UNIT 5 ANSWERS

UNIT 5: NUMBER 5

EXERCISE 1

1 ▶ 11.9 **2** ▶ 8.10 **3** ▶ 7.81
4 ▶ 6.57 **5** ▶ 49.9 **6** ▶ 0.779
7 ▶ 17.0 **8** ▶ 40.0 **9** ▶ 6.53
10 ▶ 11.3 **11** ▶ 10.2 **12** ▶ 8.75
13 ▶ 20.5 **14** ▶ 1.36 **15** ▶ 161 000
16 ▶ 306 **17** ▶ 530 **18** ▶ 68 100 000
19 ▶ 693 000 **20** ▶ 21 800

EXERCISE 1*

1 ▶ 30.1 **2** ▶ 18.1
3 ▶ 0.005 77 **4** ▶ 2.17×10^{-4}
5 ▶ 0.122 **6** ▶ 9.05
7 ▶ 4.84 **8** ▶ 2.26
9 ▶ 74.4 **10** ▶ 456
11 ▶ 3.80×10^{-3} **12** ▶ 7140
13 ▶ 707 **14** ▶ 18 900
15 ▶ 1.62×10^{8} **16** ▶ 2.36×10^{29}
17 ▶ 7.21 **18** ▶ 18.1
19 ▶ 2.34 **20** ▶ 2.68

EXERCISE 2

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 ▶ 2×10^{5} **27** ▶ 4×10^{6}
28 ▶ 9×10^{7} **29** ▶ 8×10^{2}
30 ▶ 9×10^{3}

EXERCISE 2*

1 ▶ 4 **2** ▶ 1250
3 ▶ 8 **4** ▶ 80
5 ▶ 600 cm^3, 470 cm^2 **6** ▶ 100 cm^2
7 ▶ 68 cm^2 **8** ▶ 10 cm
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** ▶ 0.004
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}

EXERCISE 3

	Dimension	Rounded to nearest…	Lower bound	Upper bound	Dimension as $a \pm b$
1 ▶	230 m	10 m	225	235	230 ± 5
2 ▶	70 kg	10 kg	65	75	70 ± 5
3 ▶	74°F	1°F	73.5	74.5	74 ± 0.5
4 ▶	19 m^2	1 m^2	18.5	19.5	19 ± 0.5
5 ▶	2.5 litres	0.5 litres	2.25	2.75	2.5 ± 0.25
6 ▶	10.5 cm	0.1 cm	10.45	10.55	10.5 ± 0.05
7 ▶	5465 g	5 g	5462.5	5467.5	5465 ± 2.5
8 ▶	5470 g	10 g	5465	5475	5470 ± 5
9 ▶	5500 g	100 g	5450	5550	5500 ± 50
10 ▶	6000 g	1000 g	5500	6500	6000 ± 500
11 ▶	12.2 m/s	0.2 m/s	12.0	12.4	12.2 ± 0.2
12 ▶	20.2 s	0.1 s	20.15	20.25	20.2 ± 0.05
13 ▶	10 m/s^2	10 m/s^2	5	15	10 ± 5
14 ▶	20 mph	2 mph	19	21	20 ± 1
15 ▶	30 kg/m^3	1 kg/m^3	29.5	30.5	30 ± 0.5

EXERCISE 3*

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 0.345; 7.225 and 7.235; 12.885 and 12.895
7 ▶ 42.5 kg and 43.5 kg
8 ▶ 2.15×10^{7} and 2.25×10^{7}
9 ▶ Max perimeter = 38 m, min perimeter = 34 m
Max area = 89.25 m^2, min area = 71.25 m^2
10 ▶ p(max) = 1.82, p(min) = 1.40
11 ▶ p(max) = 4.98, p(min) = 4.02
12 ▶ Radius = 1.54 cm, circumference = 9.61 cm
13 ▶ A_{max} = 33.6 cm^2; d_{min} = 8.18 cm
14 ▶ 44.4 cm, 46.7 cm

EXERCISE 4 REVISION

1 ▶ **a** 486
b 2.66×10^{-3}
c 3.13×10^{-2}
d 16 400

2 ▶ 4

3 ▶ 600 cm^2

4 ▶ Max = 85 ml; min = 75 ml

5 ▶ Max radius = 3.8 cm, min circumference = 24 cm

6 ▶ **a** 10.7 m **b** 9.48 m

EXERCISE 4* REVISION

1 ▶ **a** 63.4 **b** 19 200
c 2.94×10^{-4} **d** 164 000

2 ▶ **a** 63.5 mins, 64.5 mins
b 15 g, 25 g
c 27.5 m/s, 32.5 m/s
d 7450 mm, 7550 mm

3 ▶ $w_{min} = 2.38$, $w_{max} = 3.5$

4 ▶ **a** 3×10^8 **b** 2×10^2
c 2×10^2 **d** 3×10^7

5 ▶ 1 m/s, 1.23 m/s

6 ▶ 12.4 cm, 13.1 cm

EXAM PRACTICE: NUMBER 5

1 ▶ **a** 7.13 **b** 444
c 1.85×10^{-3} **d** 13 800

2 ▶ **a** 21.5 m, 22.5 m
b 49.5 kg, 50.5 kg
c 745 s, 755 s
d 1350 km, 1450 km

3 ▶ $w_{min} = 2.5$, $w_{max} = 5$

4 ▶ **a** 8×10^5 **b** 2×10^2
c 3×10^2 **d** 5×10^3

5 ▶ 5.2 m/s, 6.3 m/s

6 ▶ 28.3 m, 29.7 m

UNIT 5: ALGEBRA 5

EXERCISE 1

1 ▶ $x^2 + 5x + 4$ **2** ▶ $x^2 - 4x - 21$
3 ▶ $x^2 - 4x - 12$ **4** ▶ $x^2 - 8x + 15$
5 ▶ $x^2 + 6x + 9$ **6** ▶ $x^2 - 8x + 16$
7 ▶ $x^2 - 25$ **8** ▶ $-x^2 + 6x + 16$
9 ▶ $15x^2 - 7x - 2$ **10** ▶ $x^3 + 2x^2 - 5x - 10$
11 ▶ **a** $x^2 + 3x + 2$ **b** $3x + 2$ **c** $x = 3$
12 ▶ **a** $5x^2 + 25x + 30$ **b** $2x^2 + 30x + 62$
13 ▶ $x = 6$

EXERCISE 1*

1 ▶ $x^2 + 4x - 21$
2 ▶ $x^2 - 9$
3 ▶ $x^2 + 24x + 144$
4 ▶ $-12x^2 + 25x - 12$
5 ▶ $x^2 + x(b - a) - ab$
6 ▶ $16x^2 - 40x + 25$
7 ▶ $15x^3 + 21x^2 + 5x + 7$
8 ▶ $8x + 8 = 8(x + 1)$
9 ▶ $\frac{a^2}{4} - \frac{ab}{5} + \frac{b^2}{25}$
10 ▶ $10x^5 + 11x^4 + 3x^3$
11 ▶ 4
12 ▶ $x = -\frac{5}{3}$
13 ▶ $a = 3$, $b = 1$
14 ▶ **a** $\pi(x^2 + 12x + 36)$
b $x = 0.75$
15 ▶ **a** $4x^2 + 37x + 40$
b $x = 1.5$
16 ▶ $x = 6$

EXERCISE 2

1 ▶ $x^3 + 2x^2 - 7x + 4$
2 ▶ $x^3 + 5x^2 + 6x$
3 ▶ $x^3 + x^2 - 4x - 4$
4 ▶ $x^3 - 13x + 12$
5 ▶ $x^3 - 14x^2 + 64x - 96$
6 ▶ $3x^3 - 2x^2 - 3x + 2$
7 ▶ $x^3 - 3x + 2$
8 ▶ $x^3 + 3x^2 + 3x + 1$

EXERCISE 2*

1 ▶ $2x^3 - 7x^2 - 11x + 6$
2 ▶ $x^3 - 3x^2 - 10x$
3 ▶ $3x^3 - 28x^2 + 43x + 42$
4 ▶ $24x^3 - 62x^2 + 49x - 12$
5 ▶ $2x^3 + 5x^2 - 4x - 12$
6 ▶ $8x^4 + 24x^3 + 10x^2 + 24x + 10$
7 ▶ $8x^3 - 36x^2 + 54x - 27$
8 ▶ $x^4 + 4x^3 - 7x^2 - 22x + 24$

