Chapter 2

Algebra and graphs

01. 0580_m24_qp_42 Q: 5

(a) (i) Factorise.

$$x^2 - x - 12$$

..... [2]

(ii) Simplify.

$$\frac{x^2 - 16}{x^2 - x - 12}$$

..... [2]

(b) Simplify.

$$(2x - 3)^2 - (x + 1)^2$$

..... [3]

(c) Write as a single fraction in its simplest form.

$$\frac{2x + 4}{x + 1} - \frac{x}{x - 3}$$

..... [4]

(d) Expand and simplify.

$$(x-3)(x-5)(2x+1)$$

..... [3]

(e) Solve the simultaneous equations.
You must show all your working.

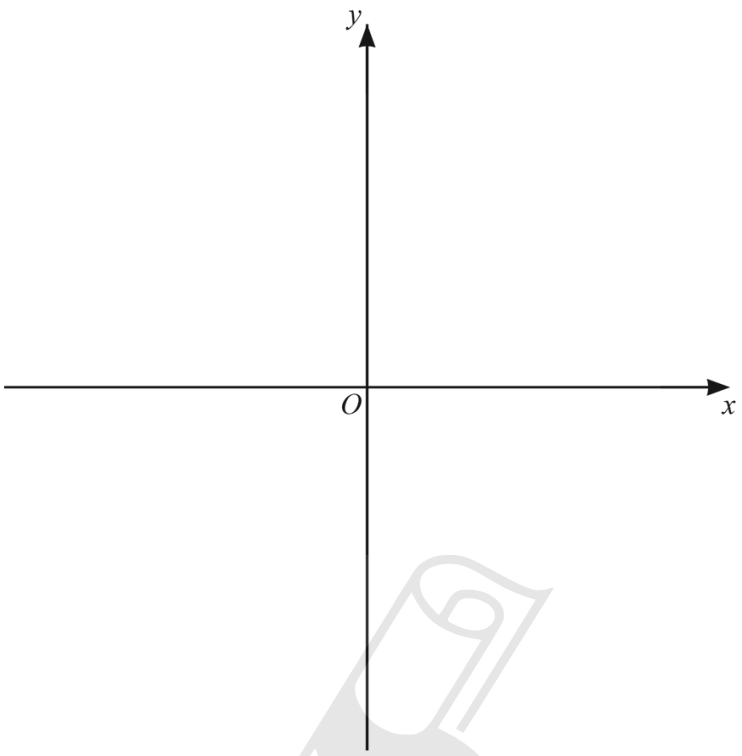
$$x-3y=13$$
$$2x^2-9y=116$$

$x =$ ..... $y =$ .....

$x =$ ..... $y =$ ..... [6]

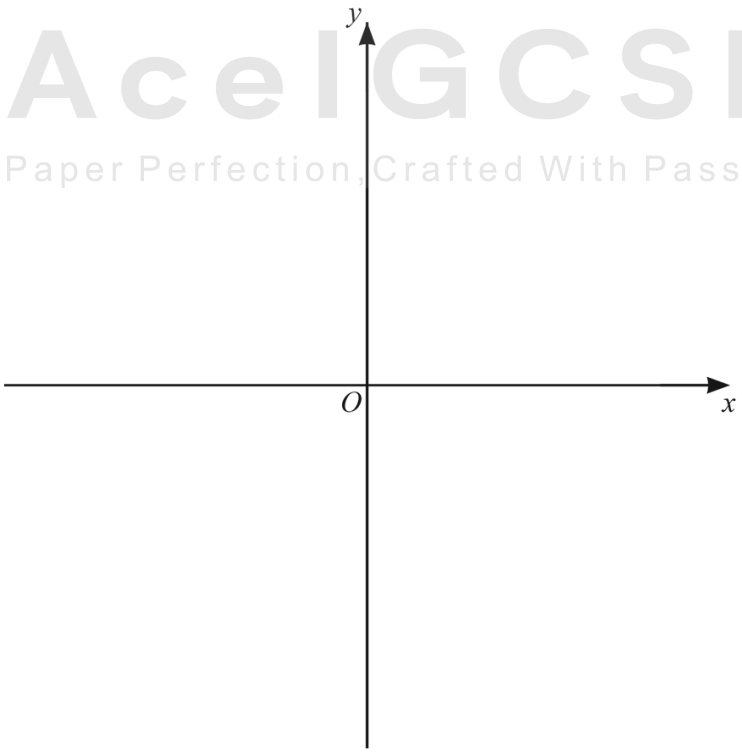
02. 0580_m24_qp_42 Q: 8

(a) On the axes, sketch the graph of $y = 4 - 3x$.



[2]

(b) On the axes, sketch the graph of $y = -x^2$.



[2]

(c) **(i)** Find the coordinates of the turning points of the graph of $y = 10 + 9x^2 - 2x^3$.
You must show all your working.

(..... , ...) and (..... , ...) [5]

(ii) Determine whether each turning point is a maximum or a minimum.
Show how you decide.

[3]

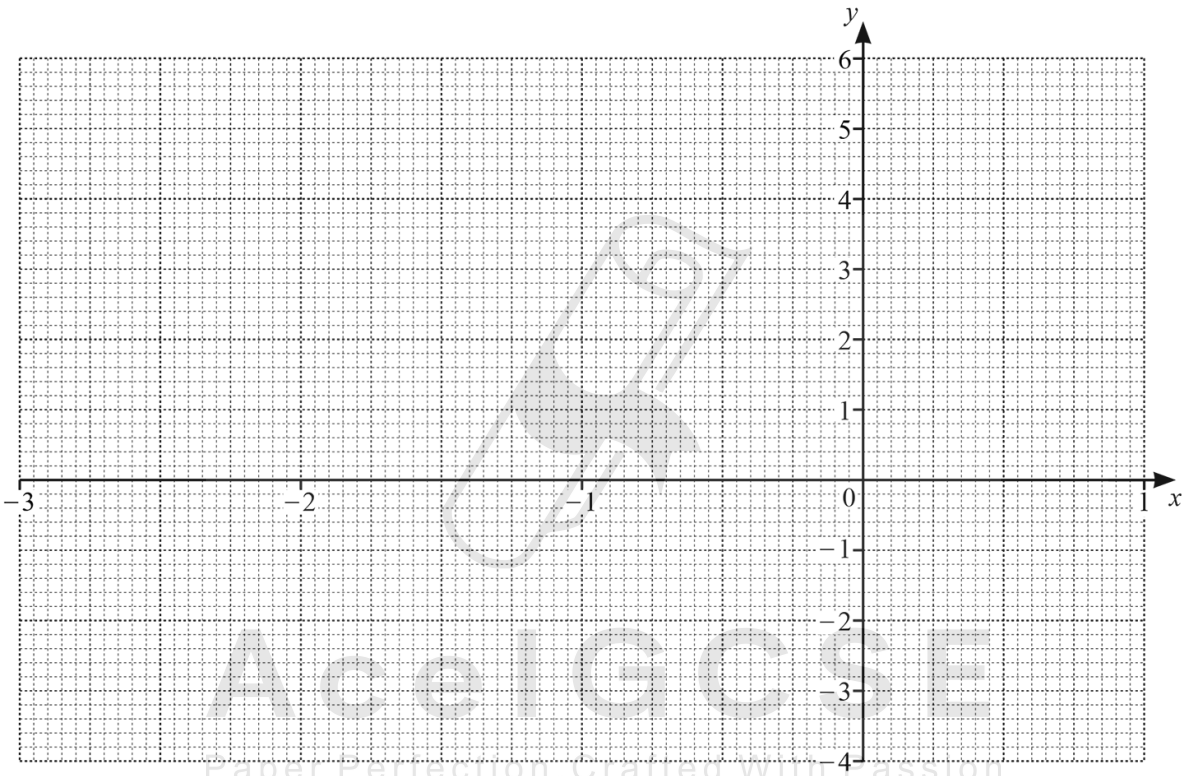
03. 0580_m24_qp_42 Q: 10

The table shows some values for $y = 2x^3 + 6x^2 - 2.5$.

x	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1
y		3.75	5.5	4.25	1.5		-2.5	-0.75	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 2x^3 + 6x^2 - 2.5$ for $-3 \leqslant x \leqslant 1$.



[4]

(c) By drawing a suitable line on the graph, solve the equation $2x^3 + 6x^2 = 4.5$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(d) The equation $2x^3 + 6x^2 - 2.5 = k$ has exactly two solutions.

Write down the two possible values of k.

$k =$ ..... or $k =$ ..... [2]

$f(x) = \frac{1}{x}, x \neq 0$ $g(x) = 3x - 5$ $h(x) = 2^x$

(a) Find.

(i) gf(2)

..... [2]

(ii) $g^{-1}(x)$

$g^{-1}(x) =$ ..... [2]

(b) Find in its simplest form $g(x-2)$.

..... [2]

(c) Find the value of x when

(i) $fg(x) = 0.1$

$x =$ ..... [2]

(ii) $h(x) - g(7) = 0$.

$x =$ ..... [2]

05. 0580_s24_qp_41 Q: 3

(a) $C = \frac{1}{4}xy^2$

(i) Find C when $x = 5$ and $y = 8$.

$C =$ ..... [2]

(ii) Find the positive value of y when $C = 15$ and $x = 2.4$.

$y =$ ..... [2]

(b) Write as a single fraction in its simplest form.

$$\frac{4}{x-1} - \frac{3}{2x+5}$$

..... [3]

(c) Expand and simplify.

$$(2x+3)(4-x)^2$$

..... [3]

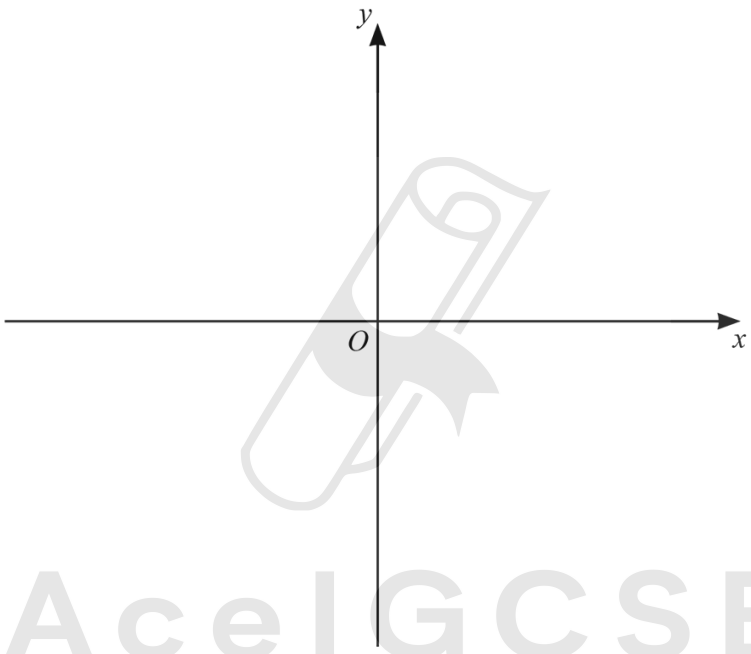
(d) Simplify.

$$\left(\frac{y^8}{16x^{16}}\right)^{-\frac{3}{4}}$$

..... [3]

06. 0580_s24_qp_41 Q: 8

(a) On the axes, sketch the graph of $y = x^2 + 7x - 18$.
On your sketch, write the values where the graph meets the x-axis and the y-axis.



[4]

(b) (i) Find the derivative of $y = x^2 - 3x - 28$.

..... [2]

(ii) Find the coordinates of the turning point of $y = x^2 - 3x - 28$.

(..... , ...) [3]

(c) The line $y = 5 - 2x$ intersects the graph of $y = x^2 - 3x - 28$ at point P and point Q.

Find the coordinates of P and Q.
You must show all your working and give your answers correct to 2 decimal places.

(..... , ...)

(..... , ...) [6]

07. 0580_s24_qp_41 Q: 9

$f(x) = 4x + 1$ $g(x) = 6 - 2x$ $h(x) = 3^{x-2}$

(a) Find

(i) f(3)

..... [1]

(ii) gf(3).

..... [1]

(b) Find $g^{-1}(x)$.

$g^{-1}(x) =$ ..... [2]

(c) Find x when $f(x) = g(2x - 7)$.

$x =$ ..... [4]

(d) Find the value of hh(2).

..... [2]

(e) Find x when $h^{-1}(x) = 10$.

$x =$ ..... [2]

---

08. 0580_s24_qp_42 Q: 7

(a) Solve $3x-8=6-4x$.

$x =$ ..... [2]

(b) Factorise fully $10a^2+5a$.

..... [2]

(c) Factorise fully $(2x-3)^2-9$.

..... [2]

(d) $f(x)=\frac{1}{4x-1}$, $x \neq \frac{1}{4}$ $\quad g(x)=3^x$

(i) Find f(4).

..... [1]

(ii) Find gg(2).

..... [2]

(iii) Find k when $g(k)=f(7)$.

..... [2]

09. 0580_s24_qp_42 Q: 11

(a) The point $(-1, 6)$ lies on a curve.

This curve has the derived function $\frac{dy}{dx} = -4x^3 - 9x^2 + 5$.

Show that $(-1, 6)$ is a stationary point of the curve.

[2]

(b) A different curve has equation $y = 2x^3 - 6x + 8$.

(i) Calculate the gradient of the tangent to this curve at the point $(-2, 2)$.

..... [3]

(ii) Find the x-coordinates of the stationary points of this curve.

$x =$ ..... and $x =$ ..... [2]

10. 0580_s24_qp_43 Q: 2

(a) The nth term of a sequence is $120 - n^3$.

(i) Find the 4th term of this sequence.

..... [1]

(ii) Find the value of n when the nth term is -1211.

$n =$ ..... [2]

(b) The nth term of a different sequence is $3 \times (0.2)^{n-1}$.

Find the 5th term of this sequence.

..... [1]

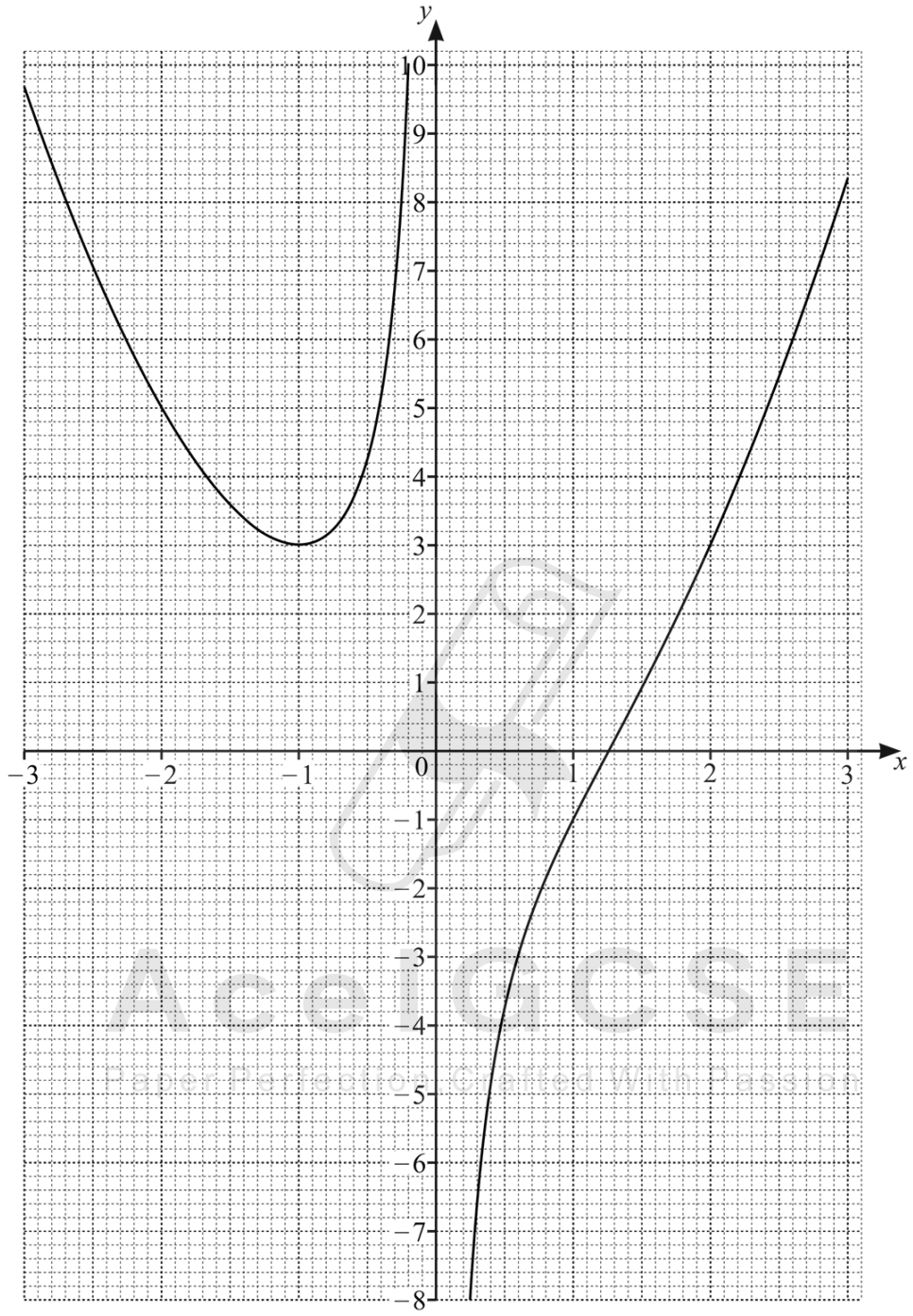
(c) The table shows the first four terms of sequences A, B and C.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	7	4	1	-2			
B	$\frac{1}{4}$	$\frac{2}{5}$	$\frac{3}{6}$	$\frac{4}{7}$			
C	0	2	6	12			

Complete the table for each sequence.

[8]

11. 0580_s24_qp_43 Q: 5



The diagram shows the graph of $y = f(x)$ for values of x from -3 to 3.

(a) (i) Use the graph to find $f(2)$.

..... [1]

(ii) Use the graph to solve the equation $f(x) = 5$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(iii) The equation $f(x) = k$ has exactly two solutions.

Write down the value of k.

$k =$ ..... [1]

(iv)

tangent	asymptote	root	perpendicular

Choose the correct word from the box to complete the statement.

The line $x = 0$ is the ..... to the graph of $y = f(x)$. [1]

(b) (i) On the grid, draw the graph of $y = x - 2$ for values of x from -3 to 3. [2]

(ii) Find x when $f(x) = x - 2$.

$x =$ ..... [1]

(c) $f(x) = x^2 - \frac{c}{x}, x \neq 0$

Use the graph to show that $c = 2$.

[2]

(d) The equation $f(x) = x - 2$ can be written as $x^3 + px^2 + qx = 2$.

Find the value of p and the value of q.

$p =$ .....

$q =$ ..... [2]

12. 0580_s24_qp_43 Q: 10

$$y = x^7 - 7x^6$$

(a) Find the derivative of y with respect to x.

..... [2]

(b) Find the equation of the tangent to the graph of $y = x^7 - 7x^6$ at the point where $x = -1$.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

(c) The graph of $y = x^7 - 7x^6$ has two turning points.

Find the coordinates of these points.
You must show all your working.

(..... , ...)

(..... , ...) [5]

13. 0580_m23_qp_42 Q: 5

(a) Expand and simplify.

$$(2p^2-3)(3p^2-2)$$

..... [2]

(b) $s=\frac{1}{2}(u+v)t$

(i) Find the value of s when $u=20$, $v=30$ and $t=7$.

$s=$ ..... [2]

(ii) Rearrange the formula to write v in terms of s, u and t.

$v=$ ..... [3]

(c) Factorise completely.

(i) $2qt-3t-6+4q$

..... [2]

(ii) x^3-25x

..... [3]

14. 0580_m23_qp_42 Q: 9

$$f(x) = x^3 - 3x^2 - 4$$

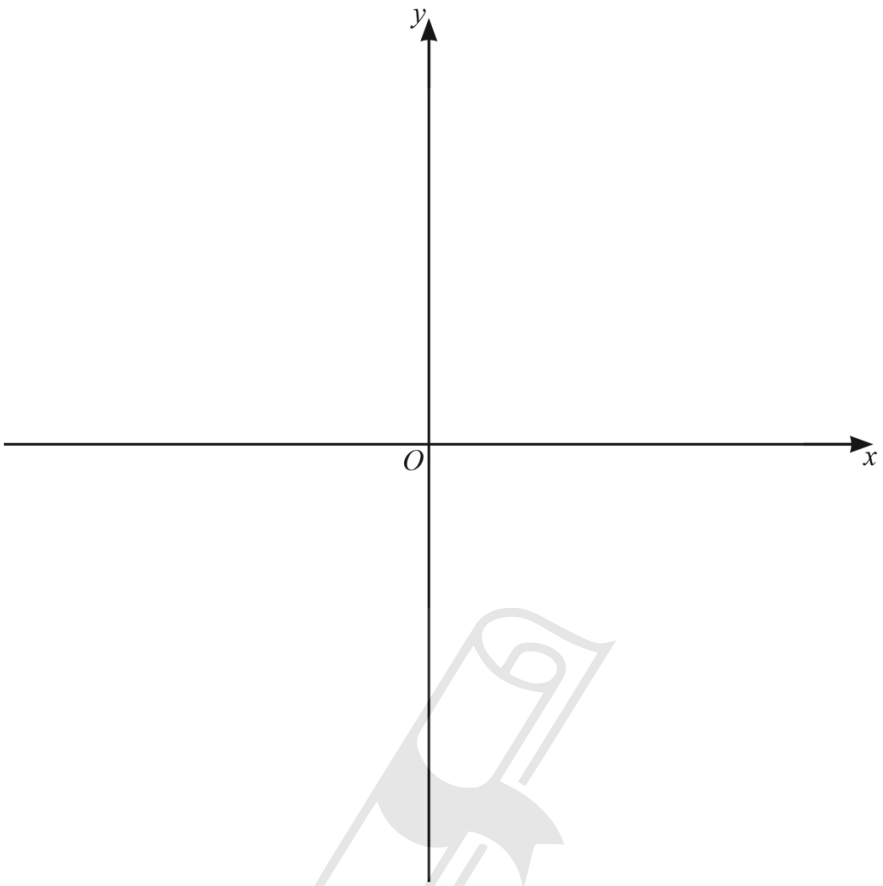
(a) Find the gradient of the graph of $y = f(x)$ where $x = 1$.

..... [3]

(b) Find the coordinates of the turning points of the graph of $y = f(x)$.

(..... , ...) , (..... , ...) [4]

(c) Sketch the graph of $y = \mathrm{f}(x)$.



[2]

15. 0580_m23_qp_42 Q: 11

$f(x) = 2x - 1$ $g(x) = 3x + 2$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = x^2$

(a) Find $j(-1)$.

..... [1]

(b) Find x when $f(x) + g(x) = 0$.

$x =$ ..... [2]

(c) Find $gg(x)$, giving your answer in its simplest form.

..... [2]

(d) Find $hf(x) + gh(x)$, giving your answer as a single fraction in its simplest form.

..... [4]

(e) When $pp(x) = x$, $p(x)$ is a function such that $p^{-1}(x) = p(x)$.

Draw a ring around the function that has this property.

$f(x) = 2x - 1$ $g(x) = 3x + 2$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = x^2$

[1]

16. 0580_s23_qp_41 Q: 7

(a) Factorise fully.

(i) $27y^2 - 3$

..... [3]

(ii) $2m - pk + 2k - pm$

..... [2]

(b) Solve $\frac{x-1}{x+1} - \frac{6}{x-1} = 1$.

$x =$ ..... [5]

(c) Solve $4x^2 - 3x - 2 = 0$.
You must show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [4]

(d) Make k the subject of the formula.

$$\frac{k}{m} = 4 + kp$$

$k =$ ..... [4]

---

17. 0580_s23_qp_41 Q: 8

A tailor makes x dresses and y shirts in one week.
In one week

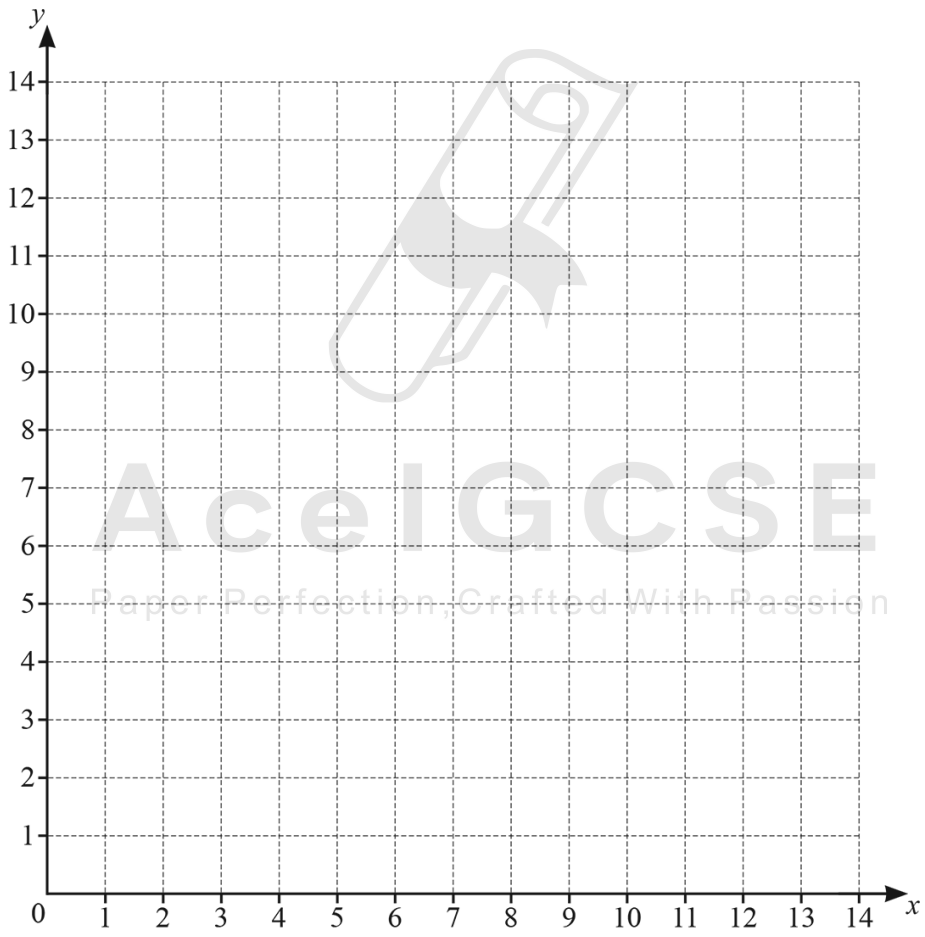
- he makes at least 4 dresses
- he makes no more than 7 shirts
- he makes less than 14 dresses and shirts altogether
- the number of shirts he makes is more than $\frac{2}{3}$ of the number of dresses.

One of the inequalities that shows this information is $x \geqslant 4$.

(a) Write down the other three inequalities in x and/or y.

.... [3]

(b)



On the grid, draw 4 straight lines and shade the unwanted regions to show these inequalities.
Label the region R that satisfies the 4 inequalities. [6]

(c) Use your diagram to find the smallest number of dresses and the smallest number of shirts the tailor makes in one week.

..... dresses and ..... shirts [1]

(d) The profit the tailor makes on one dress is $10 and the profit on one shirt is $6.

Use your diagram to find the largest profit the tailor can make in one week.

$ ..... [2]

18. 0580_s23_qp_41 Q: 10

$f(x) = x - 4$ $g(x) = 2x + 5$ $h(x) = 3^x$

(a) Find

(i) $f(-3)$

..... [1]

(ii) $g^{-1}(x)$

$g^{-1}(x) =$ ..... [2]

(iii) $f(x) \times g(x) \times f(x)$.

..... [4]

(b) Find x when $h(x) = g(f(2))$.

$x =$ ..... [2]

19. 0580_s23_qp_42 Q: 6

(a) A sequence has nth term $\frac{n}{2n+3}$.

(i) Find the first three terms of this sequence.

Give your answers as fractions.

..... , ... , ... [2]

(ii) The kth term of this sequence is $\frac{12}{25}$.

Find the value of k.

$k =$ ..... [2]

(b) Find the nth term of each sequence.

(i) 6, 13, 32, 69, 130, …

..... [2]

(ii) 100, 50, 25, 12.5, 6.25, …

..... [2]

20. 0580_s23_qp_42 Q: 9

(a) Simplify.

(i) $(3x^2y^4)^3$

..... [2]

(ii) $\left(\frac{16}{x^{16}y^8}\right)^{-\frac{3}{2}}$

..... [3]

(b) **(i)** Factorise.

$x^2 - 9$

..... [1]

(ii) Simplify.

$$\frac{x^2 - 9}{2xy - 6y + 5x - 15}$$

..... [3]

(c) Solve the simultaneous equations.
You must show all your working and give your answers correct to 2 decimal places.

$$2x + y = 7$$
$$y = 5x^2 + 2x - 13$$

$x =$ ..... , $y =$ .....

$x =$ ..... , $y =$ ..... [6]

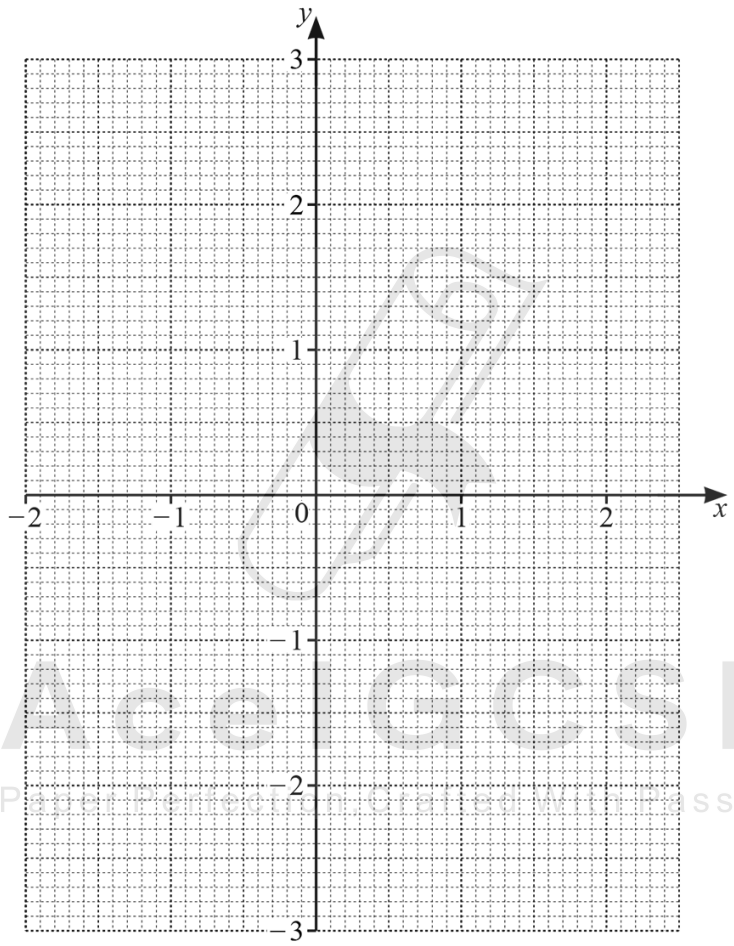
21. 0580_s23_qp_43 Q: 10

The table shows some values for $y = 2^x - 3$.

x	-2	-1	0	0.5	1	1.5	2	2.5
y	-2.75			-1.58		-0.17	1	2.66

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 2^x - 3$ for $-2 \leqslant x \leqslant 2.5$.



[4]

(c) Use your graph to solve the equation $2^x - 3 = 2$.

$x =$ ..... [1]

(d) By drawing a suitable straight line, solve the equation $2^x - x - 1.5 = 0$.

$x =$ ..... or $x =$ ..... [4]

22. 0580_w23_qp_41 Q: 2

(a) $s = \frac{1}{2}at^2$

Find the value of s when $a = 9.8$ and $t = 20$.

$s =$ ..... [2]

(b) Solve.

$5(4y-3) = 15$

$y =$ ..... [3]

(c) Expand and simplify.

$3(5x-8)-2(3x-7)$

..... [2]

(d) Rearrange $A = 2b^2 - 3c^3$ to make c the subject.

$c =$ ..... [3]

(e) Factorise completely.

$6pq-4q-3p+2$

..... [2]

23. 0580_w23_qp_41 Q: 6

(a)

Sequence	1st term	2nd term	3rd term	4th term	5th term		*n*th term
A	-7	-3	1	5			
B	7	13	23	37			
C	$\frac{2}{27}$	$\frac{3}{81}$	$\frac{4}{243}$	$\frac{5}{729}$			

Complete the table for the three sequences.

[10]

(b) In a sequence, the sum of the first 49 terms is 7644.
The sum of the first 50 terms is 7975.

Find the 50th term of this sequence.

..... [1]

24. 0580_w23_qp_41 Q: 9

$f(x) = (3x+1)(x+5)(x-4)$ $g(x) = 2x-3$ $h(x) = 4^{2x-1}$

(a) Find

(i) $f(0)$

..... [1]

(ii) $g^{-1}(x)$

$g^{-1}(x) =$ ..... [2]

(iii) $gh(2)$.

..... [2]

(b) $g(2x) = 7$

Find the value of x.

$x =$ ..... [2]

(c) Simplify $g(x^2) + gg(x) + 1$.

..... [3]

(d) Find $h^{-1}(16)$.

..... [2]

(e) $f(x) = (3x+1)(x+5)(x-4)$

This can be written in the form $f(x) = ax^3 + bx^2 + cx + d$.

Find the value of each of a, b, c and d.

$a =$ ..... $b =$ ..... $c =$ ..... $d =$ ..... [3]

25. 0580_w23_qp_41 Q: 11

(a) Differentiate $x^3 - 4x^2 - 3x$.

..... [2]

(b) A curve has equation $y = x^3 - 4x^2 - 3x$.

Work out the coordinates of the two stationary points.
Show all your working.

(..... , ...)

(..... , ...) [5]

(c) Determine whether each stationary point is a maximum or a minimum.
Show all your working.

[3]

26. 0580_w23_qp_42 Q: 5

(a) In a shop the cost of a fiction book is $\$x$ and the cost of a reference book is $\$(x+2)$.
The cost of 11 fiction books is the same as the cost of 10 reference books.

Find the value of x.

$x =$ ..... [2]

(b) In another shop, the cost of a fiction book is $\$y$ and the cost of a reference book is $\$(y+2)$.
Maria spends \$95 on fiction books and \$147 on reference books.
She buys a total of 12 books.

(i) Show that $6y^2 - 109y - 95 = 0$.

[4]

(ii) Factorise $6y^2 - 109y - 95$.

..... [2]

(iii) Find the value of y.

$y =$ ..... [1]

27. 0580_w23_qp_42 Q: 11

$f(x) = 1-3x$ $g(x) = (x-1)^2$ $h(x) = \frac{3}{x}, x \neq 0$

(a) Find g(3).

..... [1]

(b) Find $f(x-2)$, giving your answer in its simplest form.

..... [2]

(c) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(d) $gf(x) - g(x)f(x) = 3x^3 + ax^2 + bx + c$

Find the value of each of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [5]

(e) Find $\mathrm{h}(x) - \mathrm{f}(x)$, giving your answer as a single fraction in its simplest form.

..... [3]

(f) $\mathrm{h}(x^n) = 3x^7$

Find the value of n.

$n =$ ..... [1]

28. 0580_w23_qp_43 Q: 6

$f(x) = 5x - 3$ $g(x) = 64^x$ $h(x) = \frac{2}{x+1}, \quad x \neq -1$

(a) Find the value of

(i) f(2)

..... [1]

(ii) gf(0.5).

..... [2]

(b) Find $h^{-1}(x)$.

$h^{-1}(x) =$ ..... [3]

(c) Find x when $g(x) = \frac{1}{2^5}$.

$x =$ ..... [2]

(d) Write as a single fraction in its simplest form $\frac{1}{f(x)} - h(x)$.

..... [4]

29. 0580_w23_qp_43 Q: 10

(a) Expand and simplify.

$$4(2x-1)-6(3-x)$$

..... [2]

(b) Factorise completely.

(i) $6x^2y+9xy$

..... [2]

(ii) $4x^2-y^2+8x+4y$

..... [3]

(c) Antonio travels 100 km at an average speed of x km/h.
He then travels a further 150 km at an average speed of $(x+10)$ km/h.
The time taken for the whole journey is 4 hours 20 minutes.

(i) Show that $13x^2 - 620x - 3000 = 0$.

[4]

(ii) Solve $13x^2 - 620x - 3000 = 0$ to find the speed Antonio travels for the first 100 km of the journey.
You must show all your working and give your answer correct to 1 decimal place.

..... km/h [3]

30. 0580_m22_qp_42 Q: 2

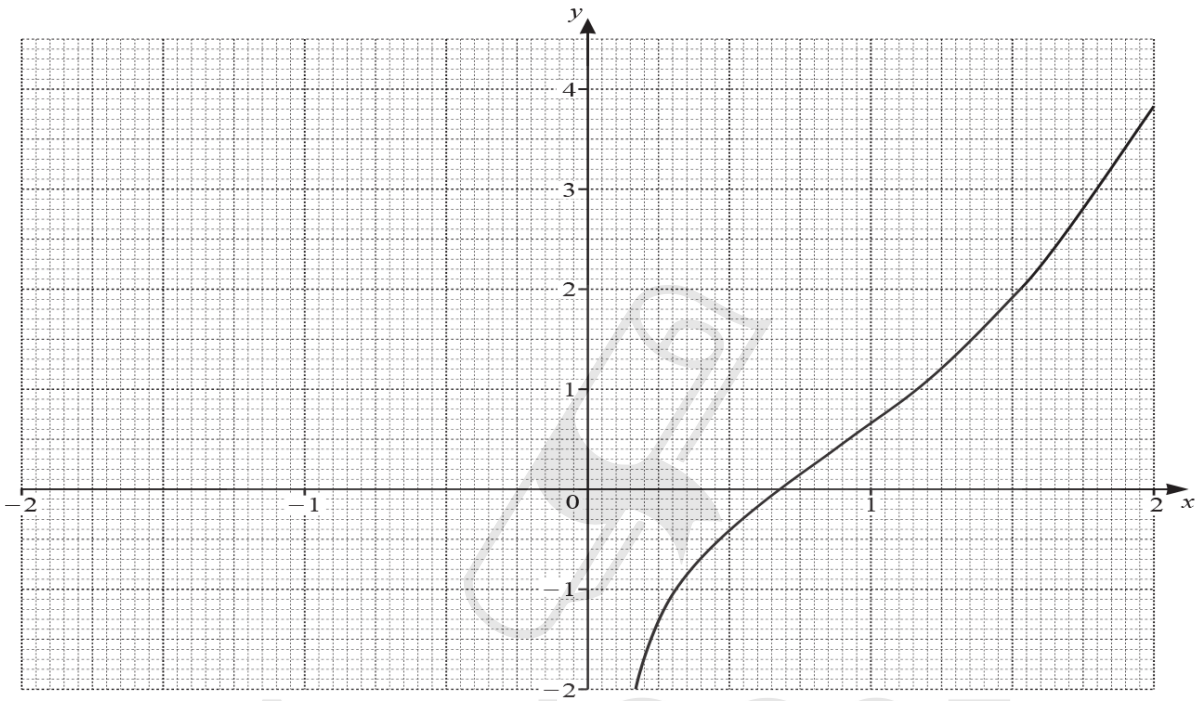
The table shows some values for $y = x^2 - \frac{1}{3x}$, $x \neq 0$.
The y-values are rounded to 1 decimal place.

x	-2	-1.5	-1	-0.75	-0.5	-0.25	-0.1
y	4.2	2.5	1.3			1.4	3.3

(a) Complete the table. [2]

(b) On the grid, draw the graph of $y = x^2 - \frac{1}{3x}$ for $-2 \leqslant x \leqslant -0.1$.

The graph of $y = x^2 - \frac{1}{3x}$ for $x > 0$ has been drawn for you.



[4]

(c) By drawing a suitable line on the grid, solve the equation $x^2 - \frac{1}{3x} + 1 = 0$.

$x =$ ..... [2]

31. 0580_m22_qp_42 Q: 3

$f(x) = 1 + 4x$ $g(x) = x^2$

(a) Find

(i) gf(3),

..... [2]

(ii) fg(x),

..... [1]

(iii) $f^{-1}f(x)$.

..... [1]

(b) Find the value of x when $f(x) = 15$.

$x =$ ..... [2]

32. 0580_m22_qp_42 Q: 8

Darpan runs a distance of 12 km and then cycles a distance of 26 km.
His running speed is x km/h and his cycling speed is 10 km/h faster than his running speed.
He takes a total time of 2 hours 48 minutes.

(a) An expression for the time, in hours, Darpan takes to run the 12 km is $\frac{12}{x}$.

Write an equation, in terms of x, for the total time he takes in hours.

..... [3]

(b) Show that this equation simplifies to $7x^2 - 25x - 300 = 0$.

[4]

(c) Use the quadratic formula to solve $7x^2 - 25x - 300 = 0$.
You must show all your working.

$x =$ ..... or $x =$ ..... [4]

(d) Calculate the number of minutes Darpan takes to run the 12 km.

..... min [2]

33. 0580_m22_qp_42 Q: 10

(a) Expand and simplify.

$$(x+1)(x-2)(x+3)$$

..... [3]

(b) Make g the subject of the formula.

$$M = \frac{2fg}{g-c}$$

$g =$ ..... [4]

(c) Simplify.

$$\frac{4x^2-16x}{x^2-16}$$

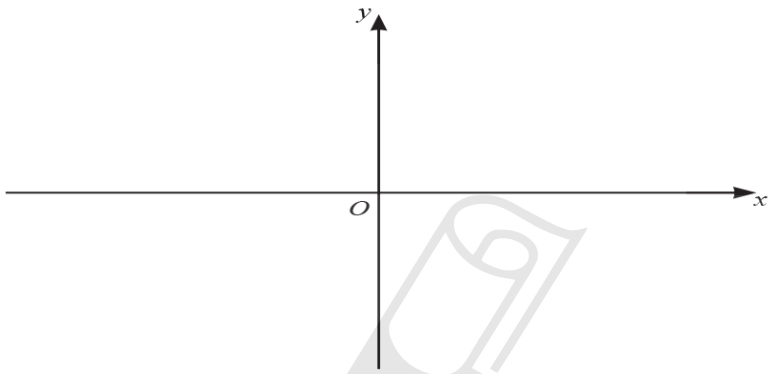
..... [3]

34. 0580_m22_qp_42 Q: 12

(a) Solve the equation $\tan x = 11.43$ for $0° \leqslant x \leqslant 360°$.

$x =$ ..... or $x =$ ..... [2]

(b) Sketch the curve $y = x^3 - 4x$.



[3]

(c) A curve has equation $y = x^3 + ax + b$.
The stationary points of the curve have coordinates $(2, k)$ and $(-2, 10 - k)$.

Work out the value of a, the value of b and the value of k.

$a =$ ..... , $b =$ ..... , $k =$ ..... [6]

35. 0580_s22_qp_41 Q: 3

(a) Geeta buys x apples, $(x+7)$ oranges and $(2x-1)$ bananas.
The total number of pieces of fruit Geeta buys is 30.

(i) Find the number of apples Geeta buys.

..... [3]

(ii) The cost of one apple is 15 cents.
The cost of one orange is 18 cents.
The total cost of all the fruit is \$5.55 .

Find the cost, in cents, of one banana.

..... cents [3]

(b) **(i)** Solve.

$$\frac{3w}{16} - 1 = \frac{1}{2}$$

$w =$ ..... [2]

(ii) $$\frac{3(2^{-y})}{16} - 1 = \frac{1}{2}$$

Find the value of y.

$y =$ ..... [2]

(c) **(i)** Solve the simultaneous equations.

$$2p + q = 2$$
$$p - q = -\frac{1}{2}$$

$p =$ .....

$q =$ ..... [2]

(ii) Hence, for $0° \leqslant u \leqslant 360°$ and $0° \leqslant v \leqslant 360°$, solve the simultaneous equations.

$$2\sin u + \cos v = 2$$
$$\sin u - \cos v = -\frac{1}{2}$$

$u =$ ..... or $u =$ .....

$v =$ ..... or $v =$ ..... [4]

36. 0580_s22_qp_41 Q: 4

$f(x) = 2x - 1$ $g(x) = 3x - 2$ $h(x) = \frac{1}{x}, \ x \neq 0$ $j(x) = 5^x$

(a) Find

(i) $f(2)$,

..... [1]

(ii) $gf(2)$.

..... [1]

(b) Find $g^{-1}(x)$.

$g^{-1}(x) =$ ..... [2]

(c) Find x when $h(x) = j(-2)$.

$x =$ ..... [2]

(d) Write $f(x) - h(x)$ as a single fraction.

..... [2]

(e) Find the value of $jj(2)$.

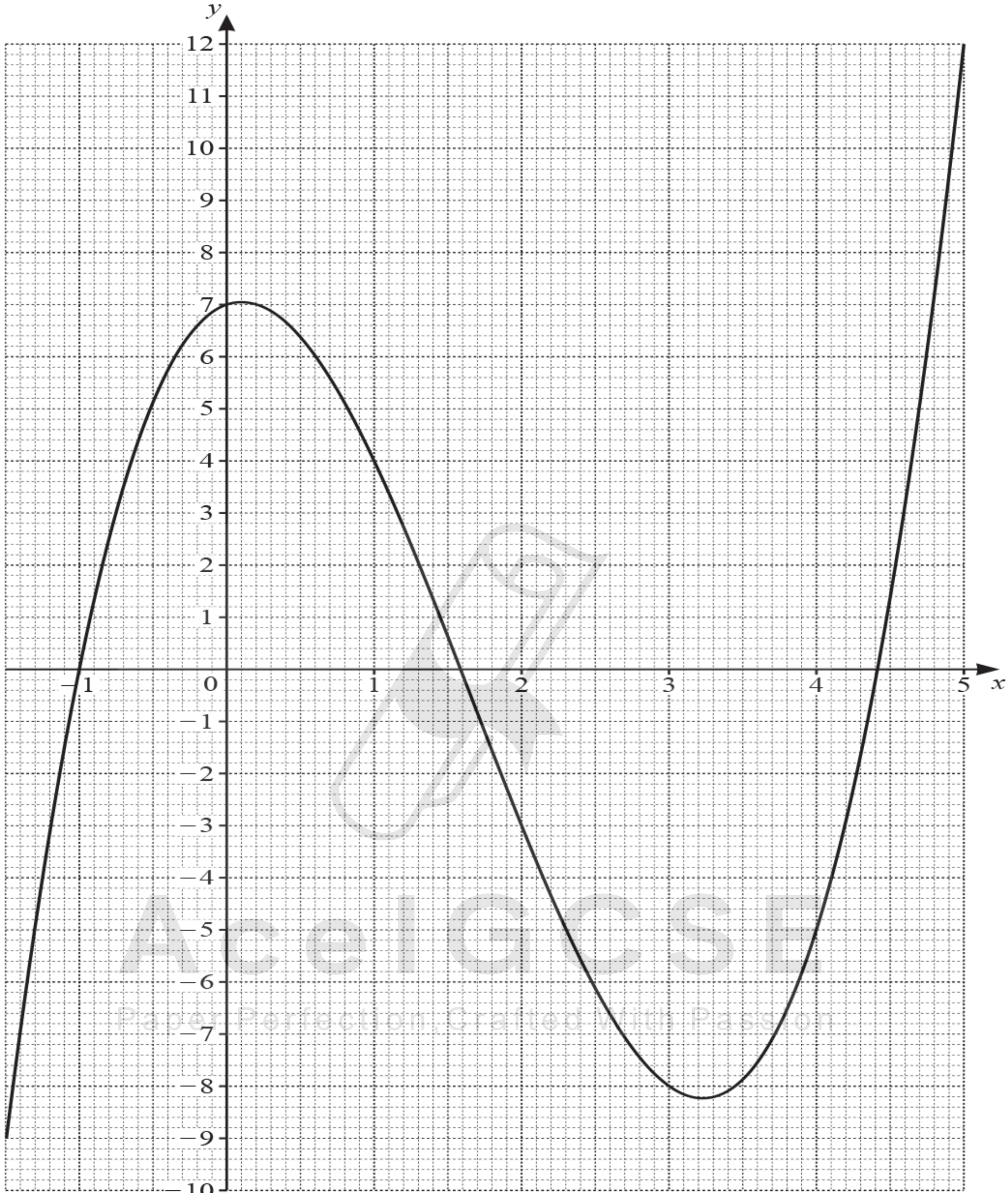
..... [1]

(f) Find x when $j^{-1}(x) = 4$.

$x =$ ..... [2]

37. 0580_s22_qp_41 Q: 6

(a)



The diagram shows the graph of $y = f(x)$ for $-1.5 \leqslant x \leqslant 5$.

(i) Find $f(2)$.

..... [1]

(ii) Solve the equation $f(x) = 0$ for $-1.5 \leqslant x \leqslant 5$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(iii) $f(x) = k$ has three solutions for $-1.5 \leqslant x \leqslant 5$ where k is an integer.

Find the smallest possible value of k.

$k =$ ..... [1]

(iv) On the grid, draw a line $y = mx$ so that $f(x) = mx$ has exactly one solution for $-1.5 \leqslant x \leqslant 5$. [2]

(b) $y = 3x^2 - 12x + 7$

(i) Find the value of $\frac{dy}{dx}$ when $x = 5$.

..... [3]

(ii) Find the coordinates of the point on the graph of $y = 3x^2 - 12x + 7$ where the gradient is 0.

(..... , ...) [2]

(c) When $y = 2x^p + qx^2$, $\frac{dy}{dx} = 14x^6 + 6x$.

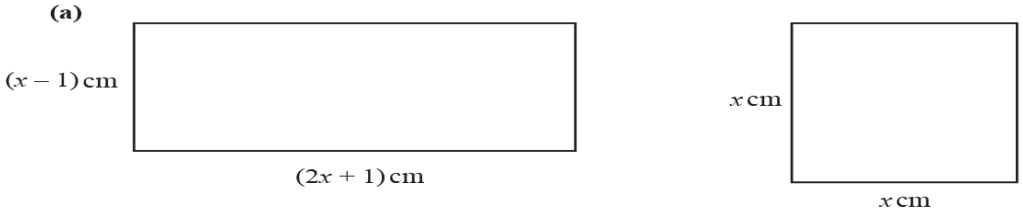
Find the value of p and the value of q.

$p =$ .....

$q =$ ..... [2]

38. 0580_s22_qp_41 Q: 9

(a)

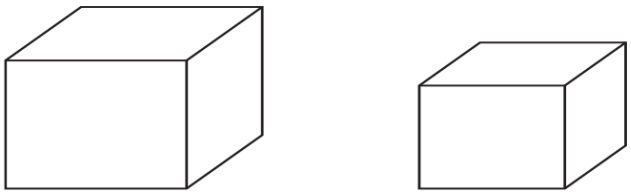


The area of the rectangle is $29\,cm^2$ greater than the area of the square.
The difference between the perimeters of the two shapes is k cm.

Find the value of k.
You must show all your working.

$k =$ ..... [6]

(b)



The volume of the larger cube is $5\,\text{cm}^3$ greater than the volume of the smaller cube.

(i) Show that $3y^2 + 3y - 4 = 0$.

[4]

(ii) Find the volume of the smaller cube.
Show all your working and give your answer correct to 2 decimal places.

..... cm^3 [4]

39. 0580_s22_qp_42 Q: 8

(a) Solve.

$$10 - 3p = 3 + 11p$$

$p =$ ..... [2]

(b) Make m the subject of the formula.

$$mc^2 - 2k = mg$$

$m =$ ..... [3]

(c) Solve.

$$\frac{1}{x-3} + \frac{4}{2x+3} = 1$$

$x =$ ..... or $x =$ ..... [5]

(d) Solve the simultaneous equations.
You must show all your working.

$$x + 2y = 12$$
$$5x + y^2 = 39$$

$x =$ ..... $y =$ .....

