

REPUBLIQUE DU CAMEROUN

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REPUBLIC OF CAMEROON

Peace-Work-Fatherland

MINISTRY OF SECONDARY EDUCATION

TEACHERS' RESOURCE UNIT  
REGIONAL BRANCH FOR THE NORTH WEST

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MARCH 2022

The Teachers' Resource Unit and the Regional Inspectorate of Pedagogy in collaboration with MTA	SUBJECT CODE NUMBER 0765	PAPER NUMBER 3
	SUBJECT TITLE MATHEMATICS WITH MECHANICS	
GENERAL CERTIFICATE OF EDUCATION REGIONAL MOCK EXAMINATION		
ADVANCED LEVEL		

*Iyei*  
Time Allowed: **THREE** hours  
INSTRUCTIONS TO CANDIDATES

Mobile phones are **NOT ALLOWED** in the examination room.

Full marks may be obtained for answers to **ALL** questions.

Mathematical Formulae Booklets published by The GCE Board are allowed.

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

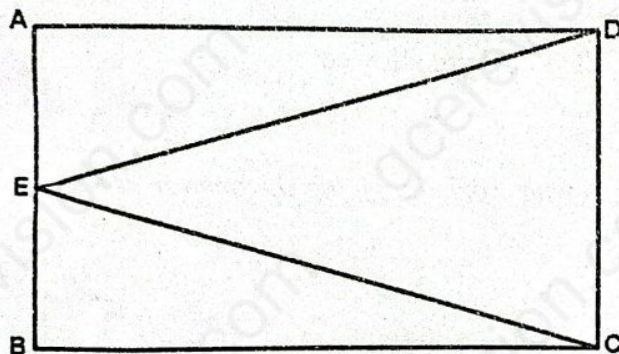
Start each question on a fresh page.

TURN OVER

1. The particles A and B have position vectors at time  $t$  seconds given by  $\vec{r}_A = t\mathbf{i} + (t^2 - 2t)\mathbf{j}$  and  $\vec{r}_B = (t - 2)\mathbf{i} + (t^2 - 6t)\mathbf{j}$  respectively.
- i) How far apart are the particles initially? (3mks)
  - ii) Show that the velocity of B relative to A is a constant (4mks)
  - iii) Deduce that if the particles have the same mass, then they produce the same force. (3mks)
  - iv) Show that the path of the particles is parabolic (3mks)

2. A particle A is projected vertically upwards from a point O with speed  $30\text{ m/s}$ . Calculate
- (i) the time it takes to attain maximum height above O (2mks)
  - (ii) the maximum height above O it attains (2mks)
- Five (5) seconds after A was projected from O, another particle B was dropped from O;
- (iii) calculate the height,  $h$  above O at which A was, and its speed, just before B was dropped (3mks)
  - (iv) show that the particles collide  $\frac{5}{4}\text{ s}$  after B was dropped. (4mks)
- Hence or otherwise, show that the particles collide at a depth  $d = \frac{25}{4}\text{ m}$  below O. (2mks)
- $(g = 10\text{ m/s}^2)$

3. (a) The figure below represents a uniform rectangular plate ABCD of length  $12a$  and width  $10a$ . A portion of the plate in the shape of an isosceles triangle DEC, with  $DE = EC = 13a$  is cut out and removed.



Find the distance of the centre of mass from the side AB. (7mks)

- (b) A car of mass  $1200\text{ kg}$  moves up a slope inclined  $\sin^{-1}(\frac{1}{20})$  to the horizontal. The non-gravitational resistance to the motion is  $800\text{ N}$ . Find the power developed by the engine, at the instant the car has a velocity of  $15\text{ m/s}$  and an acceleration of  $\frac{1}{5}\text{ m/s}^2$  (6mks)
- $(g = 10\text{ m/s}^2)$

4. (a) The forces  $F_1 = pi + qj$  and  $F_2 = 2qi - pj$ , both act through the point with position vector  $r_1 = 2i + j$ , while the force  $F_3 = -5i + 2qj$  acts through  $r_2 = -i + 2j$ .

