Answers

Exercise 1

1 **a** 2 days **b** 1 day **c** $\frac{1}{2}$ day

2 **a** $2\frac{1}{2}$ days **b** $1\frac{1}{4}$ days **c** $\frac{1}{2}$ day

3

Number of years, n	Number of men, m
1	12 000
2	6000
3	4000
4	3000
6	2000
12 000 ÷ m	m
n	12 000 ÷ n

4 **a** **i** $2\frac{1}{2}$ days **ii** $1\frac{1}{4}$ days **iii** 1 day **iv** $\frac{5}{p}$ days

b **i** 10 people **ii** 5 people **iii** 4 people **iv** $\frac{20}{d}$ people

5 **a** 9 hours **b** 90 km/hr

6 **a** $0.\dot{3}$ **b** $0.\dot{1}$ **c** $0.08\dot{3}$ **d** $0.0\dot{6}$

7 **a** $\frac{4}{9}$ **b** $\frac{7}{9}$ **c** $\frac{53}{99}$ **d** $\frac{82}{99}$

8 **a** $\frac{301}{999}$ **b** $\frac{707}{999}$ **c** $\frac{7}{198}$ **d** $\frac{409}{99\,900}$

Exercise 1*

1

Number of women, w	Length of dry-stone wall, x m	Time of construction, t days
1	8	8
3	18	6
4	24	6
6	12	2
$2\frac{2}{3}$	32	12
w	x	$x \div w$
w	wt	t
$x \div t$	x	t

2

Number of bees, b	Length of bee's journey, x km	Mass of honey, m g
10	150	10
20	375	50
100	750	500
500	300	1000
10^6	1000	6.67×10^7
b	x	$bx \div 150$
b	$150m \div b$	m
$150m \div x$	x	m

3

Number of grass-cutters, n	Number of rugby pitches, r	Time, t hours
2	1	0·5
$1\frac{1}{3}$	2	1.5
4	4	1
$r \div t$	r	t
n	tn	t
n	r	$r \div n$

4

Number of houses, h	Mass of waste, w kg	Time, t weeks
1	20	1
100	20 000	10
9615	10^6	52
h	w	$w \div 20h$
$w \div 20t$	w	t
h	$20ht$	t

5 **a** $\frac{107}{333}$ **b** $\frac{34}{45}$ **c** $\frac{25}{66}$ **d** $\frac{203}{198}$

6 $\frac{254}{713}$

Exercise 2

1 **a** $y = 9x$ **b** $y = 90$ **c** $x = 5$

2 **a** $y = 0.4x^2$ **b** $y = 90$ **c** $x \approx 6.12$

3 **a** $p = 20\sqrt{q}$ **b** $p = 160$ **c** $q = 6.25$

4 **a** $p = \frac{50}{q}$ **b** $p = 2.5$ **c** $q = 2.5$

5 $a = 20b$

b	10	5	30
a	200	300	600

6 **a** $d = 5t^2$ **b** $d = 20$ m **c** $t \approx 4.24$ s

7 **a** $C = 1.5d$ **b** \$97.50 **c** 53.3 cm

8 **a** $p = 1.5n^2$ **b** $p =$ £216 **c** $n = 20$

Exercise 2*

1 **a** $y = 4x^3$ **b** $y = 256$ **c** $x = 6$

2 **a** $y = \dfrac{80}{x^2}$ **b** $y = 5$ **c** $x \approx 12.6$

3 **a** $p = \dfrac{2500}{\sqrt{q}}$ **b** $p = 250$ **c** $q = 2500$

4 **a** $p^2 = \dfrac{800}{q^3}$ **b** $p \approx 3.54$ **c** $q \approx 3.17$

5

b	125	8	1
a	2	5	10

6 **a** $e = 0.5v^2$ **b** $e = 1250\,\text{kJ}$ **c** $v = 1414\,\text{m/s}$

7 **a** $n = \dfrac{250}{t^2}$ **b** $n = 62.5$ **c** $t = 15.8\,\text{yrs}$

8 **a** $v = 3.1\sqrt{d}$ **b** **i** $v = 21.9\,\text{m/s}$ **ii** $v = 98.0\,\text{m/s}$

c $0.104\,\text{m}$ **d** $d = 5011\,\text{m}$

Exercise 3

1

x	-2	-1	0	1	2	3	4
y	-17	-1	3	1	-1	3	19

2

x	-2	-1	0	1	2	3	4
y	-19	0	1	-4	-3	16	65

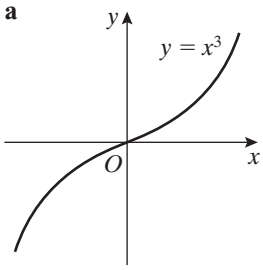
3

x	-4	-3	-2	-1	0	1	2	3	4
y	-3	-4	-6	-12	—	12	6	4	3

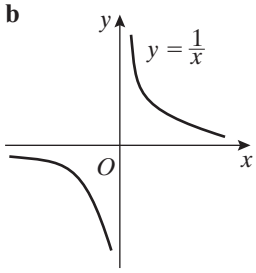
4

x	1	4	8	12	16	20
y	100	25	12.5	8.3	6.25	5

5 **a**



b



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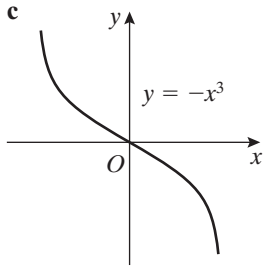

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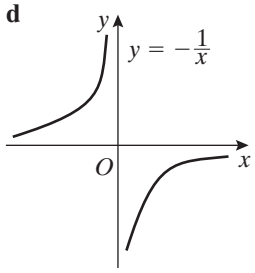


6 **a**

t	1	2	4	6	8	10	12
p	20	10	5	3.3	2.5	2	1.7

b **i** $1\frac{1}{3}$ months **ii** \$2222

c $x = 80$

7 a

t	0	1	2	3	4	5	6
d	18	23	18	9	2	3	18

b 23.1 m depth at 00:54 **c** $02{:}54 \leqslant t \leqslant 05{:}36$

Exercise 3*

1 a $a = -5$

x	-2	-1	0	1	2	3	4	5
y	-23	1	9	7	1	-3	1	18

c $x \approx -1.1$, 2.2 or 3.8

2 a $a = -7, b = 8$

x	-1	0	1	2	3	4	5	6
y	-9	8	11	6	-1	-4	3	26

c $x \approx -0.6$, 2.8 or 4.7

3 a $k = 12$

x	1	2	3	4	5	6
y	12	6	4	3	2.4	2

4 a $a = 4$

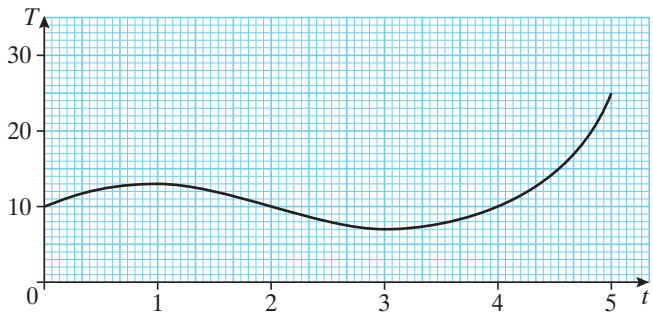
x	1	2	3	4	5	6
y	8	10	13.3	17	20.8	24.7

c $x = 1, y = 8$

5 a $a = -6, b = 10$

t	0	1	2	3	4	5
T	10	13	10	7	10	25

b

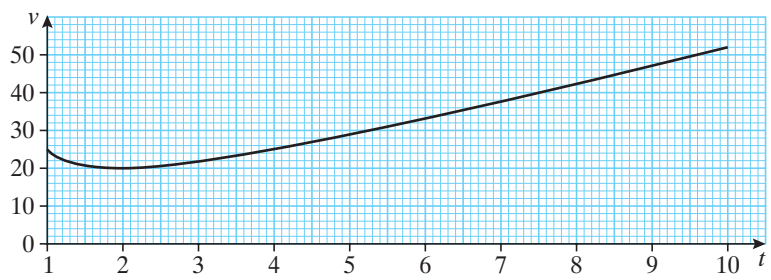


c $T = 6.9\,°\text{C}, t = 10{:}12$

6 a $a = 5, b = 20$

t	1	2	4	6	8	10
v	25	20	25	33.3	42.5	52

b



c **i** $v = 20$ m/s, $t = 2$. Time = 12:02

ii $t \geqslant 4$. Time for speed to be at least 25 m/s is: 12:04 $\leqslant$ time $\leqslant$ 12:10

Exercise 4

1 62° **2** 55° **3** 124° **4** 132° **5** 54° **6** 66° **7** 30° **8** 222°

9 12 **10** 3 **11** 8 **12** 8 **13** 4 **14** 3 **15** 5 **16** 4

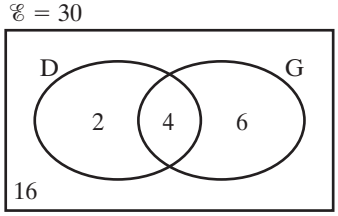
Exercise 4*

1 57° **2** 112° **3** 68° **4** 42° **5** 44° **6** 42° **7** 228° **8** 44

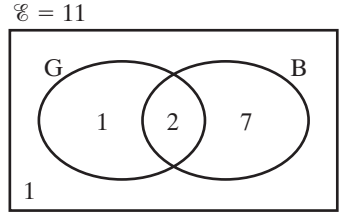
9 6 **10** 3 **11** 8 **12** 5 **13** 4 **14** 4 **15** $\sqrt{2}$ **16** 4.85

Exercise 5

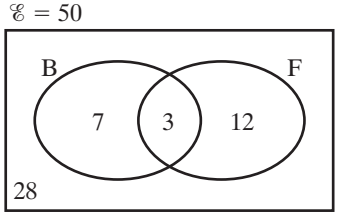
1 16 $\mathscr{E} = 30$



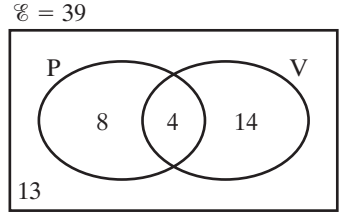
2 2 $\mathscr{E} = 11$



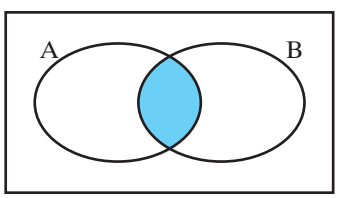
3 3 $\mathscr{E} = 50$



4 8 $\mathscr{E} = 39$



5 **a**



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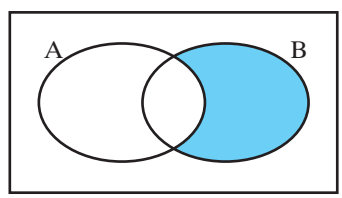

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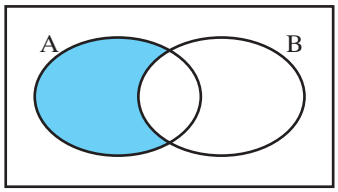

