

0765/3/2024  
P.M.M. A/L

**SOUTH WEST REGIONAL MOCK EXAMINATION  
GENERAL EDUCATION**

**THE TEACHERS' RESOURCE UNIT (TRU)**

**IN COLLABORATION WITH**

**THE REGIONAL INSPECTORATE OF PEDAGOGY FOR SCIENCE EDUCATION**

**AND**

**THE SOUTH-WEST ASSOCIATION OF MATHEMATICS TEACHERS**

**(SWAMT)**

**MONDAY AFTERNOON, 25/03/2024**

**ADVANCED LEVEL**

Subject Title	Pure Mathematics With Mechanics
Paper Number	Paper 3
Subject Code Number	0765

**Three Hours**

**INSTRUCTIONS TO CANDIDATES:**

*Answer ALL questions.*

*For your guidance, the approximate mark allocation for parts of each question is indicated in brackets.*

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

*Mathematical formulae and tables published by the CGCE Board and noiseless, non-programmable calculators are allowed.*

*In calculations, you are advised to show all the steps in your working, giving your answer at each stage.  
Where necessary, take  $g$  as  $10 \text{ ms}^{-2}$ .*

1. A particle  $P$  of mass  $5 \text{ kg}$  moves on a horizontal plane under the action of a force  $F$  at time  $t$  seconds, where  $F = (3t^2 - 2t)\mathbf{i} + (5 - 4t)\mathbf{j}$ . Given that  $P$  is initially at rest, find
- The acceleration of  $P$  at time  $t$  seconds (2 marks)
  - The velocity of  $P$  at time  $t$  seconds (4 marks)
  - The value of  $t$  at the instant when  $P$  moves parallel to vector  $\mathbf{i}$  (4 marks)

When  $t = 5$ , the particle  $P$  receives an impulse  $J \text{ N s}$ . Immediately after the impulse the velocity of  $P$  is  $(15\mathbf{i} - 10\mathbf{j}) \text{ m s}^{-1}$ . Find

- The magnitude of  $J$ , (3 marks)

2.

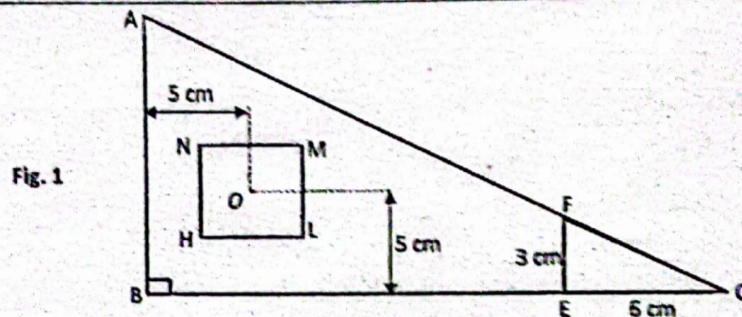


Fig. 1 shows a uniform lamina which is formed by cutting off the square  $HLMN$  of sides  $5 \text{ cm}$  with centre  $O$  and the right-angle triangle  $ECF$ , from a uniform right-angled triangular lamina  $ABC$  with side  $AB = 12 \text{ cm}$  and  $BC = 21 \text{ cm}$ . Find,

- the distance of the centre of mass,  $G$ , of the remaining lamina from sides  $AB$  and  $BC$  (10 marks)

The remaining lamina is freely suspended from  $A$  and hangs in equilibrium.

- Find the tangent of the angle which  $AB$  makes with the vertical (3 marks)

3. The end  $A$  of a uniform rod  $AB$  of mass  $m$  and length  $4a$  is freely hinged to a point on a vertical wall. A particle of mass  $m$  is attached to the rod at  $B$ . One end of a light inextensible string is attached to the rod at  $C$ , where  $AC = 3a$ . The other end of the string is attached to the wall at  $D$ , where  $AD = 2a$  and  $D$  is vertically above  $A$ . The rod rests horizontally in equilibrium in a vertical plane perpendicular to the wall and the tension in the string is  $T$ .

