Marks: /80

Time: 1 hour 30 minutes

Name: ....   Date: ....

INSTRUCTIONS TO CANDIDATES

Section A (40 marks)   **Time: 45 minutes**

1. Answer all the questions in this section.
2. Calculators may **not** be used in this section.
3. All working must be clearly shown. Omission of essential working will result in loss of marks.
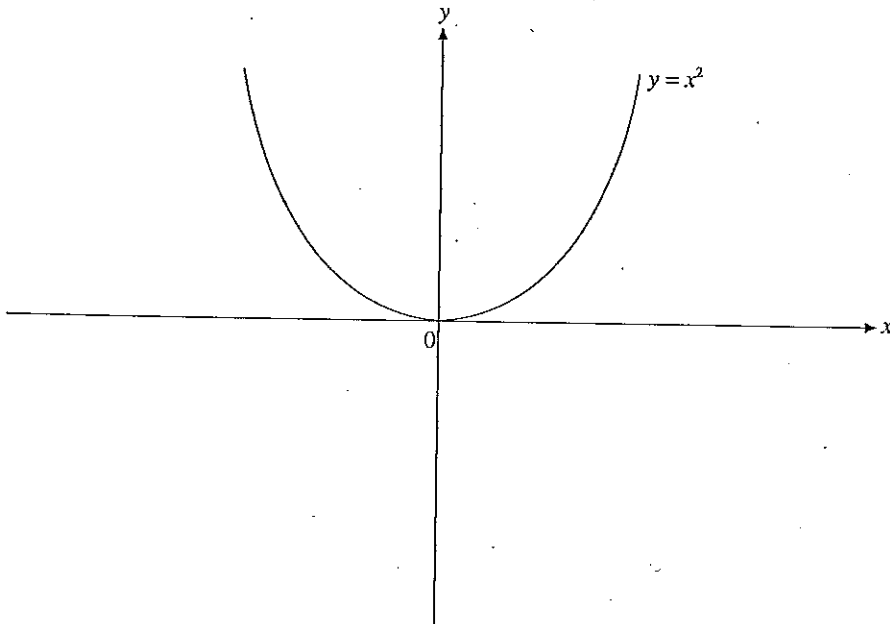4. The marks for each question is shown in brackets [   ] at the end of each question.

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1   The diagram below shows the graph of $y = x^2$. On the same axes below, sketch and label the graphs of
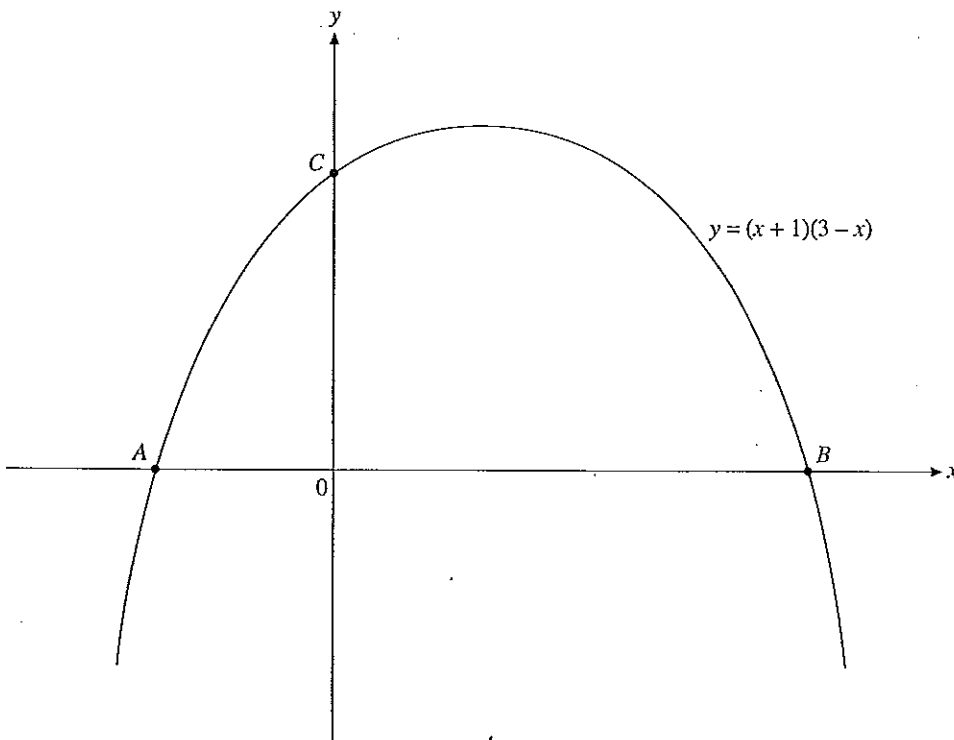
(a) $y = \frac{1}{2}x^2$,

(b) $y = -x^2 + 1$.

Answer (a), (b)

[2]

2 The diagram shows the curve of $y = (x + 1)(3 - x)$ cutting the x-axis at the points A and B, and the y-axis at the point C.

(a) Write down the coordinates of A, B and C.

(b) Find the equation of the line of symmetry of the curve $y = (x + 1)(3 - x)$.

