



Additional Math with Ali Hashir

Quadratics

Worksheet

CIE O Level Additional Mathematics 4037 • Total: 76 marks

Answer all questions. Completing the square is the expected method throughout: write every quadratic in the form $a(x + p)^2 + q$ before reading off a maximum or minimum value. When a sketch is asked for, show the coordinates of the turning point and the y -intercept, and make the direction of the curve clear. Give all answers as exact values.

Q1

In each of the following, state the minimum or maximum value of y and the corresponding value of x .

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

(b) $y = (x + 1)^2 - 5$

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

(d) $y = 9 - (2x - 1)^2$

[4]

Q2

State the maximum value of $y = 1 - (x + 3)^2$ and the corresponding value of x . Hence sketch the curve, indicating the y -intercept.

[3]

Q3

Express $x^2 + 8x + 21$ in the form $(x + p)^2 + q$, where p and q are constants. Hence state the minimum value of $x^2 + 8x + 21$ and the value of x at which it occurs.

[3]

Q4

Express $2x^2 - 12x + 23$ in the form $a(x - p)^2 + q$, where a , p and q are constants. Hence state the coordinates of the minimum point of the curve $y = 2x^2 - 12x + 23$, and sketch the curve, indicating the y -intercept. [5]

Q5

Express $3 + 9x - x^2$ in the form $q - (x + r)^2$, where q and r are constants. Hence

(a) state its extreme value and the value of x when this occurs,

(b) sketch the curve $y = 3 + 9x - x^2$. [6]

Q6

Given that $4x^2 - 16x + 15 = a(x - p)^2 + q$ for all values of x , find the values of the constants a , p and q . Hence

(a) state the coordinates of the minimum point of the curve $y = 4x^2 - 16x + 15$,

(b) solve the equation $4x^2 - 16x + 15 = 0$. [5]

Q7

State the minimum value of $3(x + 2)^2$ and the corresponding value of x . Sketch the curve $y = 3(x + 2)^2$ for $-3 \leq x \leq 0$. [4]

Q8

Given that the greatest value of $k + 8x - 2x^2$ is 9, find the value of the constant k and sketch the curve $y = k + 8x - 2x^2$. [5]

Q9

The curve $y = x^2 + px + q$ has a minimum point at $(3, -4)$. Find the values of the constants p and q , and find the coordinates of the points where the curve crosses the x -axis. [5]

Q10

Express $5 - 6x - 3x^2$ in the form $q - a(x + p)^2$, where a , p and q are constants. Hence state the maximum value of $5 - 6x - 3x^2$ and the value of x at which it occurs. [4]

Q11

Find the equation of the quadratic curve with a turning point at $(-2, 3)$ and which passes through $(-1, 5)$. Give your answer in the form $y = ax^2 + bx + c$. [5]

Q12

The curve C has equation $y = 3 - 12x + kx^2$, where k is a positive constant.

- (i) Express y in the form $a(x + b)^2 + c$, giving a , b and c in terms of k . [3]
- (ii) Given that the minimum value of y is -9 , find the value of k . [3]
- (iii) Using this value of k , sketch C , showing the coordinates of the minimum point and of the points where the curve meets the coordinate axes. [2]

Q13

The curve $y = 2x^2 - 8x + 3$ is drawn for values of x in the interval $0 \leq x \leq 3$.

- (i) Express $2x^2 - 8x + 3$ in the form $a(x - p)^2 + q$. [2]
- (ii) State the coordinates of the minimum point of the curve. [1]
- (iii) Find the greatest and least values of y for $0 \leq x \leq 3$. [3]

Q14

A rectangular pen is to be built against a long straight wall. The wall forms one side of the pen and 40 m of fencing is used for the remaining three sides. The two sides perpendicular to the wall are each of length x m, and the area of the pen is A m².

- (i) Show that $A = 40x - 2x^2$. [2]
- (ii) Express A in the form $c - a(x - p)^2$, where a , c and p are constants. [3]
- (iii) Hence state the largest possible area, and the value of x giving it. [2]

Challenge

Given that $y = kx^2 - 4x + 3k$, express y in the form $a(x - p)^2 + q$, where a , p and q are in terms of k . Hence find the value of k if the maximum value of y is 4. [6]

Answers available at the website.



Instagram: @vectorspacepk

Website: www.vectorspace.pk