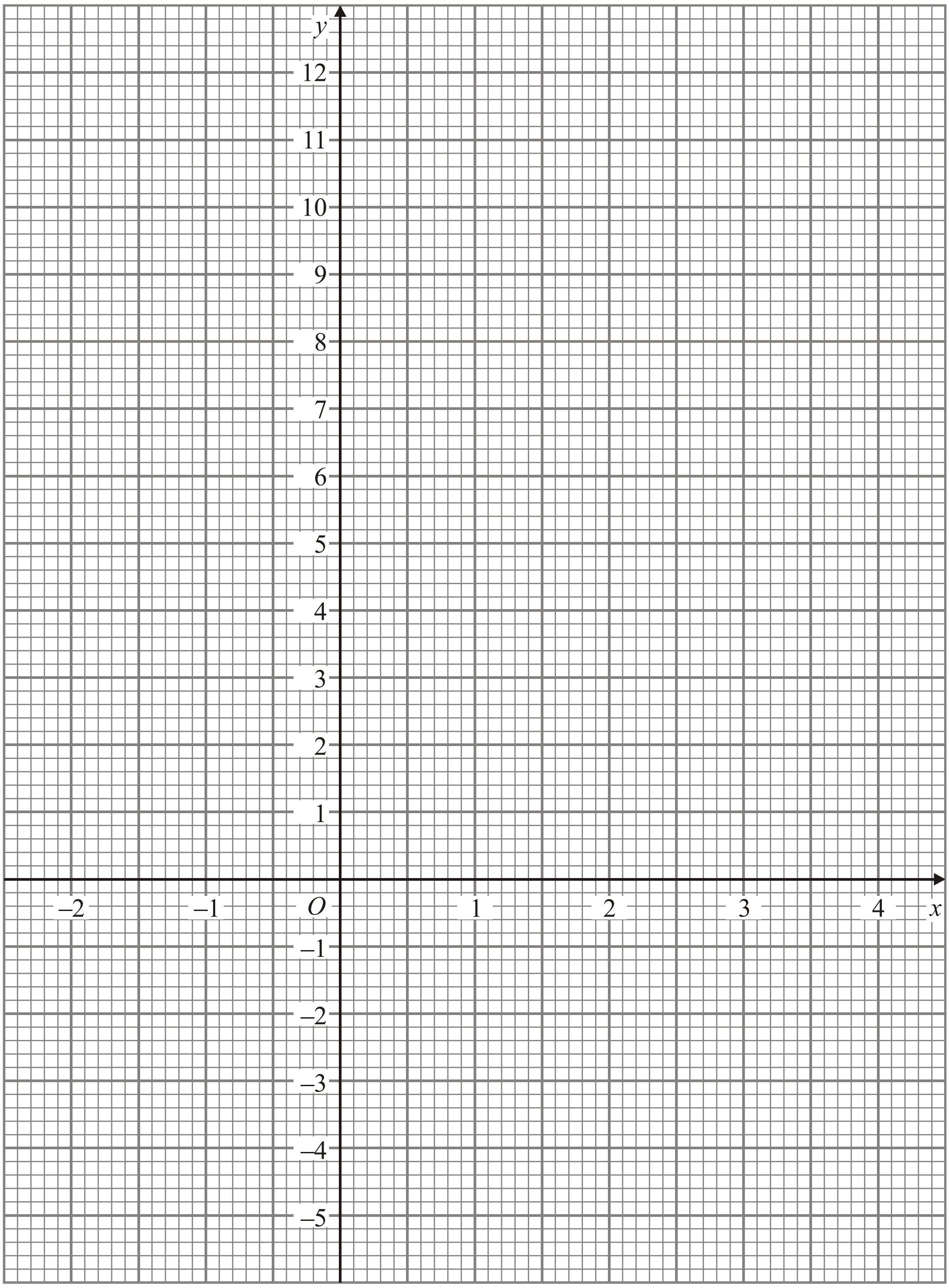
1. (a) Complete the table for $y = x^2 - 3x + 1$

x	–2	–1	0	1	2	3	4
y	11		1	–1		1	5

(2)

(b) On the grid below, draw the graph of $y = x^2 - 3x + 1$

(2)


y
12
11
10
9
8
7
6
5
4
3
2
1
O
–2
–1
1
2
3
4
x
–1
–2
–3
–4
–5

(c) Use your graph to find an estimate for the minimum value of y.

y = ……………………

(1)
(Total 5 marks)

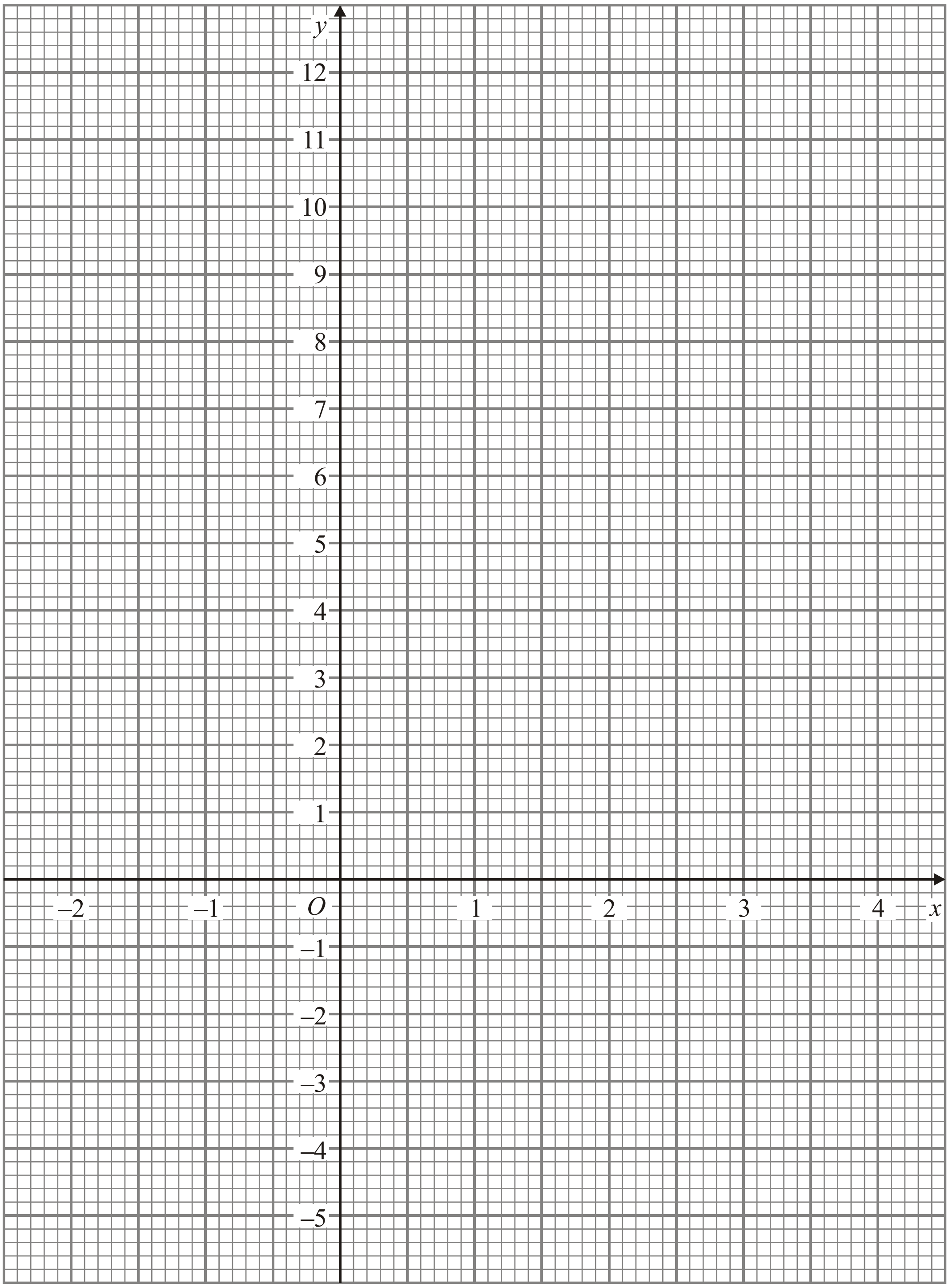
2. (a) Complete the table for $y = x^2 - 3x + 1$