(c) Find the maximum value of y.

(d) The point $D(2, h)$ lies on the curve $y = (x + 1)(3 - x)$. Find the value of h.

Answer (a) $A = $ ....

$\qquad\qquad B = $ ....

$\qquad\qquad C = $ .... [3]

$\qquad$ *(b)* .... [1]

$\qquad$ *(c)* $y = $ .... [1]

$\qquad$ *(d)* $h = $ .... [1]

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

   (a) Draw the axis of symmetry on the diagram and write down the equation of the axis of symmetry.

   (b) Use the graph to find

      (i) the values of x when $y = 2$,

      (ii) the value of y when $x = -0.5$.

   (c) Use your graph to solve $x^2 - 2x - 4 = 0$.

Answer (a)

[1]

$y = x^2 - 2x - 4$
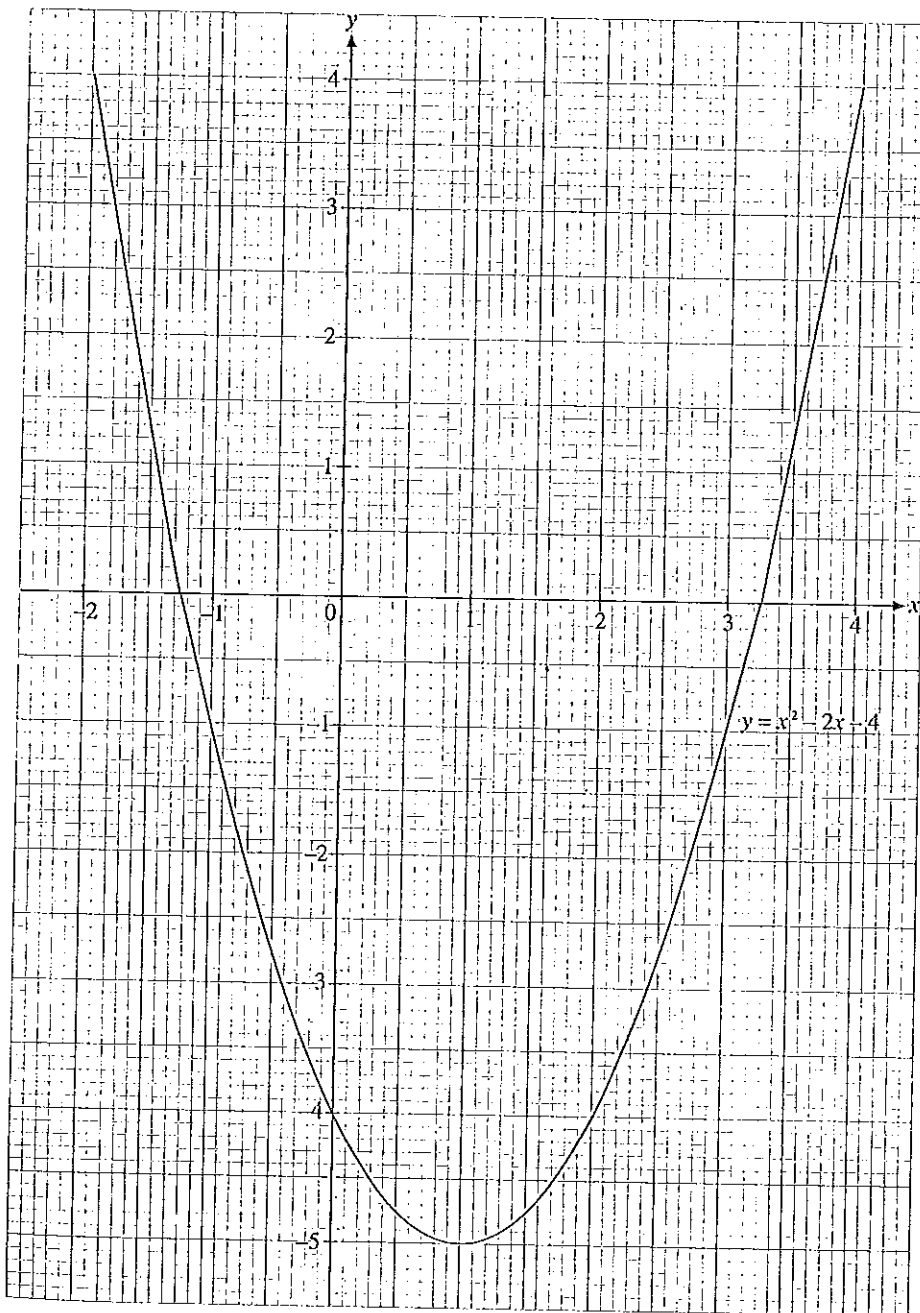
$$Answer \ (a) \dots\dots\dots\dots\dots\dots [1]$$

$$(b) \ (i) \ x = \dots\dots , \dots\dots [2]$$

$$(ii) \ y = \dots\dots\dots [1]$$

$$(c) \ \dots\dots\dots\dots\dots [2]$$

4   In the diagram, the y-axis is the line of symmetry of the curve which passes through $P(2, 12)$ and $Q(a, 12)$.

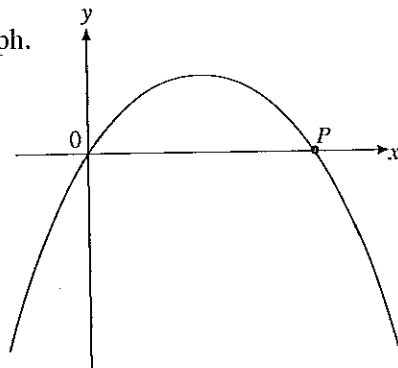(a) Write down the equation of the line of symmetry.