EXERCISE 3

1 ▶ $x(x - 3)$ **2** ▶ $x(x + 2)$
3 ▶ $x(x - 31)$ **4** ▶ $x(x + 42)$
5 ▶ $(x - 4)(x + 4)$ **6** ▶ $(x - 7)(x + 7)$

EXERCISE 3*

1 ▶ $x(x - 312)$ **2** ▶ $x(x + 51)$
3 ▶ $(x - 8)(x + 8)$ **4** ▶ $(x - 11)(x + 11)$
5 ▶ $(x + 15)(x - 15)$ **6** ▶ $4(x + 2)(x - 2)$

EXERCISE 4

1 ▶ $a = 1$
2 ▶ $a = 4$
3 ▶ $a = -1$
4 ▶ $a = -2$
5 ▶ $a = 2$
6 ▶ $a = -1$

EXERCISE 4*

1 ▶ $a = 3$
2 ▶ $a = 4$
3 ▶ $a = -7$
4 ▶ $a = -3$
5 ▶ $a = -8$
6 ▶ $a = \frac{1}{2}$

EXERCISE 5

1 ▶ $(x - 2)(x - 1)$
2 ▶ $(x - 1)(x - 3)$
3 ▶ $(x - 4)(x - 3)$
4 ▶ $(x + 4)(x + 4)$
5 ▶ $(x - 1)(x - 8)$
6 ▶ $(x - 1)(x - 1)$

EXERCISE 5*

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

EXERCISE 6

1 ▶ $(x + 3)(x - 2)$
2 ▶ $(x + 2)(x - 5)$
3 ▶ $(x + 2)(x - 6)$
4 ▶ $(x + 1)(x - 10)$
5 ▶ $(x + 7)(x - 2)$
6 ▶ $(x + 8)(x - 1)$

EXERCISE 6*

1 ▶ $(x + 6)(x - 5)$
2 ▶ $(x + 4)(x - 6)$
3 ▶ $(x + 12)(x - 5)$
4 ▶ $(x + 5)(x - 14)$
5 ▶ $(x + 8)(x - 15)$
6 ▶ $(x - 5)(x + 15)$

EXERCISE 7

1 ▶ $(x - 1)(x - 2)$
2 ▶ $(x + 3)(x - 1)$
3 ▶ $(x + 1)(x + 12)$
4 ▶ $(x - 2)(x - 6)$
5 ▶ $(x - 4)(x - 4)$
6 ▶ $(x - 4)(x + 5)$

EXERCISE 7*

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

EXERCISE 8

1 ▶ $x = -1$ or $x = -2$
2 ▶ $x = -4$ or $x = 1$
3 ▶ $x = 7$ or $x = 2$
4 ▶ $x = -8$
5 ▶ $x = 0$ or $x = 10$

EXERCISE 8*

1 ▶ $x = -8$ or $x = 4$
2 ▶ $x = -21$ or $x = 5$
3 ▶ $x = 0$ or $x = 8$
4 ▶ $x = -\frac{3}{2}$ or $x = \frac{3}{4}$
5 ▶ $x = -1$ or $x = 1$ or $x = -\frac{5}{2}$

EXERCISE 9

1 ▶ $x = 1$ or $x = 2$
2 ▶ $x = -2$ or $x = 1$
3 ▶ $x = -2$ or $x = -4$
4 ▶ $x = 4$ or $x = -3$
5 ▶ $x = 5$ or $x = 3$
6 ▶ $x = -4$

EXERCISE 9*

1 ▶ $x = 4$ or $x = 5$
2 ▶ $x = -3$ or $x = 8$
3 ▶ $x = -9$ or $x = -12$
4 ▶ $x = 14$ or $x = 4$
5 ▶ $x = -16$ or $x = -6$
6 ▶ $x = 3$ or $x = -1$
7 ▶ $x = -15$ or $x = 8$

EXERCISE 10

1 ▶ $x = 0$ or $x = 2$
2 ▶ $x = 0$ or $x = -7$
3 ▶ $x = 0$ or $x = 25$
4 ▶ $x = 0$ or $x = -23$
5 ▶ $x = -2$ or $x = 2$
6 ▶ $x = -5$ or $x = 5$

EXERCISE 10*

1 ▶ $x = 0$ or $x = 125$
2 ▶ $x = 0$ or $x = -231$
3 ▶ $x = -8$ or $x = 8$
4 ▶ $x = -13$ or $x = 13$
5 ▶ $x = -\sqrt{7}$ or $x = \sqrt{7}$
6 ▶ No (real) solutions

EXERCISE 11

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

EXERCISE 11*

1 ▶ 11, 13 or –13, –11
2 ▶ 30 cm by 40 cm
3 ▶ 1 s and 2 s
4 ▶ 8, 9 or –9, –8
5 ▶ 20
6 ▶ 4 cm

EXERCISE 12 REVISION

1 ▶ $x^2 - 10x + 21$
2 ▶ $x^2 + 4x + 4$
3 ▶ $x^3 + 4x^2 + x - 6$
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

EXERCISE 12* **REVISION**

1 ▶ $x^2 - 3x - 108$

2 ▶ $4x^2 - 12x + 9$

3 ▶ $6x^2 + 7x - 3$

4 ▶ $x^3 + 6x^2 - x - 30$

5 ▶ 4.25 m

6 ▶ 27 cm

7 ▶ $x = -11$ or $x = 11$

8 ▶ $x = 0$ or $x = 7$

9 ▶ $x = -7$ or $x = 8$

10 ▶ $x = 9$ or $x = 6$

11 ▶ −4, −10 and 4, 10

12 ▶ **b** $x = 30$

13 ▶ 400 cm^2

EXAM PRACTICE: ALGEBRA 5

1 ▶ **a** $x^2 - 4x - 12$ **b** $x^2 - 14x + 49$

c $x^3 - 6x^2 + 11x - 6$

2 ▶ **a** $x(x - 1)$ **b** $(x - 5)(x + 5)$

c $(x - 4)(x - 1)$

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

b $(x + 1)(x - 3) = 0$, $x = -1$ or 3

c $x(x + 3) = 0$, $x = 0$ or -3

d $(x - 2)(x + 2) = 0$, $x = -2$ or 2

4 ▶ **a** $x(x + 1)$

b $x^2 + x - 42 = 0 \Rightarrow (x + 7)(x - 6) = 0$
$\Rightarrow x = 6$

5 ▶ **a** $x^2 + 5x + 2$

b $x^2 + 5x - 14 = 0 \Rightarrow x = -7$ or $x = 2$
$\Rightarrow$ dimensions are 5 cm by 4 cm

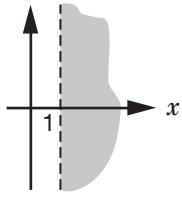
UNIT 5: GRAPHS 5

EXERCISE 1

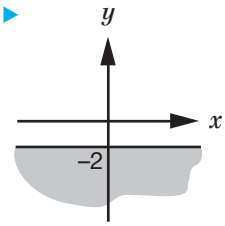
1 ▶ $x \leq 2$ **2** ▶ $y > 4$

3 ▶ $y \leq 3$ **4** ▶ $x + y \geq 6$

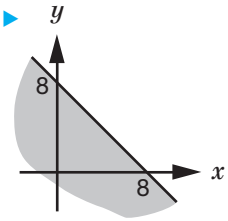
5 ▶



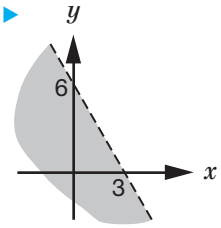
6 ▶



7 ▶



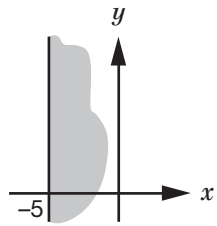
8 ▶



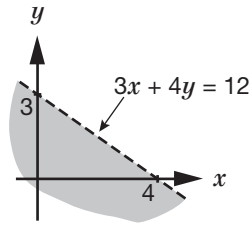
EXERCISE 1* **1** ▶ $y > -2$ **2** ▶ $2x + y \geq 6$

