

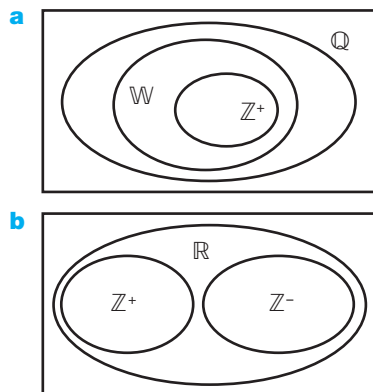
UNIT 10 ANSWERS

UNIT 10: NUMBER 10

ACTIVITY 1

- a 4.51, 0.528, 0.602, 0.0402, 2.36×10^{-3} , 8.49×10^{-6} , 0.658, 7.18×10^{-3} , 3.21×10^{-8}
- b Around 3×10^7 km (around 80 times the distance from the Earth to the Moon)

ACTIVITY 2



EXERCISE 1

- 1 ► $\frac{57}{10}$ 2 ► $\frac{47}{99}$ 3 ► $\frac{7}{1}$
- 4 ► Irrational 5 ► $\frac{3}{1}$ 6 ► $\frac{1}{1}$
- 7 ► Irrational 8 ► 0 9 ► e.g. 2.5
- 10 ► e.g. $\sqrt{53}$ 11 ► $\frac{2}{\pi}$ 12 ► $\frac{3}{\sqrt{\pi}}$

EXERCISE 1*

- 1 ► Irrational 2 ► $\frac{2}{5}$ 3 ► $\frac{3}{5}$
- 4 ► $\frac{3}{2}$ 5 ► Irrational 6 ► $\frac{1}{1}$
- 7 ► Irrational 8 ► e.g. 3.5 9 ► e.g. $\sqrt{7}$
- 10 ► e.g. $\sqrt{2} \times \sqrt{8}$ 11 ► $\frac{9}{\pi}$
- 12 ► a e.g. 3:4:5 b e.g. $\sqrt{2}:\sqrt{2}:2$
c e.g. 1:2: $\sqrt{5}$ d e.g. 1: $\sqrt{3}:2$

EXERCISE 2

- 1 ► $6\sqrt{5}$ 2 ► $4\sqrt{3}$ 3 ► 32
- 4 ► 20 5 ► 8 6 ► 105
- 7 ► $2\sqrt{2}$ 8 ► 4 9 ► 8

EXERCISE 2*

- 1 ► $5\sqrt{11}$ 2 ► $4\sqrt{7}$ 3 ► 99
- 4 ► 96 5 ► $56\sqrt{7}$ 6 ► $120\sqrt{2}$
- 7 ► 9 8 ► 4 9 ► 6

EXERCISE 3

- 1 ► $2\sqrt{3}$ 2 ► $3\sqrt{2}$ 3 ► $8\sqrt{3}$
- 4 ► $9\sqrt{5}$ 5 ► $3\sqrt{3}$ 6 ► $2\sqrt{2}$
- 7 ► $14\sqrt{2}$ 8 ► $\sqrt{50}$ 9 ► $\sqrt{27}$
- 10 ► $\sqrt{54}$ 11 ► $\frac{1}{2}$ 12 ► $\frac{2}{5}$
- 13 ► $\frac{2}{3}$ 14 ► 18, $10\sqrt{3}$, $\sqrt{3}\sqrt{13}$

EXERCISE 3*

- 1 ► $2\sqrt{7}$ 2 ► $3\sqrt{11}$ 3 ► $20\sqrt{5}$
- 4 ► $9\sqrt{13}$ 5 ► $5\sqrt{3}$ 6 ► $\sqrt{3}$
- 7 ► $22\sqrt{7}$ 8 ► $\sqrt{75}$ 9 ► $\sqrt{80}$
- 10 ► $\sqrt{63}$ 11 ► $\frac{1}{6}$ 12 ► $\frac{9}{10}$
- 13 ► $\frac{7}{13}$
- 14 ► $2\sqrt{2}$ cm, $(8 + 2\sqrt{2})$ cm, $(2 + 3\sqrt{2})$ cm²

ACTIVITY 3

- a i $\sqrt{2}$ ii 45°
- iii
- | | | |
|--------------------------------------|--------------------------------------|---------------------|
| $\sin 45^\circ = \frac{1}{\sqrt{2}}$ | $\cos 45^\circ = \frac{1}{\sqrt{2}}$ | $\tan 45^\circ = 1$ |
|--------------------------------------|--------------------------------------|---------------------|
- b i $\sqrt{3}$ ii $60^\circ, 30^\circ$
- iii
- | | | |
|--------------------------------------|--------------------------------------|--------------------------------------|
| $\sin 30^\circ = \frac{1}{2}$ | $\cos 30^\circ = \frac{\sqrt{3}}{2}$ | $\tan 30^\circ = \frac{1}{\sqrt{3}}$ |
| $\sin 60^\circ = \frac{\sqrt{3}}{2}$ | $\cos 60^\circ = \frac{1}{2}$ | $\tan 60^\circ = \sqrt{3}$ |

EXERCISE 4

- 1 ► $3 + 2\sqrt{2}$ 2 ► $4 - 2\sqrt{3}$
- 3 ► $21 + 12\sqrt{3}$ 4 ► $27 - 18\sqrt{2}$
- 5 ► -4 6 ► $5 + 2\sqrt{6}$
- 7 ► $7 - 2\sqrt{10}$ 8 ► $1 + \sqrt{2} - \sqrt{5} - \sqrt{10}$
- 9 ► $1 + \sqrt{2} - \sqrt{3} - \sqrt{6}$ 10 ► $4\sqrt{3}, 2, 2\sqrt{2}$

EXERCISE 4*

- 1 ► $9 + 4\sqrt{5}$
- 2 ► $18 - 8\sqrt{2}$
- 3 ► 13
- 4 ► $36 + 16\sqrt{2}$
- 5 ► $91 - 40\sqrt{3}$
- 6 ► $10 - 2\sqrt{21}$
- 7 ► 2
- 8 ► $15 + 10\sqrt{2} - 6\sqrt{7} - 4\sqrt{14}$
- 9 ► $8 + 12\sqrt{3} - 6\sqrt{5} - 9\sqrt{15}$
- 10 ► $1 + \sqrt{2}, 1.5 + \sqrt{2}$

ACTIVITY 4

- a i -1 ii 13 iii 1
- b Rational
- c i $(2 - \sqrt{2})$ ii $(3 + 2\sqrt{5})$
- d i $(a - \sqrt{b})$ ii $(a + c\sqrt{b})$

EXERCISE 5

- 1 ► $\frac{\sqrt{5}}{5}$ 2 ► $\sqrt{3}$
- 3 ► $2\sqrt{2}$ 4 ► $\frac{\sqrt{2}}{2}$
- 5 ► $\sqrt{5}$ 6 ► $\sqrt{3}$
- 7 ► $\frac{3\sqrt{2}}{4}$ 8 ► $\frac{2 + \sqrt{2}}{2}$
- 9 ► $2 + \sqrt{5}$ 10 ► $\frac{-1 + \sqrt{5}}{4}$
- 11 ► $2 + \sqrt{3}$ 12 ► $\frac{5 - 4\sqrt{2}}{7}$

EXERCISE 5*

- 1 ▶ $\frac{\sqrt{13}}{13}$ 2 ▶ \sqrt{a}
 3 ▶ $2\sqrt{3} - 1$ 4 ▶ $\frac{\sqrt{6}}{3}$
 5 ▶ $3 + 2\sqrt{7}$ 6 ▶ $\sqrt{2}$
 7 ▶ $\frac{2 - \sqrt{7}}{-3}$ 8 ▶ $\frac{12 + 2\sqrt{3}}{3}$
 9 ▶ $7 + 4\sqrt{3}$ 10 ▶ $4 + 6\sqrt{2}$
 11 ▶ $5(\sqrt{5} - \sqrt{3})$ 12 ▶ $a = -3, b = 4$

