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PURE MATHS WITH MECHS 3

0765/3

MOCK EXAMINATIONS

MARCH 2024

ADVANCED LEVEL

Subject Title	Pure Mathematics With Mechanics
Paper N0.	3
Subject Code N0.	0765

THREE HOURS

Full marks may be obtained for answers to All questions, All
questions carry equal marks.

You are reminded of the necessity for good English and orderly presentation in your answers.

Mathematical formulae booklet published by the GCE Board is allowed.

In calculations, you are advised to show all the steps in your working, giving the answer at each stage.

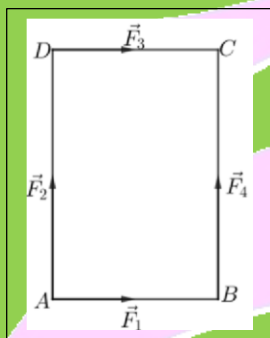
Calculators are allowed.

Start each question on a fresh page.

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1. A particle moving along a straight line starts at time $t=0$ seconds with a velocity of 4ms^{-1} . At any subsequent time t seconds the acceleration of the particle is $(6t - 8)\text{ms}^{-1}$. Find the:
 - a) Distance the particle moves before coming to instantaneous rest. (4 MARKS)
 - b) Total time T seconds taken by the particle to return to the starting point. (4 MARKS)
 - c) Greatest speed of the particle for $0 \leq t \leq T$ (5 MARKS)
2. The diagram shows a rectangle ABCD, in which $AB=4\text{m}$, $BC=6\text{m}$,



- a) Find the magnitude of the resultant of the forces. (3 MARKS)
- b) Find the direction of the resultant of the forces. (3 MARKS)
- c) Find the perpendicular distance from B to the line of action of the resultant. (4 MARKS)
- d) Find the total moment of the forces about B. (3 MARKS)

3. A parachutist of mass m falls freely until his parachute opens. When it is open, he experiences an upward resistance kv where v is his speed and k is a positive constant.
 - a) Prove that, after time t from the opening of his parachute, $m \frac{dv}{dt} = mg - kv$ (3 MARKS)
 - b) Find the expression of speed as a function of time. (4 MARKS)
 - c) Prove also that, irrespective of his speed when he opens his parachute, his speed approaches a limiting value of $\frac{mg}{k}$ (3 MARKS)
 - d) Prove that the limiting height to be attained by the parachutist before the parachute opens is $\frac{m^2g}{2k^2}$. (3 MARK)

4. A light elastic string ACB , of natural length $2l$, is made by joining an elastic string AC , of natural length l and modulus of elasticity λW , and an elastic string CB , of natural length l and modulus of elasticity $K\lambda W$. A is attached to a fixed point and a weight W hangs at rest from the free end B .
 - a) Find the extension produced in the positions AC and CB (7 MARKS)
 - b) Find also the new length of the string ACB (6 MARKS)

5. A car of mass 1000kg is moving on a level road at a steady speed of 100km/h with its engine working at 60KW .
 - a) Calculate in Newtons the total resistance to motion, which may be assumed constant. (3 MARKS)
The engine is now disconnected, the brakes are applied, and the car comes to rest in 100m . Assuming that the total resistance remains the same;
 - b) Show that the retarding force of the brakes is about 1700N . (6 MARKS)
If the engine is still disconnected;

- c) Find the distance the car would run up a hill of inclination $\sin^{-1}\left(\frac{1}{10}\right)$ before coming to rest, starting at 100km/h when the same resistance and breaking force are operating . (4 MARKS)

(Take g as $9.8ms^{-2}$)

6. A small smooth sphere P of mass $6m$ moving on a smooth plane in a straight line with constant speed $8U$ collides directly with a small smooth sphere Q of the same radius but of mass $4m$ and moving in the same direction with speed $6U$. The direction of motion of sphere Q is unchanged by the collision and immediately after the collision it moves with speed $8U$. Find :

- The speed of P immediately after collision. (3 MARKS)
- The coefficient of restitution. (4 MARKS)
- The magnitude of the impulse exerted by P on Q . (2 MARKS)
- The total loss of kinetic energy due to the impact. (4 MARKS)

7.

- (i) A uniform framework is constructed by bending wire into the shape of a semi-circle and a diameter. The semi-circle has a radius of $15cm$ as represented below.



- Find the distance of the centre of mass from AB (5 MARKS)
- The metal used to form the framework has a mass of 8 grams per cm. Two identical particles of masses 100grams are attached to the framework, at A and B. Find;
 - The total mass of the loaded framework. (3 MARKS)
 - The distance of the centre of mass of the loaded framework from AB. (4 MARKS)

8. i) Consider the events A, B and C. Two of the events A and C are independent. Probabilities relating events A, B and C are as follows: $P(A) = \frac{1}{5}$, $P(B) = \frac{1}{6}$, $P(A \cap C) = \frac{1}{20}$, $P(B \cap C) = \frac{3}{8}$. Evaluate the following;

- $P(C)$ (1 MARKS)
- $P(A' \cup C')$ (2 MARKS)
- Show that the events B and C are independent (3 MARKS)
- Two cards are drawn without replacement from ten cards which are numbered from 1 to 10. Find the probability that;

- The number on both cards are even. (3 MARKS)
- The number on one card is odd and the number on the other card is even. (2 MARKS)
- The sum of the numbers on the two cards exceed 4. (2 MARKS)

GO BACK AND CHECK YOUR WORK.