(b) Find the value of a.
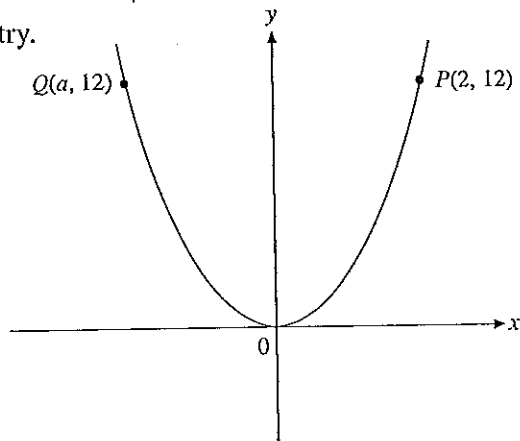
$$Answer \ (a) \dots\dots\dots\dots\dots\dots [1]$$

$$(b) \ a = \dots\dots\dots\dots [1]$$

5   The diagram shows the graph of $y = 6x - x^2$. The graph passes through the origin and crosses the x-axis again at the point P.

(a) Calculate the coordinates of P.

(b) Write down the equation of line of symmetry of the graph.

(c) Find the coordinates of the highest point on the graph.
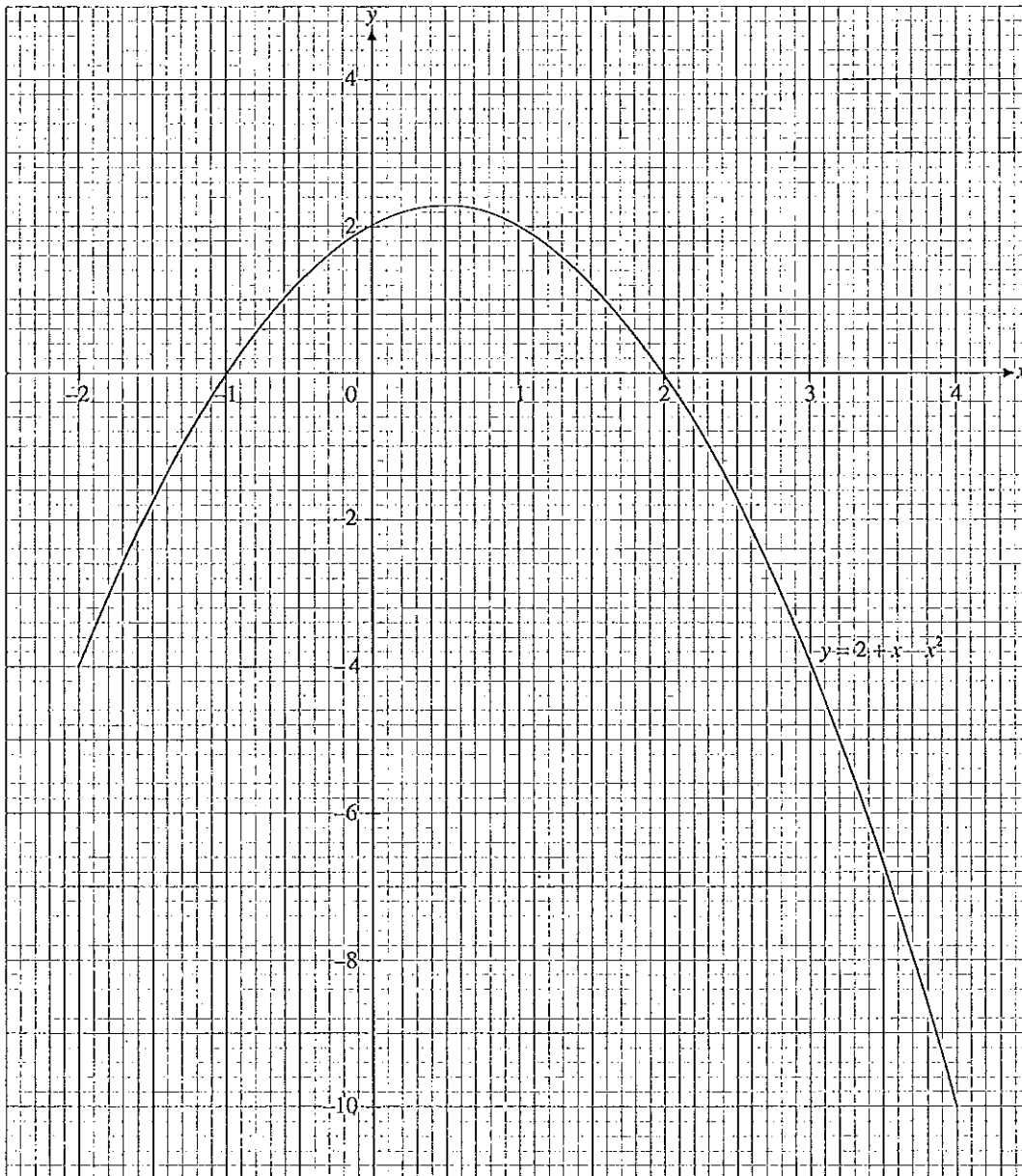