ACTIVITY 6

- a $\frac{1}{\sqrt{1} + \sqrt{2}} = \sqrt{2} - \sqrt{1}, \frac{1}{\sqrt{2} + \sqrt{3}} = \sqrt{3} - \sqrt{2},$
 $\frac{1}{\sqrt{3} + \sqrt{4}} = \sqrt{4} - \sqrt{3},$
 so sum is $-\sqrt{1} + \sqrt{4} = 2 - 1 = 1$
 b Sum is $-\sqrt{1} + \sqrt{9} = 3 - 1 = 2$
 c Sum is $-\sqrt{1} + \sqrt{n} \Rightarrow n = 100$

EXERCISE 6

REVISION

- 1 ▶ $0.\dot{3}$ and $\sqrt{25}$
 2 ▶ 2, for example (answers may vary)
 3 ▶ e.g. $\sqrt{11}$ 4 ▶ $\sqrt{45}$
 5 ▶ $5\sqrt{3}$ 6 ▶ $\sqrt{3}$
 7 ▶ 18 8 ▶ 1.5
 9 ▶ $3\sqrt{7}$ 10 ▶ $12\sqrt{2}$
 11 ▶ $3\sqrt{2}$ 12 ▶ $2\sqrt{2}$
 13 ▶ $59 + 30\sqrt{2}$ 14 ▶ -1
 15 ▶ $2\sqrt{3}$ 16 ▶ $\frac{3}{2}$
 17 ▶ $1 + \sqrt{3}$ 18 ▶ $\sqrt{7} - 1$
 19 ▶ $4\sqrt{5} + 8$ 20 ▶ $16\sqrt{2}, 30, 2\sqrt{17}$

EXERCISE 6*

REVISION

- 1 ▶ $(\sqrt{3})^2$ and $0.\dot{2}\dot{3}$
 2 ▶ 3, for example (answers may vary)
 3 ▶ e.g. $\sqrt{40}$ 4 ▶ $\sqrt{176}$
 5 ▶ $2\sqrt{5}$ 6 ▶ 75
 7 ▶ $11\sqrt{2}$ 8 ▶ $19\sqrt{6}$
 9 ▶ $\frac{\sqrt{3}}{6}$ 10 ▶ 8
 11 ▶ $-5 + \sqrt{14}$ 12 ▶ $37 - 20\sqrt{3}$
 13 ▶ $4 + 4\sqrt{2}$ 14 ▶ $\frac{\sqrt{5}}{10}$
 15 ▶ $2\sqrt{6}$ 16 ▶ $2 + \sqrt{6}$
 17 ▶ 2 18 ▶ $\frac{5 - \sqrt{7}}{2}$
 19 ▶ $\frac{7(\sqrt{11} - \sqrt{7})}{2}$ 20 ▶ $\frac{2 + 3\sqrt{2}}{4}$
 21 ▶ $5\sqrt{3}, 12\sqrt{3}, 18$ 22 ▶ $\sqrt{3}, \frac{1}{2}, \frac{\sqrt{3}}{2}$

EXAM PRACTICE: NUMBER 10

- 1 ▶ a $2\sqrt{5}$ b $\frac{7}{8}$
 2 ▶ a $8\sqrt{3}$ b $7\sqrt{2}$
 3 ▶ a $16 - 8\sqrt{3}$ b -2
 4 ▶ a $1 + \frac{\sqrt{5}}{5}$ b $2 + \sqrt{11}$
 5 ▶ a $\frac{7\sqrt{2}}{2}$ b $\frac{-\sqrt{2}}{6}$
 6 ▶ a $\sin 45^\circ = \frac{\sqrt{2}}{2}, \cos 45^\circ = \frac{\sqrt{2}}{2}$ b $18\sqrt{2}$ km
 7 ▶ $x = 2$

UNIT 10: ALGEBRA 10

EXERCISE 1

- 1 ▶ $\frac{3}{2}$ 2 ▶ $\frac{5}{2x}$ 3 ▶ $\frac{y}{x}$
 4 ▶ $x + 2$ 5 ▶ $\frac{x - 3}{5}$ 6 ▶ $\frac{1}{x + 2}$
 7 ▶ $x + 2$ 8 ▶ $\frac{2x}{x + 1}$ 9 ▶ $\frac{x + y}{x - y}$
 10 ▶ $\frac{4x}{x - 6}$ 11 ▶ $\frac{x + 1}{x - 3}$ 12 ▶ $\frac{x + 3}{x + 2}$

EXERCISE 1*

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

EXERCISE 2

- 1 ▶ $\frac{5x + 3}{6}$ 2 ▶ $\frac{x - 2}{4}$ 3 ▶ $\frac{8x + 12}{15}$
 4 ▶ $\frac{5x + 3}{4}$ 5 ▶ $\frac{1 - 4x}{5}$ 6 ▶ $\frac{7x + 2}{12}$
 7 ▶ $\frac{3x - 17}{10}$ 8 ▶ $\frac{5x + 8}{6}$ 9 ▶ $\frac{3x - 10}{18}$
 10 ▶ $\frac{3x + 2}{6}$ 11 ▶ $\frac{39 - 2x}{12}$ 12 ▶ $\frac{23x - 11}{10}$

EXERCISE 2*

- 1 ▶ $\frac{9x + 13}{10}$ 2 ▶ $\frac{1 - 2x}{12}$ 3 ▶ $\frac{-3x + 16}{14}$
 4 ▶ $\frac{6x - 2}{35}$ 5 ▶ $\frac{-x + 5}{2}$ 6 ▶ $\frac{x - 230}{15}$
 7 ▶ $\frac{16x - 21}{6}$ 8 ▶ $\frac{x - 6}{72}$ 9 ▶ $\frac{47x - 22}{60}$
 10 ▶ $\frac{5x - 8}{6}$ 11 ▶ $\frac{23x + 7}{18}$ 12 ▶ $\frac{59 - 78x}{10}$

