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Question 1

Show that $a^3 - a + 1$ is odd for all positive integer values of a. **(5)**

Question 2

Find the value of the constant k if

$$\int_1^3 6x^2 + kx \ dx = 8.$$

(5)

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Question 3

$$f(x) = x^2, \; x \in \mathbb{R}.$$

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

$$f'(x) = 2x. \qquad \textbf{(5)}$$

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Question 4

The graph of the curve with equation

$$y = 2\sin(2x + k)°, \quad 0 \le x < 360,$$

where k is a constant so that $0 < k < 90$, passes through the points with coordinates $P(55,1)$ and $Q(\alpha, \sqrt{3})$.

a) Show, without verification, that $k = 40$. **(5)**

b) Determine the possible values of α. **(5)**

Question 5

The variables x and y are thought to obey a law of the form

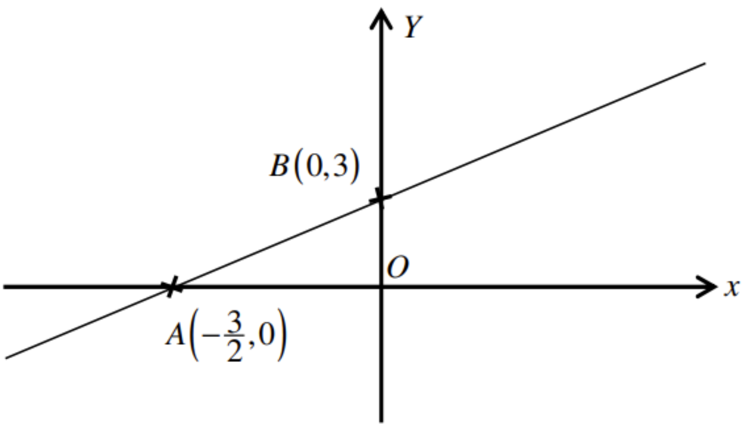
$$y = a \times k^x,$$

where a and k are positive constants.

Let $Y = \log_{10} y$.

a) Show there is a linear relationship between x and Y. **(4)**

The figure below shows the graph of Y against x.



b) Determine the value of a and the value of k. **(4)**

Question 6

The triangle ABC has $AB = 13$ cm and $BC = 15$ cm.

Given that $\measuredangle BCA = 60°$, determine the possible values of AC. **(5)**

Question 7

The points A, B and C have coordinates $(2,1)$, $(4,0)$ and $(6,4)$ respectively.

a) Determine an equation of the straight line L which passes through C and is parallel to AB. **(4)**

b) Show that the angle ABC is $90°$. **(3)**

c) Calculate the distance AC. **(2)**

A circle passes through the points A, B and C.

d) Show that the equation of this circle is given by

$$x^2 + y^2 - 8x - 5y + 16 = 0.$$ **(5)**

e) Find the coordinates of the point other than the point C where L intersects the circle. **(5)**

Question 8

A cubic curve C_1 has equation

$$y = (x-8)(x^2-4x+3).$$

A quadratic curve C_2 has equation

$$y = (2x-3)(8-x).$$

a) Sketch on separate set of axes the graphs of C_1 and C_2.

The sketches must contain the coordinates of the points where each of the curves meet the coordinate axes. **(5)**

b) Hence find the solutions of the following equation.

$$(x-8)(x^2-4x+3) = (2x-3)(8-x).$$ **(6)**

Question 9

The points A and C have coordinates $(3,2)$ and $(5,6)$, respectively.

a) Find an equation for the perpendicular bisector of AC, giving the answer in the form $ax+by=c$, where a, b and c are integers. **(5)**

The perpendicular bisector of AC crosses the y axis at the point B.

The point D is such so that $ABCD$ is a rhombus.

b) Show that the coordinates of D are $(8,2)$. **(3)**

c) Calculate the area of the rhombus $ABCD$. **(4)**

Question 10

The point P, whose x coordinate is $\frac{1}{4}$, lies on the curve with equation

$$y=\frac{k+4x\sqrt{x}}{7x}, \ x\in\mathbb{R}, \ \ x>0,$$

where k is a non zero constant.

a) Determine, in terms of k, the gradient of the curve at P. **(5)**

The tangent to the curve at P is parallel to the straight line with equation

$$44x+7y-5=0.$$

b) Find an equation of the tangent to the curve at P. **(7)**

Question 11

Find the exact solutions of the equation

$$2e^{2x} - 5e^{x} + 3e^{-x} = 4.$$ **(8)**