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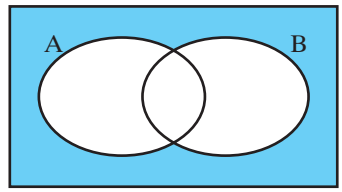
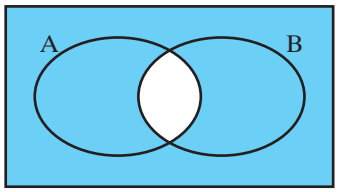
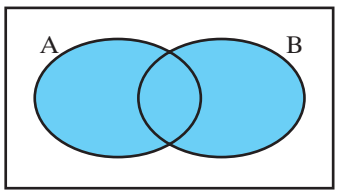


e



6 a



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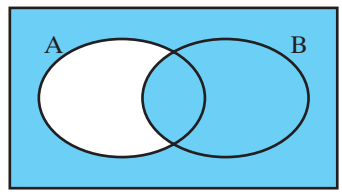

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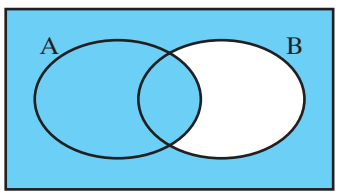

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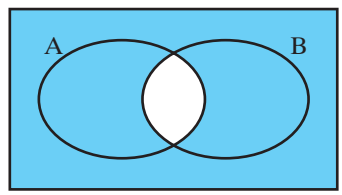

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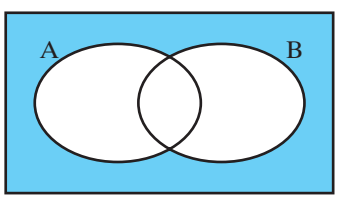
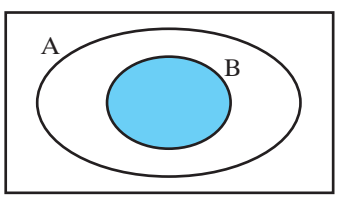


7 a



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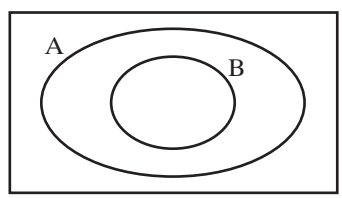

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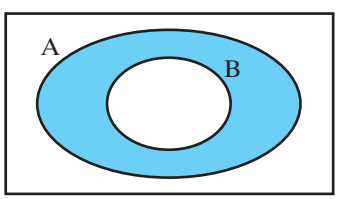

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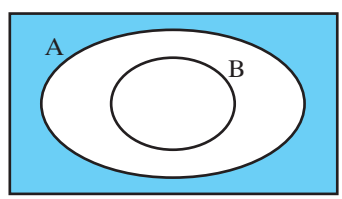

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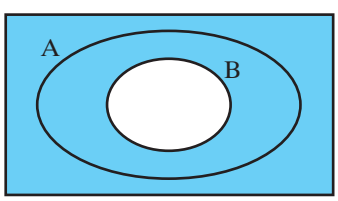
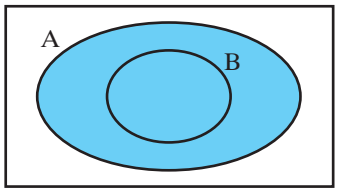
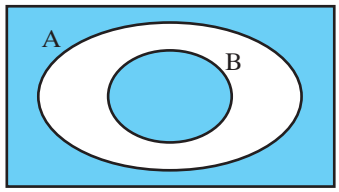


8 **a**



b



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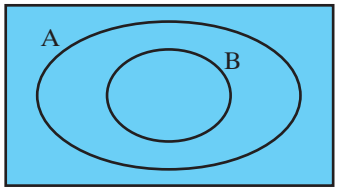

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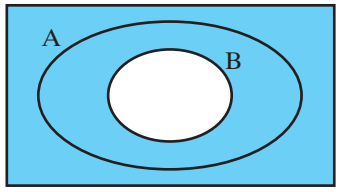

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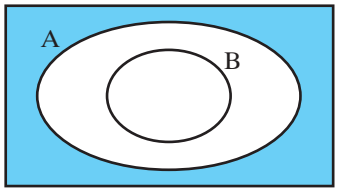
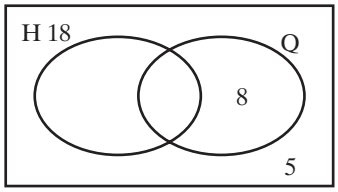


9 **a** $A = \{-1, 0, 1\}$ **b** $B = \{3, 4, 5\}$
c $C = \{-1, 0, 1\}$ **d** $D = \{1, 2, 3, 4\}$

10 **a** $A = \{x: x < 5\}$ **b** $B = \{x: x \geqslant -8\}$
c $C = \{x: -2 < x < 4\}$ **d** $D = = \{x: 3 \leqslant x \leqslant 8\}$

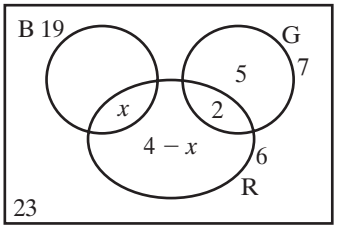
Exercise 5*

1



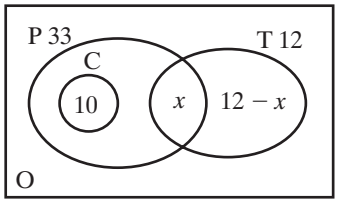
$n(\mathscr{E}) = 31$

2 $\mathscr{E} = 50$



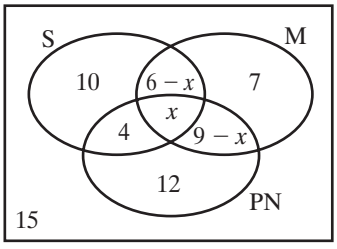
a $4 - x$
b $x = 3$

3 $\mathscr{E} = 40$



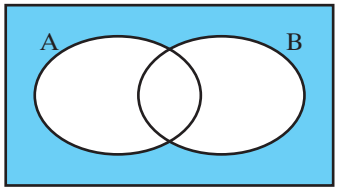
a $12 - x$
b $x = 5$

4 $\mathscr{E} = 60$

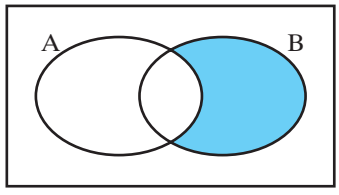


a $6 - x$
b $x = 3$

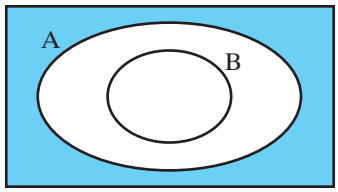
5 **a**



b



6 **a** Yes **a**



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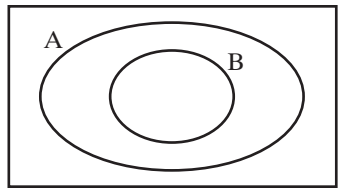
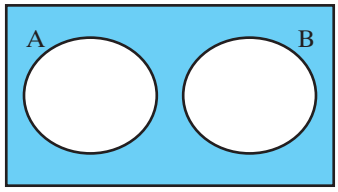


b Yes **a**



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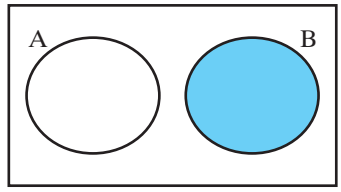
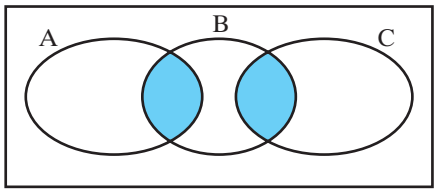


7 **a**



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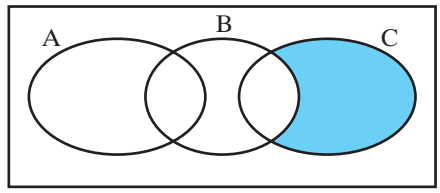
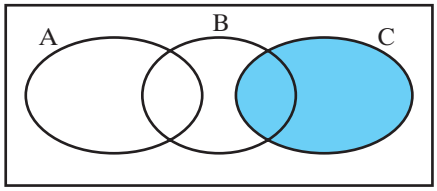
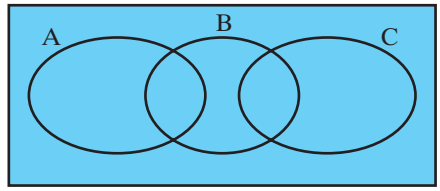


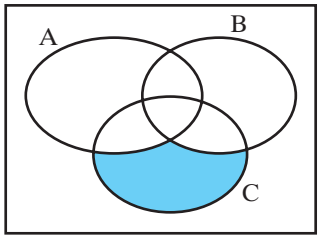
c



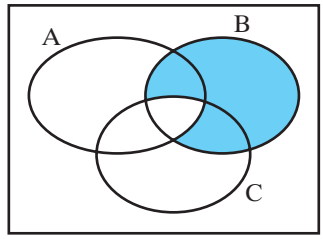
d



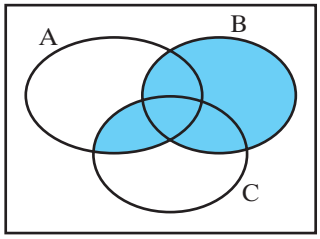
8 **a**



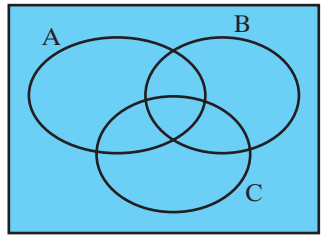
b



c



d



9 **a** $A = \{-2, -1, 0, 1, 2, 3\}$
b $B = \{10, 12, 14\}$
c $C = \{-2, 2\}$
d $D = \{-1, 0, 1, 2, 3, 4, 5, 6\}$

10 **a** $A = \{x: x \geqslant -4\}$
b $B = \{x: -2 \leqslant x \leqslant 5\}$
c $C = \{x: -2 \leqslant x \leqslant 2\}$ or $C = \{x: -3 < x < 3\}$
d $D = \{x: x = 2y \text{ and } 2 \leqslant y \leqslant 4\}$ or $D = \{x: x = 2y \text{ and } 1 < y < 5\}$

Examination practice 1

1 **a** 4 girls **b** 40 cars

2

Number of men, m	Number of humous tubs, h	Time, t mins
2	120	5
4	480	10
6	1080	15
m	h	$h \div (12m)$
$h \div (12t)$	h	t
m	$12mt$	t

3 **a** $\frac{5}{9}$ **b** $\frac{37}{990}$ **c** $\frac{2908}{4995}$ **d** $\frac{35\,117}{33\,300}$

4 $\frac{263}{329}$

5 **a** $y = 8x$ **b** $y = 80$ **c** $x = 5$

6 **a** $x = 4\sqrt[3]{y}$ **b** $y = 512$

7 **a** $y = \frac{48}{x}$ **b** $y = 6$ **c** $x = 4$

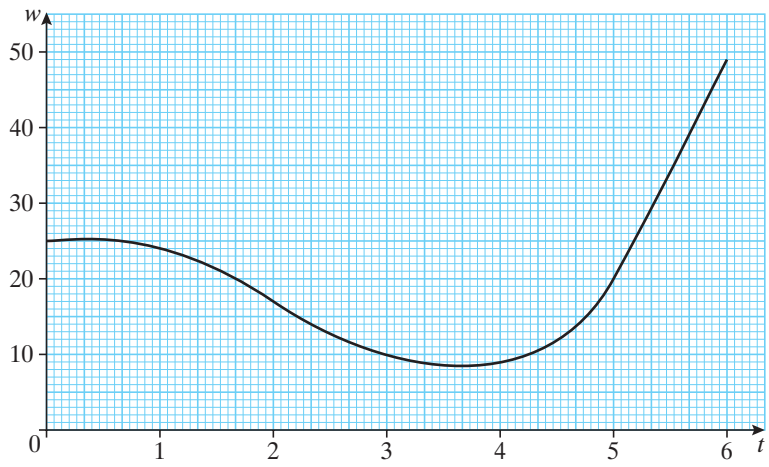
8 **a** $N = \frac{9000}{d^2}$ **b** $N = 2250$ **c** $d = 3$