$$Answer \ (a) \ P = \dots\dots\dots\dots [1]$$

$$(b) \dots\dots\dots\dots\dots [1]$$

$$(c) \dots\dots\dots\dots\dots [1]$$

6 The diagram below shows the graph of $y = 2 + x - x^2$.
   (a) From the graph, find
       (i) the value(s) of y when $x = 2.8$,
       (ii) the value(s) of x when $y = 1$.
   (b) Draw and state the equation of the line of symmetry of the graph $y = 2 + x - x^2$.

Answer (b)   [1]
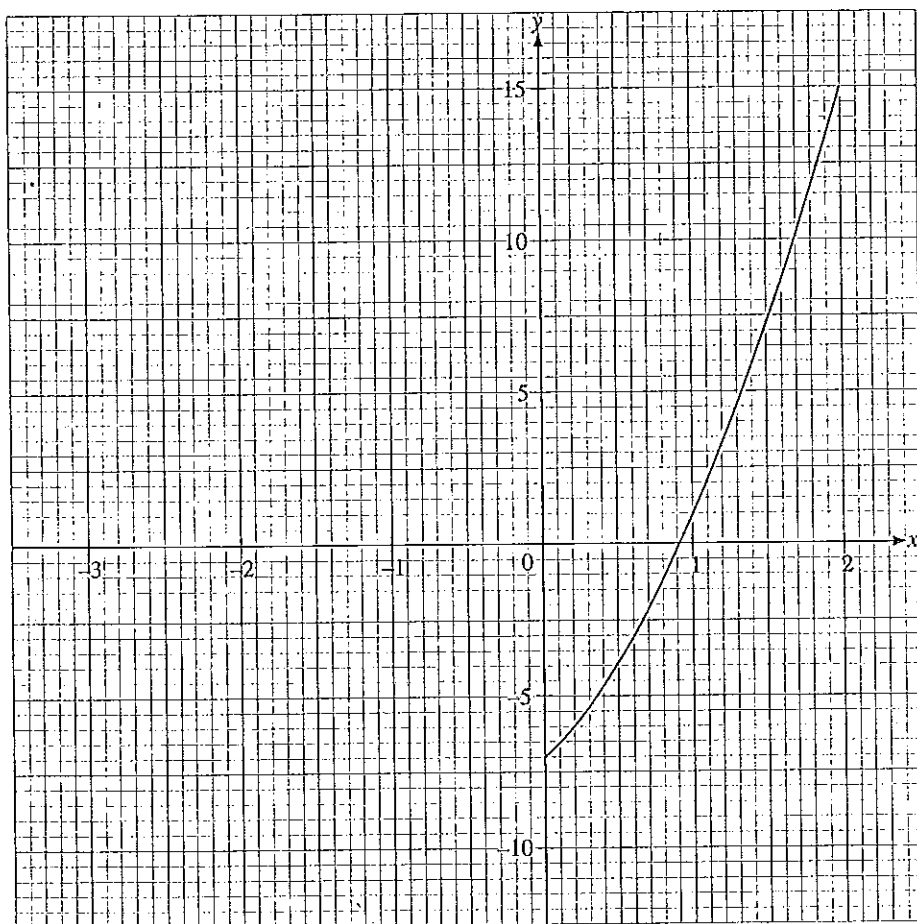

$y = 2 + x - x^2$

Answer (a) (i) $y = $ ....

           (ii) $x = $ .... [3]

       (b) .... [1]

7   The diagram shows part of the graph of $y = 3x^2 + 5x - 7$ for $0 \le x \le 2$.
   (a) Plot the three points of the curve $y = 3x^2 + 5x - 7$ for which $x = -3, -2$ and -1. Complete
       the curve for $-3 \le x \le 0$.
   (b) Find from your graph,
       (i)   the value of y when $x = -2.3$,
       (ii) the minimum value of y,
       (iii) the solutions of the equation $3x^2 + 5x - 7 = 0$.

