INTERNATIONAL BACCALAUREATE

Mathematics: applications and interpretation

MAI

EXERCISES [MAI 2.2]

QUADRATICS

Compiled by Christos Nikolaidis

A. Paper 1 questions (SHORT)

1. [Maximum mark: 30]

Complete the following table for the three quadratic functions below

	$y = 2x^2 - 12x + 10$	$y = 2x^2 - 12x + 18$	$y = 2x^2 - 12x + 23$
y-intercept			
Roots			
Factorisation (if possible)			
axis of symmetry			
Vertex			
Vertex form $f(x) = a(x-h)^2 + k$			
Solve $f(x) \geq 0$			
Solve $f(x) > 0$			
Solve $f(x) \leq 0$			
Solve $f(x) < 0$			

2. [Maximum mark: 12]

Consider the quadratic $y = 4x^2 - 120x + 800$

(a) (i) Find the roots.

(ii) **Hence** express the quadratic in the form $y = a(x - x_1)(x - x_2)$ [3]

(b) (i) Find the coordinates of the vertex.

(ii) **Hence** express the quadratic in the form $y = a(x - h)^2 + k$

(iii) Write down the equation of the axis of symmetry

(iv) Write down the minimum value of y [5]

(c) Write down the y - intercept of the quadratic [1]

(d) Draw the graph of the quadratic on the diagram below. [3]

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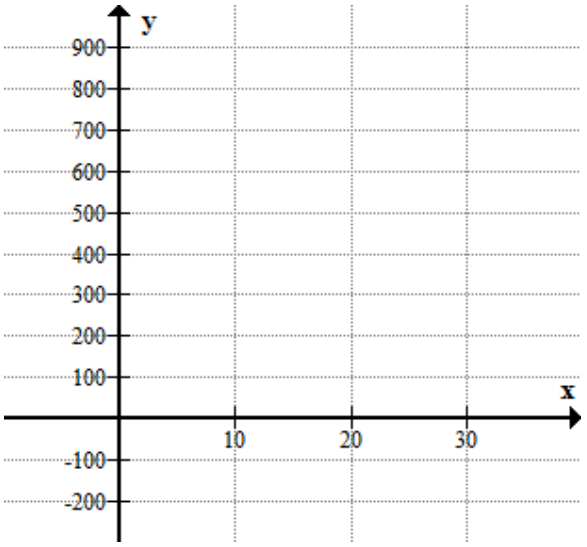

3. [Maximum mark: 14]

Consider the quadratic $y = -4x^2 + 120x - 800$

(a) (i) Find the roots.

(ii) **Hence** express the quadratic in the form $y = a(x - x_1)(x - x_2)$ [3]

(b) (i) Find the coordinates of the vertex.

(ii) **Hence** express the quadratic in the form $y = a(x - h)^2 + k$

(iii) Write down the equation of the axis of symmetry

(iv) Write down the maximum value of y [5]

(c) Write down the y - intercept of the quadratic [1]

(d) Draw the graph of the quadratic on each of the diagrams below. [5]

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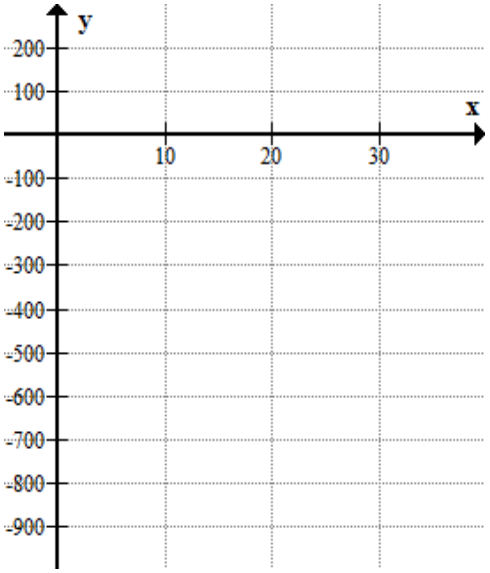
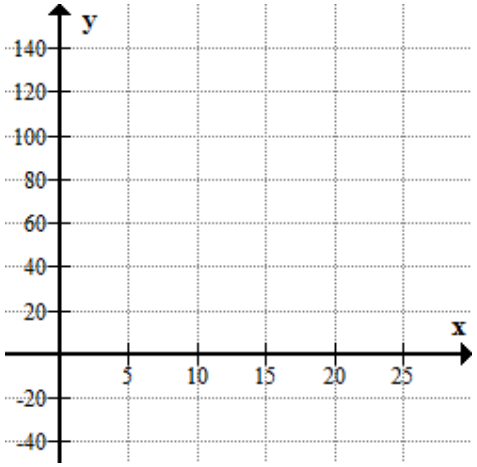
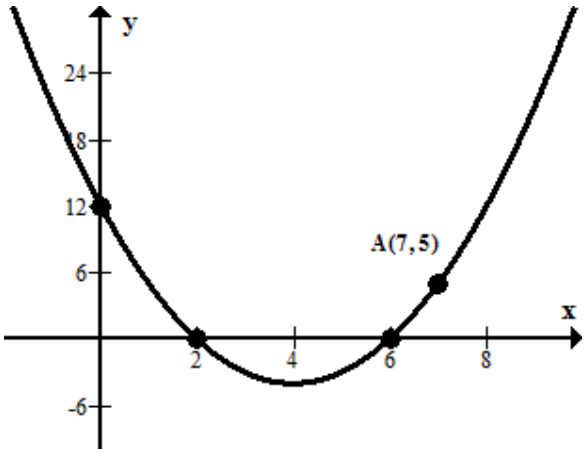




