Pure Maths With Mechs 3
0765

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2018 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 Board is 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 new page.

1. (i) A force F, where $\mathbf{F} = (6\mathbf{i} - 36t^2\mathbf{j} + 54t\,\mathbf{k})$ N, acts at time t seconds on a particule P of mass 3 kg. Initially, the particle is moving with velocity $(3\mathbf{i} + 3\mathbf{j})$ m s^{-1}.
Find,
(a) the acceleration of P at time t, **(2 marks)**
(b) the velocity of P at time t. **(5 marks)**

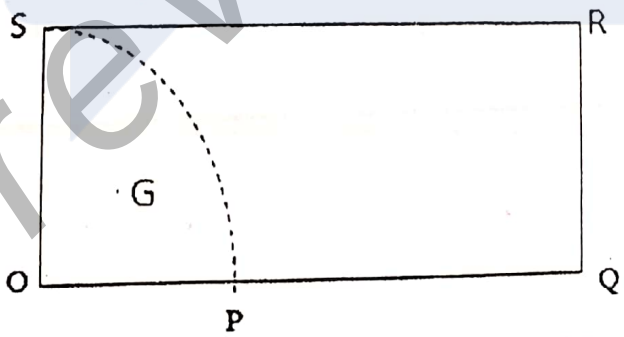
Calculate, when $t = 2$,
(c) the kinetic energy of P, **(2 marks)**
(d) the work done by the force to move P in the interval $1 \leq t \leq 2$. **(4 marks)**

2. Two smooth spheres A and B with respective masses m and $2m$ and of equal radii rest on a smooth horizontal plane. A is projected towards B with speed u to collide directly with B. Given that the coefficient of restitution between A and B is e and that the speed of B after this is $\frac{4u}{9}$, find:
(a) the value of e and the velocity of A after impact, **(6 marks)**
(b) the magnitude of impulse exerted by A on B, **(3 marks)**
(c) the percentage loss in kinetic energy during this impact. **(5 marks)**

3. (i) A particle of mass m kg lies on a smooth plane inclined at an angle of 30° to the horizontal. The particle is attached to a light inextensible string which passes over a smooth pulley fixed at the top of the plane. Another particle of mass $3m$ kg is attached to the other end of the string and hangs freely.
The system is released from rest with the string taut and the hanging part vertical. Find, in terms of m and g,
(a) the acceleration of the system and the tension in the string, **(5 marks)**
(b) the magnitude of the reaction force exerted by the string on the pulley. **(2 marks)**

(ii) One end of a light inextensible string is fixed at a point A and a particle of mass m kg is attached to the other end B. When the particle moves in a horizontal circle of radius r below A with constant speed v m s^{-1}, the string is inclined at an angle θ to the downward vertical.
Show that $v^2 = gr \tan\theta$. **(5 marks)**

4.



The figure above shows a uniform rectangular lamina $OQRS$, where $OQ = 4a$ and $QR = a$. A sector OPS of radius a and centre O is removed from the lamina. Given that the centre of gravity G of the sector OPS is at a distance $\frac{175}{3\pi}$ from both OQ and OS. Find the distances of the centre of gravity of the remaining lamina $PQRS$ from OS and from OQ. **(13 marks)**

5. A uniform ladder AB of weight W and length $2l$ rests with the end A against a smooth vertical wall and the end B on a rough horizontal ground. A man of weight equal to that of the ladder stands at the point C on the ladder, where $BC = \frac{5}{3}l$. The coefficient of friction between the ladder and the ground is $\frac{1}{3}$. Given that the ladder is in limiting equilibrium when it makes an angle θ to the horizontal,
(a) show that $\tan\theta = 2$. **(8 marks)**
(b) find the magnitude of the reaction force at the wall and on the ground. **(5 marks)**

6. A particle P is projected with speed 50 m s^{-1} at an angle α to the horizontal from a point O on a horizontal plane. Given that the particle attains a maximum height of 31.25 m, calculate

(a) the value of α, **(2 marks)**

(b) the speed of P after 3 seconds, **(5 marks)**

(c) the horizontal distance travelled by P while above the height of 30 m. **(5 marks)**

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

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7. A car is towing a carriage along a straight horizontal road by means of a tow-bar. The mass of the car is 1400 kg and the mass of the carriage is 700 kg. The non-gravitational resistances to the motion of the car and the carriage are 630 N and 280 N respectively.

Given that when the car and the carriage are moving at 6 m s^{-1}, the engine is working at 14.28 kW, find

(a) the acceleration of the car, **(4 marks)**

(b) the tension in the tow-bar. **(2 marks)**

When the car and the carriage are moving at 12 m s^{-1}, the tow-bar suddenly disconnects. Assuming that the power of the engine and the resistances are unchanged, find

(c) the new accelation of the car, **(3 marks)**

(d) the time taken by the carriage to come to rest. **(4 marks)**

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

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8. (i) Two events A and B are such that $P(A) = \frac{3}{5}$, $P(B) = \frac{1}{4}$ and $P(A \cup B) = \frac{3}{4}$. Find

(a) $P(A \cap B)$ **(3 marks)**

(b) $P(A|B)$ **(3 marks)**

(ii) Show that A and B are neither mutually exclusive nor independent. **(2 marks)**

(iii) The probability that a vaccinated person (V) contracts a disease is $\frac{1}{20}$. For a person not vaccinated (V '), the probability of contracting the disease (D) is $\frac{5}{6}$. In a certain town 90% of the population has been vaccinated against the disease. A person is selected at random from the town, find the probability that

(a) he has the disease, **(3 marks)**

(b) he is vaccinated or he has the disease. **(2 marks)**