EXERCISE 3

- 1 ▶ $\frac{5}{6x}$ 2 ▶ $\frac{1}{4x}$

3 ▶ $\frac{x-4}{2(x-2)}$

5 ▶ $\frac{2x}{(x-1)(x+1)}$

7 ▶ $\frac{x+8}{(x-1)(x+2)}$

9 ▶ $\frac{2}{(x-1)}$

4 ▶ $\frac{4y-2x}{x^2y}$

6 ▶ $\frac{x+10}{(x-4)(x+3)}$

8 ▶ $\frac{x^2+x-3}{x(x-3)}$

10 ▶ $\frac{3}{(x+3)}$

EXERCISE 3*

1 ▶ $\frac{5}{12x}$

3 ▶ $\frac{x}{1+x}$

5 ▶ $\frac{1}{x+1}$

7 ▶ $\frac{1}{x+1}$

9 ▶ $\frac{8}{(x-3)(x+1)}$

2 ▶ $\frac{3(x+6)}{(x+1)(x+4)}$

4 ▶ $\frac{3x^2-2y^2}{4xy}$

6 ▶ $\frac{2x}{(x+2)(x-2)}$

8 ▶ $\frac{7x-11}{2(x-1)(x+3)}$

10 ▶ $\frac{8-x}{(x-4)(x+1)(x-2)}$

EXERCISE 4

1 ▶ $\frac{(x+1)^2}{2}$

4 ▶ $2x$

7 ▶ $\frac{2a}{b}$

10 ▶ $\frac{x-2}{x-4}$

2 ▶ $(x+2)(x-1)$

5 ▶ 6

8 ▶ $\frac{p-1}{p-2}$

11 ▶ $\frac{x-3}{x-5}$

6 ▶ $\frac{y}{x}$

9 ▶ $\frac{r+2}{r-1}$

12 ▶ $\frac{x+3}{x+4}$

EXERCISE 4*

1 ▶ $\frac{2(x-3)}{x+2}$

4 ▶ $\frac{1}{x+1}$

6 ▶ $x+2$

9 ▶ $\frac{p+4}{p-5}$

12 ▶ $\frac{x-y}{x}$

2 ▶ $\frac{2(x-4)}{x-3}$

5 ▶ $\frac{(x+1)^2}{(x+2)(x+3)}$

7 ▶ $\frac{x+2}{x-2}$

10 ▶ $\frac{q+2}{q+6}$

3 ▶ $\frac{2(x-3)}{x+2}$

8 ▶ $\frac{x-4}{x+2}$

11 ▶ $\frac{y}{x+3y}$

EXERCISE 5

1 ▶ 21

4 ▶ 3

7 ▶ $\frac{1}{2}$

10 ▶ -6

2 ▶ 2

5 ▶ -8

8 ▶ $21\frac{1}{2}$

11 ▶ 2

3 ▶ $\frac{1}{2}$

6 ▶ $-\frac{2}{3}$

9 ▶ $\frac{3}{2}$

12 ▶ 0

EXERCISE 5*

1 ▶ $\frac{2}{5}$

4 ▶ 0

7 ▶ 1

10 ▶ 3

13 ▶ 6 km

2 ▶ 15

5 ▶ 15

8 ▶ $\frac{7}{3}$

11 ▶ $-\frac{8}{3}$

14 ▶ 30 km

3 ▶ $\frac{1}{3}$

6 ▶ 7

9 ▶ 4

12 ▶ $-\frac{5}{13}$

EXERCISE 6

1 ▶ -7, 2

4 ▶ $-\frac{5}{3}, 4$

7 ▶ 2

10 ▶ -1, 4

2 ▶ 6

5 ▶ $-\frac{2}{3}$

8 ▶ -4, 5

11 ▶ -6, 3

3 ▶ 2

6 ▶ $\frac{3}{4}$

9 ▶ -3, 7

12 ▶ $-\frac{1}{3}, 2$

EXERCISE 6*

1 ▶ -3.5, 1

4 ▶ 3

7 ▶ -0.768, 0.434

9 ▶ -2, 6

12 ▶ 10.47

15 ▶ $-\frac{2}{3}, 5$

2 ▶ -2, 5

5 ▶ -6, 6

8 ▶ -8.28, 0.785

10 ▶ 3.2, 5

13 ▶ -2.5

3 ▶ 4

6 ▶ $-\frac{7}{3}, 2$

11 ▶ 60

14 ▶ $\frac{2}{5}, 2$

EXERCISE 7

REVISION

1 ▶ 3

4 ▶ $\frac{x-1}{2x+3}$

7 ▶ $\frac{5x+1}{(x-1)(x+1)}$

9 ▶ -2

12 ▶ 1

2 ▶ $x+2$

5 ▶ $\frac{7x-8}{12}$

8 ▶ $\frac{4x+10}{(x+2)(x+4)}$

10 ▶ $\frac{1}{2}$

3 ▶ $\frac{x+3}{x-3}$

6 ▶ $\frac{3x-10}{18}$

11 ▶ -8, 2

EXERCISE 7*

REVISION

1 ▶ $\frac{2}{3}$

4 ▶ $\frac{x-1}{3x+1}$

7 ▶ $\frac{2x+3}{(x+1)(x+2)}$

9 ▶ 5

11 ▶ -0.464 or 6.46

2 ▶ $\frac{x-11}{x+5}$

5 ▶ $\frac{13x-5}{18}$

8 ▶ $\frac{-1}{(x-4)(x+1)}$

10 ▶ $-\frac{2}{3}$ or 1

12 ▶ -9.16 or 3.16

3 ▶ $\frac{x+4}{x-7}$

6 ▶ $\frac{5x+7}{12}$

EXAM PRACTICE: ALGEBRA 10

1 ▶ a x

2 ▶ a $\frac{22-5x}{12}$

3 ▶ a $\frac{2(x+1)}{x}$

4 ▶ a 2

c -2.24 or 6.24

b $\frac{x+2}{2}$

b $\frac{-1}{(x-4)(x+1)}$

b $(x-2)(2x-1)$

b $\frac{1}{3}$ or 2

c $\frac{x-1}{x+2}$

UNIT 10: GRAPHS 9

EXERCISE 1

1 ▶ $\frac{dy}{dx} = 0$

3 ▶ $\frac{dy}{dx} = 3x^2$

5 ▶ $\frac{dy}{dx} = 5x^4$

2 ▶ $\frac{dy}{dx} = 2$

4 ▶ $\frac{dy}{dx} = 4x^3$

6 ▶ $\frac{dy}{dx} = 10x^9$

7 ▶ $\frac{dy}{dx} = 6x^2$

8 ▶ $\frac{dy}{dx} = 8x^3$

9 ▶ $\frac{dy}{dx} = 10x^4$

10 ▶ $\frac{dy}{dx} = 20x^9$

11 ▶ $\frac{dy}{dx} = 0$

12 ▶ $\frac{dy}{dx} = 0$

13 ▶ $\frac{dy}{dx} = 2$

14 ▶ $\frac{dy}{dx} = 12$

15 ▶ $\frac{dy}{dx} = 24$

16 ▶ $\frac{dy}{dx} = 20$

EXERCISE 1*

1 ▶ $\frac{dy}{dx} = -2x$

2 ▶ $\frac{dy}{dx} = -3x^2$

3 ▶ $\frac{dy}{dx} = -x^{-2}$

4 ▶ $\frac{dy}{dx} = -2x^{-3}$

5 ▶ $\frac{dy}{dx} = -3x^{-4}$

6 ▶ $\frac{dy}{dx} = -4x^{-5}$

7 ▶ $\frac{dy}{dx} = -\frac{1}{x^2}$

8 ▶ $\frac{dy}{dx} = -\frac{2}{x^3}$

9 ▶ $\frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}}$

10 ▶ $\frac{dy}{dx} = \frac{1}{2\sqrt{x}}$

11 ▶ $\frac{dy}{dx} = \frac{1}{3}x^{-\frac{2}{3}}$

12 ▶ $\frac{dy}{dx} = \frac{1}{3\sqrt[3]{x^2}}$

13 ▶ $\frac{dy}{dx} = -1$

14 ▶ $\frac{dy}{dx} = -\frac{1}{4}$

15 ▶ $\frac{dy}{dx} = \frac{1}{4}$

16 ▶ $\frac{dy}{dx} = \frac{1}{12}$

EXERCISE 2

1 ▶ $\frac{dy}{dx} = 2x + 1$

2 ▶ $\frac{dy}{dx} = 2x + 2$

3 ▶ $\frac{dy}{dx} = 3x^2 + 2x$

4 ▶ $\frac{dy}{dx} = 4x^3 + 3x^2 + 2x + 1$

5 ▶ $\frac{dy}{dx} = 6x^2 - 6x$

6 ▶ $\frac{dy}{dx} = 50x^4 + 5$

7 ▶ $\frac{dy}{dx} = -2x^{-3} - x^{-2}$

8 ▶ $\frac{dy}{dx} = -4x^{-3} - 3x^{-2}$

9 ▶ $\frac{dy}{dx} = -6x^{-3} + 2x^{-2}$

10 ▶ $\frac{dy}{dx} = -6x^{-4} + 12x^{-5}$

11 ▶ $\frac{dy}{dx} = 100x^9 + 25x^4$

