

Pure Math With Mechs 3
0765

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2017

ADVANCED LEVEL

Subject Title	Pure Mathematics with Mechanics
Paper No.	3
Subject Code No.	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 Board are allowed.

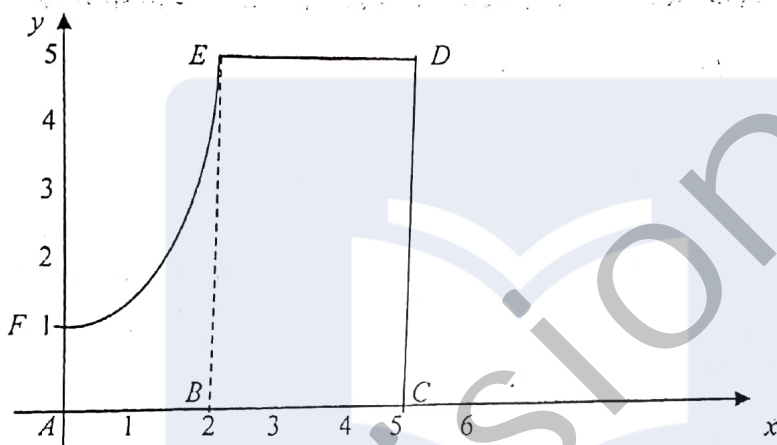
In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

Calculators are allowed.

Start each question on a fresh page.

1. (i) The position vectors of two particles A and B at time t seconds are \mathbf{r}_A and \mathbf{r}_B , where
 $\mathbf{r}_A = [(t^2 + 1)\mathbf{i} + t^3\mathbf{j} - 6t\mathbf{k}]$ m,
 $\mathbf{r}_B = [(t + 1)^2\mathbf{i} + 2(t + 1)\mathbf{j} - 2t(t + 2)\mathbf{k}]$ m respectively.
- (a) Find the velocity of A relative to B when $t = 2$.
- (b) Show that B travels in a straight line.
- (ii) Forces $\mathbf{F}_1 = (-\mathbf{i} + 3\mathbf{j} + \mathbf{k})$ N and $\mathbf{F}_2 = (2\mathbf{i} + 4\mathbf{j} - 4\mathbf{k})$ N act through the points with position vectors $\mathbf{r}_1 = (3\mathbf{i} - 3\mathbf{j} - 3\mathbf{k})$ m and $\mathbf{r}_2 = (3\mathbf{i} + 2\mathbf{j} - 4\mathbf{k})$ m, respectively. Show that these forces are concurrent at a point and find the position vector of the point.

2.



In figure above EF is a portion of the curve of $y = x^2 + 1$ and $BCDE$ is a rectangle in which $BC = 3$ cm, and $CD = 5$ cm. Find the coordinates of the centroid of the lamina $ABCDEF$.

- 3 A particle P , of mass 3 kg, rests on a rough plane inclined at 30° to the horizontal. The coefficient of friction between the plane and the particle is $\frac{1}{\sqrt{3}}$. P is connected to a second particle Q , of mass 4 kg, by a light inextensible string passing over a fixed smooth pulley at the top of the plane and hangs freely. The system is released from rest with the string taut and Q hanging vertically. Find the acceleration of the system and the tension in the string.

After travelling 3 m, the particle Q hits a horizontal plane but does not rebound. Find the further distance travelled by P before first coming to rest.

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

4. (i) The engine of a train, of mass 250,000 kg, works at a constant rate of 40 kW. The train travels along a straight level track against a constant resistance of 15000 N to the motion of the train. Find

- (a) the maximum speed of the train on level track,
 (b) the maximum speed of the train up a slope inclined at $\sin^{-1}\left(\frac{1}{125}\right)$ to the horizontal.

- (ii) A particle, of mass m kg, is attached to a light inextensible string of length 0.9 m whose other end is fixed at a point O . The particle is rotating in a horizontal circle with centre A vertically below O . If the string makes an angle of 60° with the vertical, find the angular speed of the particle and the time taken by the particle to make one revolution.

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

5. Three spheres A , B and C , of equal radii and of masses $3m$, $2m$ and m respectively, lie on a smooth horizontal table with B between A and C and their centres in straight line. The coefficient of restitution between each pair of spheres is $\frac{1}{2}$. A is projected with speed 20 ms^{-1} to collide with B directly and B subsequently collides with C directly.
- Find the speed of each sphere after each collision,
 - Prove that there will be only two collisions.

6. A particle is projected from O with speed 30 ms^{-1} at an angle θ to the horizontal. The particle just clears a vertical fence $\frac{40}{3} \text{ m}$ high and a horizontal distance $5\sqrt{3} \text{ m}$ from O .
- Find the values of $\tan \theta$.
 - Using the smaller value of θ , find the speed of the particle when it is just passing over the fence.
 - Find the range of the particle.
 - Find the time taken to cover the range.

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

7. A particle is moving in a straight line with uniform acceleration f and passes through a point A , with speed u . Three seconds later another particle moving in the same straight line with constant acceleration $\frac{4}{3}f$ passes through the same point A with speed $\frac{1}{3}u$. The second particle bypasses the first particle when their speeds are 31 ms^{-1} and 27 ms^{-1} respectively.
- Find
- the values of f and u .
 - the distance travelled from the point A and the time taken to the point where the second particle bypassed the first particle.

- 8 (i) A bag contains 3 white balls and 5 black balls. An experiment consists of drawing three balls from the bag, one after the other and without replacement. Draw a tree diagram illustrating all the possible outcomes. Hence, or otherwise, find the probability that
- no white ball is drawn,
 - at least one white ball is drawn,
 - at least one black ball is drawn given that at least one white ball is drawn.
- (ii) The events A and B are such that $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{5}$, $P(A|B) = \frac{1}{3}$.
- Find $P(B)$ and $P(A \cap B)$.
- Show that A and B are not independent events.