9 **a** $A = 15h^2$ **b** $A = 135\,\text{m}^2$ **c** $h = 6\,\text{m}$

10 **a**

t	0	1	2	3	4	5	6
w	25	24	17	10	9	20	49

b



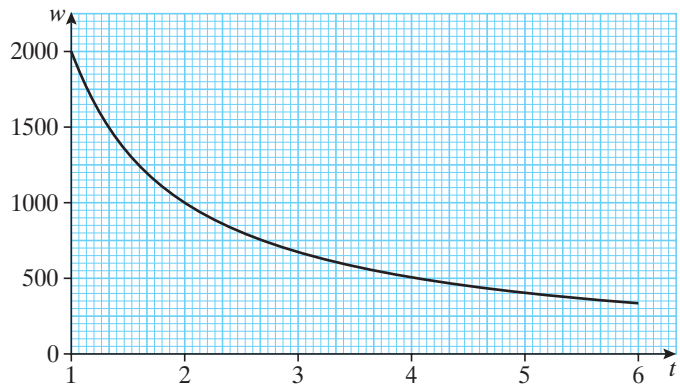
i 12.6 mph

ii 01:40, 05:00

11 a

t	1	2	3	4	5	6
w	2000	1000	667	500	400	333

b



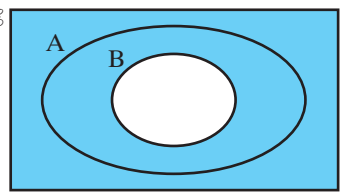
i 571 approx
ii March 15th approx.

12 a $x = 60°, y = 60°, z = 55°$ **b** $x = 40°, y = 70°, z = 40°$

13 a $x = 16$ **b** $x = 10$

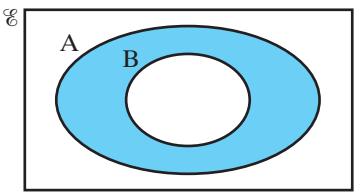
14 a 9 **b** 5 **c** 7

15 a



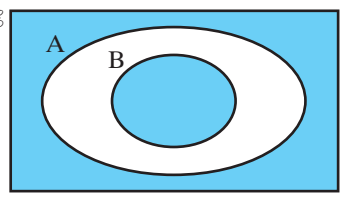
$(A \cap B)'$

b



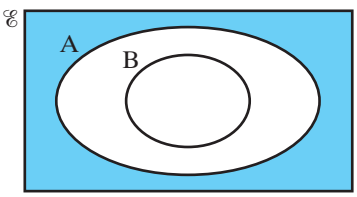
$(A' \cup B)'$

c



$(A \cap B')'$

d



$(A \cup B)'$

Exercise 6

1 a 5×10^6 mm **b** 8×10^5 cm **c** 20 km **d** 400 km

2 a 500 m^2 **b** 3×10^6 m^2 **c** 4×10^6 mm^2 **d** 2 km^2

3 a 2×10^6 cm^3 **b** 4×10^9 m^3 **c** 80 mm^3 **d** 70 m^3

4 a^{m+n} **5** a^{m-n} **6** a^{mn} **7** 1

8 $\frac{1}{100}$ **9** $\frac{1}{1000}$ **10** $\frac{1}{8}$ **11** $\frac{1}{9}$

12 $\frac{1}{25}$ **13** $\frac{1}{125}$ **14** $\frac{1}{27}$ **15** $\frac{1}{64}$

16 $\frac{1}{81}$ **17** $\frac{1}{256}$ **18** $\frac{1}{125}$ **19** $\frac{1}{36}$

20 $\frac{1}{125}$ **21** $\frac{1}{10\,000}$ **22** $\frac{1}{32}$ **23** $\frac{1}{49}$

24 a^6 **25** 1 **26** c^5 **27** d^2

28 e^4 **29** f^2 **30** g^3 **31** h^{15}

32 $\frac{1}{2}$ **33** -1 **34** -2 **35** -3

36 $\frac{1}{3}$ **37** $-\frac{1}{2}$ **38** $-\frac{1}{3}$ **39** $-\frac{1}{4}$

40 1 **41** 2 **42** 3 **43** 3

44 -5 **45** -4 **46** -4 **47** -3

48 1 **49** $\frac{1}{2}$ **50** 1 **51** $\frac{1}{4}$

52 2 **53** 2 **54** -1 **55** 10 000

Exercise 6*

1 **a** 8.3×10^6 mm **b** 5700 km **c** 19 km **d** 3.5×10^4 km

2 **a** 5×10^6 cm^2 **b** 9.6×10^3 km^2 **c** 3.8×10^{12} mm^2 **d** 0.84 m^2

3 5.3×10^{19} mm^3 **b** 3.3 km^3 **c** 0.1 m^3 **d** 0.001 m^3

4 $\frac{1}{3}$ **5** $\frac{1}{4}$ **6** $\frac{1}{5}$ **7** $\frac{1}{6}$

8 $\frac{1}{2}$ **9** $\frac{1}{3}$ **10** $\frac{1}{4}$ **11** $\frac{1}{5}$

12 $\frac{1}{4}$ **13** $\frac{1}{9}$ **14** $\frac{1}{16}$ **15** $\frac{1}{25}$

16 $\frac{1}{8}$ **17** $\frac{1}{8}$ **18** $\frac{1}{1000}$ **19** $\frac{1}{125}$

20 $\frac{125}{8}$ **21** $\frac{2197}{64}$ **22** $\frac{25}{4}$ **23** $\frac{125}{27}$

24 $\frac{3}{4}$ **25** $\frac{4}{5}$ **26** $\frac{3}{10}$ **27** $\frac{4}{9}$

28 $a^{-2} = \frac{1}{a^2}$ **29** $b^{-1} = \frac{1}{b}$ **30** c^2 **31** d^2

32 $e^{-1} = \frac{1}{e}$ **33** $f^{-2} = \frac{1}{f^2}$ **34** $g^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{g}}$ **35** h^2

36 $x = \frac{3}{10}, y = -\frac{9}{10}$ **37** $x = \frac{3}{4}, y = 0$ **38** $x = 2, y = -\frac{3}{5}$ **39** $x = \frac{3}{5}, y = \frac{7}{3}$

Exercise 7

1 1, 3 **2** $-4, -3$ **3** 1 **4** $-2, 5$

5 $-3, 2$ **6** $-2, 4$ **7** $-3, -7$ **8** $-2, 9$

9 $-3, 8$ **10** -1 **11** $-4, 0$ **12** 0, 7

13 $-2, -1$ **14** $-3, 2$ **15** $-5, -2$ **16** $-3, 5$

17 3 **18** $-6, 2$ **19** $-1, 0$ **20** 0, 4

21 $-2, 2$ **22** $-3, 3$ **23** $-3.73, -0.268$ **24** 0.697, 4.30

25 $-1.45, 3.45$ **26** $-3.79, 0.791$ **27** $-5.24, -0.764$ **28** 0.298, 6.70

29 $-0.898, 3.90$ **30** $-1.86, -0.537$ **31** $-2.77, 0.271$ **32** $-0.231, 7.23$

33 $-3.31, -0.393$ **34** $-0.345, 0.637$ **35** $x(x + 1) = 7$, 2.19 m by 3.19 m

36 $\frac{1}{2}x(x + 3) = 25$, 5.73 cm **37** $x^2 + (x + 1)^2 = (x + 2)^2, x = 3$

38 $x^2 + (x + 1)^2 = 145$, 8 and 9 **39** $x(30 - x) = 210$, 11.1 cm by 18.9 cm

40 $x(x + 2) = 2 \times 3, x = 1.65$ **41** $-2 \leqslant x \leqslant 2$ **42** $x < -7$ or $x > 7$

43 $-4 < x < 4$ **44** $x \leqslant -3$ or $x \geqslant 3$ **45** $-2 < x < 1$ **46** $x < -4$ or $x > -2$

47 $-1 \leqslant x \leqslant 6$ **48** $x < 3$ or $x > 4$ **49** $-1 < x < 5$ **50** $x \leqslant 1$ or $x \geqslant 2$

Exercise 7*

1 $-5, -2$ **2** $-5, 3$ **3** 2 **4** $2, 6$

5 $1, 9$ **6** $-7, 2$ **7** $-6, 8$ **8** $-12, -3$

9 4 **10** $0, 19$ **11** $-1, 4$ **12** $-6, 3$

13 $-3, -2$ **14** $-2, 1$ **15** $-4, -3$ **16** $-2, 4$

17 2 **18** $-8, 3$ **19** $-2, 0$ **20** $0, 3$

21 $-6, 6$ **22** $-7, 7$ **23** $1.59, 4.41$ **24** $-4.35, 0.345$

25 $-0.436, 3.44$ **26** $-0.135, 2.47$ **27** $-2.84, 1.17$ **28** $-0.257, 2.59$

29 $-12.7, -0.315$ **30** $3.11, -1.61$ **31** $-1.82, 0.823$ **32** $-57.9, -4.29$

33 $-3.30, 0.379$ **34** $-2.45, -0.147$ **35** $x^2 + (x + 2)^2 = 202$, 9 and 11

36 $\frac{x}{21} = \frac{21}{2x}, x = 14.85$ cm **37** $x^2 + (5 - x)^2 = 16$, 1.18 cm and 3.82 cm

38 $x(x + 3) = 9 \times 5, x = 5.37$ **39** $\pi(x + 2)^2 - \pi 2^2 = \pi 2^2, x = 0.828$ m

40 $\left(\frac{1200}{x} - 20\right)(x + 3) = 1200, x = 12$ days **41** $x \leqslant -4$ or $x \geqslant 4$

42 $-2 < x < 2$ **43** $2 \leqslant x \leqslant 6$ **44** $x < -5$ or $x > 3$ **45** $-8 < x < -1$

46 $-2 \leqslant x \leqslant 7$ **47** $x \leqslant -9$ or $x \geqslant 7$ **48** $-5 < x < 8$ **49** $x < -3.45$ or $x > 1.45$

50 $-1.65 \leqslant x \leqslant 3.65$

Exercise 8

1 **a** $-2.6, 2.6, y = 7$ **b** $0, 1, y = x$ **c** $-1.3, 2.3, y = x + 3$

d $-2.6, 1.6, y = 4 - x$ **e** $1, y = 2x - 1$ **f** $-2.4, 0.4, y = 1 - 2x$

2 **a** $-1.6, 0.6, y = 0$ **b** $-1, 0, y = -1$ **c** $-2, 1, y = 1$

d $-2.6, 1.6, y = 3$ **e** $-3.3, 0.3, y = -2x$ **f** $-1, 1, y = x$

3 **a** $y = 2$ **b** $y = x$ **c** $y = 1 - x$ **d** $y = 3 + 2x$

4 **a** $y = 0$ **b** $y = -3$ **c** $y = 3$ **d** $y = x$

5 **a** $x^2 + 1 = 0$ **b** $2x^2 + x - 3 = 0$ **c** $x^2 - 4x + 3 = 0$ **d** $2x^2 + 2x - 4 = 0$