x	–2	–1	0	1	2	3	4
y	11		1	–1		1	5

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$

(2)



(c) Use your graph to find an estimate for the minimum value of y.

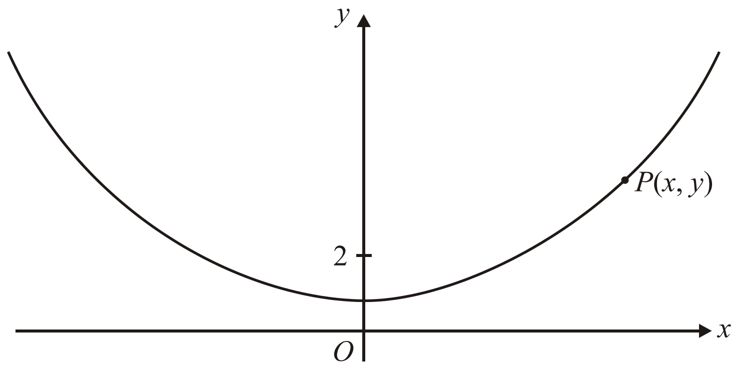
y = ……………………
(1)

(d) Use a graphical method to find estimates of the solutions to the equation

$$x^2 - 3x + 1 = 2x - 4$$

x = …………………… or x = ……………………
(3)
(Total 8 marks)

3.



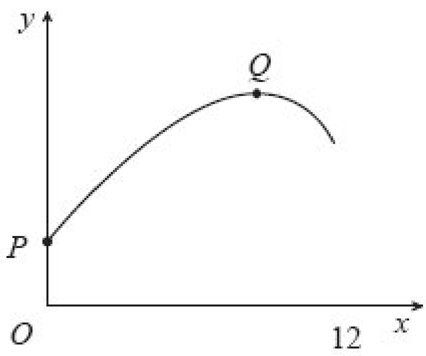
The diagram shows a sketch of a curve.
The point $P(x, y)$ lies on the curve.
The locus of P has the following property:

> The distance of the point P from the point (0, 2) is the same as the distance of the point P from the x-axis.

Show that $y = \frac{1}{4}x^2 + 1$

(Total 4 marks)

4. Here is a sketch of the graph of $y = 25 - \frac{(x-8)^2}{4}$ for $0 \le x \le 12$



P and *Q* are points on the graph.

P is the point at which the graph meets the *y*-axis.

Q is the point at which *y* has its maximum value.

(a) Find the coordinates of

(i) *P*,

(…… , ……)

(ii) *Q*.

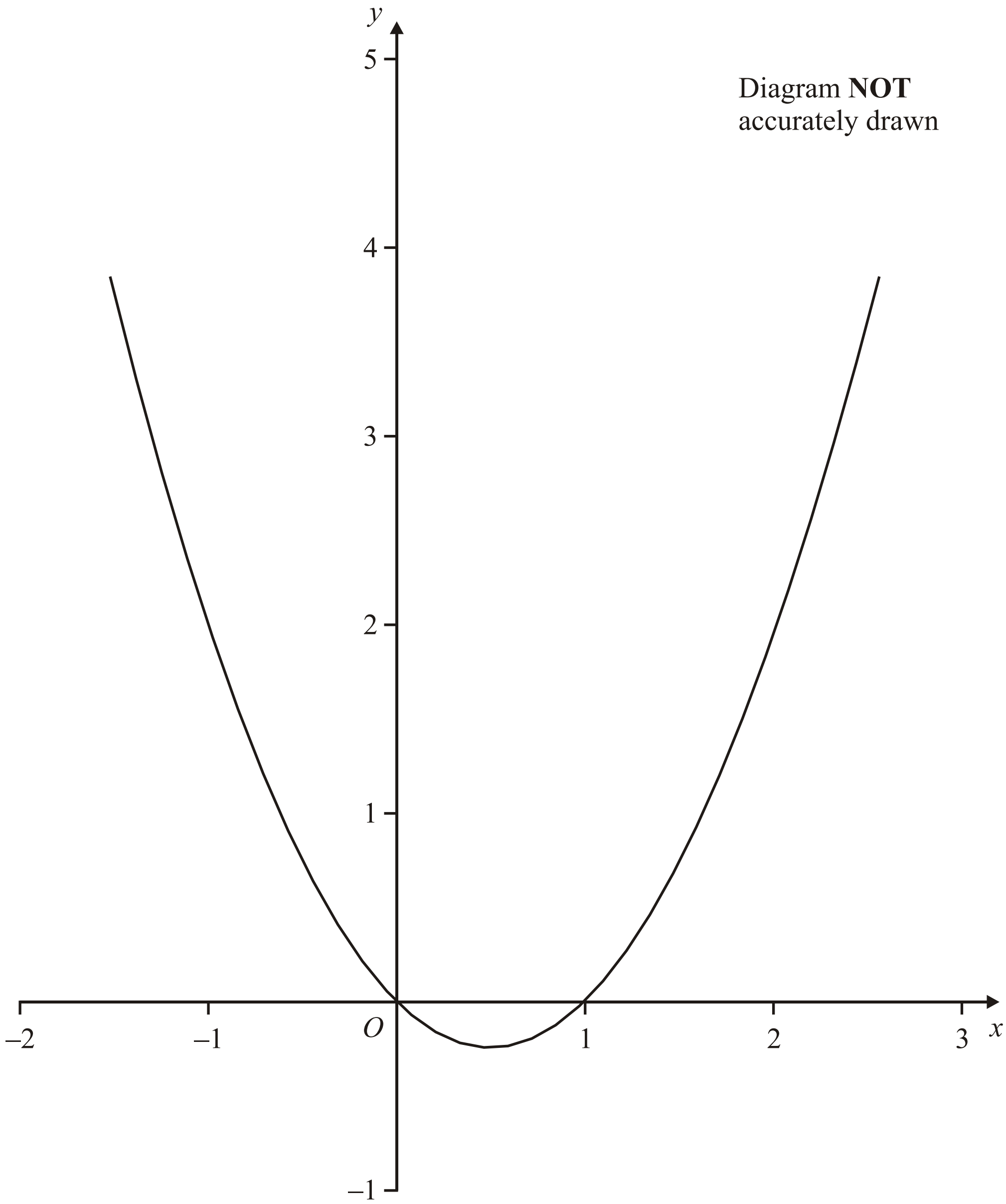
(…… , ……)