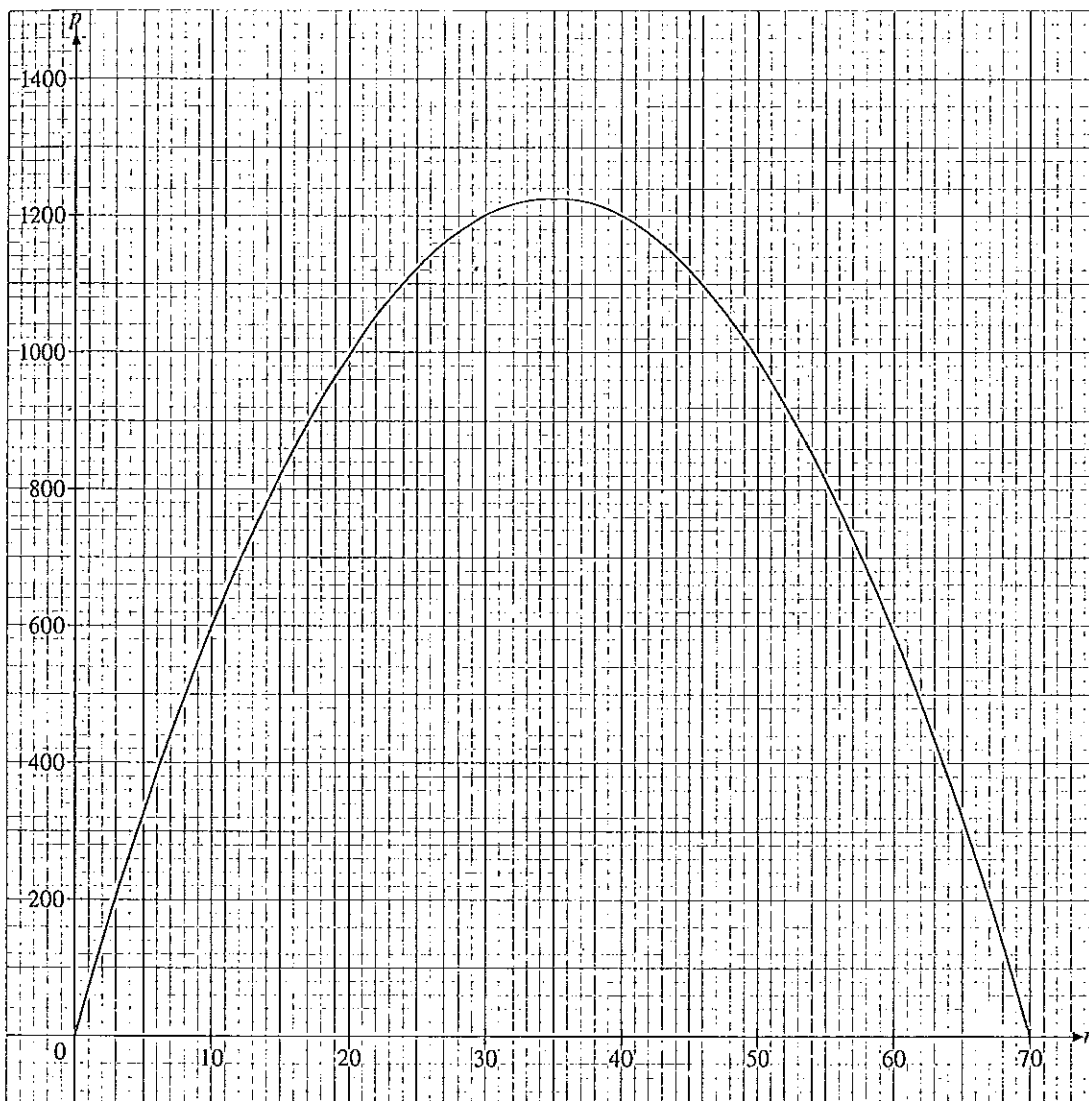*Answer (a)*   [2]

Answer (b) (i) $y =$ .... [1]

(ii) $y =$ .... [1]

(iii) .... [2]

8 The daily profit, p dollars, of a toy factory is related to n, the number of toys it produces daily where $p = 70n - n^2$. The diagram below shows the graph of $p = 70n - n^2$ for $0 \leq n \leq 70$. From the graph, find

(a) the number of toys the factory needs to produce daily in order to achieve the maximum profit,

(b) the maximum profit.

Answer (a) .... toys [2]

(b) $ .... [2]

9   A ball is thrown upwards from the top of a building. The height, h metres, of the ball above the top of the building after t seconds is given by the equation $h = 25t - 5t^2$. Diagram I shows the graph of $h = 25t - 5t^2$ for $0 \leq t \leq 6$.

(a) From the graph, find
    (i)   the greatest height of the ball above the top of the building,
    (ii) the value of t when the ball is at the maximum height,
    (iii) the value of t when the ball passes the top of the building again.

(b) Given that the ball hits the ground 5.7 seconds after it was thrown, find the height of the building from the graph.