12 ▶ $\frac{dy}{dx} = -100x^{-11} + 25x^{-6}$

EXERCISE 2*

13 ▶ $\frac{dy}{dx} = 3$

14 ▶ $\frac{dy}{dx} = 6$

15 ▶ $\frac{dy}{dx} = 16$

16 ▶ $\frac{dy}{dx} = 125$

17 ▶ $\frac{dy}{dx} = 9$

18 ▶ $\frac{dy}{dx} = -9$

1 ▶ $\frac{dy}{dx} = 2x + 3$

2 ▶ $\frac{dy}{dx} = 3x^2 + 6x$

3 ▶ $\frac{dy}{dx} = 2x + 8$

4 ▶ $\frac{dy}{dx} = 4x + 11$

5 ▶ $\frac{dy}{dx} = 2x + 8$

6 ▶ $\frac{dy}{dx} = 8x - 12$

7 ▶ $\frac{dy}{dx} = 18x - 6$

8 ▶ $\frac{dy}{dx} = 27x^2 - 12x + 1$

9 ▶ $\frac{dy}{dx} = 18x - 2x^{-3}$

10 ▶ $\frac{dy}{dx} = 18x - 2x^{-3}$

11 ▶ $\frac{dy}{dx} = -\frac{1}{x^2} - \frac{2}{x^3}$

12 ▶ $\frac{dy}{dx} = -\frac{1}{x^2} + \frac{2}{x^3}$

13 ▶ $\frac{dy}{dx} = -\frac{2}{x^2} - \frac{6}{x^3}$

14 ▶ $\frac{dy}{dx} = 4x + 4$

15 ▶ $\frac{dy}{dx} = 3 + \frac{3}{x^2}$

16 ▶ $\frac{dy}{dx} = 1 + \frac{1}{2\sqrt{x}}$

17 ▶ $\frac{dy}{dx} = 1 - \frac{1}{2\sqrt{x^3}}$

18 ▶ $\frac{dy}{dx} = 1 + \frac{1}{2\sqrt{x^3}}$

19 ▶ $\frac{dy}{dx} = 5$

20 ▶ $\frac{dy}{dx} = 15$

21 ▶ $\frac{dy}{dx} = 4$

22 ▶ $\frac{dy}{dx} = -8$

23 ▶ $\frac{dy}{dx} = 5$

24 ▶ $\frac{dy}{dx} = 6$

EXERCISE 3

1 ▶ $y = 7x - 3$

2 ▶ $y = 2x + 4$

3 ▶ a $\frac{dy}{dt} = t - 3$

b i $\frac{dy}{dt} = -2 \text{ m/s}$

ii $\frac{dy}{dt} = 0 \text{ m/s}$

iii $\frac{dy}{dt} = 3 \text{ m/s}$

4 ▶ a $\frac{dP}{dt} = t + 1$

b i $\frac{dP}{dt} = 2 \text{ millions/day}$

ii $\frac{dP}{dt} = 4 \text{ millions/day}$

iii $\frac{dP}{dt} = 5 \text{ millions/day}$

- 5 ▶ a $\frac{dT}{dt} = 6t + 5$
 b i $\frac{dT}{dt} = 11^\circ\text{C/min}$
 ii $\frac{dT}{dt} = 35^\circ\text{C/min}$
 iii $\frac{dT}{dt} = 65^\circ\text{C/min}$

- 6 ▶ a $\frac{dh}{dt} = 11 - 4t$
 b i $\frac{dh}{dt} = 7 \text{ m/hr}$
 ii $\frac{dh}{dt} = -1 \text{ m/hr}$
 iii $\frac{dh}{dt} = -7 \text{ m/hr}$

EXERCISE 3*

- 1 ▶ $y = 7x - 15$
 2 ▶ $y = -20x - 14$
 3 ▶ a $\frac{dN}{dt} = 40t + 80$
 b i $\frac{dN}{dt} = 80 \text{ people/hr}$
 ii $\frac{dN}{dt} = 160 \text{ people/hr}$
 iii $\frac{dN}{dt} = 230 \text{ people/hr}$
 4 ▶ a $\frac{dQ}{dt} = 3t^2 - 16t + 24$
 b i $\frac{dQ}{dt} = 11 \text{ m}^3/\text{s}$
 ii $\frac{dQ}{dt} = 2.75 \text{ m}^3/\text{s}$
 iii $\frac{dQ}{dt} = 3.6875 \text{ m}^3/\text{s}$
 5 ▶ a $\frac{dT}{dm} = -\frac{400}{m^2}$
 b i $\frac{dT}{dm} = -16^\circ\text{C/min}$
 ii $\frac{dT}{dm} = -4^\circ\text{C/min}$
 6 ▶ a $\frac{dP}{dt} = 4t - \frac{180}{t^2}$
 b i $\frac{dP}{dt} = -176 \text{ spiders/month}$
 ii $\frac{dP}{dt} = 46.75 \text{ spiders/month}$

EXERCISE 4

- 1 ▶ $\frac{dy}{dx} = 2x - 2, (1, 2) \text{ min.}$
 2 ▶ $\frac{dy}{dx} = 2x + 4, (-2, -5) \text{ min.}$
 3 ▶ $\frac{dy}{dx} = 6 - 2x, (3, 14) \text{ max.}$
 4 ▶ $\frac{dy}{dx} = -8 - 2x, (-4, 28) \text{ max.}$

- 5 ▶ $\frac{dy}{dx} = 4x - 4, (1, 5) \text{ min.}$
 6 ▶ $\frac{dy}{dx} = -12 - 4x, (-3, 26) \text{ max.}$
 7 ▶ $\frac{dy}{dx} = 2x - 2, (1, -4) \text{ min.}$
 8 ▶ $\frac{dy}{dx} = -8x, (0, 1) \text{ max.}$

- 9 ▶ a $\frac{dN}{dt} = 100t - 300$
 b $t = 3, 8:03 \text{ pm}$
 10 ▶ a $\frac{dN}{dt} = 200 - 20t$
 b 2000 leaves, when $t = 10$, on September 10th

EXERCISE 4*

- 1 ▶ $\frac{dy}{dx} = 3x^2 - 12x, (0, 0) \text{ max}, (4, -32) \text{ min.}$
 2 ▶ $\frac{dy}{dx} = 3x^2 + 6x, (0, 0) \text{ min}, (-2, 4) \text{ max.}$
 3 ▶ $\frac{dy}{dx} = 3x^2 - 18x, (6, -105) \text{ min}, (0, 3) \text{ max.}$
 4 ▶ $\frac{dy}{dx} = -6x - 3x^2, (-2, 0) \text{ min}, (0, 4) \text{ max.}$
 5 ▶ $\frac{dy}{dx} = 3x^2 + 6x - 9, (1, 0) \text{ min}, (-3, 32) \text{ max.}$
 6 ▶ $\frac{dy}{dx} = -18 - 24x - 6x^2, (-3, -11) \text{ min}, (-1, 19) \text{ max.}$
 7 ▶ $\frac{dy}{dx} = 6x^2 + 18x - 24, (1, -13) \text{ min}, (-4, 112) \text{ max.}$
 8 ▶ $\frac{dy}{dx} = 12x^2 - 8x + 1, (\frac{1}{2}, 0) \text{ min}, (\frac{1}{6}, \frac{2}{27}) \text{ max.}$
 9 ▶ a $V = x(10 - 2x)^2 = 100x - 40x^2 + 4x^3$
 b $\frac{dV}{dx} = 100 - 80x + 12x^2$
 c $\frac{dV}{dx} = 0 = (3x - 5)(x - 5), V_{\text{max}} \text{ at } x = \frac{5}{3},$
 $V_{\text{max}} = \frac{2000}{27}, \frac{20}{3} \times \frac{20}{3} \times \frac{5}{3}$
 $x = 5$ is not in the domain for the model.
 10 ▶ a $\frac{dT}{dt} = 5 - \frac{20}{t^2}$
 b T_{min} at $t = 2$ from graph,
 $T = 15^\circ\text{C}$ March 1st