3 ▶ $y - x < 4$ **4** ▶ $2y + x \leq 4$

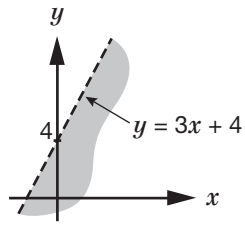
5 ▶



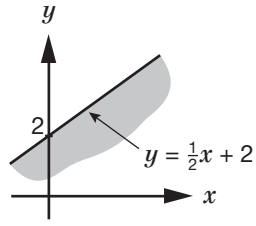
6 ▶



7 ▶



8 ▶



EXERCISE 2

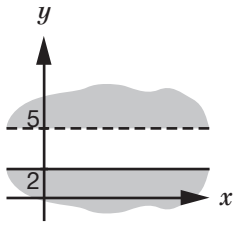
1 ▶ $2 < x < 5$ **2 ▶** $-2 < y \leq 3$

3 ▶ $x \geq 4$ or $x \leq -3$ **4 ▶** $y \geq 9$ or $y < 3$

5 ▶ $x + y > 3$ and $x - y \leq 2$

6 ▶ $y < x + 3$, $2y + x \leq 6$ and $y \geq 0$

7 ▶



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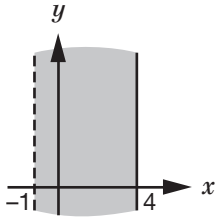
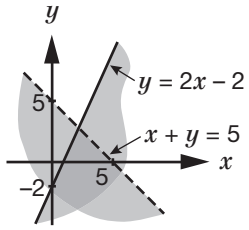
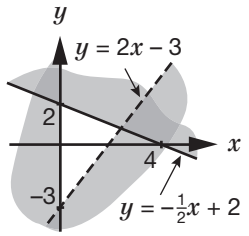


9 ▶



10 ▶



EXERCISE 2*

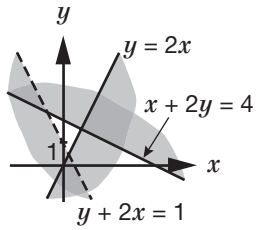
1 ▶ $-3 \leq x < 4$

2 ▶ $2y + x \geq 10$ or $2y + x \leq 4$

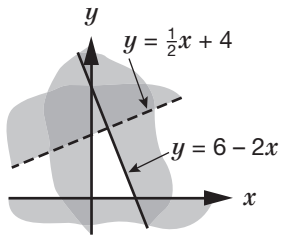
3 ▶ $4x + 3y \leq 12$, $y \geq 0$ and $y < 2x + 4$

4 ▶ $x \geq 0$, $y \geq 0$, $y < -\frac{3x}{2} + 9$ and $y \leq -\frac{2x}{3} + 6$

5 ▶



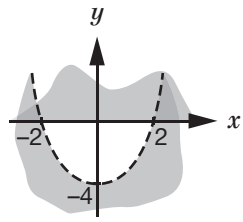
6 ▶



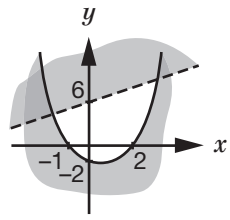
7 ▶ **b** $y < x + 2$, $y < -2x + 2$ and $2y + x > -2$

c $y = -1$

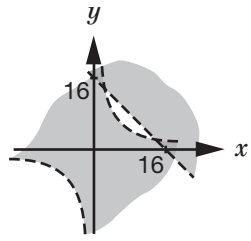
8 ▶



9 ▶



10 ▶



4 and 10, 4 and 11, 5 and 8, 5 and 9, 5 and 10, 6 and 7, 6 and 8, 6 and 9, 7 and 6, 7 and 7, 7 and 8, 8 and 5, 8 and 6, 8 and 7, 9 and 5, 9 and 6, 10 and 4, 10 and 5, 11 and 4

ACTIVITY 2

Point A	Point B	Point C	m_1	m_2	$m_1 \times m_2$
(1, 0)	(3, 2)	(0, 5)	1	–1	–1
(5, 0)	(3, 4)	(5, 5)	–2	$\frac{1}{2}$	–1
(10, 3)	(7, 2)	(6, 5)	$\frac{1}{3}$	–3	–1

Comment: The lines are at right angles.

Completed statement: Lines that are perpendicular have $m_1 \times m_2 = -1$

EXERCISE 3

1 ▶ $-\frac{1}{2}$ **2 ▶** $\frac{1}{3}$ **3 ▶** 3 **4 ▶** $-\frac{2}{3}$

5 ▶ $\frac{1}{2}$, –2 **6 ▶** 3, $-\frac{1}{3}$

7 ▶ Nothing **8 ▶** Parallel

9 ▶ Perpendicular **10 ▶** $y = \frac{x}{2} + 1$

11 ▶ **a** 2

b $-\frac{1}{2}$

c Product is –1 so yes

EXERCISE 3*

1 ▶ $-\frac{1}{4}$ **2 ▶** 5

3 ▶ $\frac{3}{2}$ **4 ▶** $\frac{1}{6}$

5 ▶ $\frac{3}{8}$, $-\frac{8}{3}$ **6 ▶** $\frac{5}{4}$, $-\frac{4}{5}$

7 ▶ $y = -\frac{x}{8} + 8.4$

8 ▶ **a** 7 m **b** $-\frac{5}{4}$ **c** 8.2 m

9 ▶ **a** $-\frac{3}{2}$ **b** $\frac{2}{3}$

c $y = \frac{2x}{3} + 5$ **d** No

10 ▶ $\frac{3}{2}$ or $-\frac{3}{2}$ **11 ▶** 19 **12 ▶** 0.32

EXERCISE 4

1 ▶ (6, 6)

2 ▶ (1, −3)

3 ▶ $\sqrt{61}$

4 ▶ $\sqrt{29}$

5 ▶ $y = -3x + 3$

EXERCISE 4*

1 ▶ $y = \frac{3}{2}x + \frac{1}{2}$

2 ▶ Gradient of PQ = gradient of SR = 1, gradient of SP = gradient of RQ = $-\frac{3}{2}$

3 ▶ **a** **(i)** $AB^2 = 40$, $BC^2 = 10$, $AC^2 = 50$, $AB^2 + BC^2 = AC^2$

(ii) Gradient of AB is 3, gradient of BC is $-\frac{1}{3}$, product of the gradients is −1

b 10

4 ▶ $y = x + 1$

5 ▶ **a** $y = -\frac{1}{2}x + 7$

b (2, 6)

c $\sqrt{20}$ or 4.47 to 3 s.f.

6 ▶ **a** $y = \frac{1}{2}x + 1$

b $y = -7x + 16$

c (2, 2)

d AD = BD = CD = 5

e A, B and C lie on a circle of radius 5 centre at D.

EXERCISE 5 REVISION

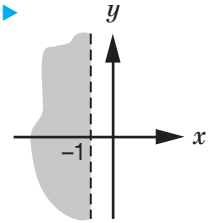
1 ▶ $x > 5$

2 ▶ $x + 2y < 8$

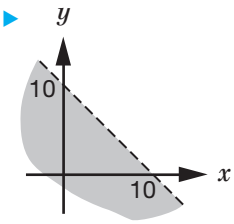
3 ▶ $3 < y < 8$

4 ▶ $x + 2y \leq 6$ and $2x - y \leq 2$

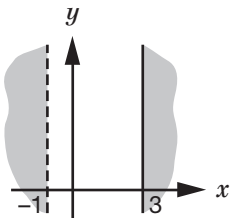
5 ▶



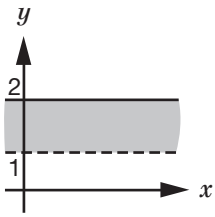
6 ▶



7 ▶



8 ▶



9 ▶ $(-3, \frac{1}{2})$

10 ▶ $\sqrt{74}$ or 8.60 to 3 s.f.