$x =$ ..... $y =$ ..... [5]

(e) Expand and simplify.

$$(2x - 3)(x + 6)(x - 4)$$

..... [3]

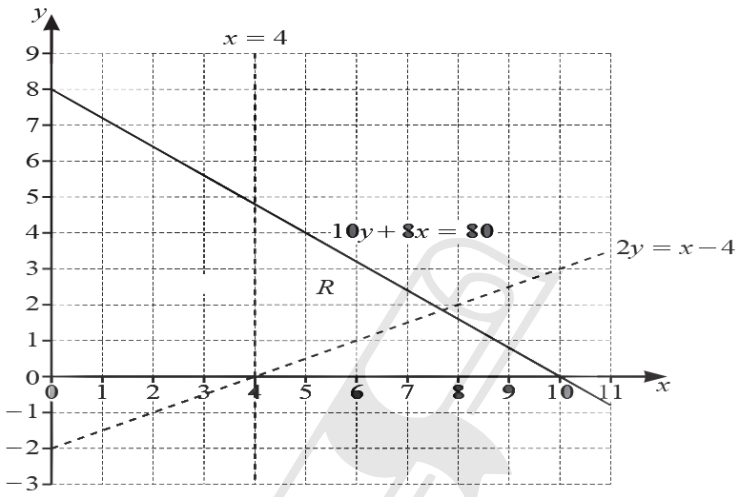
40. 0580_s22_qp_42 Q: 10

(a) Find all the positive integers which satisfy the inequality.

$$3n - 8 > 5n - 15$$

..... [2]

(b)



The region marked R is defined by three inequalities.

(i) Find these three inequalities.

.....

.....

..... [3]

(ii) Write down the largest value of $3x + y$ in the region R for integers x and y.

.....

..... [2]

41. 0580_s22_qp_42 Q: 12

A curve has equation $y = x^3 - kx^2 + 1$.
When $x = 2$, the gradient of the curve is 6.

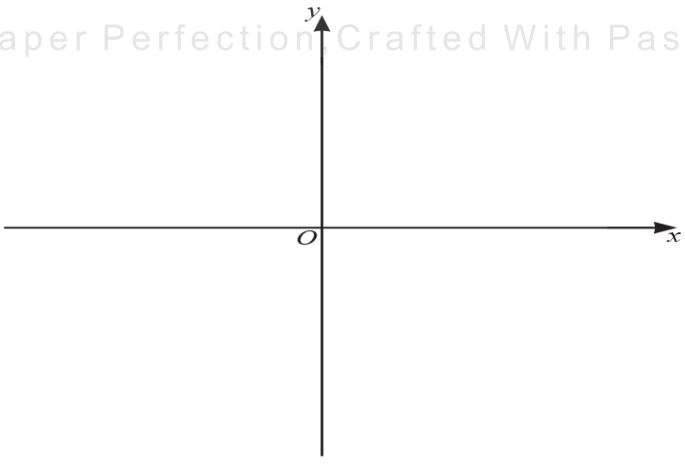
(a) Show that $k = 1.5$.

[5]

(b) Find the coordinates of the two stationary points of $y = x^3 - 1.5x^2 + 1$.
You must show all your working.

(.....,.....) and (.....,.....) [4]

(c) Sketch the curve $y = x^3 - 1.5x^2 + 1$.



[2]

42. 0580_s22_qp_43 Q: 3

(a) The table shows the numbers of tigers reported to be living in the wild in the year 2014 in some countries.

Country	Number
India	2226
Indonesia	371
Nepal	198
Bangladesh	106

(i) Using the table,

(a) find the number of tigers in Nepal as a percentage of the number of tigers in Bangladesh,

..... % [1]

(b) find the ratio tigers in Bangladesh : tigers in Indonesia : tigers in India, giving your answer in its simplest form.

..... : ..... : ..... [2]

(ii) Five years later, the number of tigers reported in India was 2967.

Find the percentage increase in the population of tigers in India.

..... % [2]

(iii) The number of tigers in India in the year 2014 is approximately 30.48% greater than in the year 2010.

Find the number of tigers in India in the year 2010.
Give your answer correct to the nearest integer.

..... [3]

(b) At the start of June, a hive has a population of 2000 bees.
Three months after the start of June the hive has a population of 2662 bees.

The population of this hive can be calculated using the formula

$$P = ab^x,$$

where P is the population of the hive x months after the start of June.

By finding the value of a and the value of b, calculate the population of the hive 7 months after the start of June.
Give your answer correct to the nearest integer.

..... [5]

43. 0580_s22_qp_43 Q: 6

(a) Simplify.

$$a-2b-3a+7b$$

..... [2]

(b) Expand and simplify.

$$4(x-5)-(3-2x)$$

..... [2]

(c) Write as a single fraction in its simplest form.

$$\frac{3}{x-5}-\frac{7}{2x}$$

..... [3]

(d) Solve.

$$\frac{13-4x}{3}=6-x$$

$x =$ ..... [3]

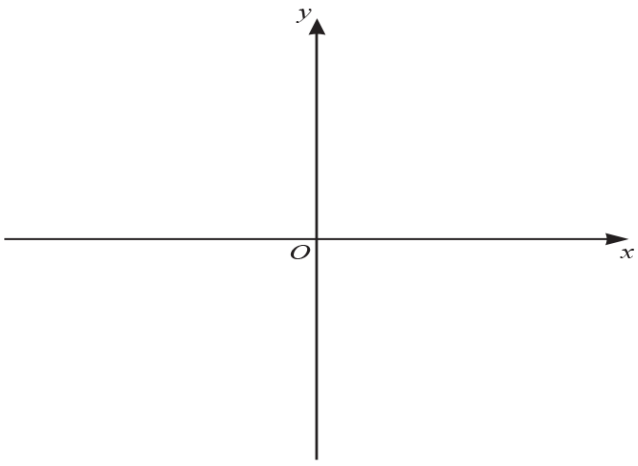
(e) Make x the subject of the formula.

$$y=\frac{5(p-2x)}{x}$$

$x =$ ..... [4]

44. 0580_s22_qp_43 Q: 9

(a) Sketch the graph of $y = (x+1)(3-x)(3+x)$, indicating the coordinates of the points where the graph crosses the x-axis and the y-axis.



[4]

(b) **(i)** Show that $y = (x+1)(3-x)(3+x)$ can be written as $y = 9+9x-x^2-x^3$.

[2]

(ii) Calculate the x–values of the turning points of $y = 9 + 9x - x^2 - x^3$.
Show all your working and give your answers correct to 2 decimal places.

$x =$ ....., $x =$ ..... [7]

(iii) The equation $9 + 9x - x^2 - x^3 = k$ has one solution only when $k < a$ and when $k > b$, where a and b are integers.

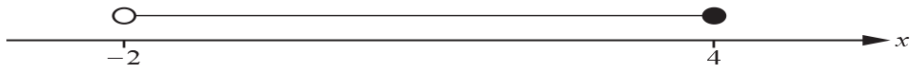
Find the maximum value of a and the minimum value of b.

$a =$ .....

$b =$ ..... [3]

45. 0580_w22_qp_41 Q: 3

(a)



Write down the inequality shown by the number line.

..... [1]

(b) $-3 \leqslant 2x+3 < 9$

(i) Solve the inequality.

..... [3]

(ii) Write down all the integer values of x that satisfy the inequality.

..... [2]

(c) Solve the equations.

(i) $3(3-x) - \frac{2(x+2)}{5} = 1$

$x =$ ..... [4]

(ii) $\frac{5}{x+3} = \frac{3}{x+5}$

$x =$ ..... [3]

46. 0580_w22_qp_41 Q: 7

$f(x) = 10 - x$ $g(x) = \frac{2}{x}, \ x \neq 0$ $h(x) = 2^x$ $j(x) = 5 - 2x$

(a) (i) Find $g\left(\frac{1}{2}\right)$.

..... [1]

(ii) Find $hg\left(\frac{1}{2}\right)$.

..... [1]

(b) Find x when $f(x) = 7$.

$x =$ ..... [1]

(c) Find x when $g(x) = h(3)$.

$x =$ ..... [2]

(d) Find $j^{-1}(x)$.

$j^{-1}(x) =$ ..... [2]

(e) Write $f(x) + g(x) + 1$ as a single fraction in its simplest form.

..... [3]

(f) $\left(\mathrm{f}(x)\right)^2 - \mathrm{ff}(x) = ax^2 + bx + c$

Find the values of a, b and c.

$a =$ .....

$b =$ .....

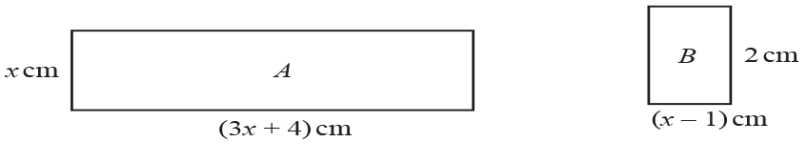
$c =$ ..... [4]

(g) Find x when $\mathrm{h}^{-1}(x) = 10$.

$x =$ ..... [2]

47. 0580_w22_qp_41 Q: 9

(a)



The total of the areas of rectangles A and B is $20\,\text{cm}^2$.

(i) Show that $3x^2 + 6x - 22 = 0$.

[2]

(ii) Solve the equation $3x^2 + 6x - 22 = 0$, giving your answers correct to 4 significant figures. You must show all your working.

$x =$ ..... or $x =$ ..... [4]

(iii) Find the perimeter of rectangle B.

..... cm [1]

(b)

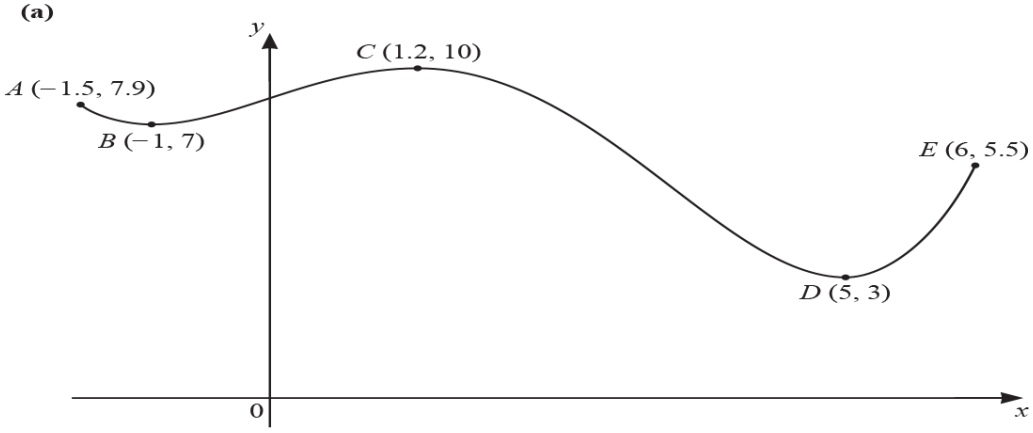
The diagram shows two rectangles where $H - h = 1$.

By forming a quadratic equation and factorising, find the value of y.

$y =$ ..... [7]

48. 0580_w22_qp_41 Q: 10

(a)



The diagram shows a sketch of the graph of $y = f(x)$ for $-1.5 \leqslant x \leqslant 6$.
The coordinates of five points on the graph of $y = f(x)$ are shown on the diagram.

(i) $f(x) = k$ has two solutions in the interval $-1.5 \leqslant x \leqslant 6$.

Write down a possible integer value of k.

$k =$ ..... [1]

(ii) $f(x) = j$ has no solutions in the interval $-1.5 \leqslant x \leqslant 6$ when $j < a$ or $j > b$.

Find the maximum value of a and the minimum value of b.

$a =$ .....

$b =$ ..... [2]

(b) Find the coordinates of the two stationary points on the graph of $y = x^6 - 6x^5$.
You must show all your working.

(..... , ...)

(..... , ...) [5]

49. 0580_w22_qp_42 Q: 1

(a) (i) At a football club, season tickets are sold for seated areas and for standing areas.
The cost of season tickets are in the ratio seated : standing = 5 : 3.
The cost of a season ticket for the standing area is $45.

Find the cost of a season ticket for the seated area.

$ ..... [2]

(ii) In 2021, the value of the team's players was $2.65 million.
In 2022 this value has decreased by 12%.

Find the value in 2022.

$ ..... million [2]

(iii) The number of people at a football match is 1455.
This is 6.25% of the total number of people allowed in the stadium.

Find the total number of people allowed in the stadium.

..... [2]

(iv) The average attendance increased exponentially by 4% each year for the three years from 2016 to 2019.
In 2019 the average attendance was 1631.

Find the average attendance for 2016.

..... [3]

(b) Another club sells season tickets for individuals and for families.
In 2018, the number of season tickets sold is in the ratio family : individual = 2 : 7.

(i) The number of family season tickets sold is x.

Write an expression, in terms of x, for the number of individual season tickets sold.

..... [1]

(ii) In 2019, the number of family season tickets sold increases by 12 and the number of individual season tickets sold decreases by 26.

Complete the table by writing expressions, in terms of x, for the number of tickets sold each year.

Year	Family tickets	Individual tickets
2018	x	
2019		

[2]

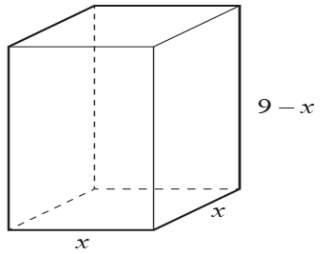
(iii) In 2019, the number of individual season tickets sold is 3 times the number of family season tickets sold.

Write an equation in x and solve it to find the number of family tickets sold in 2018.

x = ... [4]

50. 0580_w22_qp_42 Q: 2

All the lengths in this question are measured in centimetres.



The diagram shows a solid cuboid with a square base.

(a) The volume, $V\,\text{cm}^3$, of the cuboid is $V = x^2(9-x)$.
The table shows some values of V for $0 \leqslant x \leqslant 9$.

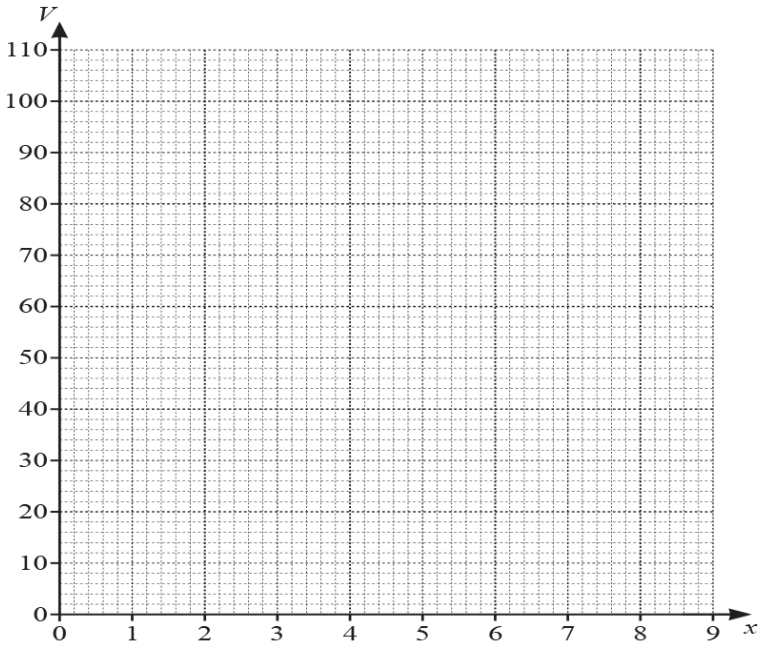
x	0	1	2	3	4	5	6	7	8	9
V	0	8		54	80	100	108	98	64	0

(i) Complete the table. [1]

(ii) On the grid on the opposite page, draw the graph of $V = x^2(9-x)$ for $0 \leqslant x \leqslant 9$. [4]

(iii) Find the values of x when the volume of the cuboid is $44\,\text{cm}^3$.

$x =$ ..... or $x =$ ..... [2]



(b) (i) Show that the total surface area of the cuboid is $(36x - 2x^2)\text{cm}^2$.

[2]

(ii) Find the surface area when the volume of the cuboid is a maximum.

..... cm^2 [3]

51. 0580_w22_qp_42 Q: 6

(a) Solve.

$$4x + 15 = 9$$

$x =$ ..... [2]

(b) Factorise.

$$a^2 - 9$$

..... [1]

(c) Write as a single fraction in its simplest form.

$$\frac{4a}{5} \div \frac{3ad}{10c}$$

..... [3]

(d) $5^n + 5^n + 5^n + 5^n + 5^n = 5^m$

Find an expression for m in terms of n.

$m =$ ..... [2]

(e) Solve by factorisation.

$$4x^2 + 8x - 5 = 0$$

$x =$ ..... or $x =$ ..... [3]

(f) **(i)** y is directly proportional to $(x+3)^3$.
When $x = 2$, $y = 13.5$.

Find x when $y = 108$.

$x =$ ..... [3]

(ii) g is inversely proportional to the square of d.
When d is halved, the value of g is multiplied by a factor n.

Find n.

$n =$ ..... [2]

(g) Expand and simplify.

$$(2x+3)(x-1)(x+3)$$

..... [3]

(h) Find the derivative, $\frac{dy}{dx}$, of $y = 3x^2 + 4x - 1$.

..... [2]

52. 0580_w22_qp_43 Q: 2

(a) Simplify fully.

(i) $p^3 \times p^{11}$

..... [1]

(ii) $\frac{18m^6}{3m^2}$

..... [2]

(iii) $\left(\frac{27x^9y^{27}}{64}\right)^{-\frac{1}{3}}$

..... [3]

(b) A sequence has nth term $3n^2$.

Write down the first 3 terms of this sequence.

....., ..., ... [2]

(c) Find the nth term for each of these sequences.

(i) 13, 16, 19, 22, 25, ...

..... [2]

(ii) 3, 17, 55, 129, 251, ...

..... [2]

(d) Solve.

$$\frac{3x-22}{4} = 23$$

$x =$ ..... [3]

(e) Use the quadratic formula to solve $3x^2 + 8x - 20 = 0$.
Show all your working and give your answers correct to 2 decimal places.

$x =$ ..... , $x =$ ..... [4]

53. 0580_w22_qp_43 Q: 6

(a) $P = 5k^2 - 7$

(i) Find the value of P when $k = 3$.

$P =$ ..... [2]

(ii) Rearrange the formula to make k the subject.

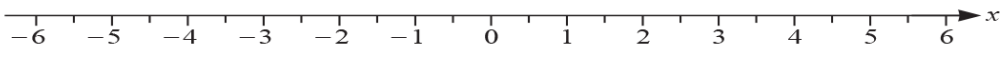
$k =$ ..... [3]

(b) **(i)** Solve.

$$x - 3 \leqslant 5x + 7$$

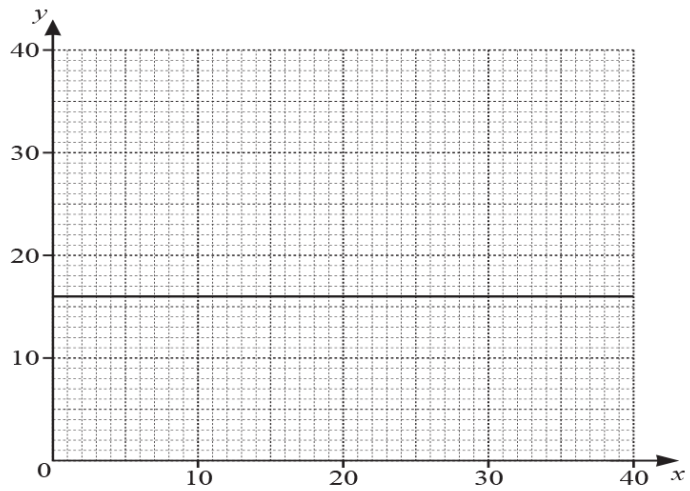
..... [2]

(ii) Show your answer to **part (b)(i)** on the number line.



[1]

(c) The line $y = 16$ is drawn on the grid.



The region R satisfies the following inequalities.

$y \geqslant 16$ $x > 2$ $2x + 3y \geqslant 72$ $y \leqslant 32 - x$

(i) By drawing three more lines and shading the region **not required**, find and label region R. [6]

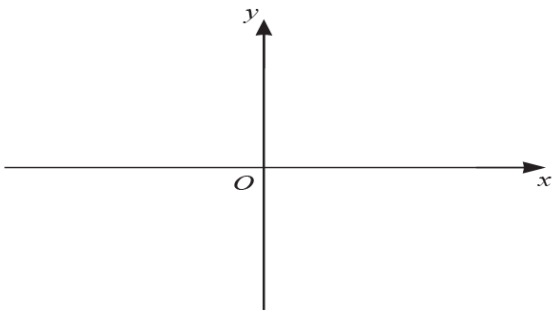
(ii) Find the integer coordinates (x, y) in the region R that give the maximum value of $2x + y$.

(..... , ...) [2]

54. 0580_w22_qp_43 Q: 9

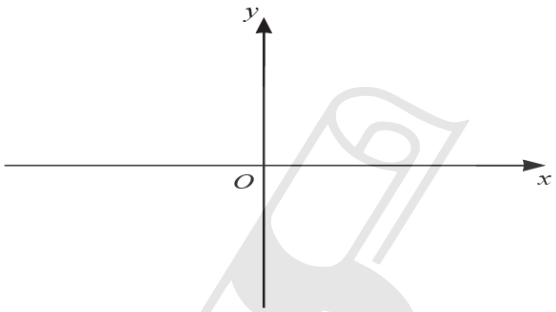
(a) Sketch the following graphs.
On each sketch, indicate any intercepts with the axes.

(i) $3x - 4y = 12$



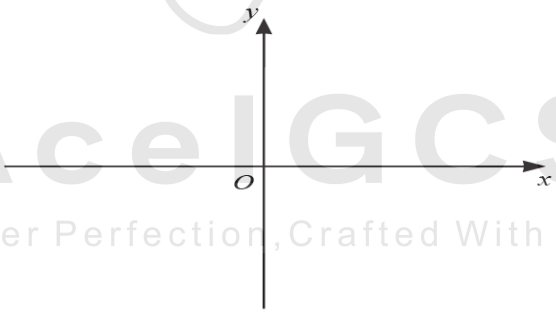
[2]

(ii) $y = x^2 - 3x - 4$



[4]

(iii) $y = 6^x$



[2]

(b) (i) Find the derivative, $\frac{dy}{dx}$, of $y = 5 + 8x - \frac{4}{3}x^3$.

..... [2]

(ii) Find the gradient of $y = 5 + 8x - \frac{4}{3}x^3$ at $x = -1$.

..... [2]

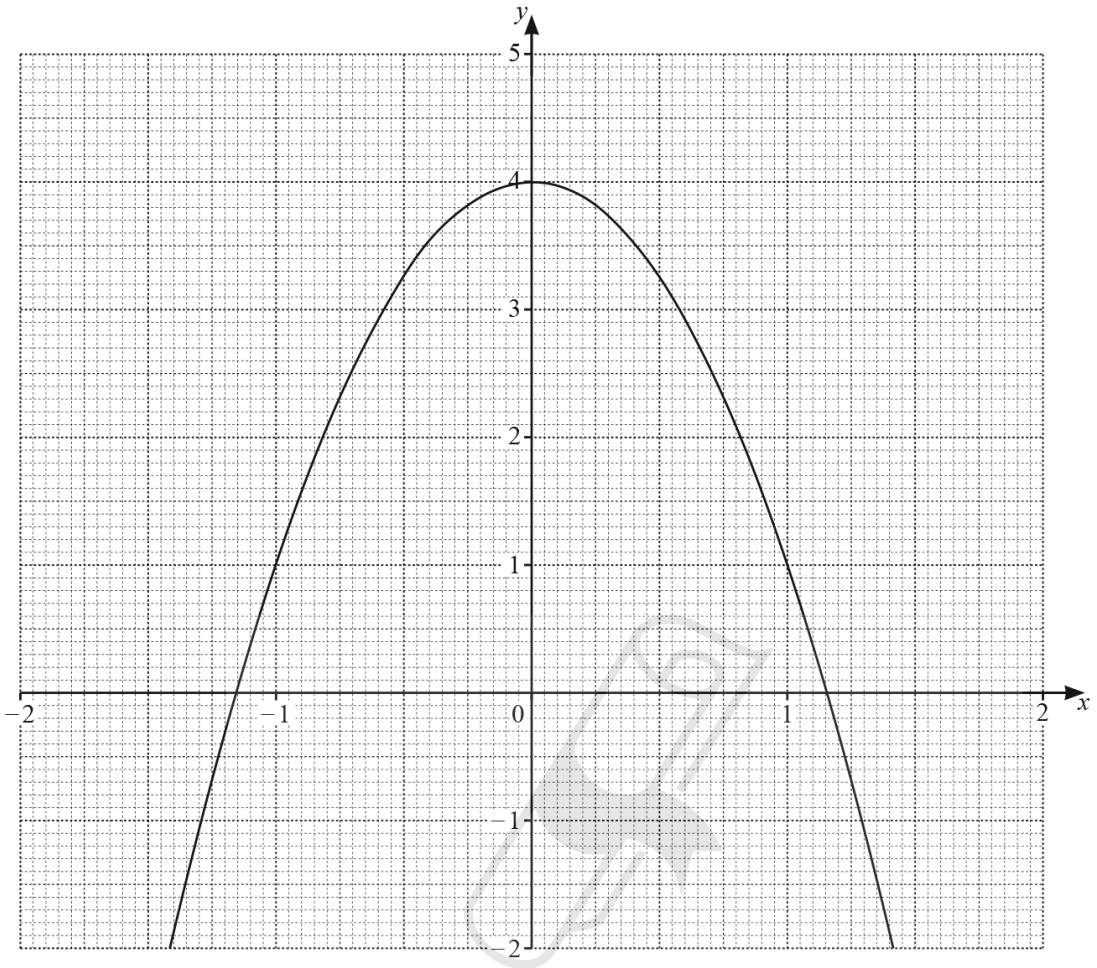
(iii) A tangent is drawn to the graph of $y = 5 + 8x - \frac{4}{3}x^3$.
The gradient of the tangent is -28.

Find the coordinates of the two possible points where this tangent meets the graph.

(....., ...)

(....., ...) [5]

55. 0580_m21_qp_42 Q: 6



(a) The grid shows the graph of $y = a + bx^2$.

The graph passes through the points with coordinates (0, 4) and (1, 1).

(i) Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [2]

(ii) Write down the equation of the tangent to the graph at (0, 4).

..... [1]

(iii) The equation of the tangent to the graph at $x = -1$ is $y = 6x + 7$.

Find the equation of the tangent to the graph at $x = 1$.

..... [2]

(b) The table shows some values for $y = 1 + \frac{5}{3-x}$ for $-2 \leqslant x \leqslant 1.5$.

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5
y	2	2.11		2.43		3		4.33

(i) Complete the table. [3]

(ii) On the grid, draw the graph of $y = 1 + \frac{5}{3-x}$ for $-2 \leqslant x \leqslant 1.5$. [4]

(c) (i) Write down the values of x where the two graphs intersect.

$x =$ ..... or $x =$ ..... [2]

(ii) The answers to **part(c)(i)** are two solutions of a cubic equation in terms of x.

Find this equation in the form $ax^3 + bx^2 + cx + d = 0$, where a, b, c and d are integers.

..... [4]

56. 0580_m21_qp_42 Q: 9

(a) Factorise.

(i) $5am + 10ap - bm - 2bp$

..... [2]

(ii) $15(k+g)^2 - 20(k+g)$

..... [2]

(iii) $4x^2 - y^4$

..... [2]

(b) Expand and simplify.

$$(x-3)(x+1)(3x-4)$$

..... [3]

(c) $(x+a)^2 = x^2 + 22x + b$

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [2]

57. 0580_m21_qp_42 Q: 11

Gaya spends \$48 to buy books that cost \$$x$ each.

(a) Write down an expression, in terms of x, for the number of books Gaya buys.

..... [1]

(b) Myra spends \$60 to buy books that cost \$$(x+2)$ each.
Gaya buys 4 more books than Myra.

Show that $x^2+5x-24=0$.

[4]

(c) Solve by factorisation.

$x^2+5x-24=0$

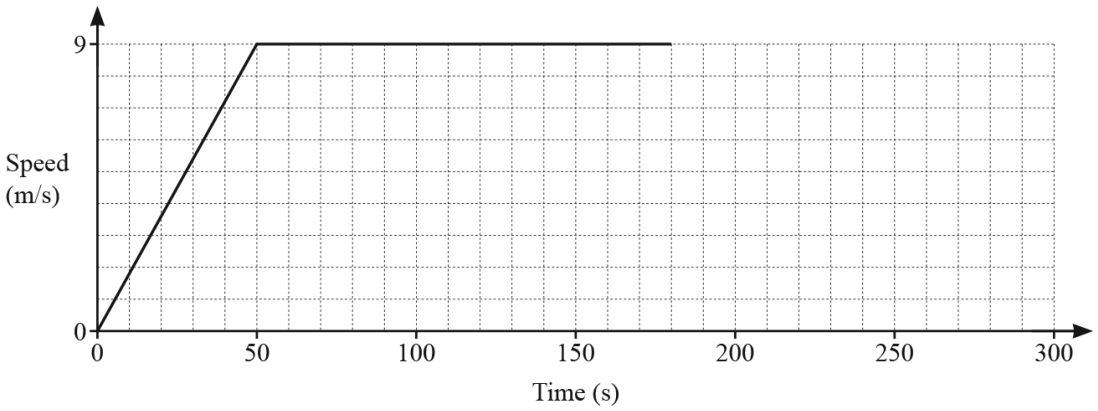
$x =$ ..... or $x =$ ..... [3]

(d) Find the number of books Myra buys.

..... [1]

58. 0580_s21_qp_41 Q: 2

The diagram shows the speed–time graph for the first 180 seconds of a train journey.



(a) Find the acceleration, in m/s^2, of the train during the first 50 seconds.

..... m/s^2 [1]

(b) After 180 seconds, the train decelerates at a constant rate of 1944 **km/h^2**.

Show that the train decelerates for 60 seconds until it stops.

[2]

(c) Complete the speed–time graph. [1]

(d) Calculate the average speed of the train for the whole journey.

..... m/s [4]

59. 0580_s21_qp_41 Q: 7

(a) Simplify.

$$\frac{x^2-25}{x^2-x-20}$$

..... [3]

(b) Write as a single fraction in its simplest form.

$$\frac{x+5}{x}+\frac{x+8}{x-1}$$

..... [3]

(c) A curve has equation $y = 2x^3 - 4x^2 + 6$.

(i) Find $\frac{dy}{dx}$, the derived function of y.

..... [2]

(ii) Calculate the gradient of the curve $y = 2x^3 - 4x^2 + 6$ at $x = 4$.

..... [2]

(iii) Find the coordinates of the two stationary points on the curve.

(..... , ...) and (..... , ...) [4]

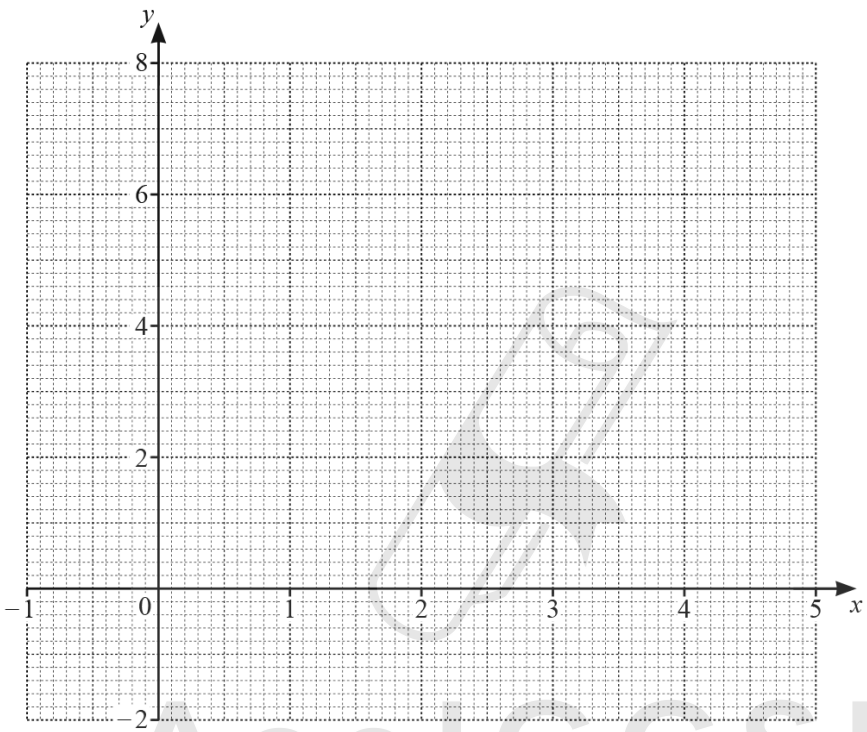
60. 0580_s21_qp_41 Q: 10

The table shows some values of $y = 3 + 4x - x^2$ for $-1 \leqslant x \leqslant 5$.

x	-1	-0.5	0	1	2	3	4	4.5	5
y	-2			6		6			-2

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 3 + 4x - x^2$ for $-1 \leqslant x \leqslant 5$.



[4]

(c) Write down an **integer** value of k for which the equation $3 + 4x - x^2 = k$ has no solutions.

..... [1]

(d) By drawing a suitable straight line on the grid, solve the equation $-1 + \frac{9}{2}x - x^2 = 0$.

$x =$ ..... or $x =$ ..... [4]

61. 0580_s21_qp_41 Q: 12

$f(x) = 3-2x$ $g(x) = x^2+5$ $h(x) = x^3$

(a) Find $f(-5)$.

..... [1]

(b) Find $ff(x)$.
Give your answer in its simplest form.

..... [2]

(c) Solve $g(x) = f(x)+37$.

$x =$ ..... or $x =$ ..... [4]

(d) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(e) Find $hf(x) + g(x)$.
Give your answer in its simplest form.

..... [5]

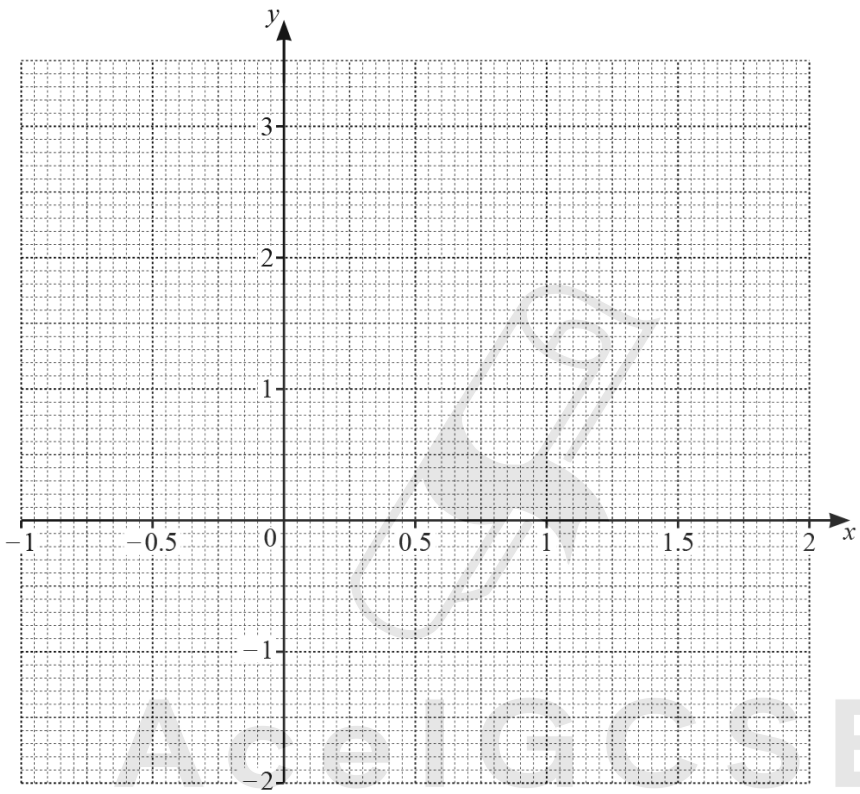
62. 0580_s21_qp_42 Q: 2

The table shows some values for $y = 2 \times 0.5^x - 1$.

x	-1	-0.5	0	0.5	1	1.5	2
y	3	1.83		0.41	0	-0.29	

(a) (i) Complete the table. [2]

(ii) On the grid, draw the graph of $y = 2 \times 0.5^x - 1$ for $-1 \leqslant x \leqslant 2$.



[4]

(b) By drawing a suitable straight line, solve the equation $2 \times 0.5^x + 2x - 3.5 = 0$ for $-1 \leqslant x \leqslant 2$.

$x =$ ..... [3]

(c) There are no solutions to the equation $2 \times 0.5^x - 1 = k$ where k is an integer.

Complete the following statements.

The highest possible value of k is .....

The equation of the asymptote to the graph of $y = 2 \times 0.5^x - 1$ is ..... [2]

63. 0580_s21_qp_42 Q: 3

(a) Simplify, giving your answer as a single power of 7.

(i) $7^5 \times 7^6$

..... [1]

(ii) $7^{15} \div 7^5$

..... [1]

(iii) $42 + 7$

..... [1]

(b) Simplify.

$(5x^2 \times 2xy^4)^3$

..... [3]

(c) $P = 2^5 \times 3^3 \times 7$ $Q = 540$

(i) Find the highest common factor (HCF) of P and Q.

..... [2]

(ii) Find the lowest common multiple (LCM) of P and Q.

..... [2]

(iii) $P \times R$ is a cube number, where R is an integer.

Find the smallest possible value of R.

..... [2]

(d) Factorise the following completely.

(i) $x^2 - 3x - 28$

..... [2]

(ii) $7(a+2b)^2 + 4a(a+2b)$

..... [2]

(e) $3^{2x-1} = \frac{1}{9^x} \times 3^{2y-x}$

Find an expression for y in terms of x.

$y =$ ..... [4]

64. 0580_s21_qp_42 Q: 10

The table shows four sequences A, B, C and D.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	1	8	27	64			
B	5	11	17	23			
C	0.25	0.5	1	2	4		
D	4.75	10.5	16	21			

Complete the table.

[9]

65. 0580_s21_qp_43 Q: 2

(a) $y = px^2 + t$

(i) Find the value of y when $p = 3$, $x = 2$ and $t = -13$.

$y =$ ..... [2]

(ii) Rearrange the formula to write x in terms of p, t and y.

$x =$ ..... [3]

(b) **(i)** Factorise.

$15x^2 - 2x - 8$

..... [2]

(ii) Solve the equation.

$15x^2 - 2x - 8 = 0$

$x =$ ..... or $x =$ ..... [1]

(c) Factorise completely.

$x^3 - 16xy^2$

..... [3]

(d) Simplify. $\dfrac{2x-1-4ax+2a}{2x^2-x}$

..... [4]

66. 0580_s21_qp_43 Q: 5

Solve the simultaneous equations.

(a) $x+2y=13$
$x+5y=22$

$x =$ .....

$y =$ ..... [2]

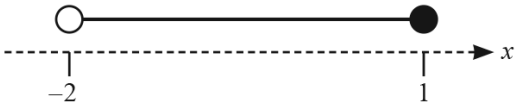
(b) $y=2-x$
$y=x^2+2x+2$

$x =$ ..... $y =$ .....

$x =$ ..... $y =$ ..... [4]

67. 0580_s21_qp_43 Q: 7

(a)



Write down the inequality in x shown by the number line.

..... [2]

(b) (i) Write x^2+4x+1 in the form $(x+p)^2+q$.

..... [2]

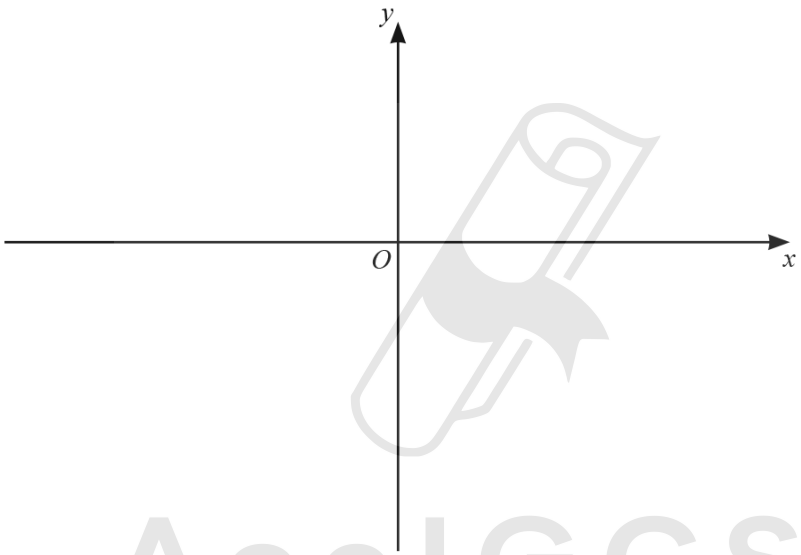
(ii) Use your answer to **part (b)(i)** to solve the equation $x^2+4x+1=0$.

$x =$ ..... or $x =$ ..... [2]

(iii) Use your answer to **part (b)(i)** to write down the coordinates of the minimum point on the graph of $y = x^2 + 4x + 1$.

(..... , ...) [2]

(iv) On the diagram, sketch the graph of $y = x^2 + 4x + 1$.



[2]

68. 0580_s21_qp_43 Q: 10

$f(x) = 3x - 2$ $g(x) = 5x - 7$ $h(x) = x^2 + x$ $j(x) = 3^x$

(a) Find

(i) f(2),

..... [1]

(ii) g(2),

..... [1]

(iii) gf(2).

..... [1]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) Find hf(x), giving your answer in the form $ax^2 + bx + c$.

..... [3]

(d) Find the derivative of h(x).

..... [1]

(e) **(i)** Find x when $j^{-1}(x) = 4$.

$x =$ ..... [1]

(ii) Simplify $j^{-1}j(x)$.

..... [1]

69. 0580_s21_qp_43 Q: 11

(a) These are the first four terms of a sequence.

11 7 3 −1

(i) Write down the next term.

..... [1]

(ii) Write down the term to term rule for this sequence.

..... [1]

(iii) Find the nth term of this sequence.

..... [2]

(b) The nth term of a different sequence is $\frac{2n}{n+1}$.

(i) Find the difference between the 5th term and the 6th term of this sequence.
Give your answer as a fraction.

..... [2]

(ii) Is $\frac{3}{4}$ a term in this sequence?
Show how you decide.

[3]

70. 0580_m20_qp_42 Q: 5

(a) Write as a single fraction in its simplest form.

$$\frac{x+3}{x-3} - \frac{x-2}{x+2}$$

..... [4]

(b) $2^{12} \div 2^{\frac{k}{2}} = 32$

Find the value of k.

$k =$ ..... [2]

(c) Expand and simplify.

$$(y+3)(y-4)(2y-1)$$

..... [3]

(d) Make x the subject of the formula.

$$x = \frac{3+x}{y}$$

$x =$ ..... [3]

71. 0580_m20_qp_42 Q: 7

(a) Naga has n marbles.
Panav has three times as many marbles as Naga.
Naga loses 5 marbles and Panav buys 10 marbles.
Together they now have more than 105 marbles.

Write down and solve an inequality in n.

..... [3]

(b) y is inversely proportional to x^2.
When $x = 4$, $y = 7.5$.

Find y when $x = 5$.

$y =$ ..... [3]

(c) Find the nth term of each sequence.

(i) 4 2 0 −2 −4 …

..... [2]

(ii) 1 7 17 31 49 …

..... [2]

72. 0580_m20_qp_42 Q: 10

$f(x) = 4x - 1$ $g(x) = x^2$ $h(x) = 3^{-x}$

(a) Find in its simplest form

(i) $f(x-3)$,

..... [1]

(ii) $g(5x)$.

..... [1]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) Find the value of $hh(1)$, correct to 4 significant figures.

..... [3]

(d) **(i)** Show that $g(3x-2)-h(-3)$ can be written as $9x^2-12x-23$.

[2]

(ii) Use the quadratic formula to solve $9x^2-12x-23=0$.
Give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [4]

(e) Find x when $f(61)=h(x)$.

$x =$ ..... [2]

73. 0580_m20_qp_42 Q: 11

A curve has equation $y = x^3 - 3x + 4$.

(a) Work out the coordinates of the two stationary points.

(..... , ...)

(..... , ...) [5]

(b) Determine whether each stationary point is a maximum or a minimum.
Give reasons for your answers.

[3]

74. 0580_p20_qp_40 Q: 7

$f(x) = 2x + 1$ $g(x) = x^2 + 4$ $h(x) = 2^x$

(a) Solve the equation $f(x) = g(1)$.

$x =$ ..... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) Find $gf(x)$ in its simplest form.

..... [3]

(d) Solve the equation $h^{-1}(x) = 0.5$.

$x =$ ..... [1]

(e) $\frac{1}{h(x)} = 2^{kx}$

Write down the value of k.

$k =$ ..... [1]

75. 0580_p20_qp_40 Q: 11

A curve has equation $y = x^3 - 6x^2 + 16$.

(a) Find the coordinates of the two turning points.

(..... , ...) and (..... , ...) [6]

(b) Determine whether each of the turning points is a maximum or a minimum.
Give reasons for your answers.

[3]

76. 0580_s20_qp_41 Q: 3

(a) $s = ut + \frac{1}{2}at^2$

Find the value of s when $u = 5.2$, $t = 7$ and $a = 1.6$.

$s =$ ..... [2]

(b) Simplify.

(i) $3a - 5b - a + 2b$

..... [2]

(ii) $\frac{5}{3x} \times \frac{9x}{20}$

..... [2]

(c) Solve.

(i) $\frac{15}{x} = -3$

$x =$ ..... [1]

(ii) $4(5 - 3x) = 23$

$x =$ ..... [3]

(d) Simplify.

$$(27x^9)^{\frac{2}{3}}$$

..... [2]

(e) Expand and simplify.

$$(3x - 5y)(2x + y)$$

..... [2]

---

77. 0580_s20_qp_41 Q: 6

Raheem makes baskets and mats.
Each week he makes x baskets and y mats.

He makes fewer than 10 mats.
The number of mats he makes is greater than or equal to the number of baskets he makes.

(a) One of the inequalities that shows this information is $y < 10$.

Write down the other inequality.

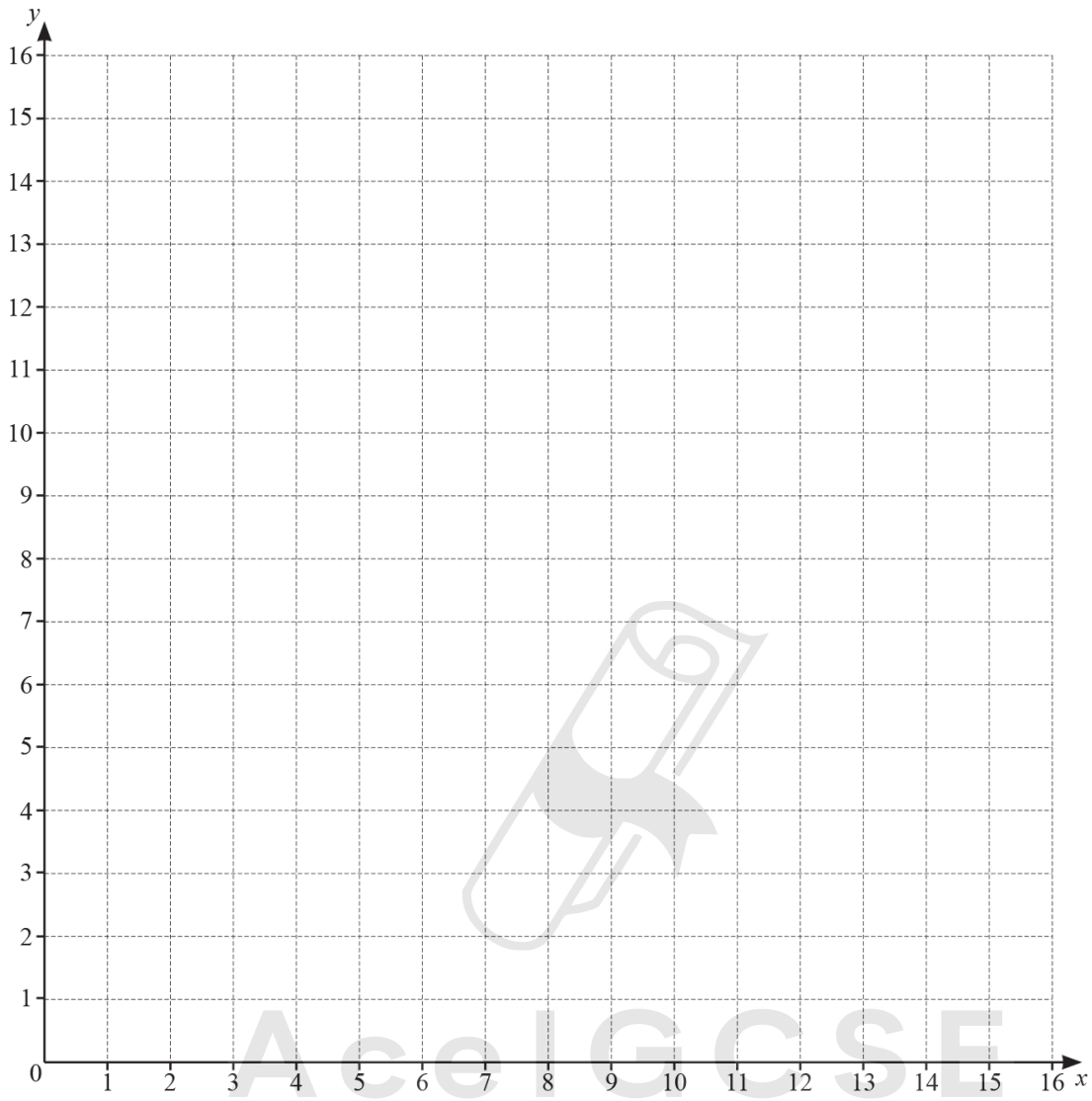
..... [1]

(b) He takes $2\frac{1}{4}$ hours to make a basket and $1\frac{1}{2}$ hours to make a mat.
Each week he works for a maximum of 22.5 hours.

Show that $3x + 2y \leqslant 30$.

[2]

(c) On the grid, draw three straight lines and shade the **unwanted** regions to show these inequalities.



[5]

(d) He makes \$40 profit on each basket he sells and \$28 profit on each mat he sells.

Calculate the maximum profit he can make each week.

\$ ..... [2]

78. 0580_s20_qp_42 Q: 6

$f(x) = 3x+2$ $g(x) = x^2+1$ $h(x) = 4^x$

(a) Find h(4).

..... [1]

(b) Find fg(1).

..... [2]

(c) Find gf(x) in the form ax^2+bx+c.

..... [3]

(d) Find x when $f(x) = g(7)$.

$x =$ ..... [2]

(e) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(f) Find $\frac{g(x)}{f(x)} + x$.

Give your answer as a single fraction, in terms of x, in its simplest form.

..... [3]

(g) Find x when $h^{-1}(x) = 2$.

$x =$ ..... [1]

79. 0580_s20_qp_42 Q: 10

(a) $y = x^4 - 4x^3$

(i) Find the value of y when $x = -1$.

$y =$ ..... [2]

(ii) Find the two stationary points on the graph of $y = x^4 - 4x^3$.

(..... , ...)

(..... , ...) [6]

(b) $y = x^p + 2x^q$

$\frac{dy}{dx} = 11x^{10} + 10x^4$, where $\frac{dy}{dx}$ is the derived function.

Find the value of p and the value of q.

$p =$ .....