Diagram I

INSTR

Section

1. Ans
2. Cal
3. All
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10 The
   val

(a)
(b)

(c)

(d)
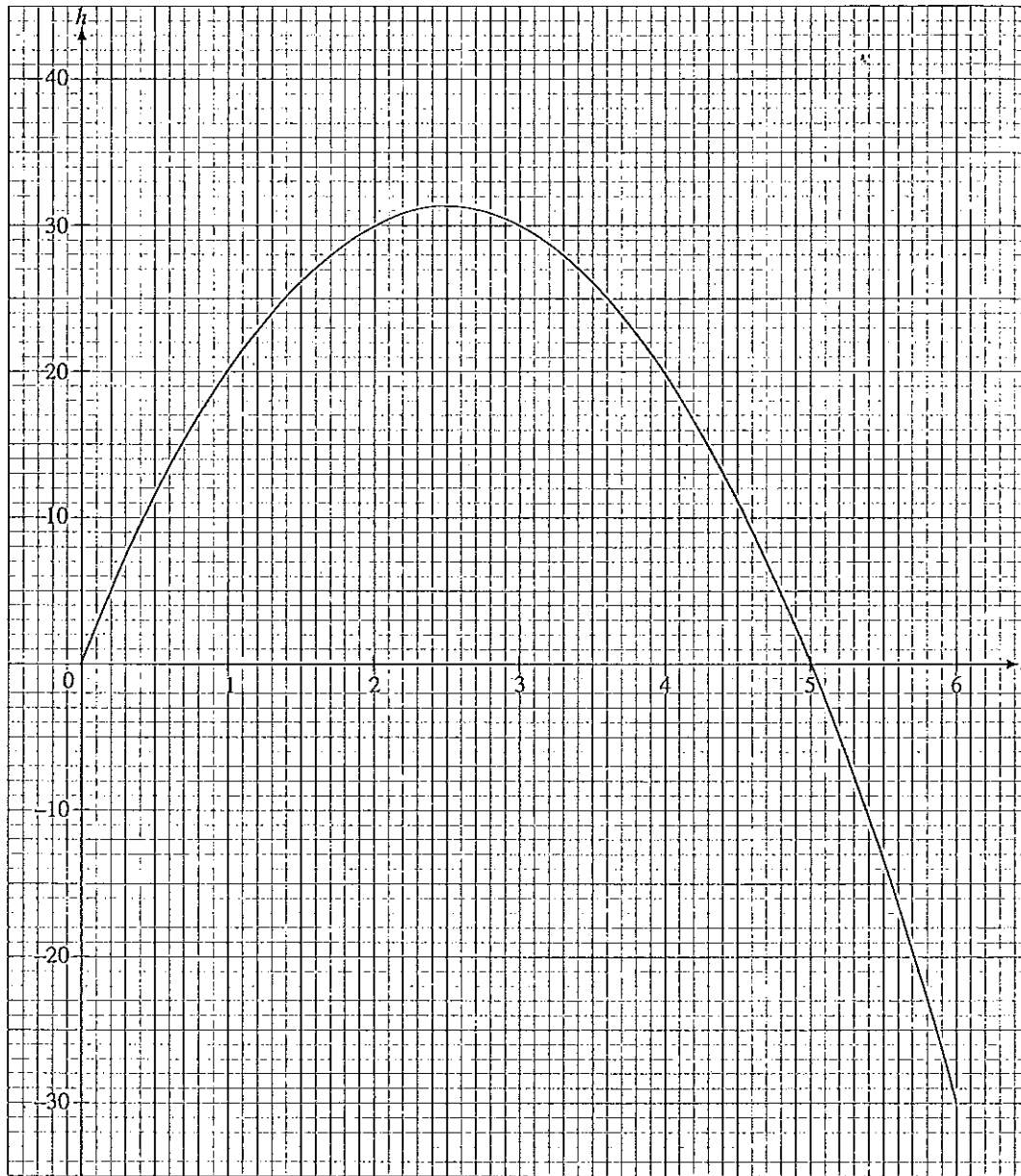
Answer (a) (i) .... m [1]

(ii) $t =$ .... [1]

(iii) $t =$ .... [1]

(b) .... m [2]

Section A

1.
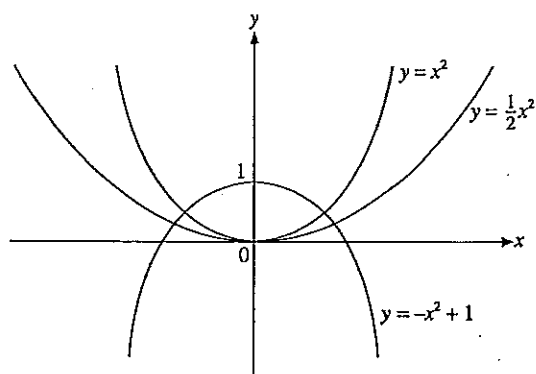
2.
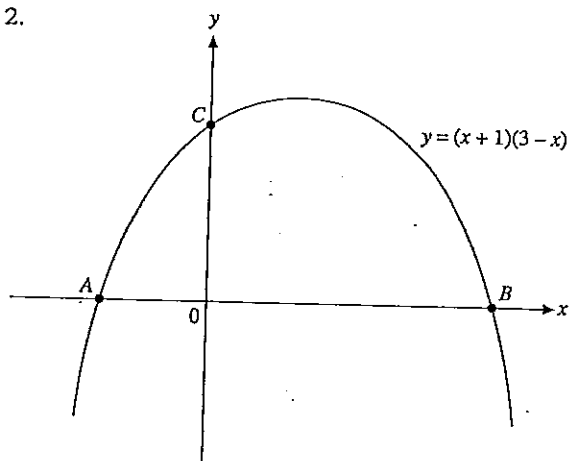
(a) $y = (x + 1)(3 - x)$

When $y = 0$,

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

$\therefore (x + 1) = 0$ or $(3 - x) = 0$
$\qquad x = -1$ or $\qquad x = 3$
$\therefore A = (-1, 0)$ and $B = (3, 0)$.