11 ▶ $y = -3x + 12$

12 ▶ $y = 2x - 6$

EXERCISE 5* REVISION

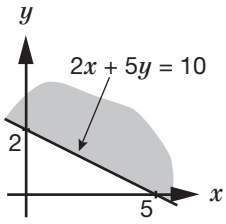
1 ▶ $y - 2x \geq 2$

2 ▶ $3y + x > 9$

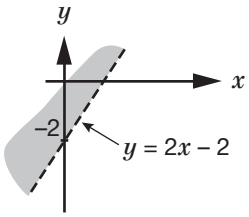
3 ▶ $-2 \leq 2x - y \leq 2$

4 ▶ $y > \frac{3x}{4} - 3$, $y \leq 0$ and $y \geq -\frac{3x}{2} - 3$

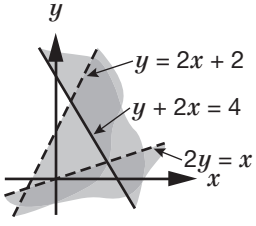
5 ▶



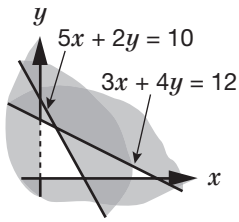
6 ▶



7 ▶



8 ▶



9 ▶ **b** $2y < x + 5$, $y > 2x - 2$ and $2y > 5 - 5x$

c $x = 1$

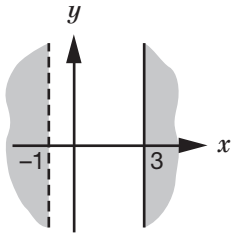
10 ▶ $y = -\frac{1}{4}x + 2$

11 ▶ Gradient OB = 2, gradient of AC = $-\frac{1}{2}$
$\Rightarrow$ OB is perpendicular to AC as $2 \times -\frac{1}{2} = -1$
Mid-point of OB is (3, 6), mid-point of AC is (3, 6) so diagonals bisect each other.

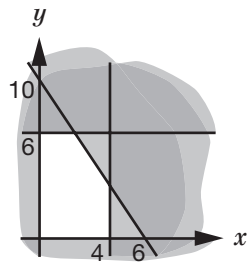
12 ▶ $\sqrt{0.8}$ or 0.894 to 3 s.f.

EXAM PRACTICE: GRAPHS 5

1 ▶



2 ▶ **a, b**



c (2, 6)

3 ▶ **a** $\sqrt{68}$

b (2, 2)

c $y = -\frac{1}{4}x + 2\frac{1}{2}$

4 ▶ **a** (4, 3)

b $\sqrt{26}$ or 5.10 to 3 s.f.

c DC = $\sqrt{26}$

d Gradient of AD is −1, gradient of BD is 1, product of gradients is −1
$\Rightarrow$ perpendicular

UNIT 5: SHAPE AND SPACE 5

EXERCISE 1

1 ▶ A 2 square right, 2 squares up

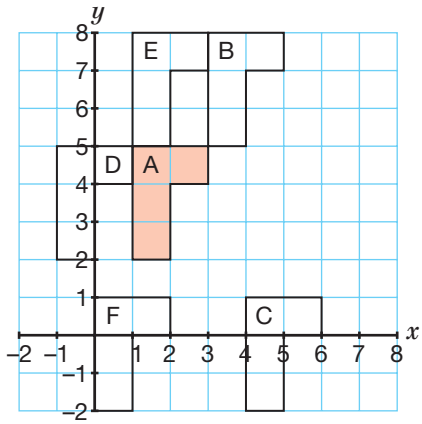
B 2 squares left, 2 squares up

C 2 squares left, 2 squares up

D 1 square left, 2 squares up

E 2 squares left, 5 squares down

2 ▶

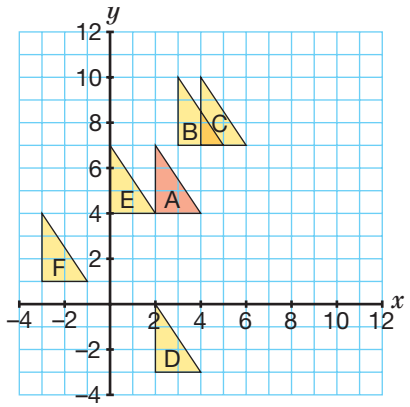


3 ▶ **a** $\begin{pmatrix}4\\2\end{pmatrix}$ **b** $\begin{pmatrix}0\\-4\end{pmatrix}$

c $\begin{pmatrix}4\\-6\end{pmatrix}$ **d** $\begin{pmatrix}5\\1\end{pmatrix}$

e $\begin{pmatrix}-5\\-1\end{pmatrix}$

4 ▶

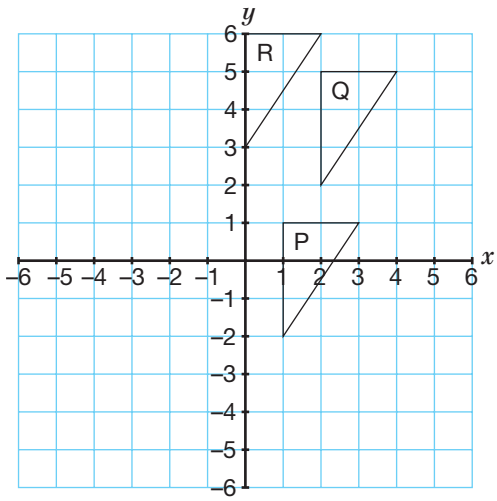


5 ▶ **a** $\begin{pmatrix}-6\\2\end{pmatrix}$ **b** $\begin{pmatrix}0\\-6\end{pmatrix}$ **c** $\begin{pmatrix}8\\7\end{pmatrix}$

d $\begin{pmatrix}5\\0\end{pmatrix}$ **e** $\begin{pmatrix}-5\\0\end{pmatrix}$

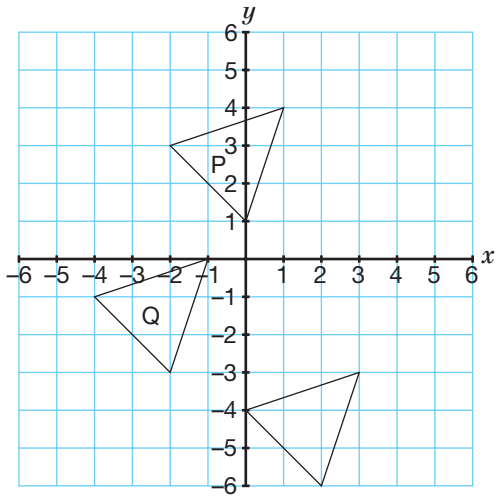
EXERCISE 1*

1 ▶ **a, b**



c $\begin{pmatrix}-1\\5\end{pmatrix}$

2 ▶ a, b



c $\begin{pmatrix}-2\\-4\end{pmatrix}$

3 ▶ a $\begin{pmatrix}1\\4\end{pmatrix}$ **b** $\begin{pmatrix}4\\-6\end{pmatrix}$

4 ▶ a $\begin{pmatrix}4\\1\end{pmatrix}$

b $\begin{pmatrix}a+c\\b+d\end{pmatrix}$, e.g. because this is the total horizontal movement and total vertical movement.

5 ▶ P (–5, 3)

EXERCISE 2

1 ▶ a Reflection in the y-axis or the line $x = 0$

b Reflection in the line $y = -1$

c Reflection in the line $y = -x$

d Reflection in the line $y = 1$

2 ▶ a Reflection in the line $x = 3$

b Reflection in the line $y = -x$

3 ▶ a Rotation 90° clockwise about (–3, 3)

b Rotation 90° clockwise about (1, 4)

c Rotation 90° anti-clockwise about (3, –3)

d Rotation 180° about (–3, –3)

4 ▶ a Reflection in x-axis

b Reflection in the line $x = 1$

c Reflection in the line $y = -x$

d Reflection in the line $x = 4$

5 ▶ a Reflection in the line $x = 5$

b Reflection in the line $y = x$

6 ▶ A: Rotation 180° about (1, 2)

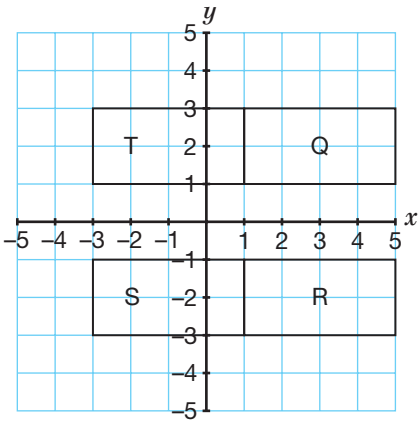
B: Rotation 180° about (–3, 2)

C: Rotation 90° anti-clockwise about (5, –2) (or 270° clockwise)

D: Rotation 90° clockwise about (–5, 3) (or 270° anti-clockwise)