$q =$ ..... [2]

80. 0580_s20_qp_43 Q: 4

(a) Solve the inequality.

$$3m + 12 \leqslant 8m - 5$$

..... [2]

(b) Solve the equation. $\dfrac{2x+5}{3-x} = \dfrac{14}{15}$

$x =$ ..... [3]

(c) Solve the simultaneous equations.
You must show all your working.

$$y = 4 - x$$
$$x^2 + 2y^2 = 67$$

$x =$ ..... , $y =$ .....

$x =$ ..... , $y =$ ..... [6]

81. 0580_s20_qp_43 Q: 11

$f(x) = 7x - 4$ $\quad g(x) = \frac{2x}{x-3}, x \neq 3$ $\quad h(x) = x^2$

(a) Find $g(6)$.

..... [1]

(b) Find $fg(4)$.

..... [2]

(c) Find $fh(x)$.

..... [1]

(d) Find $\frac{f(x)}{2} + g(x)$.

Give your answer as a single fraction, in terms of x, in its simplest form.

..... [3]

(e) Find the value of x when $f(x+2) = -11$.

$x =$ ..... [2]

(f) Find the values of p that satisfy $h(p) = p$.

..... [2]

82. 0580_s20_qp_43 Q: 12

(a) A curve has equation $y = 4x^3 - 3x + 3$.

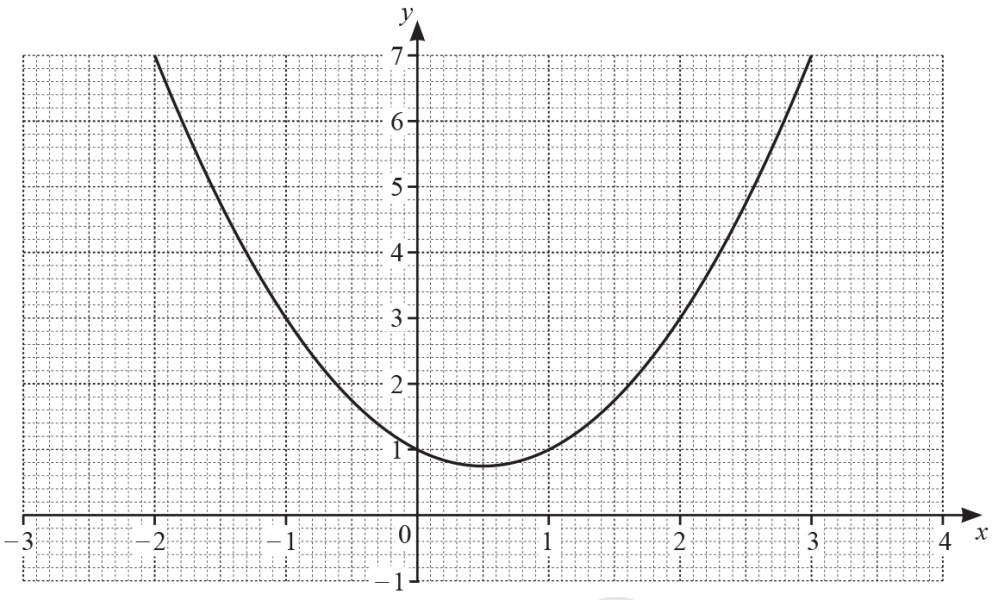
(i) Find the coordinates of the two stationary points.

(..... , ...) and (..... , ...) [5]

(ii) Determine whether each of the stationary points is a maximum or a minimum.
Give reasons for your answers.

[3]

(b) The graph of $y = x^2 - x + 1$ is shown on the grid.

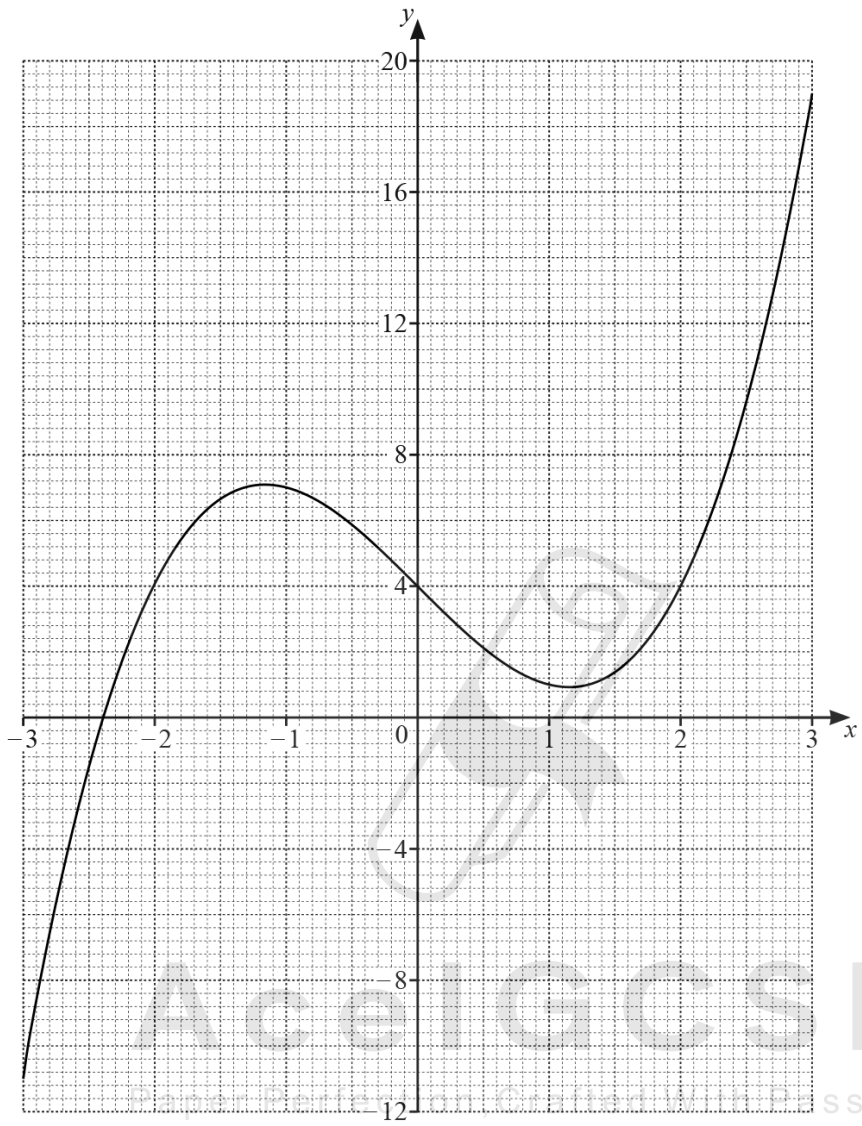


By drawing a suitable line on the grid, solve the equation $x^2 - 2x - 2 = 0$.

$x =$ ..... or $x =$ ..... [3]

83. 0580_w20_qp_41 Q: 5

(a) The diagram shows the graph of $y = f(x)$ for $-3 \leqslant x \leqslant 3$.



(i) Solve $f(x) = 14$.

$x =$ ..... [1]

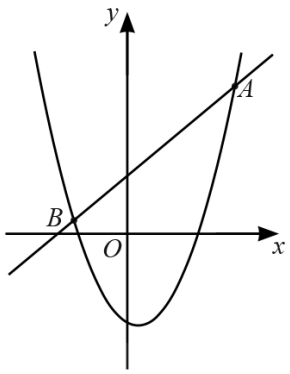
(ii) By drawing a suitable tangent, find an estimate of the gradient of the graph at the point $(-2, 4)$.

..... [3]

(iii) By drawing a suitable straight line on the grid, solve $f(x) = 2x - 2$ for $-3 \leqslant x \leqslant 3$.

$x =$ ..... [3]

(b)



NOT TO SCALE

The diagram shows a curve with equation $y = 2x^2 - 2x - 7$.
The straight line with equation $y = 3x + 5$ intersects the curve at the points A and B.

Find the coordinates of the points A and B.

A (..... , ...)

B (..... , ...) [5]

84. 0580_w20_qp_41 Q: 7

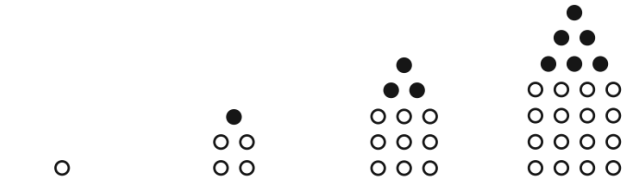


Diagram 1 Diagram 2 Diagram 3 Diagram 4

These are the first four diagrams of a sequence.
The diagrams are made from white dots and black dots.

(a) Complete the table for Diagram 5 and Diagram 6.

Diagram	1	2	3	4	5	6
Number of white dots	1	4	9	16		
Number of black dots	0	1	3	6		
Total number of dots	1	5	12	22		

[2]

(b) Write an expression, in terms of n, for the number of white dots in Diagram n.

..... [1]

(c) The expression for the total number of dots in Diagram n is $\frac{1}{2}(3n^2 - n)$.

(i) Find the total number of dots in Diagram 8.

..... [1]

(ii) Find an expression for the number of black dots in Diagram n.
Give your answer in its simplest form.

..... [2]

(d) T is the total number of dots used to make **all** of the first n diagrams.

$$T = an^3 + bn^2$$

Find the value of a and the value of b.
You must show all your working.

$a =$ .....

$b =$ ..... [5]

85. 0580_w20_qp_41 Q: 8

(a) Factorise completely.

$3a^2b - ab^2$

..... [2]

(b) Solve the inequality.

$3x + 12 < 5x - 3$

..... [2]

(c) Simplify.

$(3x^2y^4)^3$

..... [2]

(d) Solve.

$\frac{2}{x} = \frac{6}{2-x}$

$x =$ ..... [3]

(e) Expand and simplify.

$(x-2)(x+5)(2x-1)$

..... [3]

(f) Alan invests \$200 at a rate of r% per year compound interest.
After 2 years the value of his investment is \$206.46 .

(i) Show that $r^2 + 200r - 323 = 0$.

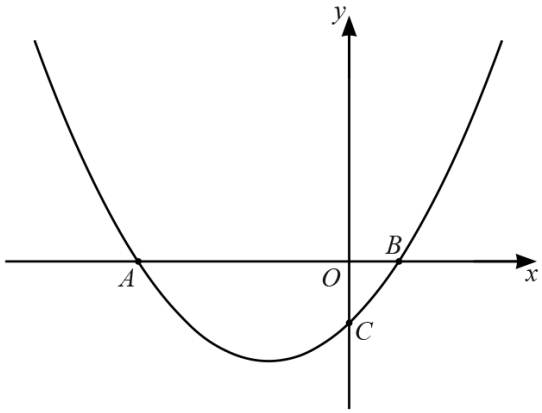
[3]

(ii) Solve the equation $r^2 + 200r - 323 = 0$ to find the rate of interest.
Show all your working and give your answer correct to 2 decimal places.

$r =$ ..... [3]

86. 0580_w20_qp_41 Q: 10

(a)



NOT TO SCALE

The diagram shows a sketch of the curve $y = x^2 + 3x - 4$.

(i) Find the coordinates of the points A, B and C.

A (..... , ...)

B (..... , ...)

C (..... , ...) [4]

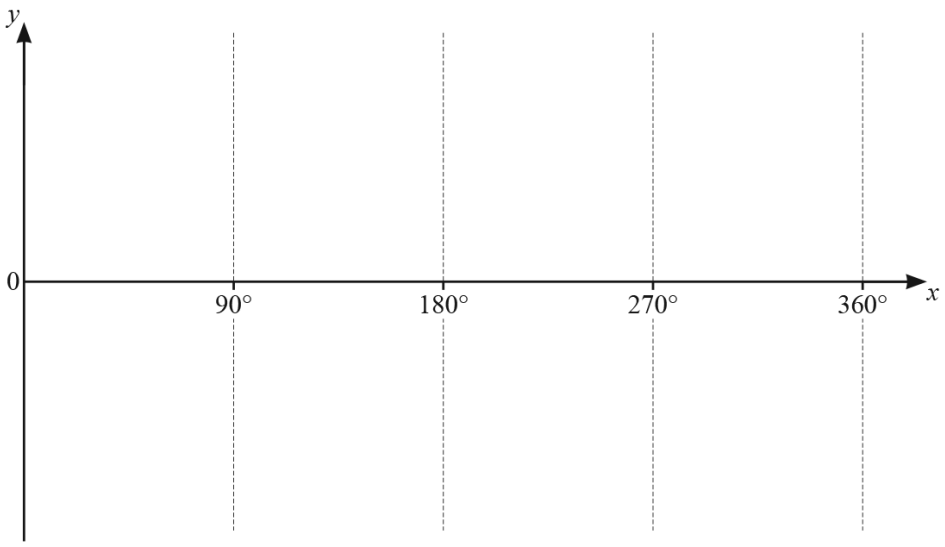
(ii) Differentiate $x^2 + 3x - 4$.

..... [2]

(iii) Find the equation of the tangent to the curve at the point (2, 6).

..... [3]

(b)



(i) On the diagram, sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$. [2]

(ii) Solve the equation $5\tan x = -7$ for $0° \leqslant x \leqslant 360°$.

$x =$ ..... or $x =$ ..... [3]

87. 0580_w20_qp_42 Q: 5

Ahmed sells different types of cake in his shop.
The cost of each cake depends on its type and its size.

Every small cake costs $\$x$ and every large cake costs $\$(2x + 1)$.

(a) The total cost of 3 small lemon cakes and 2 large lemon cakes is \$12.36 .

Find the cost of a small lemon cake.

\$ ..... [3]

(b) The cost of 18 small chocolate cakes is the same as the cost of 7 large chocolate cakes.

Find the cost of a small chocolate cake.

\$ ..... [3]

(c) The number of small cherry cakes that can be bought for \$4 is the same as the number of large cherry cakes that can be bought for \$13.

Find the cost of a small cherry cake.

\$ ..... [3]

(d) Petra spends \$20 on small coffee cakes and \$10 on large coffee cakes.
The total number of cakes is 45.

Write an equation in terms of x.
Solve this equation to find the cost of a small coffee cake.
Show all your working.

\$ ..... [7]

88. 0580_w20_qp_42 Q: 7

$y = x^2 + \frac{1}{x}, \ x \neq 0$

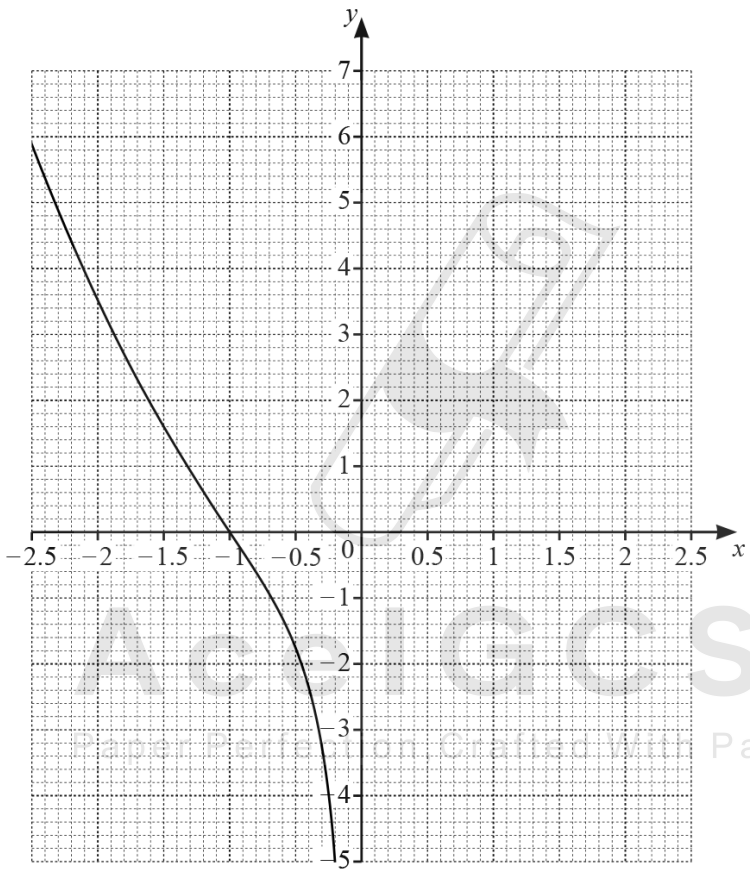
(a) Complete the table.

x	0.2	0.3	0.5	1	1.5	2	2.5
y	5.0	3.4	2.3		2.9		6.7

[2]

(b) On the grid, draw the graph of $y = x^2 + \frac{1}{x}$ for $0.2 \leqslant x \leqslant 2.5$.

The graph of $y = x^2 + \frac{1}{x}$ for $-2.5 \leqslant x \leqslant -0.2$ has been drawn for you.



[4]

(c) By drawing suitable straight lines on the grid, solve the following equations.

(i) $x^2 + \frac{1}{x} = -2$

$x =$ ..... [1]

(ii) $x^2 + \frac{1}{x} + x - 1 = 0$

$x =$ ..... [2]

(d) k is an integer and the equation $x^2 + \frac{1}{x} = k$ has three solutions.

Write down a possible value of k.

$k =$ ..... [1]

89. 0580_w20_qp_42 Q: 10

$f(x) = x^2 + 1$ $g(x) = 1 - 2x$ $h(x) = \frac{1}{x},\ x \neq 0$ $j(x) = 5^x$

(a) Find the value of

(i) f(3),

..... [1]

(ii) gf(3).

..... [1]

(b) Find $g^{-1}(x)$.

$g^{-1}(x) =$ ..... [2]

(c) Find x when $h(x) = 2$.

$x =$ ..... [1]

(d) Find $g(x)g(x) - gg(x)$, giving your answer in the form $ax^2 + bx + c$.

..... [4]

(e) Find hh(x), giving your answer in its simplest form.

..... [1]

(f) Find j(5).

..... [1]

(g) Find x when $\mathrm{j}^{-1}(x) = 2$.

$x =$ ..... [1]

(h) $\mathrm{j}(x) = \mathrm{hg}(-12)$

Find the value of x.

$x =$ ..... [2]

90. 0580_w20_qp_42 Q: 11

Sequence	1st term	2nd term	3rd term	4th term	5th term		*n*th term
A	13	9	5	1			
B	0	7	26	63			
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$			

(a) Complete the table for the three sequences.

[10]

(b) One term in Sequence C is $\frac{p}{q}$.

Write down the next term in Sequence C in terms of p and q.

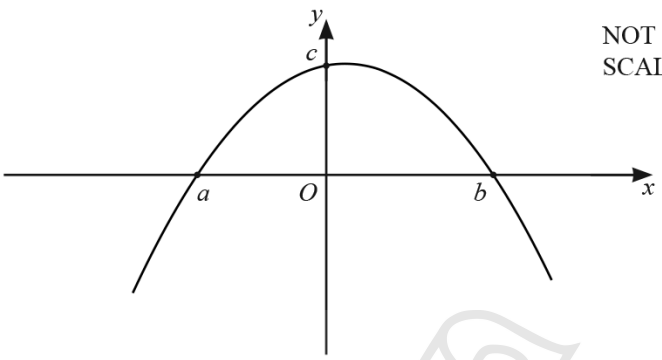
..... [2]

91. 0580_w20_qp_43 Q: 7

(a) (i) Factorise $24+5x-x^2$.

..... [2]

(ii) The diagram shows a sketch of $y=24+5x-x^2$.



NOT TO SCALE

Work out the values of a, b and c.

$a =$ .....

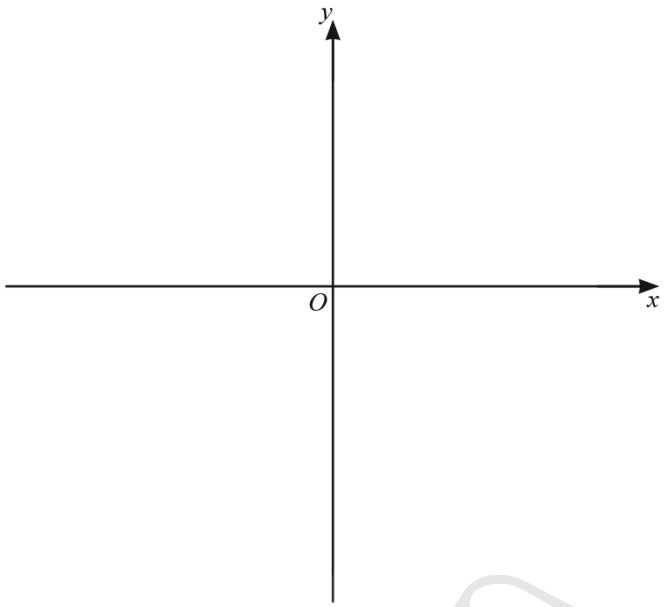
$b =$ .....

$c =$ ..... [3]

(iii) Calculate the gradient of $y=24+5x-x^2$ at $x=-1.5$.

..... [3]

(b) (i) On the diagram, sketch the graph of $y = (x+1)(x-3)^2$.
Label the values where the graph meets the x-axis and the y-axis.



[4]

(ii) Write $(x+1)(x-3)^2$ in the form ax^3+bx^2+cx+d.

..... [3]

92. 0580_w20_qp_43 Q: 9

(a) Find the integer values that satisfy the inequality $2 < 2x \leqslant 10$.

..... [2]

(b) Factorise completely.

(i) $6y^2 - 15xy$

..... [2]

(ii) $y^2 - 9x^2$

..... [2]

(c) Simplify.

$$\frac{3}{x-1} - \frac{2}{2x+1}$$

..... [3]

(d) The straight line $y = 3x + 2$ intersects the curve $y = 2x^2 + 7x - 11$ at two points.

Find the coordinates of these two points.
Give your answers correct to 2 decimal places.

(..... , ...)

(..... , ...) [6]

93. 0580_w20_qp_43 Q: 10

$f(x) = 4 - 3x$ $g(x) = x^2 + x$ $h(x) = 3^x$

(a) Find fh(2).

..... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) Simplify.

(i) $f(1 - 2x)$

..... [2]

(ii) $gf(x) - 9g(x)$

..... [4]

(d) $\frac{1}{h(x)} = 9^{kx}$

Find the value of k.

$k =$ ..... [2]

94. 0580_w20_qp_43 Q: 11

The table shows the first four terms in sequences A, B, and C.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	4	9	14	19			
B	3	10	29	66			
C	1	4	16	64			

Complete the table.

[9]

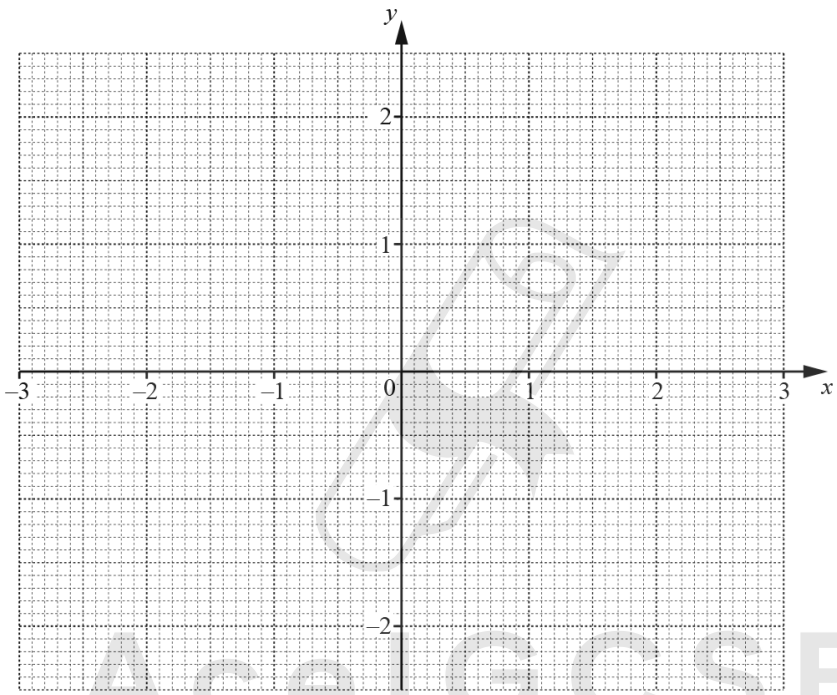
95. 0580_m19_qp_42 Q: 5

The table shows some values for $y = \frac{3}{10}x^3 - 2x$ for $-3 \leqslant x \leqslant 3$.

x	−3	−2	−1.5	−1	0	1	1.5	2	3
y			2.0	1.7	0		−2.0	−1.6	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = \frac{3}{10}x^3 - 2x$ for $-3 \leqslant x \leqslant 3$.



[4]

(c) On the grid opposite, draw a suitable straight line to solve the equation $\frac{3}{10}x^3 - 2x = \frac{1}{2}(1-x)$ for $-3 \leqslant x \leqslant 3$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [4]

(d) For $-3 \leqslant x \leqslant 3$, the equation $\frac{3}{10}x^3 - 2x = 1$ has n solutions.

Write down the value of n.

$n =$ ..... [1]

96. 0580_m19_qp_42 Q: 8

$f(x) = \frac{3}{x+2}, x \neq -2$ $g(x) = 8x - 5$ $h(x) = x^2 + 6$

(a) Work out $g\left(\frac{1}{4}\right)$.

..... [1]

(b) Work out $ff(2)$.

..... [2]

(c) Find $gg(x)$, giving your answer in its simplest form.

..... [2]

(d) Find $g^{-1}(x)$.

$g^{-1}(x) =$ ..... [2]

(e) Write $g(x) - f(x)$ as a single fraction in its simplest form.

..... [3]

(f) **(i)** Show that $\text{hg}(x) = 19$ simplifies to $16x^2 - 20x + 3 = 0$.

[3]

(ii) Use the quadratic formula to solve $16x^2 - 20x + 3 = 0$.
Show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [4]

97. 0580_m19_qp_42 Q: 10

(a) Solve the simultaneous equations.
You must show all your working.

$$6x + 5y = 27$$
$$5x - 3y = 44$$

$x =$ .....

$y =$ ..... [4]

(b) y is inversely proportional to $(x+3)^2$.
When $x = 2$, $y = 8$.

Find y when $x = 7$.

$y =$ ..... [3]

(c) Solve the inequality.

$$3(x-2) < 7(x+2)$$

..... [3]

98. 0580_m19_qp_42 Q: 11

(a) The table shows the first five terms of sequence A and sequence B.

Term	1	2	3	4	5	6
Sequence A	7	13	23	37	55	
Sequence B	1	3	9	27	81	

(i) Complete the table for the 6th term of each sequence. [2]

(ii) Find the nth term of

(a) sequence A,

..... [2]

(b) sequence B.

..... [2]

(b) The nth term of another sequence is $4n^2 + n + 3$.

Find

(i) the 2nd term,

..... [1]

(ii) the value of n when the nth term is 498.

$n =$ ..... [3]

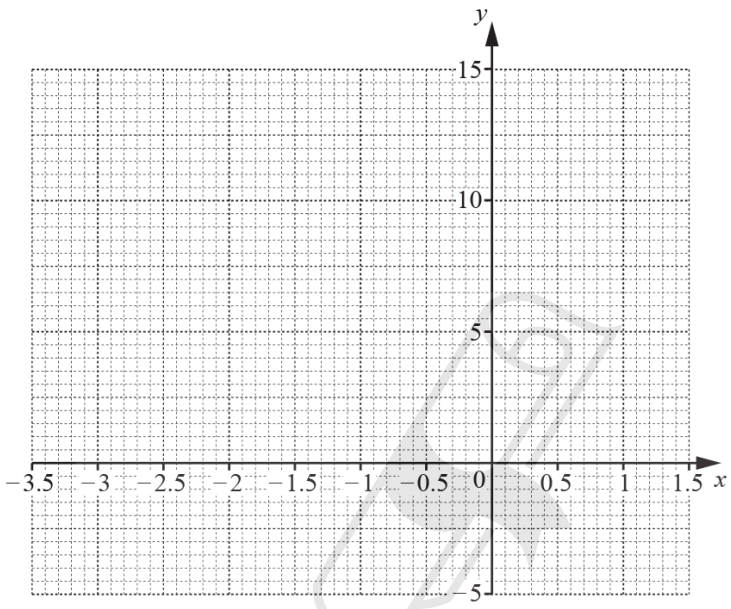
99. 0580_s19_qp_41 Q: 2

The table shows some values for $y = x^3 + 3x^2 + 2$.

x	−3.5	−3	−2.5	−2	−1.5	−1	−0.5	0	0.5	1	1.5
y	−4.1		5.1	6	5.4	4	2.6		2.9		12.1

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = x^3 + 3x^2 + 2$ for $-3.5 \leqslant x \leqslant 1.5$.



[4]

(c) Use your graph to solve the equation $x^3 + 3x^2 + 2 = 0$ for $-3.5 \leqslant x \leqslant 1.5$.

$x =$ ..... [1]

(d) By drawing a suitable straight line, solve the equation $x^3 + 3x^2 + 2x + 2 = 0$ for $-3.5 \leqslant x \leqslant 1.5$.

$x =$ ..... [2]

(e) For $-3.5 \leqslant x \leqslant 1.5$, the equation $x^3 + 3x^2 + 2 = k$ has three solutions and k is an integer.

Write down a possible value of k.

$k =$ ..... [1]

100. 0580_s19_qp_41 Q: 7

(a) $s = ut + \frac{1}{2}at^2$

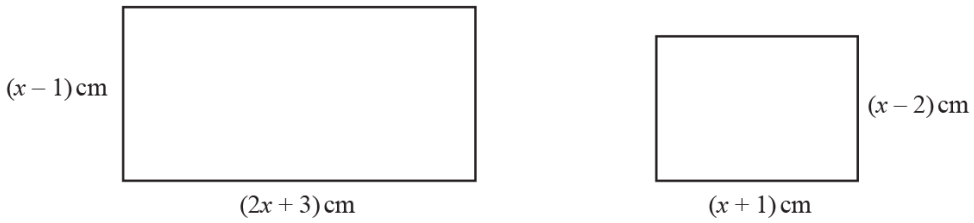
(i) Find s when $t = 26.5$, $u = 104.3$ and $a = -2.2$.
Give your answer in standard form, correct to 4 significant figures.

$s =$ ..... [4]

(ii) Rearrange the formula to write a in terms of u, t and s.

$a =$ ..... [3]

(b)



NOT TO SCALE

The difference between the areas of the two rectangles is $62\,\text{cm}^2$.

(i) Show that $x^2 + 2x - 63 = 0$.

[3]

(ii) Factorise $x^2 + 2x - 63$.

..... [2]

(iii) Solve the equation $x^2 + 2x - 63 = 0$ to find the difference between the perimeters of the two rectangles.

..... cm [2]

101. 0580_s19_qp_41 Q: 9

$f(x) = 7x - 2$ $g(x) = x^2 + 1$ $h(x) = 3^x$

(a) Find gh(2).

..... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) $gg(x) = ax^4 + bx^2 + c$

Find the values of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [3]

(d) Find x when $hf(x) = 81$.

$x =$ ..... [3]

102. 0580_s19_qp_42 Q: 5

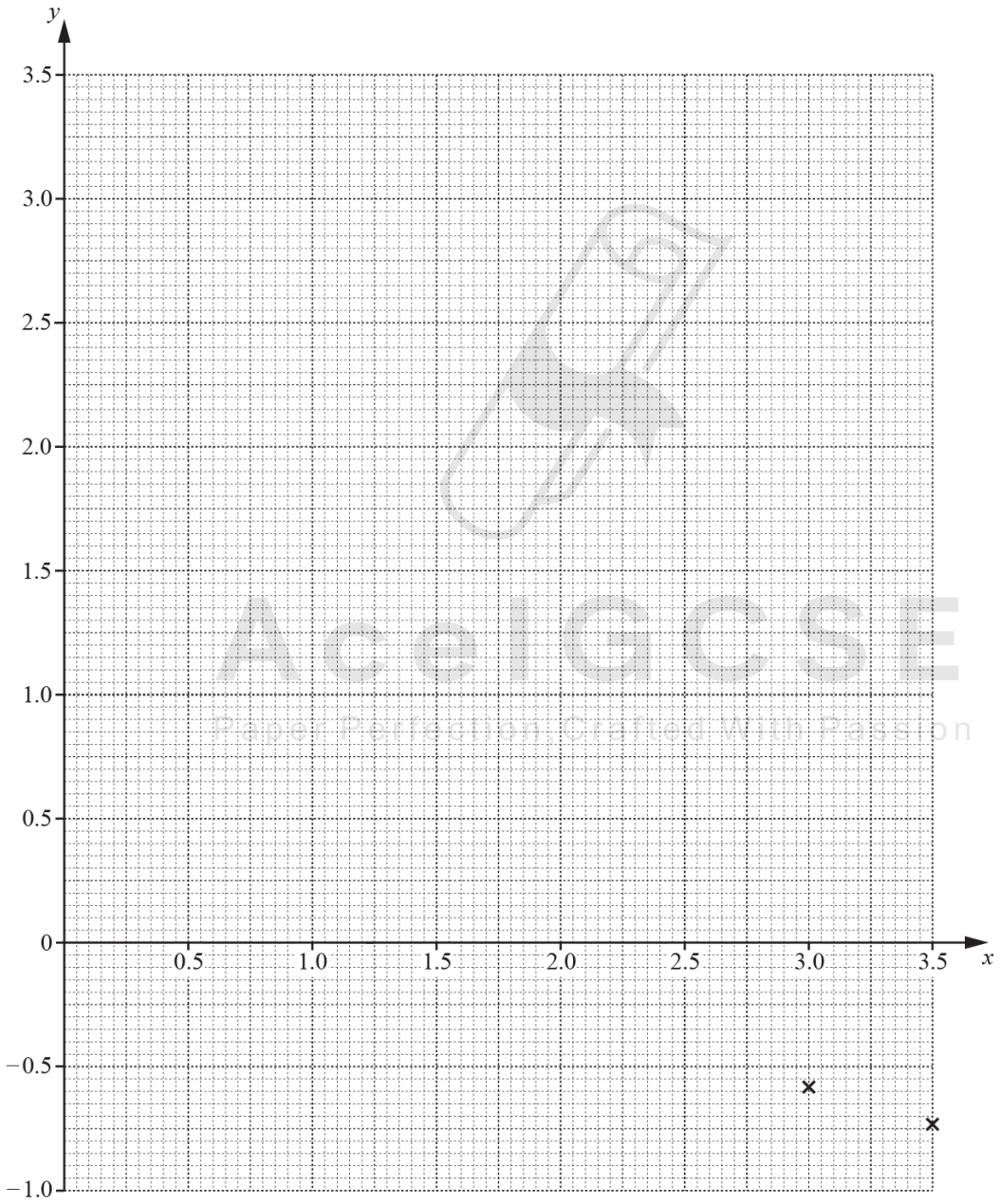
The table shows some values of $y = \frac{1}{2x} - \frac{x}{4}$ for $0.15 \leqslant x \leqslant 3.5$.

x	0.15	0.2	0.5	1	1.5	2	2.5	3	3.5
y	3.30		0.88		−0.04		−0.43	−0.58	−0.73

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = \frac{1}{2x} - \frac{x}{4}$ for $0.15 \leqslant x \leqslant 3.5$.

The last two points have been plotted for you.



[4]

(c) Use your graph to solve the equation $\frac{1}{2x} - \frac{x}{4} = \frac{1}{2}$ for $0.15 \leqslant x \leqslant 3.5$.

$x =$ ..... [1]

(d) **(i)** On the grid, draw the line $y = 2 - x$. [2]

(ii) Write down the x co-ordinates of the points where the line $y = 2 - x$ crosses the graph of $y = \frac{1}{2x} - \frac{x}{4}$ for $0.15 \leqslant x \leqslant 3.5$.

$x =$ ..... and $x =$ ..... [2]

(e) Show that the graph of $y = \frac{1}{2x} - \frac{x}{4}$ can be used to find the value of $\sqrt{2}$ for $0.15 \leqslant x \leqslant 3.5$.

[2]

103. 0580_s19_qp_42 Q: 6

(a) Expand and simplify.

$$(x+7)(x-3)$$

..... [2]

(b) Factorise completely.

(i) $15p^2q^2 - 25q^3$

..... [2]

(ii) $4fg + 6gh + 10fk + 15hk$

..... [2]

(iii) $81k^2 - m^2$

..... [2]

(c) Solve the equation.

$$3(x-4) + \frac{x+2}{5} = 6$$

$x =$ ..... [4]

104. 0580_s19_qp_42 Q: 11

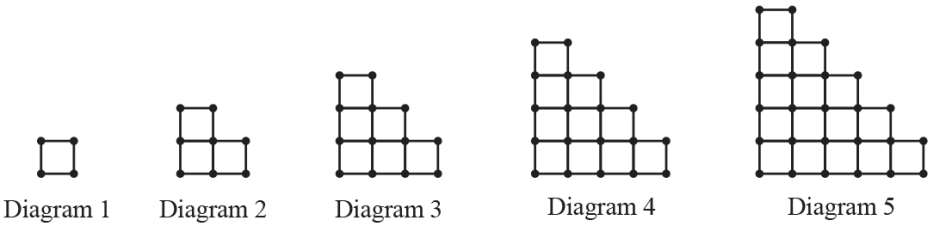


Diagram 1 Diagram 2 Diagram 3 Diagram 4 Diagram 5

The sequence of diagrams above is made up of small lines and dots.

(a) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of small lines	4	10	18	28		
Number of dots	4	8	13	19		

[4]

(b) For Diagram n find an expression, in terms of n, for the number of small lines.

..... [2]

(c) Diagram r has 10 300 small lines.

Find the value of r.

$r =$ ..... [2]

(d) The number of dots in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [2]

105. 0580_s19_qp_43 Q: 2

(a) Solve.

$$5x - 17 = 7x + 3$$

$x =$ ..... [2]

(b) Find the integer values of n that satisfy this inequality.

$$-7 < 4n \leqslant 8$$

..... [3]

(c) Simplify.

(i) $a^3 \times a^6$

..... [1]

(ii) $(5xy^2)^3$

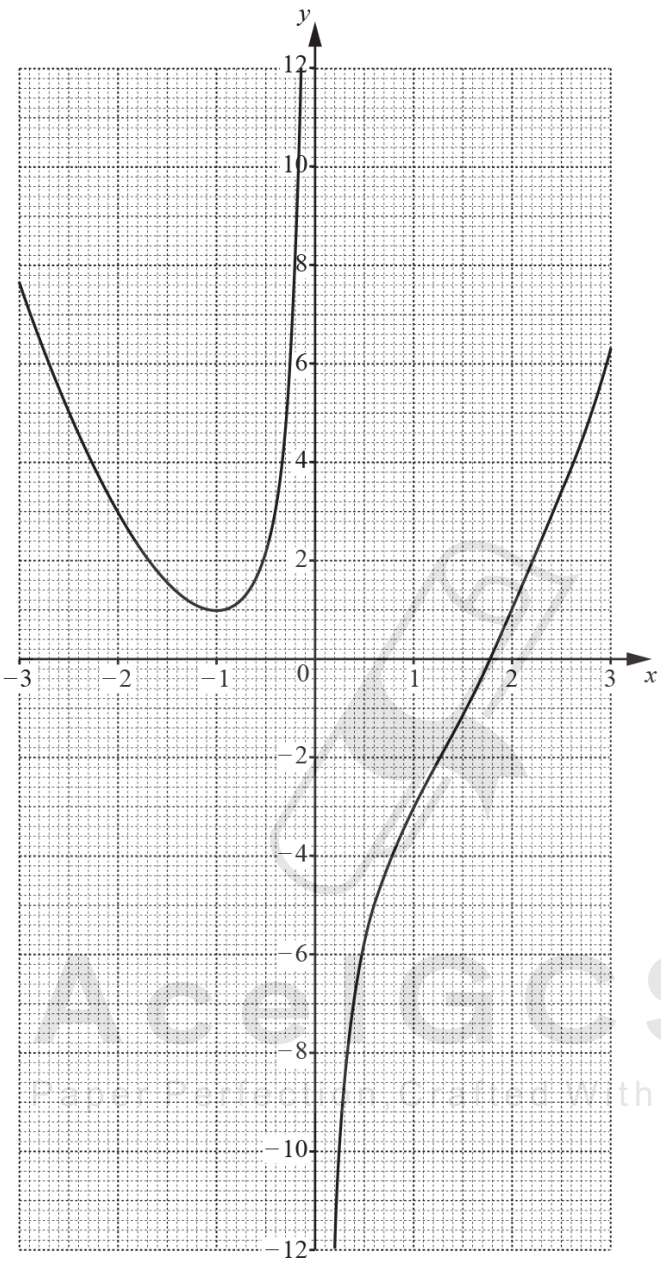
..... [2]

(iii) $\left(\frac{27x^{12}}{64y^3}\right)^{-\frac{1}{3}}$

..... [3]

106. 0580_s19_qp_43 Q: 5

The diagram shows the graph of $y = f(x)$ where $f(x) = x^2 - \frac{2}{x} - 2, x \neq 0$.



(a) Use the graph to find

(i) f(1),

..... [1]

(ii) ff(−2).

..... [2]

(b) On the grid opposite, draw a suitable straight line to solve the equation

$x^2 - \frac{2}{x} - 7 = -3x$ for $-3 \leqslant x \leqslant 3$.

$x =$ ..... or $x =$ ..... [4]

(c) By drawing a suitable tangent, find an estimate of the gradient of the curve at $x = -2$.

..... [3]

(d) **(i)** Complete the table for $y = g(x)$ where $g(x) = 2^{-x}$ for $-3 \leqslant x \leqslant 3$.

x	−3	−2	−1	0	1	2	3
y		2		1	0.5		0.125

[3]

(ii) On the grid opposite, draw the graph of $y = g(x)$. [3]

(iii) Use your graph to find the **positive** solution to the equation $f(x) = g(x)$.

$x =$ ..... [1]

107. 0580_s19_qp_43 Q: 10

(a) 19, 15, 11, 7, ...

(i) Write down the next two terms of the sequence.

..... , ... [2]

(ii) Find the nth term of this sequence.

..... [2]

(iii) Find the value of n when the nth term is -65.

$n =$ ..... [2]

(b) Another sequence has nth term $2n^2 + 5n - 15$.

Find the difference between the 4th term and the 5th term of this sequence.

..... [2]

108. 0580_w19_qp_41 Q: 7

(a) Oranges cost 21 cents each.
Alex buys x oranges and Bobbie buys $(x+2)$ oranges.
The total cost of these oranges is \$4.20 .

Find the value of x.

$x =$ ..... [3]

(b) The cost of one ruler is r cents.
The cost of one protractor is p cents.

The total cost of 5 rulers and 1 protractor is 245 cents.
The total cost of 2 rulers and 3 protractors is 215 cents.

Write down two equations in terms of r and p and solve these equations to find the cost of one protractor.

..... cents [5]

(c) Carol walks 12 km at x km/h and then a further 6 km at $(x-1)$ km/h.
The total time taken is 5 hours.

(i) Write an equation, in terms of x, and show that it simplifies to $5x^2 - 23x + 12 = 0$.

[3]

(ii) Factorise $5x^2 - 23x + 12$.

..... [2]

(iii) Solve the equation $5x^2 - 23x + 12 = 0$.

$x =$ ..... or $x =$ ..... [1]

(iv) Write down Carol's walking speed during the final 6 km.

..... km/h [1]

109. 0580_w19_qp_41 Q: 9

A car hire company has x small cars and y large cars.
The company has at least 6 cars in total.
The number of large cars is less than or equal to the number of small cars.
The largest number of small cars is 8.

(a) Write down three inequalities, in terms of x and/or y, to show this information.

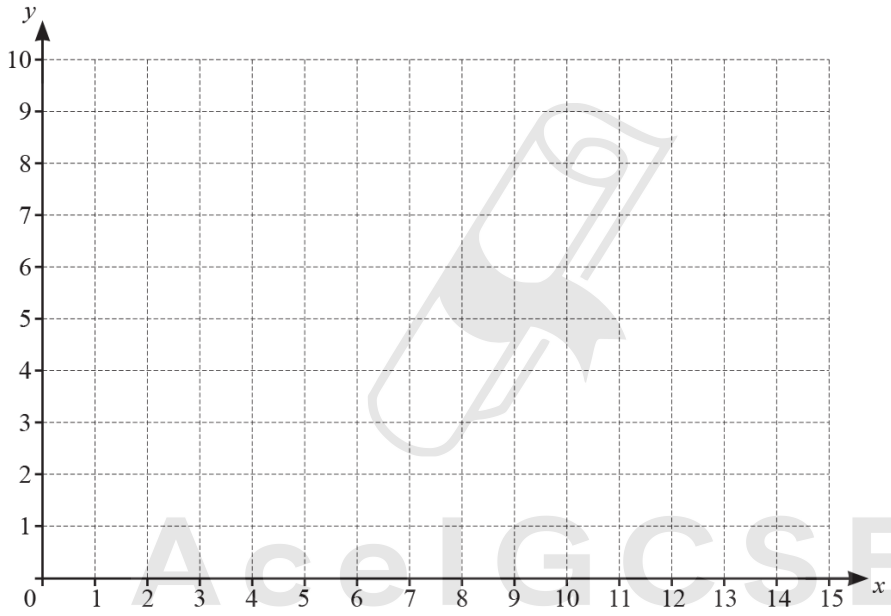
..... , ... , ... [3]

(b) A small car can carry 4 people and a large car can carry 6 people.
One day, the largest number of people to be carried is 60.

Show that $2x + 3y \leqslant 30$.

[1]

(c)



By shading the **unwanted** regions on the grid, show and label the region R that satisfies all four inequalities. [6]

(d) **(i)** Find the number of small cars and the number of large cars needed to carry exactly 60 people.

..... small cars, ... large cars [1]

(ii) When the company uses 7 cars, find the largest number of people that can be carried.

..... [2]

110. 0580_w19_qp_41 Q: 10

(a) Complete the table for the 5th term and the nth term of each sequence.

1st term	2nd term	3rd term	4th term	5th term		nth term
9	5	1	−3			
4	9	16	25			
1	8	27	64			
8	16	32	64			

[11]

(b) 0, 1, 1, 2, 3, 5, 8, 13, 21, …

This sequence is a Fibonacci sequence.
After the first two terms, the rule to find the next term is "add the two previous terms".
For example, $5 + 8 = 13$.

Use this rule to complete each of the following Fibonacci sequences.

2 4 ....

1 11

..... −1 1

[3]

(c) $\frac{1}{3}$, $\frac{3}{4}$, $\frac{4}{7}$, $\frac{7}{11}$, $\frac{11}{18}$, …

(i) One term of this sequence is $\frac{p}{q}$.

Find, in terms of p and q, the next term in this sequence.

..... [1]

(ii) Find the 6th term of this sequence.

..... [1]

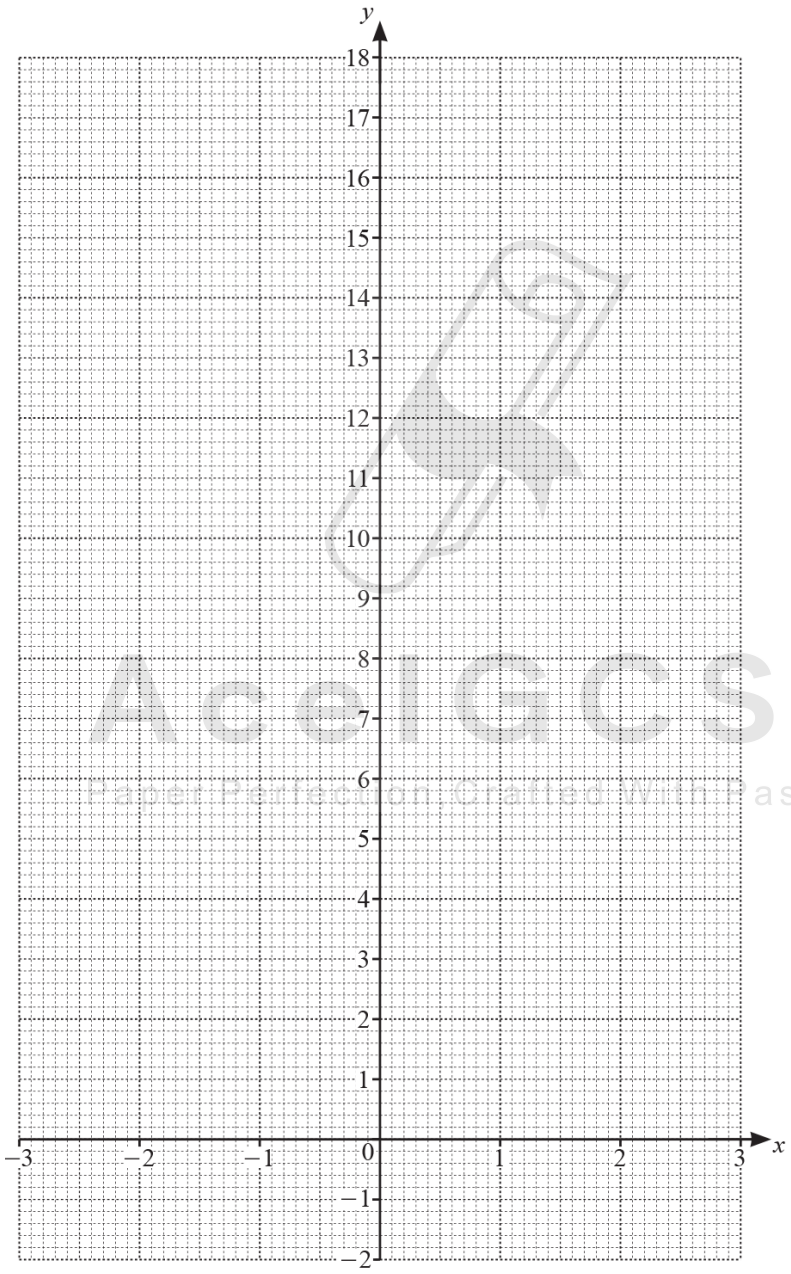
111. 0580_w19_qp_42 Q: 5

The table shows some values of $y = \frac{x^2}{2} + \frac{1}{x^2} - \frac{2}{x}$, $x \neq 0$.

x	−3	−2	−1	−0.5	−0.3		0.2	0.3	0.5	1	2	3
y	5.3	3.3		8.1	17.8			4.5	0.1	−0.5	1.3	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = \frac{x^2}{2} + \frac{1}{x^2} - \frac{2}{x}$ for $-3 \leqslant x \leqslant -0.3$ and $0.2 \leqslant x \leqslant 3$.



[5]

(c) Use your graph to solve $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}\leqslant 0$.

..... $\leqslant x \leqslant$ ..... [2]

(d) Find the smallest positive integer value of k for which $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=k$ has two solutions for $-3\leqslant x\leqslant -0.3$ and $0.2\leqslant x\leqslant 3$.

..... [1]

(e) **(i)** By drawing a suitable straight line, solve $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=3x+1$ for $-3\leqslant x\leqslant -0.3$ and $0.2\leqslant x\leqslant 3$.

$x =$ ..... [3]

(ii) The equation $\frac{x^2}{2}+\frac{1}{x^2}-\frac{2}{x}=3x+1$ can be written as $x^4+ax^3+bx^2+cx+2=0$.

Find the values of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [3]

112. 0580_w19_qp_42 Q: 7

$f(x) = 7 - 2x$ $g(x) = \frac{10}{x}$, $x \neq 0$ $h(x) = 27^x$

(a) Find

(i) $f(-3)$,

..... [1]

(ii) $hg(30)$,

..... [2]

(iii) $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(b) Solve.

$g(2x+1) = 4$

$x =$ ..... [3]

(c) Simplify, giving your answer as a single fraction.

$$\frac{1}{\mathrm{f}(x)} + \mathrm{g}(x)$$

..... [3]

(d) Find $\mathrm{h}^{-1}(19\,683)$.