Given that the system of the three forces reduces to a couple, find the values of  $p$  and  $q$ . Hence find the magnitude and direction of the moment of the couple about an axis through the origin  $O$ .

(7mks)

- (b) A uniform ladder  $AB$  of weight  $W$  and length  $2a$ , rests with its upper end  $A$  against a smooth vertical wall and the end  $B$  on rough horizontal ground. The coefficient of friction between the ladder and the ground is  $\frac{2}{5}$ . A human of weight four (4) times that of the ladder climbs up the ladder. When the human is  $\frac{3}{2}a$  up, the ladder begins to slip. Given that the angle the ladder makes with the ground at this instant is  $\theta$ ; show that  $8 \tan \theta = 13$

(6mks)

5. Two (2) smooth spheres  $A$  and  $B$  of masses  $2m$  kg and  $3m$  kg respectively, lie at rest on a smooth horizontal floor, in a line perpendicular to a wall, with  $B$  nearer the wall than  $A$ . The sphere  $A$  is projected with speed  $u$  m/s to strike  $B$  directly. Given that the coefficient of restitution between the spheres is  $e$ , show that the velocity of  $A$  after the collision is  $v_A = \frac{1}{5}(2 - 3e)u$

(4mks)

The sphere  $B$  goes on to strike the wall, rebound from it to collide with  $A$  again. Given that, the coefficient of restitution between  $B$  and the wall is also  $e$  and that  $B$  is brought to rest by its second impact with  $A$ , show that  $e^2 - 3e + 1 = 0$ .

(9mks)

6. Two particles  $P$  and  $Q$  are respectively of mass  $3$  kg and  $5$  kg. They are connected by a light inextensible string, passing over a smooth fixed pulley  $O$ . The system is released from rest with the string taut and both particles at a height of  $\frac{5}{4}$  m above the horizontal ground. In the ensuing motion,  $Q$  hits the ground and does not rebound. Find:

i) The tension  $T$  in the string, and the speed  $v$  with which  $Q$  strikes the ground. (7mks)

ii) The further distance moved up by  $P$ , when the portion  $OQ$  of the string is slack (3mks)

iii) The total distance covered by  $P$  before the portion of the string  $OP$ , gets taut again. (3mks)

$$(g = 10\text{m/s}^2)$$

7. A particle is projected with speed  $u$  at an angle  $\alpha$  to the horizontal in a plane in which the acceleration due to gravity is  $g$ . Deduce that the equation of the path of its flight is

$$y = x \tan \alpha - \frac{gx^2 \sec^2 \alpha}{2u^2} \quad (3\text{mks})$$

Given that the particle has a horizontal range of  $\frac{3u^2}{5g}$ , show that  $3 \tan^2 \alpha - 10 \tan \alpha + 3 = 0$ . (3mks)

(i) Hence show that there are two possible angles of projection (2mks)

(ii) Also show that the difference in maximum heights attained with the two angles of projection is

$$\frac{2u^2}{5g} \quad (3\text{mk})$$

(iii) Find, for the smaller angle of projection, the time at which the particle is travelling horizontally. (2mks)

8. (a)  $X$  and  $Y$  are non-independent events. Given that  $p(X) = \frac{2}{5}$ ,  $p(X/Y) = \frac{3}{8}$  and  $p(Y/X) = \frac{1}{2}$ ,

find

a)  $p(X \cap Y)$

(2mks)

b)  $p(Y)$

(2mks)

c)  $p(\bar{X} \cap \bar{Y})$

(3mks)

(b) Ten (10) cards are cut from a piece of cardboard. The cards are numbered 1,2,3,...,10. Two (2) cards are then drawn at random; one after the other, without replacement, from the ten (10) identical cards, and the sum of their ordinal numbers is calculated.

Find the probability of obtaining a sum, which is odd.

(6mks)

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