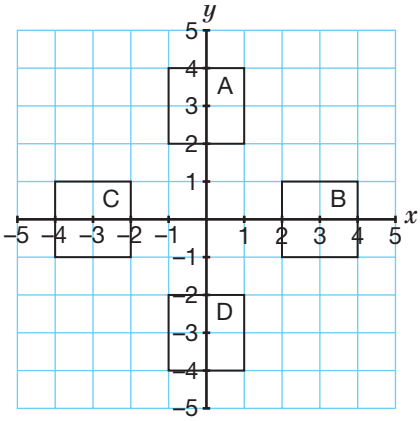
EXERCISE 2*

1 ▶ a–d



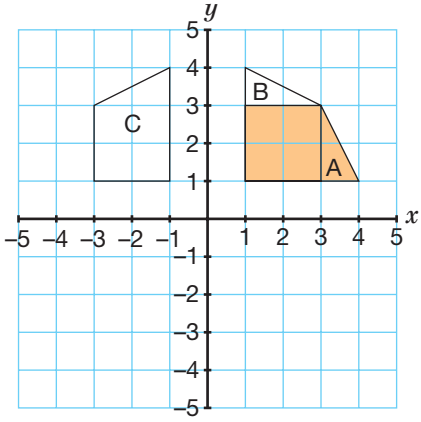
e Reflection in the line $x = 1$

2 ▶ a–d



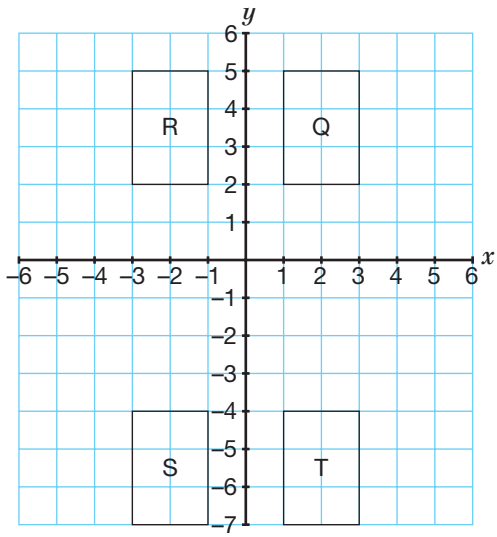
e Reflection in the line $y = -x$

3 ▶ a–d



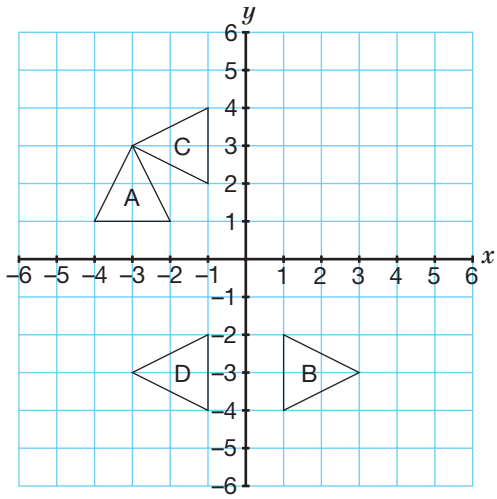
d Rotation 90° anti-clockwise about (0, 0)

4 ▶ a–d



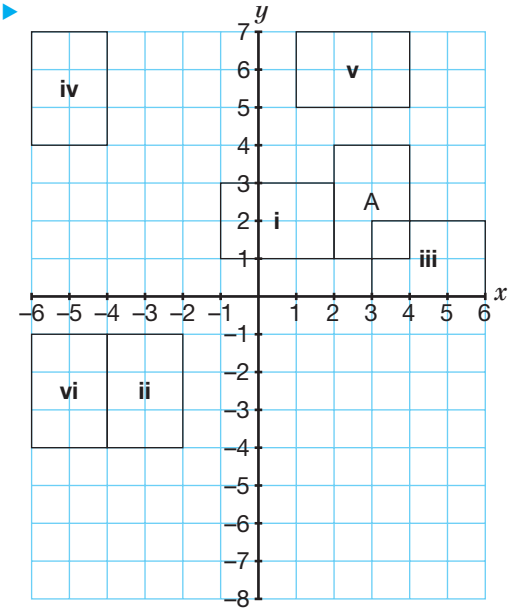
e Reflection in the line $y = -1$

5 ▶ a–d



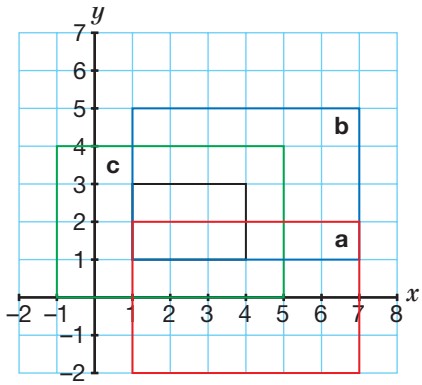
e Reflection in the y-axis

6 ▶

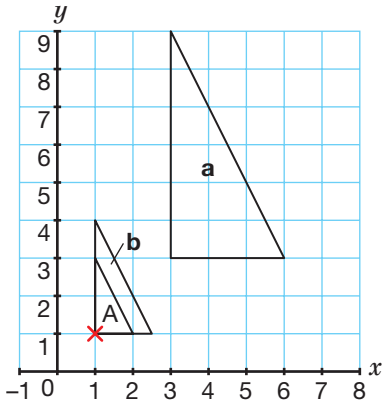


EXERCISE 3

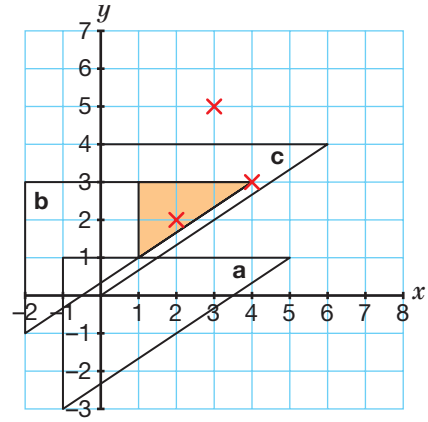
1 ▶ a–c



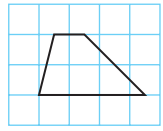
2 ▶ a, b



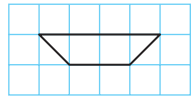
3 ▶ a–c



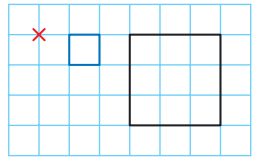
4 ▶ a



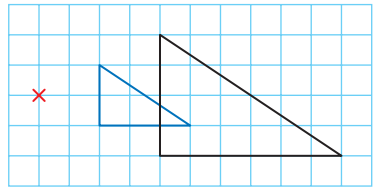
b



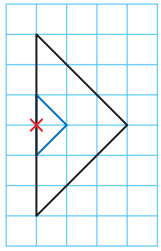
5 ▶ a



b



c



EXERCISE 3*

1 ▶ a 4 **b** Students' own drawings

c (–6, 6)

d Enlargement by scale factor 4, centre (–6, 6)

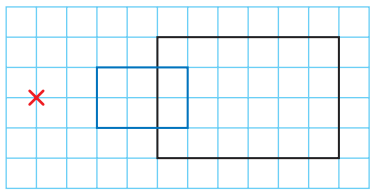
2 ▶ a Scale factor 3

b Correct construction lines

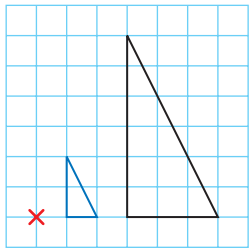
c (–5, –2)

d Enlargement by scale factor 3, centre (–5, –2)

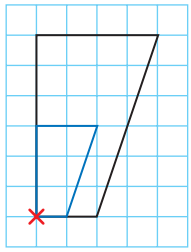
3 ▶ a



b



c



4 ▶ a Enlargement, scale factor $\frac{1}{3}$, centre (–5, –2)

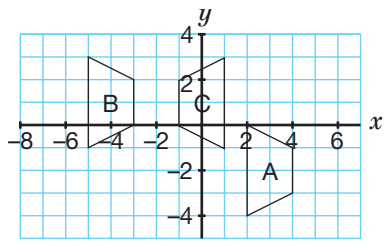
b Enlargement, scale factor $\frac{1}{3}$, centre (2, –5)

5 ▶ a Enlargement scale factor $\frac{1}{3}$, centre (–4, 6)

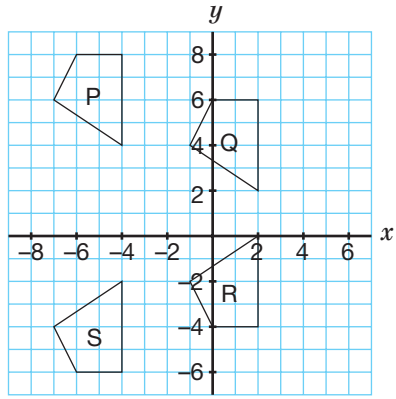
b Enlargement scale factor $\frac{1}{2}$, centre (–2, –6)