EXERCISE 5

- 1 ▶ a $v = 20t - 30 \text{ m/s}, 10 \text{ m/s}$
 b $a = 20 \text{ m/s}^2$
 2 ▶ a $v = 7 - 2t \text{ m/s}, 1 \text{ m/s}$
 b $a = -2 \text{ m/s}^2$
 3 ▶ a $v = 3t^2 + 4t - 3 \text{ m/s}, 17 \text{ m/s}$
 b $a = 6t + 4 \text{ m/s}^2, 16 \text{ m/s}^2$

- 4 ▶ a $v = 12 + 6t - 3t^2$ m/s, 12 m/s
 b $a = 6 - 6t$ m/s², -6 m/s²
- 5 ▶ $v = 16 - 8t$, $v = 0$ at $t = 2$, $s_{\max} = 16$ m
- 6 ▶ a $v = 24$ m/s
 b $a = 12 - 2t$ m/s², $a = 8$ m/s²
 c $t = 6$, $v_{\max} = 40$ m/s

EXERCISE 5*

- 1 ▶ a $v = 10t + \frac{4}{t^2}$ m/s, 21 m/s
 b $a = 10 - \frac{8}{t^3}$ m/s², 9 m/s²
- 2 a $v = \frac{5}{\sqrt{t}}$ m/s, $\frac{5}{2}$ m/s
 b $a = -\frac{5}{2\sqrt{t^3}}$ m/s², $a = -\frac{5}{16}$ m/s²
- 3 a $s = 50$ m b $t = \sqrt{10}$ s
 c $-10\sqrt{10}$ m/s
- 4 a $v = 40 - 10t$ m/s, $t = 0$, 40 m/s
 b $v = 0$, $t = 4$, $s = 80$ m
- 5 a $a = -1 + \frac{25}{t^2}$ km/s²
 b $t = 5$, $v_{\max} = 10$ km/s
- 6 a $t = 11$ s b $v = -60$ m/s
 c Mean speed = $\frac{305}{11}$ m/s

ACTIVITY 1

- a Volume = $\pi r^2 h$
 $50 = \pi r^2 h$
 $\frac{50}{\pi r^2} = h$
 Area = $2\pi r^2 + 2\pi r h$
 $A = 2\pi r^2 + \frac{2r\pi \times 50}{\pi r^2}$
 $A = \pi r^2 + \frac{100}{r}$
- c $r = 2.00$ m (3 s.f.), $h = 3.99$ m (3 s.f.),
 $A_{\min} = 75.1$ m² (3 s.f.)

EXERCISE 6

REVISION

- 1 ▶ $\frac{dy}{dx} = 4$
- 2 ▶ a $\frac{dp}{dt} = \$40\,000/\text{yr}$ (profit increasing)
 b $\frac{dp}{dt} = -\$40\,000/\text{yr}$ (profit decreasing)
- 3 ▶ (0, -2) minimum point
- 4 ▶ a $v = 25$ m/s b $a = 6$ m/s²

EXERCISE 6*

REVISION

- 1 ▶ $y = 11x - 25$
- 2 ▶ $t = 50$, $n_{\max} \approx 104\,167$

- 3 ▶ (4, -13) minimum point, (1, 14) maximum point
- 4 ▶ a $a = -1 + \frac{144}{t^2}$ m/s²
 b $a = 0$ at $t = 12$, $v_{\max} = 6$ m/s

EXAM PRACTICE: GRAPHS 9

- 1 ▶ a 19 b 14 c 4
- 2 ▶ (2, 3) minimum point, (1, 4) maximum point
- 3 ▶ a $\frac{dp}{dx} = -\frac{1}{3} + \frac{2400}{x^2}$
 b $x = 60\sqrt{2} = 84.9$ km/hr,
 $y_{\max} = 13.4$ km/litre
- 4 ▶ a $v = 6$ m/s b $a = -\frac{5}{2}$ m/s²

UNIT 10: SHAPE AND SPACE 10

ACTIVITY 1

$\theta(^{\circ})$	0	30	60	90	120	150	180
$\sin \theta$	0	0.5	0.87	1	0.87	0.5	0

$\theta(^{\circ})$	210	240	270	300	330	360
$\sin \theta$	-0.5	-0.87	-1	-0.87	-0.5	0

The graph of $y = \sin \theta$ is given in the text following Activity 1.

ACTIVITY 2

$\theta(^{\circ})$	0	30	60	90	120	150	180
$\cos \theta$	1	0.87	0.5	0	-0.5	-0.87	-1

$\theta(^{\circ})$	210	240	270	300	330	360
$\cos \theta$	-0.87	-0.5	0	0.5	0.87	1

The graph of $y = \cos \theta$ is given in the text following Activity 2.

ACTIVITY 3

$\theta(^{\circ})$	0	30	60	90	120	150	180
$\tan \theta$	0	0.58	1.7	-	-1.7	-0.58	0

$\theta(^{\circ})$	210	240	270	300	330	360
$\tan \theta$	0.58	1.7	-	-1.7	-0.58	0

The graph of $y = \tan \theta$ is given in the text following Activity 3.

EXERCISE 1

- 1 ▶ a $\theta = 0^{\circ}, 180^{\circ}, 360^{\circ}$ b $\theta = 90^{\circ}, 270^{\circ}$
 c $\theta = 0^{\circ}, 180^{\circ}, 360^{\circ}$ d $\theta = 90^{\circ}$
 e $\theta = 0^{\circ}, 360^{\circ}$ f $\theta = 45^{\circ}, 225^{\circ}$
- 2 ▶ a $\theta = 30^{\circ}, 150^{\circ}$ b $\theta = 60^{\circ}, 300^{\circ}$
 c $\theta = 30^{\circ}, 210^{\circ}$ d $\theta = 45^{\circ}, 135^{\circ}$
 e $\theta = 45^{\circ}, 315^{\circ}$ f $\theta = 60^{\circ}, 240^{\circ}$

EXERCISE 1*

- 1 ▶ a $\theta = -360^{\circ}, -180^{\circ}, 0^{\circ}, 180^{\circ}, 360^{\circ}, 540^{\circ}, 720^{\circ}$
 b $\theta = -270^{\circ}, -90^{\circ}, 90^{\circ}, 270^{\circ}, 450^{\circ}, 630^{\circ}$
 c $\theta = -360^{\circ}, -180^{\circ}, 0^{\circ}, 180^{\circ}, 360^{\circ}, 540^{\circ}, 720^{\circ}$

- d** $\theta = -270^\circ, 90^\circ, 450^\circ$
e $\theta = -360^\circ, 0^\circ, 360^\circ, 720^\circ$
f $\theta = -315^\circ, -135^\circ, 45^\circ, 225^\circ, 405^\circ, 585^\circ$
2 ▶ **a** $\theta = -150^\circ, -30^\circ, 210^\circ, 330^\circ, 570^\circ, 690^\circ$
b $\theta = -240^\circ, -120^\circ, 120^\circ, 240^\circ, 480^\circ, 600^\circ$
c $\theta = -210^\circ, -30^\circ, 150^\circ, 330^\circ, 510^\circ, 690^\circ$
d $\theta = -135^\circ, -45^\circ, 225^\circ, 315^\circ, 585^\circ, 675^\circ$
e $\theta = -225^\circ, -135^\circ, 135^\circ, 225^\circ, 495^\circ, 585^\circ$
f $\theta = -240^\circ, -60^\circ, 120^\circ, 300^\circ, 480^\circ, 660^\circ$

