OCR
Oxford Cambridge and RSA

A Level Mathematics B (MEI)

H640/01 MEI Pure Mathematics and Mechanics

Pure

Question Set 1

1 **In this question you must show detailed reasoning.**

Show that $\int_4^9 (2x+\sqrt{x})\mathrm{d}x = \frac{233}{3}$. **[3]**

2 Show that the line which passes through the points $(2, -4)$ and $(-1, 5)$ does not intersect the line $3x+y=10$. **[3]**

3 The function $\mathrm{f}(x)$ is given by $\mathrm{f}(x) = (1-ax)^{-3}$, where a is a non-zero constant. In the binomial expansion of $\mathrm{f}(x)$, the coefficients of x and x^2 are equal.

(a) Find the value of a. **[3]**

(b) Using this value for a,

(i) state the set of values of x for which the binomial expansion is valid, **[1]**

(ii) write down the quadratic function which approximates $\mathrm{f}(x)$ when x is small. **[1]**

4 **(a)** Prove that $\frac{\sin\theta}{1-\cos\theta} - \frac{1}{\sin\theta} = \cot\theta$. **[4]**

(b) Hence find the exact roots of the equation $\frac{\sin\theta}{1-\cos\theta} - \frac{1}{\sin\theta} = 3\tan\theta$ in the interval $0 \leqslant \theta \leqslant \pi$. **[3]**

5 An arithmetic series has first term 9300 and 10th term 3900.

(a) Show that the 20th term of the series is negative. **[3]**

(b) The sum of the first n terms is denoted by S. Find the greatest value of S as n varies. **[4]**

6 **(a)** Express $7\cos x - 2\sin x$ in the form $R\cos(x+\alpha)$ where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$, giving the exact value of R and the value of α correct to 3 significant figures. **[4]**

(b) Give details of a sequence of two transformations which maps the curve $y = \sec x$ onto the curve $y = \frac{1}{7\cos x - 2\sin x}$. **[3]**

7 Fig. 7 shows a circle with centre O and radius r cm. The chord AB is such that angle AOB $= x$ radians. The area of the shaded segment formed by AB is 5% of the area of the circle.

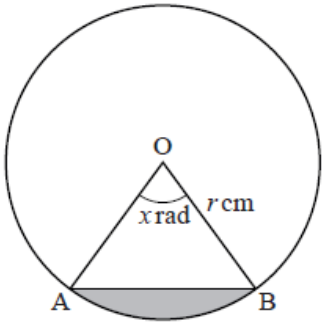

Fig. 7

(a) Show that $x - \sin x - \frac{1}{10}\pi = 0$. **[4]**

The Newton-Raphson method is to be used to find x.

(b) Write down the iterative formula to be used for the equation in part **(a)**. **[1]**

(c) Use three iterations of the Newton-Raphson method with $x_0 = 1.2$ to find the value of x to a suitable degree of accuracy. **[3]**

8 A model for the motion of a small object falling through a thick fluid can be expressed using the differential equation

$$\frac{dv}{dt} = 9.8 - kv,$$

where $v\,\text{m s}^{-1}$ is the velocity after t s and k is a positive constant.

(a) Given that $v = 0$ when $t = 0$, solve the differential equation to find v in terms of t and k. **[7]**

(b) Sketch the graph of v against t. **[2]**

Experiments show that for large values of t, the velocity tends to $7\,\text{m s}^{-1}$.

(c) Find the value of k. **[2]**

(d) Find the value of t for which $v = 3.5$. **[1]**

Total Marks for Question Set 1: 52