..... [1]

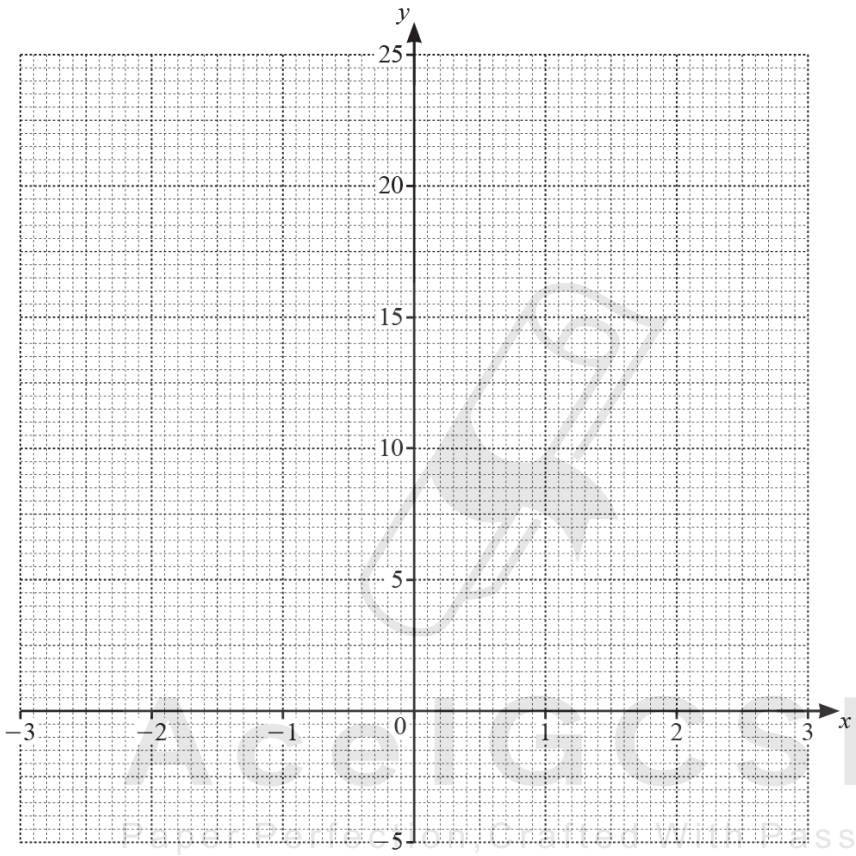
113. 0580_w19_qp_43 Q: 3

The table shows some values for $y = x^3 + x^2 - 5x$.

x	−3	−2	−1.5	−1	0	1	1.5	2	2.5	3
y	−3	6	6.4		0		−1.9	2	9.4	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = x^3 + x^2 - 5x$ for $-3 \leqslant x \leqslant 3$.



[4]

(c) Use your graph to solve the equation $x^3 + x^2 - 5x = 0$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [2]

(d) By drawing a suitable tangent, find an estimate of the gradient of the curve at $x = 2$.

..... [3]

(e) Write down the largest value of the integer, k, so that the equation $x^3 + x^2 - 5x = k$ has three solutions for $-3 \leqslant x \leqslant 3$.

$k =$ ..... [1]

114. 0580_w19_qp_43 Q: 9

$f(x) = 2x - 3$ $g(x) = 9 - x^2$ $h(x) = 3^x$

(a) Find

(i) f(4),

..... [1]

(ii) hg(3),

..... [2]

(iii) g(2x) in its simplest form,

..... [1]

(iv) fg(x) in its simplest form.

..... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(c) Find x when $5f(x) = 3$.

$x =$ ..... [2]

(d) Solve the equation $\mathrm{gf}(x) = -16$.

$x =$ ..... or $x =$ ..... [4]

(e) Find x when $\mathrm{h}^{-1}(x) = -2$.

$x =$ ..... [1]

115. 0580_w19_qp_43 Q: 10

Solve.

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

Show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [7]

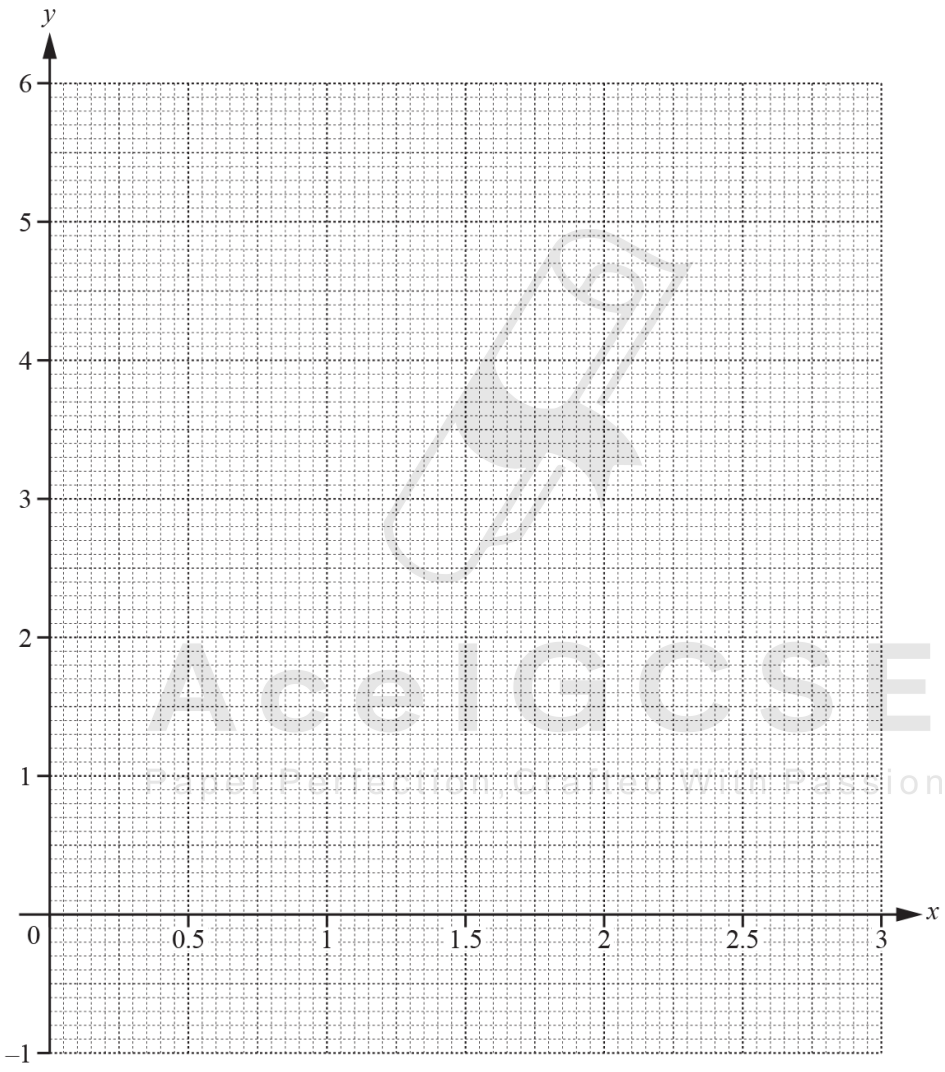
116. 0580_m18_qp_42 Q: 3

The table shows some values for $y = 2x + \frac{1}{x} - 3$ for $0.125 \leqslant x \leqslant 3$.

x	0.125	0.25	0.375	0.5	0.75	1	1.5	2	2.5	3
y	5.25	1.5	0.42			0	0.67	1.5		3.33

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 2x + \frac{1}{x} - 3$ for $0.125 \leqslant x \leqslant 3$.



[4]

(c) Use your graph to solve $2x + \frac{1}{x} - 3 \geqslant 2$.

.....

..... [3]

(d) The equation $\frac{1}{x} = 7 - 3x$ can be solved using your graph in **part (b)** and a straight line.

(i) Write down the equation of this straight line.

..... [2]

(ii) Draw this straight line and solve the equation $\frac{1}{x} = 7 - 3x$.

$x =$ ..... or $x =$ ..... [3]

117. 0580_m18_qp_42 Q: 4

(a) Make t the subject of the formula $s = k - t^2$.

$t =$ ..... [2]

(b) **(i)** Factorise $x^2 - 25$.

..... [1]

(ii) Simplify $\dfrac{x^2 - 25}{x^2 - 2x - 35}$.

..... [3]

(c) Write as a single fraction in its simplest form.

$$\frac{x-8}{x} + \frac{3x}{x+1}$$

..... [3]

(d) Find the **integer** values of n that satisfy the inequality.

$$18 - 2n < 6n \leqslant 30 + n$$

..... [3]

118. 0580_m18_qp_42 Q: 6

Klaus buys x silver balloons and y gold balloons for a party.

He buys

- more gold balloons than silver balloons
- at least 15 silver balloons
- less than 50 gold balloons
- a total of no more than 70 balloons.

(a) Write down four inequalities, in terms of x and/or y, to show this information.

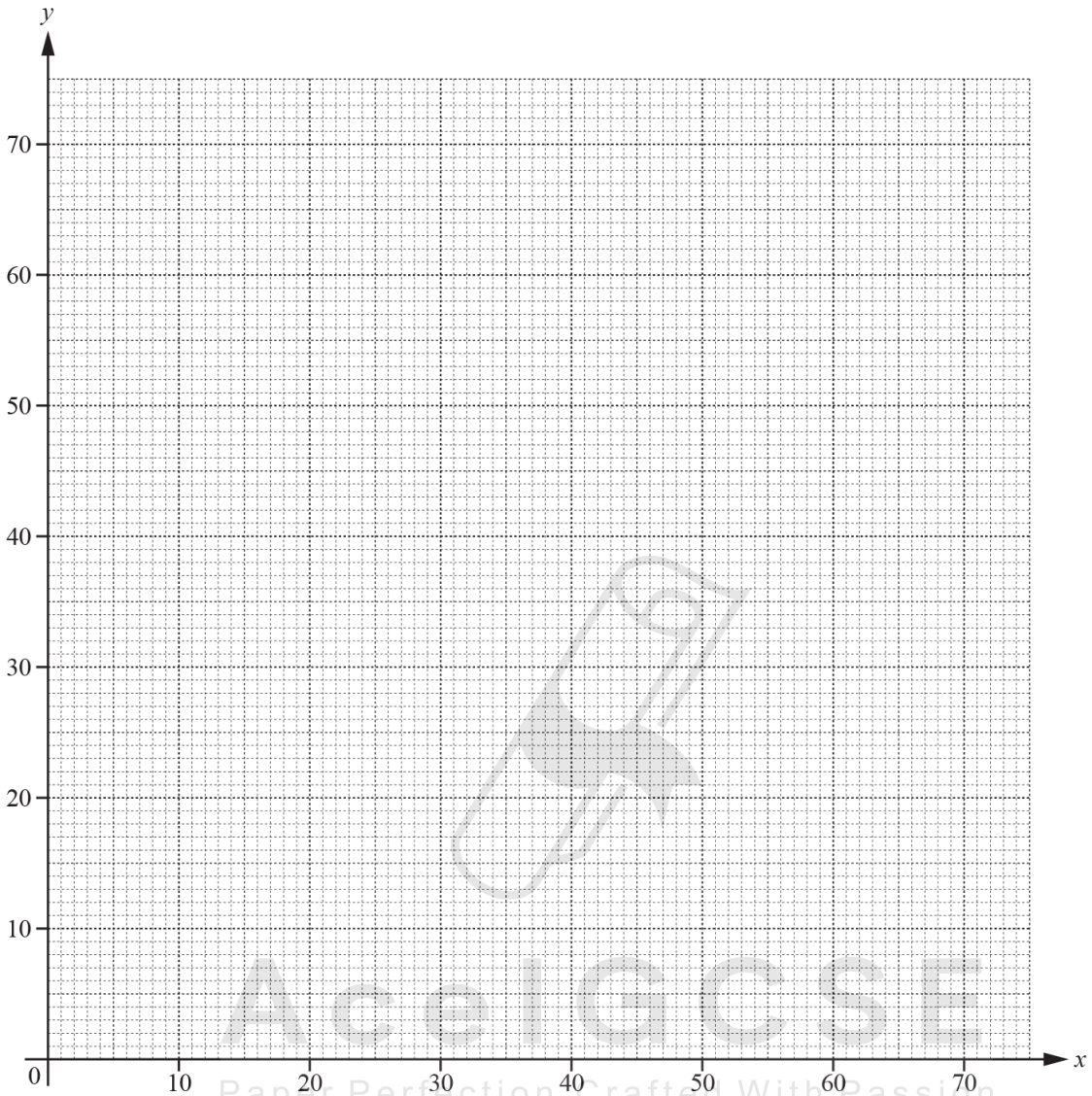
.....

.....

.....

..... [4]

(b) On the grid, show the information from **part (a)** by drawing four straight lines and shading the unwanted regions.



[5]

(c) Silver balloons cost \$2 and gold balloons cost \$3.

Calculate the most that Klaus could spend.

\$ ..... [2]

119. 0580_m18_qp_42 Q: 11
The table shows the first five terms of sequences A, B and C.

Sequence	1st term	2nd term	3rd term	4th term	5th term	6th term
A	0	1	4	9	16	
B	4	5	6	7	8	
C	−4	−4	−2	2	8	

(a) Complete the table. [3]

(b) Find an expression for the nth term of

(i) sequence A,

..... [2]

(ii) sequence B.

..... [1]

(c) Find the value of n when the nth term of sequence A is 576.

$n =$ ..... [2]

(d) **(i)** Find an expression for the nth term of sequence C.
Give your answer in its simplest form.

..... [3]

(ii) Find the value of the 30th term of sequence C.

..... [2]

120. 0580_s18_qp_41 Q: 5

(a) Factorise.

(i) $2mn + m^2 - 6n - 3m$

..... [2]

(ii) $4y^2 - 81$

..... [1]

(iii) $t^2 - 6t + 8$

..... [2]

(b) Rearrange the formula to make x the subject.

$$k = \frac{2m - x}{x}$$

$x =$ ..... [4]

(c) Solve the simultaneous equations.
You must show all your working.

$$\frac{1}{2}x - 3y = 9$$
$$5x + y = 28$$

$x =$ .....

$y =$ ..... [3]

(d) $\dfrac{3}{m+4} - \dfrac{4}{m} = 6$

(i) Show that this equation can be written as $6m^2 + 25m + 16 = 0$.

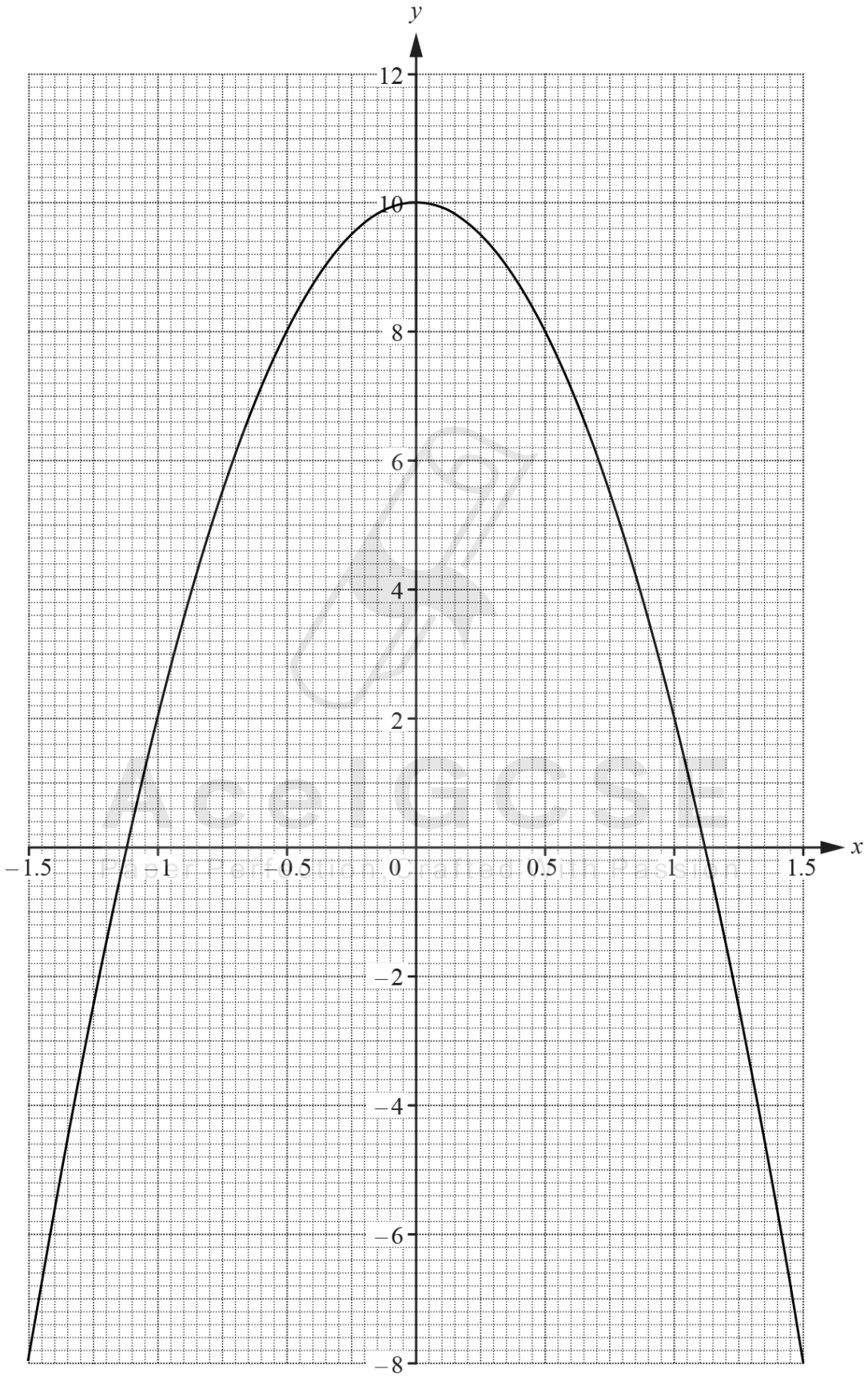
[3]

(ii) Solve the equation $6m^2 + 25m + 16 = 0$.
Show all your working and give your answers correct to 2 decimal places.

$m =$ ..... or $m =$ ..... [4]

121. 0580_s18_qp_41 Q: 7

The graph of $y = 10 - 8x^2$ for $-1.5 \leqslant x \leqslant 1.5$ is drawn on the grid.



(a) Write down the equation of the line of symmetry of the graph.

..... [1]

(b) On the grid opposite, draw the tangent to the curve at the point where $x = 0.5$.
Find the gradient of this tangent.

..... [3]

(c) The table shows some values for $y = x^3 + 3x + 4$.

x	-1.5	-1	-0.5	0	0.5	1	1.5
y	-3.9				5.6	8	11.9

(i) Complete the table. [3]

(ii) On the grid opposite, draw the graph of $y = x^3 + 3x + 4$ for $-1.5 \leqslant x \leqslant 1.5$. [4]

(d) Show that the values of x where the two curves intersect are the solutions to the equation $x^3 + 8x^2 + 3x - 6 = 0$.

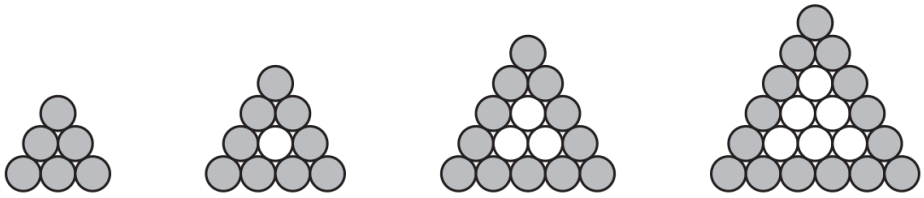
[1]

(e) By drawing a suitable straight line, solve the equation $x^3 + 5x + 2 = 0$ for $-1.5 \leqslant x \leqslant 1.5$.

$x =$ ..... [3]

122. 0580_s18_qp_41 Q: 12

Marco is making patterns with grey and white circular mats.



Pattern 1 Pattern 2 Pattern 3 Pattern 4

The patterns form a sequence.
Marco makes a table to show some information about the patterns.

Pattern number	1	2	3	4	5
Number of grey mats	6	9	12	15	
Total number of mats	6	10	15	21	

(a) Complete the table for Pattern 5. [2]

(b) Find an expression, in terms of n, for the number of grey mats in Pattern n.

..... [2]

(c) Marco makes a pattern with 24 grey mats.

Find the total number of mats in this pattern.

..... [2]

(d) Marco needs a total of 6 mats to make the first pattern.
He needs a total of 16 mats to make the first two patterns.
He needs a total of $\frac{1}{6}n^3 + an^2 + bn$ mats to make the first n patterns.

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [6]

123. 0580_s18_qp_42 Q: 4

(a) Simplify.

(i) $(3p^2)^5$

..... [2]

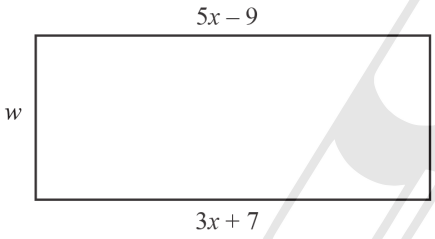
(ii) $18x^2y^6 \div 2xy^2$

..... [2]

(iii) $\left(\frac{5}{m}\right)^{-2}$

..... [1]

(b) In this part, all measurements are in metres.



NOT TO SCALE

The diagram shows a rectangle.
The area of the rectangle is $310\,m^2$.

Work out the value of w.

$w =$ ..... [4]

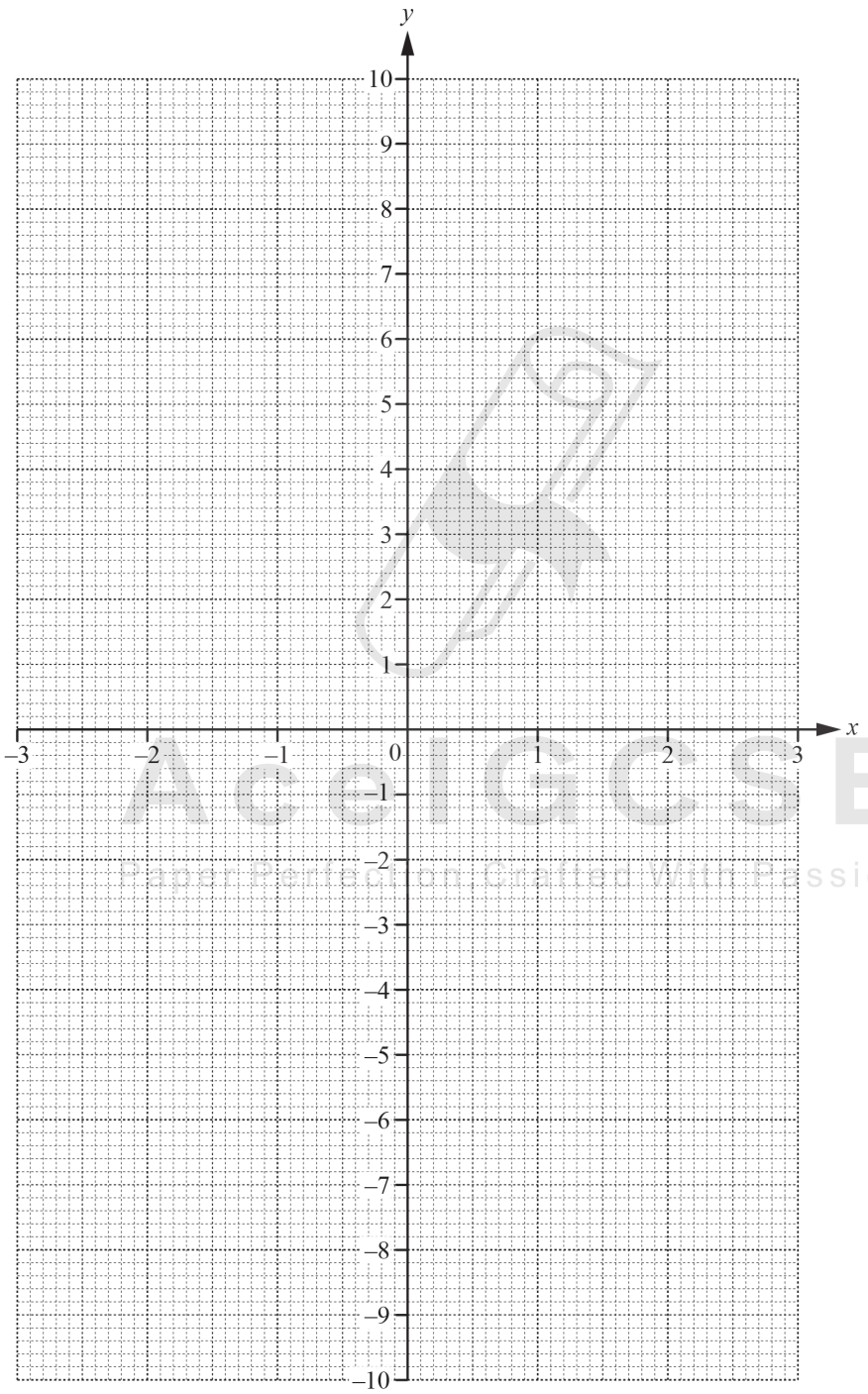
124. 0580_s18_qp_42 Q: 6

(a) Complete the table of values for $y = \frac{x^3}{3} - \frac{1}{2x^2}$, $x \neq 0$.

x	-3	-2	-1	-0.5	-0.3		0.3	0.5	1	2	3
y	-9.1	-2.8	-0.8		-5.6		-5.5	-2.0			8.9

[3]

(b) On the grid, draw the graph of $y = \frac{x^3}{3} - \frac{1}{2x^2}$ for $-3 \leqslant x \leqslant -0.3$ and $0.3 \leqslant x \leqslant 3$.



[5]

(c) **(i)** By drawing a suitable tangent, find an estimate of the gradient of the curve at $x = -2$.

..... [3]

(ii) Write down the equation of the tangent to the curve at $x = -2$.
Give your answer in the form $y = mx + c$.

$y =$ ..... [2]

(d) Use your graph to solve the equations.

(i) $\frac{x^3}{3} - \frac{1}{2x^2} = 0$

$x =$ ..... [1]

(ii) $\frac{x^3}{3} - \frac{1}{2x^2} + 4 = 0$

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(e) The equation $\frac{x^3}{3} - \frac{1}{2x^2} + 4 = 0$ can be written in the form $ax^n + bx^{n-3} - 3 = 0$.

Find the value of a, the value of b and the value of n.

$a =$ .....

$b =$ .....

$n =$ ..... [3]

125. 0580_s18_qp_42 Q: 8

$f(x) = 8-3x$ $\quad g(x) = \frac{10}{x+1}, x \neq -1$ $\quad h(x) = 2^x$

(a) Find

(i) $hf\left(\frac{8}{3}\right)$,

..... [2]

(ii) $gh(-2)$,

..... [2]

(iii) $g^{-1}(x)$,

$g^{-1}(x) =$ ..... [3]

(iv) $f^{-1}f(5)$.

..... [1]

(b) Write $f(x) + g(x)$ as a single fraction in its simplest form.

..... [3]

126. 0580_s18_qp_43 Q: 5

(a) At a football match, the price of an adult ticket is $\$x$ and the price of a child ticket is $\$(x-2.50)$.
There are 18 500 adults and 2400 children attending the football match.
The total amount paid for the tickets is \$320 040.

Find the price of an adult ticket.

\$..... [4]

(b) **(i)** Factorise $y^2+5y-84$.

..... [2]

(ii)

NOT TO SCALE

The area of the rectangle is $84\,cm^2$.

Find the perimeter.

..... cm [3]

(c) In a shop, the price of a monthly magazine is $\$m$ and the price of a weekly magazine is $\$(m-0.75)$.
One day, the shop receives

- \$168 from selling monthly magazines
- \$207 from selling weekly magazines.

The total number of these magazines sold during this day is 100.

(i) Show that $50m^2 - 225m + 63 = 0$.

[3]

(ii) Find the price of a monthly magazine.
Show all your working.

\$ ..... [3]

127. 0580_s18_qp_43 Q: 10

(a) $f(x) = 2x - 3$ $g(x) = x^2 + 1$

(i) Find gg(2).

..... [2]

(ii) Find $g(x+2)$, giving your answer in its simplest form.

..... [2]

(iii) Find x when $f(x) = 7$.

$x =$ ..... [2]

(iv) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(b) $h(x) = x^x$, $x > 0$

(i) Calculate h(0.3).
Give your answer correct to 2 decimal places.

..... [2]

(ii) Find x when $h(x) = 256$.

$x =$ ..... [1]

128. 0580_w18_qp_41 Q: 9

Paulo and Jim each buy sacks of rice but from different shops.
Paulo pays \$72 for sacks costing \$$m$ each.
Jim pays \$72 for sacks costing \$(m + 0.9) each.

(a) (i) Find an expression, in terms of m, for the number of sacks Paulo buys.

..... [1]

(ii) Find an expression, in terms of m, for the number of sacks Jim buys.

..... [1]

(b) Paulo buys 4 more sacks than Jim.

Write down an equation, in terms of m, and show that it simplifies to $10m^2 + 9m - 162 = 0$.

[4]

(c) (i) Solve $10m^2 + 9m - 162 = 0$.

m = ... or m = ... [3]

(ii) Find the number of sacks of rice that Paulo buys.

..... [1]

129. 0580_w18_qp_41 Q: 11

(a) Factorise $5m^2 - 20p^4$.

..... [3]

(b) Make P the subject of the formula $A = P + \frac{PRT}{100}$.

$P =$ ..... [3]

130. 0580_w18_qp_42 Q: 2

(a) Solve $30 + 2x = 3(3 - 4x)$.

$x =$ ..... [3]

(b) Factorise $12ab^3 + 18a^3b^2$.

..... [2]

(c) Simplify.

(i) $5a^3c^2 \times 2a^2c^7$

..... [2]

(ii) $\left(\frac{16a^8}{c^{12}}\right)^{\frac{3}{4}}$

..... [2]

(d) y is inversely proportional to the square of $(x + 2)$.
When $x = 3$, $y = 2$.

Find y when $x = 8$.

$y =$ ..... [3]

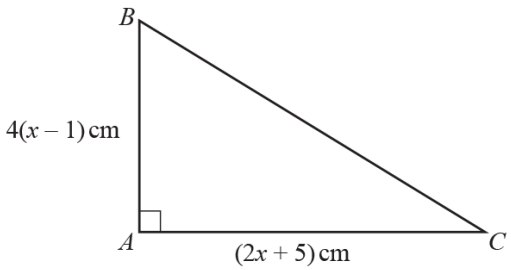
(e) Write as a single fraction in its simplest form.

$$\frac{5}{x-2} - \frac{x-5}{2}$$

..... [3]

131. 0580_w18_qp_42 Q: 4

The diagram shows a right-angled triangle ABC.



NOT TO SCALE

The area of this triangle is $30\,cm^2$.

(a) Show that $2x^2 + 3x - 20 = 0$.

[3]

(b) Use factorisation to solve the equation $2x^2 + 3x - 20 = 0$.

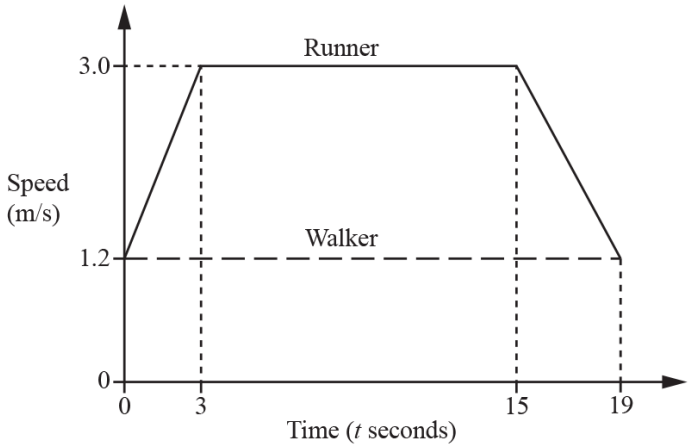
$x =$ ..... or $x =$ ..... [3]

(c) Calculate BC.

$BC =$ ..... cm [3]

132. 0580_w18_qp_42 Q: 6

The diagram shows the speed–time graph for part of a journey for two people, a runner and a walker.



NOT TO SCALE

(a) Calculate the acceleration of the runner for the first 3 seconds.

..... m/s^2 [1]

(b) Calculate the total distance travelled by the runner in the 19 seconds.

..... m [3]

(c) The runner and the walker are travelling in the same direction along the same path.
When $t = 0$, the runner is 10 metres behind the walker.

Find how far the runner is ahead of the walker when $t = 19$.

..... m [3]

133. 0580_w18_qp_43 Q: 4

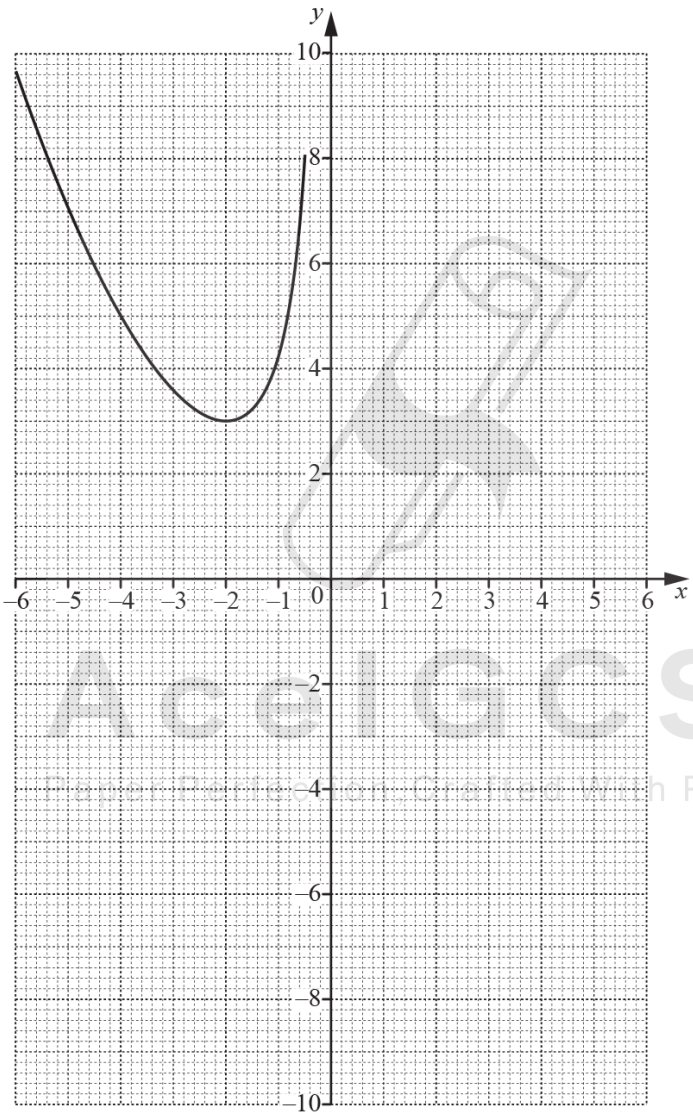
$f(x) = \frac{x^2}{4} - \frac{4}{x}$, $x \neq 0$

(a) Complete the table for $f(x)$.

x	0.5	1	2	3	4	5	6
$f(x)$	–7.9	–3.8		0.9		5.5	8.3

[2]

(b) The graph of $y = f(x)$ for $-6 \leqslant x \leqslant -0.5$ is drawn on the grid.



On the same grid, draw the graph of $y = f(x)$ for $0.5 \leqslant x \leqslant 6$. [3]

(c) By drawing a suitable tangent, estimate the gradient of the graph of $y = f(x)$ at the point $(-4, 5)$.

..... [3]

(d) $g(x) = \frac{9}{x}$, $x \neq 0$

Complete the table for $g(x)$.

x	–4	–3	–2	–1		1	2	3	4
$g(x)$	–2.3		–4.5	–9		9	4.5		2.3

[1]

(e) On the same grid, draw the graph of $y = g(x)$ for $-4 \leqslant x \leqslant -1$ and $1 \leqslant x \leqslant 4$. [4]

(f) **(i)** Use your graphs to find the value of x when $f(x) = g(x)$.

$x =$ ..... [1]

(ii) Write down an inequality to show the **positive** values of x for which $f(x) > g(x)$.

..... [1]

(g) The exact answer to **part (f)(i)** is $\sqrt[3]{k}$.

Use algebra to find the value of k.

$k =$ ..... [2]

134. 0580_w18_qp_43 Q: 9

$f(x) = 3x + 4$ $g(x) = 2x - 1$ $h(x) = 3^x$

(a) Find $g\left(\frac{1}{2}\right)$.

..... [1]

(b) Find $fh(-1)$.

..... [2]

(c) Find $g^{-1}(x)$.

$g^{-1}(x) =$ ..... [2]

(d) Find $ff(x)$ in its simplest form.

..... [2]

(e) Find $(f(x))^2$ in the form $ax^2 + bx + c$.

..... [2]

(f) Find x when $h^{-1}(x) = g(2)$.

$x =$ ..... [2]

135. 0580_w18_qp_43 Q: 10

(a) Find the next term and the nth term of this sequence.

$$\frac{3}{5}, \quad \frac{4}{7}, \quad \frac{5}{9}, \quad \frac{6}{11}, \quad \frac{7}{13}, \quad \ldots$$

Next term = ...

nth term = ... [3]

(b) Find the nth term of each sequence.

(i) –1, –3, –5, –7, –9, …

..... [2]

(ii) 2, 9, 28, 65, 126, …

..... [2]

136. 0580_m17_qp_42 Q: 5

(a) **(i)** Factorise $3x^2 + 11x - 4$.

..... [2]

(ii) Solve the equation $3x^2 + 11x - 4 = 0$.

$x =$ ..... or $x =$ .....[1]

(b) **(i)** Show that $\frac{2}{2x+11} - \frac{1}{x-4} = \frac{1}{2}$ simplifies to $2x^2 + 3x - 6 = 0$.

[4]

(ii) Solve the equation $2x^2 + 3x - 6 = 0$.
You must show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ .....[4]

137. 0580_m17_qp_42 Q: 9

Bernie buys x packets of seeds and y plants for his garden.
He wants to buy more packets of seeds than plants.
The inequality $x > y$ shows this information.

He also wants to buy
- less than 10 packets of seeds
- at least 2 plants.

(a) Write down two more inequalities in x or y to show this information.

.....

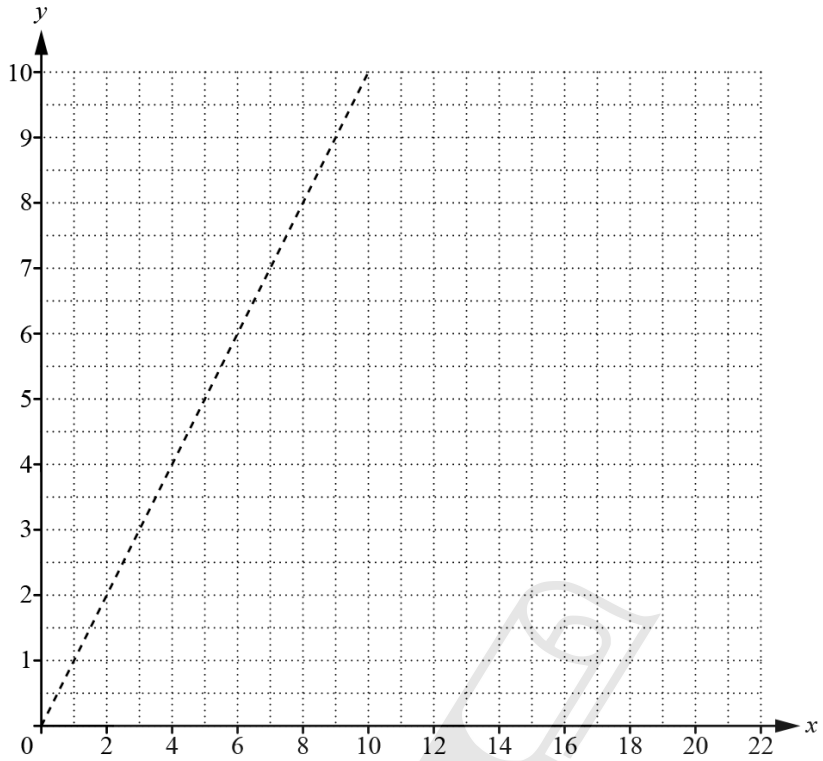
..... [2]

(b) Each packet of seeds costs \$1 and each plant costs \$3.
The maximum amount Bernie can spend is \$21.

Write down another inequality in x and y to show this information.

..... [1]

(c) The line $x = y$ is drawn on the grid.
Draw three more lines to show your inequalities and shade the **unwanted** regions.



[5]

(d) Bernie buys 8 packets of seeds.

(i) Find the maximum number of plants he can buy.

..... [1]

(ii) Find the total cost of these packets of seeds and plants.

$..... [1]

138. 0580_m17_qp_42 Q: 11

On Monday, Ankuri sent this text message to two friends.

> Today is Day Number 1.
> Tomorrow, please add 1 to the Day Number and send this text message to two friends.

All the friends who receive a text message follow the instructions.

(a) Complete the table.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Day Number	1	2	3				
Number of text messages sent today	2	4					

[4]

(b) Write down an expression for the number of text messages sent on Day Number n.

..... [1]

(c) Ankuri thinks that, by the end of Day Number 3, the **total** number of text messages that have been sent is $2^4 - 2$.

(i) Show that she is correct.

[2]

(ii) Complete the statement.

The **total** number of text messages sent by the end of Day Number 5 is ..... which is equal to $2^k - 2$ where $k =$ ..... . [2]

(iii) Write down an expression for the **total** number of text messages sent by the end of Day Number n.

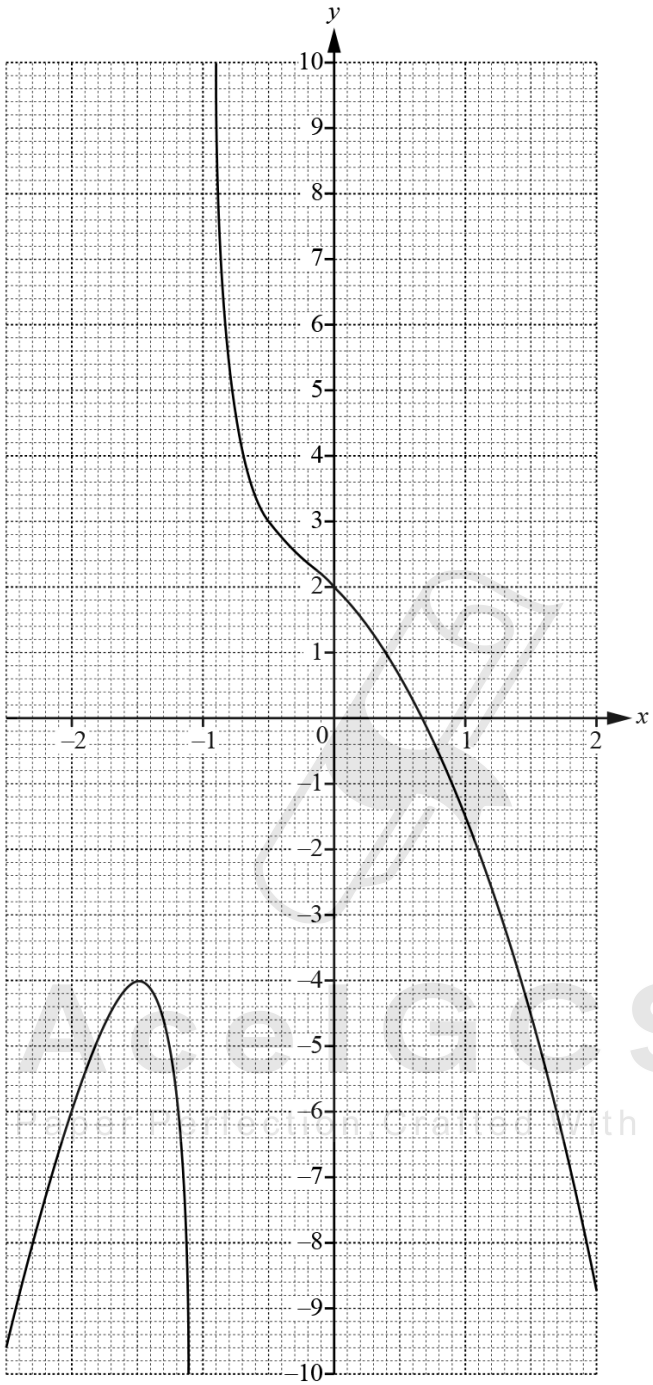
..... [1]

(iv) Find the Day Number when the **total** number of text messages sent by the end of the day is 1022.

..... [1]

139. 0580_s17_qp_41 Q: 4

The diagram shows the graph of $y = f(x)$ for $-2.5 \leqslant x \leqslant 2$.



(a) Find f(1).

..... [1]

(b) Solve $f(x) = 3$.

$x =$ ..... [1]

(c) The equation $f(x) = k$ has only one solution for $-2.5 \leqslant x \leqslant 2$.

Write down the range of values of k for which this is possible.

..... [2]

(d) By drawing a suitable straight line, solve the equation $f(x) = x - 5$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(e) Draw a tangent to the graph of $y = f(x)$ at the point where $x = 1$.

Use your tangent to estimate the gradient of $y = f(x)$ when $x = 1$.

..... [3]

140. 0580_s17_qp_41 Q: 6

(a) Expand the brackets and simplify.

(i) $4(2x+5)-5(3x-7)$

..... [2]

(ii) $(x-7)^2$

..... [2]

(b) Solve.

(i) $\frac{2x}{3}+5=-7$

$x =$ ..... [3]

(ii) $4x+9=3(2x-7)$

$x =$ ..... [3]

(iii) $3x^2-1=74$

$x =$ ..... or $x =$ ..... [3]

141. 0580_s17_qp_41 Q: 9

(a) The nth term of a sequence is $8n - 3$.

(i) Write down the first two terms of this sequence.

..... , ... [1]

(ii) Show that the number 203 is not in this sequence.

[2]

(b) Find the nth term of these sequences.

(i) 13, 19, 25, 31, …

..... [2]

(ii) 4, 8, 14, 22, …

..... [2]

(c) … , 20, 50, …

The second term of this sequence is 20 and the third term is 50.
The rule for finding the next term in this sequence is subtract y then multiply by 5.

Find the value of y and work out the first term of this sequence.

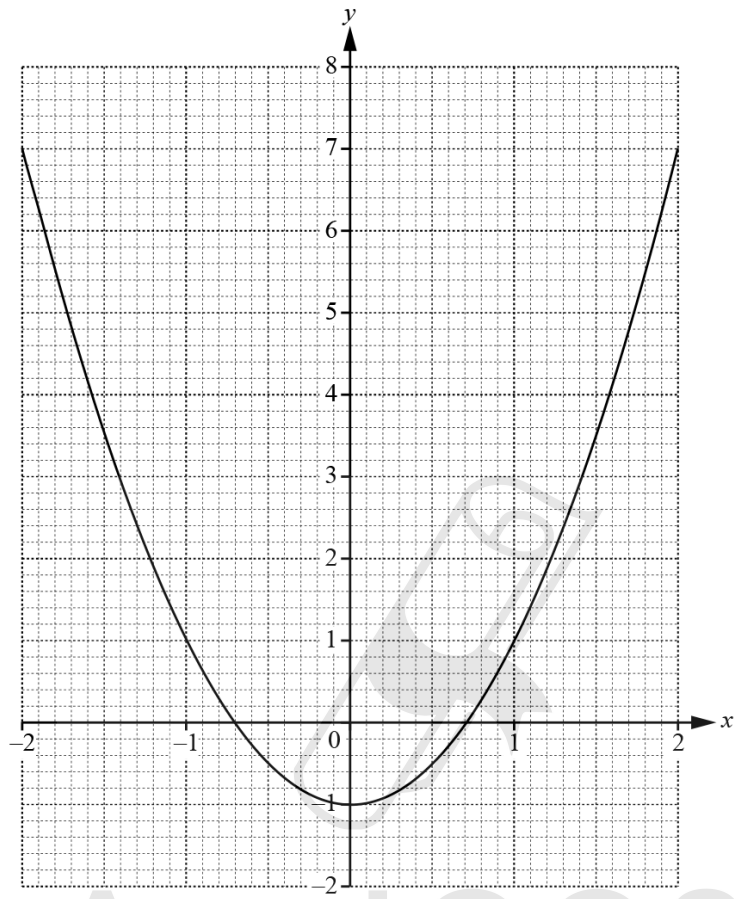
y = ...

First term = ... [4]

142. 0580_s17_qp_42 Q: 4

$f(x) = 2x^2 - 1$

The graph of $y = f(x)$, for $-2 \leqslant x \leqslant 2$, is drawn on the grid.



(a) Use the graph to solve the equation $f(x) = 5$.

$x =$ ..... or $x =$ ..... [2]

(b) **(i)** Draw the tangent to the graph of $y = f(x)$ at the point $(-1.5, 3.5)$. [1]

(ii) Use your tangent to estimate the gradient of $y = f(x)$ when $x = -1.5$.

..... [2]

(c) $g(x) = 2^x$

(i) Complete the table for $y = g(x)$.

x	-2	-1	0	1	2
y	0.25	0.5		2	4

[1]

(ii) On the grid opposite, draw the graph of $y = g(x)$ for $-2 \leqslant x \leqslant 2$. [3]

(d) Use your graphs to solve

(i) the equation $f(x) = g(x)$,

$x =$ ..... or $x =$ ..... [2]

(ii) the inequality $f(x) < g(x)$.

..... [1]

(e) **(i)** Write down the three values.

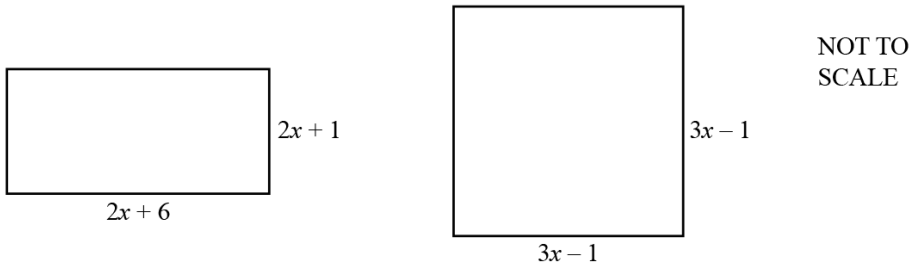
$g(-3) =$ ..... $g(-5) =$ ..... $g(-10) =$ ..... [1]

(ii) Complete the statement.

As x decreases, $g(x)$ approaches the value ..... [1]

143. 0580_s17_qp_42 Q: 7

(a) In this part, all lengths are in centimetres.



(i) Find the value of x when the perimeter of the rectangle is equal to the perimeter of the square.

$x =$ ..... [3]

(ii) Find the value of x when the area of the rectangle is equal to the area of the square.
Show all your working.

$x =$ ..... [7]

(b) (i) Factorise $x^2 + 4x - 5$.

..... [2]

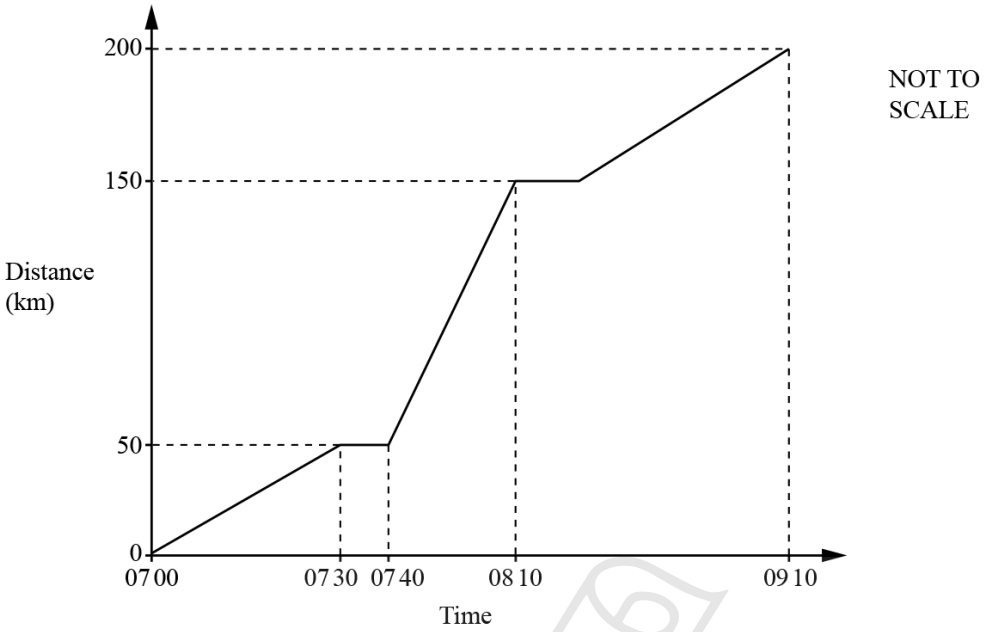
(ii) Solve the equation $\frac{5}{x} - \frac{8}{x+1} = 1$.