6 **a** $-1.4, 0, 1.4, y = 2x$ **b** $0, y = -3x$

c $1.4, y = 4 - x$ **d** $-1.9, 0.3, 1.5, y = 3x - 1$

7 **a** $-1.5, y = -2$ **b** $-1.7, 1.7, y = x$ **c** $1, 3, y = 4 - x$ **d** $-2.3, 1.3, y = x + 1$

8 $-0.6, 1.6$

9 $-1.3, 2.3$

10 $(1.5, 2.5)$

Exercise 8*

1 **a** 0.4, 2.6, $y = 0$ **b** -0.8, 3.8, $y = 4$ **c** 0.3, 3.7, $y = x$
d -0.2, 4.2, $y = x + 2$ **e** -1.4, 3.4, $y = 6 - x$ **f** -1.3, 2.3, $y = 4 - 2x$
g $k = -2.25$

2 **a** $y = -1$ **b** $y = 6$ **c** $y = x$
d $y = 2x + 2$ **e** $y = -4x + 3$ **f** $y = -\frac{1}{2}$

3 **a** $y = 2$ **b** $y = 1$ **c** $y = x$ **d** $y = 4 - x$

4 **a** $5x^2 - 3x + 17 = 0$ **b** $4x^2 - 4x - 7 = 0$
c $x^2 - 7x + 3 = 0$ **d** $3x^2 - 3x + 5 = 0$

5 **a** -1.6, 0.6, 1, $y = 1$ **b** -1.7, 0, 1.7, $y = -x$
c -1.3, $y = x + 1$ **d** -1.8, -0.5, 1.2, $y = x^2 - 1$
e $k > 1.1$ or $k < -1.1$

6 **a** 0.4, 2.6, $y = 3$ **b** -1, 1, $y = 2x$
c -3.4, -0.6, $y = \frac{x}{2} - 2$ **d** -2.7, 0.3, 1.4, $y = 4 - x^2$

7 -1.5, -0.3, 1.9

8 -1.7, 0.3, 1.8

9 (2, 3)

10 (72, 14)

Exercise 9

1 **a** A = 45.9, P = 35.4 **b** A = 1.93, P = 10.7
c A = 3.43, P = 12.6 **d** A = 17.7, P = 22.3

2 **a** A = 19.5, P = 20.9 **b** A = 43. 3, P = 29.6
c A = 6.98, P = 11.0 **d** A = 13.1, P = 28.2

3 **a** SA = 207, V = 226 **b** SA = 152, V = 96

4 $r = 1.91$ cm, A = 11.5 cm^2 **5** $r = 4.57$ cm, SA = 263 cm^2 **6** P = 20, A = 18.75

7 $x = 12$ **8** V = 246, A = 62.5 **9** $h = 10$, SA = 120

Exercise 9*

1 **a** A = 96, P = 49.1 **b** A = 113, P = 49.7
c A = 5.37, P = 25.7 **d** A = 49.1, P = 28.6

2 **a** $x = 45.8°$, A = 10 **b** $x = 251°$, P = 39

3 **a** SA = 452, V = 509 **b** SA = 223, V = 192

4 $r = 4.67$ cm, A = 34.2 cm^2 **5** $r = 2.84$ cm, V = 48.0 cm^3

6 P = 20, A = 31.36 **7** $x = 4.5$

8 V = 2048, SA = 1875

9 Diameter of Moon = 3479 km, SA Earth = 5.09×10^8 km^2

Exercise 10

1 **a** $\frac{1}{4}$ **b** $\frac{1}{2}$ **c** $\frac{1}{4}$ **2** **b** **i** $\frac{1}{225}$ **ii** $\frac{196}{225}$ **iii** $\frac{28}{225}$

3 **b** $\frac{3}{8}$ **c** $\frac{1}{10}$ **4** **b** $\frac{9}{49}$ **c** $\frac{24}{49}$

5 **b** **i** $\frac{1}{200}$ **ii** $\frac{8}{25}$ **iii** $\frac{4}{25}$ **6** **c** **i** $\frac{1}{21}$ **ii** $\frac{3}{14}$ **iii** $\frac{13}{42}$

Exercise 10*

1 **b** **i** $\frac{8}{15}$ **ii** $\frac{2}{5}$ **iii** $\frac{14}{15}$ **2** **b** **i** $\frac{1}{4}$ **ii** $\frac{1}{2}$ **iii** $\frac{3}{4}$

3 **b** $P(H \geqslant 2) = \frac{1}{2}$ so she is not especially lucky.

4 **b** **i** $\frac{3}{10}$ **ii** $\frac{3}{5}$ **iii** $\frac{7}{10}$

5 **b** **i** $\frac{1}{4}$ **ii** $\frac{7}{24}$ **iii** $\frac{3}{8}$

6 **b** **i** $\frac{7}{25}$ **ii** $\frac{43}{75}$ **iii** $\frac{18}{25}$

Examination practice 2

1 **a** x **b** x^3 **c** 1 **d** x

2 **a** x^{-2} **b** x^{-2} **c** x **d** x

3 **a** 4 **b** 8 **c** $\frac{1}{9}$ **d** $\frac{1}{64}$

4 **a** $1.8 \times 10^{3n+1}$ **b** $5 \times 10^{n-1}$

5 **a** ± 4 **b** $0, 16$ **c** $-16, 0$

6 **a** $-4, -3$ **b** $1, 3$ **c** $-2, 4$ **d** $-5, 1$

7 **a** 3 **b** ± 2 **c** $0, 2$

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

9 **a** $-5.83, -0.172$ **b** $0.438, 4.56$ **c** $-0.732, 2.73$ **d** $0.279, 2.39$

10 $x = 3$

11 **c** $x = 0.697$

12 **a** $-10 \leqslant x \leqslant 10$ **b** $x < -4$ or $x > 4$ **c** $-1 < x < 2$ **d** $x \leqslant -5$ or $x \geqslant 3$

13 **a** $y = 6$ **b** $y = 2x + 1$ **c** $y = 2 - x$

14 $3x^2 - x - 1 = 0$

15 **a** 3×10^7 mm **b** $10\,\text{km}^2$ **c** $1.2 \times 10^7\,\text{cm}^3$

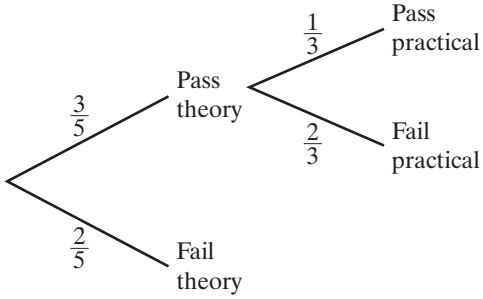
16 $P = 20.1$ cm, $A = 30.2\,\text{cm}^2$

17 **a** 5 cm **b** $x = 53.1°$ **c** $23.2\,\text{cm}^2$ **d** $224\,\text{cm}^3$

18 **a** $135\,\text{cm}^3$ **b** 10.8 cm **c** $12\,\text{cm}^2$ and $55.7\,\text{cm}^2$

19 **a** **i** 0.6 **ii** 0.2 **b** **i** 0.04 **ii** 0.055

20 **a**



b P(Fails) $= \frac{4}{5}$ **c** $\frac{1}{20}$

Exercise 11

1 $1255 Australian **2** £199.20 **3** 176.20 Yuan **4** 1243.91 Rubles

5 7010 Ringitts, 88 490 Rupees, 46 776 Yuan **6** £11 531

7 **a** £250 **b** £500 **c** £1000

8 **a** £276 **b** £629 **c** £1653

9 £646.25 **10** £638.30 **11** £3055

12 Gerard: €865.38/week, Marcelle: €860/week. Gerard by €5.38/week.

13 **a** €21 000 p.a. **b** €403.85 **c** 16%

14 **a** €51960 **b** €999.23 **c** 18.4%

Exercise 11*

1 **a** $13 650 **b** $9360 **c** $5841

2 **a** $4635 **b** $5217 **c** $6048

3 Saskia was overcharged by £10

4 Roman worked 24 hours.

5 Frida worked 10 hours overtime.

6 £679.90 VAT

7 **a** €906.67 **b** €11 520.16

8 **a** €1012.50 **b** €15 750

9 €2 263 333.33 p.a.

10 **a** €733 500 p.a. **b** 43.6%

Exercise 12

1 **a** $(-1, 2)$ or $(2, 4)$ **b** $(1, 1)$ or $(-3, 9)$ **c** $(2, 1)$ or $(-4, 13)$

2 **a** $(-1.30, 0.30)$ or $(-2.30, -3.30)$ **b** $(3, 1)$ or $(9, 4)$

3 **a** $(3, -1)$ or $(-2, 4)$ **b** $(3, -2)$ or $(-\frac{1}{2}, -5\frac{1}{2})$

4 **a** $(0.382, 2.62)$ or $(2.62, 0.382)$ **b** $(0.191, 0.809)$ or $(1.31, -0.309)$

5 Takes off at (0, 4), lands at (1.5, 2.5)

6 **a** 1 **b** 11 **c** 7

7 **a** 2 **b** 0 **c** $\frac{3}{5}$

8 **a** $2x + 2$ **b** $2x + 1$

9 -5

10 2, 4

11 **a** $x = -2$ **b** $x = \frac{1}{2}$ **c** $x < 1$ **d** $x < -1$

12 **a** All x **b** $x \geqslant -1$ **c** $x \geqslant 0$

13 **a** **i** $2\sqrt{x} + 1$ **ii** $\sqrt{2x + 1}$

b **i** $x < 0$ **ii** $x < -\frac{1}{2}$

c $4x + 3$

14 **a** $\frac{x + 4}{5}$ **b** $3 - x$ **c** $\frac{1}{x} - 3$ **d** $\sqrt{x + 3}$

15 **a** **i** x **ii** x

b Inverse of each other. **c** π

Exercise 12*

1 **a** (3, 5) or (−4, 12) **b** (3, 2) or (−3, −2) **c** (2, 3) or (3, 2)

2 **a** (1, 1) **b** (1, 1) or (−3, 5)

3 **a** (0.586, 2.83) or (3.41, −2.83) **b** (−4.16, −6.16) or (2.16, 0.162)

4 **a** (−1.92, 6.92) or (3.92, 1.08) **b** (−1.24, −3.24) or (3.24, 1.24)

5 (71.7, 14.3)

6 (2, 3)

7 **a** **i** 1.5 **ii** −1.5

b $\frac{1}{0}$ is undefined.

8 **a** 2, 3 **b** −1, 6 **9** **a** $8 + 6x$ **b** $4 + 6x$

10 1 or $-\frac{2}{3}$

11 **a** $x = -\frac{3}{4}$ **b** $x = 1$ **c** $x > 2.5$

12 **a** $x \geqslant -1$ **b** $x \geqslant 0$ **c** $x \geqslant 0$

13 **a** **i** $\sqrt{3x + 3}$ **ii** $3\sqrt{x + 1} + 2$

b **i** $x < -1$ **ii** $x < -1$ **c** $9x + 8$

14 **a** **i** $2 - \frac{x}{7}$ **ii** $x^2 - 5$ **iii** $\sqrt{x} - 1$ **iv** $\frac{4}{x + 2}$

b **i** $f^{-1}(x) = \frac{x}{x - 1}$ **ii** Self inverse

15 **a** **i** x **ii** x

b Inverse of each other. **c** $\sqrt{19}$

Exercise 13

Note these are calculated answers. Students' answers will differ.

