Section A

[48 marks]

Answer **all** *the questions in this section.*

All *questions carry* **equal** *marks.*

1. Given the exponential sequence (*G.P.*) $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$, find the:

(a) common ratio;

(b) 9^{th} term;

(c) sum of the first nine terms, of the sequence.

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2. Solve $4 \sin 2\theta \tan \theta = 3$, $0° \leq \theta \leq 360°$, correct to the **nearest** degree.

3. Using trapezoidal rule with **nine** ordinates, find, correct to **two** decimal places, the area of the region bounded by the curve $y = \frac{1}{1 + x^2}$, the x- axis and the lines $x = 0$ and $x = 8$.

4. Find the equation of the normal to the curve $y = \frac{2x + 1}{x - 1}, x \neq 1$ at the point $(0, -1)$.

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Do not write in this margin.

5. The ages (in years) of 9 members of a social club are 17, 11, 31, 18, 25, 12, 29, 13 and 15. Calculate the mean deviation.

6. A group consists of 8 men and 7 women. If **two** representatives are to be selected from the group at random **without** replacement for a debate competition, find the probability that they are:
(a) both women;

Do not write in this margin.

(b) of the same sex.

7. The position vectors of A and B relative to an origin are given as $\overrightarrow{OA} = 2i - 8j$ and $OB = 5i + j$ Find $\angle AOB$ and state the type of angle it is.

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Do not write in this margin.

8. A bullet of mass 25 g is fired with velocity $(80\boldsymbol{i} - 200\boldsymbol{j})\ ms^{-1}$ into a wooden block of mass 4 kg which is at rest. If the bullet got stuck in the block, find the common velocity of the bullet and the block.

SECTION II

[52 marks]

Answer **four** *questions* **only** *from this section* **with at least one** *question from* **each** *part.*

All *questions carry* **equal** *marks.*

PART I

PURE MATHEMATICS

9. *(a)* Express $\frac{2x + 1}{x^2 - 8x + 16}$ in partial fractions.

(b) If ${}^{8}C_{n} : {}^{6}C_{(n-1)} = 56 : 15$, find the values of n.

10. *(a)* A function g is defined as $g : x \to \frac{1}{2} - \frac{3x}{1 - x}$. Find the image of 1 under g^{-1}(the inverse of g).

(b) A curve has an equation $y = \frac{x}{2 + x^2}$. Find, correct to **one** decimal place, the gradient of the curve at $x = \frac{1}{2}$.

11. *(a)* **Two** linear transformations, P and Q are defined by

$P : (x, y) \to (2x + y, x + 2y)$

$Q : (x, y) \to (2x + 3y, 2y)$

(i) Write down the matrices of P and Q.

(ii) Find the image of $(2, -4)$ under the transformation P followed by Q.

(b) Solve $\log x = 1 + 2\log y$ and $2x = 9y - 1$ simultaneously.

PART II

STATISTICS AND PROBABILITY

12. **Fifteen** percent of the participants in a conference presented papers. If a random sample of 10 participants is taken, find the probability that:

(a) **exactly three**;

(b) **not more than two**;

(c) **not less than eight**,

presented papers.

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13. *(a)* The numbers 1, 2, 3, 4 and 5 have frequencies p, 11, q, 8 and 9 respectively. If the total frequency is 50 and the arithmetic mean is 2.7, find the values of p and q.

(b) The Spearman's rank correlation coefficient of 20 students marks in two tests is 0.8562. Find $\sum d^2$ (sum of squares of the rank difference for each pair of ranks).

PART III

VECTORS AND MECHANICS

14. A body weighing 700 N is suspended at point P by two inextensible strings at points M and T, where $|PM| = 1.5\ m$, $|PT| = 2.0\ m$ and $|MT| = 2.8\ m$. If the body remains in equilibrium, calculate to **three** significant figures, the tension in each string.

15. A particle P of mass 1.2 kg is acted upon by forces $F_1 = (15\ N, 090°)$, $F_2 = (20\ N, 000°)$, $F_3 = (30\ N, 210°)$ and $F_4 = (k\ N, \alpha°)$. If the acceleration of the particle is $a = (14\ ms^{-2}, 240°)$, find, correct to the **nearest** whole number, F_4.

END OF PAPER