EXERCISE 4

1 ▶ a, b

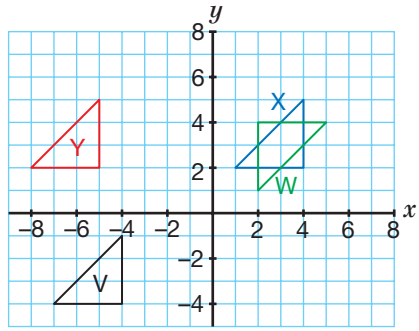


2 ▶ a–c



d Reflection in the line $y = 1$

3 ▶ a–c



d Translation by $\begin{pmatrix} -1 \\ 6 \end{pmatrix}$

4 ▶ a Rotation 180° about (2, 1)

b Reflection in the line $y = 2$

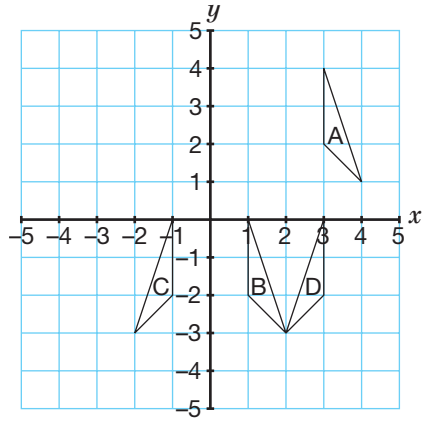
c Rotation 180° about (2, 3)

d Rotation 90° anti-clockwise about (0, 0)

e Rotation 180° about (–1, 2)

5 ▶ a Translation by $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$

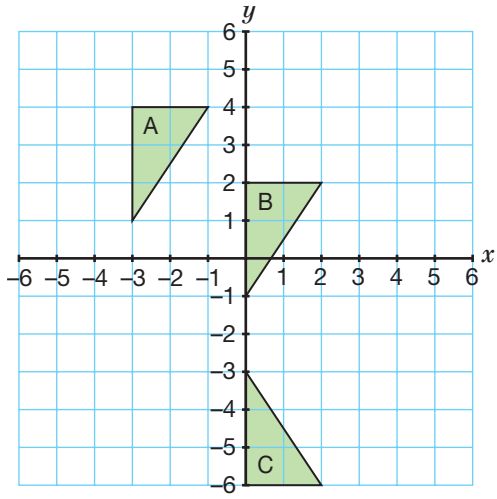
b



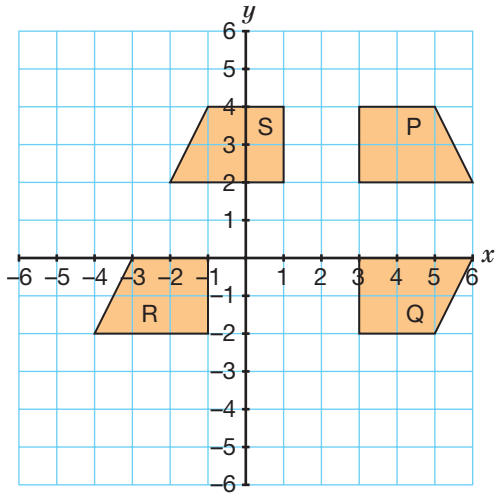
c Reflection in the line $x = 2$

EXERCISE 4*

1 ▶ a, b

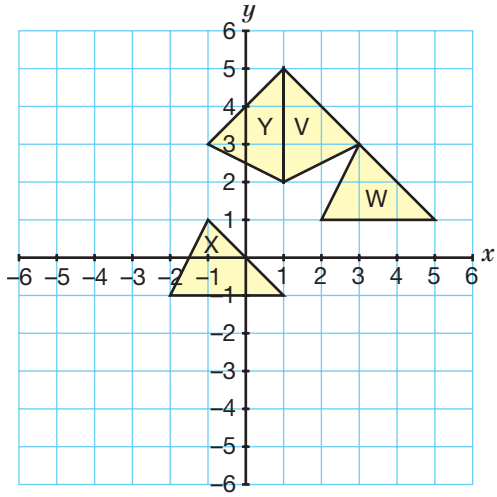


2 ▶ a–c



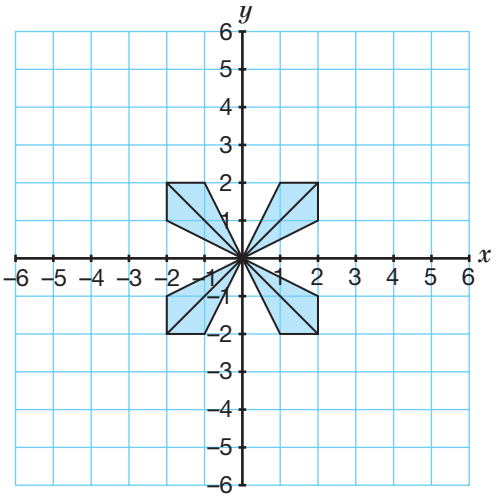
d Reflection in the line $x = 2$

3 ▶ a–c



d Reflection in the line $x = 1$

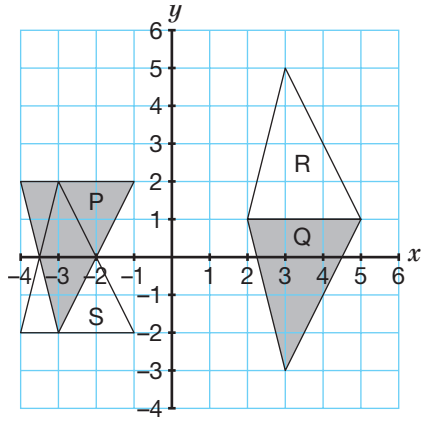
4 ▶ a–c



d Enlargement scale factor 3, centre (0, 0)

5 ▶ a Translation by $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$

b



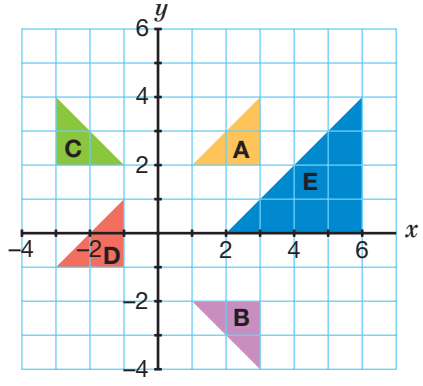
c Reflection in the line $y = 1$

EXERCISE 5 REVISION

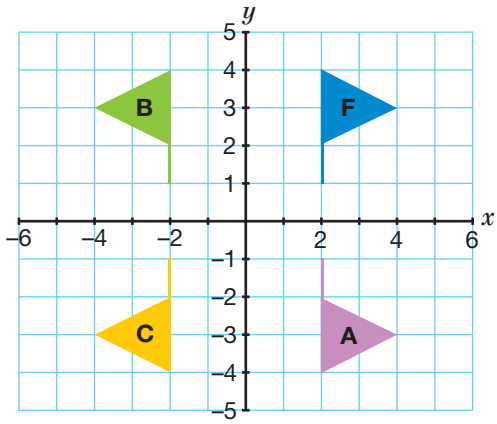
1 ▶ a (1, –2) **b** (–1, 2)
c (–2, 1) **d** (4, 6)

2 ▶ a (4, 1) **b** (–4, –1)
c (–1, –4) **d** (11, –2)

3 ▶ a–d

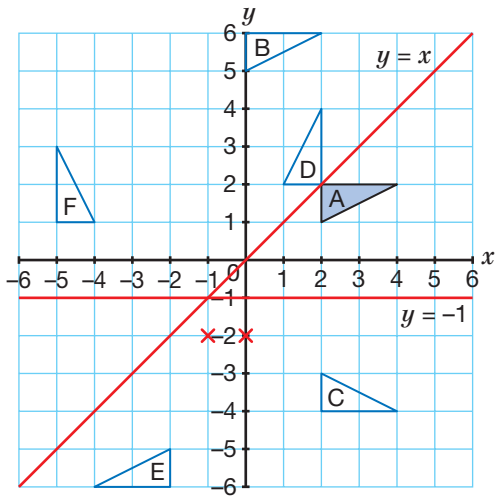


4 ▶ a–d



e 180° rotation about (0, 0)