(3)

(b) Show that $25 - \frac{(x-8)^2}{4} = \frac{(2+x)(18-x)}{4}$

(3)
(Total 6 marks)

5.



The diagram shows a sketch of the graph of $y = x^2 - x$

(a) On the same diagram, sketch and label where the graph of $y = (x - 1)^2 - (x - 1)$
Show clearly where this graph crosses the x-axis and where it crosses the y-axis.

(3)

(b) On the same diagram, sketch and label the graph of $y = 3(x^2 - x)$

(1)

The line $y = 4 - 4x$ intersects the curve $y = 3(x^2 - x)$ at the points A and B.

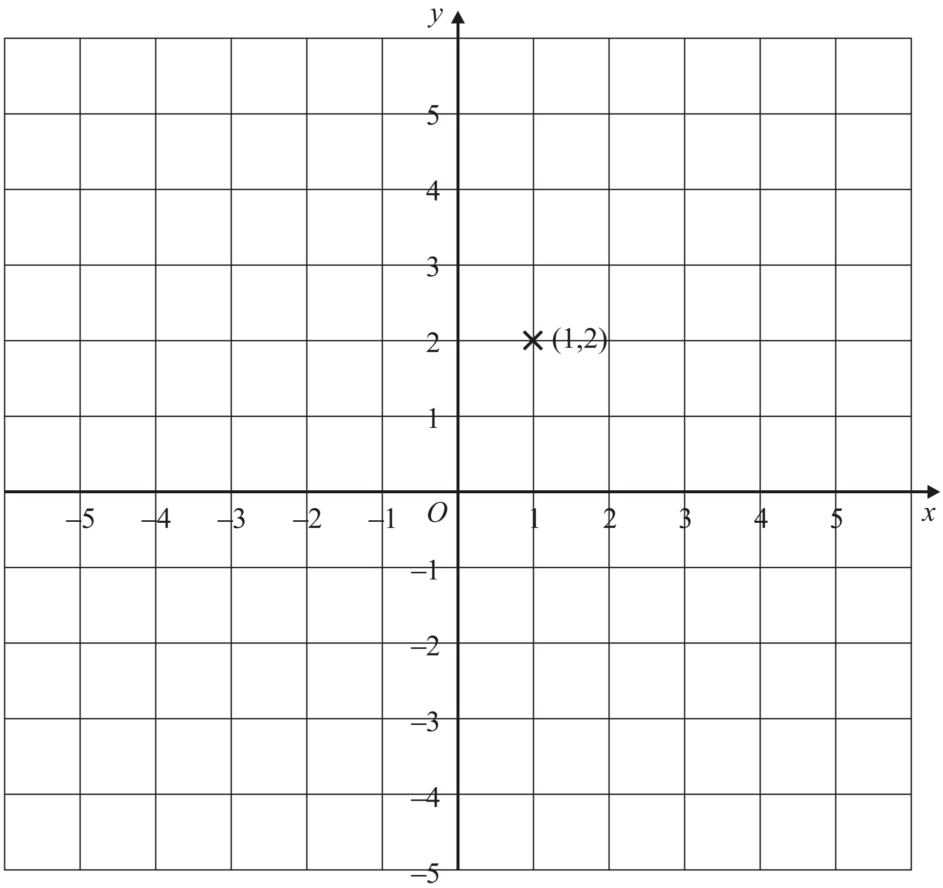
(c) Use an algebraic method to find the coordinates of A and B.

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

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

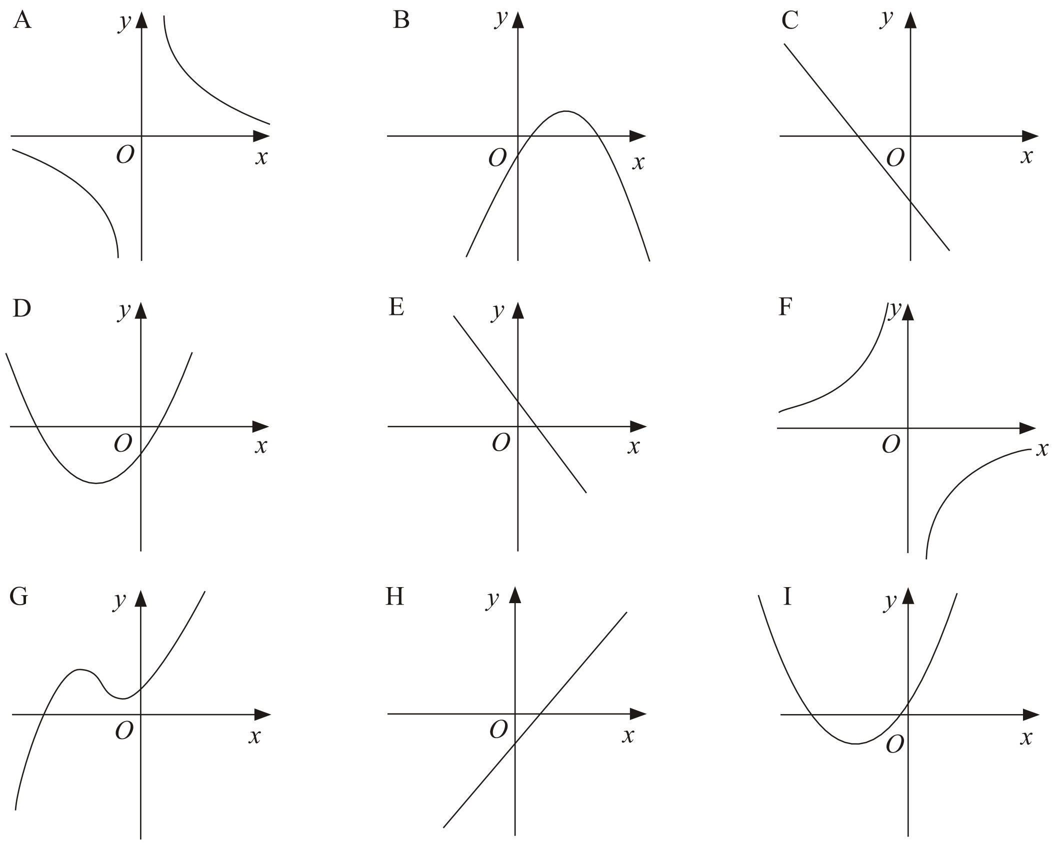
(5)
(Total 9 marks)

6. Show that any straight line that passes through the point (1,2) must intersect the curve with equation $x^2 + y^2 = 16$ at two points.



