## Question 1

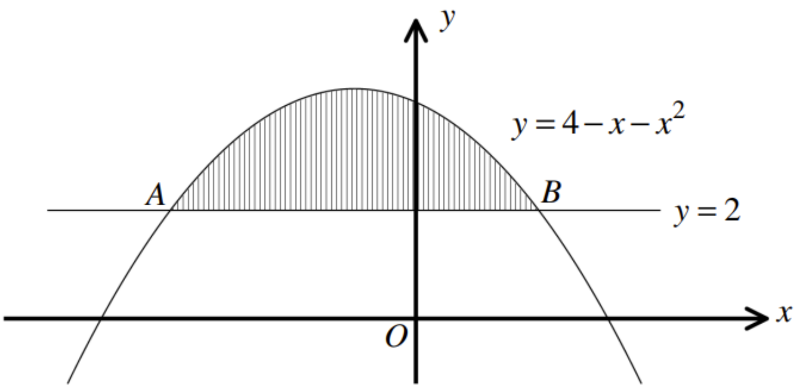
The straight line $l_1$ passes through the points $A(3,20)$ and $B(13,0)$.

The straight line $l_2$ has gradient $\frac{1}{3}$ and passes through the point $C(0,5)$.

The point $D$ is the intersection of $l_1$ and $l_2$.

Show that the length of $AD$ is $k\sqrt{5}$, where $k$ is an integer. **(8)**

## Question 2




The figure above shows a quadratic curve and a straight line with respective equations

$$y=4-x-x^2 \quad \text{and} \quad y=2.$$

The points $A$ and $B$ are the points of intersection between the quadratic curve and the straight line.

**a)** Find the coordinates of $A$ and $B$. **(3)**

**b)** Determine the exact area of the finite region bounded by the quadratic curve and the straight line, shown shaded in the above figure. **(5)**

**Question 3**

A circle $C$ with centre at the point $P$ and radius $r$, has equation

$$x^2 - 8x + y^2 - 2y = 0.$$

**a)** Find the value of $r$ and the coordinates of $P$. **(3)**

**b)** Determine the coordinates of the points where $C$ meets the coordinate axes. **(3)**

The points $A$, $B$ and $Q(8,2)$ lie on $C$.

The straight line $AB$ is diameter of the circle so that $PQ$ is perpendicular to $AB$.

**c)** Calculate the coordinates of $A$ and $B$. **(6)**

## Question 4

A polynomial $f(x)$ is defined in terms of the constants $a$, $b$ and $c$ as

$$f(x) = 2x^3 + ax^2 + bx + c, \quad x \in \mathbb{R}.$$

It is further given that

$$f(2) = f(-1) = 0 \quad \text{and} \quad f(1) = -14.$$

**a)** Find the value of $a$, $b$ and $c$ . **(5)**

**b)** Sketch the graph of $f(x)$.

The sketch must include any points where the graph of $f(x)$ meets the coordinate axes. **(4)**

## Question 5

Solve the following trigonometric equation in the range given.

$$\frac{5\cos 2x + \sin 2x}{3\sin 2x} = 7, \quad -90° \le x < 90°. \qquad \textbf{(6)}$$

## Question 6

$$x^3 - 4x + 1 = 0.$$

The above cubic equation has three real roots $x_1$, $x_2$ and $x_3$.

Use transformation arguments to find, in a simplified form, another cubic equation whose roots are

$$x_1 + 1, \qquad x_2 + 1, \qquad x_3 + 1.$$ **(4)**

**Question 7**

A curve $C$ has equation

$$y = 4x^3 + 7x^2 + x + 11, \quad x \in \mathbb{R}.$$

The point $P$ lies on $C$, where $x = -1$.

**a)** Find an equation of the tangent to $C$ at $P$. **(4)**

The tangent to $C$ at $P$ meets $C$ again at the point $Q$.

**b)** Determine the $x$ coordinate of $Q$. **(5)**

**Question 8**

A quadratic curve has equation

$$f(x) \equiv 12x^2 + 4x - 161,\ x \in \mathbb{R}.$$

Express the above equation as the product of two linear factors.

***A detailed method must be shown in this question.*** **(5)**

**Question 9**

Show that if $x$ is numerically small

$$\left(2+x-x^2\right)^5 \approx A+Bx+Cx^3$$

where $A$, $B$ and $C$ are integers to be found. **(6)**

**Question 10**

$$f(x) = x^4 - 4x, \ x \in \mathbb{R}.$$

**a)** Find a simplified expression for

$$f(2+h) - f(2).$$ **(4)**

**b)** Use the formal definition of the derivative as a limit, to show that

$$f'(2) = 28.$$ **(3)**

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**Question 11**

Find, **without** the use of any calculating aid, the solution of the equation

$$\frac{1}{2}\times 4^{2x} = 64^{64}.$$ **(5)**