Show all your working.

$x =$ ..... or $x =$ ..... [4]

144. 0580_s17_qp_42 Q: 9

(a)



The distance-time graph shows the journey of a train.

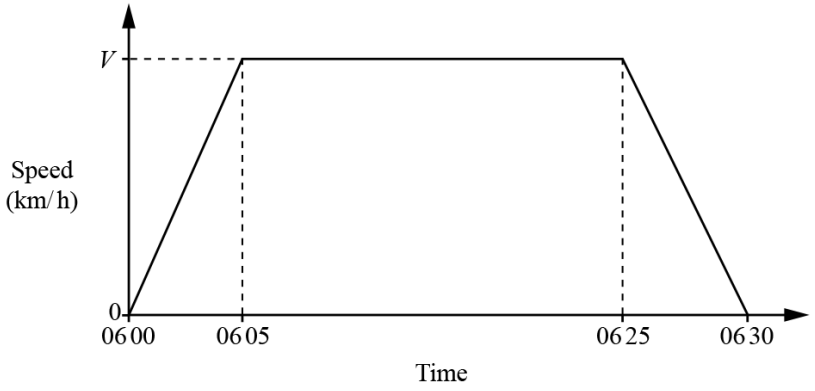
(i) Find the speed of the train between 0700 and 0730.

..... km/h [1]

(ii) Find the average speed for the whole journey.

..... km/h [3]

(b)



NOT TO SCALE

The speed-time graph shows the first 30 minutes of another train journey.
The distance travelled is 100 km.
The maximum speed of the train is V km/h.

(i) Find the value of V.

$V =$ ..... [3]

(ii) Find the acceleration of the train during the first 5 minutes.
Give your answer in m/s^2.

..... m/s^2 [2]

145. 0580_s17_qp_42 Q: 10

$f(x) = 3x - 2$ $g(x) = x^2$ $h(x) = 3^x$

(a) Find $f(-3)$.

..... [1]

(b) Find the value of x when $f(x) = 19$.

$x =$ ..... [2]

(c) Find $fh(2)$.

..... [2]

(d) Find $gf(x) + f(x) + x$.
Give your answer in its simplest form.

..... [3]

(e) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

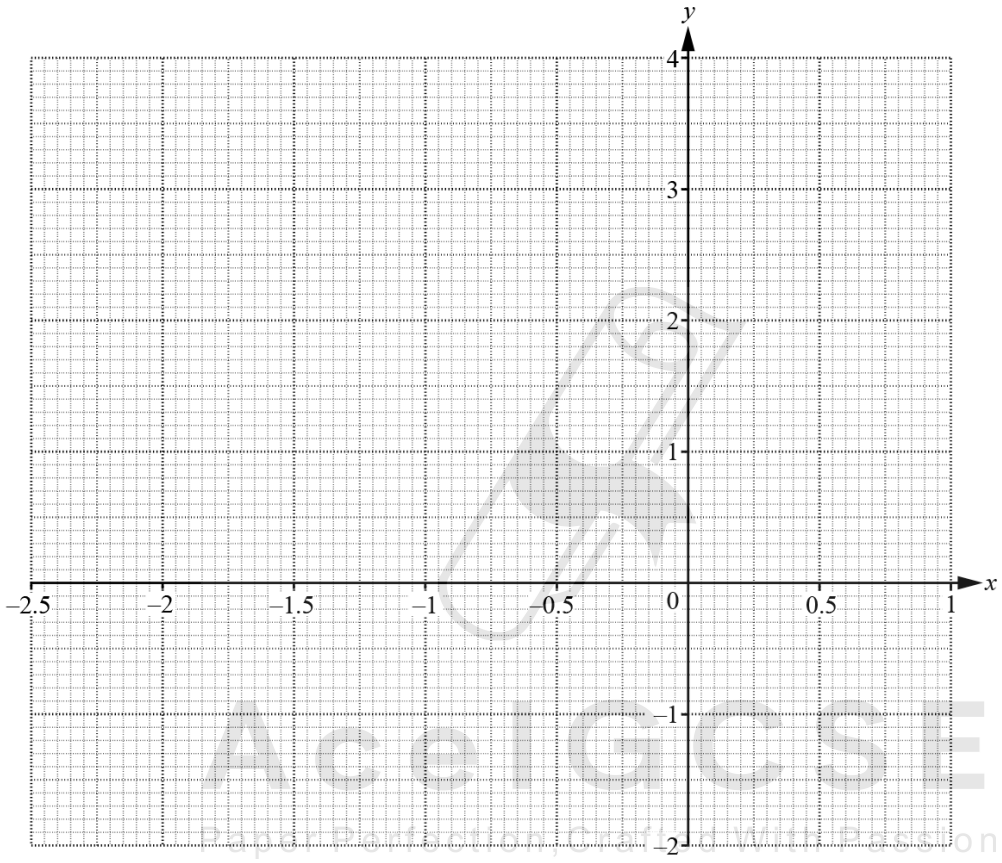
146. 0580_s17_qp_43 Q: 3

The table shows some values for $y = 2x^3 + 4x^2$.

x	–2.2	–2	–1.5	–1	–0.5	0	0.5	0.8
y	–1.94				0.75	0		3.58

(a) Complete the table. [4]

(b) Draw the graph of $y = 2x^3 + 4x^2$ for $-2.2 \leqslant x \leqslant 0.8$.



[4]

(c) Find the number of solutions to the equation $2x^3 + 4x^2 = 3$.

..... [1]

(d) **(i)** The equation $2x^3 + 4x^2 - x = 1$ can be solved by drawing a straight line on the grid.

Write down the equation of this straight line.

$y =$ ..... [1]

(ii) Use your graph to solve the equation $2x^3 + 4x^2 - x = 1$.

$x =$ ..... or $x =$ ..... or $x =$ .....[3]

(e) The tangent to the graph of $y = 2x^3 + 4x^2$ has a negative gradient when $x = k$.

Complete the inequality for k.

..... $< k <$ .....[2]

147. 0580_s17_qp_43 Q: 7

(a) Solve the simultaneous equations.
You must show all your working.

$$2x+3y=11$$
$$3x-5y=-50$$

$x =$ .....

$y =$ ..... [4]

(b) $x^2-12x+a=(x+b)^2$

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [3]

(c) Write as a single fraction in its simplest form.

$$\frac{x}{2x-5}+\frac{3x+2}{x-1}$$

..... [4]

148. 0580_s17_qp_43 Q: 11

The table shows the first four terms in sequences A, B, C and D.

Complete the table.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	16	25	36	49			
B	5	8	11	14			
C	11	17	25	35			
D	$\frac{3}{2}$	$\frac{4}{3}$	$\frac{5}{4}$	$\frac{6}{5}$			

[12]

149. 0580_w17_qp_41 Q: 3

(a) Solve.

$11x + 15 = 3x - 7$

$x =$ ..... [2]

(b) **(i)** Factorise.

$x^2 + 9x - 22$

..... [2]

(ii) Solve.

$x^2 + 9x - 22 = 0$

$x =$ ..... or $x =$ ..... [1]

(c) Rearrange $y = \frac{2(x-a)}{x}$ to make x the subject.

$x =$ ..... [4]

(d) Simplify. $\frac{x^2 - 6x}{x^2 - 36}$

..... [3]

150. 0580_w17_qp_41 Q: 4

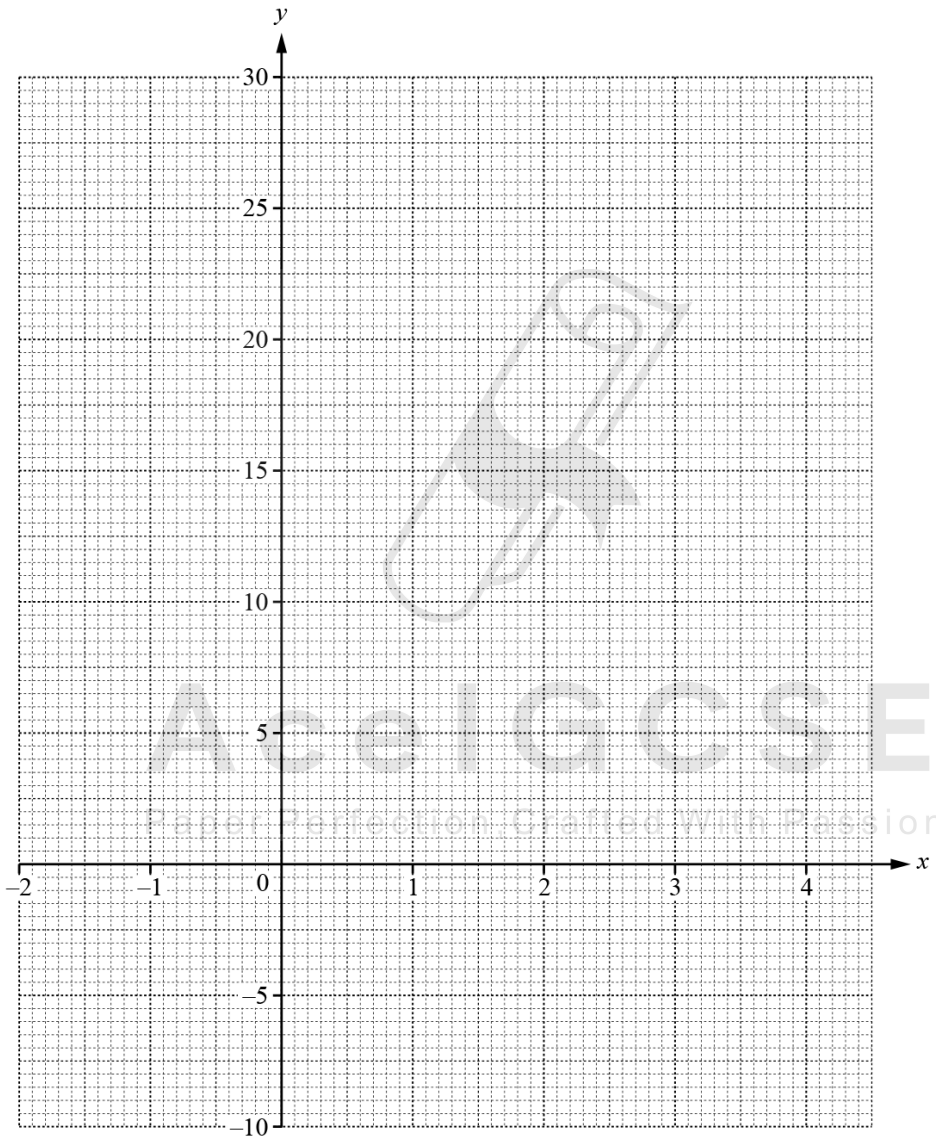
$f(x) = x^3 - 4x^2 + 15$

(a) Complete the table of values for $y = f(x)$.

x	–2	–1	–0.5	0	1	2	2.5	3	3.5	4	4.5
y	–9		13.9	15	12		5.6	6	8.9	15	25.1

[2]

(b) On the grid, draw the graph of $y = f(x)$ for $-2 \leqslant x \leqslant 4.5$.



[4]

(c) Use your graph to solve the equation $f(x) = 0$.

$x =$ ..... [1]

(d) By drawing a suitable tangent, estimate the gradient of the graph of $y = f(x)$ when $x = 3.5$.

..... [3]

(e) By drawing a suitable straight line on the grid, solve the equation $x^3 - 4x^2 - 2x + 5 = 0$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [4]

151. 0580_w17_qp_41 Q: 6

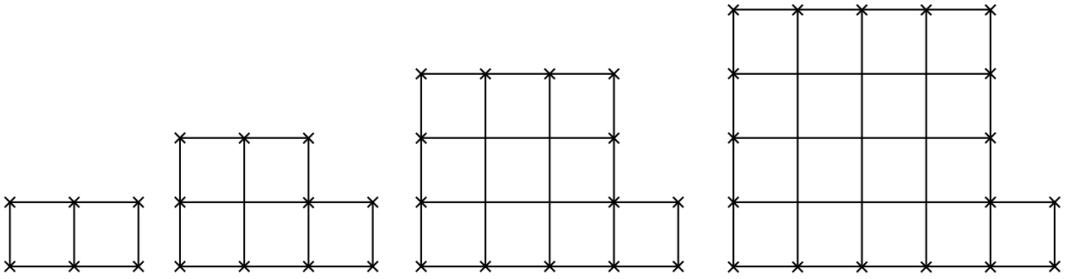


Diagram 1 Diagram 2 Diagram 3 Diagram 4

These are the first four diagrams in a sequence.
Each diagram is made from small squares and crosses.

(a) Complete the table.

Diagram	1	2	3	4	5		n
Number of crosses	6	10	14				
Number of small squares	2	5	10				

[6]

(b) Find the number of crosses in Diagram 60.

..... [1]

(c) Which diagram has 226 squares?

Diagram ..... [1]

(d) The side of each small square has length 1 cm.
The number of lines of length 1 cm in Diagram n is $2n^2 + 2n + q$.

Find the value of q.

q = ... [2]

152. 0580_w17_qp_41 Q: 7

$f(x) = 3 - 2x$ $\quad g(x) = \frac{4}{x},\ x \neq 0$ $\quad h(x) = 4^x$

(a) Find f(5).

..... [1]

(b) Find gh(3).

..... [2]

(c) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(d) Show that $hf(x) = \frac{64}{16^x}$.

[3]

(e) Find the value of x when $h(x) = g(0.5)$.

$x =$ ..... [2]

153. 0580_w17_qp_42 Q: 5

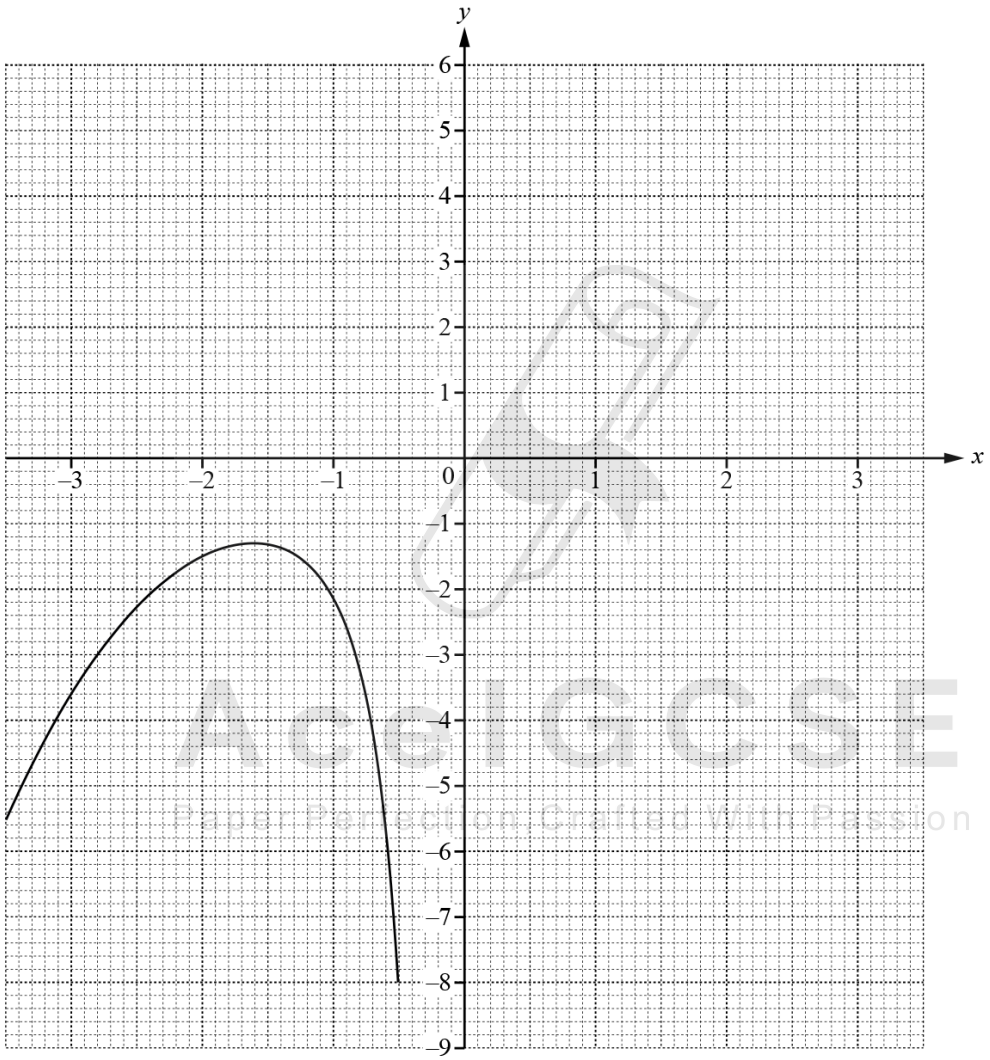
$y = \frac{x^3}{8} - \frac{2}{x^2}$, $x \neq 0$

(a) Complete the table of values.

x	0.5	1	1.5	2	2.5	3	3.5
y	−8.0	−1.9	−0.5	0.5	1.6		

[2]

(b)



The graph of $y = \frac{x^3}{8} - \frac{2}{x^2}$ for $-3.5 \leqslant x \leqslant -0.5$ has already been drawn.

On the grid, draw the graph of $y = \frac{x^3}{8} - \frac{2}{x^2}$ for $0.5 \leqslant x \leqslant 3.5$. [4]

(c) Use your graph to solve the equation $\frac{x^3}{8} - \frac{2}{x^2} = 0$.

$x =$ ..... [1]

(d) $\frac{x^3}{8} - \frac{2}{x^2} = k$ and k is an integer.

Write down a value of k when the equation $\frac{x^3}{8} - \frac{2}{x^2} = k$ has

(i) one answer, $k =$ ..... [1]

(ii) three answers. $k =$ ..... [1]

(e) By drawing a suitable tangent, estimate the gradient of the curve where $x = -3$.

..... [3]

(f) **(i)** By drawing a suitable line on the grid, find x when $\frac{x^3}{8} - \frac{2}{x^2} = 6 - x$.

$x =$ ..... [3]

(ii) The equation $\frac{x^3}{8} - \frac{2}{x^2} = 6 - x$ can be written as $x^5 + ax^3 + bx^2 + c = 0$.

Find the values of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [4]

154. 0580_w17_qp_42 Q: 8

(a) The cost of 1 apple is a cents.
The cost of 1 pear is p cents.
The total cost of 7 apples and 9 pears is 354 cents.

(i) Write down an equation in terms of a and p.

..... [1]

(ii) The cost of 1 pear is 2 cents more than the cost of 1 apple.

Find the value of a and the value of p.

$a =$ .....

$p =$ ..... [3]

(b) Rowena walks 2 km at an average speed of x km/h.

(i) Write down an expression, in terms of x, for the time taken.

..... h [1]

(ii) Rowena then walks 3 km at an average speed of $(x - 1)$ km/h.
The total time taken to walk the 5 km is 2 hours.

(a) Show that $2x^2 - 7x + 2 = 0$.

[3]

(b) Find the value of x.
Show all your working and give your answer correct to 2 decimal places.

$x =$ ..... [4]

155. 0580_w17_qp_42 Q: 9

$f(x) = 1 - 2x$ $g(x) = x + 4$ $h(x) = x^2 + 1$

(a) Find $f(-1)$.

..... [1]

(b) Solve the equation.

$2f(x) = g(x)$

$x =$ ..... [2]

(c) Find $fg(x)$.
Give your answer in its simplest form.

..... [2]

(d) Find $hh(2)$.

..... [2]

(e) Find $f^{-1}(x)$.

$f^{-1}(x) =$ ..... [2]

(f) $\text{hgf}(x) = 4x^2 + px + q$

Find the value of p and the value of q.

p = ...

q = ... [4]

156. 0580_w17_qp_43 Q: 2

(a) Solve.

$$\frac{x}{7} = 49$$

$x =$ ..... [1]

(b) Simplify.

(i) x^0

..... [1]

(ii) $x^7 \times x^3$

..... [1]

(iii) $\dfrac{(3x^6)^2}{x^{-4}}$

..... [2]

(c) **(i)** Factorise completely.

$2x^2 - 18$

..... [2]

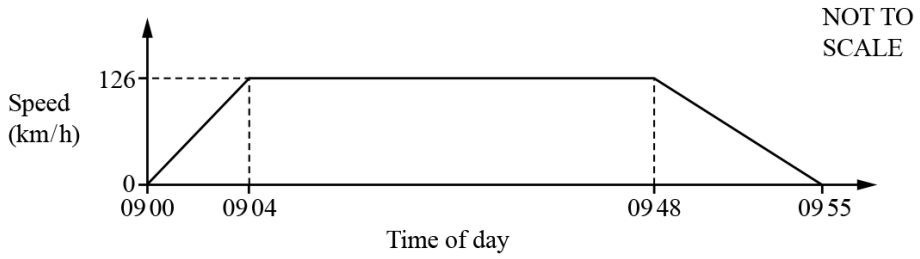
(ii) Simplify.

$$\frac{2x^2 - 18}{x^2 + 7x - 30}$$

..... [3]

157. 0580_w17_qp_43 Q: 3

The graph shows information about the journey of a train between two stations.



(a) **(i)** Work out the acceleration of the train during the first 4 minutes of this journey.
Give your answer in km/h^2.

..... km/h^2 [2]

(ii) Calculate the distance, in kilometres, between the two stations.

..... km [4]

(b) **(i)** Show that 126 km/h is the same speed as 35 m/s.

[1]

(ii) The train has a total length of 220 m.
At 09 30, the train crossed a bridge of length 1400 m.

Calculate the time, in seconds, that the train took to completely cross the bridge.

.....s [3]

(c) On a different journey, the train took 73 minutes, correct to the nearest minute, to travel 215 km, correct to the nearest 5 km.

Calculate the upper bound of the average speed of the train for this journey.
Give your answer in km/h.

.....km/h [4]

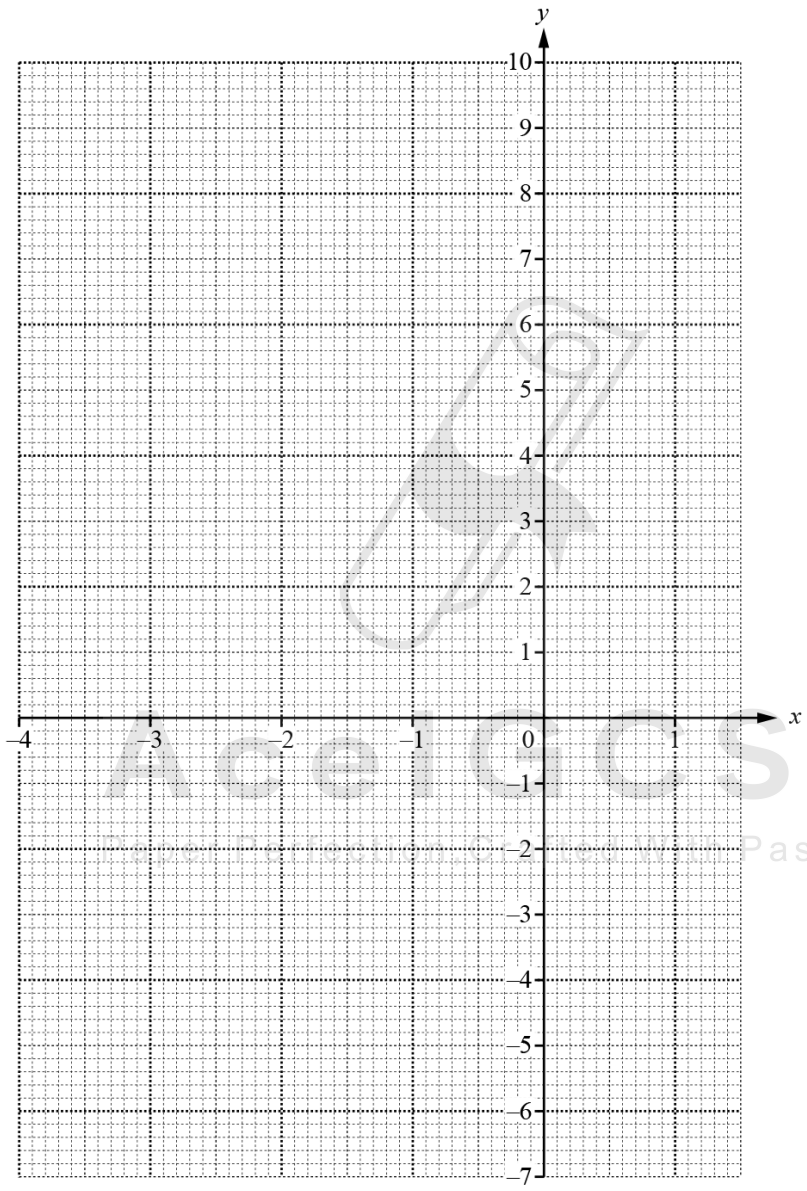
158. 0580_w17_qp_43 Q: 7

The table shows some values of $y = 2x^2 + 5x - 3$ for $-4 \leqslant x \leqslant 1.5$.

x	-4	-3	-2	-1	0	1	1.5
y		0	-5		-3	4	

(a) Complete the table. [3]

(b) On the grid, draw the graph of $y = 2x^2 + 5x - 3$ for $-4 \leqslant x \leqslant 1.5$.



[4]

(c) Use your graph to solve the equation $2x^2 + 5x - 3 = 3$.

$x =$ ..... or $x =$ ..... [2]

(d) $y = 2x^2 + 5x - 3$ can be written in the form $y = 2(x+a)^2 + b$.

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [3]

159. 0580_w17_qp_43 Q: 9

Luigi and Alfredo run in a 10 km race.
Luigi's average speed was x km/h.
Alfredo's average speed was 0.5 km/h slower than Luigi's average speed.

(a) Luigi took $\frac{10}{x}$ hours to run the race.

Write down an expression, in terms of x, for the time that Alfredo took to run the race.

..... h [1]

(b) Alfredo took 0.25 hours longer than Luigi to run the race.

(i) Show that $2x^2 - x - 40 = 0$.

[4]

(ii) Use the quadratic formula to solve $2x^2 - x - 40 = 0$.
Show all your working and give your answers correct to 2 decimal places.

x = ... or x = ... [4]

(iii) Work out the time that Luigi took to run the 10 km race.
Give your answer in hours and minutes, correct to the nearest minute.

..... h ..... min [3]

160. 0580_w17_qp_43 Q: 10

(a) **(i)** Write 180 as a product of its prime factors.

..... [2]

(ii) Find the lowest common multiple (LCM) of 180 and 54.

..... [2]

(b) An integer, X, written as a product of its prime factors is $a^2 \times 7^{b+2}$.
An integer, Y, written as a product of its prime factors is $a^3 \times 7^2$.

The highest common factor (HCF) of X and Y is 1225.
The lowest common multiple (LCM) of X and Y is 42 875.

Find the value of X and the value of Y.

$X =$ .....

$Y =$ ..... [4]

01. 0580_m24_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)(i)	$(x-4)(x+3)$ final answer	2	**M1** for $(x+a)(x+b)$ where $ab=-12$ or $a+b=-1$ or for $x(x+3)-4(x+3)$ or $x(x-4)+3(x-4)$
(a)(ii)	$\frac{x+4}{x+3}$ final answer	2	**M1** for $(x-4)(x+4)$ seen
(b)	$3x^2-14x+8$ or $(x-4)(3x-2)$ final answer	3	**M2** for $((2x-3)-(x+1))((2x-3)+(x+1))$ or $(4x^2-6x-6x+9)-(x^2+x+x+1)$ or better or correct answer seen or **M1** for $(x-4)(ax+b)$ or $(3x-2)(x+c)$ or $(4x^2-6x-6x+9)$ or $\pm(x^2+x+x+1)$ oe
(c)	$\frac{x^2-3x-12}{(x+1)(x-3)}$ or $\frac{x^2-3x-12}{x^2-2x-3}$ final answer	4	**B1** for common denominator $(x+1)(x-3)$ oe isw **B1** for $(2x+4)(x-3)-x(x+1)$ or better seen **B1** for $2x^2-6x+4x-12$ or $-x^2-x$ seen

Question	Answer	Marks	Partial Marks
(d)	$2x^3-15x^2+22x+15$ final answer	3	**B2** for correct expansion of three brackets unsimplified or for simplified four-term expression of correct form with 3 terms correct in final answer or **B1** for correct expansion of two brackets with at least 3 terms out of 4 correct
(e)	$2x^2-3x-77[=0]$ oe $\left(6x^2-9x-231[=0]\right)$ or $18y^2+147y+222[=0]$ oe $\left(6y^2+49y+74[=0]\right)$	M2	**M1** for correct method to eliminate one variable e.g. $2(13+3y)^2-9y=116$ or $2x^2-3(x-13)=116$ oe
	$(2x+11)(x-7)\,[=0]$ oe or $\frac{[--]3\pm\sqrt{([-]3)^2-4\times2\times-77}}{2\times2}$ oe or $(6y+37)(3y+6)\,[=0]$ or $\frac{-147\pm\sqrt{147^2-4\times18\times222}}{2\times18}$ oe	M2	**FT** *their* 3-term quadratic in x or y, correct factors, correct substitution into formula or for correctly completing square **M1** for a pair of factors giving 2 correct terms when expanded *their* quadratic or for e.g. $\sqrt{([-]3)^2-4\times2\times-77}$ oe or $\frac{[--]3\pm\sqrt{p}}{2\times2}$ oe
	$x=7$ and $y=-2$ $x=-5\frac{1}{2}$ oe and $y=-6\frac{1}{6}$ oe	B2	**B1** for both x-values or both y-values or for 1 correct pair

Question	Answer	Marks	Partial Marks
(a)	Ruled line with negative gradient and positive y-intercept	**2**	**B1** for ruled line with negative gradient or for ruled line with positive y-intercept or straight line with negative gradient and positive y-intercept
(b)	Negative quadratic, with vertex at origin	**2**	**B1** for negative quadratic in other position or for sketch in 3rd and 4th quadrants only with single maximum at (0, 0) and no other turning point or for positive quadratic, with vertex at origin
(c)(i)	$18x - 6x^2$ isw	**B2**	**B1** for one correct term $18x$ or $-6x^2$ seen
	setting *their* derivative = 0 or $\frac{dy}{dx} = 0$	**M1**	**Dep** on at least B1 earned or *their* derivative = $\pm 18x \pm 6x^2$
	(0, 10) and (3, 37)	**B2**	**B1** for $x = 0$ and $x = 3$ or for (0, 10) or (3, 37)

Question	Answer	Marks	Partial Marks
(c)(ii)	(0, 10) minimum with correct reason AND (3, 37) maximum with correct reason	**3**	Reasons could be e.g. 1 A reasonable sketch of a negative cubic 2 Correct use of 2nd derivative = –12(0) + 18 = 18, 18 > 0, so (0, 10) is a minimum oe. 2nd derivative = –12(3) + 18 = –18, –18 < 0 so (3, 37) is a maximum oe. 3 Evaluates correctly values of y on both sides of both correct stationary points 4 Finds gradient on each side of both correct stationary points. **B2** for 1 correct with correct reason for that stationary point or for **both** x-values correct and reasonable sketch of a negative cubic, or for correct substitution and evaluation of **both** of *their* x-values into *their* second derivative or substitution and evaluation for one x-value on both sides of **both** of *their* stationary points to find the gradients soi or **M1** for showing [2nd derivative =] $-12x + 18$ or correct FT *their* 2nd derivative or substitution and evaluation shown for one x-value on both sides of **one** of *their* stationary points to find the gradients soi or for sketch of any negative cubic.

03. 0580_m24_ms_42 Q: 10

Question	Answer	Marks	Partial Marks
(a)	−2.5 −1.25 5.5	3	**B1** for each
(b)	Correct graph	4	**B3FT** for 8 or 9 correct points or **B2FT** for 6 or 7 correct points or **B1FT** for 4 or 5 correct points
(c)	$y = 2$ drawn	M1	
	−2.75 to –2.65 –1.1 to −1.05 0.75 to 0.85	A2	**A1** for 1 solution
(d)	–2.5 5.5	2	**B1** for each

04. 0580_m24_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)(i)	−3.5 oe	2	**M1** for $g\left(\frac{1}{2}\right)$ seen or $3\left(\frac{1}{x}\right)-5$ or better
(a)(ii)	$\frac{x+5}{3}$ oe final answer	2	**M1** for correct first step $y+5=3x$, $\frac{y}{3}=x-\frac{5}{3}$ or $x=3y-5$
(b)	$3x-11$ final answer	2	**M1** for $3(x-2)-5$
(c)(i)	5	2	**M1** for $\frac{1}{3x-5}[=0.1]$
(c)(ii)	4 nfww	2	**M1** for $2^x-(3\times7-5)[=0]$ or better

05. 0580_s24_ms_41 Q: 3

Question	Answer	Marks	Partial Marks
(a)(i)	80	2	**M1** for $\frac{1}{4}\times5\times8^2$
(a)(ii)	5	2	**M1** for $[y^2=]\frac{15\times4}{2.4}$ oe

Question	Answer	Marks	Partial Marks
(b)	$\frac{5x+23}{(x-1)(2x+5)}$ or $\frac{5x+23}{2x^2+3x-5}$ final answer	3	**B1** for $4(2x + 5) - 3(x - 1)$ oe isw **B1** for common denominator = $(x - 1)(2x + 5)$ oe isw
(c)	$2x^3 - 13x^2 + 8x + 48$ final answer	3	**B2** for correct expansion of 3 brackets but unsimplified or for simplified four-term expression of correct form with 3 terms correct or **B1** for correct expansion of two brackets with at least 3 terms out of 4 correct
(d)	$\frac{8x^{12}}{y^6}$ or $8x^{12}y^{-6}$ final answer	3	**B2** for two elements correct in final answer or for correct answer seen then spoiled or for correct expression where all parts of the power have been dealt with or for $(\,)^{-1}$ or $\left(\frac{2x^4}{y^2}\right)^3$ or **B1** for 8 or y^6 or y^{-6} or x^{12} correct in final answer or for $\left(\frac{16x^{16}}{y^8}\right)^{\frac{3}{4}}$ or $\left(\frac{y^2}{2x^4}\right)^{-3}$

06. 0580_s24_ms_41 Q: 8

Question	Answer	Marks	Partial Marks
(a)	Correct sketch with roots indicated at $x = -9$ and $x = 2$ and y intercept = –18 Minimum should be in 3rd quadrant	**4**	**B1** for U shaped parabola **B2** for roots at –9 and 2 on diagram or **M1** for $(x + 9)(x - 2)$ [= 0] **B1** for y – intercept at –18 on diagram Maximum 3 marks if sketch not fully correct
(b)(i)	$2x - 3$	**2**	**B1** for $2x + k$ or $kx^{[p]} - 3$
(b)(ii)	(1.5, –30.25) oe	**3**	**B2** for $x = 1.5$ or **M1** for *their* **(b)(i)** = 0 or for $(x - 1.5)^2$
(c)	$x^2 - x - 33$ [= 0] seen	**B1**	
	$\frac{[--]1 \pm \sqrt{([-]1)^2 - 4(1)(-33)}}{2 \times 1}$ oe	**B2FT**	**FT** *their* quadratic dep on no factors **B1** for $\sqrt{([-]1)^2 - 4(1)(-33)}$ or better or **B1** for $\frac{[--]1 + \sqrt{q}}{2(1)}$ oe or $\frac{[--]1 - \sqrt{q}}{2(1)}$ oe
	–5.27 or –5.267 to –5.266 **and** 6.27 or 6.266 to 6.267	**B2**	**B1** for each If 0 scored, **SC1** for –6.27 and 5.27
	(–5.27, 15.53 or 15.54) **and** (6.27, –7.53 or – 7.54)	**B1**	

07. 0580_s24_ms_41 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	13	**1**	
(a)(ii)	–20	**1**	**FT** 6 – 2(*their* **(a)(i)**)

Question	Answer	Marks	Partial Marks
(b)	$\frac{6-x}{2}$ oe final answer	2	**M1** for correct first step $x = 6 - 2y, y - 6 = -2x, \frac{y}{2} = 3 - x$
(c)	2.375 oe	4	**B1** for $6 - 2(2x - 7)$ oe **B1** for $4x + 1 = 6 - 4x + 14$ **M1** for $8x = 19$ FT *their* linear equation rearranged correctly from $ax + b = cx + d$ to form $ex = f$
(d)	$\frac{1}{3}$ or 0.333…	2	**M1** for h(1) or 3^(3^(x-2) – 2) or 3^(3^(2-2) – 2) or better
(e)	6561	2	**M1** for 3^{10-2} or x = h(10)

08. 0580_s24_ms_42 Q: 7

Question	Answer	Marks	Partial Marks
(a)	2	2	**M1** for $3x + 4x = 6 + 8$ or better
(b)	$5a(2a + 1)$ final answer	2	**B1** for $a(10a + 5)$ or $5(2a^2 + a)$ or $5a(2a + 1)$ then spoilt
(c)	$4x(x - 3)$ final answer	2	**M1** for $((2x - 3) - 3)((2x - 3) + 3)$ or better or for $4x^2 - 6x - 6x + 9$ [–9] oe or better
(d)(i)	$\frac{1}{15}$ oe	1	
(d)(ii)	19 683	2	**B1** for g(9), 3^9 or 3^{3^x} seen
(d)(iii)	–3	2	**M1** for $3^k = \frac{1}{27}$ or $3^k = 3^{-3}$ or answer g(–3)

09. 0580_s24_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)	$-4\,(-1)^3 - 9\,(-1)^2 + 5$ or better	**M1**	
	= 0 [so stationary point]	**A1**	with no errors
(b)(i)	18	**3**	**B2** for $6x^2 - 6$ isw OR **B1** for $6x^2 + k$ (any k) isw or $px^2 - 6$ isw ($p \neq 0$) or $6x^2 - 6 + 8$ **M1**dep on B1 for $x = -2$ substituted into *their* $\frac{dy}{dx}$
(b)(ii)	1 and –1	**2**	**M1** for $6x^2 - 6 = 0$ oe seen or for *their* $\frac{dy}{dx} = 0$ if B1 scored in part **(b)(i)**

10. 0580_s24_ms_43 Q: 2

Question	Answer	Marks	Partial Marks
(a)(i)	56	**1**	
(a)(ii)	11	**2**	**M1** for $120 - n^3 = -1211$ or $120 - 11^3 = -1211$
(b)	0.0048 or $\frac{3}{625}$ oe	**1**	

Question	Answer	Marks	Partial Marks
(c)	A: –5 ; $10-3n$ B: $\frac{5}{8}$; $\frac{n}{n+3}$ C: 20 ; n^2-n	8	**B1** for –5 **B2** for $10-3n$ oe or **B1** for $k-3n$ or for $10-kn$ **B1** for $\frac{5}{8}$ **B1** for $\frac{n}{n+3}$ oe **B1** for 20 **B2** for n^2-n oe or **B1** for any quadratic or for at least two second differences of 2

11. 0580_s24_ms_43 Q: 5

Question	Answer	Marks	Partial Marks
(a)(i)	3 cao	**1**	
(a)(ii)	–2, –0.45 to –0.4, 2.40 to 2.45	**3**	**B1** each
(a)(iii)	3 cao	**1**	
(a)(iv)	Asymptote	**1**	
(b)(i)	Correct ruled line	**2**	**B1** for ruled line through (0, –2) but not $y = –2$ or for ruled line with gradient 1
(b)(ii)	1 cao	**1**	
(c)	Substituting values of x and y into $y = x^2 - \frac{c}{x}$ for an exact point on graph of $y = f(x)$ or substituting *their* value of x from 5b(ii) into $x^2 - \frac{c}{x} = x - 2$	**M1**	
	leading to $c = 2$ with no errors	**A1**	
(d)	$[p =]$ –1 and $[q =]$ 2 nfww	**2**	**M1** for $x^3 - x^2 + 2x = 2$ seen or **B1** for each nfww

12. 0580_s24_ms_43 Q: 10

Question	Answer	Marks	Partial Marks
(a)	$7x^6 - 42x^5$ final answer	**2**	**B1** for one correct term $7x^6$ or $42x^5$ or for $7x^6 - 42x^5$ seen and spoiled

Question	Answer	Marks	Partial Marks
(b)	$49x + 41$	4	**M1** for substituting $x = -1$ into $[y =] x^7 - 7x^6$ **M1** for $x = -1$ substituted in *their* (a) or the correct derivative to give *their m* **M1** for *their* $-8 = (\textit{their } m)(-1) + c$ oe
(c)	(0, 0) (6, –46 656)	5	**B4** for (6, –46 656) or **B3** for $x = 0$ and 6 **OR** **M1** for *their* $\frac{dy}{dx} = 0$ or stating $\frac{dy}{dx} = 0$ and **M1** for a correct method to solve *their* $7x^6 - 42x^5$

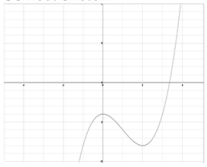
13. 0580_m23_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)	$6p^4 - 13p^2 + 6$ final answer	2	**B1** for three of $6p^4 - 9p^2 - 4p^2 + 6$ seen
(b)(i)	175	2	**M1** for $\frac{1}{2}(20 + 30) \times 7$ oe
(b)(ii)	$\frac{2s - ut}{t}$ or $\frac{2s}{t} - u$ final answer	3	**B2** for correct answer but unsimplified e.g. $\frac{s \div t}{0.5} - u$, $\frac{s}{\frac{1}{2}t} - u$, $\frac{s}{0.5t} - u$ **OR** **M1** for correct multiplication by 2 or division by 0.5 **M1** for correctly rearranging terms to isolate term in v **M1** for correct division by t Max 2 marks if final answer incorrect
(c)(i)	$(2q - 3)(t + 2)$ final answer	2	**B1** for $t(2q - 3) + 2(2q - 3)$ or $2q(t + 2) - 3(t + 2)$

Question	Answer	Marks	Partial Marks
(c)(ii)	$x(x + 5)(x - 5)$ final answer	3	**B2** for $(x^2 - 5x)(x + 5)$ or $(x^2 + 5x)(x - 5)$ or for correct answer seen then spoiled or **B1** for $x(x^2 - 25)$

14. 0580_m23_ms_42 Q: 9

Question	Answer	Marks	Partial Marks
(a)	–3	3	**B2** for $3x^2 - 6x$ or **B1** for $3x^2 - kx$ or for $kx^2 - 6x$ or for $3x^2 - 6x + c$
(b)	(0, –4) and (2, –8)	4	**B3** for $x = 0$ and 2 or for (2, –8) OR **M1** for *their* $3x^2 - 6x = 0$ or stating $\frac{dy}{dx} = 0$ oe **M1** for correct method to solve *their* $3x^2 - 6x = 0$

Question	Answer	Marks	Partial Marks
(c)	Correct sketch 	2	Max on negative y-axis and min in correct quadrant and extends into first quadrant **B1** for positive cubic graph and two turning points

15. 0580_m23_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)	1	1	
(b)	$-\frac{1}{5}$ or –0.2	2	**M1** for $2x - 1 + 3x + 2 = 0$ oe isw
(c)	$9x + 8$ final answer	2	**M1** for $3(3x + 2) + 2$

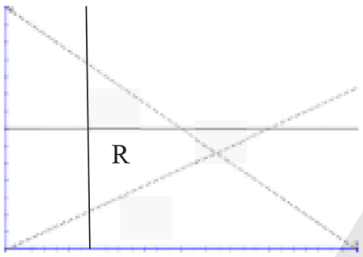
Question	Answer	Marks	Partial Marks
(d)	$\frac{4x^2 + 5x - 3}{x(2x-1)}$ final answer	4	**M1** for $\frac{1}{2x-1}$ and $3\left(\frac{1}{x}\right) + 2$ oe **B1** for $x + 3(2x-1) + 2x(2x-1)$ oe or better isw **B1** for common denominator = $x(2x - 1)$ isw If 0 scored, **SC1** for answer $\frac{4x^2 + 9x + 3}{x(2x+1)}$
(e)	h(x) indicated	1	

16. 0580_s23_ms_41 Q: 7

Question	Answer	Marks	Partial Marks
(a)(i)	$3(3y-1)(3y+1)$ final answer	3	**B2** for $(9y-3)(3y+1)$ or $(3y-1)(9y+3)$ or or **M1** for $3(9y^2-1)$ or [...]$(3y-1)(3y+1)$ if 0 scored **SC1** for an otherwise correctly completely factorised expression but with fractions within the brackets
(a)(ii)	$(2-p)(m+k)$ final answer	2	**M1** for $2(m+k)-p(m+k)$ or $m(2-p)+k(2-p)$
(b)	$-\frac{1}{2}$ oe nfww	5	**B4** $-8x=+4$ oe nfww or **B3** for $\frac{x^2-8x-5}{(x-1)(x+1)}=1$ or better OR **B2** x^2-8x-5 or **M1** for $(x-1)(x-1)-6(x+1)$ or better **B1** $(x-1)(x+1)$ as full denominator or on the right hand side

Question	Answer	Marks	Partial Marks
(c)	$\frac{-(-3)\pm\sqrt{(-3)^2-4(4)(-2)}}{2\times 4}$ oe or $\frac{3}{8}\pm\sqrt{\left(\frac{3}{8}\right)^2+\frac{2}{4}}$ oe	**M2**	**M1** for $\sqrt{(-3)^2-4(4)(-2)}$ or for $\frac{-(-3)+\sqrt{q}}{2(4)}$ or $\frac{-(-3)-\sqrt{q}}{2(4)}$ or for [4]$\left(x-\frac{3}{8}\right)^2$
	−0.43 and 1.18 final ans cao	**A2**	**B1** for each **SC1** for −0.4 ,–0.42 or −0.425.... and 1.2 or 1.17 or 1.175.... or answers 0.43 and –1.18 or −0.43 and 1.18 seen in working
(d)	$k=\frac{4m}{1-pm}$ or $k=\frac{-4m}{pm-1}$ final answer	**4**	**M1** for clearing fractions **M1** for collecting terms in k **M1** for factorising **M1** for dividing by bracket Maximum 3 marks if answer incorrect

17. 0580_s23_ms_41 Q: 8

Question	Answer	Marks	Partial Marks
(a)	$y \leqslant 7$ oe $x + y < 14$ oe $y > \frac{2}{3}x$ oe	**3**	**B1** for each
(b)	$x = 4$ solid $y = 7$ solid $x + y = 14$ dashed $y = \frac{2}{3}x$ dashed	**M4**	**B1** for each
	correct shading everywhere but region R 	**A2**	**M1dep** (dependent on M4 or B1B1B1B0 where the only error is wrong use of solid/dashed lines) for shading the correct side of 3 of the 4 lines.