(Total 3 marks)

7.



Write down the letter of the graph which could have the equation

(i) $y = 1 - 3x$

....

(ii) $y = \dfrac{1}{x}$

....

(iii) $y = 2x^2 + 7x + 3$

....

(Total 3 marks)

8. For all values of x,

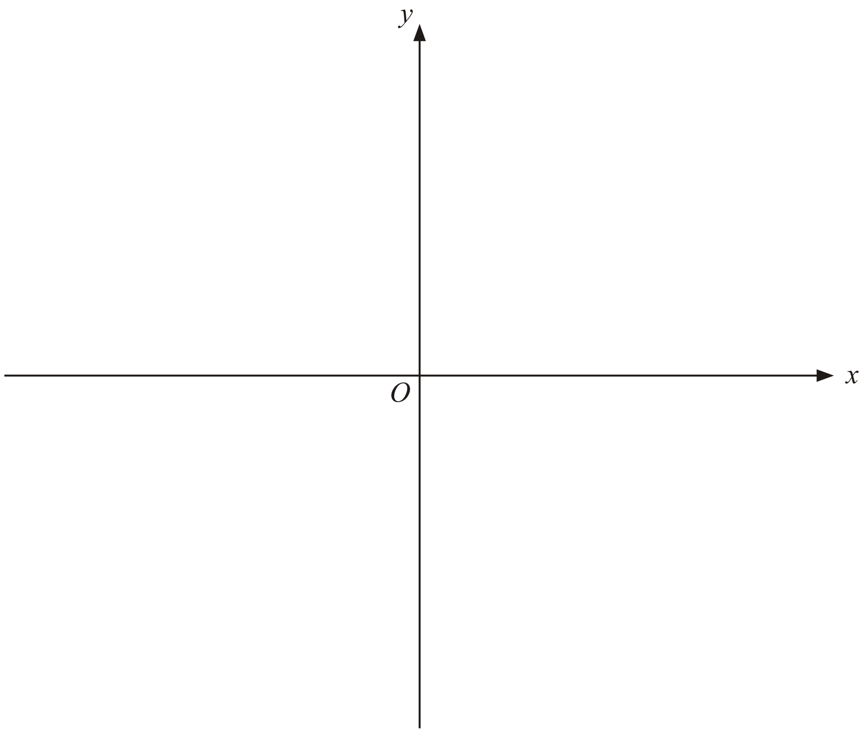
$$x^2 - 6x + 15 = (x - p)^2 + q$$

(a) Find the value of p and the value of q.

p = ... , q = ...

(2)

(b) On the axes, draw a sketch of the graph $y = x^2 - 6x + 15$



(2)
(Total 4 marks)

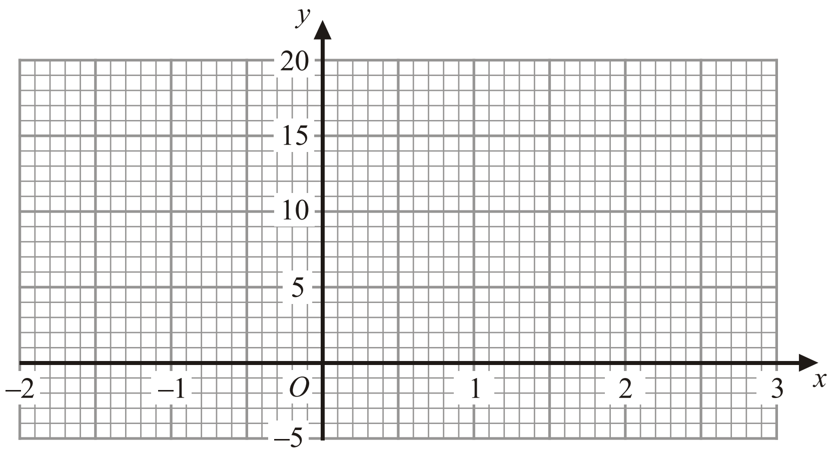
9. (a) Complete the table of values for $y = 2x^2 - 4x$

x	–2	–1	0	1	2	3
y	16		0			6

(2)

(b) On the grid, draw the graph of $y = 2x^2 - 4x$ for values of x from −2 to 3

(2)



(c) (i) On the same axes, draw the straight line $y = 2.5$

(ii) Write down the values of x for which $2x^2 - 4x = 2.5$.

....

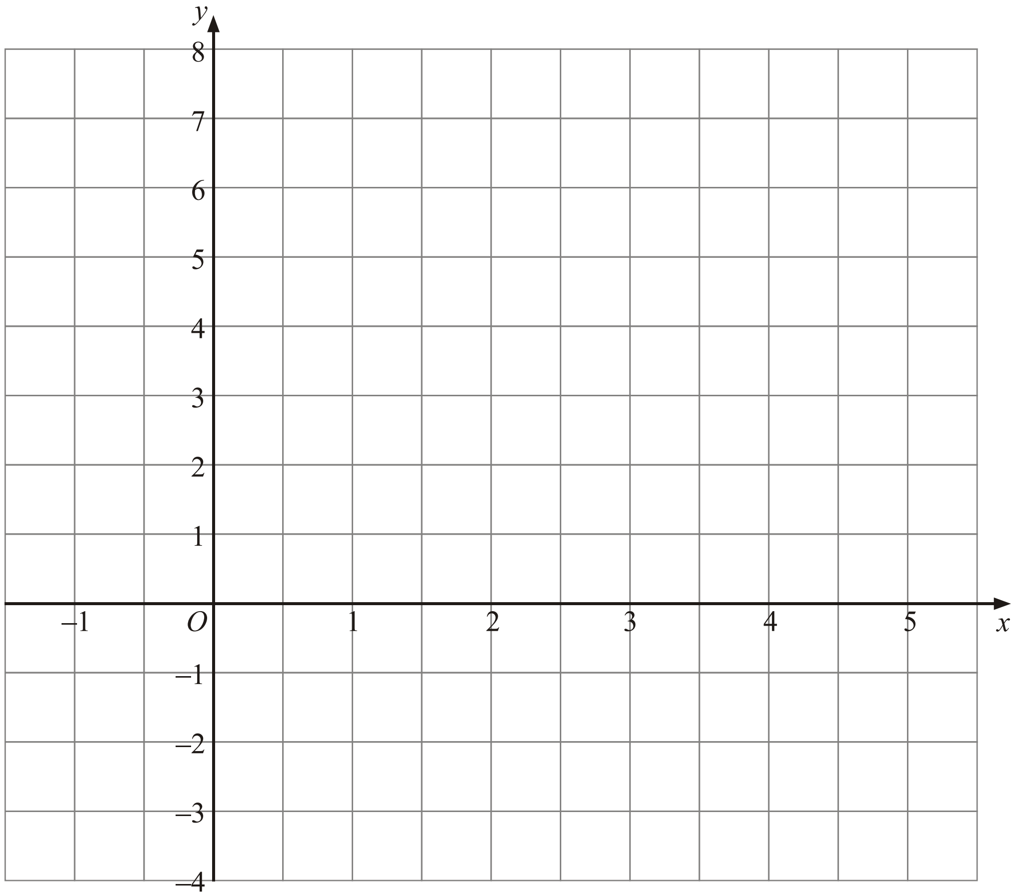
(2)
(Total 6 marks)

