 min, IQR ≈ 41 – 23 = 18 min

b mean = 32.5 min

c Few big values 'raise' the mean

8 **b**



c Men: m ≈ 27.5 years, Q_1 ≈ 25 years, Q_3 ≈ 31 years
Women: m ≈ 24 years, Q_1 ≈ 21 years, Q_3 ≈ 27 years

e Women are 3 or 4 years younger

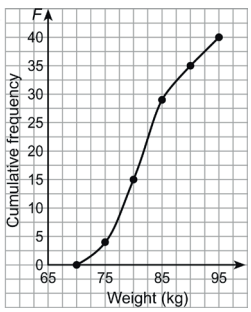
REVISION EXERCISE 119

1 median = 10.5, LQ = 4.5, UQ = 19, range = 21, IQR = 14.5

2 **a** m ≈ 32 years, IQR ≈ 12 years

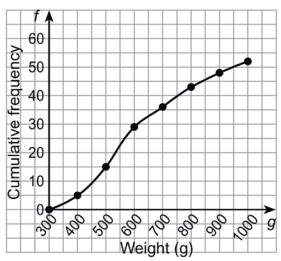
b 18

3 **a**



b m ≈ 81.5 kg, IQR ≈ 86 – 78 = 8 kg

4 **a**



b m ≈ 580 g, IQR ≈ 743 – 480 = 263 g

c 19 fish

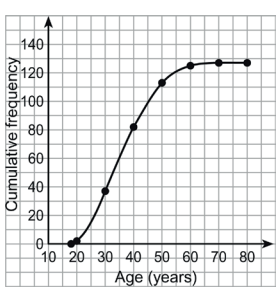
REVISION EXERCISE 119*

1 median = 1, LQ = 0, UQ = 2, range = 4, IQR = 2

2 **a** m ≈ 17 min, Q_1 ≈ 15 min, Q_3 ≈ 18.5 min, IQR ≈ 3.5 min

b 38

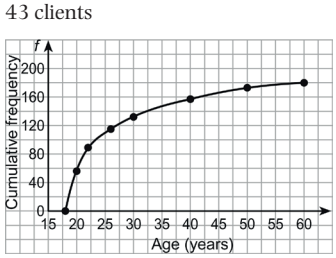
3 **a**



b m ≈ 37 years, IQR ≈ 45 – 29 = 16 years

c 43 clients

4 **a**



b m ≈ 22.5 years, IQR ≈ 30 – 20 = 10 years

c 35 students

d Distribution is skewed; median is best

EXAMINATION PRACTICE 5

1 **a** $1.6^9 = 68.7$ **b** $16.7^5 = 1\,300\,000$

c $1.065^9 = 1.76$

2 $\frac{4}{25}$, $\frac{7}{20}$, $\frac{3}{8}$

3 **a** $2x^2 + 3x - 5$ **b** $8 - 10x + 3x^2$

4 **a** $Q_1 = 55.3$ g, $Q_3 = 56.4$ g, m = 55.9 g,
b IQR = 1.1 g

5 **a** $7n - 3$, 697 **b** $41 - 9n$, -859

6 **a** 68% **b** 79 – 59 = 20
c 32

7 16 m/s

8 **a** $(x - 10)(x + 8) = 0$, $x = 10$ or -8 **b** $(x - 12)(x + 2) = 0$, $x = 12$ or -2

9 56, 76

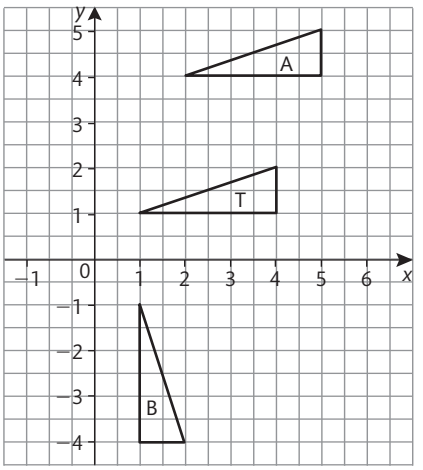
10 **a** Translation $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ **b** Rotation about (–1, 1), 90°
c Reflection in $y = -1$ **d** Enlargement: SF = 3
Centre = (3, 4)

