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General Certificate of Education
2019

Centre Number

Candidate Number

Mathematics

Assessment Unit AS1
assessing
Pure Mathematics

MV18

[SMT11]
WEDNESDAY 15 MAY, MORNING

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 H.B. 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.

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Information for Candidates

The total mark for this paper is 100.
Figures in brackets 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)

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1 **(a)** Solve the simultaneous equations [7 marks]

$$x + 2y + 3z = 9$$
$$2x - y + 4z = 17$$
$$3x + y - z = 2$$

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(b) $\overrightarrow{OA} = 4\mathbf{i} - \mathbf{j}$

$\overrightarrow{OB} = 6\mathbf{i} + 2\mathbf{j}$

Find:

(i) the magnitude of the vector $\overrightarrow{AB}$, [3 marks]

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(ii) the angle $\overrightarrow{AB}$ makes with the positive x-axis.
[2 marks]

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2 **Fig. 1** below shows a sketch of the graph of the curve given by the equation $y = f(x)$.

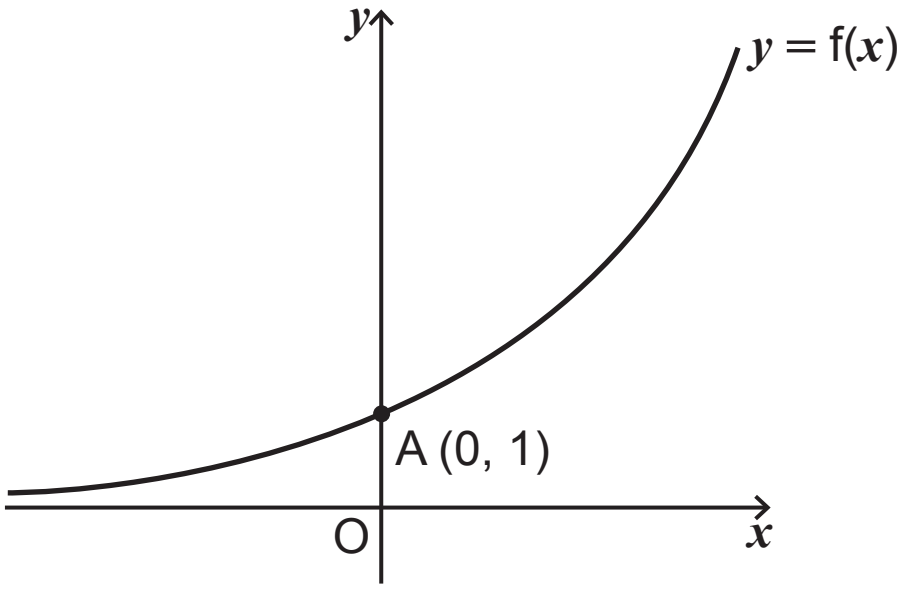

Fig. 1

Point A has coordinates (0, 1).

(a) Write down the coordinates of the point A under the following transformations:

(i) $y = f(x) + 1$ [2 marks]

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(ii) $y = f(x - 3)$ [2 marks]

(iii) $y = f(-x)$ [2 marks]

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(b) f(x) has an asymptote given by the equation $y = 0$

Write down the equation of the asymptote of the curve under the transformation

$y + 2 = f(x)$. [1 mark]

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3 **(a)** **(i)** Given that $\log_2 a = 3$ state the value of a.
[1 mark]

(ii) Hence solve the equation

$\log_2 x - \log_2 (x - 1) = 3$ [5 marks]

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(b) Find the exact solution of the equation

$3e^{2x} - 4 = 0$ [4 marks]

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4 **(a)** Find the range of values of k for which the equation

$$x^2 + kx + 16 = 0$$

has no real roots. [6 marks]

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(b) Find the centre and area of the circle given by the equation

$x^2 - 4x + y^2 + 6y - 3 = 0$ [6 marks]

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5 **(a)** Given that

$$\int_{1}^{k} 2\sqrt{x}\,\mathrm{d}x = \frac{28}{3}$$

find the value of k. [6 marks]

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(b) Solve the equation

$2\cos^2\theta = 1 - \sin\theta$

for $0 \leqslant \theta \leqslant 360°$ [7 marks]

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6 An open tin in the shape of a cylinder is shown in **Fig. 2** below.

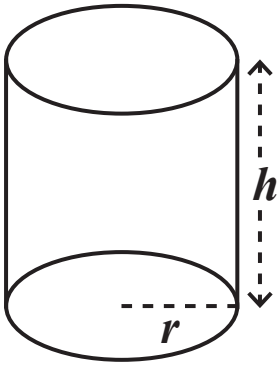

Fig. 2

The open tin has base radius r cm and height h cm.
The total surface area of the tin is 300π cm^2

(i) Express h in terms of r. [4 marks]

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(ii) Hence show that the volume of the tin can be expressed as

$$V = 150\pi r - \frac{\pi r^3}{2}$$ [3 marks]

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The volume of the tin is

$$V = 150\pi r - \frac{\pi r^3}{2}$$

(iii) Using calculus, find the values of r and h for which the volume of the tin is a maximum. [7 marks]

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7 Solve the equation

$2x^3 - 8x^2 + 3x + 10 = 0$ [7 marks]

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8 The points A and B have coordinates $(2a, a^2)$ and $(a+1, a)$ respectively, where $a \neq 0$

(i) A straight line, perpendicular to AB and passing through the point A, cuts the x-axis at the point P.

Find, in terms of a, the coordinates of the point P.
[8 marks]

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(ii) The midpoint of the line AB has equal x and y ordinates.

Find the possible values of a in their simplest surd form.
[5 marks]

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9 **Fig. 3** below shows a diagram of a circle with centre O.

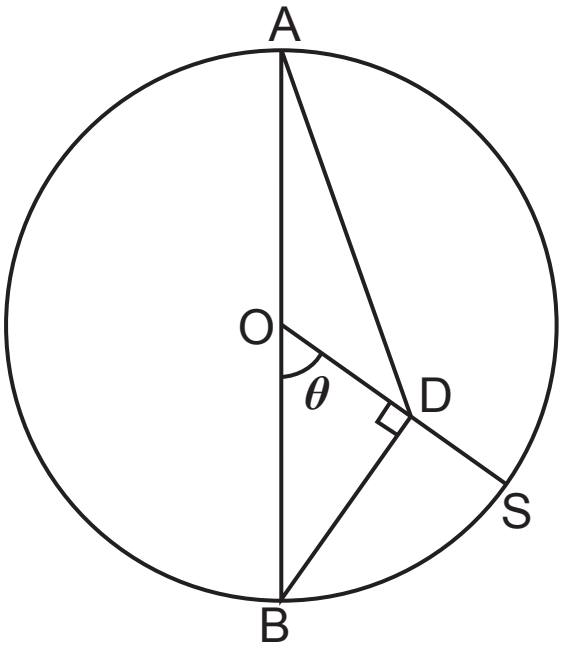

Fig. 3

AB is a diameter of the circle.
S lies on the circumference of the circle.
D is the foot of the perpendicular from B to OS.

The acute angle BOS is θ
OA = OB = r
OD = x

(i) By applying the cosine rule to triangle AOD, show that

$AD^2 = r^2 (1 + 3\cos^2\theta)$ [7 marks]

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(ii) When BD bisects OS,

$$\text{AD} = \frac{r\sqrt{k}}{2}$$

Find the value of k, where k is a positive integer.
[5 marks]

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This is the end of the question paper

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

Examiner Number

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