10. (a) Complete the table of values for $y = x^2 - 4x + 2$

x	–1	0	1	2	3	4	5
y		2	–1		–1		7

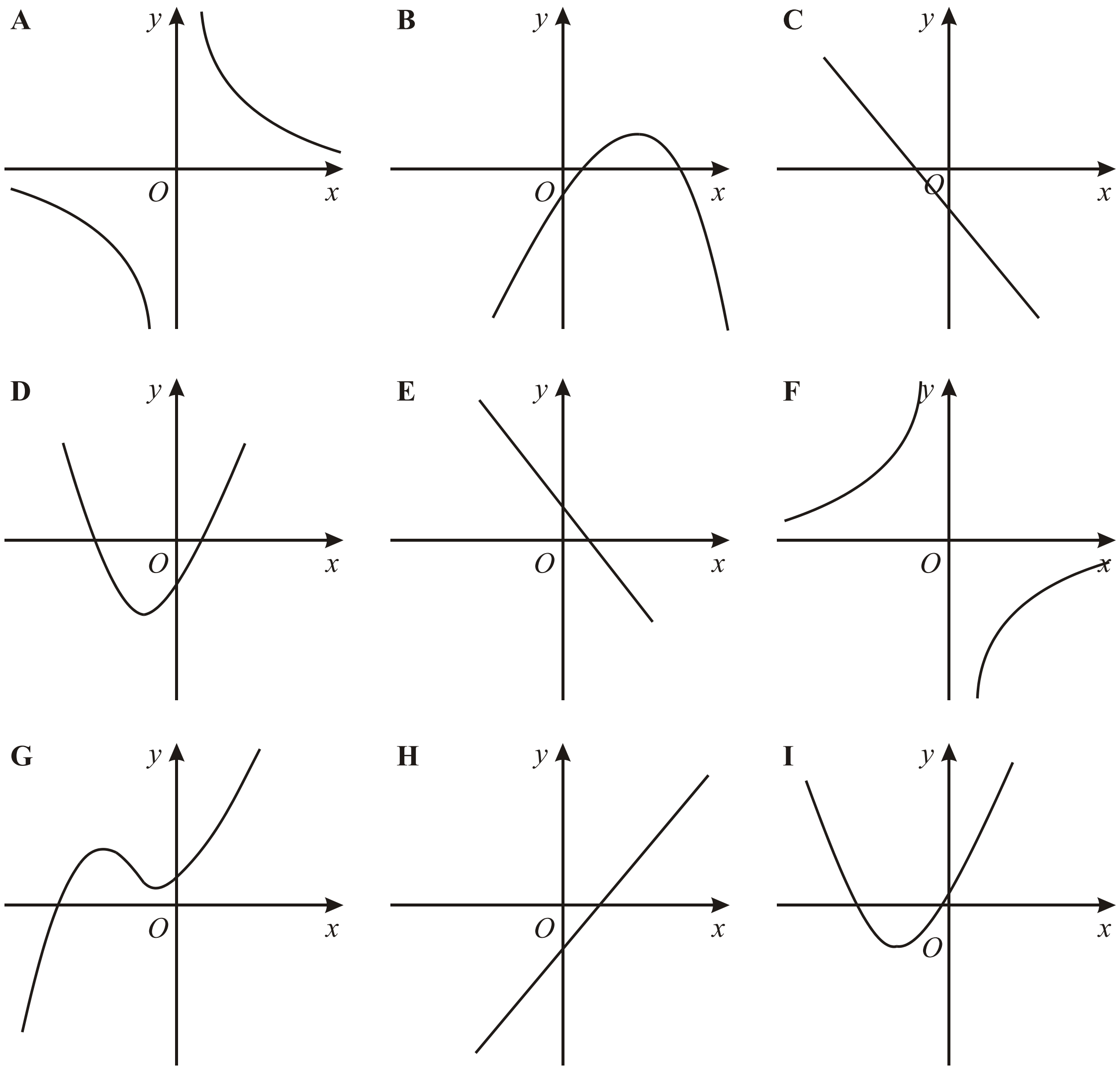
(2)

(b) On the grid, draw the graph of $y = x^2 - 4x + 2$



(2)
(Total 4 marks)

11.



