

Pure Math With Mechanics 3

0765

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2020

ADVANCED LEVEL

Subject Title	Pure Mathematics with Mechanics
Paper No.	Paper 3
Subject Code No.	0765

GCE REVISION

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 booklets published by Board are allowed.

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

Calculators are allowed.

Start each question on a fresh page.

<http://www.gcerevision.com>

Turn Over

1. The position vector \mathbf{r} of a particle of mass 2 kg at time t seconds is given by

$$\mathbf{r} = [(2 \sin 2t) \mathbf{i} + (1 - \cos 2t) \mathbf{j}] \text{ m.}$$

Find

- (a) the velocity and the acceleration of the particle when $t = \frac{\pi}{6}$, (6 marks)
 (b) the kinetic energy of the particle when $t = \frac{\pi}{6}$, (2 marks)
 (c) the force acting on the particle when $t = \frac{\pi}{6}$, (2 marks)
 (d) the values of t where $0 \leq t \leq \frac{\pi}{2}$ for which the velocity of the particle is perpendicular to its acceleration. (3 marks)

2. (a) A force \mathbf{F}_1 , of magnitude $12\sqrt{5}$ N, acts at the point (1, 7) towards the point (7, 10). Another force, \mathbf{F}_2 acts at the point (1, 4). Given that \mathbf{F}_1 and \mathbf{F}_2 form a couple. Find the cartesian equation of the line of action of \mathbf{F}_2 and the magnitude of the couple. (8 marks)
 (b) An elastic string AB of natural length 2 m has the end A fixed. A load of mass 4 kg is attached to the other end B so that the system hangs freely in equilibrium. Find the work that must be done to extend the unloaded string from a length of 2.5 m to 2.9 m. (5 marks)

(Take g as 10 m s^{-2})

3. A particle is projected from a point O on horizontal plane with speed u at an angle α to the plane. The particle just clears two vertical walls, each of height h , and at horizontal distances $2h$ and $4h$ from O .

Show that

- (a) $4 \tan \alpha = 3$, (7 marks)
 (b) $2u^2 = 12h$, (3 marks)
 (c) the maximum height $H = \frac{9}{8}h$. (3 marks)

(Take g as 10 m s^{-2}).

4. The foot of a uniform ladder, of length $2a$ and weight W , rests on rough horizontal ground and the top of the ladder rests against a smooth vertical wall. The ladder makes an angle of 60° with the horizontal. A man of weight $4W$ climbs up the ladder. Given that the ladder begins to slip when the man has climbed two-thirds of the way up the ladder, find

- (a) the coefficient of friction between the ladder and the ground, (7 marks)
 (b) how far a boy of weight $2W$ can climb up the ladder before it slips. (6 marks)

5. Two spheres A and B of the same radius and of masses $3m$ and m respectively lie at rest on a smooth horizontal floor in a line perpendicular to a vertical wall with B nearer to the wall. Sphere A is projected with speed u and collides directly with B . B then moves to strike the wall directly and after rebounding from the wall, it collides directly again with A . The coefficients of restitution between the spheres is $\frac{1}{3}$ and between B and the wall is $\frac{1}{2}$. Find the loss in kinetic energy due to the impacts.

(13 marks)

6. A particle moves in a straight line with uniformly accelerated motion. From the initial point, the particle covers a distance of 4 m in 1 s, and a distance of 18 m in 3 s.

Find

- (a) the initial speed and the acceleration of the particle, (7 marks)
 (b) the speed of the particle after 5 s, (3 marks)
 (c) the speed of the particle when it is 10 m away from its initial point. (3 marks)

7. (i) A particle of mass 3kg is attached to the centre of a smooth table by a light inextensible string. If the particle is moving in a horizontal circle with speed $2\sqrt{2}$ m/s and the string is 2 m long. Find
- (a) the angular speed, (2 marks)
 - (b) the tension in the string. (2 marks)
- (ii) A wheel of radius 0.5 m completes 6 revolutions in 3 seconds while rotating with a constant speed. Find
- (c) its angular speed in rad/s, (4 marks)
 - (d) its acceleration. (2 marks)
- (iii) An elastic string of natural length 0.4m and modulus of elasticity 16N is stretched until the tension in it is 9N. Calculate the extension in the string. (3 marks)
-

8. Two bags *A* and *B* each contains 6 balls. Bag *A* contains 4 red balls and 2 white balls. Bag *B* contains 3 red balls and 3 white balls. A die is thrown. If the score on the die is greater than 4, bag *A* is chosen otherwise, bag *B* is chosen. Two balls are drawn from the chosen bag, one after the other, without replacement. Using a tree diagram, calculate the probability that
- (a) one ball of each color is drawn, (6 marks)
 - (b) no red ball is drawn, (2 marks)
 - (c) at most one white ball is drawn. (2 marks)
- Given that two white balls are drawn, calculate the probability that they came from bag *A*. (3 marks)
-