11 9

12 15

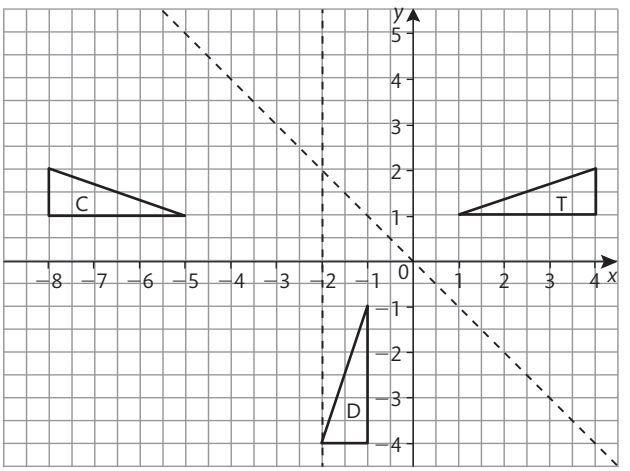
13 **a** 6 **b** 8 – 6 = 2

14 **a** and **b**



c Clockwise rotation of 90° about (–1, 2)

15 **a** and **b**



c Anticlockwise rotation of 90° about (–2, 2)

16 **b** 2^{n-1} or $\frac{2^n}{2}$ **c** 10 hurdles

17 g/p to 3 s.f.: 4.03, 4.04 and 3.95 so 400 g, 500 g and 300 g

18 **a** $(x - 1)(x - 3) = 0$, $x = 1$ or 3 **b** $(x + 3)(x + 2) = 0$, $x = -3$ or -2

SKILLS PRACTICE 1

NUMBER

1	270	**2**	304	**3**	73	**4**	94
5	124.5	**6**	479.5	**7**	35.8	**8**	55.4
9	45.6	**10**	0.45	**11**	8430	**12**	340
13	83.74	**14**	151.5	**15**	314.3	**16**	299.1
17	0.24	**18**	0.25	**19**	3	**20**	0.375
21	0.8	**22**	0.4	**23**	8.4	**24**	4.6
25	21	**26**	28	**27**	0.15	**28**	0.075
29	1.8	**30**	2.4				

ALGEBRA

1	$5x$	**2**	$8y$	**3**	$2x$	**4**	$2y$	**5**	$6x$
6	$8x$	**7**	$2x$	**8**	$2y$	**9**	$12y^2$	**10**	$25y^2$
11	9	**12**	16	**13**	26	**14**	72	**15**	25
16	18	**17**	17	**18**	15	**19**	4	**20**	13
21	15	**22**	8	**23**	3	**24**	2.5	**25**	32
26	7	**27**	36	**28**	144	**29**	1	**30**	1

SKILLS PRACTICE 2

NUMBER

1	609	**2**	474	**3**	43	**4**	46	**5**	2.574
6	2.106	**7**	123	**8**	21.28	**9**	46	**10**	37
11	67	**12**	49	**13**	0.695	**14**	0.1459	**15**	0.78
16	0.091	**17**	0.75	**18**	0.59	**19**	0.55	**20**	0.57
21	$4\frac{1}{3}$	**22**	$1\frac{5}{7}$	**23**	$\frac{11}{3}$	**24**	$\frac{19}{4}$	**25**	$\frac{1}{2}$
26	$\frac{1}{12}$	**27**	$\frac{1}{3}$	**28**	$\frac{2}{7}$	**29**	$2\frac{1}{3}$	**30**	$1\frac{1}{2}$