Write down the letter of the graph which could have the equation

(i) $y = 3x - 2$ ……………

(ii) $y = 2x^2 + 5x - 3$ ……………

(iii) $y = \frac{3}{x}$ ……………

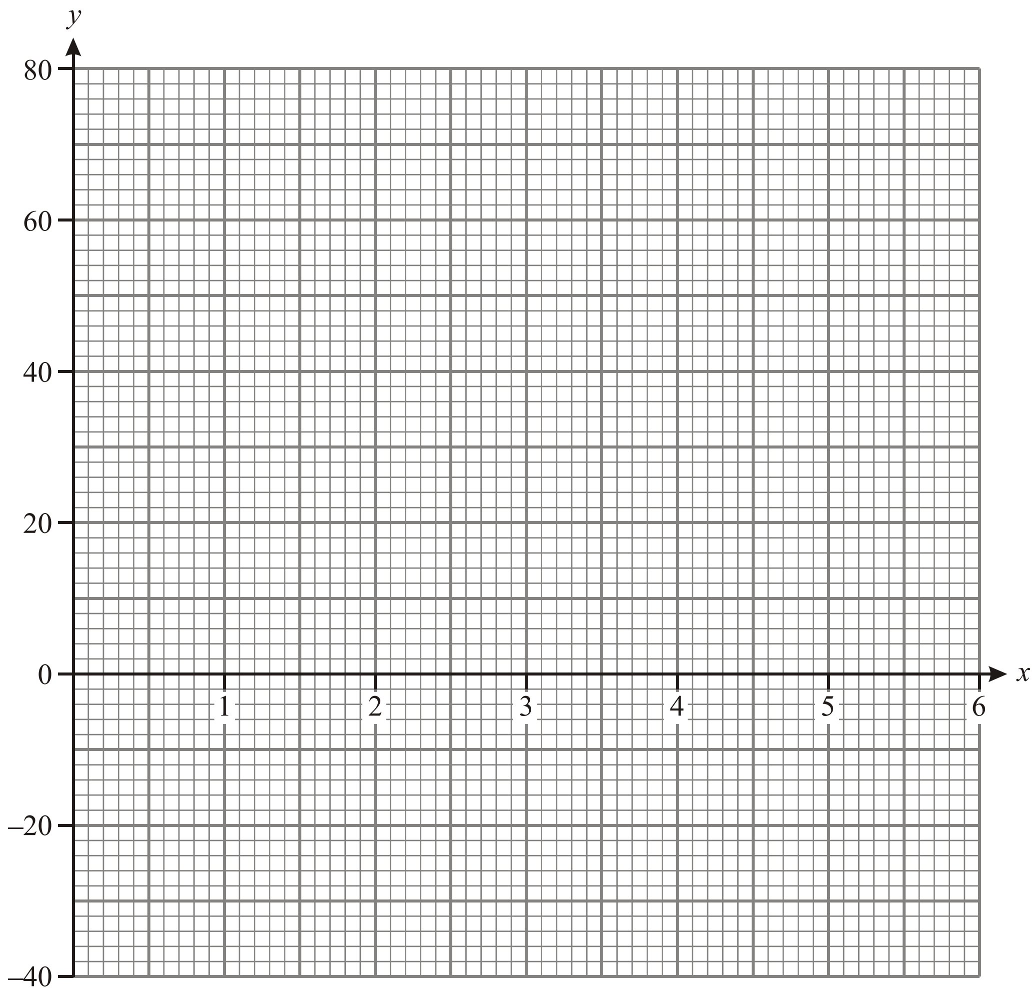
(Total 3 marks)

12. (a) Complete the table of values for the graph of $y = 4x(11 - 2x)$

x	0	1	2	3	4	5	6
y	0			60			–24

(2)

(b) On the grid, draw the graph of $y = 4x(11 - 2x)$



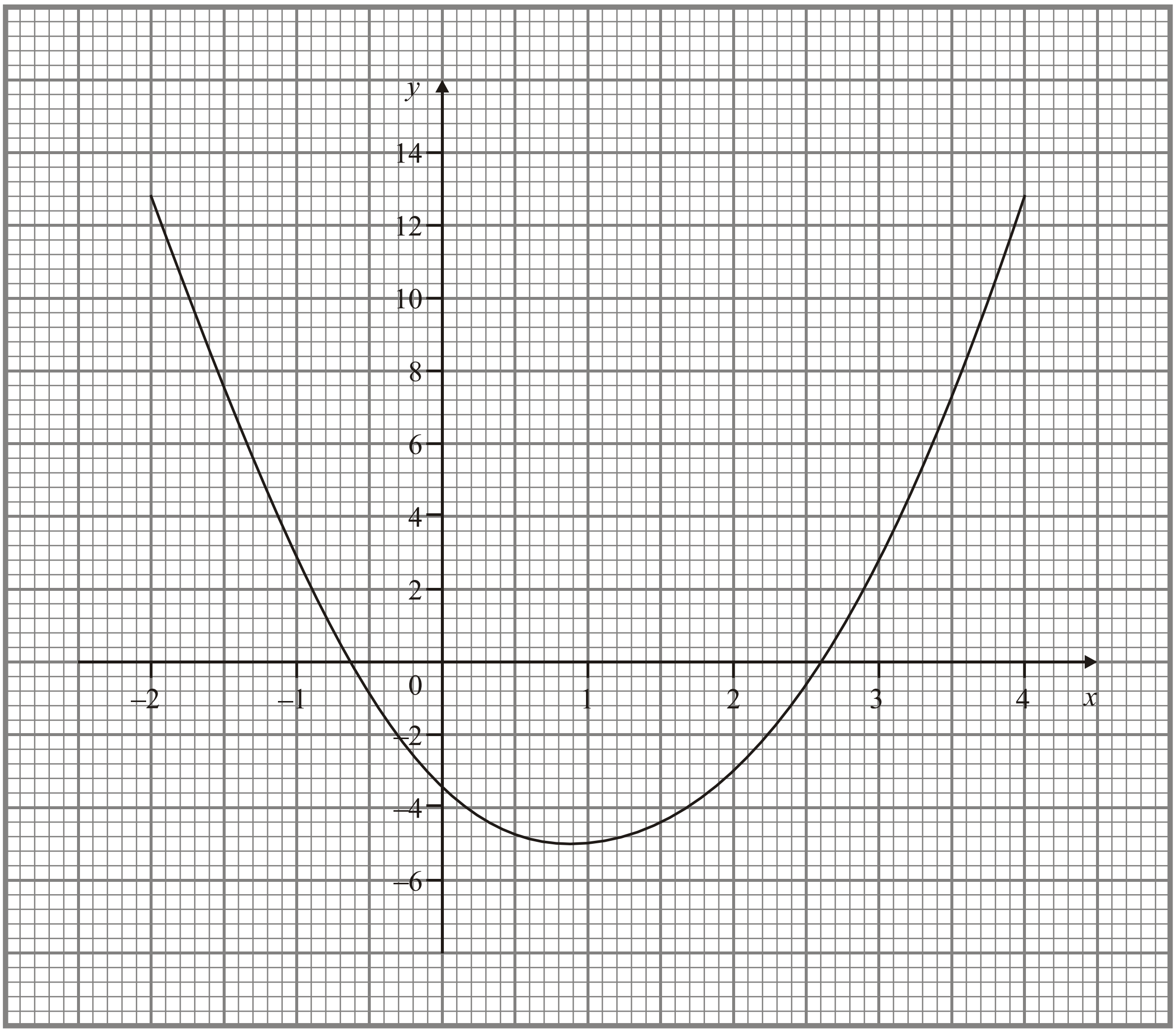
(2)

(c) Use your graph to find the maximum value of y.

……………..

(1)
(Total 5 marks)

13.



The diagram shows the graph of the equation $y = 2x^2 - 4x - 3$

Use the graph to find the approximate values of x when $2x^2 - 4x - 3 = 0$

x = ... or x = ...