$y = (x + 1)(3 - x)$

When $x = 0$,
$y = (0 + 1)(3 - 0)$
$\quad = 3$
$\therefore$ the coordinates of C are $(0, 3)$.

(b) Equation of the line of symmetry is $x = 1$.

(c) $y = (x + 1)(3 - x)$
When $x = 1$,
$y = (1 + 1)(3 - 1)$
$\quad = (2)(2)$
$\quad = 4$

$\therefore$ the maximum value of y is 4.
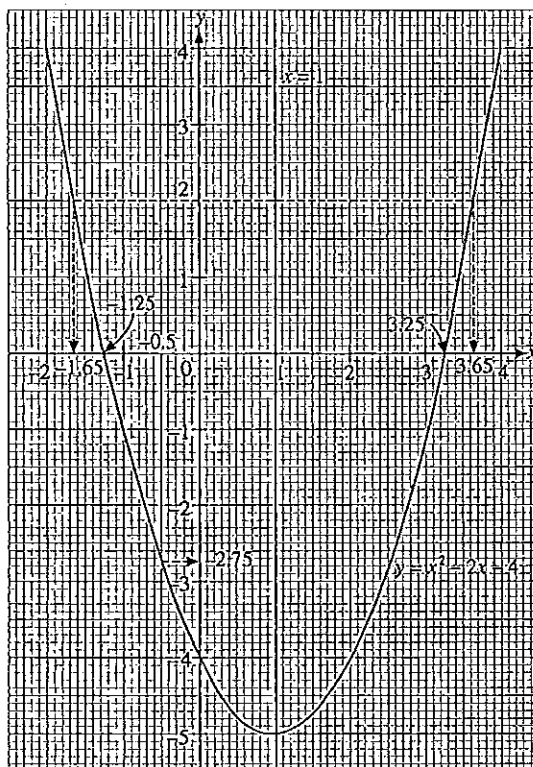
(d) $y = (x + 1)(3 - x)$
D(2, h) lies on the curve.
$\therefore h = (2 + 1)(3 - 2)$
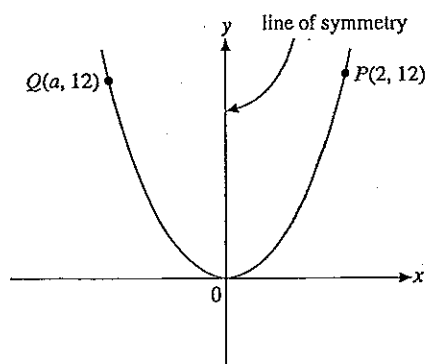$\qquad = (3)(1)$
$\qquad = 3$

3.

(a) Equation of axis of symmetry is $x = 1$.

(b) (i) From the graph,
when $y = 2$, $x \approx -1.65$ and $x \approx 3.65$.

(ii) From the graph,
when $x = -0.5$, $y \approx -2.75$.

(c) From the graph,
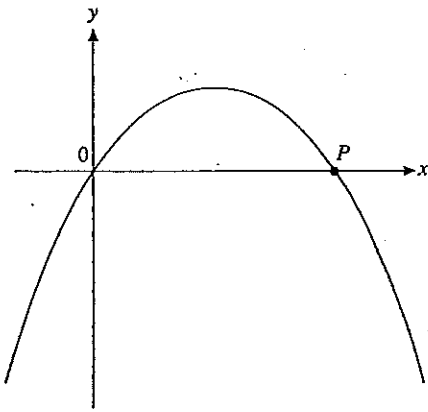the solutions are $x \approx -1.25$ and $x \approx 3.25$.

4.

(a) Equation of the line of symmetry is $x = 0$.
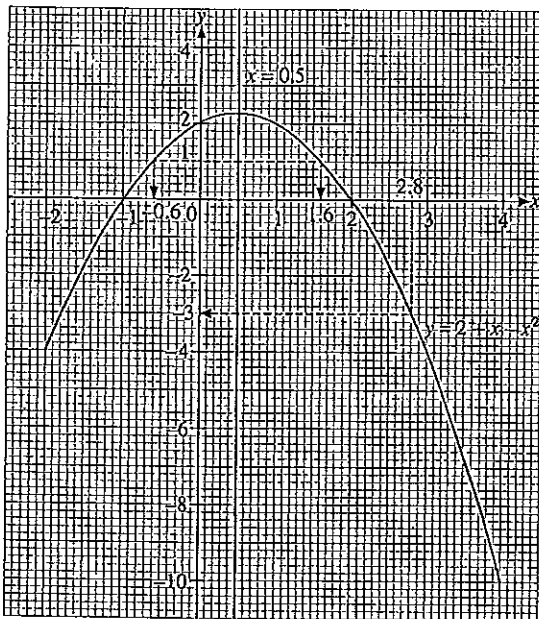(i.e. the y-axis)

(b) $a = -2$

5.