Question	Answer	Marks	Partial Marks
(c)	4 dresses and 3 shirts	**1**	
(d)	106	**2**	**M1** for $10x + 6y$ evaluated for (x, y) in *their* region R or **B1** for (7, 6) After 0 scored, **SC1** for answer 112 or 116

18. 0580_s23_ms_41 Q: 10

Question	Answer	Marks	Partial Marks
(a)(i)	-7	**1**	
(a)(ii)	$\frac{x-5}{2}$ oe final answer	**2**	**M1** for correct first step e.g. $x = 2y + 5$ or $2x = y - 5$ or $\frac{y}{2} = x + \frac{5}{2}$
(a)(iii)	$2x^3 - 11x^2 - 8x + 80$ final answer	**4**	**M1** for $(x-4)(2x+5)(x-4)$ oe **B2** for $2x^3 - 8x^2 - 8x^2 + 5x^2 - 20x - 20x + 32x + 80$ or for simplified 4 term expression of the correct form with 3 terms correct in final answer or **B1** for 3 terms correct out of 4 from $x^2 - 4x - 4x + 16$ or $2x^2 - 8x + 5x - 20$

Question	Answer	Marks	Partial Marks
(b)	0	**2**	**M1** for g(− 2) or $2(x-4) + 5$ oe or $3^x = 1$ or $g(f(2)) = 1$

19. 0580_s23_ms_42 Q: 6

Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{1}{5}, \frac{2}{7}, \frac{3}{9}$ final answer	**2**	**B1** for 2 correct terms isw or for 0.2 and (0.286 or 0.2857…) and 0.333…
(a)(ii)	36	**2**	**M1** for $k = \frac{12(2k+3)}{25}$ or better

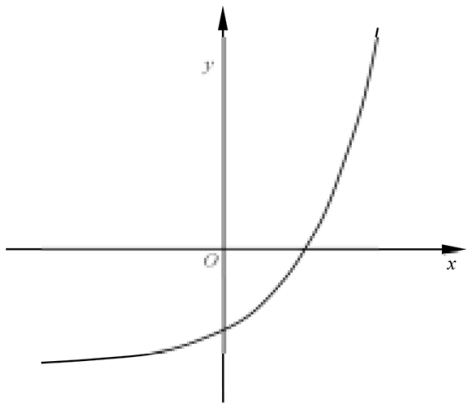
Question	Answer	Marks	Partial Marks
(b)(i)	$n^3 + 5$ oe final answer	**2**	**B1** for any cubic or common third differences of 6 (at least 2) or for correct answer seen and spoilt
(b)(ii)	$100 \times 2^{1-n}$ oe final answer	**2**	**B1** for $2^{-n\,[+k]}$ oe or $\left(\frac{1}{2}\right)^{n[+k]}$ oe in answer or for correct answer seen and spoilt

20. 0580_s23_ms_42 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	$27x^6y^{12}$ final answer	**2**	**B1** for two terms correct in answer e.g. $27x^6y^k$ or $27x^ky^{12}$ or kx^6y^{12} or for correct answer seen then spoilt

Question	Answer	Marks	Partial Marks
(a)(ii)	$\frac{x^{24}y^{12}}{64}$ final answer	3	**B2** for final answer with two correct elements or final answer $\frac{64}{x^{24}y^{12}}$ or $\frac{64^{-1}}{x^{-24}y^{-12}}$ or better or for correct answer seen or **B1** for 64 or x^{24} or y^{12} seen in final answer or final answer $\frac{k}{x^{-24}y^{-12}}$ or **M1** for first correct step seen eg $\left(\frac{x^{16}y^{8}}{16}\right)^{\left[\frac{3}{2}\right]}$ or $\left(\frac{4}{x^{8}y^{4}}\right)^{[-3]}$ or $\left(\frac{4096}{x^{48}y^{24}}\right)^{\left[-\frac{1}{2}\right]}$
(b)(i)	$(x + 3)(x – 3)$ final answer	1	
(b)(ii)	$\frac{x+3}{2y+5}$ final answer	3	**M2** for $(x – 3)(2y + 5)$ or **M1** for $2y(x – 3) + 5(x – 3)$ or $x(2y + 5) – 3(2y + 5)$
(c)	$5x^2 + 4x – 20$ [= 0] oe or $5y^2 – 78y + 221$ [= 0] oe	M2	**M1** for $7 – 2x = 5x^2 + 2x – 13$ oe seen or $y = 5\left(\frac{7-y}{2}\right)^2 + 2\left(\frac{7-y}{2}\right) – 13$ oe seen
	$\frac{-4 \pm \sqrt{(4)^2 – 4(5)(–20)}}{2(5)}$ oe or $-\frac{4}{10} \pm \sqrt{4 + \left(\frac{4}{10}\right)^2}$ oe	M2	**FT** *their* 3-term quadratic or **M1** for $\sqrt{(4)^2 – 4(5)(–20)}$ or better or for $\frac{–4 + \sqrt{q}}{2 \times 5}$ or $\frac{–4 – \sqrt{q}}{2 \times 5}$ or for $\left(x + \frac{4}{10}\right)^2$ oe
	$x = 1.64$ $y = 3.72$ and $x = – 2.44$ $y = 11.88$	B2	**B1** for one correct pair or both x-values correct or both y – values correct

21. 0580_s23_ms_43 Q: 10

Question	Answer	Marks	Partial Marks
(a)	–2.5 –2 –1	**3**	**B1** for each
(b)	Correct curve 	**4**	**B3 FT** for 8 or 7 correct plots **B2 FT** for 6 or 5 correct plots **B1 FT** for 4 or 3 correct plots
(c)	2.3 to 2.4	**1**	
(d)	ruled line $y = x - 1.5$	**M2**	**M1** for $y = x - 1.5$ soi or for $2^x - 3 = x - 1.5$ seen. or $y = x + k$ or $y = kx - 1.5$ drawn Do not accept $y = -1.5$
	–1 and 1.55 to 1.7	**A2**	**A1** for each

22. 0580_w23_ms_41 Q: 2

Question	Answer	Marks	Partial Marks
(a)	1960	**2**	**M1** for $\frac{1}{2} \times 9.8 \times 20^2$ oe
(b)	1.5 or 1½ or $\frac{3}{2}$	**3**	**M1** for a first correct step, e.g. $20y - 15 = 15$ or $4y - 3 = 3$ **M1FTdep** for a second correct step, e.g. $20y = 30$ or $4y = 6$ or $y - \frac{15}{20} = \frac{15}{20}$ oe
(c)	$9x - 10$ final answer	**2**	**B1** for $kx - 10$ or $9x + c$ or **M1** for $15x - 24$ or $-6x + 14$ or **B1** for correct answer seen and then spoiled
(d)	$\sqrt[3]{\frac{2b^2 - A}{3}}$ oe final answer	**3**	**M1** for isolating $3c^3$, $3c^3 = 2b^2 - A$ oe or for $\frac{A}{3} = \frac{2b^2}{3} - c^3$ or $\frac{A}{-3} = \frac{2b^2}{-3} + c^3$ **M1FT** for isolating c^3, follow through their first step dep on a 3-term expression with a kc^3 term **M1FT** taking the cube root to the final answer, follow through their previous step Maximum of two marks if answer incorrect
(e)	$(2q - 1)(3p - 2)$ or $(1 - 2q)(2 - 3p)$ final answer	**2**	**M1** for $2q(3p - 2) - [1](3p - 2)$ or $3p(2q - 1) - 2(2q - 1)$ or for correct answer seen then spoiled

23. 0580_w23_ms_41 Q: 6

Question	Answer	Marks	Partial Marks
(a)	A 9	**B1**	
	$4n - 11$ oe final answer	**B2**	**B1** for $4n - k$ or $jn - 11$ oe $j \neq 0$
	B 55	**B1**	
	$2n^2 + 5$ oe final answer	**B2**	**B1** for any quadratic or second differences = 4
	C $\frac{6}{2187}$ oe	**B1**	
	$\frac{n+1}{3^{n+2}}$ oe final answer	**B3**	**B2** for 3^{n+2} oe OR **B1** for 3^{n+k} seen oe **B1** for $n + 1$ as the numerator of a fraction
(b)	331 cao	**1**	

24. 0580_w23_ms_41 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	–20	**1**	
(a)(ii)	$\frac{x+3}{2}$ oe final answer	**2**	**M1** for $x = 2y - 3$ or better or $y + 3 = 2x$ or better or $\frac{y}{2} = x - \frac{3}{2}$ or better
(a)(iii)	125	**2**	**M1** for g(64) or $2(4^{2x-1}) - 3$
(b)	2.5 oe	**2**	**M1** for $2(2x) - 3 = 7$ or better
(c)	$2x^2 + 4x - 11$ final answer	**3**	**B2** for $2x^2$ and either $+4x$ or -11 in final 3 term answer or for correct answer seen then spoiled or **M1** for $2x^2 - 3 + 2(2x - 3) - 3$ [+ 1]

Question	Answer	Marks	Partial Marks
(d)	1.5 oe	2	**M1** for $4^{2x-1} = 4^2$ or better
(e)	$a = 3$ $b = 4$ $c = -59$ $d = -20$	3	**B2** for 3 correct values or for correct unsimplified expanded expression or for simplified four-term expression of correct form with 3 terms correct or **B1** for 2 correct values or for correct expansion of one pair of brackets with at least 3 out of 4 terms correct.

25. 0580_w23_ms_41 Q: 11

Question	Answer	Marks	Partial Marks
(a)	$3x^2 - 8x - 3$	2	**B1** for two terms correct or correct answer seen

Question	Answer	Marks	Partial Marks
(b)	$3x^2 - 8x - 3 = 0$	M1	**FT** their **part (a)**
	Correct method to solve their 3-term quadratic $(3x + 1)(x - 3)$ [=0] $\frac{-(-8) \pm \sqrt{(-8)^2 - 4(3)(-3)}}{2(3)}$	M2	**M1** for $(3x + a)(x + b)$ [=0] where $ab = -3$ or $3b + a = -8$ or for $\sqrt{(-8)^2 - 4(3)(-3)}$ or for $\frac{p \pm \sqrt{q}}{r}$ where $p = -(-8)$ and $r = 2(3)$ seen or for a correct method for solving a 2-term quadratic
	$(3, -18)$ $\left(-\frac{1}{3}, \frac{14}{27}\right)$	B2	**B1** for one correct point or for two correct x-values, or **M1** for substitution of *their* x-values into $y = x^3 - 4x^2 - 3x$ **shown**

Question	Answer	Marks	Partial Marks
(c)	(3, –18) minimum with reason $\left(-\frac{1}{3}, \frac{14}{27}\right)$ maximum with reason	3	Reasons could be e.g. 1. A reasonable sketch of a positive cubic 2. Correct use of 2nd derivative = $6x - 8 = 10$, $10 > 0$, so (3, –18) is a minimum oe. 2nd derivative = $6x - 8 = -10$, $-10 < 0$ so $\left(-\frac{1}{3}, \frac{14}{27}\right)$ is a maximum oe. 3. Evaluates correctly values of y on both sides of both correct stationary points 4. Finds gradient on each side of both correct stationary points. **B2** for 1 correct with a reason for that stationary point or for **both** x-values correct with correct conclusions and reasonable sketch of a positive cubic, or for correct substitution of **both** of *their* x-values into *their* second derivative shown, or substitution shown for one x-value either side of **both** of *their* stationary points to find the gradients. Or **M1** for showing [2nd derivative =] $6x - 8$ or substitution shown for one x-value either side of **one** of *their* stationary points to find the gradients. or for reasonable sketch of positive cubic.

26. 0580_w23_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)	20	2	**M1** for $11x = 10(x + 2)$ oe

Question	Answer	Marks	Partial Marks
(b)(i)	$\frac{95}{y}+\frac{147}{y+2}=12$	**M2**	**M1** for $\frac{95}{y}$ or $\frac{147}{y+2}$
	$95(y+2)+147y=12y(y+2)$ oe	**M1**	Allow correct or for clearing *their* equation with algebraic fractions in y and $y+2$ Allow $95y+190+147y=12y^2+24y$ oe
	leading to $6y^2 - 109y - 95 = 0$	**A1**	With all brackets shown expanded and no errors or omissions
(b)(ii)	$(6y + 5)(y - 19)$	**2**	**B1** for $(6y + a)(y + b)$ with $ab = -95$ or $a + 6b = -109$ or $(3y + a)(2y + b)$ with $ab = -95$ or $2a + 3b = -109$ or for partial factorisation $y(6y + 5) - 19(6y + 5)$ or $6y(y - 19) + 5(y - 19)$
(b)(iii)	19	**1**	Correct or FT *their* positive answer from factors dep on B1 earned

27. 0580_w23_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)	4	**1**	
(b)	$7 - 3x$ final answer	**2**	**M1** for $1 - 3(x - 2)$
(c)	$\frac{1-x}{3}$ oe final answer	**2**	**M1** for $x = 1 - 3y$ or $y - 1 = -3x$ or $1 - y = 3x$ or $\frac{y}{3} = \frac{1}{3} - x$
(d)	$a = 2, b = 5, c = -1$	**5**	**B4** for two correct values only after correct substitution seen i.e. $(1 - 3x - 1)^2 - (x - 1)^2(1 - 3x)$ or for correct unsimplified expansion or a correct simplified expansion. OR **M1** for $(1 - 3x - 1)^2 - (x - 1)^2(1 - 3x)$ **B2** for correct expansion of $[-](x - 1)^2(1 - 3x)$ $[-](x^2 - x - x + 1 - 3x^3 + 3x^2 + 3x^2 - 3x)$ or better or **B1** for expansion of one pair of brackets $[(x-1)^2 =]x^2 - x - x + 1$ or better or $[(x - 1)(1 - 3x) =] - 3x^2 + x + 3x - 1$
(e)	$\frac{3 - x + 3x^2}{x}$ final answer	**3**	**B1** for $3 - x(1 - 3x)$ or better **B1** for common denominator x isw
(f)	–7	**1**	

28. 0580_w23_ms_43 Q: 6

Question	Answer	Marks	Partial Marks
(a)(i)	7	**1**	
(a)(ii)	$\frac{1}{8}$ oe	**2**	**M1** for g(–0.5) or for $64^{5(x)-3}$ or better

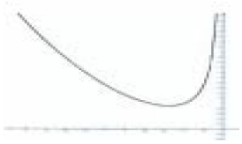
Question	Answer	Marks	Partial Marks
(b)	$\frac{2-x}{x}$ or $\frac{2}{x}-1$ final answer	3	**M1** for $y(x+1)=2$ or $x=\frac{2}{y+1}$ or better **M1** for $\frac{2-y}{y}$ or $xy=2-x$ oe
c	$-\frac{5}{6}$ –0.833 or better	2	**M1** for $[64^x=]\ 2^{6x}$ or $(2^6)^x$ or $6x=-5$
(d)	$\frac{7-9x}{(5x-3)(x+1)}$ or $\frac{7-9x}{5x^2+2x-3}$ or $-\frac{9x-7}{5x^2+2x-3}$ final answer	4	**B1** for $\frac{1}{5x-3}-\frac{2}{x+1}$ **M1** for $x+1-2(5x-3)$ seen isw **M1** for $(5x-3)(x+1)$ seen isw

29. 0580_w23_ms_43 Q: 10

Question	Answer	Marks	Partial Marks
(a)	$14x-22$ or $2(7x-11)$ final answer	2	**B1** for answer $kx-22$ or $14x+c$ or for $8x-4$ or $-18+6x$ or for correct answer seen in working
(b)(i)	$3xy(2x+3)$ final answer	2	**M1** for answer $3(2x^2y+3xy)$ or $3x(2xy+3y)$ or $3y(2x^2+3x)$ or $xy(6x+9)$ **B1** for correct answer seen and spoilt
(b)(ii)	$(2x+y)(2x-y+4)$ final answer	3	**M1** for $(2x+y)(2x-y)$ **M1** for $4(2x+y)$ If 0 scored, SC1 for answer $4x(x+2)+y(4-y)$ oe
(c)(i)	$\frac{100}{x}+\frac{150}{x+10}=4\frac{1}{3}$ oe or $150=\left(\frac{13}{3}-\frac{100}{x}\right)(x+10)$	M1	
	$\frac{100(x+10)+150x}{x(x+10)}$ [= *their* $4\frac{1}{3}$] or better	M1	
	$300x+3000+450x=13x^2+130x$ oe or better	B1	Allow correct multiples
	$13x^2-620x-3000=0$	A1	With no errors or omissions

Question	Answer	Marks	Partial Marks
(c)(ii)	$\frac{[--]620 \pm \sqrt{(-620)^2 - 4(13)(-3000)}}{2(13)}$ or $-\frac{(-620)}{2\times13} \pm \sqrt{\frac{620^2}{4\times13^2} - \frac{(-3000)}{13}}$ both oe or better	M2	**M1** for $\sqrt{(-620)^2 - 4\times13\times-3000}$ oe or for $\frac{--620+\sqrt{p}}{2(13)}$ or $\frac{--620-\sqrt{p}}{2(13)}$ oe
	52.1 final answer	B1	

30. 0580_m22_ms_42 Q: 2

Question	Answer	Marks	Partial Marks
(a)	1[.0] 0.9	2	**B1** for each
(b)	correct curve 	4	**B3 FT** for 6 or 7 points **B2 FT** for 4 or 5 points **B1 FT** for 2 or 3 points

Question	Answer	Marks	Partial Marks
(c)	ruled line at $y = -1$	B1	
	0.3 to 0.32	B1	

31. 0580_m22_ms_42 Q: 3

Question	Answer	Marks	Partial Marks
(a)(i)	169	2	**M1** for g(13) or $(1+4x)^2$ or better
(a)(ii)	$1+4x^2$ final answer	1	
(a)(iii)	x	1	
(b)	3.5 or $\frac{7}{2}$	2	**M1** for $1+4x=15$

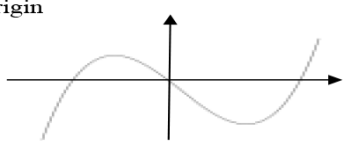
32. 0580_m22_ms_42 Q: 8

Question	Answer	Marks	Partial Marks
(a)	$\frac{12}{x}+\frac{26}{x+10}=2.8$ oe isw	3	**B2** for $\frac{12}{x}+\frac{26}{x+10}$ oe isw OR **B1** for $\frac{26}{x+10}$ seen **B1** for time = 2.8 or $\frac{168}{60}$ or $2\frac{48}{60}$ oe
(b)	$12(x+10)+26x=2.8x(x+10)$ or better	M2	**FT** *their* time, provided 2 algebraic fractions one in x and other in $\pm x \pm 10$ **M1** for $12(x+10)+26x$ seen or better
	$12x+120+26x=2.8x^2+28x$	M1	**FT** *their* equation dep on M2
	$2.8x^2-10x-120=0$ oe or $30x + 300 + 65x = 7x^2 + 70x$ or better leading to $7x^2-25x-300=0$	A1	with no errors or omissions
(c)	$\frac{[--]25\pm\sqrt{([-]25)^2-4\times7\times-300}}{2\times7}$ oe	B2	**B1** for $\sqrt{([-]25)^2-4(7)(-300)}$ or better or for $\frac{[--]25+\sqrt{q}}{2\times7}$ or $\frac{[--]25-\sqrt{q}}{2\times7}$
	-5 and 8.57 or 8.571...	B2	**B1** for each or **SC1** for final answers 5 and –8.57
(d)	84 to 84.01...	2	**FT** $\frac{720}{\textit{their}\text{ positive answer}}$ to 3 sf or better **M1** for $\frac{12}{\textit{their}\text{ positive answer}}$ [× 60] oe

33. 0580_m22_ms_42 Q: 10

Question	Answer	Marks	Partial Marks
(a)	x^3+2x^2-5x-6 final answer	3	**B2** for correct expansion of three brackets unsimplified or for simplified expression of correct form with 3 out of 4 terms correct or **B1** for correct expansion of 2 of the 3 given brackets with at least 3 terms out of four correct
(b)	$\frac{Mc}{M-2f}$ or $\frac{-Mc}{2f-M}$ final answer	4	**M1** for clearing $g-c$ from denominator e.g. $M(g-c)=2fg$ **M1** for correctly isolating terms in g in numerator on one side **M1** for correctly factorising or simplifying, to single term in g in an equation **M1** for correctly dividing by bracket to final answer
(c)	$\frac{4x}{x+4}$ final answer	3	**B1** for $4x(x-4)$ **B1** for $(x+4)(x-4)$

34. 0580_m22_ms_42 Q: 12

Question	Answer	Marks	Partial Marks
(a)	85[.0], 265[.0] and no others	2	**B1** for each If 0 scored **SC1** for two values in the range with a difference of 180 but not multiples of 90
(b)	correct shape and passes through origin 	3	**B1** for any positive cubic shape **B1** for sketch with one max and one min and with 3 roots including zero If 0 scored, **SC1** for $x(x+2)(x-2)$ soi
(c)	$a=-12$ $b=5$ $k=-11$	6	**B5** for 2 correct OR **B2** for $3x^2+a$ or **B1** for $3x^2$ isw **M1dep** on at least B1 for *their* $\frac{dy}{dx}=0$ **M1dep** on at least B1M1 for $x=2$ or $x=-2$ substituted in *their* $\frac{dy}{dx}=0$ equation **M1** for $k=2^3+2\times$*their* $a+b$ **and** $10-k=(-2)^3+(-2)\times$*their* $a+b$

35. 0580_s22_ms_41 Q: 3

Question	Answer	Marks	Partial Marks
(a)(i)	6	3	**B2** for $4x+6=30$ or better or **M1** for $x+x+7+2x-1$ [= 30]
(a)(ii)	21	3	**M2** for (555 – *their* $x\times15$ – *their* $(x+7)\times18$) ÷ *their* $(2x-1)$ or **M1** for *their* $x\times15$ or *their* $(x+7)\times18$
(b)(i)	8	2	**M1** for isolating the term in w or correctly removing all fractions e.g. $\frac{3w}{16}=1+\frac{1}{2}$ or better or $3w-16=8$
(b)(ii)	–3	2	**M1** for $2^{-y}=8$ or $2^{y}=\frac{1}{8}$ or $2^{-y}=$*their* w or better

Question	Answer	Marks	Partial Marks
(c)(i)	$[p=]\ \frac{1}{2}$ oe $[q=]\ 1$	2	**B1** for each If zero scored, **SC1** for 2 values satisfying one of the original equations
(c)(ii)	$[u=]$ 30 and 150 $[v=]$ 0 and 360	4	**B1** for each OR **SC1** for $\sin u = $ *their* p and $\cos v = $ *their* q **SC1** if their two different angles for u sum to 180 or if their different two angles for v sum to 360

36. 0580_s22_ms_41 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	3	1	
(a)(ii)	7	1	**FT** *their* (i) 3×*their* (i) −2
(b)	$\frac{x+2}{3}$ oe final answer	2	**M1** for $y+2=3x$ or $\frac{y}{3}=x-\frac{2}{3}$ or $x=3y-2$
(c)	25	2	**M1** for $\frac{1}{x}=5^{-2}$ oe
(d)	$\frac{2x^2-x-1}{x}$ final answer	2	**M1** for $2x-1-\frac{1}{x}$
(e)	2.98×10^{17} or $2.980...\times10^{17}$	1	
(f)	625	2	**M1** for $x = $ j(4)

37. 0580_s22_ms_41 Q: 6

Question	Answer	Marks	Partial Marks
(a)(i)	–3	1	
(a)(ii)	–1 1.55 to 1.6 4.4 to 4.45	3	**B1** for each
(a)(iii)	–8	1	
(a)(iv)	Ruled line through origin intersecting curve once	2	**B1** for ruled line through origin
(b)(i)	18	3	**B2** for $6x - 12$ or **B1** for $6x$ or -12
(b)(ii)	(2, –5)	2	**B1** for each. If 0 scored, **M1** for *their* $6x - 12 = 0$ or states $\frac{dy}{dx} = 0$
(c)	$[p =]$ 7 $[q =]$ 3	2	**B1** for each

38. 0580_s22_ms_41 Q: 9

Question	Answer	Marks	Partial Marks
(a)	$x^2 - x - 30 [= 0]$	B3	M1 for $(2x+1)(x-1) - x^2 = 29$ oe B1 for $(2x+1)(x-1) = 2x^2 - 2x + x - 1$ oe soi
	$(x-6)(x+5)$ oe	M1	or correct factors for *their* 3 term quadratic equation or for correct substitution into quadratic formula or correctly completing the square for *their* 3 term quadratic equation
	$x = 6$ cao	B1	
	12 or 2 × *their x* evaluated or $k = 2x$ stated	B1 FT	
(b)(i)	$(y+1)^3 - y^3 = 5$ oe	M1	
	$(y+1)^3 = y^3 + 3y^2 + 3y + 1$ soi	B2	B1 for $(y+1)^2 = y^2 + y + y + 1$ oe soi
	Completion to $3y^2 + 3y - 4 = 0$	A1	With no errors or omissions
(b)(ii)	$\frac{-3 \pm \sqrt{3^2 - 4(3)(-4)}}{2 \times 3}$	B2	or B1 for $\sqrt{3^2 - 4(3)(-4)}$ or for $\frac{-3+\sqrt{...}}{2\times3}$ or $\frac{-3-\sqrt{...}}{2\times3}$
	0.44	B2	B1 for 0.758 or 0.7583...

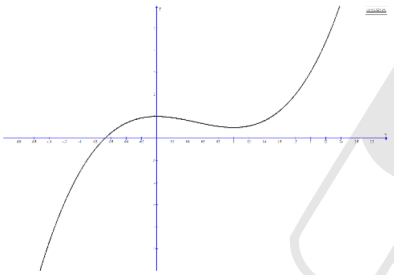
39. 0580_s22_ms_42 Q: 8

Question	Answer	Marks	Partial Marks
(a)	$\frac{1}{2}$ or 0.5 oe	**2**	**M1** for $10-3=11p+3p$ oe or better
(b)	$[m=]\frac{2k}{c^2-g}$ oe final answer	**3**	**M1** for correctly isolating m terms **M1** for correctly factorising **M1** for dividing by a bracket with two terms to the final answer Maximum mark **M2** if final answer incorrect
(c)	0 4.5 oe	**5**	**B4** for $2x^2-9x\,[=0]$ or $9x-2x^2\,[=0]$ or better OR **M2** for $(2x+3)+4(x-3)=(x-3)(2x+3)$ or better or **M1** for $(2x+3)+4(x-3)$ seen oe or common denominator $(x-3)(2x+3)$ oe **B1** for $2x^2-6x+3x-9$ or better seen
(d)	$y^2-10y+21[=0]$ or $x^2-4x-12[=0]$	**M2**	**M1** for $y^2+5(12-2y)=39$ oe or $5x+\frac{(12-x)^2}{2^2}=39$ seen oe
	$(y-3)(y-7)\,[=0]$ or $(x+2)(x-6)\,[=0]$	**M1**	or for correct factors for *their* 3– term quadratic equation or for correct substitution into quadratic formula or correctly completing the square for *their* 3–term quadratic equation
	$x=-2 \quad y=7$ $x=6 \quad y=3$	**B2**	**B1** for $x=-2, x=6$ or for $y=7, y=3$ or for one correct pair of x and y values
(e)	$2x^3+x^2-54x+72$ final answer	**3**	**B2** correct expansion of three brackets unsimplified or for final answer of correct form with 3 out of 4 terms correct or **B1** correct expansion of two brackets with at least three terms out of four correct

40. 0580_s22_ms_42 Q: 10

Question	Answer	Marks	Partial Marks
(a)	1, 2, 3	**2**	**M1** for $15 - 8 > 5n - 3n$ oe If 0 scored, **B1** for 2 correct answers and no others or 3 correct answers with one extra value
(b)(i)	$10y + 8x \leqslant 80$ oe final answer $x > 4$ oe final answer $2y > x - 4$ oe final answer	**3**	**B1** for each If 0 scored, **SC1** for $10y + 8x < 80$ oe final answer and $x \geqslant 4$ oe final answer and $2y \geqslant x - 4$ oe final answer
(b)(ii)	23 final answer	**2**	**M1** for 7 and 2 selected soi

41. 0580_s22_ms_42 Q: 12

Question	Answer	Marks	Partial Marks
(a)	$3x^2 - 2kx$	**M2**	**M1** for $3x^2$ or $-2kx$
	their $\frac{dy}{dx} = 6$	**M1**	Dep on at least M1 for derivative
	$x = 2$ substituted in *their* $\frac{dy}{dx}$	**M1**	Dep on at least M1 for derivative
	Correct working leading to 1.5 oe	**A1**	A0 if any errors in working leading to 1.5
(b)	(0, 1) (1, 0.5)	**4**	**B3** for $x = 0$ and $x = 1$ or for (1, 0.5) OR **M1** for *their* $\frac{dy}{dx} = 0$ **B1** for $3x^2 - 3x$ oe or better
(c)	correct sketch 	**2**	with max on positive y-axis and min in 1st quadrant **B1** for positive cubic or for graph with one max which is on pos y-axis and one min which is in 1st quadrant

42. 0580_s22_ms_43 Q: 3

Question	Answer	Marks	Partial Marks
(a)(i)(a)	187 or 186.7 to 186.8 or $186\frac{42}{53}$	**1**	
(a)(i)(b)	2 : 7 : 42 cao	**2**	**B1** for 106 : 371 : 2226 or any equivalent ratio If 0 scored, **SC1** for 2 : 7 : 42 in the wrong order
(a)(ii)	33.3 or 33.28 to 33.29	**2**	**M1** for $\frac{2967 - 2226}{2226}$ [× 100] oe or $\frac{2967}{2226} \times 100$ [– 100] oe

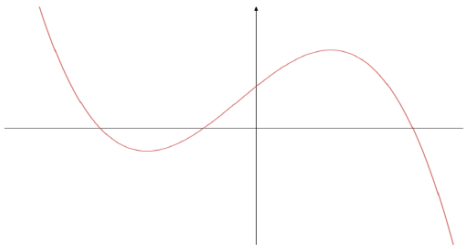
Question	Answer	Marks	Partial Marks
(a)(iii)	1706 cao nfww	3	**B2** for 1705 to 1706.0... or 1710 or **M1** for $\left(1+\frac{30.48}{100}\right)x = 2226$ oe or better If 0 or M1 scored, **SC1** for rounding *their* decimal answer seen to nearest integer
(b)	3897	5	**B1** for $a = 2000$ **M2** for $[b =] \sqrt[3]{\frac{2662}{2000}}$ or **M1** for $2662 = 2000b^3$ **M1** for *their* $2000 \times \left(\sqrt[3]{\frac{2662}{their 2000}}\right)^7$ or for *their* $a \times (their\ b)^7$ provided *their* a and *their* b are clearly identified in the working If 0 or M1 scored, **SC1** for rounding *their* decimal answer seen to nearest integer.

43. 0580_s22_ms_43 Q: 6

Question	Answer	Marks	Partial Marks
(a)	$5b - 2a$ final answer	2	**B1** for $5b$ or $-2a$ in final answer or for $5b - 2a$ seen
(b)	$6x - 23$ final answer nfww	2	**M1** for $4x - 20$ or $-3 + 2x$

Question	Answer	Marks	Partial Marks
(c)	$\frac{35-x}{2x(x-5)}$ or $\frac{35-x}{2x^2-10x}$ oe final answer nfww	3	**B1** for $3(2x) - 7(x - 5)$ or better isw **B1** for $2x(x - 5)$ as common denominator isw, allow expanded
(d)	-5	3	**M1** for $13 - 4x = 18 - 3x$ oe or $\frac{-4x}{3} + x = 6 - \frac{13}{3}$ oe **M1FT** for $-4x + 3x = 18 - 13$ oe or for $\frac{-x}{3} = \frac{5}{3}$
(e)	$[x =] \frac{5p}{y+10}$ oe final answer	4	**M1** for correctly clearing the x from the denominator **M1** for correctly expanding the brackets or (dealing with the 5 correctly throughout) **M1** for correctly isolating terms in x **M1** for correctly factorising and dividing by the bracket Max 3 marks if answer is incorrect

44. 0580_s22_ms_43 Q: 9

Question	Answer	Marks	Partial Marks
(a)	Correct sketch of negative cubic crossing the x-axis at -3, -1 and 3 and crossing the y-axis at 9 	**4**	**B1** for any negative cubic shape with two turning points **B2** for three intercepts only with x-axis labelled at -3, -1 and 3 or **B1** for one or two correctly labelled x-intercepts **B1** for intercept with y-axis labelled at 9 If no graph drawn, **SC1** for all four intercepts labelled on axes.
(b)(i)	$3 - x + 3x - x^2$ or better or $3 + x + 3x + x^2$ or better or $9\ [-3x + 3x] - x^2$	**M1**	At least 3 of the four terms correct or for the correct expansion of all three brackets with all 8 terms correct
	Correct completion to $[y =]\ 9 + 9x - x^2 - x^3$	**A1**	with no errors or omissions seen

Question	Answer	Marks	Partial Marks
(b)(ii)	$9 - 2x - 3x^2 = 0$ oe	**B3**	**B2** for $9 - 2x - 3x^2$ or **B1** for two correct terms **M1** for *their* derivative = 0 or stating $\frac{dy}{dx} = 0$
	$\frac{-{-2} \pm \sqrt{(-2)^2 - 4 \times -3 \times 9}}{2 \times -3}$ oe **OR** $-\frac{1}{3} \pm \sqrt{\frac{9}{3} + \left(\frac{1}{3}\right)^2}$ oe	**B2**	FT *their* derivative **B1FT** for $\sqrt{(-2)^2 - 4(-3)(9)}$ or better or for $\frac{-(-2) + \sqrt{q}}{2 \times -3}$ or $\frac{-(-2) - \sqrt{q}}{2 \times -3}$ OR **B1** for $\left(x + \frac{1}{3}\right)^2$
	-2.10 and 1.43 final answer	**B2**	**B1** for each or for answers -2.1 or -2.097 ... and 1.4 or 1.430 to 1.431 or **SC1** for -2.097... **and** 1.43[0] to 1.431 seen in working or for -1.43 **and** 2.10 as final answer
(b)(iii)	$[a =] -6$ $[b =]\ 17$	**3**	**B2** for either a correct or b correct or for $[a =]$ -5.04 or -5.049 to -5.05 **and** $[b =]$ 16.9... seen or **M1** for substitution of one of *their* solutions into $9 + 9x - x^2 - x^3$ oe or **SC1** for reversed answers, $a = 17$, $b = -6$

45. 0580_w22_ms_41 Q: 3

Question	Answer	Marks	Partial Marks
(a)	$-2 < x \leqslant 4$ oe	1	
(b)(i)	$-3 \leqslant x < 3$ final answer	3	**M2** for $-3 \leq x < k$ or for $k \leqslant x < 3$ or for $-6 \leqslant 2x < 6$ or for $-\frac{3}{2} - \frac{3}{2} \leqslant x < \frac{9}{2} - \frac{3}{2}$ or **M1** for $-3 - 3 \leqslant 2x < 9 - 3$ or for $-\frac{3}{2} \leqslant x + \frac{3}{2} < \frac{9}{2}$ After 0 scored SC1 for $-3 \leqslant x$ or for $x < 3$
(b)(ii)	$-3, -2, -1, 0, 1, 2$ final answer	2	**FT** *their* **(i)** as long as negative and positive values **B1FT** for one error or omission
(c)(i)	$\frac{36}{17}$ oe	4	**B3** for $-15x - 2x = 5 + 4 - 45$ or better OR **B2** for $45 - 15x - 2x - 4 = 5$ oe OR **M1** for correct removal of fraction or **M1** for correct removal of brackets
(c)(ii)	-8	3	**B2** for $5x - 3x = 9 - 25$ or better or **M1** for $5(x + 5) = 3(x + 3)$ oe or better

46. 0580_w22_ms_41 Q: 7

Question	Answer	Marks	Partial Marks
(a)(i)	4	1	
(a)(ii)	16	1	**FT** $2^{their\,4}$
(b)	3	1	
(c)	$\frac{1}{4}$ oe	2	**M1** for $\frac{2}{x} = 2^3$ or better
(d)	$\frac{5-x}{2}$ oe final answer	2	**M1** for $x = 5 - 2y$ or $y + 2x = 5$ oe or $\frac{y}{2} = \frac{5}{2} - x$ oe
(e)	$\frac{11x - x^2 + 2}{x}$ final answer	3	**B2** for $\frac{x(10-x)+2+x}{x}$ oe single fraction or **B1** for $x(10-x) + 2 + x$ oe or **M1** for $10 - x + \frac{2}{x} + 1$
(f)	$[a =]$ 1 $[b =] -21$ $[c =]$ 100	4	**B3** for $x^2 - 21x + 100$ OR **M1** for $(10-x)^2 - (10-(10-x))$ oe or better **B2** for $[(10-x)^2] = 100 - 10x - 10x + x^2$ or **B1** for three out of four terms of $[(10-x)^2] = 100 - 10x - 10x + x^2$ correct
(g)	1024	2	**M1** for $[x =]$ h(10) oe or better

47. 0580_w22_ms_41 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	$x(3x+4)+2(x-1)[=20]$	M1	Correct expression with brackets unexpanded
	Leading to $3x^2+6x-22=0$ with no errors or omissions	A1	Must see equated to 20 and brackets expanded first to award A1
(a)(ii)	$\frac{-6\pm\sqrt{6^2-4(3)(-22)}}{2.3}$ oe or for $=-1\pm\sqrt{1+\frac{22}{3}}$ oe	B2	**B1** for $\sqrt{6^2-4(3)(-22)}$ or $\frac{-6+\text{or}-\sqrt{k}}{2.3}$ or $(x+1)^2=k$ oe
	–3.887 and 1.887 cao	B2	**B1** for one correct answer or for answers –3.89 or – 3.88 or -3.886 or –3.8868 to –3.8867 and 1.88 or 1.89 or 1.886 or 1.8867 to 1.8868 or correct answers seen in working or –1.887 and 3.887 answers
(a)(iii)	5.77 or 5.773 to 5.774	1	**FTdep** 2(positive x +1) evaluated to 3 sig. fig. or more, dep on $x > 1$

Question	Answer	Marks	Partial Marks
(b)	$y^2+3y-40[=0]$ oe	B4	Oe 3 term quadratic **M3** for $15y-20(y-2)=y(y-2)$ oe Or **M2** for $\frac{15}{y-2}-\frac{20}{y}=1$ oe Or **M1** for $H(y-2)=15$ or $hy=20$ soi
	$(y+8)(y-5)$ [= 0] oe	B2	**Strict FT** a three term quadratic **B1FT** for $(y+a)(y+b)$ where $ab=-40$ or $a+b=3$ or y(y – 5) + 8 (y – 5) or $y(y+8)-5(y+8)$
	5	B1	

48. 0580_w22_ms_41 Q: 10

Question	Answer	Marks	Partial Marks
(a)(i)	4 or 5 or 7 or 8 or 9	1	
(a)(ii)	[a =] 3, [b =] 10	2	**B1** for each or for a and b transposed
(b)	$6x^5-30x^4$	B2	**B1** for $6x^5$ or $-30x^4$
	their derivative = 0.	M1	
	(0, 0) and (5, –3125)	B2	**B1** for (5, –3125) or for $x = 0$ and $x = 5$

49. 0580_w22_ms_42 Q: 1

Question	Answer	Marks	Partial Marks
(a)(i)	75	2	**M1** for $\frac{45}{3}$ [× k] where k is 1, 5 or 8
(a)(ii)	2.332 oe	2	**M1** for 2.65 [million] × $\left(1-\frac{12}{100}\right)$ oe or **B1** for 0.318[million] seen
(a)(iii)	23 280 cao	2	**M1** for $\frac{6.25}{100}\times x = 1455$ or better
(a)(iv)	1450 or 1449 to 1450	3	**M2** for $1631 = k\left(1+\frac{4}{100}\right)^3$ oe or better or **B1** for $\left(1+\frac{4}{100}\right)^3$ oe seen or **M1** for $1631 = k\left(1+\frac{4}{100}\right)^n$, $n > 0$ oe
(b)(i)	$\frac{7x}{2}$ oe	1	
(b)(ii)	$x + 12$ $\frac{7x}{2} - 26$ oe final answer	2	**FT** *their* **(b)(i)** **B1** for $x + 12$ **B1** for *their* $\frac{7x}{2} - 26$

Question	Answer	Marks	Partial Marks
(b)(iii)	$\frac{7x}{2} - 26 = 3(x + 12)$ oe leading to 124	4	**M1dep** for *their* $\left(\frac{7x}{2} - 26\right) = 3 \times$ *their* $(x + 12)$ oe **M2dep** for isolating x terms, dep on eqn with term in x and constant on each side and with a bracket **or** fraction. or **M1dep** for correctly removing brackets or dealing with fractions, dep on eqn with term in x and constant on each side and with a bracket **or** fraction.

50. 0580_w22_ms_42 Q: 2

Question	Answer	Marks	Partial Marks
(a)(i)	28	1	
(a)(ii)	Correct curve	4	**B3FT** for 9 or 10 correct points or **B2FT** for 7 or 8 correct points or **B1FT** for 5 or 6 correct points
(a)(iii)	2.5 to 2.8 8.2 to 8.5	2	**B1** for each value
(b)(i)	$2x^2 + 4x(9 - x)$ oe	M1	Accept the sum of individual areas if done in smaller parts
	$2x^2 + 36x - 4x^2$ oe Leading to $36x - 2x^2$	A1	With intermediate step shown and brackets removed with no errors or omissions
(b)(ii)	144	3	**B1** for $x = 6$ identified from graph or using calculus **M1** for $36 \times \textit{their}6 - 2 \times (\textit{their}\ 6)^2$

51. 0580_w22_ms_42 Q: 6

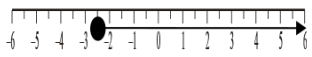
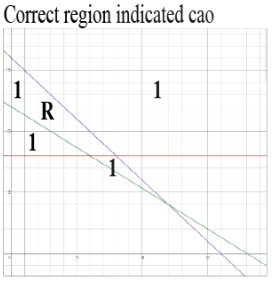
Question	Answer	Marks	Partial Marks
(a)	-1.5 or $-1\frac{1}{2}$ or $-\frac{3}{2}$	2	**M1** for $4x = 9 - 15$ or $x + \frac{15}{4} = \frac{9}{4}$
(b)	$(a-3)(a+3)$ final answer	1	
(c)	$\frac{8c}{3d}$ final answer	3	**B2** for $\frac{8ac}{3ad}$ or $\frac{40c}{15d}$ or $\frac{4}{1}\times\frac{2c}{3d}$ seen or for correct answer seen then spoiled or **M1** for $\frac{4a}{5}\times\frac{10c}{3ad}$ or $\frac{8ac}{10c}\div\frac{3ad}{10c}$ oe
(d)	$n+1$ final answer	2	**M1** for 5×5^n or 5^{n+1} seen
(e)	$(2x-1)(2x+5)$ [= 0] oe	B2	**M1** for $2x(2x+5) - [1](2x+5)$ [= 0] or $2x(2x-1) + 5(2x-1)$ [= 0] or for $(2x+m)(2x+n)$ [= 0] with and $mn = -5$ or $n + m = 4$
	$\frac{1}{2}$ or 0.5 and -2.5 or $-2\frac{1}{2}$ or $-\frac{5}{2}$	B1	
(f)(i)	7	3	**M1** for $y = k(x+3)^3$ or better **M1** for $108 = \textit{their}\ k(x+3)^3$
(f)(ii)	4	2	**M1** for $\left(\frac{1}{2}\right)^2$ oe or $\frac{k}{\frac{1}{4}d^2}$ oe seen or better

Question	Answer	Marks	Partial Marks
(g)	$2x^3 + 7x^2 - 9$ final answer	3	**B2** for correct expansion unsimplified or for simplified 4 term expression of correct form with 3 terms correct or **B1** for one pair of brackets expanded with at least 3 terms out of 4 correct
(h)	$6x + 4$	2	**B1** for $6x$ or 4 or $6x + 4$ with one extra term seen

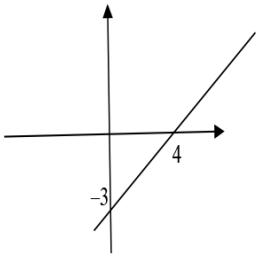
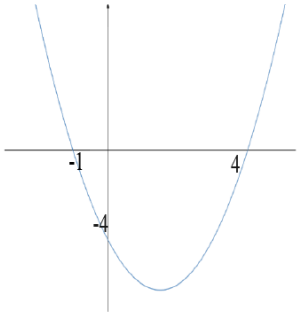
52. 0580_w22_ms_43 Q: 2

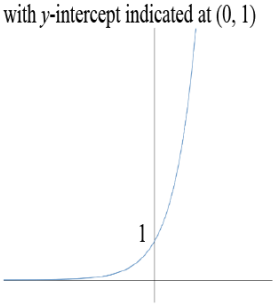
Question	Answer	Marks	Partial Marks
(a)(i)	p^{14} final answer	1	
(a)(ii)	$6m^4$ final answer	2	**B1** for $6m^k$ or km^4 in final answer or correct answer seen and spoilt
(a)(iii)	$\frac{4}{3x^3y^9}$ or $\frac{4x^{-3}y^{-9}}{3}$ final answer	3	**B2** for correct answer seen and spoilt or 2 correct elements in final answer or **B1** for one of $\frac{4}{3}$ or $\frac{3}{4}$ oe or x^3 **or** y^9 seen
(b)	3, 12, 27	2	**B1** for 12 or 27
(c)(i)	$3n + 10$ oe final answer	2	**B1** for $3n + k$ oe or $jn + 10$ oe ($j \neq 0$) or for correct expression shown in working and then spoilt
(c)(ii)	$2n^3 + 1$ oe final answer	2	**B1** for 3rd diff = 12 (both needed) or for cubic answer or for correct expression shown in working and then spoilt
(d)	38	3	**M2** for $3x = 4 \times 23 + 22$ or **M1** for $3x - 22 = 4 \times 23$ or for $\frac{3x}{4} = 23 + \frac{22}{4}$ oe
(e)	$\frac{-8 \pm \sqrt{8^2 - 4(3)(-20)}}{2 \times 3}$ or $\frac{-8}{2 \times 3} \pm \sqrt{\frac{8^2}{4 \times 3^2} - \frac{(-20)}{3}}$ or better	B2	**B1** for $\sqrt{8^2 - 4(3)(-20)}$ oe or $\frac{-8 + \sqrt{q}}{2 \times 3}$ oe or $\frac{-8 - \sqrt{q}}{2 \times 3}$ oe or both
	– 4.24, 1.57 final answers	B2	**B1** for each If **B0, SC1** for answers – 4.2 or –4.23 or –4.240 to – 4.239 **and** 1.6 or 1.572 to 1.573 or – 4.24 **and** 1.57 seen in working or for –1.57 and 4.24 as final answer

53. 0580_w22_ms_43 Q: 6

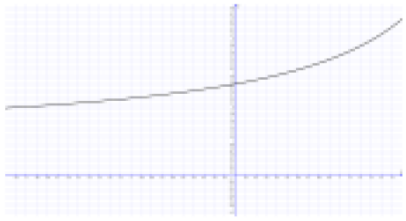
Question	Answer	Marks	Partial Marks
(a)(i)	38	2	**M1** for $5 \times 3^2 - 7$ oe
(a)(ii)	$[\pm]\sqrt{\frac{P+7}{5}}$ oe final answer	3	**M1** for $P + 7 = 5k^2$ or $\frac{P}{5} = k^2 - \frac{7}{5}$ **M1** for $k^2 =$ ..... FT *their* first step **M1** for square root to final answer Max M2 for incorrect answer
(b)(i)	$x \geqslant -2.5$ final answer	2	**M1** for $-4x \leqslant 7 + 3$ or better
(b)(ii)		1	**FT** *their* inequality in **(b)(i)**
(c)(i)	$x = 2$ broken line	**B1**	
	$y = 32 - x$ solid line	**B1**	
	$2x + 3y = 72$ solid line	**B2**	**B1** for line passing through (0, 24) or (36, 0)
	Correct region indicated cao 	**B2**	**B1** for region satisfying 3 of the inequalities
(c)(ii)	(16, 16)	2	**M1** for substitution into $2x + y$ for any integer point in *their* region

54. 0580_w22_ms_43 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	Correct sketch of $3x - 4y = 12$ with $y = -3$ and $x = 4$ indicated on axes 	2	**B1** for line with positive gradient
(a)(ii)	Correct sketch of $y = x^2 - 3x - 4$ with $(0, -4)$ indicated as y – intercept and $x = -1$ and $x = 4$ indicated as roots  Minimum in fourth quadrant, not at $x = 0$	4	**B3** for correct sketch with one value omitted or incorrect or for a poor sketch with all 3 intercepts correct. or **B2** for roots $x = -1$ and $x = 4$ soi with no extra roots or for correct shape with $y = -4$ indicated or **B1** for correct shape or for $(x - 4)(x + 1)$ shown or for incorrect sketch with $(0, -4)$ indicated as y – intercept

Question	Answer	Marks	Partial Marks
(a)(iii)	Correct sketch of $y = 6^x$ with y-intercept indicated at (0, 1)  	2	**B1** for increasing exponential graph seen on both sides of the y-axis.
(b)(i)	$8 - 4x^2$ [+ 0]	2	**B1** for two terms correct and one extra incorrect term or for one of two terms correct or for correct answer seen and spoilt
(b)(ii)	4	2	**M1** for substitution of $x = -1$ into *their* **(b)(i)**
(b)(iii)	(3, –7) and (–3, 17)	5	**B4** for (3, –7) or (–3, 17) or **B3** for $x = \pm 3$ or **M2** for $x^2 = 9$ or $k(x - 3)(x + 3) = 0$ oe or for correct method for solving *their* **(b)(i)** = – 28 or **M1** for *their* **(b)(i)** = – 28

55. 0580_m21_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	$[a =]\ 4$ $[b =] -3$ nfww	**2**	**B1** for $[a =]\ 4$ **B1** for $[b =] -3$ nfww
(a)(ii)	$y = 4$ oe	**1**	
(a)(iii)	$y = -6x + 7$ oe final answer	**2**	**B1** for answer $-6x + 7$ or answers $y = -6x + c$ or $y = kx + 7$ $(k < 0)$
(b)(i)	2.25 2.67 3.5	**3**	**B1** for each
(b)(ii)	correct curve 	**4**	**B3 FT** for 7 or 8 points or **B2 FT** for 5 or 6 points or **B1 FT** for 3 or 4 points
(c)(i)	–0.78 to –0.72 and 0.55 to 0.59	**2**	**B1** for each
(c)(ii)	$3x^3 - 9x^2 - 3x + 4$ $[= 0]$ final answer	**4**	**B3FT** for 3 out of 4 correct terms or for $bx^3 - 3bx^2 + (a - 1)x + 8 - 3a$ $[= 0]$ oe or **B2FT** for 2 out of 4 correct terms or for 3 out of 4 terms from $bx^3 - 3bx^2 + (a - 1)x + 8 - 3a$ $[= 0]$ or **M1** for $1 + \frac{5}{3 - x} = their\ 4 + (their(-3))x^2$ oe

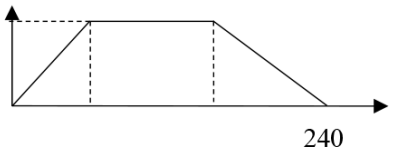
56. 0580_m21_ms_42 Q: 9

	Answer	Mark	Partial Marks
(a)(i)	$(5a-b)(m+2p)$ final answer	2	**M1** for $5a(m+2p)-b(m+2p)$ or $m(5a-b)+2p(5a-b)$ or **B1** for correct answer seen
(a)(ii)	$5(k+g)(3k+3g-4)$ final answer	2	**M1** for correct partial factorisation by 5 or $(k+g)$ isw eg $5\left(3k^2+6kg+3g^2-4k-4g\right)$ or $5(3(k+g)^2-4(k+g))$ or $(k+g)\left(15(k+g)-20\right)$ or $(5k+5g)(3k+3g-4)$ or **B1** for correct answer seen
(a)(iii)	$\left(2x-y^2\right)\left(2x+y^2\right)$ final answer	2	**M1** for answer in form $(a+b)(a-b)$ or **B1** for correct answer seen
(b)	$3x^3-10x^2-x+12$ final answer	3	**B2** for correct unsimplified expansion or simplified expression with 3 terms correct in a 4-term expression of required form or **B1** for correct expansion of two of the brackets with at least 3 terms correct
(c)	$[a=]$ 11 $[b=]$ 121	2	**B1** for each

57. 0580_m21_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)	$\frac{48}{x}$ final answer	**1**	Accept $48 \div x$
(b)	$their(a) - \frac{60}{x+2} = 4$ oe	**M1**	FT *their* (a) provided expression in x
	$48(x+2) - 60x = 4x(x+2)$ oe	**M2**	**FT** *their* 3 term eqn with algebraic denominators, x and $x + 2$, for M2 or M1 **M1** for common denominator $x(x+2)$ oe seen or any two terms in a 3 term equation from $\pm 48\,(x + 2)$, $\pm 60x$, $\pm 4x(x + 2)$ oe seen
	$48x + 96 - 60x = 4x^2 + 8x$ oe leading to $x^2 + 5x - 24 = 0$	**A1**	With brackets expanded and no errors or omissions seen
(c)	$(x-3)(x+8)$	**B2**	**B1** for $x(x + 8) - 3(x + 8)$ or $x(x - 3) + 8(x - 3)$ or $(x + a)(x + b)$ [= 0] where $ab = -24$ or $a + b = 5$ [a, b integers]
	3 and -8	**B1**	
(d)	12	**1**	

58. 0580_s21_ms_41 Q: 2

	Answer	Mark	Partial Marks
(a)	0.18 or $\frac{9}{50}$	1	
(b)	$1944\times\frac{1000}{3600\times3600}$	M1	
	$9 \div 0.15 = 60$	M1	
(c)		1	ruled line to axis with point of contact at 240
(d)	6.9375	4	**M2** for area = $\frac{1}{2}\times(130+240)\times9$ oe or **M1** for one correct partial area **M1dep** for *their* total area ÷ 240

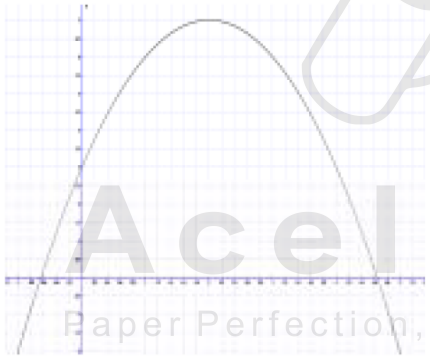
59. 0580_s21_ms_41 Q: 7

	Answer	Mark	Partial Marks
(a)	$\frac{x+5}{x+4}$ final answer	3	**B1** for $(x-5)(x+5)$ **B1** for $(x-5)(x+4)$
(b)	$\frac{2x^2+12x-5}{x(x-1)}$ or $\frac{2x^2+12x-5}{x^2-x}$ final answer	3	**B1** for common denominator $x(x-1)$ oe **B1** for $(x-1)(x+5)+x(x+8)$ or better
(c)(i)	$6x^2-8x$ final answer	2	**B1** for each term in final answer or **M1** for correct answer seen and spoilt

	Answer	Mark	Partial Marks
(c)(ii)	64	**2**	**FT** *their* **(c)(i)** correctly evaluated provided at least 2 terms but not the original equation **M1** for substituting $x = 4$ into *their* **(c)(i)**
(c)(iii)	(0, 6) $\left(\frac{4}{3}, \frac{98}{27}\right)$ oe	**4**	**M1** for *their* derivative = 0 or $\frac{dy}{dx} = 0$ soi **B1** for $x = 0$ and $x = \frac{4}{3}$ **M1dep** for substituting one of *their* x values into $y = 2x^3 - 4x^2 + 6$ soi

60. 0580_s21_ms_41 Q: 10

	Answer	Mark	Partial Marks
(a)	0.75 3 7 3 0.75	**3**	**B2** for 4 or 3 correct or **B1** for 2 correct

	Answer	Mark	Partial Marks
(b)	correct curve 	**4**	**B3FT** for 8 or 9 correct plots **B2FT** for 6 or 7 correct plots **B1FT** for 4or 5 correct plots
(c)	Accept any integer ≥ 8	**1**	
(d)	line $y = 4 - \frac{1}{2}x$ ruled	**B3**	**B2** for $[y =]4 - \frac{1}{2}x$ identified or **B1** for ruled line with gradient $-\frac{1}{2}$ or **B1** for ruled line through (0, 4) but not $y = 4$
	0.2 to 0.3 4.2 to 4.3	**B1**	