4. [Maximum mark: 5]

The parabola of a quadratic is shown below. The x-intercepts are $x = 2$ and $x = 6$. The y-intercept is $y = 12$. The curve passes through the point A(7,5).



Without finding the equation of the curve and by just using the symmetry of the graph

(a) Write down the equation of the axis of symmetry. [1]

(b) Find the value of y for $x = 8$. Justify your answer. [2]

(c) Find the value of y for $x = 1$. Justify your answer. [2]

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5. [Maximum mark: 4]

(a) Solve the equation $x^2 - 3x - 10 = 0$. [2]

(b) Factorize $x^2 - 3x - 10$. [2]

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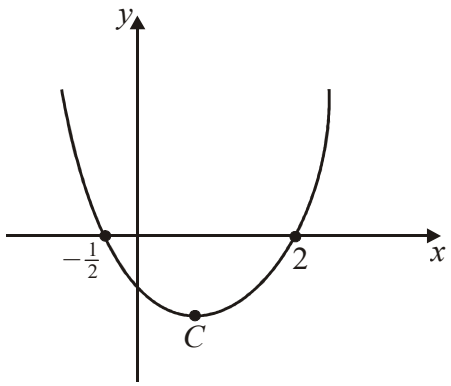
6. [Maximum mark: 4]

The diagram represents the graph of the function $f: x \mapsto (x-p)(x-q)$.



(a) Write down the values of p and q. [2]

(b) The function has a minimum value at the point C. Find the x-coordinate of C. [2]

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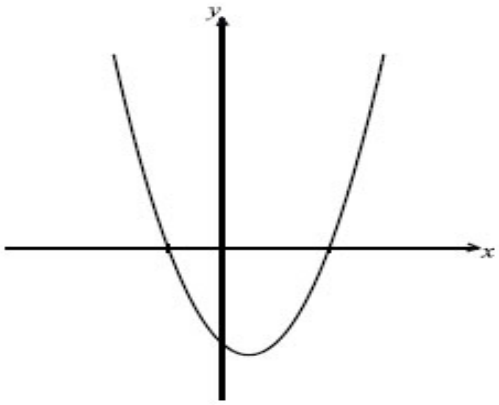
7. [Maximum mark: 2]

The following diagram shows part of the graph of f, where $f(x) = x^2 - x - 2$.



(a) Find both x-intercepts. [2]

(b) Find the x-coordinate of the vertex. [2]

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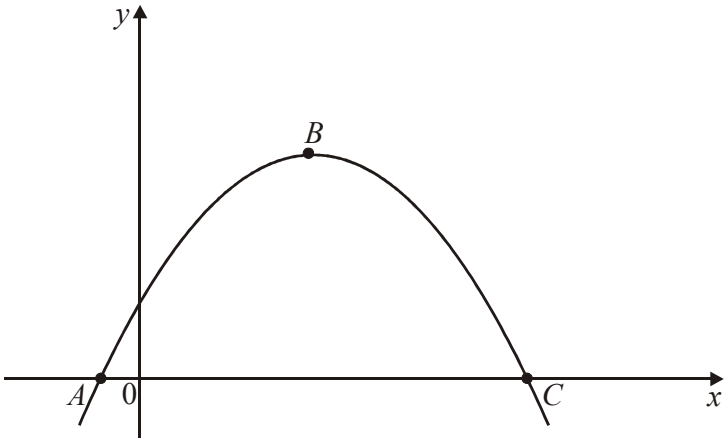
8. [Maximum mark: 4]

The diagram shows the parabola $y = (7 - x)(1 + x)$. The points A, C are the x-intercepts and the point B is the maximum point. Find the coordinates of A, B and C.