EXERCISE 2

- 1** ▶ $x = 5.94$ **2** ▶ $y = 11.1$
3 ▶ $MN = 39.0 \text{ cm}$ **4** ▶ $RT = 8.75 \text{ cm}$
5 ▶ $AC = 37.8 \text{ cm}$ **6** ▶ $YZ = 33.0 \text{ cm}$
7 ▶ $x = 37.3^\circ$ **8** ▶ $y = 37.8^\circ$
9 ▶ $\angle ABC = 38.8^\circ$ **10** ▶ $\angle XYZ = 26.0^\circ$
11 ▶ $\angle ACB = 62.2^\circ$ **12** ▶ $\angle DCE = 115^\circ$

EXERCISE 2*

- 1** ▶ $x = 29.7$ **2** ▶ $y = 8.35$
3 ▶ $\angle LMN = 67.4^\circ$ **4** ▶ $\angle RST = 71.9^\circ$
5 ▶ $EF = 10.4 \text{ cm}, \angle DEF = 47.5^\circ, \angle FDE = 79.0^\circ$
6 ▶ $MN = 10.8 \text{ cm}, \angle MLN = 68.3^\circ, \angle LNM = 49.7^\circ$
7 ▶ 13.5 km **8** ▶ 1089 m
9 ▶ $BC = 261 \text{ m}$
10 ▶ $YT = 53.3 \text{ m}, 17.35 \text{ m}$
11 ▶ **a** 11.3 cm **b** 38.7°
12 ▶ 59.0° or 121.0°

EXERCISE 3

- 1** ▶ $x = 7.26$ **2** ▶ $b = 8.30$
3 ▶ $AB = 39.1 \text{ cm}$ **4** ▶ $AB = 32.9 \text{ cm}$
5 ▶ $RT = 24.2 \text{ cm}$ **6** ▶ $MN = 6.63 \text{ cm}$
7 ▶ $X = 73.4^\circ$ **8** ▶ $Y = 70.5^\circ$
9 ▶ $\angle ABC = 92.9^\circ$ **10** ▶ $\angle XYZ = 110^\circ$

EXERCISE 3*

- 1** ▶ $x = 9.34$ **2** ▶ $y = 13.3$
3 ▶ $\angle XYZ = 95.5^\circ$ **4** ▶ $\angle ABC = 59.0^\circ$
5 ▶ $\angle BAC = 81.8^\circ$ **6** ▶ $\angle RST = 27.8^\circ$
7 ▶ **a** 30.4 km **b** 092°
8 ▶ **a** 10.3 km and 205° **b** 8.60 km
9 ▶ 11.6 km
10 ▶ **a** $VWU = 36.3^\circ$ **b** 264°

EXERCISE 4

- 1** ▶ **a** 9.64 **b** 38.9°
2 ▶ **a** 6.62 **b** 49.0°
3 ▶ **a** 54.8° **b** 92.1° **c** 33.1°
4 ▶ **a** 24.1° **b** 125.1° **c** 30.8°
5 ▶ **a** 7.88 **b** 6.13
6 ▶ **a** 4.13 **b** 4.88
7 ▶ **a** 79.1° **b** 7.77

- 8** ▶ **a** 44.7° **b** 4.11
9 ▶ **a** 16.8 km **b** 168°
10 ▶ **a** 8.89 km **b** 063.0°

EXERCISE 4*

- 1** ▶ 055.1°
2 ▶ **a** 52.7 km **b** 076.9°
3 ▶ $247 \text{ km}, 280^\circ$
4 ▶ $14.7 \text{ km/h}, 088.9^\circ$
5 ▶ **a** 50.4° **b** 7.01 m **c** 48.4°
6 ▶ $x = 5.29 \text{ cm}, y = 8.72 \text{ cm}$
7 ▶ $\angle BXA = 75.9^\circ$
8 ▶ $CS = 2.64 \text{ km}, 040.2^\circ$
9 ▶ **a** 38.1° **b** 29.4 cm
10 ▶ **a** 16.8 cm **b** 9.23 cm **c** 98.3°

EXERCISE 5

- 1** ▶ 7.39 cm^2 **2** ▶ 29.7 cm^2
3 ▶ 36.2 cm^2 **4** ▶ 8.46 cm^2
5 ▶ 121 cm^2 **6** ▶ 173 cm^2

EXERCISE 5*

- 1** ▶ 48.1 cm **2** ▶ 16.5 cm
3 ▶ 64.3° **4** ▶ 53.5 cm^2
5 ▶ 65.8 cm **6** ▶ $15\,600 \text{ m}^2$ (3 s.f.)

ACTIVITY 5

- a** $\frac{1}{2}ab \sin C$
b $\frac{1}{2}ac \sin B, \frac{1}{2}bc \sin A$
c Each expression must have the same value so,
 $\frac{1}{2}ab \sin C = \frac{1}{2}ac \sin B$
 $ab \sin C = ac \sin B$
 $b \sin C = c \sin B$
 $\frac{b}{\sin B} = \frac{c}{\sin C}$

ACTIVITY 6

- a** $a^2 = h^2 + b^2 - 2bx + x^2$
b $c^2 = h^2 + x^2$
c Substituting for $h^2 + x^2$ in part **a** gives
 $a^2 = b^2 + c^2 - 2bx$
d $x = c \cos A$, so $a^2 = b^2 + c^2 - 2bc \cos A$

EXERCISE 6

REVISION

- 1** ▶ A(90, 1), B(180, 0), C(270, -1), D(540, 0)
2 ▶ A(90, 0), B(180, -1), C(360, 1)
3 ▶ **a** Every 180° **b i** 1.7 **ii** -1.7
c Rotational symmetry of order 2 about (180, 0)
d i 240° **ii** 280° **iii** 300°
4 ▶ **a** 22.9° **b** 22.9
5 ▶ 148 cm^2
6 ▶ **a** $50^\circ, 60^\circ, 70^\circ$ **b** $AB = 4.91 \text{ km}$
7 ▶ **a** 8.04 cm **b** 82.0° **c** 104 cm^2
8 ▶ **a** 061.2° **b** 224 km^2

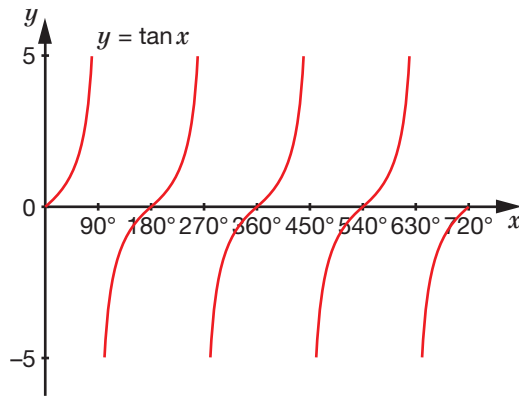
EXERCISE 6*

REVISION

1 ► A(90, 1), B(180, 0), C(-90, -1), D(-180, 0)

2 ► A(0, 1), B(180, -1), C(-90, 0), D(-180, -1)