1 **a** 1.17 **b** −3.5 **c** 0.67

2 **a** −1.79, 1.12 **b** −2.81, 2.14 **c** −2.36, 1.69

3 (1.1, 1.8), (−1.8, −3.2)

4 $(-2.8, -3.2), (2.1, 1.9)$

5 **a** **i** 1 **ii** -2 **iii** 3
b $x = -2$ **c** $y = 2x - 2$

6 **a** $2\,\text{ms}^{-1}$ **ii** $0\,\text{ms}^{-1}$ **iii** $-1.6\,\text{ms}^{-1}$
b 23.5 s at $-2.8\,\text{ms}^{-1}$
c Increases velocity for 5 secs, slows down for 5 secs, on flower for 10 secs, returns faster than outward journey.

7 **b** **i** $8\,\text{ms}^{-2}$ **ii** $4\,\text{ms}^{-2}$ **c** 2.5 s

8 **a**

Time, *t*, in days	0	1	2	3	4	5	6	7	8
Depth, *d*, in cm	20	17	14.45	12.28	10.44	8.87	7.54	6.41	5.45

b 4.27 days **c** -2.35 cm/day
d -0.051 cm/hr **e** -3.25 cm/day at $t = 0$

Exercise 13*

Note these are calculated answers. Students' answers will differ.

1 **a** **i** -1.125 **ii** 1.875 **iii** 0
b **i** 0.85 or 3.15 **ii** -1.06 or 5.06 **iii** 0 or 4

2 **a** -1.125 **b** $y = -1.125x + 1.975$

3 1.85 or -1.5

4 1.6 or 2.4

5 **a** **i** 1 **ii** -2 **iii** 3
b -10 **c** Negative of each other.
d $y = 2x + 6$ **e** ± 1.414

6 **b** **i** 5 **ii** 10 **iii** 15 **iv** 20 **v** 0
c Should be $v = 5t$ **d** Constant acceleration of $5\,\text{ms}^{-2}$

7 **b** Runs off for about 1.7 secs, returns more slowly, at 5 secs runs off again
c **i** $1.6\,\text{ms}^{-1}$ **ii** $-1.6\,\text{ms}^{-1}$ **d** 6.9 s

8 **a**

Time, *t* (years)	0	10	20	30	40	50	60	70
Number, *N*, of eagles	100	150	225	338	506	759	1139	1709

b **i** 13.7 **ii** 30.8 **c** After 39 years

Exercise 14

1 **a** $\mathbf{p} = \begin{pmatrix}-1\\5\end{pmatrix}, \sqrt{26}$ **b** $\mathbf{q} = \begin{pmatrix}3\\-1\end{pmatrix}, \sqrt{10}$ **c** $\mathbf{r} = \begin{pmatrix}-4\\13\end{pmatrix}, \sqrt{185}$ **d** $\mathbf{s} = \begin{pmatrix}7\\0\end{pmatrix}, 7$

2 **a** $\mathbf{p} = \begin{pmatrix}5\\2\end{pmatrix}, \sqrt{29}$ **b** $\mathbf{q} = \begin{pmatrix}1\\0\end{pmatrix}, 1$ **c** $\mathbf{r} = \begin{pmatrix}12\\1\end{pmatrix}, \sqrt{145}$ **d** $\mathbf{s} = \begin{pmatrix}-2\\-42\end{pmatrix}, \sqrt{1768}$

3 **a** $\mathbf{w} = \begin{pmatrix}-7\\19\end{pmatrix}$ **b** $\sqrt{410}, 339.8°$ **c** 5.06 km/h

4 **a** $\overrightarrow{AB} = -\mathbf{a} + \mathbf{b}$ **b** $\overrightarrow{AM} = \frac{1}{2}(\mathbf{b} - \mathbf{a})$ **c** $\overrightarrow{OM} = \frac{1}{2}(\mathbf{a} + \mathbf{b})$

5 **a** $\overrightarrow{AB} = -2\mathbf{x} + 2\mathbf{y}$ **b** $\overrightarrow{AM} = \mathbf{y} - \mathbf{x}$ **c** $\overrightarrow{OM} = \mathbf{x} + \mathbf{y}$

6 **a** $\overrightarrow{ED} = \mathbf{p}$ **b** $\overrightarrow{DE} = -\mathbf{p}$ **c** $\overrightarrow{AC} = \mathbf{p} + \mathbf{q}$ **d** $\overrightarrow{AE} = 2\mathbf{q} - \mathbf{p}$

Exercise 14*

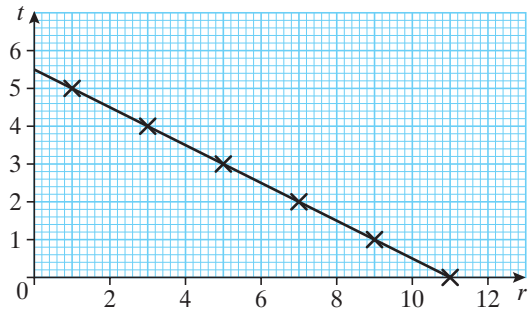
1 **a** **i** $\begin{pmatrix}6\\-3\end{pmatrix}$ **ii** $\begin{pmatrix}3\\9\end{pmatrix}$ **b** $m = 1, n = 3$ **c** $r = 2, s = 9$ **d** $u = -1, v = 2$

2 $m = 2, n = -1$

3 **a**

t	0	1	2	3	4	5
r	$\begin{pmatrix}1\\5\end{pmatrix}$	$\begin{pmatrix}3\\4\end{pmatrix}$	$\begin{pmatrix}5\\3\end{pmatrix}$	$\begin{pmatrix}7\\2\end{pmatrix}$	$\begin{pmatrix}9\\1\end{pmatrix}$	$\begin{pmatrix}11\\0\end{pmatrix}$

b



c 8050 km/hr, 117°

4 **a** $\overrightarrow{RS} = -\mathbf{r} + \mathbf{s}$ **b** $\overrightarrow{OP} = \frac{3}{2}\mathbf{r}$ **c** $\overrightarrow{PQ} = -\frac{3}{2}\mathbf{r} + 2\mathbf{s}$ **d** $\overrightarrow{OM} = \mathbf{s} - \frac{3}{4}\mathbf{r}$

5 **a** **i** $\overrightarrow{PQ} = -\mathbf{p} + \mathbf{q}$ **ii** $\overrightarrow{PR} = \frac{1}{3}(\mathbf{q} - \mathbf{p})$ **iii** $\overrightarrow{OR} = \frac{1}{3}(2\mathbf{p} + \mathbf{q})$

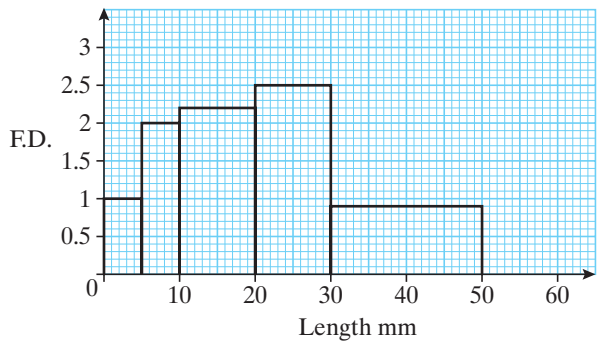
b **i** $k = \frac{3}{5}$ **ii** $\overrightarrow{OS} = \frac{1}{5}(2\mathbf{p} + \mathbf{q})$

6 **a** **i** $\overrightarrow{MP} = \frac{2}{5}\mathbf{p}$ **ii** $\overrightarrow{PQ} = -\mathbf{p} + \mathbf{q}$ **iii** $\overrightarrow{PN} = \frac{2}{5}(\mathbf{q} - \mathbf{p})$ **iv** $\overrightarrow{MN} = \frac{2}{5}\mathbf{q}$

b $\overrightarrow{MN} = \frac{2}{5}\overrightarrow{OQ}$, OQ is parallel to MN

Exercise 15

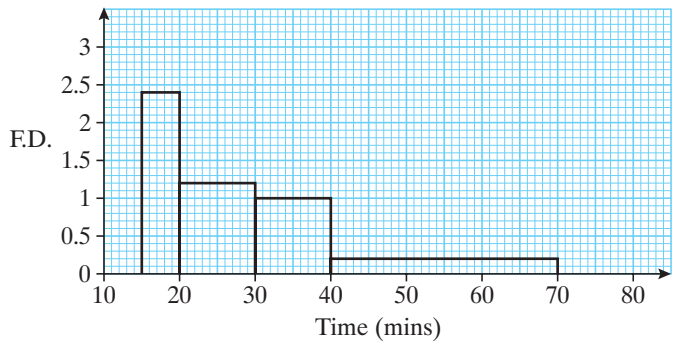
1 **a**



Length, l mm	F.D.
$0 < l \leq 5$	1
$5 < l \leq 10$	2
$10 < l \leq 20$	2.2
$20 < l \leq 30$	2.5
$30 < l \leq 50$	0.9

b 7 **c** 22.0 mm

2 **a**

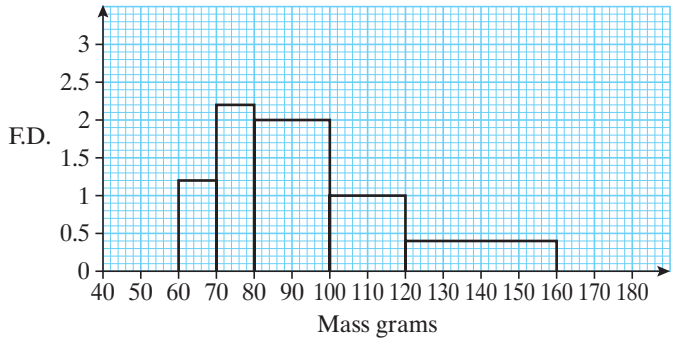


Time, t mins	F.D.
$15 < t \leq 20$	2.4
$20 < t \leq 30$	1.2
$30 < t \leq 40$	1
$40 < t \leq 70$	0.2

b 2 **c** 17 (16.8)