ALGEBRA

1	$5x^2$	**2**	$2y^3$	**3**	$a + 2b$	**4**	$3a - 3b$	**5**	$3x^3$
6	$4x^3$	**7**	$6x^2$	**8**	$8x^2$	**9**	$3x^2$	**10**	$6x$
11	$x = 4.92$	**12**	$x = 0.91$	**13**	$x = 34.8$	**14**	$x = 68.4$	**15**	$x = 1.9$
16	$x = 5.4$	**17**	$x = 78$	**18**	$x = 74$	**19**	$x = 4$	**20**	$x = 5$
21	4	**22**	–1	**23**	11	**24**	9	**25**	12
26	–18	**27**	12	**28**	36	**29**	–1	**30**	25

SKILLS PRACTICE 3

NUMBER

1	245	**2**	119	**3**	243	**4**	45	**5**	36
6	3.2	**7**	9.4	**8**	53	**9**	308.7	**10**	90.4
11	92.8	**12**	7	**13**	700	**14**	0.7	**15**	6.75
16	675	**17**	60	**18**	100	**19**	10^{10}	**20**	256
21	$2\frac{1}{3}$	**22**	$2\frac{1}{2}$	**23**	$\frac{21}{5}$	**24**	$\frac{16}{3}$	**25**	$\frac{7}{12}$
26	$\frac{5}{12}$	**27**	$\frac{1}{6}$	**28**	$\frac{3}{5}$	**29**	$1\frac{2}{3}$	**30**	$\frac{7}{10}$
31	20 000	**32**	40	**33**	100	**34**	25		

ALGEBRA

1	$4x$	**2**	$2x$	**3**	3	**4**	$9x$	**5**	$8x - 5y$
6	x^2y^2	**7**	$7x^2 - 2y$	**8**	$x^3y^3z^3$	**9**	$\frac{3x}{y}$	**10**	$8x^3$

11	$x = 15$	**12**	$x = -47$	**13**	$x = 30$	**14**	$x = 89$	**15**	$x = 25$
16	$x = 14$	**17**	-4	**18**	31	**19**	31	**20**	61
21	900	**22**	216	**23**	1	**24**	121	**25**	11
26	1								

SKILLS PRACTICE 4

NUMBER

1	207	**2**	189	**3**	216	**4**	160	**5**	28
6	39	**7**	147.2	**8**	799.7	**9**	308.7	**10**	899.1
11	654.3	**12**	0.14	**13**	16.8	**14**	420	**15**	3.36
16	$4\frac{5}{18}$	**17**	$1\frac{3}{11}$	**18**	$4\frac{1}{6}$	**19**	$\frac{1}{2}$	**20**	16
21	$1\frac{1}{4}$	**22**	$3\frac{2}{5}$	**23**	$\frac{22}{7}$	**24**	$\frac{13}{5}$	**25**	$\frac{19}{35}$
26	$\frac{37}{99}$	**27**	$\frac{1}{6}$	**28**	$\frac{1}{12}$	**29**	$1\frac{1}{3}$	**30**	$2\frac{1}{2}$
31	21 000	**32**	4	**33**	300	**34**	8		

ALGEBRA

1	$15x - 10$	**2**	$6x^2y^2$	**3**	$8x^2y$	**4**	$-4x^2y$	**5**	$12x^4y^2$
6	$\frac{1}{3}$	**7**	$25x^2$	**8**	x	**9**	$3x$	**10**	$18x^2$
11	$x = 8$	**12**	$x = 17$	**13**	$x = 4$	**14**	$x = 19$	**15**	$x = \frac{1}{2}$
16	$x = \frac{1}{2}$	**17**	5	**18**	25	**19**	17	**20**	16
21	-1	**22**	10	**23**	81	**24**	-16	**25**	16
26	1								

SKILLS PRACTICE 5

NUMBER

1	43.2	**2**	47.2	**3**	90	**4**	90.01	**5**	0.927
6	78.5	**7**	1.69	**8**	0.216	**9**	13	**10**	3
11	7.6	**12**	4.9	**13**	160.8	**14**	262.2	**15**	58
16	8.7	**17**	36.86	**18**	16.8	**19**	3.2	**20**	1.5
21	$1\frac{1}{8}$	**22**	$\frac{1}{2}$	**23**	$1\frac{4}{9}$	**24**	$\frac{7}{13}$	**25**	$\frac{67}{100}$
26	0.375	**27**	$0.\dot{1}42857\dot{}$			**28**	$\frac{1}{3}$	**29**	30 000
30	500	**31**	30	**32**	140				