5 ▶ a–e



f Rotation 180° about (–1, 0)

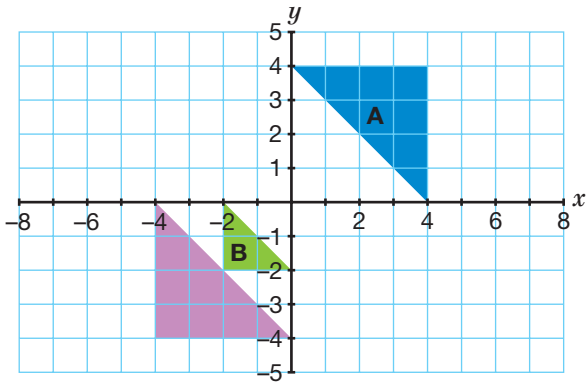
g Rotation 90° clockwise about (–1, –1)

6 ▶ $a = -3$, $b = 10$

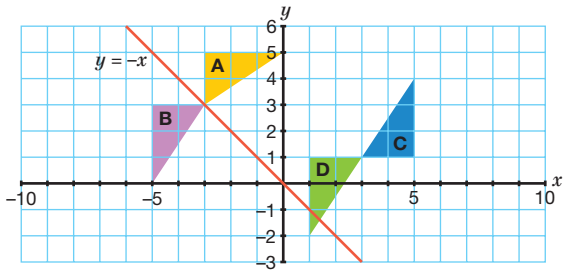
EXERCISE 5* REVISION

1 ▶ $a = 13$, $b = 1$

2 ▶

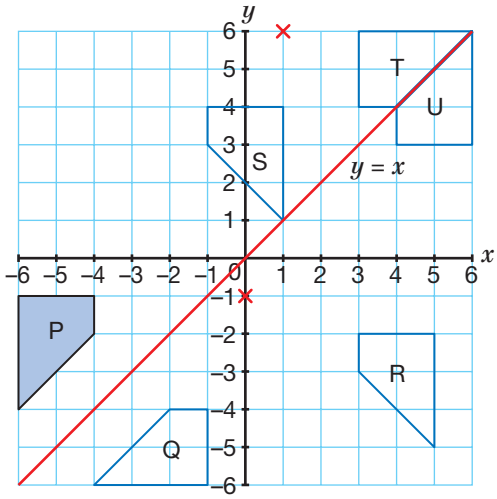


3 ▶



c Translation by $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

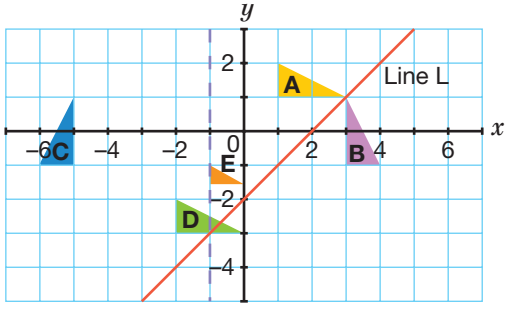
4 ▶ a–e



f Rotation 180° about (0, 1)

g Rotation 90° clockwise about (–5, 0)

5 ▶ a, b



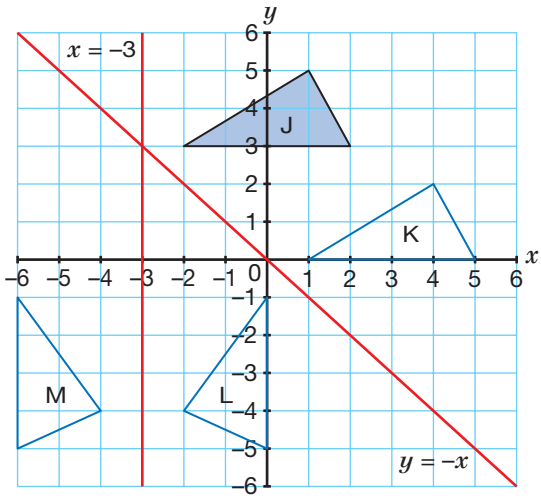
c (i) Rotation 90° anti-clockwise about (–1, –3)

(ii) Enlargement scale factor 2 about (–3, –4)

6 ▶ P $(-b - 4, 3 - a)$

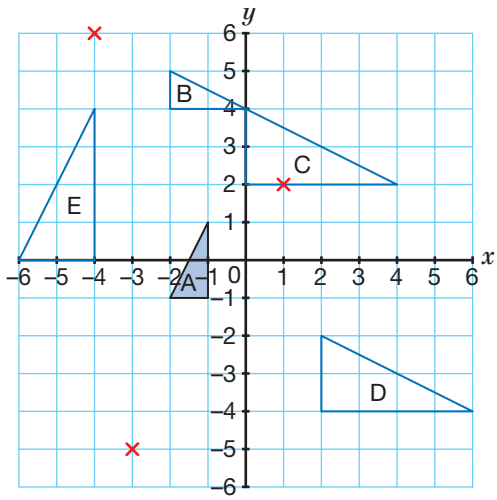
EXAM PRACTICE: SHAPE AND SPACE 5

1 ▶ a–c



d Rotation 90° anti-clockwise about (–6, 3)

2 ▶ a–d



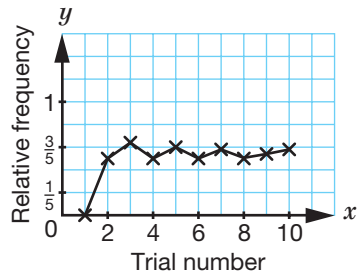
e Enlargement, scale factor $\frac{1}{2}$, centre of enlargement (2, –2)

3 ▶ $a = 7$, $b = -1$

UNIT 5: HANDLING DATA 4

EXERCISE 1

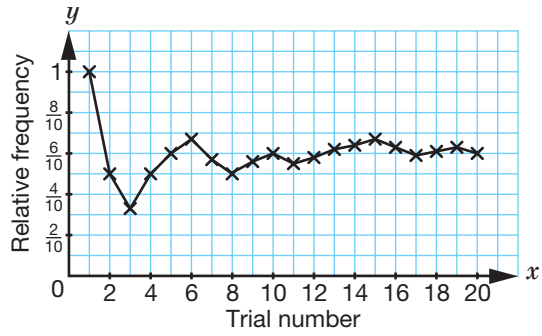
1 ▶ a



b p(biased) = $\frac{3}{5}$

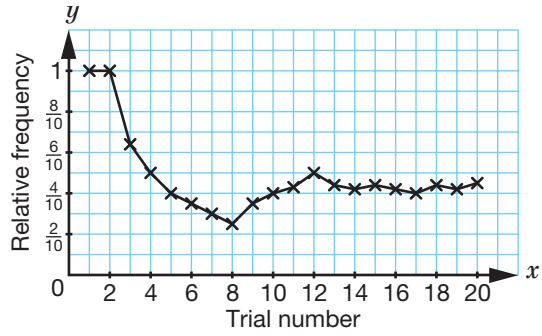
Heidi's suspicion seems to be true. More trials would improve the experiment.

2 ▶ a p(rain) = $\frac{3}{5}$



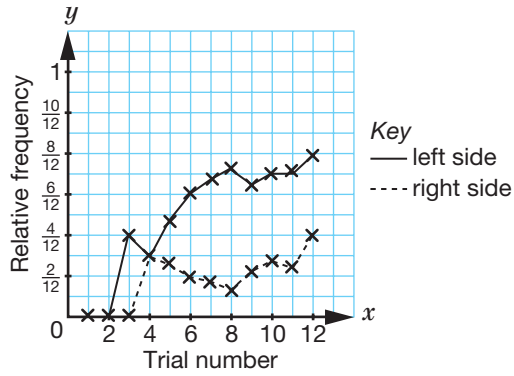
b More likely than not to rain in first 20 days of April.

3 ▶ p(vowel) = $\frac{9}{20}$



EXERCISE 1*

1 ▶ a



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

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

2 ▶ a 0.23, 0.22, 0.21, 0.18, 0.09, 0.07

b 0.07

c 35

d No, a fair die has a theoretical probability of 0.17 for each outcome. For this die, the estimated probability of rolling a 1 is more than three times higher than of rolling a 6.