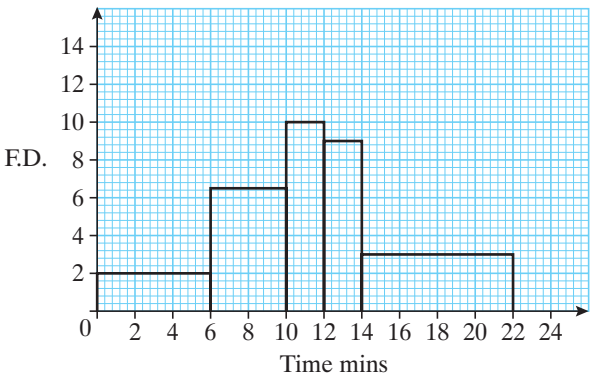
3 a b

Mass, m g	Frequency	F.D.
$60 < m \leqslant 70$	12	1.2
$70 < m \leqslant 80$	22	2.2
$80 < m \leqslant 100$	40	2
$100 < m \leqslant 120$	20	1
$120 < m \leqslant 160$	16	0.4



c 41

4



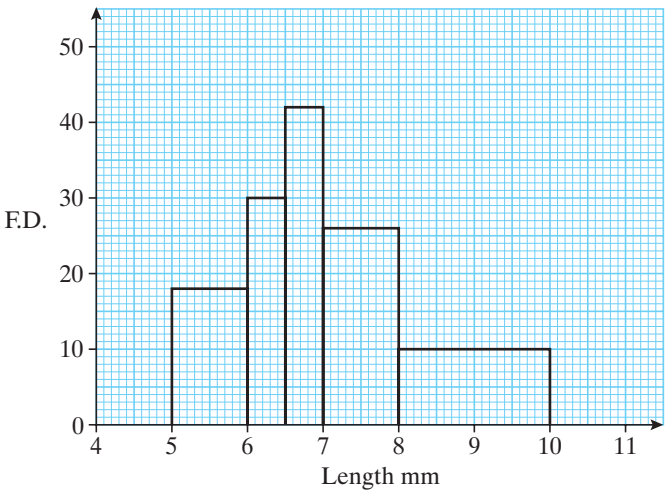
Time, t mins	Frequency	F.D.
$0 < t \leqslant 6$	12	2
$6 < t \leqslant 10$	26	6.5
$10 < t \leqslant 12$	20	10
$12 < t \leqslant 14$	18	9
$14 < t \leqslant 22$	24	3

c 60%

d 11.2 mins

Exercise 15*

1 a



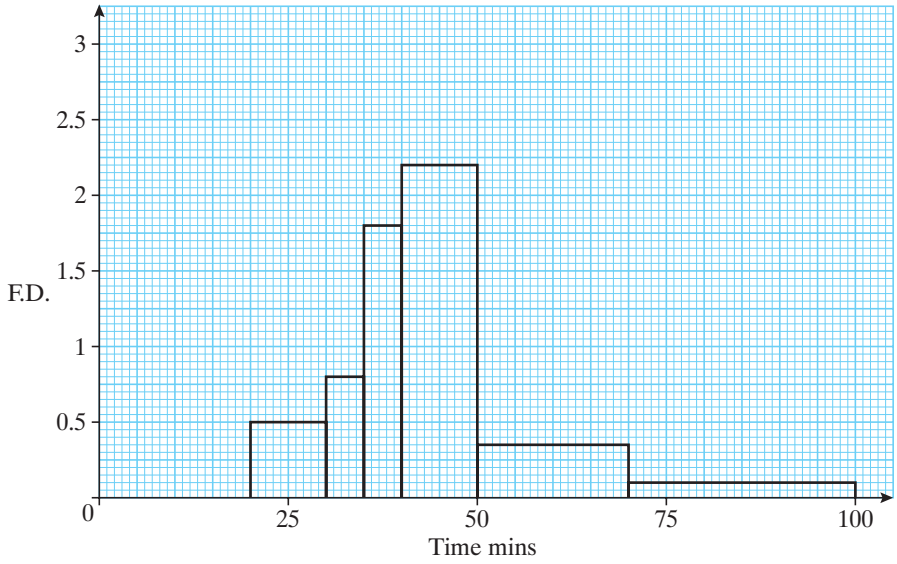
Length, l mm	F.D.
$5 < l \leqslant 6$	18
$6 < l \leqslant 6.5$	30
$6.5 < l \leqslant 7$	42
$7 < l \leqslant 8$	26
$8 < l \leqslant 10$	10

b 76

c 7.10 mm

2 a

Time, t mins	F.D.
$20 < t \leqslant 30$	0.5
$30 < t \leqslant 35$	0.8
$35 < t \leqslant 40$	1.8
$40 < t \leqslant 50$	2.2
$50 < t \leqslant 70$	0.35
$70 < t \leqslant 100$	0.1

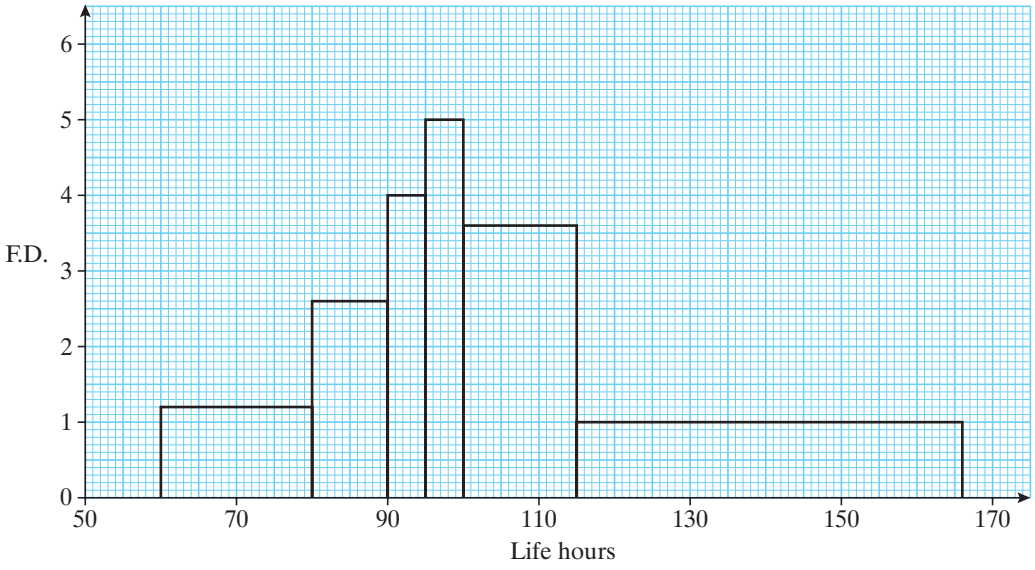


b 71.2%

c 43.2 mins

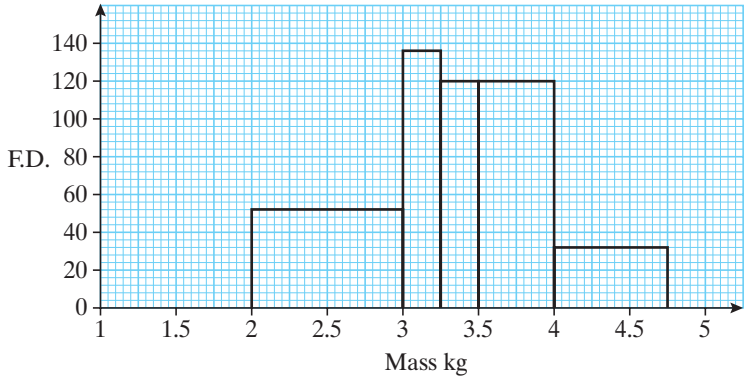
3 a, c **b** $x = 166$

Life, t hrs	Frequency	F.D.
$60 < t \leqslant 80$	24	1.2
$80 < t \leqslant 90$	26	2.6
$90 < t \leqslant 95$	20	4
$95 < t \leqslant 100$	25	5
$100 < t \leqslant 115$	54	3.6
$115 < t \leqslant x$	51	1



4 **a, b**

Mass, m kg	Frequency	F.D.
$2 < m \leqslant 3$	52	52
$3 < m \leqslant 3.25$	34	136
$3.25 < m \leqslant 3.5$	30	120
$3.5 < m \leqslant 4$	60	120
$4 < m \leqslant 4.75$	24	32



c 0.83 **d** 3.37 kg

Examination practice 3

1 \$446.50 **2** £166.25 **3** €546

4 **a** $x = 4, y = 1$ or $x = -4, y = -3$ **b** $x = 2, y = 0$ or $x = -6, y = 8$

5 **a** **i** -7 **ii** 13 **b** $\frac{3 - x}{5}$ **c** $\frac{1}{2}$

6 **b** **i** $y \geqslant 0$ **ii** $y \geqslant 1$ **iii** $y \geqslant -1$

7 **a** $ff(x) = x$ **b** Self inverse

8 **a** $\begin{pmatrix}1\\5\end{pmatrix}$ **b** $\begin{pmatrix}13\\10\end{pmatrix}$ **c** 5.10 **d** 052.4°

9

Time, t	$10 < t \leqslant 20$	$20 < t \leqslant 25$	$25 < t \leqslant 30$	$30 < t \leqslant 40$	$40 < t \leqslant 50$	$50 < t \leqslant 70$	$70 < t \leqslant 95$
Frequency	7	15	25	18	12	8	5
Frequency density	0.7	3	5	1.8	1.2	0.4	0.2

10 **a** \$3 000 **b** \$35 000 **c** \$72 500 **d** 7.94%

11 **a** $x < 0$ **b** **i** $fg(x) = 1 - \sqrt{2 + 3x}$ **ii** $gf(x) = 5 - 3\sqrt{x}$

c **i** $x = -0.539$ **ii** $x = 0.382$

12 1, 4

13 **a** 1800 m

b **i** $-22\,\text{ms}^{-1}$ **ii** $-50\,\text{ms}^{-1}$ **iii** $-28\,\text{ms}^{-1}$

c Accelerates to terminal velocity of $-50\,\text{ms}^{-1}$ in 11 secs, then falls at constant velocity, opens parachute at 45 secs, then slows to constant velocity of $-5\,\text{ms}^{-1}$ from 55 secs on.

14 A is $(-0.411, 1.82)$, B is $(0.911, -0.823)$

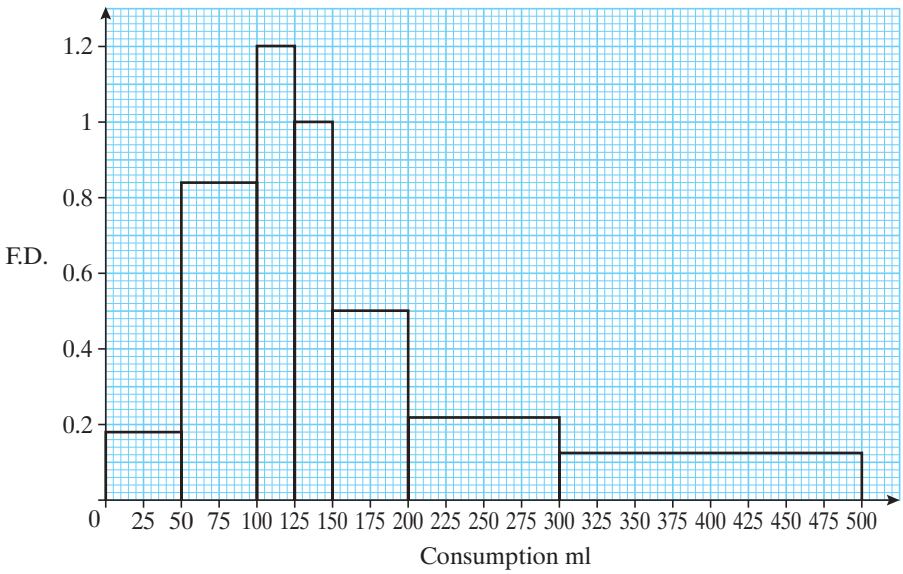
15 **a** **i** **a** **ii** $\frac{1}{2}(\mathbf{a} + \mathbf{b})$ **iii** $\mathbf{a} - \mathbf{b}$ **iv** $\frac{1}{2}(\mathbf{a} + \mathbf{b})$

b Parallel and equal lengths

c PQRS is a parallelogram

16

Consumption, m, ml	**Frequency**
$0 < m \leqslant 50$	9
$50 < m \leqslant 100$	42
$100 < m \leqslant 125$	30
$125 < m \leqslant 150$	25
$150 < m \leqslant 200$	25
$200 < m \leqslant 300$	22
$300 < m \leqslant 500$	27