ALGEBRA

1	$9x^4$	**2**	$10x^2$	**3**	$8x^2$	**4**	9
5	$2 + x$	**6**	$1 - 2y^2$	**7**	$x^2 - 4x + 4$	**8**	$a^2 - b^2$
9	$\frac{11x}{15}$	**10**	$\frac{5}{6}$	**11**	$3xy(x - 2)$	**12**	$(x - 2)(x - 4)$
13	$(x + y)(x - y)$	**14**	$x = 6.8$	**15**	$x = \pm 2.5$	**16**	$x = 2$ or $x = 4$
17	$d(c + a) = x$	**18**	$\frac{ad - c}{b} = x$	**19**	$x = \frac{a}{c - b}$	**20**	$x < -3$
21	$x \leqslant -8$	**22**	25	**23**	1	**24**	-12
25	36	**26**	5	**27**	19	**28**	-8

CHALLENGES

1 **a** 1×10^{606} **b** 1×10^{90} **c** 1×10^{1200}

2 8.47×10^{56} mm^3 (to 3 s.f.)

3 **(i)** By calculator working 'in to out' of the expression should give a value approaching 2.

(ii) For brighter groups:

$$\begin{aligned} \text{Let } \sqrt{2+\sqrt{2+\sqrt{2+\ldots}}} &= u \\ 2 + u &= u^2 \\ 0 &= u^2 - u - 2 \\ 0 &= (u - 2)(u + 1) \\ \Rightarrow \quad u &= 2 \end{aligned}$$

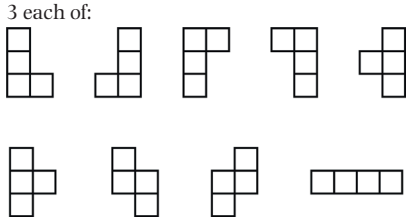
(iii) Very able groups could consider exploring this hypothesis:

$$\sqrt{x+\sqrt{x+\sqrt{x+\ldots}}} = u$$

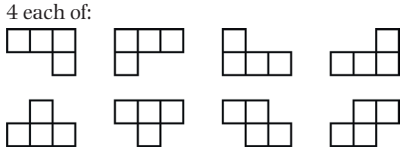
4 $2^5 \times 9^2 = 2592$

5 65 different ways: $(3 \times 9) + (4 \times 8) + (6 \times 1) = 65$.

3 each of:

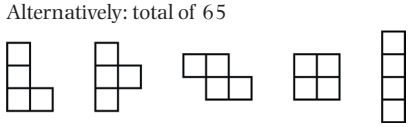


4 each of:



6 of

Alternatively: total of 65



×28 ×14 ×14 ×6 ×3

6 $100^2 = 10\,000$ and $101^2 = 10\,201$. Therefore the number of whole numbers which have their square roots between 100 and 101 $= (10\,201 - 10\,000) - 1 = 200$.

7

Mrs Hack, Mr Woof, Mrs Smart

Mr Grim

Mrs Chatty, Mr Nice, Mrs Pain

8 6400 km (2 s.f.)

9 $2^{30} = 1\,073\,741\,824$

10 **a** 6 **b** 1

c Yes. Last digit of 3^{444} is 1, last digit of 4^{333} is 4, last digit of $3^{444} + 4^{333}$ is 5

11 Ratio of areas for round peg in square hole is $\frac{\pi}{4} \approx 0.785$.

Ratio of areas for square peg in round hole is $\frac{2}{\pi} \approx 0.637$.

So a round peg in a square hole is the better fit.