3 ► a



b 60°, 240°, 420°, 600°

4 ► BC = 506 m

5 ► 6.32 cm and 9.74 cm

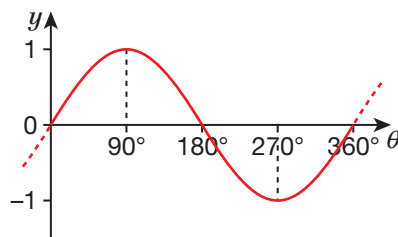
6 ► 4.68 m²

7 ► a 15.2 cm b 68.0°

8 ► 79.5° or 100.5°

EXAM PRACTICE: SHAPE AND SPACE 10

1 ► a

b $\theta = 60^\circ, 120^\circ$

2 ► 10.4 cm, 35.5°

3 ► a 47.1° b 131 cm²

4 ► a 31.0 km b 078°

UNIT 10: HANDLING DATA 7

EXERCISE 1

1 ► a $\frac{1}{9}$ b $\frac{4}{9}$ 2 ► a $\frac{1}{5}$ b $\frac{1}{5}$ c Let X be the number of kings dealt in the first three cards:

$$P(X \geq 1) = 1 - P(X = 0)$$

$$= 1 - \frac{16}{20} \times \frac{15}{19} \times \frac{14}{18} = \frac{29}{57}$$

3 ► a $\frac{43}{63}$ b $\frac{20}{63}$ c $\frac{2}{7}$ d Let X be the number of beads added to the box:

$$P(W_2) = \frac{2}{7} \times \frac{(2+X)}{(7+X)} + \frac{5}{7} \times \frac{2}{(7+X)}$$

$$= \frac{2}{[7(7+X)]} \times [(2+X) + 5] = \frac{2}{7}$$

Therefore true!

4 ► a 0.0459 b 0.3941

5 ► a 0.655 b 0.345

6 ► a 0.1 b 0.7 c 0.36

d 0.147 e 0.441

7 ► a $\frac{1}{36}$ b $\frac{5}{18}$ 8 ► a i $\frac{1}{15}$ ii $\frac{1}{15}$ b $\frac{104}{105}$ 9 ► a $\frac{2}{9}$ b $\frac{5}{9}$ c $\frac{1}{9}$ 10 ► a $\frac{2}{15}$ b $\frac{5}{21}$ c $\frac{2}{21}$

EXERCISE 1*

1 ► a 0.0034 b 0.0006 c 0.0532

2 ► a 0.6 b 0.025 c 0.725

3 ► a $\frac{1}{8}$ b $\frac{8}{15}$ c $\frac{13}{60}$ 4 ► a $\frac{5}{18}$ b Let event X be 'clock is slow at noon on Wednesday':

$$P(X) = 1 - P(\bar{X}) = 1 - \frac{7}{54} = \frac{47}{54}$$

5 ► a $\frac{1}{11}$ b $\frac{1}{3}$ c $\frac{3}{11}$ d $\frac{9}{55}$ 6 ► a $\frac{9}{16}$ b $\frac{27}{64}$ c $\frac{29}{128}$ 7 ► a $\frac{19}{66}$ b $\frac{13}{33}$ c $\frac{15}{22}$ 8 ► a $\frac{1}{16}$ b $\frac{1}{4}$ c $\frac{15}{16}$ 9 ► a $P(H_1) = \frac{1}{4}$

$$b \quad P(H_2) = P(HH) + P(H'H) = \frac{1}{4} \times \frac{12}{51} + \frac{3}{4} \times \frac{13}{51}$$

$$= \frac{1}{4}$$

$$c \quad P(H_3) = P(HHH) + P(H'H'H) + P(H'HH) + P(HH'H)$$

$$= \frac{1}{4} \times \frac{12}{51} \times \frac{11}{50} + \frac{3}{4} \times \frac{38}{51} \times \frac{13}{50} +$$

$$\frac{3}{4} \times \frac{13}{51} \times \frac{12}{50} + \frac{1}{4} \times \frac{39}{51} \times \frac{12}{50}$$

$$= \frac{1}{4}$$

10 ► a $P(RR) = \frac{3}{5} \times \frac{5}{9} = \frac{1}{3}$

Outcome		Probability
Bag X	Bag Y	
4R + 4W	5R + 5W	$\frac{1}{3}$
5R + 3W	4R + 6W	$\frac{8}{15}$
6R + 2W	3R + 7W	$\frac{2}{15}$

c i $P(WY \rightarrow X) = \frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$ ii $P(RY \rightarrow X) = \frac{2}{15} \times \frac{3}{10} = \frac{1}{25}$

$$\begin{aligned} \text{iii } P(RY \rightarrow X \text{ or } WY \rightarrow X) \\ &= \frac{8}{15} \times \frac{4}{10} + \frac{2}{15} \times \frac{7}{10} = \frac{23}{75} \\ \text{iv } P(WY \rightarrow X \text{ or } WY \rightarrow X) \\ &= \frac{8}{15} \times \frac{6}{10} + \frac{1}{3} \times \frac{1}{2} = \frac{73}{150} \end{aligned}$$

ACTIVITY 1

Possible questions:

Have you ever broken a school rule?

Do you enjoy Mathematics?

Do you think the number 13 is unlucky?

Do you know the birthday of your parents?

Do you think school meals are delicious?

ACTIVITY 2

Let Y be the event that Yosef wins the game.

$$P(O) + P(Y) = 1$$

$$P(Y) = 1 - P(O) = 1 - \frac{6}{11} = \frac{5}{11}$$

(Clearly it is an advantage to go first!)

EXERCISE 2

REVISION

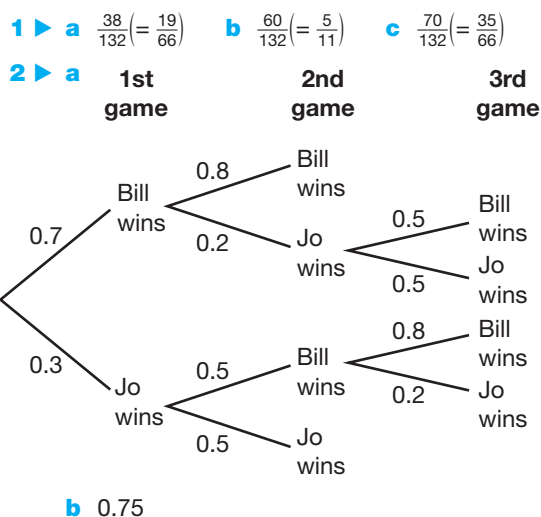
- 1 ▶ a i $\frac{4}{9}$ ii $\frac{4}{9}$ b $\frac{7}{27}$
 2 ▶ a 0.36 b 0.42
 c 0.256 (3 s.f.)
 3 ▶ a $\frac{6}{25}$ b $\frac{19}{25}$
 c i $\frac{12}{43}$ ii $\frac{31}{43}$ d $\frac{191}{597}$
 4 ▶ a 0.1 b 0.1 c 0.69
 5 ▶ a 0.9 b 0.3 c 0.35

EXERCISE 2*

REVISION

- 1 ▶ a $\frac{48}{125}$ b $\frac{12}{125}$ c $\frac{61}{125}$
 2 ▶ a 0.614 b 0.0574 c 0.0608
 3 ▶ a $\frac{19}{45}$ b i $\frac{2}{15}$ ii $\frac{8}{105}$
 4 ▶ $p = \frac{1}{2}$
 5 ▶ b i $\frac{9}{16}$ ii $\frac{7}{16}$ c $\frac{1}{4}$

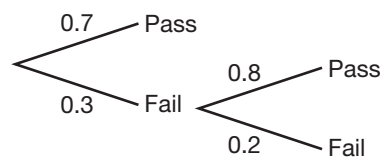
EXAM PRACTICE: HANDLING DATA 7



3 ▶ a

1st attempt

2nd attempt



b 0.24

c $P(\text{3rd attempt}) = 0.048$, $P(\text{4th attempt}) = 0.0096$, so $P(\text{3rd or 4th}) = 0.0576$