c 134 ml **d** 50.1%

Exercise 16

1 **a**, **c**, and **e**

2 **a** e.g. 2.5 **b** e.g. 2.8

3 **a** **e.g.** $\sqrt{17}$ **b** e.g. $\sqrt{23}$

4 **a** 6 **b** a **c** 18 **d** 6 **e** $\frac{2}{3}$

5 **a** $\sqrt{27}$ **b** $\sqrt{28}$ **c** $\sqrt{80}$ **d** $\sqrt{18}$

6 **a** $4\sqrt{5}$ **b** $12\sqrt{5}$ **c** 160 **d** 2

7 **a** $3\sqrt{2}$ **b** $2\sqrt{5}$ **c** $3\sqrt{3}$ **d** $2\sqrt{7}$

8 **a** $5\sqrt{2}$ **b** $2\sqrt{2}$ **c** $5\sqrt{6}$

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

10 **a** $8 + 2\sqrt{7}$ **b** $11 - 4\sqrt{7}$ **c** -6

11 **a** $2\sqrt{2}$ **b** $2\sqrt{6}$ **c** $\sqrt{6}$ **d** $1 - \sqrt{5}$

Exercise 16*

1 **a**, **b** and **d**

2 **a** e.g. 4.2 **b** e.g. 5.4

3 **a** e.g. $\sqrt{137}$ **b** e.g. $\sqrt{9.9}$

4 **a** ab **b** $\frac{a}{b}$ **c** $\frac{1}{4a}$ **d** $\frac{8a}{b}$

5 **a** $\sqrt{3}$ **b** 2 **c** 2 **d** $4\sqrt{2}$ **e** $9\sqrt{3}$

6 $17\sqrt{3}$ **b** $\sqrt{7}$ **c** $5\sqrt{10}$

7 $2\sqrt{2} - 1$ **b** $11 - 6\sqrt{2}$ **c** 24

8 **a** $a\sqrt{b}$ **b** $a + b + 2\sqrt{a}\sqrt{b}$ **c** $1 - a$ **d** $4a$

14 **a** $\frac{\sqrt{3}}{27}$ **b** $2\sqrt{2}$

15 $n = 4$

Exercise 17

1 $9 - x$ **2** $1 + 3x$ **3** 4 **4** x

5 $2x$ **6** $x + 2$ **7** $x + 1$ **8** $\frac{x + 2}{x - 5}$

9 $\frac{2 + x}{4}$ **10** $\frac{3x}{4}$ **11** $\frac{3x - 1}{6}$ **12** $\frac{3x - 7}{10}$

13 $2x$ **14** 1 **15** $\frac{4}{3x}$ **16** $\frac{4x + 3y}{xy}$

17 $\frac{2}{x(x - 2)}$ **18** $\frac{5x + 1}{(x + 1)(x + 2)}$ **19** $\frac{x + 2}{x(x + 1)}$ **20** $\frac{x(12 - x)}{5(x - 2)}$

21 6 **22** 5 **23** -2 **24** -6

25 7.2 **26** -3 **27** $-\frac{14}{9}$ **28** -44

29 20 **30** -9 **31** -5 **32** 18

33 $-\frac{2}{3}$ **34** 2, 3 **35** -4, 5 **36** -2, -1

Exercise 17*

1 $x - 2$ **2** $2 + 3x$ **3** 7 **4** $3x$

5 $-5x$ **6** $x + y$ **7** $x - 2$ **8** $\frac{x-5}{x-4}$

9 $\frac{x+2}{3}$ **10** $\frac{5x-13}{12}$ **11** $\frac{93-11x}{35}$ **12** $\frac{x(x-1)}{x+1}$

13 $(x-7)(x-3)$ **14** $\frac{1}{6x}$ **15** $\frac{5x+2}{(x+3)(x-2)}$ **16** $\frac{3x}{(1-x)(2+x)}$

17 $\frac{x+7}{(2x-1)(3x+1)}$ **18** $\frac{x^2+x+1}{1+x}$ **19** $\frac{-2}{(x+4)(x+6)}$ **20** $\frac{4x}{x^2-9}$

21 12 **22** $-\frac{7}{11}$ **23** -7 **24** -15

25 $11\frac{1}{2}$ **26** 3 **27** $\frac{19}{27}$ **28** $-\frac{36}{13}$

29 $\frac{5}{13}$ **30** 2 **31** -8 **32** 2 or 10

33 -4 or $-\frac{1}{2}$ **34** -6 or 4 **35** ± 2 **36** 2.4

Exercise 18

1 **a** $\frac{dy}{dx} = 3$ **b** $\frac{dy}{dx} = 0$ **c** $\frac{dy}{dx} = 3x^2$ **d** $\frac{dy}{dx} = 4x^3$

e $\frac{dy}{dx} = 5x^4$ **f** $\frac{dy}{dx} = 12x^5$ **g** $\frac{dy}{dx} = 15x^4$ **h** $\frac{dy}{dx} = 160x^7$

2 **a** $\frac{dy}{dx} = 6x^2 + 10x$ **b** $\frac{dy}{dx} = 14x - 3$ **c** $\frac{dy}{dx} = 15x^2$ **d** $\frac{dy}{dx} = 12x^3 - 10x$

e $\frac{dy}{dx} = 3x^2 + 10x$ **f** $\frac{dy}{dx} = 2x + 2$ **g** $\frac{dy}{dx} = 4x - 9$ **h** $\frac{dy}{dx} = 2x + 4$

3 **a** $\frac{dy}{dx} = 4$ **b** $\frac{dy}{dx} = -5$ **c** $\frac{dy}{dx} = 26$ **d** $\frac{dy}{dx} = 19$

4 **a** $\frac{dQ}{dt} = 3t^2 - 16t + 14$ **b** **i** $14\,m^3/s^2$ **ii** $-6\,m^3/s^2$ **iii** $9\,m^3/s^2$

5 **a** $\frac{dy}{dx} = 3x^2 - 3$ **b** $(1, 0), (-1, 4)$ **c** $(-1, 4)$ is max, $(1, 0)$ is min.

6 **a** $\frac{dy}{dx} = 3x^2 + 6x - 9$ **b** $(-3, 28), (1, -4)$ **c** $(-3, 28)$ is max, $(1, -4)$ is min.

7 **a** $v = 24t$ m/s, 48 m/s **b** $a = 24$ m/s^2, 24 m/s^2

8 **a** $v = 3t^2 + 8t - 3$ m/s, 377 m/s **b** $a = 6t + 8$ m/s^2, 68 m/s^2

Exercise 18*

1 **a** $\frac{dy}{dx} = -x^{-2} = -\frac{1}{x^2}$ **b** $\frac{dy}{dx} = -2x^{-3} = -\frac{2}{x^3}$ **c** $\frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}} = \frac{1}{2\sqrt{x}}$

d $\frac{dy}{dx} = -3x^{-4} = -\frac{3}{x^4}$ **e** $\frac{dy}{dx} = -16x^{-5} = -\frac{16}{x^5}$ **f** $\frac{dy}{dx} = -x^{-3} = -\frac{1}{x^3}$

g $\frac{dy}{dx} = 4x + 3 - 4x^{-2}$ **h** $\frac{dy}{dx} = 2 + 3x^{-2}$

2 **a** -2 **b** 2 **c** 0 **d** $-2\frac{1}{8}$

3 $4y = 3x + 4$

4 $y = -3x, y = 3x - 9$

5 **a** $y = 4x - 7$ **b** $x = 0$ is a max, $x = \frac{4}{3}$ is a min.

6 $p = 1$

7 **a** $\frac{dC}{dt} = 4 - 16t^{-2} = 4 - \frac{16}{t^2}$

b $t = 2, C = 16$ **c** $-12\,°C$/month

8 **a** $\frac{dP}{dt} = 10t - 10\,000t^{-2} = 10t - \frac{10\,000}{t^2}$ **b** $t = 10, P = 1500$

9 $t = 5, s = 125$ m

10 **a** $v = \frac{ds}{dt} = 3t^2 - 300$ km/s, $a = \frac{dv}{dt} = 6t$ km/s^2

b at $t = 5$, $v = -225$ km/s, $a = 30$ km/s^2

c $t = 10$ s

Exercise 19

1 9.22 cm **2** 18.0 cm **3** 15.6 cm **4** 13.5 cm **5** 11.9 cm

6 19.4 cm **7** 46.5° **8** 38.2° **9** 55.1° **10** 36.2°

11 20.7° **12** 59.0° **13** **a** 68.9 m^2 **b** 120 m^2

14 **a** 22.4 cm **b** 26.4 cm **c** 32.1° **d** 35.0°

Exercise 19*

1 **a** C = 42.2°, $a = 6.96$ m **b** C = 44.7°, $a = 5.84$ m

2 **a** 25.5 km **b** 022.7° **c** 202.7°

3 **a** 42.2 km **b** 022.7° **c** 14.1 km/h

4 92.1 m

5 **a** 70.7 m **b** 60.4 m **c** 41.8° **d** 67.5° **e** 9038 m^2

Exercise 20

1 **a** **i** $\frac{1}{25}$ **ii** $\frac{8}{25}$ **b** $\frac{13}{125}$

2 **a** **i** $\frac{5}{11}$ **ii** $\frac{6}{11}$ **b** **i** $\frac{16}{25}$ **ii** $\frac{9}{25}$ **c** $\frac{2869}{3597} = 0.798$ (3 sig.figs.)

3 **a** 0.2 **b** 0.1625 **c** 0.09725

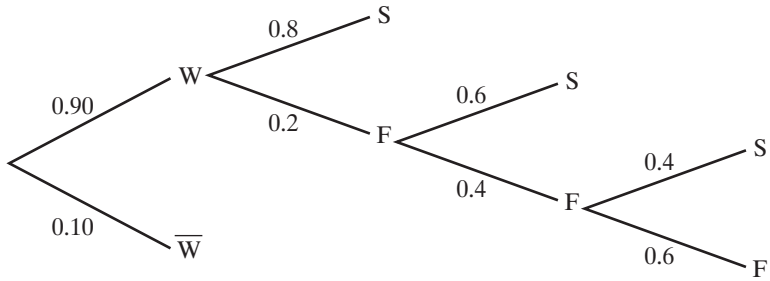
4 **a** $k = 0.1$ **b** **i** 0.8 **ii** 0.5 **c** 0.9

Exercise 20*

1 **a** $\frac{2}{17}$ **b** $\frac{1}{5525}$ **c** $\frac{72}{5525}$ **d** $\frac{64}{425}$

2 **a** 0.03 **b** 0.44 **c** **i** 0.315 **ii** 0.392 **d** 0.584

3 a



b i 0.72 **ii** 0.0288 **iii** 0.8568

4 a 15 diamonds, 5 rubies **b** $\frac{15}{38}$

5 a $r = \frac{1}{5}$ **b** Five options per question.

