

SECTION A: PURE MATHEMATICS

THIS SECTION IS COMPULSORY TO ALL CANDIDATES

(ANSWER ALL QUESTIONS)

1. (i) A quadratic equation $x^2 - 3x + 4 = 0$ has roots α and β . Without solving the equation,
 (a) write down the value of $\alpha^2 + \beta^2$
 (b) find the quadratic equation, with integral coefficients, whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$ (8 marks)
2. Given that $f(x) = x^3 - x^2 + 4ax + b$ and $g(x) = 2x^3 - 9x^2 - 3ax + h$ have a common factor $(x - 1)$ where a and b are constants,
 (a) find the values of a and b ,
 with these values of a and b ,
 (b) factorise $f(x)$ completely. (10 marks)
3. The first term of a geometric progression is 32 and the sum to infinity is 48.
 Find,
 (a) the common ratio,
 (b) the eighth term of the progression. (5 marks)
4. (a) A committee of 2 men and 3 women is to be chosen from five men and four women. How many different committees can be formed? (4 marks)
 (b) Find the coefficient of the term in x^6 in the expansion of $\left(x^2 + \frac{2}{x}\right)^9$ (5 marks)
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5. The set S , where $S = \{1, 3, 5, 7, 9\}$.
 (a) Draw an operation table for the set S under the operation multiplication modulo 10 (θ).
 From your operation table or otherwise,
 (b) state why S does not form a group under (θ),
 (c) find a subset of four elements of S which forms a group under (θ). (7 marks)
 (d) the area of triangle ABC. (9 marks)
6. The points A, B and C have coordinates (2, 2), (4, 5) and (7, 3) respectively.
 (a) Find the equation of the line l joining the points A and B,
 (b) Find the equation of the line l_2 perpendicular to and passes through the point B,
 (c) Show that C lies on the line l_2
 hence, or otherwise, find,
7. The function f is defined as $f(x) = \cos 2x + \sin x$, where $0 \leq x \leq \pi$.
 (a) Copy and complete the table
- | | | | | | | | |
|--------|---|-----------------|-----------------|-----------------|------------------|------------------|-------|
| x | 0 | $\frac{\pi}{6}$ | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\frac{5\pi}{6}$ | π |
| $f(x)$ | | | | 0 | | | |
- (b) Taking 2 cm to represent $\frac{\pi}{6}$ on the x-axis and 2 cm to represent 1 unit on the y-axis, draw the graph of $y = f(x)$, for intervals of $\frac{\pi}{6}$. From your graph, (9 marks)
 (c) estimate the minimum and the maximum value of $f(x)$. (4 marks)
8. (i) Differentiate with respect to x the expression $2x^3 + \frac{1}{x}$. (4 marks)
 (ii) Find the area bounded by the curve $y = x - x^2$, the x-axis for $0 \leq x \leq 1$. (5 marks)

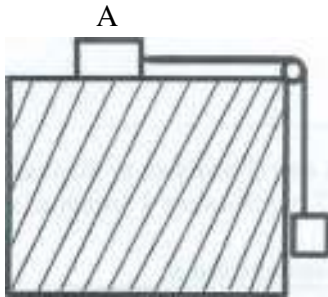
SECTION B: (MECHANICS)

IF THIS SECTION IS CHOSEN, THEN SECTION C MAY NOT BE CHOSEN

(ANSWER ANY TWO QUESTIONS)

9. (i) A particle P moves on a straight line from a fixed point O and its distance x from O after t seconds is given as $x = \frac{1}{4}t^4 - \frac{3}{2}t^2 + 2t$.
Find;
(a) the velocity of P when $t = 2$,
(b) the acceleration of P when $t = 2$,
(c) the time at which the speed of P is minimum. **(9 marks)**
- (ii) At time t , the force acting on a particle P of mass 2 kg is $(2ti + 4j)$ N. P is initially at rest at the point with position vector $(i + 2j)$.
Find;
(a) the velocity of P when $t = 2$.
(b) the position vector when $t = 2$. **(8 marks)**
10. (i) The area bounded by the line $y = 3x + 2$, the x -axis and the ordinates at $x = 0$ and $x = 1$ is rotated completely through one complete revolution about the x -axis. Calculate the volume of the solid generated. **(6 marks)**
- (ii) The rate of change of the radius of a circle of any time t is 2 cms^{-1} . What is the rate of change of the area of the circle when the radius 5cm. **(5 marks)**
- (iii) Find the position vector of the centre of gravity of particles of mass 3 kg, 5kg and 1 kg which are at the points with position vectors $4i + 2j$, $3i - 2j$ and $6i$ respectively. **(6 marks)**
11. (i) The engine of a car is working at the steady rate of 6 Kw. The car of mass 3,600 kg is being driven along a level straight road against a constant resistance to motion of 300N. Find,
(a) the acceleration of the car when its speed is 6 ms^{-1} ,
(b) the maximum speed of the car on the level **(8 marks)**

(ii)



In the figure above, a particle A of mass 2kg is lying on a rough wooden block. The particle A is connected by a light inextensible horizontal string passing over a smooth light fixed pulley at the edge of the block, to a particle B of mass 3kg which hangs freely. The coefficient of friction between the particle A and the surface of the block is μ .

Given that the string is taut and the system is released from rest such that the particles move with an acceleration of 4 ms^{-2} . Find

- (a) the tension
(b) the value of μ . **(9 marks)**

SECTION C: (PROBABILITY AND STATISTICS)*IF THIS SECTION IS CHOSEN, THEN SECTION B MAY NOT BE CHOSEN***(ANSWER TWO QUESTIONS)**

12. The marks scored by 40 students in an examination is given below:

Mark(x)	23-27	28-32	33-37	38-42	43-47	48-52
No. of students(f)	3	7	11	9	6	4

- (i) Draw the cumulative frequency graph for the above data. Hence, from your graph, find
- the median mark,
 - the semi interquartile range of the distribution.

(10 marks)

- (ii) Calculate the mean and the variance mark of the distribution.

(7 marks)

13. (i) A fair die of six faces is tossed 36 times and the side X that falls up is recorded as represented on the frequency distribution function as follows:

$$f(x) = \begin{cases} k(5+x), & \text{for } x = 1, 2, 3 \\ k(10-x), & \text{for } x = 4, 5, 6 \end{cases}$$

Where K is a constant

- (a) Copy and complete the frequency distribution table

Side X	1	2	3	4	5	6
Number of times it falls up (f)	6k				5k	

- Find the value of k.
- Find the mean and variance of X
- Evaluate $p(x = 5)$ and $p(x < 4)$

(12 marks)

- (ii) $X \sim B(n, 0.2)$

Given that the mean of X is 2, find;

- the value of n,
- the variance of X.

(5 marks)

14. (i) Tomatoes from a particular farm are packed in two boxes A and B and sent to the market.

Given that 1 out of every 4 tomatoes in box A is rotten and 2 out of every 4 tomatoes in box B are rotten. An experiment consists of choosing a box and selecting a tomato from it.

- Draw a tree diagram to illustrate this experiment. Hence or otherwise, find the probability that;
- a rotten tomato is chosen from box A.
- a rotten tomato is chosen.

(9 marks)

- (ii) A class consist of 120 students of which 80 are girls and 40 are boys. It is known that 20% of the girls and 40% of the boys in the class have brown eyes. A student X is chosen from the class, find the probability that:

- X has brown eyes,
- X is a girl or X has brown eyes.

(8 marks)