Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Centre Number

Candidate Number

Mathematics

Assessment Unit AS 1
assessing
Pure Mathematics

MV24

[SMT11]

THURSDAY 16 MAY, AFTERNOON

Time

1 hour 45 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer **all nine** questions in the spaces provided.
Do not write on blank pages.
Complete in black ink only.
Questions which require drawing or sketching should be completed using an HB pencil.

All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
Answers without working may not gain full credit.
Answers should be given to three significant figures unless otherwise stated.
You are permitted to use a graphic or scientific calculator in this paper.

Information for Candidates

The total mark for this paper is 100.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
A copy of the **Mathematical Formulae and Tables booklet** is provided.
Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_e z$

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(Questions start overleaf)

1 $\mathbf{q} = 5\mathbf{i} + 2\mathbf{j}$
$\mathbf{r} = \mathbf{i} - 3\mathbf{j}$

(i) Find $\mathbf{p}$ where $\mathbf{p} = \mathbf{q} - 2\mathbf{r}$ [2 marks]

(ii) Hence find the magnitude of **p** and the angle it makes with the positive x-axis.
[4 marks]

2 Point A has coordinates (–1, 2).
Point B has coordinates (3, 10).

(i) Find the mid-point of AB. [2 marks]

(ii) Find the gradient of AB. [2 marks]

(iii) Hence find the equation of the line perpendicular to AB, which passes through the mid-point of AB.

Leave your answer in the form $ax + by + c = 0$, where a, b and c are integers. [4 marks]

3 A circle is given by the equation
$x^2 + y^2 + 4x - 2y = 12$

(i) Find the centre and radius of the circle.
[5 marks]

(ii) Find the coordinates of the points where the circle crosses the x-axis. [4 marks]

4 **(a)** The expression $(x^3 - 5x^2 + 7x - a)$ has a factor $(2x - 1)$.

Find the value of a. [4 marks]

(b) (i) Find the first four terms, in ascending powers of x, in the binomial expansion of $(1 + kx)^6$, where k is a non-zero constant. [5 marks]

(ii) Given that the coefficients of x^2 and x^3 are equal, find the value of k.
[3 marks]

5 **(a)** Prove that

$$\tan\theta + \frac{1}{\tan\theta} \equiv \frac{1}{\sin\theta\cos\theta}$$ [5 marks]

(b) Solve

$$2\sin^2\theta + 2 = 7\cos\theta \qquad 0 \leqslant \theta \leqslant 360°$$

[7 marks]

6 **(a)** Solve

$4^{2x-1} = 25$ [5 marks]

(b) The temperature θ°C of a cooling body, at time t hours, is given by

$$\theta = 120\,e^{kt}$$

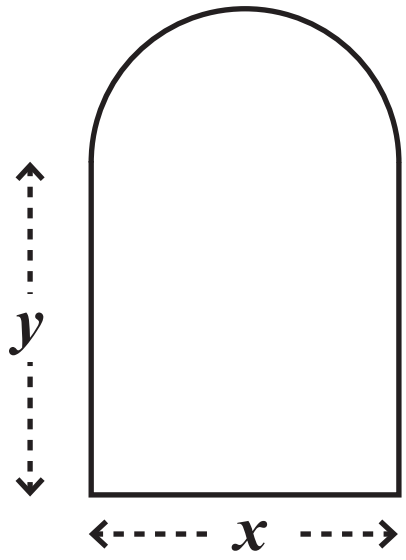
where k is a constant.

When $t = 2 \quad \theta = 80$

Find the value of θ when $t = 5$
[6 marks]

7 A single piece of wire is bent into a shape as shown in **Fig.1** below

Fig.1



The wire forms the outline of three sides of a rectangle surmounted by a semi-circle.

The rectangle has width x cm and length y cm.

The wire is 8 cm long.

(i) Show that

$$y = 4 - \frac{x}{2} - \frac{\pi x}{4}$$ [4 marks]

(ii) Hence find, in terms of π, the value of x for which the area of the **rectangle** is a maximum. [10 marks]

8 Given that $4^x = 32^y$

and $(\sqrt{3})^x = \dfrac{9^{2y}}{27^{y-1}}$

find the values of x and y. [10 marks]

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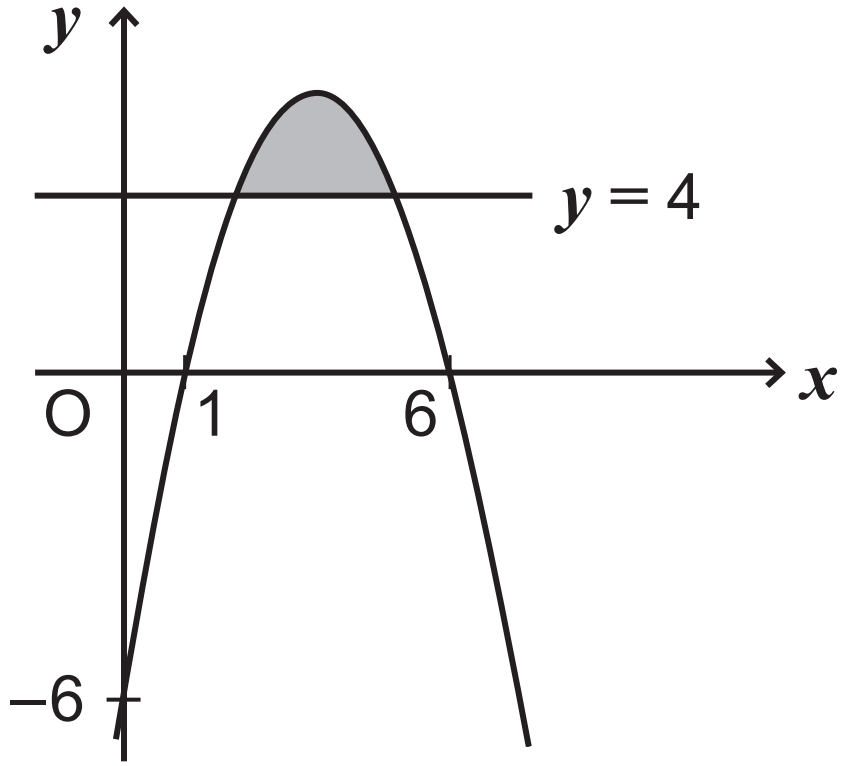
(Questions continue overleaf)

9 **(a)** **Fig. 2** below shows a sketch of a quadratic curve and a straight line.

Fig. 2



The curve crosses the x-axis at $x = 1$ and $x = 6$

The curve crosses the y-axis at $y = -6$

The straight line has equation $y = 4$

Find the value of the shaded area.
[11 marks]

(b) Find the range of values of p for which the expression

$$2x^2 + px - (p + 1)$$

is always positive. [7 marks]

This is the end of the question paper

SOURCES

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

Examiner Number

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