Examination practice 4

1 a $7\sqrt{3}$ **b** 30 **c** 6 **d** $11 + 6\sqrt{2}$
e 7 **f** 3

2 a $3\sqrt{2}$ **b** $\frac{\sqrt{2}}{3}$ **c** $\frac{7 + 2\sqrt{3}}{37}$

3 $\sqrt{65}$

4 a $\frac{3}{2}$ **b** $\frac{1}{x + 5}$ **c** $\frac{x + y}{2(x - y)}$ **d** $\frac{x - y}{x + y}$

5 a $2x$ **b** $\frac{x + 3}{(x + 5)(x - 3)}$ **c** $\frac{x - 2}{x - 5}$ **d** $\frac{4(x - y)}{x}$

6 a $\frac{7x + 5y}{xy}$ **b** $\frac{8(x - 2)}{(x + 3)(x - 5)}$ **c** $\frac{7}{(x - 5)(x + 2)}$ **d** $\frac{1}{(x + 6)(x - 1)}$

7 a $x = 4$ **b** $x = 3$ **c** $x = 2$ or -5

8 a (2, 1) min **b** (−2, 19) max, (2, −13) min **c** (−3, 28) max, (1, −4) min

9 a $v = 24t$ m/s, 72 m/s **b** $a = 24$ m/s^2 (constant), 24 m/s^2

10 a $v = 3t^2 - 500$ km/s, $a = 6t$ km/s^2 **b** at $t = 10$ s, $v = -200$ km/s, $a = 60$ km/s^2
c $t = \frac{\sqrt{500}}{3}s$, 12.9 s

11 PQ = 10.4 cm, angle P = 42°, angle Q = 83°

12 b AB = 41.4 km **c** 103.0°

13 a 16.7° **b** DF = 94.3 m **c** 9.03° **d** 2.19 m/s

14 107.6 m

15 a i $\frac{13}{30}$ **ii** $\frac{2}{7}$ **b i** $\frac{1}{15}$ **ii** $\frac{34}{35}$

Paper 1

1 a 35% **b** 1 : 2.5

2 a $12y - 8$ **b** $x^2 + 3x - 10$ **c** $4(2y + 5z)$ **d** $x(x - 5)$ **e** $x = 3$

3 a (5, 3) **b** 7.21 cm

4 a $x > 2$ **b**

5 a 2 **b** 2.6

6 **a** 0.57 **b** 30

7 **a** $42\,\text{cm}^2$ **b** $630\,\text{cm}^3$

8 **a** **i** $\{1, 3\}$ **ii** $\{1, 2, 3, 4, 5\}$ **b** 3 is a member of the set A

9 **a** 29.25 **b** c.f. are 8, 46, 74, 78, 80 **c** median ~29

10 **a** $\frac{360°}{32} = 11.25°$ **b** 84.375° **c** 424 m **d** 27 minutes

11 **a** $\frac{3}{4}$ **b** $(3, -1.5)$

12 **a** **i** -1 **ii** $\frac{1}{7}$ **b** **i** $\frac{3}{x} - 2$ **ii** 0 **c** ± 1

13 **a** **i** F.D. for 2000 − 2500 is 0.28 if F.D. for 0 − 1000 is 0.09

ii Frequencies are 90, 130, 140, 120

b UQ is 360^{th} person which is at 2500 calories.

14 **a** **i** $R = \frac{3.6}{r^2}$ **b** 0.4 ohms

15 **b** 4.73

16 **a** $(1, -5)$ **b** $-1.2, 3.2$ **c** Line is $y = x + 2$, solutions 4.4 or -1.4

d **i** $\frac{dy}{dx} = 2x - 2$ **ii** Gradient is 10

17 **a** 3.90 cm **b** $10.2\,\text{cm}^2$

18 **a** $\frac{1}{6}$ **b** $\frac{7}{18}$

19 15 cm

20 $\frac{4}{x - 3}$

Paper 2

1 71

2

182 units at £0.0821 per unit	£14.94
429 units at £0.0704 per unit	£30.20
Total amount	£45.14
Tax at 5% of the total amount	£2.26
Amount to pay	£47.40

3 **a** $4x$ **b** $x + 6 = 4x - 6$ **c** 4

4 **a** 632 cm **b** 148 cm

5 **a** Tin 40 grams, Lead 80 grams **b** 75 grams

6 **a** $2^3 \times 3$ **b** $2 \times 3^2 \times 5$ **c** 6 **d** 360

7 **a** $g = 10, h = 0.8$ **b** $h = \frac{v^2}{2g}$

8 **a** Kitchen chiars

b **i** $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ **ii** Yes, an integer cannot be both odd and even

9 **a** 38.2° **b** **i** 7.65 cm **ii** 7.55 cm

10 **a** 72 s **b** 4.17 cents **c** 16.7%

11 **a** $x = 3$ **b** $x = 1, y = -2$ **c** $3x^2 + 7x - 6$

12 **a** 7.5 **b** 10 **c** $135\,\text{cm}^2$

13 4.7 cm

14 **a** $\begin{pmatrix}5\\2\end{pmatrix}$ **b** **i** $k\begin{pmatrix}5\\2\end{pmatrix}$ **ii** $k\begin{pmatrix}5\\2\end{pmatrix}-\begin{pmatrix}1\\2\end{pmatrix}$ **iii** $\begin{pmatrix}4\\0\end{pmatrix}-k\begin{pmatrix}5\\2\end{pmatrix}$

c $k=\frac{1}{2}$

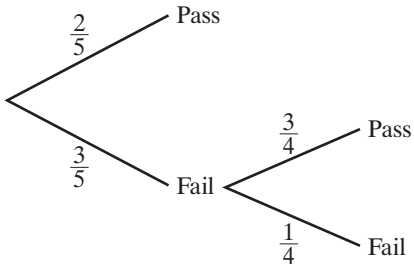
d X is halfway along OB as $k=\frac{1}{2}$. $\overrightarrow{AX}=\overrightarrow{XC}$ means AX = XC and the vectors are parallel, so AXC is a straight line with X as its midpoint.

15 **a** $x=4.9t^2$ **b** $x=44.1$ **c** 1.43 s

16 **b** **i** $28-4x$ **ii** $x=7$ **iii** Graph is a negative parabola **c** 98 m²

17 **a** 138 cm²

18 **a** First attempt Second attempt **b** $\frac{17}{20}$



19 $(1, 0)$ or $(-\frac{1}{3}, -\frac{4}{3})$

20 **a** $v=3-2t-\frac{8}{t^2}$ **b** $a=-2+\frac{16}{t^3}$ **c** $t=2$

Paper 3

1 240°

2 **a** width = $6x$ cm, height = $4x+28$ cm **b** **i** $6x=4x+28$ **ii** $x=14$ cm

3 **a** $3\frac{1}{3}$ **b** **i** 12 **ii** $6\frac{7}{12}$

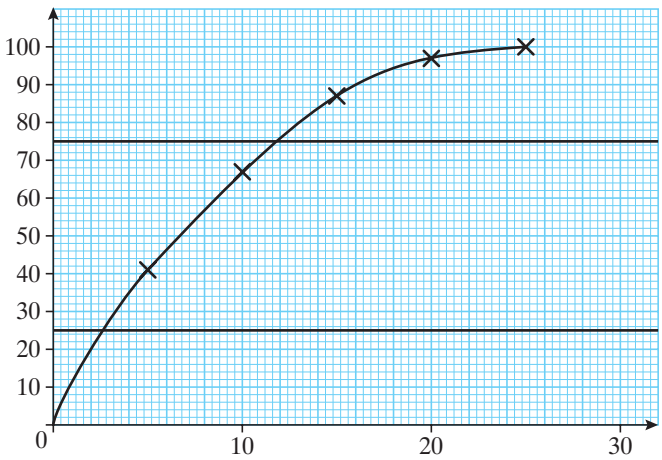
4 4.225 **5** £76.80, a decrease of 4%. **6** Cement: 10 kg, Sand: 45 kg

7 $x \geqslant 6$ **8** **a** 0.4 **b** 0.35 **9** **a** 12 cm **b** 340 cm²

10 **a** Triangle vertices are: (0, 6), (2, 6), (2, 10)

b Triangle vertices are: (6, 3), (6, 4), (8, 3)

11 **a** CF: 41, 67, 87, 97, 100



c IQR = 9 years

12 **a** gradient = 2 **b** $y = 2x - 1$ **c** $y = 2x \pm c$, where c is a positive constant.

13 **a** 3^4 **b** $m = -3, n = 2$

14 **a** $\frac{dy}{dx} = 5000 - 1250x$ **b** $x = 4, y = 10\,000$

c **i** (4, 10 000) max **ii** curve is an inverted parabola.

d **i** $x = £4$ **ii** Produces the max profit of £10 000

15 **a** $r = 10.3$ cm **b** $V = 2289\text{ cm}^3$

16 **a** **i** $w = 5$ **ii** $x = 7$ **iii** $y = 9$ **b** **i** 3 **ii** 15 **iii** 0

17 **a** **i** $f(3) = \frac{3}{2}$ **ii** $f(-3) = \frac{3}{4}$ **b** $x = 1$

c **i** $ff(x) = x$ **ii** $f(x)$ is its own inverse.

18 (6, 5), (−0.4, −7.8) **19** **a** $7 - x$ **b** $x = 3$

20 **a** $3n$ **b** $\frac{n}{3n} \times \frac{n-1}{3n-1} = \frac{1}{10} \Rightarrow n = 7, 3n = 21$ people

Paper 4

1 2.4×10^1

2 **a** **i** $15x - 20$ **ii** $6x^3 - 8x^2$ **iii** $9x^2 - 16$ **iv** $9x^2 - 24x + 16$

b **i** $2xy(1 - 6xy^2)$ **ii** $3x^2y(1 - 3xy + 5x^2y^2)$

c **i** x^4y^6 **ii** xy^5z^2

3 **a** 150 cm^3 **b** 320 cm^3

4 **a** $p = 2(n + 1)$ **b** $n = \frac{p-2}{2}$ **5** **a** 7.06 km/h **b** 1.96 m/s

6 **a** **i** 1, 2, 3, 4, 5, 6 **ii** 2, 3, 4, 5 **iii** ∅

7 **a** 0.162 m^3 **b** \$43 200 **8** 50

9 **a** 18 red **b** 12 red beads **10** $360 = 2^3 \times 3^2 \times 5$

11 **a** Rotation of 90° clockwise about (2, 0) **b** **i** F **ii** T **iii** T

12 $x = 3, y = -1$

13 **a** 3.7×10^{10} **b** 0.000 075 **c** 2×10^{-10}

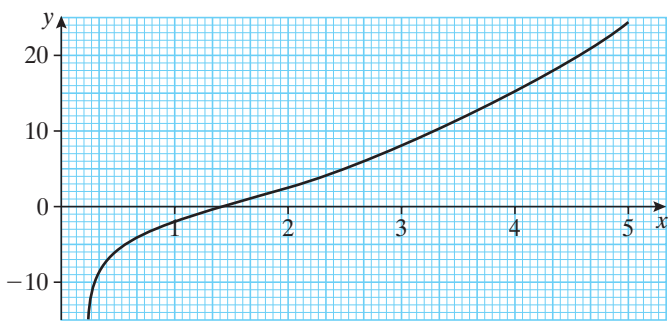
14 **a** $y_{max} = 1.05$ **b** $y_{min} = 0.53$

15 $n = 5$ **16** 992 cm^2 **17** **a** 12.6 cm **b** 2.6 cm^2

18 **a**

x	0.5	1	1.5	2	3	4	5
y	−5.75	−2	0.25	2.5	8	15.25	24.4

b



c $x = 1.4$ **d** $y = 2x, x = 2.5$

19 **a**

w kg	f
$0 < w \leqslant 2$	128
$2 < w \leqslant 3.5$	150
$3.5 < w \leqslant 4.5$	136
$4.5 < w \leqslant 62$	72

b $3.5 < w \leqslant 4.5$ block is 136 high (6.8 blocks high)

20 **a** $(4 + x)^2 = (6 - x)^2 + (5 - x)^2 \Rightarrow x^2 - 30x + 45 = 0$

b $x \approx 1.58$ cm