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

b Number of white ≈ $\frac{3}{5} \times 100 = 60$

⇒ number of purple ≈ 40

EXERCISE 2

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(consonant) = $\frac{8}{14} = \frac{4}{7}$

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

	Glasses	No glasses	Total
Boys	4	10	14
Girls	6	12	18
Total	10	22	32

b $\frac{5}{16}$ **c** $\frac{9}{16}$ **d** $\frac{2}{3}$

7 ▶ 20

8 ▶ 21

EXERCISE 2*

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) $\frac{5}{12}$

b 7

2 ▶ a

Green \ Red	2	3	5	7
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 ▶

2nd spin \ 1st spin	1	2	3	4	5
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 ▶

Spinner \ Die	1	2	3	4	5	6
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** $\frac{1}{15}$

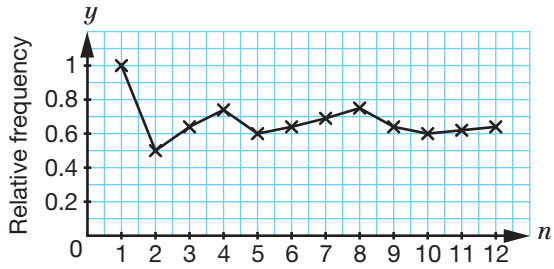
7 ▶ $f = 5$

8 ▶ a 0.4 **b** 0.9

9 ▶ b Approx. 40 darts

EXERCISE 3 REVISION

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 $\frac{1}{8}$ **b** $\frac{1}{8}$ **c** 0 **d** 1

6 ▶ $\frac{10}{494} = \frac{5}{247}$

7 ▶ 20

8 ▶ a $\frac{1}{4}$ **b** $\frac{3}{4}$ **c** 0

EXERCISE 3* REVISION

1 ▶ a 2014, $\frac{7}{10}$; 2015, $\frac{6}{10}$; 2016, $\frac{4}{10}$

b Decrease in numbers from 2014 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, THH, HTT, THT, TTH, TTT

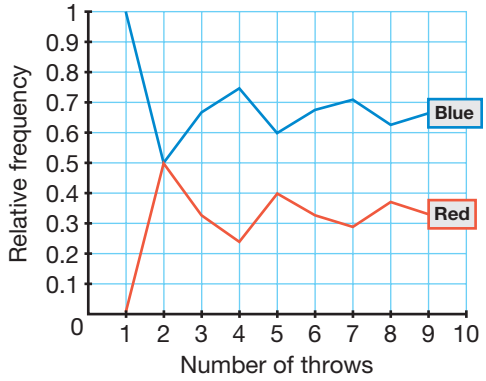
a $\frac{1}{8}$ **b** $\frac{3}{8}$ **c** $\frac{1}{2}$

7 ▶ 2

8 ▶ **a** $\frac{2}{9}$ **b** $\frac{7}{9}$ **c** $\frac{2}{3}$

EXAM PRACTICE: HANDLING DATA 4

1 ▶ **a**



b p(R) = $\frac{1}{3}$, p(B) = $\frac{2}{3}$; both as expected!

2 ▶ **a** p(B) = $\frac{1}{2}$ **b** p(H) = $\frac{1}{4}$

c p(k′) = $\frac{12}{13}$ **d** p(rp) = $\frac{1}{13}$

3 ▶ **a** p(o) = $\frac{2}{29}$ **b** p(i) = $\frac{9}{29}$

c p(x) = 0 **d** p(vowel) = $\frac{14}{29}$

4 ▶ **a**

	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	2	6	4	10	6
3	3	6	3	12	15	6
4	4	4	12	4	20	12
5	5	10	15	20	5	30
6	6	6	6	12	30	6

b **(i)** p(odd) = $\frac{1}{4}$ **(ii)** p(prime) = $\frac{1}{4}$

(iii) p(integer) = 1 **(iv)** p(square) = $\frac{1}{6}$

c 5 times

OTHER ANSWERS

FACT FINDER: ANTS

EXERCISE 1

1 ▶ 90.7 species per million years

2 ▶ 4500 kg ≈ 4.5 cars!

3 ▶ 16.7 ants/cm

4 ▶ 25 g of escamoles

5 ▶ 40 000 ants

EXERCISE 1*

1 ▶ 1 hr 28 mins 53 secs

2 ▶ 63 900 mm/s

3 ▶ 1.08×10^7 eggs = 10.8 million eggs

4 ▶ Weight of humans = 4.9×10^{11} kg

Number of ants = 9.8×10^{14}
$\approx 10^{15}$ = a quadrillion, so true!

5 ▶ **a** 1.48×10^8 km^2

b **(i)** 47.3 people/km^2

(ii) 6 630 000 ants/km^2

c 140 000 ants/person

FACT FINDER: FRAGILE EARTH

EXERCISE 1

1 ▶ 3.03 billion

2 ▶ **a** 6.48%

b 43.8%

3 ▶ **a** $178 per person

b $219 per person

4 ▶ 32.0 elephants per day

5 ▶ **a** 20.4 kg per person

b 21.4 kg per person

EXERCISE 1*

1 ▶ **a** 0.368% **b** 0.815%

2 ▶ **a** 43.8 pitches per min

b 27.2 pitches per min

3 ▶ **a** 40.3 people per km^2

b 47.7 people per km^2

4 ▶ 1 m

5 ▶ **a** 1370 kg/km^3 **b** 1700 kg/km^3

FACT FINDER: GREAT WHITE SHARK

EXERCISE 1

1 ▶ 3.17 sharks per sec approx.

2 ▶ 225 m

3 ▶ 8.57%

4 ▶ For a 1.6 m pupil, $x \approx 4.38$

5 ▶ 6.67 m/s

EXERCISE 1*

1 ▶ 5 cm × 3500 ≈ 17 500 cm = 175 m. Yes!

2 ▶ 257%

3 ▶ 24.9%

4 ▶ 54 400 kg

5 ▶ 3.55%

6 ▶ 3.1×10^3 tonnes/m^2

7 ▶ 1.26 × 10 tonnes

FACT FINDER: LONDON 2012 OLYMPICS

EXERCISE 1

1 ▶ 44.2%

2 ▶ **a** £350 per person

b £6880 per sec

3 ▶ 1.2×10^{-3} trees/m^2

4 ▶ 57.1%

5 ▶ 1600 m

EXERCISE 1*

1 ▶ 5.63×10^8 mm

2 ▶ $33\frac{1}{3}$%

3 ▶ 1118 g per person

4 ▶ Bolt: 1 hr 7 mins 22 secs

Radisha: 1 hr 28 mins 42 secs

5 ▶

Rank by points/ million	Country	Points/ million	Previous rank (by Gold)
1	Hungary	3.70	9
2	Australia	2.83	10
3	U.K.	2.30	3
4	France	1.26	7
5	South Korea	1.24	5
6	Russia	1.09	4
7	Italy	1.04	8
8	Germany	1.06	6
9	U.S.A.	0.65	1
10	China	0.14	2

FACT FINDER: THE HUMAN BODY

EXERCISE 1

1 ▶ 14.1%

2 ▶ 8.6×10^8

3 ▶ 5.87 litres/min

4 ▶ 14 300

5 ▶ 5.49×10^{-6} mm/s

EXERCISE 1*

1 ▶ 81.5 beats/min

2 ▶ 0.0907 m/s

3 ▶ 11.3

4 ▶ 2.47×10^{15} mm^3,
10 300 × volume of the classroom

5 ▶ **a** 0.0225 s **b** Yes

CHALLENGES

1 ▶ **a** $\frac{2017}{2}$ **b** $\frac{n+1}{2}$

2 ▶ $\frac{8000}{3}$

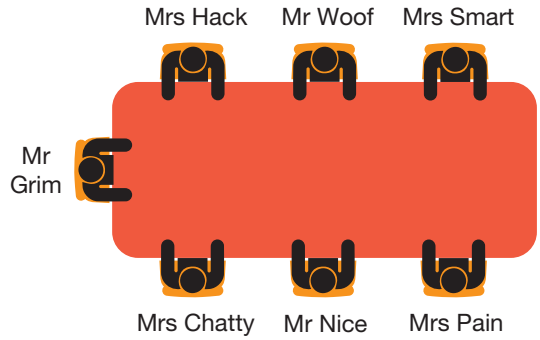
4 ▶ $x = 1, y = 2, z = 3$

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

7 ▶ 8.47×10^{56} mm^3 (to 3 s.f.)

8 ▶ 2

9 ▶



10 ▶ 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.

11 ▶ 16 cm^2

12 ▶ $p = 9$ (front), $q = 3$ (rear)