

- 1** The equation $x^2 + kx + 2 = 0$, where k is a constant has no real roots.
Find the set of possible values for k .

(Total for question 1 is 3 marks)

- 2** The equation $kx^2 + 5x + k = 0$, where k is a positive constant has equal roots.
Find the value for k .

(Total for question 2 is 3 marks)

3 The equation $kx^2 + 6kx + 2 = 0$, where k is a constant has no real roots.

Find the set of possible values for k .

(Total for question 3 is 4 marks)

4 Find the set of values of a for which the equation $ax^2 + 7x + 4 = 0$ has no real roots.

(Total for question 4 is 3 marks)

- 5** Show that the equation $2x^2 + 5 = 6x$ has no real roots.

(Total for question 5 is 3 marks)

- 6** The equation $(k + 5)x^2 + 4x + (k + 2) = 0$, where k is a constant has two distinct real solutions for x .

Find the set of possible values for k .

(Total for question 6 is 6 marks)

- 7 The equation $x^2 + (n + 1)x + (3 - 3n) = 0$, where n is a constant has two distinct real roots.
Find the set of possible values for n .

(Total for question 7 is 4 marks)

- 8 The equation $x^2 + (2k - 3)x + (k + 3) = 0$, where k is a constant has no real roots.
Find the set of possible values for k .

(Total for question 8 is 4 marks)

9 Show that $x^2 - 6x + 11 > 0$ for all real values of x .

(Total for question 9 is 3 marks)

10 Prove that, for all values of x ,

$$x^2 + 4x + 12 > x + 3$$

(Total for question 10 is 4 marks)

11

- (a) By completing the square, find in terms of the constant p the roots of the equation

$$x^2 + px + 4 = 0$$

(3)

- (b) Hence find the set of values of p for which the equation has no real roots.

(2)

(Total for question 11 is 5 marks)

- 12** The curve C has the equation

$$x^2 + ax + b = 0$$

Where a and b are constants

Given that the minimum point of C has coordinates $(4, -3)$ find the values of a and b .

(Total for question 12 is 4 marks)

- 13** $f(x) = 2x^2 + 8x + 1$

Find the values of the constants a , b and c such that

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

(Total for question 13 is 4 marks)

14

(a) Express $x^2 + 9x + 3$ in the form $(x + a)^2 + b$

(2)

(b) State the coordinates of the minimum point of the curve $y = x^2 + 9x + 3$

(2)

(Total for question 14 is 4 marks)

15

- (a) By completing the square, find in terms of the constant k the roots of the equation

$$x^2 + kx - 6 = 0$$

(4)

- (b) Hence find the exact roots of the equation $x^2 + 4x - 6 = 0$

(2)

(Total for question 15 is 6 marks)

16 The curve C has the equation $y = \frac{2}{x} + k$ $x \in \mathbb{R}, x \neq 0$

The line L has the equation $y = -3x + 2$

- (a) Show that the x -coordinate of any point of intersection of L with C is given by a solution of the equation

$$3x^2 + (k - 2)x + 2 = 0$$

(3)

- (b) Hence find the exact values of k for which L is a tangent of C .

(3)

(Total for question 16 is 6 marks)

- 17** This model can be used to predict the fuel consumption of a car, y miles per gallon, for a car travelling at x miles per hour.

$$y = 55 - 0.015(x - 50)^2$$

- (a) Calculate the fuel consumption, in miles per gallon, of a car travelling at 70 miles per hour.

(2)

- (b) Deduce the speed at which the car has the greatest fuel efficiency.

(2)

- (c) State, giving reasons, the limitation on the values of x

(3)

- 18** A curve C has equation $y = f(x)$ where

$$f(x) = -3x^2 + 18x + 4$$

- (a) Write $f(x)$ in the form $a(x + b)^2 + c$, where a , b and c are constants to be found.

(3)

- (b) Find the coordinates of P , the maximum turning point.

(2)

(Total for question 18 is 5 marks)

19 A curve with equation $y = a(x + b)^2 + c$ has a minimum turning point at $(3, 8)$

(a) State the values of b and c .

(2)

(b) When the curve is translated by the vector $\begin{pmatrix} -4 \\ 0 \end{pmatrix}$ the curve passes through the point $(-6, 13)$. Find the value of a .