OTHER ANSWERS

FACT FINDER: GOTTHARD BASE TUNNEL

EXERCISE 1

- 1 ▶ 1999
 2 ▶ $\$2.01 \times 10^6$ per day
 3 ▶ 2.68×10^3 m
 4 ▶ 6.20×10^9 kg
 5 ▶ $k = \frac{750}{79}$

EXERCISE 1*

- 1 ▶ a 8.12×10^6 m³ b 32 480 classrooms
 2 ▶ 5.05×10^2 m³/s
 3 ▶ 08:20:19
 4 ▶ 2400 kg/m³
 5 ▶ $p = 24.85$, $q = 20$, $p^q = 8.06 \times 10^{27}$

FACT FINDER: MOUNT VESUVIUS

EXERCISE 1

- 1 ▶ 1736 years 2 ▶ 14.4%
 3 ▶ $\approx 53\,300$ years 4 ▶ 57.3%
 5 ▶ 932°F 6 ▶ 0.524 m/s

EXERCISE 1*

- 1 ▶ a 3.20×10^7 m³ b 7.17×10^7 m³
 2 ▶ a 35 years approx. b 1979!
 3 ▶ 4.63×10^4 m³/s
 4 ▶ a 2.08×10^5 tonnes/s
 b Approx. 208 000 cars per second!
 5 ▶ 3.69×10^9 m³ 6 ▶ 9.93 km²

FACT FINDER: THE SOLAR SYSTEM

EXERCISE 1

- 1 ▶ Diameter = $\frac{12\,800 \times 8}{1\,390\,000} = 0.07$ cm
 Distance = $\frac{1.5 \times 10^8 \times 8}{1\,390\,000} = 863$ cm

2 ▶

Body	Diameter (mm)	Distance from the orange OR 'Sun' (m)
Sun	80	
Earth	0.737	8.63
Mars	0.391	13.1
Jupiter	8.23	44.8

3 ► 14.4 m

4 ► 8.56 years

5 ► 8.3 min

EXERCISE 1*

1 ► 9.46×10^{12} km

2 ► 2287 km (approx. London–Athens)

3 ► 2 270 000 years

4 ► 2.08×10^{19} km5 ► 2.84×10^3 revolutions around Earth

FACT FINDER: THE WORLD'S POPULATION

EXERCISE 1

1 ► a 1927 b 1960

2 ► a 8.25×10^7 people

b 2.62 people/sec

c 1.93×10^9

3 ► 3.6%

4 ► 1.85×10^7 km²5 ► 398 people/km²

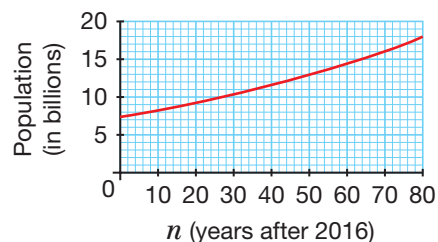
EXERCISE 1*

1 ► a 1.0113

b i 7.38×10^9 ii 7.47×10^9 iii 7.64×10^9 2 ► Multiplying factor is 1.0113 each year, so n years after 2016: $P = 7.3 \times 10^9 \times 1.0113^n$

3 ► a

Year	2016	2020	2040	2060	2080	2100
n	0	4	24	44	64	84
$P(\times 10^9)$	7.3	7.6	9.6	12	15	19



b i Population at start of 2016 is 7.3×10^9
Population is 14.6×10^9 at about start of 2078.

ii UN estimate for 2011 is 11.2 billion.
Model estimate is 19 billion, so a huge difference of 7.8 billion.
UN hopes that education about contraception will spread faster around the world.

4 ► Population density of habitable land in the year 2100 is 1012 people/km².
Approximately 2.5 times the population density in 2016.

5 ► Mass of Earth 6.6×10^{24} kg

Mass of humans in year 4733 = $7.3 \times 10^9 \times 50 \times (1.0113)^{(4733-2016)} = 6.6 \times 10^{24}$ kg

The mass of the Earth will equal the mass of humans in year 4733 assuming a rate of growth of 1.113% p.a. is constant.

FACT FINDER: THE TOUR DE FRANCE 2015

EXERCISE 1

1 ► 198

2 ► 43.2 km/hr

3 ► 90 hrs 2 mins 48 secs

4 ► a 53.4% b 0.164%

5 ► 107 000 burgers (3 s.f.)

EXERCISE 1*

1 ► 0.0743

2 ► a 6.51 m/s b 0.483 m/s

3 ► 1690%

4 ► 22.4 pedal strokes/dollar

5 ► 347 revs/min

CHALLENGES

1 ► 204

2 ► $\frac{1}{4}$

3 ► 39°

4 ► $2\pi x$ m

5 ► 1089

6 ► 333 333 332 666 666 667

7 ► 225

8 ► 59 (43 and 16)

9 ► $\frac{11}{24}$ 10 ► 100π

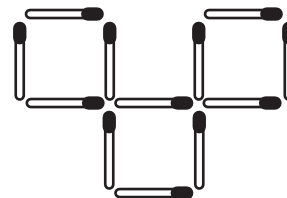
11 ► 4.8 m

12 ► 6 cm²13 ► Dividing by zero ($a - b$) in the third line

14 ► 37

15 ► 7.5 cm

16 ►

17 ► 9 cm²18 ► a 70.7 m² b 34.4 m²

19 ► 10 extra bars

20 ► $\frac{h}{n} = \frac{p}{100}$ and $\frac{(h+1)}{(n+1)} = \frac{(p+1)}{100} \Rightarrow n + p = 99$

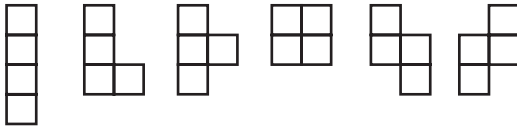
21 ► 24 cm

22 ▶ a $2.7 \times 10^{-29} \text{ m}^3$

b 7.4×10^{24}

c 5.6×10^7

23 ▶ a



b No. When the 7×4 rectangle is coloured as a chess board, 14 squares will be one colour, and 14 another colour. When the tetrominoes are coloured, the 3rd shape from the left above can only be coloured with 3 squares one colour and 1 square another colour. All the rest when coloured have 2 squares one colour and 2 squares another colour. The 7 tetrominoes will have 15 squares one colour and 13 another colour, so they cannot fit together as required.

24 ▶ 778.75 days

25 ▶ 60

26 ▶ $6(\sqrt{3} - 1) \text{ cm}$

27 ▶ Students' proof

28 ▶ 2 cm^2

29 ▶ a 305 m^2 **b** 218 m^2

30 ▶ $y = 1 - x$, $y^4 = x^4 - 5$

$$5 = x^4 - y^4 = (x^2 - y^2)(x^2 + y^2) \quad [1]$$

$$x + y = 1 \quad [2]$$

$$5 = (x + y)(x - y)[(x + y)^2 - 2xy]$$

$$= (x - y)[1 - 2xy]$$

$$5 = (2x - 1)[1 - 2x(1 - x)]$$

$$= (2x - 1)[2x^2 - 2x + 1]$$

$$0 = 2x^3 - 3x^2 + 2x - 3$$

$$x = \frac{3}{2}, y = \frac{1}{2},$$

and from Pythagoras' Theorem

$$d^2 = \left(\frac{3}{2}\right)^2 + \left(\frac{1}{2}\right)^2 = \frac{5}{2}, \text{ so } d = \sqrt{\frac{5}{2}}$$