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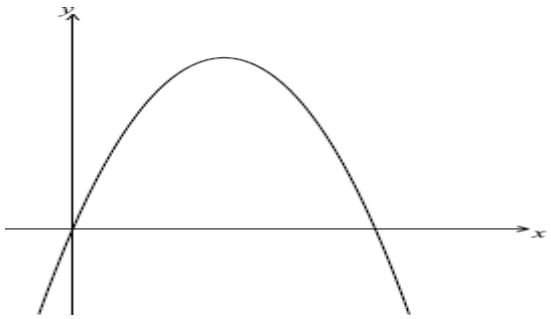
9. [Maximum mark: 7]

Let $f(x) = 8x - 2x^2$. Part of the graph of f is shown below.



(a) Find the x-intercepts of the graph. [4]

(b) (i) Write down the equation of the axis of symmetry.

(ii) Find the y-coordinate of the vertex. [3]

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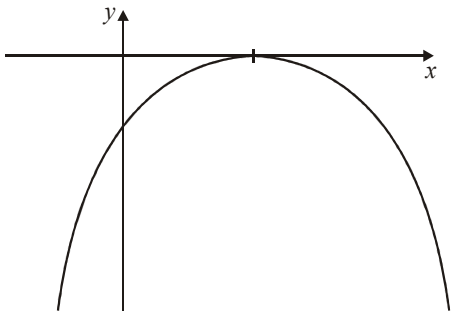
10. [Maximum mark: 5]

The following diagram shows the graph of function $y = ax^2 + bx + c$.

Complete the table next to the graph to show whether each expression is positive (+), negative (-) or zero (0).

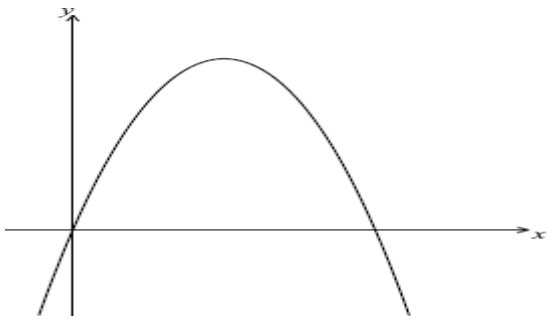


Expression	+ – 0
a	
c	
$b^2 - 4ac$	
$-\frac{b}{2a}$	
b	

11. [Maximum mark: 5]

The following diagram shows the graph of function $y = ax^2 + bx + c$.

Complete the table next to the graph to show whether each expression is positive (+), negative (-) or zero (0).

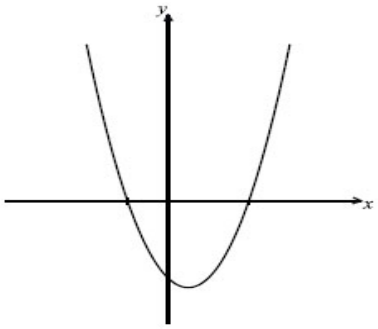


Expression	+ – 0
a	
c	
$b^2 - 4ac$	
$-\frac{b}{2a}$	
b	

12. [Maximum mark: 5]

The following diagram shows the graph of function $y = ax^2 + bx + c$.

Complete the table next to the graph to show whether each expression is positive (+), negative (-) or zero (0).



Expression	+ – 0
a	
c	
$b^2 - 4ac$	
$-\frac{b}{2a}$	
b	

13. [Maximum mark: 4]

(a) Find the vertex of $f(x) = x^2 - 6x + 14$ [2]

(b) Express the function in the form $f(x) = (x - h)^2 + k$ [2]

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14. [Maximum mark: 4]

Consider the function $f(x) = 2x^2 - 8x + 5$.

(a) Express $f(x)$ in the form $a(x - p)^2 + q$, where $a, p, q \in \mathbb{Z}$. [3]

(b) Find the minimum value of $f(x)$. [1]

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15. [Maximum mark: 4]

(a) Find the vertex of $f(x) = 2x^2 + 2x + 2$ [2]

(b) Express the function in the form $f(x) = a(x - h)^2 + k$ [2]

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16. [Maximum mark: 4]

(a) Find the vertex of $f(x) = -x^2 - x - 1$ [2]

(b) Express the function in the form $f(x) = a(x - h)^2 + k$ [2]

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17. [Maximum mark: 5]

Find the points of intersection between $y = x^2 - 5x + 3$ and $y = 3x - 9$

and sketch a graph to demonstrate the result.

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18. [Maximum mark: 5]

Find the point of intersection between $y = x^2 - 5x + 3$ and $y = 3x - 13$

and sketch a graph to demonstrate the result.

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19. [Maximum mark: 5]

Find the points of intersection (if any) between $y = x^2 - 5x + 3$ and $y = 3x - 15$ and sketch a graph to demonstrate the result.

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20. [Maximum mark: 5]

Find the points of intersection (if any) between $y = x^2 - 3$ and $y = 5 - x^2$ and sketch a graph to demonstrate the result.

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