(Total 2 marks)

1. (a) 5, –1 2

B1 for each correct answer

	(b)		*B1 ft for all 7 points plotted correctly* *B1 ft for smooth curve through all 7 points (dep on B1 in (a))*	2	
	(c)	−1.25	*B1 ft ±½ square (dep on a single minimum from a curve through 6 points)*	1	
					[5]
2.	(a)	5, -1	*B1 for each correct answer*	2	
	(b)		*B1 ft for all 7 points plotted correctly* *B1 ft for smooth curve through 7 points (dep on B1 in (a))*	2	
	(c)	−1.25	*B1 ft ± ½ square – must have single minimum from a curve through 6 points*	1	
	(d)		*B1 for line $y = 2x - 4$ drawn correctly.* *B1 + B1 ft (dep on line of gradient 2, or intercept of – 4) for each correct answer.* *Answers are 3.62 and 1.38* *OR B1 $y = x^2 - 5x + 5$ seen and attempt to plot* *B1 values (1, 1) (2, –1) (3, –1) (4, 1)* *B1 ft for 2 solutions*	3	
					[8]

3. Distance from x axis is y.
Distance from (0, 2) is $\sqrt{(x^2 + (y - 2)^2)}$
$y^2 = x^2 + (y - 2)^2$
$y^2 = x^2 + y^2 - 4y + 4$
$0 = x^2 - 4y + 4$
$4y = x^2 + 4$ and finish — 4

B1 for $(x - 0)^2 + (y - 2)^2$ or $\sqrt{((x - 0)^2 + (y - 2)^{2)}}$ oe seen
B1 for $y = \sqrt{(x-0)^2 + (y-2)^2}$
or $y^2 = (x - 0)^2 + (y - 2)^2$ oe
B1 $(y - 2)^2 = y^2 - 4y + 4$ seen
B1 for $4y = x^2 + 4$ and finish

[4]

4. (a) (i) (0, 9) — 3

B1 cao

(ii) (8, 25)

B1 for x = 8 cao
B1 for y = 25 cao
SC: B1 for (25, 8)

(b) LHS $= \left(\dfrac{100-(x^2-16x+64)}{4}\right)$

$= \left(\dfrac{36+16x-x^2}{4}\right)$

RHS $= \left(\dfrac{36-2x+18x-x^2}{4}\right) =$ LHS 3

M1 for expansion of either set of brackets with at least 3 of 4 terms correct
M1 for common denominator of 4 or multiplying through by 4 or reducing each numerator to a single term
A1 for fully correct solution
Alternative method
M1 for $\left(5-\dfrac{(x-8)}{2}\right)\left(5+\dfrac{(x-8)}{2}\right)$
M1 for $\left(\dfrac{2\times 5-(x-8)}{2}\right)\left(\dfrac{2\times 5+(x-8)}{2}\right)$
A1 for $\dfrac{(18-x)(x+2)}{4}$

[6]

5. (a) (0, 2)
(1, 0)
(2, 0) 3

B1 for graph translated through $\begin{pmatrix}1\\0\end{pmatrix}$ *or* $\begin{pmatrix}-1\\0\end{pmatrix}$
B1 for y intercept at (0, 2) ± 2 mm
B1 for x intercept at (1, 0) and (2, 0) ± 2 mm

(b) B1 correct sketch showing stretch SF3 parallel to the *y*-axis 1

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

$3x^2 + x - 4 = 0$

$(3x + 4)(x - 1) = 0$

x–1 or $x = -\frac{4}{3}$

Subs to get y=0 or y= 9 $\frac{1}{3}$

(1, 0)

$\left(-\frac{4}{3}, \frac{28}{3}\right)$ 5

M1 for equating the RHS of each equation
M1 for reduction to 3 term quadratic (= 0)
M1 for (3x ± a)(x ± b) (= 0) with ab = – 4
or $x = \frac{-1 \pm \sqrt{1^2 - 4 \times 3 \times (-4)}}{2 \times 3}$, *allowing sign errors in b and c.*
A1 for (1, 0)
A1 for $\left(-\frac{4}{3}, \frac{28}{3}\right)$ *oe*
SC B1 for (1, 0) no marks awarded previously
SC 4/5 if the correct algebra is used to find the two correct x values, but the two y values are not found or are incorrect

[9]

6. Draw circle centre (0,0) radius 4
Draw a line through (1,2)
Show two intersections
Fully correct explanation 3

M1 circle or semi-circle centre (0, 0) drawn or plotted with at least 8 points or stated
A1 correct circle drawn or stated
A1 straight line drawn through (1, 2) and cutting the (possibly freehand) circle at 2 distinct points or for stating that any straight line through (1, 2) will cut the circle in 2 places as (1, 2) is inside the circle

[3]

7. (i) E — 3

B1 for E cao

(ii) A

B1 for A cao

(iii) I

B1 for I cao

[3]

8. (a) $(x + 3)^2 - 3^2 + 15$

$p = 3, q = 6$ — 2

B2 for p = 3 and q = 6

(B1 for p = 3 OR q = 6)

SC: award B2 for $(x + 3)^{2\,+}\ 6$ *if p <u>and</u> q are not identified*

(b) Sketch — 2

B1 for U shaped curve

B1 ft for TP in first quadrant (ft if TP not in first quadrant)

[4]

9. (a) 6, –2, 0 — 2

B2 all 3 correct

(B1 one or two correct)

(b) Graph — 2

B1 for 5 or 6 points plotted either correct or ft from their table.

B1 Joined with a smooth curve

For either B mark ft on (a) if at least B1 awarded

(c) (i) $y = 2.5$ drawn

= –0.5, 2.5 — 2

B1 –0.4 to –0.6 or ft graph ± 0.1

(ii)

B1 2.4 to 2.6 or ft ft graph ± 0.1

SC If B0 then B1 $y = 2.5$ *drawn at least* $-1 \le x \le 2$*;*

tolerance within $y = 2$ *and* $y = 3$

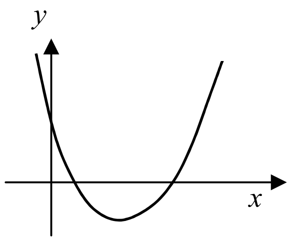
NB Accept coordinates that define the values.

[6]

10. (a) 7, –2, 2 — 2

B2 all three correct
(B1 for any one or two correct)

(b)



2

B2 fully correct graph

OR

B1 ft for 7 points plotted correctly ± 2 mm
B1 for smooth curve drawn through their points provided B1 awarded in (a).

[4]

11. H
D
A — 3

B1 cao
B1 cao
B1 cao

[3]

12. (a) 36, 56, 48, 20 — 2

B2
(B1 for 2 or 3 correct)

(b) graph — 2

B1 ft (dep on B1 in(a)) points plotted correctly ± ½ sq (condone 1 error)
B1 smooth fully correct quadratic curve

(c) 60.5 — 1

B1 for $62 \le ans < 60$ *from curve or calculation*

[5]

13. –0.6, 2.6 2

B1for 2.55 – 2.65
B1 for –0.55 – –0.65
Alternative Scheme
B1 for $\frac{4+\sqrt{40}}{4}$ *oe*
B1 for $\frac{4-\sqrt{40}}{4}$ *oe*

[2]

1. Values of $y = \pm 3$ and $y = 1$ were common errors in the table, possibly due to misuse of the calculator again, and an inability to apply BODMAS to their calculations. Most candidates plotted their points correctly, but appeared confused since they did not lie in a straight line; the answer of many candidates was to connect their points with a series of straight line segments rather than a curve. Most candidates who did connect the points failed to make any attempt to drawn the minimum point significantly below $y = -1$. In the final part, many saw $y = -1$ as the minimum value, even when their graph showed otherwise.