61. 0580_s21_ms_41 Q: 12

	Answer	Mark	Partial Marks
(a)	13	**1**	
(b)	$4x - 3$ final answer	**2**	**M1** for $3 - 2(3 - 2x)$
(c)	-7 5	**4**	**M1** for $x^2 + 2x - 35$ [= 0] or $x^2 + 2x = 35$ **M2** for $(x+7)(x-5)$ or $x(x-5) + 7(x-5)$ or $x(x+7) - 5(x+7)$ or **M1** for $(x+a)(x+b)$ where a, b are integers with $ab = -35$ or $a + b = 2$
(d)	$\frac{3-x}{2}$ oe final answer	**2**	**M1** for a correct first step: $x = 3 - 2y$ or $y - 3 = -2x$, $2x = 3 - y$ or $\frac{y}{2} = \frac{3}{2} - x$
(e)	$32 - 54x + 37x^2 - 8x^3$ final answer	**5**	**B4** for $27 - 36x - 18x + 24x^2 + 12x^2 - 8x^3 + x^2 + 5$ oe OR **B1** for $(3-2x)^3 + x^2 + 5$ and **B2** for expansion of the 3 brackets, allow one error or **B1** for correct expansion of 2 of the brackets with at least 3 terms correct

62. 0580_s21_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	1, –0.5 oe	**2**	**B1** for each
(a)(ii)	Correct curve	**4**	**B3FT** for 6 or 7 correct plots or **B2FT** for 4 or 5 correct plots or **B1FT** for 2 or 3 correct plots
(b)	$y = 2.5 - 2x$ ruled	**B2**	**B1** for $y = k - 2x$ or $y = px + 2.5$ ruled ($p \neq 0$) or for [$y =$] $2.5 - 2x$ oe identified
	1.3 to 1.4	**B1**	
(c)	–1	**B1**	
	$y = -1$	**B1**	**FT** *their k* (must be negative)

63. 0580_s21_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	7^{11} cao	**1**	
(a)(ii)	7^{10} cao	**1**	
(a)(iii)	7^2 cao	**1**	If answers 11, 10 and 2 in **(a)** then allow **SC1** in this part
(b)	$1000x^9y^{12}$ final answer	**3**	**B2** for correct answer seen or answer of the form $1000x^9y^k$ or $1000x^ky^{12}$ or kx^9y^{12} or **B1** for answer with one correct element in product or $(10x^3y^4)^{[3]}$ seen
(c)(i)	108	**2**	**M1** for [540 =] 2^2 [×] 3^3 [×] 5 or **B1** for 108 oe not in prime factor form e.g. $2^2 \times 3 \times 9$

	Answer	Mark	Partial Marks
(c)(ii)	30 240	**2**	**M1** for $(540 \times 2^5 \times 3^3 \times 7) \div$ *their* **(c)(i)** oe or **B1** for answer 30 240 oe not in prime factor form e.g. $2^5 \times 3^3 \times 35$
(c)(iii)	98	**2**	**B1** for 592 704 seen or $2^6 \times 3^3 \times 7^3$ seen or 2×7^2 oe seen
(d)(i)	$(x - 7)(x + 4)$ final answer	**2**	**M1** for $x(x - 7) + 4(x - 7)$ or $x(x + 4) - 7(x + 4)$ or better or for $(x + a)(x + b)$ where $ab = -28$ or $a + b = -3$
(d)(ii)	$(a + 2b)(11a + 14b)$ final answer	**2**	**M1** for $(a + 2b)(7(a + 2b) + 4a)$ or $(a + pb)(11a + qb)$ where $pq = 28$ or $11p + q = 36$ If 0 scored, **SC1** for $a + 2b\ (11a + 14b)$
(e)	$[y =]\frac{5x-1}{2}$ oe final answer	**4**	**B2** for $2x - 1 = -2x + 2y - x$ oe or **B1** for $9^x = 3^{2x}$ or better **M1dep** for correct rearrangement of *their* 5 term 'linear' equation in y and x to make y the subject

64. 0580_s21_ms_42 Q: 10

	Answer	Mark	Partial Marks
	125 n^3 oe final ans	**B2**	**B1** for 125 **B1** for n^3
	29 $6n - 1$ oe final ans	**B3**	**B1** for 29 **B2** for $6n - 1$ oe or **B1** for $6n + k$ or $an - 1$ ($a \neq 0$)
	2^{n-3} oe final ans	**B2**	**B1** for $2^{n\,[+k]}$ oe
	25 $6n - 1 - 2^{n-3}$ oe final ans OR 25.25 $-\frac{1}{24}n^3 + \frac{1}{8}n^2 + \frac{17}{3}n - 1$ oe final ans	**B2**	**FT** *their* 29 – 4 and *their* $6n - 1$ – *their* 2^{n-3} **B1FT** for each OR **B1** for each

65. 0580_s21_ms_43 Q: 2

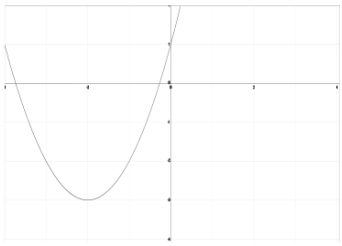
	Answer	Mark	Partial Marks
(a)(i)	–1	**2**	**M1** for $3 \times 2^2 - 13$ oe
(a)(ii)	$[\pm]\sqrt{\frac{y-t}{p}}$ oe final answer	**3**	**M1** for correct rearrangement to isolate x^2 term **M1** for correct division by p **M1** for correct square root Incorrect answer scores a maximum of M2 If 0 scored, SC1 for a correctly rearranged formula with $p = 3$ and $t = -13$ substituted

	Answer	Mark	Partial Marks
(b)(i)	$(5x-4)(3x+2)$ oe final answer	2	**B1** for $(ax+b)(cx+d)$ where either $ac = 15$ and $bd = -8$ or $ad + bc = -2$ or $5x(3x + 2) - 4(3x + 2)$ or $3x(5x - 4) + 2(5x - 4)$ or correct factors seen and spoiled
(b)(ii)	$\frac{4}{5}$ oe and $-\frac{2}{3}$ oe	1	**FT** a factorised quadratic
(c)	$x(x+4y)(x-4y)$ final answer	3	**B2** for $(x^2+4xy)(x-4y)$ or $(x+4y)(x^2-4xy)$ or answer in the form $x(a + b)(a - b)$ or correct answer seen and spoiled or **B1** for $x(x^2-16y^2)$ oe or $(x+4y)(x-4y)$
(d)	$\frac{1-2a}{x}$ oe final answer	4	**B2** for $(2x - 1)(1 - 2a)$ oe or **B1** for $2x - 1 - 2a(2x - 1)$ or $2x(1 - 2a) - (1 - 2a)$ **B1** for $x(2x - 1)$

66. 0580_s21_ms_43 Q: 5

	Answer	Mark	Partial Marks
(a)	$[x =] 7$ $[y =] 3$	2	**B1** for each
(b)	$[x =] 0$, $[y =] 2$ $[x =] -3$, $[y =] 5$	4	**B3** for $x = 0$ and $x = -3$ or **B2** for $x^2 + 3x = 0$ or **M1** for $2 - x = x^2 + 2x + 2$ If 0 scored award **B1** for $x = 0$, $y = 2$ or $x = -3$, $y = 5$ from no/incorrect working ALTERNATIVE **B3** for $y = 2$ and $y = 5$ or **B2** for $y^2 - 7y + 10 = 0$ or **M1** for $y = (2 - y)^2 + 2(2 - y) + 2$ If 0 scored award **B1** for $x = 0$, $y = 2$ or $x = -3$, $y = 5$ from no/incorrect working

67. 0580_s21_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)	$-2 < x \leqslant 1$	**2**	**B1** for $-2 < x$ or $x \leqslant 1$
(b)(i)	$(x+2)^2 - 3$	**2**	**M1** for $(x+2)^2 + k$
(b)(ii)	$(x+2)^2 = 3$	**M1**	**FTdep** *their* **(b)(i)** for $k < 0$
	–3.73 or –3.732... and –0.268 or –0.2679...	**B1**	
(b)(iii)	(–2, –3)	**2**	**FT** *their* $(x+2)^2 - 3$ **B1** for each coordinate
(b)(iv)	Correct sketch 	**2**	Parabola with minimum point in correct quadrant and both x-intercepts negative and positive y-intercept **B1** for parabola with minimum point.

68. 0580_s21_ms_43 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	4	**1**	
(a)(ii)	3	**1**	
(a)(iii)	13	**1**	**FT** $5 \times$ *their* **(a)(i)** $- 7$
(b)	$\frac{x+2}{3}$ final answer	**2**	**M1** for $y + 2 = 3x$ or for $\frac{y}{3} = x - \frac{2}{3}$ or for $x = 3y - 2$
(c)	$9x^2 - 9x + 2$ final answer	**3**	**M1** for $(3x-2)^2 + 3x - 2$ **B1** for $(3x-2)^2 = 9x^2 - 6x - 6x + 4$
(d)	$2x + 1$	**1**	
(e)(i)	81	**1**	
(e)(ii)	x	**1**	Not $y = x$

69. 0580_s21_ms_43 Q: 11

	Answer	Mark	Partial Marks
(a)(i)	–5	**1**	
(a)(ii)	Subtract 4 oe	**1**	
(a)(iii)	$15 - 4n$ oe final answer	**2**	**B1** for $k - 4n$ or $15 - jn$ $j \neq 0$
(b)(i)	$\frac{1}{21}$ or equivalent fraction	**2**	**B1** for $\frac{12}{7}$ and $\frac{10}{6}$
(b)(ii)	$n = \frac{3}{5}$ oe or $2n \geqslant n + 1$ but $3 < 4$.	**M2**	**M1** for $\frac{3}{4} = \frac{2n}{n+1}$ oe or **M1** for $2n > n + 1$ but $3 < 4$
	No, n is not an integer oe or No, $\frac{3}{4}$ is less than 1, oe	**A1**	

70. 0580_m20_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)	$\frac{10x}{(x-3)(x+2)}$ or $\frac{10x}{x^2 - x - 6}$ final answer	**4**	**M1** for common denominator $(x-3)(x+2)$ isw **M1** for $(x+3)(x+2) - (x-2)(x-3)$ isw **B1** for correct numerator in terms of x only

	Answer	Mark	Partial Marks
(b)	14	**2**	**M1** for $12-\frac{k}{2}=5$ or $2^{\frac{k}{2}}=\frac{2^{12}}{2^5}$ oe or $\frac{4096}{32}$ or $12-5$ or $2^{12}\div 2^{\frac{14}{2}}$ [= 32] seen
(c)	$2y^3-3y^2-23y+12$ final answer	**3**	**B2** for correct unsimplified expanded expression or for simplified four-term expression of correct form with 3 terms correct or **B1** for correct expansion of 2 of the brackets with at least 3 terms correct
(d)	$[x=]\frac{3}{y-1}$ final answer	**3**	**M1** for $xy = 3 + x$ **M1** for $xy - x = 3$ or $x - \frac{x}{y}=\frac{3}{y}$ **M1** for factorising and dividing

71. 0580_m20_ms_42 Q: 7

	Answer	Mark	Partial Marks
(a)	$n - 5 + 3n + 10 > 105$ or better	**B1**	
	$n > 25$ final answer	**B2**	**M1** for $4n > 100$

	Answer	Mark	Partial Marks
(b)	4.8	**3**	**M1** for $y=\frac{k}{x^2}$ or better **M1** for $[y=]\frac{their\ k}{5^2}$ OR **M2** for $y\times 5^2 = 7.5\times 4^2$
(c)(i)	$6 - 2n$ oe final answer	**2**	**B1** for answer $6 - kn$ $(k \neq 0)$ oe or answer $j - 2n$ oe or for correct expression shown in working and then spoilt
(c)(ii)	$2n^2 - 1$ oe final answer	**2**	**B1** for 2nd diff = 4 or a quadratic expression or for correct expression shown in working and then spoilt

72. 0580_m20_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	$4x-13$ final answer	**1**	
(a)(ii)	$25x^2$ final answer	**1**	
(b)	$\frac{x+1}{4}$ or $\frac{x}{4}+\frac{1}{4}$	**2**	**M1** for correct first step $x=4y-1$ or $y+1=4x$ or $\frac{y}{4}=x-\frac{1}{4}$
(c)	0.6934 final answer	**3**	**B2** for 0.69336… or $3^{-\frac{1}{3}}$ oe or 0.693 or **M1** for $3^{-3^{-x}}$ oe
(d)(i)	$(3x-2)^2-3^{-(-3)}$	**M1**	
	$9x^2-6x-6x+4-27$ or $9x^2-12x+4-27$ leading to $9x^2-12x-23$	**A1**	with no errors seen

	Answer	Mark	Partial Marks
(d)(ii)	$\frac{-(-12)\pm\sqrt{(-12)^2-4(9)(-23)}}{2\times9}$ or better	**B2**	**B1** for $\sqrt{(-12)^2-4(9)(-23)}$ oe or $\frac{-(-12)+\sqrt{q}}{2\times9}$ oe or $\frac{-(-12)-\sqrt{q}}{2\times9}$ oe or both
	– 1.07, 2.40 final answers	**B2**	**B1** for each If **B0, SC1** for answers – 1.1 or –1.06 or –1.065… to – 1.065 **and** 2.4 or 2.39 or 2.398 to 2.398… or – 1.07 **and** 2.40 seen in working or for –2.40 and 1.07 as final answer
(e)	–5 final answer	**2**	**M1** for $243 = 3^{-x}$

73. 0580_m20_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)	(1, 2) (−1, 6)	**5**	**B2** for [derivative oe =] $3x^2 - 3$ or **B1** for [derivative oe =] $3x^2$ or $f(x) - 3$ **M1** for *their* derivative = 0 or recognition of $\frac{dy}{dx} = 0$ oe **B1** for [x =] −1, 1 or for one coordinate pair
(b)	(1, 2) minimum with reason (−1, 6) maximum with reason	**3**	Reasons could be e.g. a reasonable sketch correct use of 2nd derivative = $6x$ = 6 , 6 > 0, so (1, 2) minimum oe 2nd derivative = $6x$ = –6 , –6 < 0 so (–1, 6) maximum oe, or finds gradient on each side of both correct stationary points with correct conclusion **B2** for 1 correct with reason or **M1** for showing [2nd derivative =] $6x$ or gradients for one value on either side of one correct stationary point or for reasonable sketch of cubic

74. 0580_p20_ms_40 Q: 7

	Answer	Mark	Partial Marks
(a)	2	**2**	**M1** for $2x + 1 = 1 + 4$
(b)	$\frac{x-1}{2}$ oe final answer	**2**	**M1** for $y - 1 = 2x$ or $\frac{y}{2} = x + \frac{1}{2}$ or $x = 2y + 1$
(c)	$4x^2 + 4x + 5$ final answer	**3**	**M1** for $(2x + 1)^2 + 4$ **and B1** for $[(2x + 1)^2 =] 4x^2 + 2x + 2x + 1$ or better
(d)	$\sqrt{2}$ or 1.41 or 1.414....	**1**	
(e)	–1	**1**	

75. 0580_p20_ms_40 Q: 11

	Answer	Mark	Partial Marks
(a)	(0, 16) (4, –16)	**6**	**M1** for $3x^2$ or $12x$ **A1** correct $3x^2 - 12x$ **B1** setting *their* dy/dx = 0 **M1** for factorising *their* dy/dx **A1** $x = 0$ and $x = 4$ **A1** (0, 16) and (4, –16)
(b)	(0, 16) maximum with correct reason (4, –16) minimum with correct reason	**3**	**B2** for both correct with no/one reason or **B1** for one correct (with no reasons) or **M1** correct attempt to find e.g. second derivative or gradients

76. 0580_s20_ms_41 Q: 3

	Answer	Mark	Partial Marks
(a)	75.6	**2**	**M1** for $5.2 \times 7 + \frac{1}{2} \times 1.6 \times 7^2$
(b)(i)	$2a - 3b$ final answer	**2**	**B1** for answer $2a + kb$ or $ka - 3b$ or for $2a - 3b$ seen in working
(b)(ii)	$\frac{3}{4}$	**2**	**B1** for $\frac{45x}{60x}$ oe single fraction
(c)(i)	-5	**1**	
(c)(ii)	-0.25 or $-\frac{1}{4}$	**3**	**M1** for $20 - 12x = 23$ or for $5 - 3x = \frac{23}{4}$ **M1** for correct completion to $ax = b$ FT *their* first step
(d)	$9x^6$	**2**	**B1** for $9x^k$ or kx^6
(e)	$6x^2 - 7xy - 5y^2$	**2**	**M1** for 3 terms out of 4 from $6x^2 - 10xy + 3xy - 5y^2$

77. 0580_s20_ms_41 Q: 6

	Answer	Mark	Partial Marks
(a)	$y \geqslant x$ oe	**1**	
(b)	$2.25x + 1.5y \leqslant 22.5$ oe	**M1**	
	One step shown to $3x + 2y \leqslant 30$	**A1**	
(c)	$y = 10$ ruled	**1**	Broken line
	$3x + 2y = 30$ ruled	**B2**	Solid line **B1** for line passing through (0, 15) or (10, 0)
	$y = x$ ruled	**B1**	Solid line
	Correct region indicated	**B1**	
(d)	412	**2**	**M1** for (4, 9) identified or for evaluation $40x + 28y$ for an integer point in the region ($x > 0$ and $y > 0$)

78. 0580_s20_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	256	**1**	
(b)	8	**2**	**M1** for $3(x^2 + 1) + 2$ or for $3(2) + 2$
(c)	$9x^2 + 12x + 5$	**3**	**M1** for $(3x + 2)^2 + 1$ **B1** for $[(3x + 2)^2 =]\ 9x^2 + 6x + 6x + 4$ oe
(d)	16	**2**	**M1** for $3x + 2 = 7^2 + 1$ or better
(e)	$\frac{x-2}{3}$ oe final answer	**2**	**M1** for $x = 3y + 2$ or for $y - 2 = 3x$ or for $\frac{y}{3} = x + \frac{2}{3}$
(f)	$\frac{4x^2 + 2x + 1}{3x + 2}$ final answer	**3**	**B1** for $x^2 + 1 + x\,(3x + 2)$ or better seen **M1** for common denominator $3x + 2$
(g)	16	**1**	

79. 0580_s20_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	5	**2**	**M1** for $(-1)^4 - 4(-1)^3$
(a)(ii)	(0, 0) and (3, –27)	**6**	**B2** for $4x^3 - 12x^2$ [= 0] or **B1** for $4x^3$ or $12x^2$ AND **M1** for derivative = 0 or *their* derivative = 0 **M1** for $4x^2(x - 3)$[= 0] **B1** for [x =] 0 and [x =] 3 or [y =] 0 and [y =] –27 or for one correct coordinate pair
(b)	[p =] 11 [q =] 5	**2**	**B1** for each or **M1** for $\frac{dy}{dx} = px^{p-1} + 2qx^{q-1}$

80. 0580_s20_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)	$m \geq 3.4$ oe final answer	**2**	**M1** for $12 + 5 \leq 8m - 3m$ or better or $3m - 8m \leq -5 - 12$ or better

	Answer	Mark	Partial Marks
(b)	$x = -0.75$ oe	3	**M1** for $15(2x+5)=14(3-x)$ **B1** for $30x+75=42-14x$ or better
(c)	$3x^2-16x-35[=0]$ or $3y^2-8y-51[=0]$	**M3**	**M1** for $x^2+2(4-x)^2=67$ or $(4-y)^2+2y^2=67$ seen **B1** for $16-8x+x^2$ or $16-8y+y^2$
	$(3x+5)(x-7)$ [= 0] or $(3y-17)(y+3)$[= 0]	**M1**	or for correct factors for *their* equation or for correct use of quadratic formula or completing the square for *their* equation
	$x = 7,\ y = -3$ $x=-\frac{5}{3},\ y=5\frac{2}{3}$	**B2**	**B1** for $x = 7,\ x=-\frac{5}{3}$ or for $y = -3,\ y=5\frac{2}{3}$ or for a correct pair of x and y values

81. 0580_s20_ms_43 Q: 11

	Answer	Mark	Partial Marks
(a)	4	1	
(b)	52	2	**M1** for $f(8)$ seen or $7\times\frac{2x}{x-3}-4$
(c)	$7x^2-4$	1	
(d)	$\frac{7x^2-21x+12}{2(x-3)}$ or $\frac{7x^2-21x+12}{2x-6}$ final answer	3	**M1** for $(7x-4)(x-3)+2\times 2x$ **B1** for denominator $2(x-3)$ or $2x-6$
(e)	–3	2	**M1** for $7x+14-4=-11$
(f)	[p =] 0 and [p =] 1	2	**B1** for each

82. 0580_s20_ms_43 Q: 12

	Answer	Mark	Partial Marks
(a)(i)	$\left(-\frac{1}{2}, 4\right)$ and $\left(\frac{1}{2}, 2\right)$	5	**B2** for $12x^2-3[=0]$ or **B1** for $12x^2$ or -3 **M1** for their derivative = 0 or $dy/dx = 0$ **B1** for [x =] – ½ and ½ or one coordinate pair correct

	Answer	Mark	Partial Marks
(a)(ii)	$\left(-\frac{1}{2}, 4\right)$ Max with reason $\left(\frac{1}{2}, 2\right)$ Min with reason	**3**	**B2** for one correct with reason or **M1** for correct attempt to find e.g. 2nd derivative/gradients/sketch
(b)	line $y = x + 3$ ruled	**M2**	**B1** for $[y =]x + 3$ identified or rules $y = x + k$ or $y = px + 3$
	–0.7 to –0.8 2.7 to 2.8	**A1**	

83. 0580_w20_ms_41 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	2.7 to 2.8	**1**	

	Answer	Mark	Partial Marks
(a)(ii)	tangent ruled at $x = -2$	**B1**	
	6 to 10	**2**	**dep on B1** or a close attempt at tangent at $x = -2$ or **M1** for rise/run for *their* tangent, or close attempt, at any point Must see correct or implied calculation from a drawn tangent After **M0, SC1** for gradient of tangent (or close attempt) in range embedded in $y = mx + c$
(a)(iii)	$y = 2x - 2$ ruled and $x = -2.9$ to -2.8 cao	**3**	**B2** for correct ruled line or **B1** for short line or for freehand line or broken line or ruled line with gradient 2 or with y-intercept at -2 (but not $y = -2$)
(b)	A (4, 17) B (–1.5, 0.5)	**5**	**B4** for (–1.5, 0.5) and (4, 17), or for $x = 4$ and $x = -1.5$ OR **B3** for A(4, 17) or B(–1.5, 0.5) OR **M1** for $2x^2 - 2x - 7 = 3x + 5$ oe AND either **M2** for $(2x + 3)(x - 4)$ or **M1** for $2x(x - 4) + 3(x - 4)$ or $x(2x + 3) - 4(2x + 3)$ or $(2x + c)(x + d)$ where $cd = -12$ or $c + 2d = -5$ [c and d are integers] OR **M2** for $\frac{-\text{their } b \pm \sqrt{(\text{their } b)^2 - 4(\text{their } a)(\text{their } c)}}{2(\text{their } a)}$ or **M1** for $\sqrt{(\text{their } b)^2 - 4(\text{their } a)(\text{their } c)}$ or for $p = -\text{their } b$, $r = 2(\text{their } a)$ if in the form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$

84. 0580_w20_ms_41 Q: 7

	Answer	Mark	Partial Marks
(a)	25 36 10 15 35 51	**2**	**B1** for 3, 4 or 5 correct
(b)	n^2	**1**	
(c)(i)	92	**1**	
(c)(ii)	$\frac{1}{2}(n^2 - n)$ oe	**2**	**M1** for $\frac{1}{2}(3n^2 - n) - n^2$ oe or for final quadratic answer with $\frac{1}{2}n^2$ oe or $-\frac{1}{2}n^2$ oe but not both

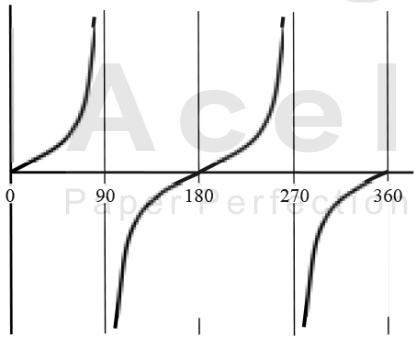
	Answer	Mark	Partial Marks
(d)	$a = \frac{1}{2}$, $b = \frac{1}{2}$	**5**	**B2** for 2 correct equations eg $a + b = 1$, $8a + 4b = 6$ or **B1** for 1 correct equation **B2** for one correct value or **M1** (dep on at least B1) for correctly eliminating one variable from two linear equations in a and b OR **B2** for $a = \frac{1}{2}$ or **B1** for 6a = 3 or for 3rd difference = 3 **B2** for $b = \frac{1}{2}$ or **M1** for substituting *their* a into a correct equation of first differences

85. 0580_w20_ms_41 Q: 8

	Answer	Mark	Partial Marks
(a)	$ab(3a - b)$ final answer	**2**	**B1** for $a(3ab - b^2)$ or $b(3a^2 - ab)$ or $ab(3a - b)$ seen
(b)	$x > 7.5$ final answer	**2**	**B1** for $12+3 < 5x - 3x$ oe
(c)	$27x^6y^{12}$	**2**	**B1** for two of 27, x^6 and y^{12} correct
(d)	0.5 or $\frac{1}{2}$	**3**	**M2** for $4 = 6x + 2x$ or better or **M1** for $2(2 - x) = 6x$ oe
(e)	$2x^3 + 5x^2 - 23x + 10$ final answer	**3**	**B2** for correct expansion of three brackets unsimplified **B1** for correct expansion of two brackets with at least 3 terms correct
(f)(i)	$200\left(1+\frac{r}{100}\right)^2 = 206.46$ oe	**M1**	
	$1 + \frac{2r}{100} + \frac{r^2}{100^2}$ oe	**M1**	
	$r^2 + 200r - 323 = 0$	**A1**	Correct solution reached with no errors or omissions seen If 0 scored, **SC1** for $200(n)^2 = 206.46$

	Answer	Mark	Partial Marks
(f)(ii)	$\frac{-200+\sqrt{200^2-4(1)(-323)}}{2\times1}$	**B2**	**B1** for $\sqrt{200^2-4(1)(-323)}$ or $(r+100)^2$ **B1** for $\frac{-200+\sqrt{q}}{2\times1}$ or $r = \sqrt{323+100^2} - 100$ OR **B2** for $100\left(\sqrt{\frac{206.46}{200}}-1\right)$ or **B1** for $\sqrt{\frac{206.46}{200}}$
	1.60 cao final answer	**B1**	

86. 0580_w20_ms_41 Q: 10

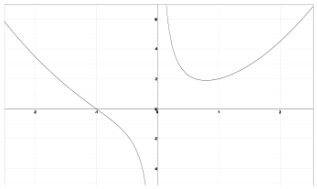
	Answer	Mark	Partial Marks
(a)(i)	$A(-4, 0)$ $B(1, 0)$ $C(0, -4)$	**4**	**B3** for A and B correct Or **B2** for B (–4, 0) and A (1, 0) Or **B1** for $(x + 4)(x – 1)$ or for $\frac{-3 \pm \sqrt{3^2 - 4 \times 1 \times -4}}{2}$ oe and **B1** for A or B correct **B1** for C(0, –4) OR **SC2** for –4, 1 and –4 in correct positions on the graph
(a)(ii)	$2x + 3$ [± 0] final answer	**2**	**B1** for answer $2x + c$ or for $ax + 3$, $a \neq 0$ or for correct answer seen
(a)(iii)	$y = 7x – 8$ oe	**3**	**B2** for answer $7x – 8$ OR **M1** for [gradient =] 2(2) + 3 FT *their* part **(a)(ii)** of the form $ax + b$ **M1dep** for substitution of (2, 6) into $y = \textit{their } mx + c$ oe
(b)(i)	Correct sketch  	**2**	**B1** for one correct section out of 4 OR **B1** for two properties correct from • Crosses x-axis at (0, 0) (180, 0) and (360, 0) only • Correct curvature in each section of 90° • Asymptotes at $x = 90$ and $x = 270$
(b)(ii)	125.5 or 125.53 to 125.54 and 305.5 or 305.53 to 305.54	**3**	**B2** for one correct angle or **B1** for –54.5 or –54.46… or for 2 angles with a difference of 180.

87. 0580_w20_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)	1.48	3	**B2** for $7x + 2 = 12.36$ or better or **M1** for $3x + 2(2x + 1)$ [= 12.36] or better
(b)	1.75 or $1\frac{3}{4}$	3	**B2** for $18x - 14x = 7$ or better or **M1** for $18x = 7(2x + 1)$
(c)	[0].8 oe	3	**B2** for $4(2x + 1) = 13x$ or **M1** for $\frac{4}{x} = \frac{13}{2x+1}$ oe or correct equation to find number of cakes

	Answer	Mark	Partial Marks
(d)	$\frac{20}{x} + \frac{10}{2x+1} = 45$ oe	M2	**B1** for $\frac{20}{x}$ seen or $\frac{10}{2x+1}$ seen
	$90x^2 - 5x - 20$ [= 0] oe	B2	**B1** for $\frac{20(2x+1)+10x}{x(2x+1)} = 45$ or better
	$(9x + 4)(2x - 1)$ [= 0] or for $\frac{--1 \pm \sqrt{(-1)^2 - 4(18)(-4)}}{2(18)}$ oe	M2	**FT** *their* 3-term quadratic **M1** for factors that give two correct terms when expanded or for correct discriminant or correct $\frac{-b}{2a}$ provided quadratic formula is in correct form
	[0].5 or $\frac{1}{2}$ final answer	B1	

88. 0580_w20_ms_42 Q: 7

	Answer	Mark	Partial Marks
(a)	2, 4.5	2	**B1** for each
(b)	Correct graph 	4	**B3 FT** for 6 or 7 correct points FT *their* table or **B2 FT** for 4 or 5 correct points FT *their* table or **B1 FT** for 2 or 3 correct points FT *their* table

	Answer	Mark	Partial Marks
(c)(i)	–0.5 to –0.4	**1**	
(c)(ii)	$y = 1 - x$ ruled **and** –1.9 to –1.75	**2**	**M1** for [$y =$] $1 - x$ or $\left[x^2 + \frac{1}{x} =\right] 1 - x$ soi or **B1** for –1.9 to –1.75
(d)	Any integer ≥ 2	**1**	

89. 0580_w20_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	10	**1**	
(a)(ii)	–19	**1**	FT 1 – 2 *their* **(a)(i)**
(b)	$\frac{1-x}{2}$ oe final answer	**2**	**M1** for $x = 1 - 2y$ or $y + 2x = 1$ or $\frac{y}{2} = \frac{1}{2} - x$ or $y - 1 = -2x$ or better
(c)	$\frac{1}{2}$ oe	**1**	
(d)	$4x^2 - 8x + 2$ final answer	**4**	**M1** for $(1 - 2x)(1 - 2x) - (1 - 2(1 - 2x))$ or better **B1** for $1 - 2x - 2x + 4x^2$ **B1** for $-(1 - 2 + 4x)$ or better or [+] $1 - 4x$ or for correct answer seen then spoiled
(e)	x final answer	**1**	
(f)	3125	**1**	
(g)	25	**1**	
(h)	–2	**2**	**B1** for $\frac{1}{25}$ or 0.04

90. 0580_w20_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)	A : –3 $17 - 4n$ oe	**3**	**B1** for –3 **B2** for $17 - 4n$ oe or **B1** for $k - 4n$ oe or $17 - pn$ oe, $p \neq 0$

	Answer	Mark	Partial Marks
	B : 124 $n^3 - 1$ oe	3	**B1** for 124 **B2** for $n^3 - 1$ oe or **B1** for any cubic
	C : $\frac{11}{128}$ $\frac{n+6}{2^{n+2}}$ oe	4	**B1** for $\frac{11}{128}$ **B3** for $\frac{n+6}{2^{n+2}}$ oe or **B2** for 2^{n+2} oe seen or **B1** for 2^k oe or $n + 6$ seen
(b)	$\frac{p+1}{2q}$ oe	2	**B1** for $p + 1$ or $2q$ oe

91. 0580_w20_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	$(8 - x)(3 + x)$	2	**M1** for $8(3 + x) - x(3 + x)$ or $3(8 - x) + x(8 - x)$ or $(a - x)(b + x)$ where $ab = 24$ or $a - b = 5$

	Answer	Mark	Partial Marks
(a)(ii)	$[a =] -3$ $[b =] 8$ [c =] 24	3	**FT** *their* **(a)(i)** for a and b **B1FT** for each of a and b or both correct but reversed **B1** for $[c =] 24$
(a)(iii)	8	3	**M2** for $5 - 2x$ or **M1** for $-2x$ or $5 - kx$, $k \neq 0$
(b)(i)	Correct sketch: positive cubic shape and max on the y-axis or to the right of y-axis with one root at (–1, 0) and turning point at (3, 0) and y-intercept at (0, 9) all labelled	4	**B1** for positive cubic shape with max on the y-axis or to the right of y-axis **B1** for root at (–1, 0) **B1** for turning point at (3, 0) **B1** for y-intercept (0, 9) If 0 score **SC1** for all three intercepts on axes identified
(b)(ii)	$x^3 - 5x^2 + 3x + 9$ final answer	3	**B2** for correct expansion of three brackets unsimplified **B1** for correct expansion of two brackets with at least 3 terms correct

92. 0580_w20_ms_43 Q: 9

	Answer	Mark	Partial Marks
(a)	2, 3, 4, 5	**2**	**B1** for 3 correct and no extra or 4 correct and one extra or **M1** for $1 < x \leqslant 5$
(b)(i)	$3y\,(2y - 5x)$	**2**	**B1** for $3(2y^2 - 5xy)$ or $y\,(6y - 15x)$ or for the correct answer seen and then spoiled

	Answer	Mark	Partial Marks
(b)(ii)	$(y - 3x)\,(y + 3x)$	**2**	**B1** for $(y + 3)\,(y - 3)$
(c)	$\frac{4x+5}{(x-1)(2x+1)}$ or $\frac{4x+5}{2x^2-x-1}$ final answer	**3**	**M1** for $3(2x + 1) - 2(x - 1)$ oe isw **M1** for $(x - 1)(2x + 1)$ oe isw
(d)	(1.74 , 7.21 to 7.24) and (–3.74 , –9.20 to –9.22) cao	**6**	For the y values accept any value rounded to 2 decimal places in the given range **B5** for (1.74 , 7.21 to 7.24) or (–3.74 , –9.20 to –9.22) or $x = 1.74$ and $x = -3.74$ OR **M2** for $2x^2 + 4x - 13 = 0$ or $2y^2 + 4y - 133 = 0$ or **M1** for $2x^2 + 7x - 11 = 3x + 2$ or $y = 2\left(\frac{y-2}{3}\right)^2 + 7\left(\frac{y-2}{3}\right) - 11$ AND **FT** *their* quadratic expression (not $2x^2 + 7x - 11$) **M2FT** for $\frac{-4 \pm \sqrt{4^2 - 4\times2\times-13}}{2\times2}$ or $-1 \pm \sqrt{\frac{15}{2}}$ oe or **M1FT** for $\sqrt{4^2 - 4\times2\times-13}$ oe or for $\frac{-4+\sqrt{k}}{2\times2}$ or $\frac{-4-\sqrt{k}}{2\times2}$ or $(x + 1)^2\,[-13/2 - 1 = 0]$

93. 0580_w20_ms_43 Q: 10

	Answer	Mark	Partial Marks
(a)	–23	2	**M1** for $4 - 3(3^x)$ oe soi
(b)	$\frac{4-x}{3}$ oe final answer	2	**M1** for $x = 4 - 3y$ or $y + 3x = 4$ or $x + 3y = 4$ or $\frac{y}{-3} = \frac{4}{-3} + x$ oe or $\frac{x}{-3} = \frac{4}{-3} + y$ oe
(c)(i)	$1 + 6x$ final answer	2	**M1** for $4 - 3(1 - 2x)$

	Answer	Mark	Partial Marks
(c)(ii)	$20 - 36x$ or $4(5 - 9x)$ final answer	4	**B3** for $20 - 36x$ seen in working then spoiled OR **M1** for $(4 - 3x)^2 + 4 - 3x - 9(x^2 + x)$ or better **B1** for $[(4 - 3x)^2 =] 16 - 12x - 12x + 9x^2$ or better **B1** for answer $20 - kx$ or $k - 36x$ oe or answer $20 - 36x + kx^2$ $k \neq 0$
(d)	$-\frac{1}{2}$ oe	2	**M1** for $(3^2)^{kx}$ or $9^{kx} = 9^{-\frac{1}{2}x}$ oe

94. 0580_w20_ms_43 Q: 11

	Answer	Mark	Partial Marks
A	24	**B1**	
	$5n - 1$ oe	**B2**	**B1** for $5n - k$ or $jn - 1$ oe $j \neq 0$
B	127	**B1**	
	$n^3 + 2$ oe	**B2**	**B1** for n^3 oe
C	256	**B1**	
	$4^{(n-1)}$ oe	**B2**	**B1** for 4^k oe

95. 0580_m19_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)	–2.1, 1.6, –1.7, 2.1	**3**	**B2** for 3 correct or **B1** for 2 correct
(b)	Fully correct curve	**4**	**B3FT** for 8 or 9 correct plots or **B2FT** for 6 or 7 correct plots or **B1FT** for 4 or 5 correct plots
(c)	line $y=\frac{1}{2}(1-x)$ ruled	**M2**	**M1** for line with gradient $-\frac{1}{2}$ **M1** for line through $(0,\frac{1}{2})$ but not $y=\frac{1}{2}$
	–2.15 to –2.01 –0.45 to –0.2 2.25 to 2.45	**B2**	**B1** for two correct
(d)	number of intersections of *their* curve and the line $y = 1$	**1**	strict **FT** for *their* curve

96. 0580_m19_ms_42 Q: 8

	Answer	Mark	Partial Marks
(a)	–3	**1**	
(b)	$\frac{12}{11}$ oe	**2**	**M1** for $\frac{3}{\frac{3}{x+2}+2}$ soi
(c)	$64x-45$ final answer	**2**	**M1** for $8(8x-5)-5$ isw
(d)	$\frac{x+5}{8}$ oe final answer	**2**	**M1** for a correct first step $y+5=8x$, $\frac{y}{8}=x-\frac{5}{8}$ or $x=8y-5$
(e)	$\frac{8x^2+11x-13}{x+2}$ final answer	**3**	**M1** for $(8x-5)(x+2)-3$ oe isw **B1** for common denominator $(x+2)$

	Answer	Mark	Partial Marks
(f)(i)	$(8x-5)^2+6 = 19$	**M1**	
	$64x^2-40x-40x+25$	**B1**	
	$64x^2-40x-40x+25+6=19$ oe leading to $16x^2-20x+3=0$	**A1**	with no errors and must show $(8x-5)^2+6 = 19$ with no omissions after this
(f)(ii)	$\frac{[--]20\pm\sqrt{([-]20)^2-4(16)(3)}}{2\times16}$ oe	**2**	**B1** for $\sqrt{([-]20)^2-4(16)(3)}$ or better or **B1** for $\frac{[--]20+\sqrt{q}}{2(16)}$ oe or $\frac{[--]20-\sqrt{q}}{2(16)}$
	0.17 and 1.08 final ans	**2**	**B1** for each If 0 scored, **SC1** for answer 0.2 and 1.1 or answer – 0.17 and –1.08 or 0.174... and 1.075 to 1.076 seen or 0.17 and 1.08 seen in working

97. 0580_m19_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)	correctly equating one set of coefficients	**M1**	or making x or y the subject of one equation correctly
	correct method to eliminate one variable	**M1**	or substitution for x or y for *their* rearranged formula
	$x=7$ $y=-3$	**A2**	**A1** for one correct value If A0 scored, **SC1** for 2 values satisfying one of the original equations or if no working shown, but 2 correct answers given
(b)	2	**3**	**M1** for $y=\frac{k}{(x+3)^2}$ oe **M1** for $y=\frac{their\ k}{(7+3)^2}$ oe OR **M2** for $8(2+3)^2=y(7+3)^2$ oe
(c)	$x>-5$ final answer	**3**	**M1** for $3x-6<7x+14$ **M1** for $their(-6)-their14<7x-3x$ oe

98. 0580_m19_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)(i)	77 243	**2**	**B1** for each
(a)(ii)(a)	$2n^2 + 5$ oe	**2**	**M1** for a quadratic expression as the answer or **B1** for common 2nd difference of 4
(a)(ii)(b)	3^{n-1} oe	**2**	**B1** for 3^k oe where k is a linear function of n
(b)(i)	21	**1**	
(b)(ii)	11	**3**	**B2** for $(4n+45)(n-11)$ seen or **B1** for $4n^2 + n + 3 = 498$ oe

99. 0580_s19_ms_41 Q: 2

	Answer	Mark	Partial Marks
(a)	2, 2, 6	**3**	**B1** for each
(b)	Correct graph	**4**	**B3FT** for 10 or 11 correct plots or **B2FT** for 8 or 9 correct plots or **B1FT** for 6 or 7 correct plots
(c)	–3.3 to –3.1	**1**	**FT** *their* graph
(d)	$y = -2x$ ruled	**M1**	or **B1** for $y = -2x$ stated
	–2.6 to –2.45	**A1**	
(e)	3 or 4 or 5	**1**	**FT** *their* graph Allow more than one correct value

100. 0580_s19_ms_41 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	1.991×10^3	**4**	**B3** for 1991 or 1.99×10^3 or $1.991\ldots \times 10^3$ or **B2** for 1990 or 1991. … OR **M1** for $104.3 \times 26.5 + \frac{1}{2} \times (-2.2) \times 26.5^2$ oe **B1** for *their* seen value correctly rounded to 4 sf **B1** for *their* seen value correctly converted into standard form
(a)(ii)	$\frac{2(s-ut)}{t^2}$ oe final answer	**3**	**M1** for correct multiplication by 2 oe **M1** for correct rearrangement to isolate term with a **M1** for correct division by t^2 for 3 marks e.g. cannot have a fraction in denominator nor $\div t^2$ in numerator
(b)(i)	$(2x+3)(x-1)-(x+1)(x-2)=62$	**M1**	
	$2x^2+3x-2x-3$ oe or $x^2+x-2x-2$ oe	**B1**	
	$x^2+2x-63=0$	**A1**	Established with no errors or omissions
(b)(ii)	$(x+9)(x-7)$	**2**	**B1** for $(x+a)(x+b)$ where $ab=-63$ or $a+b=2$ or for $x(x-7)+9(x-7)$ or for $x(x+9)-7(x+9)$
(b)(iii)	20	**2**	**FT** $2 \times$ *their* positive root $+6$ **M1** for substituting *their* positive root into four lengths or for stating $2x+6$

101. 0580_s19_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)	82	2	**M1** for $(3^x)^2+1$ soi by $(3^2)^2+1$ or g(9) isw
(b)	$\frac{x+2}{7}$ final answer	2	**M1** for $y+2=7x$ or $\frac{y}{7}=x-\frac{2}{7}$ or $x=7y-2$
(c)	[a =] 1, [b =] 2, [c =] 2	3	**B2** for $x^4+x^2+x^2+1+1$ or **M1** for $(x^2+1)^2+1$
(d)	$\frac{6}{7}$ oe	3	**M2** for $7x-2=4$ or **M1** for $3^x=81$ soi $f(x)=4$ or for $3^{7x-2}=81$ or better

102. 0580_s19_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)	2.45, 0.25, – 0.25	3	**B1** for each
(b)	Fully correct smooth curve	4	**B3FT** for 6 or 7 points or **B2 FT** for 4 or 5 points or **B1 FT** for 2 or 3 points
(c)	0.7 to 0.8	1	**FT** *their* curve
(d)(i)	Correct ruled line	2	**M1** for good freehand, or ruled line with gradient –1.05 to –0.95 or ruled line through (0, 2) but not line $y = 2$

	Answer	Mark	Partial Marks
(d)(ii)	Both intersections of *their* **(b)** and *their* **(d)(i)**	**2**	**Strict FT** intersection of *their* **(b)** and *their* **(d)(i)** **B1FT** for one correct OR **B2** for 0.27 to 0.28 **and** 2.38 to 2.39
(e)	Substitutes $x = \sqrt{2}$ into $\frac{1}{2x} - \frac{x}{4}$ OR Identifies $y = 0$ oe OR Correctly manipulates to a single fraction e.g. $\frac{2-x^2}{4x}$ oe seen	**M1**	
	Concludes 'read the graph at $y = 0$' oe OR Manipulates $0 = \frac{1}{2x} - \frac{x}{4}$ oe leading to $x^2 = 2$ OR States $\frac{2-x^2}{4x}$ oe $= 0$ leading to $x^2 = 2$	**A1**	

103. 0580_s19_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	$x^2 + 4x - 21$ final answer	**2**	**B1** for three of $x^2, +7x, -3x, -21$
(b)(i)	$5q^2(3p^2 - 5q)$ final answer	**2**	**B1** for $5(3p^2q^2 - 5q^3)$ or $q^2(15p^2 - 25q)$ or $q(15p^2q - 25q^2)$ or $5q(3p^2q - 5q^2)$ or for correct answer seen
(b)(ii)	$(2g + 5k)(2f + 3h)$ final answer	**2**	**B1** for $2g(2f + 3h) + 5k(2f + 3h)$ or $2f(2g + 5k) + 3h(2g + 5k)$ or for correct answer seen
(b)(iii)	$(9k + m)(9k - m)$ final answer	**2**	**M1** for $(9 + m)(9 - m)$ or for correct answer seen

	Answer	Mark	Partial Marks
(c)	5.5	4	**M1** for $5\times3(x-4)+x+2=5\times6$ **M1** for $15x-60+x+2=30$ **FT** *their* first step or $3x-12+\frac{x+2}{5}=6$ If M0M0, **SC1** for $3x-12+x+2=30$ oe **M1dep** for $16x=88$ **FT** *their* previous steps

104. 0580_s19_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)	40 54 26 34	4	**B1** for each
(b)	n^2+3n or $n(n+3)$ oe	2	**B1** for a quadratic expression or for 2nd common difference 2 (at least 2 shown) or for 2 correct equations seen or for subtracting n^2
(c)	100	2	**M1** for *their* **(b)** = 10300 seen
(d)	$[a=]\ \frac{1}{2}$ oe and $[b=]\ \frac{5}{2}$ oe	2	**B1** for each or **M1** for one correct equation or for 2nd difference = 1 soi (at least 2 shown)

105. 0580_s19_ms_43 Q: 2

	Answer	Mark	Partial Marks
(a)	–10	2	**M1** for $-17 - 3 = 7x - 5x$ oe or better
(b)	−1, 0, 1, 2 final answer	3	**B2** for 3 correct values and no incorrect values or 4 correct values and one incorrect value or **M2** for $-\frac{7}{4} < n \leqslant 2$ oe or **M1** for $-\frac{7}{4} < n \leqslant k$ or $k < n \leqslant 2$ oe
(c)(i)	a^9	1	
(c)(ii)	$125x^3y^6$ final answer	2	**B1** for 2 correct elements if in form kx^ny^m
(c)(iii)	$\frac{4y^{[1]}}{3x^4}$ final answer	3	**B2** for $\left(\frac{3x^4}{4y^{[1]}}\right)^{[-1]}$ oe seen OR **B1** for $3x^4$ or $4y^{[1]}$ **and** **M1** for $\left(\frac{64y^3}{27x^{12}}\right)^{\left[\frac{1}{3}\right]}$ oe If 0 scored, **SC1** for $\frac{64y^{[1]}}{27x^4}$ or $\frac{0.333x^{-4}}{0.25y^{-1}}$ seen

106. 0580_s19_ms_43 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	–3	1	
(a)(ii)	6.2 to 6.4 oe	2	**M1** for 3 seen or used
(b)	$y = 5 - 3x$ ruled	2	**B1** for $y = 5 - 3x$ soi or ruled line with gradient – 3 or with y – intercept at 5 (but not $y = 5$) or **B1FT** for incorrect line equation/expression shown in working and *their* line correctly drawn
	– 0.3 to – 0.2 1.65 to 1.8	2	**B1** for each, dep on $y = 5 - 3x$ drawn or **FT** *their* line provided equation/expression shown in working, dep on B1FT for line

	Answer	Mark	Partial Marks
(c)	Tangent ruled at $x = -2$	1	**B1** for correct tangent
	–4.5 to –2.5	2	**Dep** on B1 for tangent or close attempt at tangent at $x = -2$ **M1** for rise/run **also dep on** tangent drawn or close attempt at correct tangent Must see correct or implied calculation from a drawn tangent
(d)(i)	8, 4, 0.25 oe	3	**B1** for each
(d)(ii)	Correct graph	3	**B2FT** for 6 or 7 correct plots or **B1FT** for 4 or 5 correct plots
(d)(iii)	1.8 to 1.9	1	

107. 0580_s19_ms_43 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	3, –1	2	**B1** for each
(a)(ii)	$23 - 4n$ oe final answer	2	**M1** for $k - 4n$ or $23 - jn$ ($j \neq 0$)
(a)(iii)	22	2	**M1** for *their* **(a)(ii)** = –65
(b)	23	2	**B1** for 37 or 60

108. 0580_w19_ms_41 Q: 7

	Answer	Mark	Partial Marks
(a)	9	**3**	**M2** for $0.42x + 0.42 = 4.2$ oe or better or **M1** for $0.21x + 0.21(x + 2)$ oe [= 420 or 4.20] or for $21x + 21(x + 2)$ oe [= 420 or 4.20] or for $420 \div 21$ oe [=20]
(b)	$5r + p = 245$	**B1**	
	$2r + 3p = 215$	**B1**	
	45	**3**	Finds p **M1** for correctly equating coefficients of r **M1** for correct method to eliminate r OR **M1** for correctly making r the subject of one of *their* equations **M1** for correctly substituting *their* correct r to form an equation in p OR Finds r first **M1** for correctly eliminating p from *their* equations **M1** for correctly substituting *their* value of r to find p

	Answer	Mark	Partial Marks
(c)(i)	$\frac{12}{x} + \frac{6}{x-1}$ [= 5]	**M1**	
	$12(x - 1) + 6x = 5x(x - 1)$	**M1**	**Dependent** on previous M1 earned May be over common denominator
	$5x^2 - 23x + 12 = 0$ reached, with at least one more line of working and with no errors or omissions	**A1**	
(c)(ii)	$(5x - 3)(x - 4)$ final answer	**2**	**B1** for $(5x + a)(x + b)$ with $ab = 12$ or $a + 5b = -23$ or for $5x(x - 4) - 3(x - 4)$ or $x(5x - 3) - 4(5x - 3)$
(c)(iii)	$\frac{3}{5}$ oe and 4	**1**	**FT** from their two brackets in (c)(ii)
(c)(iv)	3 cao	**1**	

109. 0580_w19_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)	$x + y \geqslant 6$ oe $y \leqslant x$ oe $x \leqslant 8$	**3**	**B1** for each
(b)	$4x + 6y \leqslant 60$	**1**	
(c)	Correct region indicated cao	**6**	**B1** for $x + y = 6$ ruled and long enough **B1** for $x = y$ ruled and long enough **B1** for $x = 8$ ruled and long enough **B2** for $2x + 3y = 30$ ruled and long enough or **B1** for ruled line through (0, 10) or (15, 0) but not $y = 10$ or $x = 15$
(d)(i)	6, 6	**1**	
(d)(ii)	34	**2**	**M1** for trying $4x + 6y$ with (4, 3) or (5, 2) or (6, 1) or (7, 0)