12 16 cm^2

13 Either 6 red and 4 blue *or* 4 red and 6 blue

14 9 cans, no change

15 £15, £12, £9

16 4π

17 200 cm^2

18 **a** $3 \times 4 + 5 \times 6$ **b** $4 \times 5 + 3 \times 6$ **c** $6(3 + 4) + 5$

d $3 \times 5 + 6 \times 4$ **e** $3 \times 4 \times 6 - 5$

19 $x = 1985$

20 $\frac{16}{25}$ cm^2

FACT FINDERS

GREAT WHITE SHARK

1 3 sharks per sec approx. **2** 225 m
3 8.57% **4** For a 1.6 m pupil, $x \approx 4.4$
5 6.70 m/s **6** 5 cm × 3500 ≈ 17 500 cm = 175 m. Yes!
7 257% **8** 24.9%
9 54 400 kg **10** 3.55%
11 3.1×10^3 tonnes/m^2 **12** 1.26×10 tonnes

THIS TROUBLED PLANET

1 4.87 billion
2 **a** \$148 per person **b** \$147 per person
3 1600 cars per hour
4 **a** 16.8 kg per person **b** 20.4 kg per person
5 **a** 37.8 pitches per min **b** 43.8 pitches per min
6 61.6 elephants per day
7 2.73 people per second
8 **a** 34.9 people per km^2 **b** 40.6 people per km^2
9 **a** 5.43×10^7 km^2 **b** 2296 approx.
10 2023 approx.
11 7210 kg per km^3
12 4.32 m

THE CHANNEL TUNNEL

1 1994 – 1802 = 192 years **2** 76.9%
3 5.35×10^6 m^3 **4** Approx. £4.32 million
5 Approx. 36 people per hour
6 About six times height of a man, so $6 \times 1.75 \approx 10$ m
7 £31.71 per second **8** Approx. 164 weeks
9 3.5×10^6 litres per day
10 1994: 394 trains, 1998: 15 999 trains
So an increase of 3960% approx.
11 29.2 mph **12** $p = 3121y + 315$

RECYCLING

1 16.25 g **2** 2.7 tonnes m^{-3} **3** 1.2 m^2
4 4380.6 years allowing for leap years, 4383.6 not allowing for leap years
5 580 000 km **6** 333 g **7** 1.84 m^3
8 731 cm^3
9 Volume of bottles is 2.19 m^3, which is greater than volume of bottle bank
10 7.07 times **11** 20 cans **12** 5.945×10^7
13 1.497×10^9
14 1305 km **15** £2.11
16 Number to landfill sites is $0.64 \times 4 \times 10^9 = 2.56 \times 10^9$.
Weight of these cans is $\frac{2.56 \times 10^9}{(1.6 \times 10^6)} \times 26 = 41\,600$ tonnes.
Crushed volume = 41 600 × 4 = 166 400 m^3.
17 Density of crushed cans is 0.25 tonnes/m^3. Density of Al is 2.7 tonnes/m^3, so 0.25 tonnes has volume of 0.0926 m^3. Crushed cans are approx. 0.0926 m^3 of Al and 0.9074 m^3 of air. Percentage of air is 90.7%.
18 22.7 or about 23 times. In practice this figure will be greater, as bottle banks are usually emptied before they are full.
19 **a** 6.8×10^9 **b** 15.5 **c** 840 000 m^3
20 4.37

THE SOLAR SYSTEM

1 Diameter = $\frac{12\,800 \times 8}{1\,390\,000}$ cm

Distance = $\frac{1.5 \times 10^8 \times 8}{1\,390\,000}$ cm

2

Body	Diameter (mm)	Distance from the Sun (m)
Sun	80	
Earth	0.74	8.63
Mars	0.39	13.1
Jupiter	8.2	44.8
Pluto	0.17	342

3 14.4 m **4** 8.56 years **5** 8.3 min **6** 9.46×10^{12}
7 2287 km (approx. London–Athens)
8 2 270 000 years
9 1.14×10^{18} km, 6.48×10^{10} years
10 2.08×10^{19} km