2. In the table, the value of y when $x = 2$ was generally found successfully, but it was disappointing to see so many incorrect values of y found from the value of $x = -1$
Most candidates could plot their own points accurately and draw a smooth curve through them. Only a few used straight line segments or joined (1, –1) to (2, –1) with a straight-line segment. Most candidates could give a sensible estimate for the minimum value of y.

Part (d) was more testing, despite being written in a form in which it was easy to find the additional required straight line. Those that did so usually drew the correct line and were able to use the points of intersection of the straight line with the curve to estimate the solutions of the equation. A few candidates decided to start all over again and plot the graph of $y = x^2 - 5x - 5$.

They then got full marks if they were able to pick off the x values from where the graph cut the x-axis.
Solutions which used the quadratic formula were not accepted.

3. This proved to be very difficult for the candidature. Most candidates if they did anything, substituted values into the equation and tried to show that they were on a curve which satisfied the description. Many candidates thought that this was a question about $y = mx + c$.

4. **Specification A**

Many candidates working at grade B level, or above, had a good attempt at this question- often scoring a mark in each of the parts.
In part (a), very few candidates had difficulty with coordinate notation usually scoring at least one mark for (0, 9). Only candidates working at the highest grades were able to access the marks for part (a)(ii) and part (b).
In part (b), many candidates were able to score a mark for expanding either of the quadratic brackets, but were unable to deal successfully with the fractions. A common error was to multiply each fraction by 4 and ignore the 25. The best candidates were able to set up their answers in a clear and logical manner- usually starting from the left hand equation and progressing to the right hand equation. There were many sound approaches where candidates worked on both sides of the equation together.

Specification B

This was a demanding question for candidates. Over half of the candidates were, however, able to gain credit somewhere in the question. Answers to part (a) were of a very variable standard with only about 10% of candidates able to gain full marks in this part of the question. In (b) the majority of candidates appreciated the need to multiply out at least one of the pairs of brackets. This was generally done successfully although $(x - 8)^2$ was often seen incorrectly expanded as $x^2 - 64$ or $x^2 + 64$. Few candidates used a correct method to deal with the fraction on the left hand side of the given identity. There was evidence of some very creative but incorrect algebra. Candidates should be reminded that examiners will scrutinise working and only award marks for correct methods seen. A number of candidates tried to answer the question by inserting specific values for x rather than supplying a general proof; this approach gained no marks.

5. Parts (a) and (b) were unusual questions in that they could be approached by either considering the relationship of $y = f(x)$ with $y = f(x - 1)$ and with $y = 3f(x)$ respectively, or by using the explicit forms of the equations. The evidence is that the most successful candidates used a combination of the two, using the functional form to fix the transformation and then the explicit form to find the intersection with the y axis. Candidates who clearly realised that part (b) was a stretch, often did not stretch that part of the curve which lay between ($x = 0$ and $x = 1$)
On part (c) many candidates realised that they had to eliminate y, resulting in a quadratic equation. However, many did not or could not go on to solve the resulting quadratic equation. Those that did get a 3 term equation generally were able to factorise it and find the coordinates.

6. **Specification A**

Success on this question depended largely on whether the candidate recognised the equation as being one which described a circle centre O and radius 4. Some candidates successfully rearranged the equation and used it to calculate the value of y for selected values of x. Often in this case the candidate did not realise that there were equal magnitude positive and negative values of y.

Specification B

Those candidates that recognised that the equation $x^2 + y^2 = 16$ defined a circle were generally able to score full marks in this question. This did, however, account for only 25% of candidates. The vast majority were unable to recognise the given equation as that of a circle and were therefore unable to gain any marks. The most common error was to assume that the given equation represented a parabola.

7. Paper 5524

This was a badly answered question. The majority of answers given by candidates were clearly guesses, and failed to show any relationship between the equations and the diagrams.

Paper 5526

This proved to be a challenging enough question with half of the candidate managing in each part to select the correct curve.
Candidates could usually pick out a straight line for the linear equation, but often picked the wrong diagram.

8. Only the best candidates were able to gain any marks in part (a) of this question. A significant number of those candidates who, having correctly completed the square as $(x - 3)^2 + 6$, gave their final answer as $p = -3$, $q = 6$.

In part (b), many candidates were able to score at least 1 mark for drawing a U shaped curve (usually symmetrically in the y-axis). Few candidates appreciated the connection between parts (a) and (b), and simply calculated and then plotted the coordinates of points on the curve. Common errors here were to sketch an n shaped curve, a straight line or a cubic curve.

9. Higher Tier

Part (a) was usually well completed but there were a significant number of candidates who could not calculate the value of y when $x = -1$, where a value of $y = 2$ was common.

The graph was well drawn with only a few candidates joining successive points with straight line segments.

Most candidates could draw the correct line in part (c), although a minority drew the line $x = 2.5$

Intermediate Tier

Many candidates scored 1 mark for one correct value in the table, but few achieved both marks. Most then went on to plot some marks, but a significant number failed to join their points. The 2.5 was the most common answer, but some credit was given for those who correctly drew the line $y = 2.5$

10. This question was generally done well. In part (a), most candidates were able to gain at least 1 mark for a correct value in the table. A common error here was to find the value of y at $x = –1$ as 6 or 5 or –7. Despite possibly having made an error in the table, many candidates were able score 2 marks in part (b) for plotting their points correctly and drawing a smooth curve through their points. A very common error here was to join the points with straight lines. A surprising number of candidates, having drawn a completely correct graph but having made an error in the table, did not go back and correct the value in the table.

11. Many correctly identified the graph of the first equation. Part (iii) was also known but part (ii) was frequently given incorrectly as B or I.

12. The vast majority of candidates were able to score some marks on this question. Candidates should be reminded to draw a smooth curve through the points, some candidates are still drawing graphs like this using straight line segments. A number of candidates misread the scale on the y axis and so plotted points incorrectly. Few candidates were able to use the symmetry of the graph and so realise that the maximum value of y would lie above 60.

13. Success in this question appeared to be very centre dependent. It was answered correctly by about half of all candidates. Some candidates attempted to use the quadratic formula. Those who did so correctly gained full marks although many errors were seen from those choosing this method; substituting 4 instead of –4 for b being the most common.