110. 0580_w19_ms_41 Q: 10

	Answer	Mark	Partial Marks
(a)	– 7 $13 - 4n$ oe 36 $(n+1)^2$ oe 125 n^3 oe 128 2^{n+2} oe	**11**	**B1** **B2** or **B1** for $13 - kn$ ($k \neq 0$) or for $k - 4n$ **B1** **B2** or **B1** for any quadratic **B1** **B1** **B1** **B2** or **B1** for 2^k oe
(b)	...., ..., 6, 10, 16 .... , 3, 4, 7, ... 2, ..., 1, 0, ...	**3**	**B1** for each correct row
(c)(i)	$\frac{q}{p+q}$	**1**	
(c)(ii)	$\frac{18}{29}$	**1**	

111. 0580_w19_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)	3.5, 15, 3.9	**3**	**B1** for each
(b)	Correct graph	**5**	**B4** for correct curves but branches joined or touching y-axis or **B3FT** 10 or 11 points or **B2FT** for 8 or 9 points or **B1FT** for 6 or 7 points **B1indep** two separate branches not touching or crossing y-axis
(c)	0.5 to 0.6 and 1.3 to 1.6	**2**	**B1** for each or both correct but in reverse order
(d)	1	**1**	
(e)(i)	$y = 3x + 1$ ruled and 0.3 to 0.49	**3**	**B2** for correct ruled line that crosses *their* curve or **B1** for $y = 3x + 1$ soi or freehand line or ruled line with gradient 3 or with y – intercept at 1 (but not $y = 1$)
(e)(ii)	$[a =] -6$ $[b =] -2$ $[c =] -4$	**3**	**M2** for $x^4 + 2 - 4x = 6x^3 + 2x^2$ or better seen or **B1** for each correct value to a maximum of 2 marks If 0 scored, **SC1** for answer $[a =] 6$, $[b =] 2$ and $[c =] 4$ or for $x^5 + 2x - 4x^2 = 6x^4 + 2x^3$ or better

112. 0580_w19_ms_42 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	13	**1**	
(a)(ii)	3	**2**	**M1** for $\text{h}\left(\frac{10}{30}\right)$ oe soi or $27^{\frac{10}{x}}$
(a)(iii)	$\frac{7-x}{2}$ oe final answer	**2**	**M1** for $x = 7 - 2y$ or $y - 7 = -2x$ or $7 - y = 2x$ or $-\frac{y}{2} = -\frac{7}{2} + x$ oe
(b)	0.75 oe final answer	**3**	**M1** for $\frac{10}{2x+1} = 4$ **M1** for $10 = 8x + 4$ or better
(c)	$\frac{70-19x}{x(7-2x)}$ or $\frac{70-19x}{7x-2x^2}$ final answer	**3**	**M1** for $x + 10(7 - 2x)$ or better isw **B1** for common denominator $x(7 - 2x)$ oe isw
(d)	3 final answer	**1**	

113. 0580_w19_ms_43 Q: 3

	Answer	Mark	Partial Marks
(a)	5, –3, 21	**3**	**B1** for each
(b)	Fully correct curve	**4**	**B3 FT** for 9 or 10 points or **B2 FT** for 7 or 8 points or **B1 FT** for 5 or 6 points
(c)	–2.9 to –2.7 0 1.7 to 1.9	**2**	**B1** for 2 correct values

	Answer	Mark	Partial Marks
(d)	Tangent ruled at $x = 2$	**B1**	
	10 to 14	**B2**	Dep on correct tangent or close attempt at tangent at $x = 2$ **M1** for rise/run **also dep on** correct tangent drawn or close attempt at tangent Must see correct or implied calculation from a drawn tangent
(e)	6	**1**	

114. 0580_w19_ms_43 Q: 9

	Answer	Mark	Partial Marks
(a)(i)	5	**1**	
(a)(ii)	1	**2**	**M1** for h(0) or 3^{9-x^2} or better
(a)(iii)	$9 - 4x^2$ final answer	**1**	
(a)(iv)	$15 - 2x^2$ final answer	**2**	**M1** for $2(9 - x^2) - 3$ or better
(b)	$\frac{x+3}{2}$ final answer	**2**	**M1** for $x = 2y - 3$ or $y + 3 = 2x$ or better or $\frac{y}{2} = x - \frac{3}{2}$
(c)	1.8 or $1\frac{4}{5}$ or $\frac{9}{5}$	**2**	**M1** for $10x - 15 = 3$ or $2x - 3 = \frac{3}{5}$
(d)	–1 and 4 nfww	**4**	**M1** for $9 - (2x - 3)^2 = -16$ **A1** for $4x^2 - 12x - 16[= 0]$ oe **M1** (dep on first M1) for correct factors or use of formula or completing the square for their 3-term quadratic OR **M1** for $9 - y^2 = -16$ **A1** for $y^2 = 25$ **M1** (dep on first M1) for $2x - 3 = \pm 5$
(e)	$\frac{1}{9}$	**1**	

115. 0580_w19_ms_43 Q: 10

	Answer	Mark	Partial Marks
	$x + 1 - 2x = 3x(x + 1)$	**M2**	**M1** for a common denominator of $x(x + 1)$ seen or attempt to multiply through by denominators or for $\frac{x+1-2x}{x(x+1)} = 3$
	$3x^2 + 4x - 1[= 0]$ oe nfww	**A1**	
	$[x =]\frac{-4 \pm \sqrt{4^2 - 4 \times 3 \times (-1)}}{2 \times 3}$	**B2**	**B1FT** for $\sqrt{4^2 - 4 \times 3 \times (-1)}$ or better or for $\left(x + \frac{2}{3}\right)^2$ **B1FT** for $\frac{-4+\sqrt{q}}{2\times 3}$ or $\frac{-4-\sqrt{q}}{2\times 3}$ or for $-\frac{2}{3} \pm \sqrt{\frac{1}{3} + \left(\frac{2}{3}\right)^2}$
	–1.55 and 0.22 final answers	**B2**	**B1** for each or **B1** for –1.548 to –1.549 **and** 0.215… or for –1.55 **and** 0.22 seen in working or for –0.22 **and** 1.55 as final answer or for –1.5 or –1.54 **and** 0.2 or 0.21 as final answer

116. 0580_m18_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)	0 –0.17 2.4	**3**	**B1** for each
(b)	Fully correct smooth curve	**4**	**B3FT** for 9 or 10 correct points or **B2FT** for 7 or 8 correct points or **B1FT** for 5 or 6 correct points
(c)	$x \leqslant 0.17$ to 0.25 and $x \geqslant 2.25$ to 2.3	**3**	**B2** for strict inequalities or one correct or **B1** for 0.17 to 0.25 and 2.25 to 2.3 seen

	Answer	Mark	Partial Marks
(d)(i)	$y = 4 - x$ oe final answer	**2**	**B1** for $4 - x$ or $y = k - x$ or $y = 4 + kx$ oe
(d)(ii)	correct ruled line	**1**	**FT** if in form $y = mx + c$ oe ($m, c \neq 0$)
	0.125 to 0.2 and 2.15 to 2.2	**2**	**B1** for each

117. 0580_m18_ms_42 Q: 4

	Answer	Mark	Partial Marks
(a)	$[\pm]\sqrt{k-s}$ final answer	**2**	**M1** for $t^2 = k - s$
(b)(i)	$(x-5)(x+5)$ final answer	**1**	
(b)(ii)	$\frac{x-5}{x-7}$ nfww final answer	**3**	**M2** for $(x-7)(x+5)$ or **M1** for $x(x+5)-7(x+5)$ or $x(x-7)+5(x-7)$ or $(x+a)(x+b)$ where $a+b=-2$ or $ab=-35$
(c)	$\frac{4x^2-7x-8}{x(x+1)}$ or $\frac{4x^2-7x-8}{x^2+x}$ final answer	**3**	**M1** for $(x-8)(x+1)+3x\times x$ oe isw **B1** for common denominator $x(x+1)$ oe isw
(d)	3, 4, 5, 6 nfww	**3**	**B2** for 3 correct or 4 correct and 1 extra or **M2** for $n > \frac{18}{8}$ oe and $n \leqslant 6$ or **M1** for $18 < 8n$ [$\leqslant 30 + 3n$] or [$18 - 3n <$] $5n \leqslant 30$ seen

118. 0580_m18_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	$y > x$	**1**	
	$x \geqslant 15$	**1**	
	$y < 50$	**1**	
	$x + y \leqslant 70$	**1**	
(b)	Four correct ruled lines and correct region indicated	**5**	all lines ruled **B1** for $y = x$ broken **B1** for $x = 15$ **B1** for $y = 50$ broken **B1** for $x + y = 70$
(c)	189	**2**	**M1** for (21, 49) seen or for $2x + 3y$ written for a point (x, y) in *their* region where x and y are integers

119. 0580_m18_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)	25 9 16	3	**B1** for each
(b)(i)	$(n-1)^2$ oe	2	**B1** for any quadratic of form [1]n^2[+bn+c]
(b)(ii)	$n+3$ oe	1	
(c)	25	2	**M1** for *their* $(n-1)^2 = 576$
(d)(i)	n^2-3n-2 final answer	3	**M1** for *their*$(n-1)^2$ – *their*$(n+3)$ oe or 2nd diff = 2 soi **B1** for $n^2-n-n+1$ or better or $-n-3$ or for expression of form $n^2-2n-n+k$ or correct expression not in simplest form
(d)(ii)	808 cao	2	**M1** for substituting 30 in *their* **(d)(i)**

120. 0580_s18_ms_41 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	$(2n+m)(m-3)$ final answer	2	**M1** for $m(2n+m)-3(2n+m)$ or $2n(m-3)+m(m-3)$
(a)(ii)	$(2y-9)(2y+9)$ final answer	1	
(a)(iii)	$(t-4)(t-2)$ final answer	2	**B1** for $(t-4)(t-2)$ seen and spoiled or **M1** for $t(t-2)-4(t-2)$ or $t(t-4)-2(t-4)$ or $(t+a)(t+b)$ where $a+b=-6$ or $ab=+8$
(b)	$[x=]\frac{2m}{k+1}$	4	**M1** for $xk=2m-x$ or $k=\frac{2m}{x}-1$ **M1** for $xk+x=2m$ or $k+1=\frac{2m}{x}$ **M1** for $x(k+1)=2m$

	Answer	Mark	Partial Marks
(c)	correctly eliminating one variable	**M1**	
	[x =] 6	**A1**	
	[y =] –2	**A1**	If 0 scored **SC1** for 2 values satisfying one of the original equations or **SC1** if no working shown, but 2 correct answers given
(d)(i)	$3m-4(m+4)=6m(m+4)$	**M1**	or $\frac{3m-4(m+4)}{m(m+4)}$[= 6] oe
	$3m-4m-16=6m^2+24m$	**M1**	removes brackets correctly
	$6m^2+25m+16=0$	**A1**	with no errors or omissions
(d)(ii)	$\frac{-25\pm\sqrt{(25)^2-4(6)(16)}}{2\times6}$ or $\frac{-25}{12}\pm\sqrt{\left(\frac{25}{12}\right)^2-\frac{16}{6}}$	**2**	**B1** for $\sqrt{(25)^2-4(6)(16)}$ or better or **B1** for $\left(m+\frac{25}{12}\right)^2$ and if in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ **B1** for p = –25 and r = 2(6)
	–0.79 and –3.38 final ans cao	**2**	**B1** for each **SC1** for –0.8 and –3.4 or for –0.78 and –3.37 or –0.789... and –3.377... or 0.79 and 3.38 or –0.79 and –3.38 seen in working

121. 0580_s18_ms_41 Q: 7

	Answer	Mark	Partial Marks
(a)	$x = 0$	**1**	
(b)	Tangent ruled at $x = 0.5$	**B1**	No daylight between tangent and curve at point of contact
	–9 to –6.5	**2**	**dep** on ruled tangent or close attempt at tangent at $x = 0.5$ **M1** for rise/run also dep on tangent or close attempt at tangent at $x = 0.5$
(c)(i)	0 2.4 or better 4	**3**	**B1** for each
(c)(ii)	Correct smooth curve	**4**	**B3FT** for 6 or 7 correct plots or **B2 FT** for 4 or 5 correct plots or **B1 FT** for 2 or 3 correct plots **FT** *their* table
(d)	$x^3 + 3x + 4 = 10 - 8x^2$ and correctly completed	**1**	
(e)	line $y = -2x + 2$ drawn and –0.45 to –0.35 nfww	**3**	**B2** for ruled $y = -2x + 2$ or **B1** for $-2x + 2$ seen or for line $y = -2x + c$ drawn or for $y = cx + 2$ ($c \neq 0$) drawn and **B1** for –0.45 to – 0.35 nfww

122. 0580_s18_ms_41 Q: 12

	Answer	Mark	Partial Marks
(a)	18 28	**2**	**B1** for each
(b)	$3n + 3$ oe	**2**	**B1** for $3n + k$ oe or $cn + 3$ oe $c \neq 0$
(c)	45	**2**	**M1** for identifying 7th pattern or **M1** for *their* $(3n + 3) = 24$
(d)	$[a =]\frac{3}{2}$ oe $[b =]\frac{13}{3}$ oe	**6**	**M1** for any correct substitution e.g. $\frac{1}{6}(2)^3 + 2^2a + 2b$ **A1** for one of e.g. $\frac{1}{6} + a + b = 6$ oe $\frac{8}{6} + 4a + 2b = 16$ oe $\frac{27}{6} + 9a + 3b = 31$ oe $\frac{64}{6} + 16a + 4b = 52$ oe **A1** for another of the above **M1** for correctly eliminating one variable from *their* equations **A1** for $a = \frac{3}{2}$ **A1** for $b = \frac{13}{3}$ oe

123. 0580_s18_ms_42 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	$243p^{10}$ final answer	**2**	**B1** for answer $243p^{k}$ or kp^{10} $(k \neq 0)$
(a)(ii)	$9xy^{4}$ final answer	**2**	**B1** for answer with two correct elements in correct form of expression
(a)(iii)	$\frac{m^2}{25}$ final answer	**1**	
(b)	10	**4**	**B2** for $x = 8$ or for [length of rectangle =] 31 or **M1** for $5x - 9 = 3x + 7$ oe or better **M1** for $\frac{310}{(3 \times their x + 7)}$ or $\frac{310}{(5 \times their x - 9)}$ Alt method using simultaneous eqns **M1** for $5xw - 9w = 310$ **and** $3xw + 7w = 310$ **M1** for equating coefficients of xw **M1** for subtraction to eliminate term in xw

124. 0580_s18_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	– 2[.0], – 0.2, 2.5	**3**	**B1** for each
(b)	Fully correct curve	**5**	**B4** for correct curve, but branches joined or **B3FT** for 9 or 10 correct plots or **B2FT** for 7 or 8 correct plots or **B1FT** for 5 or 6 correct plots and **B1 indep** two separate branches not touching or cutting y-axis
(c)(i)	Correct tangent and $3 \leqslant$ grad $\leqslant 5$	**3**	**B2** for close attempt at tangent to curve at $x = -2$ **and** answer in range OR **B1** for ruled tangent at $x = -2$, no daylight at $x = -2$ and **M1dep** (dep on **B1** or close attempt at tangent) [at $x = -2$] for $\frac{rise}{run}$
(c)(ii)	[$y =$] *their* **(c)(i)** x + *their* y-intercept final answer	**2**	**Strict FT** *their* y-intercept for *their* line **M1** for $y =$ *their* **(c)(i)** x + *any value* or 'c' oe seen or for $y =$ *any value*(non-zero) x or 'mx' + *their* y-intercept seen oe
(d)(i)	1.05 to 1.25	**1**	
(d)(ii)	– 2.3 to – 2.2 – 0.4 to – 0.3 0.3 to 0.4	**3**	**B1** for each After 0 scored **B1** for $y = -4$ ruled

	Answer	Mark	Partial Marks
(e)	[$a =$] 2 [$b =$] 24 [$n =$] 5	**3**	**B2** for 2 correct or for $2x^5 + 24x^2$ [$-3 = 0$] or **B1** for 1 correct or for $\frac{2x^5 - 3 + 4(6x^2)}{6x^2}$ [$= 0$] oe If 0 scored **SC1** for $2x^5$ seen in final line of algebra

125. 0580_s18_ms_42 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	1	**2**	**M1** for h(0) or for 2^{8-3x}
(a)(ii)	8	**2**	**M1** for g(¼) or for $\frac{10}{2^x+1}$

	Answer	Mark	Partial Marks
(a)(iii)	$\frac{10-x}{x}$ or $\frac{10}{x}-1$ final answer	**3**	**M2** for $x = \frac{10-y}{y}$ or better or $xy = 10 - x$ or better or $y + 1 = \frac{10}{x}$ or **M1** for $x(y + 1) = 10$ or $y(x + 1) = 10$ or $x = \frac{10}{y+1}$ or $x + 1 = \frac{10}{y}$
(a)(iv)	5	**1**	
(b)	$\frac{-3x^2+5x+18}{x+1}$ final answer	**3**	**M1** for $\frac{(8-3x)(x+1)+10}{x+1}$ **B1** for $-3x^2 - 3x + 8x + 8$ [+10]

126. 0580_s18_ms_43 Q: 5

	Answer	Mark	Partial Marks
(a)	15.6[0]	**4**	**B3** for $20900x = 326040$ or better or **M2** for $18500x + 2400(x - 2.5[0]) = 320040$ or **M1** for $18500x$ or $2400(x - 2.5[0])$
(b)(i)	$(y+12)(y-7)$ final answer	**2**	**B1** for $(y+a)(y+b)$ where $ab = -84$ or $a + b = 5$ or $y(y+12) - 7(y+12)$ or $y(y-7) + 12(y-7)$
(b)(ii)	38 cao	**3**	**B2** for $y = 7$ or **M1** for $y(y+5) = 84$ oe
(c)(i)	$168(m - 0.75) + 207m = 100m(m - 0.75)$ oe OR $207 = 100m - 168 - 75 + \frac{126}{m}$	**M2**	May be all over common denominator **M1** for $\frac{168}{m}$ or $\frac{207}{m-0.75}$ used
	at least one interim line leading to $50m^2 - 225m + 63 = 0$	**A1**	No errors or omissions

	Answer	Mark	Partial Marks
(c)(ii)	$(10m - 3)(5m - 21)$ OR $m = \frac{-(-225) \pm \sqrt{(-225)^2 - 4(50)(63)}}{2(50)}$ oe OR $m = \frac{225}{100} \pm \sqrt{\left(\frac{225}{100}\right)^2 - \frac{63}{50}}$ oe	**B2**	**M1** for $(10m + a)(5m + b)$ where $ab = 63$ or $5a + 10b = -225$ or $10m(5m - 21) - 3(5m - 21)$ or $5m(10m - 3) - 21(10m - 3)$ OR **M1** for $\sqrt{(-225)^2 - 4(50)(63)}$ or for $p = -(-225)$, $r = 2(50)$ if in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ OR **M1** for $\left(m - \frac{225}{100}\right)^2$ oe
	4.2[0] cao	**B1**	

127. 0580_s18_ms_43 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	26	**2**	**M1** for g(5) or for $\left(x^2+1\right)^2+1$
(a)(ii)	x^2+4x+5	**2**	**M1** for $\left(x+2\right)^2+1$
(a)(iii)	5	**2**	**M1** for $2x-3=7$
(a)(iv)	$\frac{x+3}{2}$ oe	**2**	**M1** for $x=2y-3$ or $y+3=2x$ or $\frac{y}{2}=x-\frac{3}{2}$ oe
(b)(i)	[0].70 cao	**2**	**B1** for [0].696 to [0].697
(b)(ii)	4 cao	**1**	

128. 0580_w18_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)(i)	$\frac{72}{m}$	**1**	
(a)(ii)	$\frac{72}{m+0.9}$	**1**	
(b)	$\frac{72}{m}-\frac{72}{m+0.9}=4$ oe	**M1**	**FT** *their* **(a)(i)** and **(a)(ii)** if expressions in m
	$72\left(m+0.9\right)-72m=4m\left(m+0.9\right)$ oe	**M1**	**Dependent** on **M1** and **correct** fractions
	$\left[72m-72m\right]+64.8=4m^2+3.6m$ oe nfww	**A1**	
	Correct completion to $10m^2+9m-162=0$	**A1**	
(c)(i)	3.6 and –4.5 final answer	**3**	**B2** for $\left(2m+9\right)\left(5m-18\right)$ or $\frac{-9\pm\sqrt{(9)^2-4(10)(-162)}}{2\times10}$ or better or **B1** for $\left(am+b\right)\left(cm+d\right)$ where ac = 10 and either $bd = -162$ or $ad + bc = 9$ or for $\sqrt{(9)^2-4(10)(-162)}$ or better or $\frac{-9\pm\sqrt{q}}{2(10)}$ or better
(c)(ii)	20	**1**	

129. 0580_w18_ms_41 Q: 11

	Answer	Mark	Partial Marks
(a)	$5(m-2p^2)(m+2p^2)$ final answer	3	**M2** for $(5m+k)(m+j)$ where $kj=-20p^4$ or $5j+k=0$ or **M1** for $5(m^2-4p^4)$ seen
(b)	$[P=]\ \frac{100A}{100+TR}$ final answer	3	**M1** for $100A = 100P + PRT$ or for $A = P(1+\frac{RT}{100})$ **M1** for $100A = P(100 + RT)$ or for $\frac{A}{1+\frac{RT}{100}} = P$ or for $100A = P(1 + RT)$ after $100A = P + PRT$ as first step

130. 0580_w18_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)	-1.5	3	**M1** for $30 + 2x = 9 - 12x$ or $10 + \frac{2}{3}x = 3 - 4x$ **M1** for collecting *their* terms correctly to reach $ax = b$
(b)	$6ab^2(2b + 3a^2)$ final answer	2	**M1** for any correct partial factorisation seen or for correct answer seen
(c)(i)	$10a^5c^9$ final answer	2	**B1** for final answer with $10a^kc^9$ or $10a^5c^k$ or ka^5c^9
(c)(ii)	$\frac{8a^6}{c^9}$ or $8a^6c^{-9}$ final answer	2	**B1** for final answer with $\frac{8a^6}{c^k}$ or $\frac{8a^k}{c^9}$ or $\frac{ka^6}{c^9}$ $[k \neq 0]$ or for correct answer seen

	Answer	Mark	Partial Marks
(d)	0.5 or $\frac{1}{2}$	3	**M1** for $y = \frac{k}{(x+2)^2}$ oe **B1** for $k = 50$ or **M2** for $2(3 + 2)^2 = y(8 + 2)^2$ oe
(e)	$\frac{7x-x^2}{2(x-2)}$ or $\frac{7x-x^2}{2x-4}$ oe final answer	3	**M1** for $5 \times 2 - (x - 5)(x - 2)$ oe seen **M1** for common denominator $2(x - 2)$ oe isw

131. 0580_w18_ms_42 Q: 4

	Answer	Mark	Partial Marks
(a)	$\frac{1}{2} \times 4(x - 1) \times (2x + 5)[\sin 90] = 30$ oe	M1	
	$8x^2 - 8x + 20x - 20$ or better	B1	correct expansion of brackets
	Completion to $2x^2 + 3x - 20 = 0$	A1	with no errors or omissions seen
(b)	$(2x - 5)(x + 4)$	M2	Allow **M2** for e.g. $2x(x + 4) - 5(x + 4)$ then $2x - 5[= 0]$ and $x + 4[= 0]$ **M1** for $2x(x + 4) - 5(x + 4)$ or $x(2x - 5) + 4(2x - 5)$ or $(2x + a)(x + b)$ $[= 0]$ where $ab = -20$ or $a + 2b = 3$ [a, b integers]
	2.5 and –4 cao	B1	

	Answer	Mark	Partial Marks
(c)	11.7 or 11.66 … or 11.67	3	**M2dep** for $(4(their 2.5 - 1))^2 + (2 \times their 2.5 + 5)^2$ or **M1dep** for $4(their 2.5 - 1)$ or $2 \times their 2.5 + 5$ OR **B1** for $\sqrt{20x^2 - 12x + 41}$ and **M1dep** for substituting x = *their* 2.5 into $\sqrt{20x^2 - 12x + 41}$ at any stage

132. 0580_w18_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	0.6	**1**	
(b)	50.7	**3**	**M2** for $1.2 \times 19 + \frac{1}{2}(19 + 12) \times 1.8$ oe or **M1** for method for finding any relevant area
(c)	17.9	**3**	**M2** for *their* $50.7 - 1.2 \times 19$ [– 10] oe or **M1** for 1.2×19 oe seen isw

133. 0580_w18_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)	–1, 3	**2**	**B1** for each

	Answer	Mark	Partial Marks
(b)	Correct graph	**3**	**B2FT** for 6 or 7 correct points or **B1FT** for 4 or 5 correct points
(c)	Correct ruled tangent and $-2 \leqslant$ gradient $\leqslant -1.5$	**3**	**B2** for close attempt at tangent at $x = -4$ and answer in range OR **B1** for ruled tangent at $x = -4$ with no daylight and **M1** for rise/run **also dep on** close attempt at tangent. Must see correct or implied calculation from a drawn tangent.
(d)	–3, 3	**1**	
(e)	Correct graph	**4**	**B3FT** for 7 or 8 correct points or **B2FT** for 5 or 6 correct points or **B1FT** for 3 or 4 correct points
(f)(i)	3.6 to 3.85	**1**	
(f)(ii)	$x >$ *their* **(f)(i)**	**1**	**FT**
(g)	$\frac{x^2}{4} = \frac{9}{x} + \frac{4}{x}$ or $\frac{x^3}{4} - 4 = 9$	**M1**	Allow $\frac{13}{x}$ for $\frac{9}{x} + \frac{4}{x}$
	52	**A1**	

134. 0580_w18_ms_43 Q: 9

	Answer	Mark	Partial Marks
(a)	0	**1**	
(b)	5	**2**	**M1** for $3(3^x)+4$ or better or f$(\frac{1}{3})$ or f(3^{-1})
(c)	$\frac{x+1}{2}$ oe final answer	**2**	**M1** for $x=2y-1$ or $y+1=2x$ or $\frac{y}{2}=x-\frac{1}{2}$ or better
(d)	$9x+16$	**2**	**M1** for $3(3x+4)+4$ oe
(e)	$9x^2+24x+16$	**2**	**B1** for three terms from $9x^2+12x+12x+16$ correct
(f)	27	**2**	**M1** for x = h(*their* g(2))

135. 0580_w18_ms_43 Q: 10

	Answer	Mark	Partial Marks
(a)	$\frac{8}{15}$	**B1**	
	$\frac{n+2}{2n+3}$ oe	**B2**	**B1** for $n+2$ as numerator or $2n+3$ as denominator
(b)(i)	$1-2n$ oe	**2**	**B1** for $-2n+k$ oe or $pn+1$ $(p\neq 0)$ oe
(b)(ii)	n^3+1 oe	**2**	**M1** for cubic expression

136. 0580_m17_ms_42 Q: 5

	ANSWER	MARK	PARTIAL MARKS
(a) (i)	$(3x-1)(x+4)$	2	**M1** for $(3x+b)(x+c)$ with $bc=-4$ or $3c+b=11$ or for $3x(x+4)-1(x+4)$ or for $x(3x-1)+4(3x-1)$
(ii)	$\frac{1}{3}$ oe and -4	1	
(b) (i)	$2\times2(x-4)-2(2x+11)=(2x+11)(x-4)$ or better	M2	**M1** for common denom $2(2x+11)(x-4)$ seen or attempt to multiply through by denoms or for $\frac{2(x-4)-(2x+11)}{(2x+11)(x-4)}\left[=\frac{1}{2}\right]$
	$2x^2+11x-8x-44$ or better	B1	or for other correct relevant 2 bracket expansion if alt method used
	$4x-16-4x-22=2x^2-8x+11x-44$ $2x^2+3x-6=0$	A1	correct solution reached with all brackets expanded and no errors or omissions seen
(ii)	$\frac{-3\pm\sqrt{(3)^2-4(2)(-6)}}{2\times2}$	2	**B1** for $\sqrt{(3)^2-4(2)(-6)}$ or better or $\left(x+\frac{3}{4}\right)^2$ oe and **B1** for $\frac{-3+\sqrt{q}}{2(2)}$ or $\frac{-3-\sqrt{q}}{2(2)}$ or better or $-\frac{3}{4}+\sqrt{\frac{57}{16}}$ oe or $-\frac{3}{4}-\sqrt{\frac{57}{16}}$ oe
	–2.64 and 1.14 final ans cao	B1B1	**SC1** for –2.6 or –2.637... **and** 1.1 or 1.137... or –2.64 and 1.14 seen in working or 2.64 and –1.14 as final answers

137. 0580_m17_ms_42 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)	$x < 10$ oe	**1**	Accept $x \leqslant 9$
	$y \geqslant 2$ oe	**1**	Accept $y > 1$
(b)	$x + 3y \leqslant 21$ oe	**1**	Mark answer line isw
(c)	ruled broken line $x = 10$	**B1**	or ruled line $x = 9$
	ruled line $y = 2$	**B1**	or ruled broken line $y = 1$
	ruled line from (0, 7) to (21, 0)	**B2**	**SC1** for line with negative gradient correct only at (0, 7) or (21, 0)
	correct region indicated cao	**1**	
(d) (i)	4	**1**	
(ii)	20	**1**	

138. 0580_m17_ms_42 Q: 11

	ANSWER	MARK	PARTIAL MARKS
(a)	4 5 6 7	**1**	
	8 16 32 64 128	**3**	**B2** for 3 or 4 correct or **B1** for first 2 correct If 0 scored, **SC1** for 4 values correctly doubled **FT** one error
(b)	2^n oe	**1**	
(c) (i)	$2 + 4 + 8 = 14$	**1**	
	$16 - 2 = 14$	**1**	or for $14 + 2 = 16 = 2^4$
(ii)	62 and 6	**2**	**B1** for each
(iii)	$2^{n+1} - 2$ oe	**1**	
(iv)	9	**1**	

139. 0580_s17_ms_41 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)	–1.6 to –1.4	1	
(b)	–0.5	1	
(c)	$k > -4$	2	**B1** for identifying the –4 or for horizontal line drawn $y = -4$
(d)	$y = x - 5$ ruled and –2.3 to –2.1 –1.2 to –1.1 1.3 to 1.4	3	**B2** for correct line and 2 correct values or no line and 3 correct values or **B1** for no line and 2 correct values or **B1** for correct line
(e)	Tangent ruled at $x = 1$	B1	No daylight at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 0.8$ and 1.2
	–6 to –4	2	Dep on **B1** or close attempt at tangent at $x = 1$ **M1** for rise/run for *their* tangent at $x = 1$

140. 0580_s17_ms_41 Q: 6

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	$-7x + 55$ final answer	2	**M1** for $8x + 20$ or $-15x + 35$ or answer $-7x + k$ or $kx + 55$
(a)(ii)	$x^2 - 14x + 49$ final answer	2	**M1** for 3 of $x^2 - 7x - 7x + 49$

	ANSWER	MARK	PARTIAL MARKS
(b)(i)	–18	3	**M1** for a correct first step ie correctly multiplying by 3 or correctly dividing by 2 or for correctly subtracting 5 **M1** for correctly reaching $ax = b$ from *their* first step
(b)(ii)	15	3	**M2** for $6x - 4x = 21 + 9$ oe or **M1** for $6x - 21$ or correct division by 3 or for correctly reaching $ax = b$ from *their* first step
(b)(iii)	5 and –5	3	**B2** for 5 or –5 or **M1** for $[x^2 =] (74 + 1) \div 3$ or better

141. 0580_s17_ms_41 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	5 and 13	**1**	
(a)(ii)	$8n - 3 = 203$	**M1**	Evaluation of 25th or 26th term with supporting evidence or explanation
	25.75 or $25\frac{3}{4}$	**A1**	Second evaluation of 25th or 26th terms with supporting evidence or explanation If zero scored, **SC1** for 25.75 or 197 and 205 with partial evidence or explanation
(b)(i)	$6n + 7$ oe final answer	**2**	**B1** for $6n + c$ or $kn + 7$ $k \neq 0$
(b)(ii)	$n^2 + n + 2$ oe final answer	**2**	**B1** for a quadratic expression or second difference = 2
(c)	[y =] 10	**2**	**M1** for $5(20 - y) = 50$
	[First term =] 14	**2**	**M1** for $5(x - \textit{their } y) = 20$ or for $20 \div 5 + \textit{their } y$

142. 0580_s17_ms_42 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)	–1.75 to –1.7	**1**	
	1.7 to 1.75	**1**	
(b)(i)	Correct ruled solid tangent at (–1.5, 3.5)	**1**	
(b)(ii)	–7 to –5	**2 dep**	**dep** on close attempt at ruled solid tangent at $x = -1.5$ in part **(b)(i)** **M1** for rise/run dep on close attempt at ruled solid tangent at $x = -1.5$
(c)(i)	1	**1**	
(c)(ii)	Correct curve	**3**	**B2** for 4 or 5 correct points or **B1** for 2 or 3 correct points

	ANSWER	MARK	PARTIAL MARKS
(d)(i)	–0.95 to –0.8	**1**	
	1.1 to 1.45	**1**	
(d)(ii)	*their* (–0.95 to –0.8)< x < *their*(1.1 to 1.45) oe	**1FT**	correct or **FT** their **(d)(i)**
(e)(i)	0.125 oe and 0.03125 oe and 0.000976 to 0.000977 oe	**1**	
(e)(ii)	0	**1**	accept zero, nought, etc

143. 0580_s17_ms_42 Q: 7

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	4.5 or $4\frac{1}{2}$ or $\frac{9}{2}$ final answer	**3**	**M2** for [2](4x + 7) = [2](6x – 2) oe or **M1** for 2(2x + 6) + 2(2x + 1) oe or 4(3x – 1) oe or **M1** for correctly reaching $ax = b$ from *their* linear equation
(a)(ii)	$(2x+6)(2x+1)=(3x-1)^2$	**M1**	May be seen in different stages
	$5x^2-20x-5\,[=0]$ oe	**B3**	**B1** for 4x^2 + 2x + 12x + 6 or better **B1** for 9x^2 – 3x – 3x + 1 or better
	$\frac{-(-20)\pm\sqrt{(-20)^2-4(5)(-5)}}{2(5)}$ oe	**M2**	**FT** their 3 term quadratic provided formula used or complete the square **M1** for $\sqrt{(-20)^2-4(5)(-5)}$ oe or if in form $\frac{-(-20)+\sqrt{q}}{2(5)}$ or $\frac{-(-20)-\sqrt{q}}{2(5)}$ **FT**± *their* quadratic or for completing the square **M2** for $2\pm\sqrt{1+2^2}$ or **M1** for $(x-2)^2$
	4.24 or 4.236… cao	**B1**	
(b)(i)	$(x+5)(x-1)$ final answer	**2**	**B1** for $x(x-1)+5(x-1)$ or $x(x+5)-[1](x+5))$ or for $(x+a)(x+b)$ where $ab=-5$ or $a+b=4$

	ANSWER	MARK	PARTIAL MARKS
(b)(ii)	$5(x+1)-8x=x(x+1)$ or $5x+5-8x=x^2+x$	**M2**	Could be seen in different stages **M1** for $5(x+1)-8x$ seen or for common denominator of $x(x+1)$ for LHS or both sides soi
	–5 and 1 cao	**A2**	**A1** for $x^2+4x-5\,[=0]$ oe

144. 0580_s17_ms_42 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	100	**1**	
(a)(ii)	92.3 or 92.29… to 92.31	**3**	**M2** for $200\div(2+\frac{10}{60})$ oe or **M1** for 200 ÷ *their* time interval or **M1** for $\frac{10}{60}$ soi oe
(b)(i)	240 nfww	**3**	**M2** for $\frac{V}{2}\left(\frac{30}{60}+\frac{20}{60}\right)=100$ oe or **M1** for any correct relevant area seen in terms of V
(b)(ii)	$\frac{2}{9}$ oe	**2FT**	**FT** for *their* **(b)(i)** ÷ 1080 to 3 sf or better **M1** for *their* **(b)(i)** $\times\frac{1000}{3600}$ soi

145. 0580_s17_ms_42 Q: 10

	ANSWER	MARK	PARTIAL MARKS
(a)	–11	**1**	
(b)	7	**2**	**M1** for $3x-2=19$ or better
(c)	25	**2**	**M1** for $3\times3^x-2$ oe
(d)	$9x^2-8x+2$ final answer	**3**	**M1** for $(3x-2)^2+3x-2+x$ oe **B1** for $\left[(3x-2)^2=\right]9x^2-6x-6x+4$ oe
(e)	$\frac{x+2}{3}$ oe final answer	**2**	**M1** for $x=3y-2$ or $y+2=3x$ or $\frac{y}{3}=x-\frac{2}{3}$ or better

146. 0580_s17_ms_43 Q: 3

	ANSWER	MARK	PARTIAL MARKS
(a)	0 2.25 2 1.25	**4**	**B1** for each
(b)	Fully correct smooth curve	**4**	**B3 FT** for 7 or 8 points **or B2 FT** for 5 or 6 points **or B1 FT** for 3 or 4 points

	ANSWER	MARK	PARTIAL MARKS
(c)	1	**1**	
(d)(i)	[$y =$] $x + 1$	**1**	
(d)(ii)	–2.2 to –2.1	**1**	
	–0.45 to –0.4	**1**	
	0.51 to 0.6	**1**	If zero scored, **SC1** for *their* line in **(d)(i)** drawn. It must be of the form $y = mx + c$ ($m \neq 0$) and drawn 'fit for purpose'
(e)	$-1.33 < k < 0$ to 0.1	**2FT**	**FT** Strict ft of *their* max point and min point dep on cubic graph or accept correct answer from calculus **B1** for each If zero scored, **SC1** for two correct values reversed

147. 0580_s17_ms_43 Q: 7

	ANSWER	MARK	PARTIAL MARKS
(a)	[x =] –5 [y =] 7 with correct working	4	**M1** for correctly equating one set of coefficients **M1** for correct method to eliminate one variable OR **M1** for correctly rearranging one equation **M1** for correct method to eliminate one variable **A1** $x = -5$ **A1** $y = 7$ both dep on **M2** If zero scored, **SC1** for 2 values satisfying one of the original equations **SC1** if no correct working shown, but 2 correct answers given
(b)	[a =] 36 [b =] –6	3	**B2** for either correct or **M1** for $a = b^2$ or for $x^2 + bx + bx + b^2$ or better or for $(x - 6)^2$ seen and **M1** for $2b = -12$ soi
(c)	$\frac{7x^2 - 12x - 10}{(2x-5)(x-1)}$ oe final answer nfww	4	**B1** for common denom $(2x-5)(x-1)$ seen oe isw **M1** for $x(x-1) + (3x+2)(2x-5)$ soi isw **B1** for $6x^2 - 15x + 4x - 10$ soi

148. 0580_s17_ms_43 Q: 11

	ANSWER	MARK	PARTIAL MARKS
	64 $(n+3)^2$ oe final answer	1, 2	**M1** for a quadratic expression seen or second differences 2
	17 $3n + 2$ oe final answer	1, 2	**B1** for $3n + k$ (any k) or $kn + 2$ $(k \neq 0)$
	47 $(n+3)^2 - (3n+2)$ oe isw	1, 2FT	**FT** *their* difference expressions $A - B$ **M1** for expression $an^2 + bn + c$ seen or second differences 2
	$\frac{7}{6}$ $\frac{n+2}{n+1}$ oe final answer	1, 2	**B1** for $\frac{n+k+1}{n+k}$ seen

149. 0580_w17_ms_41 Q: 3

	ANSWER	MARK	PARTIAL MARKS
(a)	-2.75 or $-2\frac{3}{4}$	**2**	**M1** for $11x - 3x = -7 - 15$ or better
(b)(i)	$(x + 11)(x - 2)$ final answer	**2**	**M1** for $(x + a)(x + b)$ where $ab = -22$ or $a + b = 9$
(b)(ii)	-11 and 2 final answer	**1**	
(c)	$[x] = \frac{2a}{2-y}$ or $\frac{-2a}{y-2}$ nfww final answer	**4**	**M1** for clearing the x term in the denominator **M1** for correctly removing the bracket (expand or divide by 2) **M1** for factorising to obtain single x term **M1** for *their* factor and division Incorrect answer scores 3 out of 4 maximum
(d)	$\frac{x}{x+6}$ nfww final answer	**3**	**M1** for $x(x - 6)$ **M1** for $(x + 6)(x - 6)$

150. 0580_w17_ms_41 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)	10, 7	**2**	**B1** for each value
(b)	Correct curve	**4**	**B3 FT** for 10 or 11 correct points **B2 FT** for 8 or 9 correct points **B1 FT** for 6 or 7 correct points **FT** *their* table
(c)	-1.7 to -1.55	**1**	**FT** *their* graph if one answer
(d)	Tangent ruled at $x = 3.5$	**B1**	No daylight between tangent and curve at point of contact
	6.5 to 11	**B2**	**dep** on tangent drawn or close attempt at tangent at $x = 3.5$ **M1** for rise/run also dep on tangent or close attempt at $x = 3.5$
(e)	line $y = 2x + 10$ ruled AND -1.3 to -1.1 1 4.1 to 4.25	**4**	**B3** for correct line (could be short) and 1 correct value or **B2** for correct line (could be short) or **B1** for $[y =]\ 2x + 10$ seen If zero scored, **SC1** for no/wrong line and 3 correct values

151. 0580_w17_ms_41 Q: 6

	ANSWER	MARK	PARTIAL MARKS
(a)	18 22 $4n + 2$ oe 17 26 $n^2 + 1$ oe	**6**	**B2** for 18, 22, 17, 26 or **B1** for two or three correct values AND **B2** for $4n + 2$ oe or **B1** for $4n + k$ oe or $pn + 2$ ($p \neq 0$) AND **B2** for $n^2 + 1$ oe or **B1** for $n^2 + k$ oe
(b)	242	**1**	**FT** *their* $4n + 2$ provided a linear expression
(c)	15	**1**	
(d)	3	**2**	**M1** for $2 \times 1^2 + 2 \times 1 + q = 7$ oe

152. 0580_w17_ms_41 Q: 7

	ANSWER	MARK	PARTIAL MARKS
(a)	-7	**1**	
(b)	$\frac{4}{64}$ or better	**2**	**M1** for g(4^3) soi or $\frac{4}{4^x}$ or better
(c)	$\frac{3-x}{2}$ oe final answer	**2**	**M1** for $x = 3 - 2y$ or $2x = 3 - y$ or $\frac{y}{2} = \frac{3}{2} - x$ or $\frac{y-3}{-2}$ oe as final answer
(d)	4^{3-2x}	**M1**	
	Correctly interprets the indices	**M1**	Dep on previous **M1** e.g. $4^3 \times 4^{-2x}$ or $4^3 \times \frac{1}{4^{2x}}$ or $\frac{4^3}{4^{2x}}$
	$\frac{64}{16^x}$ nfww	**A1**	Correct completion with no errors
(e)	1.5	**2**	**B1** for $4^x = 8$ or better

153. 0580_w17_ms_42 Q: 5

	ANSWER	MARK	PARTIAL MARKS
(a)	3.2 or 3.15 or 3.152 to 3.153 5.2 or 5.19 or 5.20 or 5.196…	**2**	**B1** for each
(b)	Correct graph for $0.5 \leqslant x \leqslant 3.5$	**4**	**B3FT** for 6 or 7 correct points or **B2FT** for 4 or 5 correct points or **B1FT** for 2 or 3 correct points
(c)	1.7 to 1.8	**1FT**	**FT** *their* graph if one answer
(d)(i)	Any integer $k \geqslant -1$	**1**	
(d)(ii)	Any integer $k < -1$	**1**	
(e)	Tangent ruled at $x = -3$	**B1**	
	2.5 to 4	**B2**	**dep** on tangent drawn at $x = -3$ or close attempt at tangent at $x = -3$ **M1** for rise/run also dep on tangent at $x = -3$ or close attempt at tangent at $x = -3$

	ANSWER	MARK	PARTIAL MARKS
(f)(i)	$y = 6 - x$ ruled accurately	**M2**	**M1** for correct line but freehand or ruled line gradient –1.1 to –0.9, or through (0, 6) but not $y = 6$
	$2.85 \leqslant x \leqslant 3$	**A1**	
(f)(ii)	$[a =]$ 8 $[b =]$ –48 $[c =]$ –16	**4**	**B3** for 2 correct or $x^5 + 8x^3 - 48x^2 - 16 = 0$ seen or $-x^5 - 8x^3 + 48x^2 + 16 = 0$ seen or **M2** for correct multiplication by $8x^2$ or **B1** for answers ± 8, ± 48, ± 16 or **M1** for $\frac{x^2 \times x^3 - 8 \times 2}{x^2 \times 8} = 6 - x$ or **M1** for correct multiplication by 8 or **M1** for correct multiplication by x^2

154. 0580_w17_ms_42 Q: 8

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	$7a + 9p = 354$ oe final answer	**1**	
(a)(ii)	[a =] 21 [p =] 23	**3**	**M1** for correctly eliminating one variable **A1** for $a = 21$ **A1** for $p = 23$
(b)(i)	$\frac{2}{x}$	**1**	
(b)(ii)(a)	$\frac{2}{x} + \frac{3}{x-1} = 2$	**M1**	
	$2(x-1) + 3x = 2x(x-1)$ oe	**M1dep**	Both sides of the equation could be over $x(x-1)$ at this stage Dep on **M1** or 3 term equation with fractions but one sign error
	$2x - 2 + 3x = 2x^2 - 2x$ oe $2x^2 - 7x + 2 = 0$	**A1**	Answer reached with one correctly expanded line seen and no errors seen
(b)(ii)(b)	$\sqrt{(-7)^2 - 4(2)(2)}$	**B1**	or for $\left(x - \frac{7}{4}\right)^2$
	$\frac{--7 + \sqrt{q}}{2 \times 2}$ or $\frac{--7 - \sqrt{q}}{2 \times 2}$	**B1**	or for $\frac{7}{4} + \text{or} - \sqrt{-1 + \left(\frac{7}{4}\right)^2}$
	3.19 only	**B2**	**B1** for 3.19 with other root or for 3.2 or 3.186… isw other root or for 0.31 or 0.314 or 0.3138 to 0.3139

155. 0580_w17_ms_42 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)	3	**1**	
(b)	$-\frac{2}{5}$ oe	**2**	**M1** for $2(1-2x)=x+4$
(c)	$-2x-7$ final answer	**2**	**M1** for $1-2(x+4)$
(d)	26	**2**	**B1** for h(5) soi or **M1** for $\left(x^2+1\right)^2+1$
(e)	$\frac{1-x}{2}$ oe final answer	**2**	**M1** for $x=1-2y$ or $2x=1-y$ or $\frac{y}{2}=\frac{1}{2}-x$ or $y-1=-2x$
(f)	$[p=]-20$ $[q=]26$	**4**	**B3** for $[\text{hgf}(x)]=4x^2-20x+26$ seen and not spoilt by further working or **M1** for $(1-2x)+4$ **M1 dep** for $(\textit{their}\ (5-2x))^2+1$ **B1FT dep** for $25-10x-10x+4x^2$

156. 0580_w17_ms_43 Q: 2

	ANSWER	MARK	PARTIAL MARKS
(a)	343	**1**	
(b)(i)	1	**1**	
(b)(ii)	x^{10} final answer	**1**	
(b)(iii)	$9x^{16}$ final answer	**2**	**B1** for x^{12} or x^{16} or $(3x^8)^2$ seen
(c)(i)	$2(x-3)(x+3)$ final answer	**2**	**M1** for $(2x+6)(x-3)$ or $(2x-6)(x+3)$ or $(x-3)(x+3)$
(c)(ii)	$\frac{2(x+3)}{x+10}$ or $\frac{2x+6}{x+10}$ final answer nfww	**3**	**M2** for $(x+10)(x-3)$ or **M1** for $(x+a)(x+b)$ where $ab=-30$ or $a+b=7$

157. 0580_w17_ms_43 Q: 3

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	1890	**2**	**M1** for 126 ÷ 4 [× 60] oe If zero scored, **SC1** for answer 31.5
(a)(ii)	103.95	**4**	**M3** for $0.5 \times \left(\frac{44}{60} + \frac{55}{60}\right) \times 126$ oe or **SC3** for figs 10395 or figs 104 or **M2** for two correct area methods or for a full method without minutes to hours conversion or **M1** for one correct area with or without minutes to hours conversion
(b)(i)	126 × 1000 ÷ (60 × 60)	**1**	
(b)(ii)	46.3 or 46.28 to 46.29	**3**	**M2** for (1400 + 220) ÷ 35 oe or **M1** for distance ÷ speed or 1400 + 220
(c)	180 nfww	**4**	**B3** for final answer 3 OR **M3** for $\frac{217.5}{72.5} \times 60$ oe or **M2** for 217.5 ÷ 72.5 oe or $\frac{210 \text{ to } 220}{72.5} \times 60$ or $\frac{217.5}{72 \text{ to } 74} \times 60$ or **M1** for 217.5 or 72.5 seen or $\frac{215}{73} \times 60$

158. 0580_w17_ms_43 Q: 7

	ANSWER	MARK	PARTIAL MARKS
(a)	9, – 6, 9	**3**	**B1** for each
(b)	Correct graph	**4**	**B3FT** for 6 or 7 correct points or **B2FT** for 4 or 5 correct points or **B1FT** for 2 or 3 correct points
(c)	–3.5 to –3.35 and 0.8 to 0.9..	**2FT**	**FT** *their* graph **B1FT** for either
(d)	$a = \frac{5}{4}$ or $1\frac{1}{4}$ or 1.25 $b = -\frac{49}{8}$ or $-6\frac{1}{8}$ or –6.125	**3**	**B2** for either correct or **M1** for $[2]\left(x+\frac{5}{4}\right)^2$ seen isw or for $2x^2 + 4ax + 2a^2 + b$

159. 0580_w17_ms_43 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)	$\frac{10}{x-0.5}$ oe final answer	**1**	Accept $\frac{20}{2x-1}$
(b)(i)	$\frac{10}{x-0.5} - \frac{10}{x} = 0.25$ oe	**M1**	**FT** *their* **(a)**
	$10x – 10(x – 0.5) = 0.25x\ (x – 0.5)$ oe	**M1**	Clears algebraic denominators or collects as a single fraction FT *their* algebraic fractions dep on two fractions with algebraic denominators
	$10x – 10x + 5 = 0.25x^2 – 0.125x$ or better	**B1**	Expands brackets
	$2x^2 – x – 40 = 0$	**A1**	Dep on **M1M1B1** and no errors seen
(b)(ii)	$\frac{--1 \pm \sqrt{(-1)^2 - 4\times 2\times -40}}{2\times 2}$ oe	**B2**	**B1** for $\sqrt{(-1)^2 - 4(2)(-40)}$ or better or **B1** for $\frac{--1+\sqrt{q}}{2\times 2}$ or $\frac{--1-\sqrt{q}}{2\times 2}$ or both
	–4.23 and 4.73 final answers	**B1 B1**	**SC1** for –4.229… **and** 4.729… or for –4.23 **and** 4.73 seen in working or for –4.73 **and** 4.23 as final answer or for –4.2 or –4.22 **and** 4.7 or 4.72 as final answer
(b)(iii)	2 [hours] 7 [minutes]	**3**	**B2** for 2.11 or 2.114 to 2.115 or 126.8 to 126.9 or 127 or **M1** for 10 ÷ *their* positive root from **(b)(ii)**

160. 0580_w17_ms_43 Q: 10

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	$2^2 \times 3^2 \times 5$ oe	**2**	**M1** for 3 correct prime factors in a tree or table seen before the first error or for 2, 3, 5 identified
(a)(ii)	540	**2**	**M1** for $2^2 \times 3^3 \times 5$ or 2×3^3 shown or answer $540k$

	ANSWER	MARK	PARTIAL MARKS
(b)	$X = 8575$ $Y = 6125$	**4**	**B3** for $X = 8575$ or $Y = 6125$ or **B2** for $a = 5$ or $b = 1$ soi or **B1** for $1225 = 5^2 \times 7^2$ or $42875 = 5^3 \times 7^3$ or **M1** for $a^2 \times 7^2$ [= 1225] or $a^3 \times 7^{b+2}$ [= 42875]