(3)

(Total for question 19 is 5 marks)

20

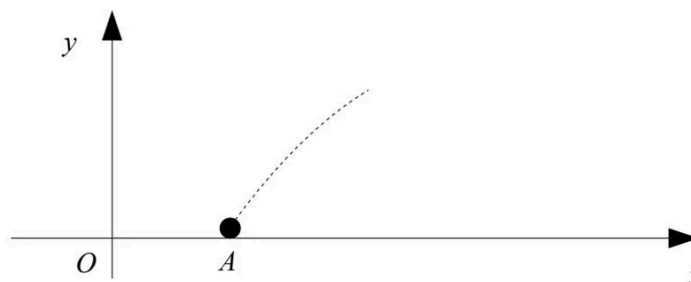
(a) Express $2x^2 + 9x + k$ in the form $a(x + b)^2 + c$

(3)

(b) Find the values of k for which the curve $y = 2x^2 + 9x + k$ does **not** intersect the line $y = 2$

(3)

(Total for question 20 is 6 marks)



The path of a projectile, projected from the point A , can be modelled by the equation

$$y = -0.25x^2 + 2.125x - 4.125$$

- (a) Find the coordinates of the point A

(3)

- (b) Find the distance **from** A that the projectile hits the ground.

(1)

- (c) Calculate the maximum vertical height of the projectile

(4)

(Total for question 21 is 8 marks)

- 22 The equation $x^2 - 5x + k = 0$ has repeated roots. Find the value of the constant k .

(Total for question 22 is 2 marks)

23

(a) Express $4x^2 - 8x + 5$ in the form $a(x + b)^2 + c$

(3)

(b) State the number of real roots of the equation $4x^2 - 8x + 5$

(2)

(c) Explain fully how the value of r is related to the number of real roots of the equation $p(x + q)^2 + r = 0$ where p, q and r are real constants and $p > 0$

(3)

24

- (a) Express $3x^2 - 15x + 4$ in the form $a(x + b)^2 + c$

(3)

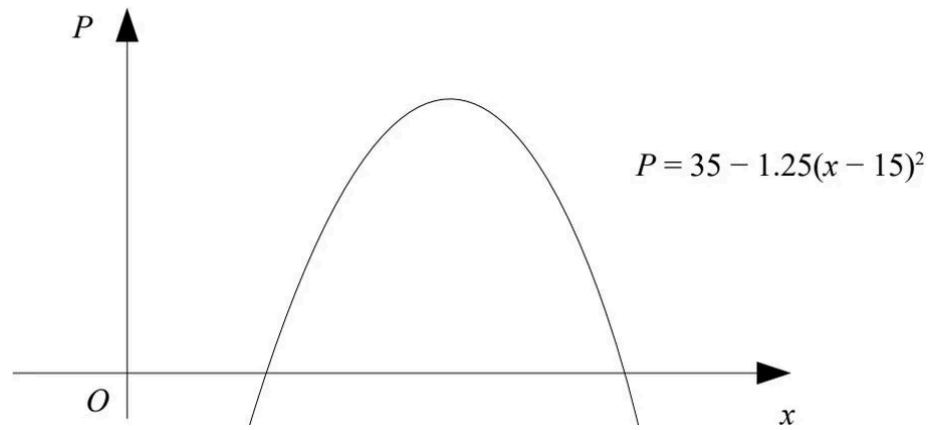
- (b) State the coordinates of the minimum point of the curve $y = 3x^2 - 15x + 4$

(2)

- (c) State the equation of the normal to the curve $y = 3x^2 - 15x + 4$ at its minimum point.

(2)

(Total for question 24 is 7 marks)



A football club selling tickets for a football match. The profit made by the football club is modelled by the equation

$$P = 35 - 1.25(x - 15)^2$$

where P is the profit measured in thousands of pounds and x is the price of each ticket in pounds.

- (a) Explain why £25 is not a sensible price for a ticket.

(3)

- (b) Given that the football club made a profit of more than £20 000, find, according to the model, the least possible price of a ticket.

(4)

- (c) State, according to the model, (i) the maximum possible profit, (ii) the ticket price that maximises the profit.

(3)

(Total for question 25 is 10 marks)