- Show that  $T = mg\sqrt{13}$  (5 marks)
- Find the reaction of the hinge on the rod at  $A$  (4 marks)

The particle of mass  $m$  at  $B$  is removed from the rod and replaced by a particle of mass  $M$  which is attached to the rod at  $B$ . The string breaks if the tension exceeds  $2mg\sqrt{13}$ . Given that the string does not break,

- show that  $M \leq \frac{5}{2}m$  (4 marks)

4. Particles A, B and C of masses  $4m$ ,  $3m$  and  $m$  respectively lie at rest in a straight line on a smooth horizontal plane with B between A and C. Particle A and B are projected towards each other with speeds  $u \text{ m s}^{-1}$  and  $v \text{ m s}^{-1}$  respectively and collide directly. As a result of the collision, A is brought to rest and B rebounds with speed  $kv \text{ m s}^{-1}$ . Given that the coefficient of restitution between A and B is  $\frac{3}{4}$ ,

- a) Show that  $u = 3v$ , (6 marks)  
b) find the value of the constant  $k$ . (2 marks)

Immediately after the collision between A and B, particle C is projected with speed  $2v \text{ m s}^{-1}$  towards B so that B and C subsequently collide directly. Given further that the coefficient of restitution between B and C is  $\frac{1}{3}$ ,

- c) show that there is no further collision. (5 marks)

5. A ball is projected with speed  $u \text{ m s}^{-1}$  at an angle  $\alpha$  to the horizontal from the top of a roof 4 meters above horizontal ground. Given that  $\tan \alpha = \frac{3}{4}$  and that the ball hits the ground at a point which is a horizontal distance 8 meters from its point of projection,

- a) show that  $uT = 10$ , where  $T$  is the time of flight (3 marks)  
b) find the value of  $u$ . (5 marks)

As the ball hits the ground, its direction of motion makes an angle  $\phi$  with the horizontal.

- c) Find the tangent of the acute angle  $\phi$  (5 marks)

6. (i) An elastic string AB of natural length 1.6 m has a particle of mass 4 kg attached to end B and the end A attached to a fixed point vertically above B. When the system hangs in equilibrium, the length of the string is 2 m. Calculate the work required to be done in stretching the loaded string from 2 m to a length of 2.2 m. (6 marks)

- (ii) A car of mass 1600 kg is travelling along a straight horizontal road at  $25 \text{ m s}^{-1}$ . The brakes are applied when the car approaches a toll gate. The car travels 50 m before coming to rest. Assuming the resistive forces are negligible, find,

- a) the acceleration of the car as it approaches the toll gate, (3 marks)  
b) the force applied in stopping the car, (2 marks)  
c) the work done in bringing the car to a stop. (2 marks)

7. (i) A particle of mass 1.2 kg is moving on the smooth inside surface of a fixed hollow sphere of radius 0.5 m. The particle moves in a horizontal circle whose centre is 0.3 m below the centre of the sphere.
- Find the reaction force exerted on the particle by the sphere (3 marks)
  - Find the speed of the particle (3 marks)
  - The time taken by the particle to complete one revolution (2 Marks)
- (ii) Two small blocks P and Q of mass 4 kg and 2 kg respectively, are connected by a light inelastic string. Block P lies on a rough horizontal table and the string passes over a smooth fixed pulley at the edge of the table to block Q which hangs freely. The system is released from rest. The coefficient of friction between block P and the table is  $\frac{1}{4}$ .  
Find in terms of  $g$ , the acceleration of the system and the tension in the string. (5 marks)
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8. i) If A and B are two events. Give the technical expressions that best describe the relationship between A and B when:
- $P(A/B) = 0$  (1 mark)
  - $P(A/B) = P(A)$  (1 mark)
  - $P(A \cup B) = 1$  (1 mark)
- ii) Two events E and D are such that  $P(E/D) = \frac{3}{5}$ ,  $P(D) = \frac{2}{3}$  and  $P(E/D) = P(E)$ , find the numerical values of the following probabilities
- $P(E \cup D)$  (3 marks)
  - $P[E/(E \cup D)]$  (2 marks)
- iii) A group of athletes from three divisions, Fako (F), Meme (M), and Ndian (N), in the South-West region present themselves in a hospital for an HIV screening test in preparation for FENASCO games. Of these, 23% are from Fako, 42% from Meme and the rest are from Ndian. The chances of a student being HIV positive are 0.4 for Fako, 0.2 for Meme and 0.3 for Ndian  
Find the probability that an athlete selected at random for screening is
- HIV positive (H). (3 marks)
  - The athlete is from Fako, given that a selected athlete was found to be HIV positive. (2 marks)

END.