(a) $y = 6x - x^2$
When $y = 0$,
$6x - x^2 = 0$
$x(6 - x) = 0$
$\therefore x = 0$ or $x = 6$.
$\therefore P = (6, 0)$.

(b) Equation of the line of symmetry is $x = 3$.

(c) $y = 6x - x^2$
When $x = 3$,
$y = 6(3) - 3^2$
$= 18 - 9$
$= 9$
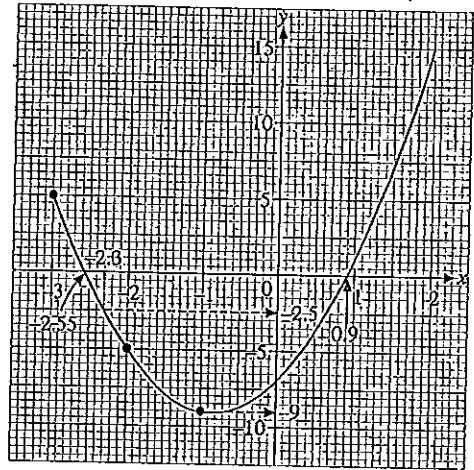$\therefore$ the coordinates of the highest point are (3, 9).

6.

(a) (i) From the graph,
when $x = 2.8$, $y \approx -3$.

(ii) From the graph,
when $y = 1$, $x \approx -0.6$ and $x \approx 1.6$.

(b) Equation of the line of symmetry is $x = 0.5$.

7. (a) $y = 3x^2 + 5x - 7$

When $x = -3$,
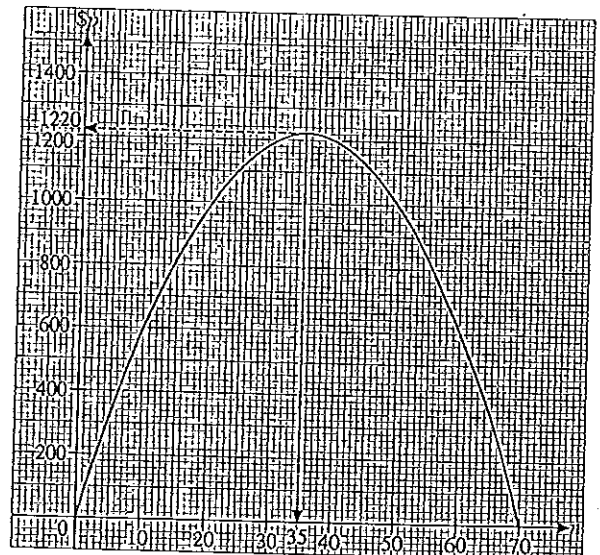$y = 3(-3)^2 + 5(-3) - 7$
$= 5$

When $x = -2$,
$y = 3(-2)^2 + 5(-2) - 7$
$= -5$

When $x = -1$,
$y = 3(-1)^2 + 5(-1) - 7$
$= -9$

(b) (i) From the graph,
when $x = -2.3$, $y \approx -2.5$.

(ii) From the graph,
the minimum value of y is -9.

(iii) From the graph,
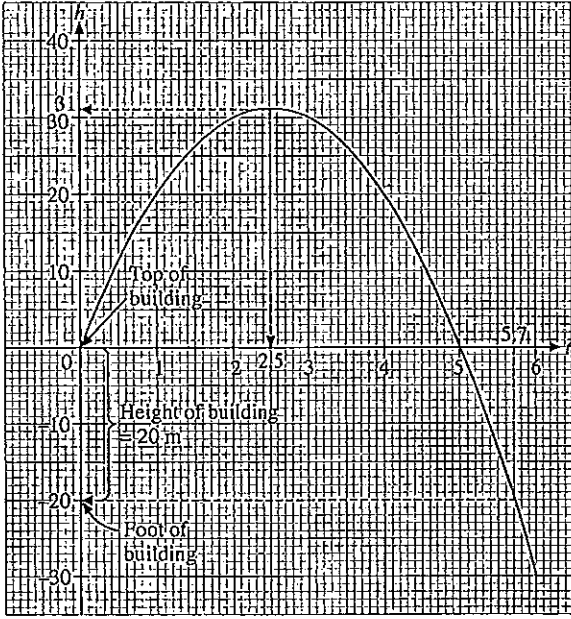the solutions are $x \approx -2.55$ and $x \approx 0.9$.

8.

(a) From the graph, the factory needs to produce 35 toys daily in order to achieve the maximum profit.

(b) From the graph, the maximum profit is $1220.

9.

(a) (i) Greatest height = 31 m ◄— From the graph,
find the maximum
value of the curve.

(ii) $t = 2.5$ ◄————┐

(iii) $t = 5$ ┐ Find the value of t corresponding to
       │   the greatest height.
       ▲

At $t = 0$, the ball is thrown upwards from the top of the
building, i.e the top of the building is at $h = 0$. To find the time
when the ball passes the top of the building again, find the
value of t when the curve cuts the t-axis again, i.e, $t = 5$.

(b) height of building = 20 m   Find from the graph
                                 the value of h when,
                                 $t = 5.7$.