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Advanced Level Further Mathematics
Paper Three

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i) The coordinates of the point *K*. *L* and M are (3,0) ,(9, 0) and (9. 9) respectively and *LOMN*, where *O* is the origin, is a uniform square. Find the x-coordnate of the centre of the centre of gravity of the lamina bounded by *KL*, *L*M, *MN* and the arc *NK* of the curve $y=9-x^2$.

ii) A particle moves at constant speed on the smooth inner surface of a fixed spherical bowl of radius 2m. The particle describes a horizontal circle at a distance 6/5 m below the centre of the bowl. Find the speed of the particle as it describes the horizontal circle. (Take g as $10ms^2$.)

2. i) The distance between two towns A and B is 8 km. A car passes through town A at a speed of $10ms^{-1}$ with a uniform acceleration of magnitude of *X* ms'^2. It maintains this acceleration until it attains a speed of $30ms'^1$. It then travels at this speed for some time and then decelerates uniformly at 3» ms^2 reaching B at a speed of $10ms'^1$. Find
   a) the value of X,
   b) the distance travelled at $30ms'^1$.

(ii) A particle moves in a straight line with an acceleration of magnitude **4/1+V MS^{-1}** where

v ms^1 is the speed of the particle when it has covered a distance of xm. Find the distance covered from rest by the particle before it attains the speed of $2ms^1$.

3. A block P of mass 80kg rests on a smooth horizontal table and is attached by light inelastic strings to blocks Q and R of mass 10kg and 70kg respectively. The strings pass over light smooth pulleys on opposite edges of the table so that Q and R hang freely. The system is released from rest. Determine
   b) the magnitude of the acceleration of the system,
   c) the tension T_1 and T, acting on block P.

Block R falls a distance of 2m and is brought to rest. Given that P remains on the table and that the string joining Q to P is long enough that Q cannot be stopped by the edge of the table, calculate the further distance that Q covers vertically upwards before momentarily coming to rest. (Take g as $lOms^{-2}$.)

4. A small sphere A, of mass 2m kg moving on a smooth horizontal floor with speed u ms^1, strikes directly another sphere B, of mass m kg, initially at rest on the floor. Given that the coefficient of restitution between A and B is 0.25, and that the impact lasts for 0.2 second, find in terms of u the speeds of A and B after impact. Also determine in terms of m and u
   the magnitude of the impulse of the impact on A,
   the magnitude of the force exerted on B by the impact,
   the kinetic energy lost in the impact. [1]

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5.

A particle is projected with speed $70ms^1$ from a point O. It hits a target 480m away on the horizontal **plane through its point of projection. Determine α and β the two possible angles** of projection.

Given that T_1 and T_2 are the times of flight for the angles of projection a and p respectively, find the ratio

$T_1:T_2$,

$H_1:H_2$. where H_1 and H_2 are the maximum heights attained corresponding to the angles of projection **α** and **β** respectively.

(Take g as 9.8 ms^{-2}.)

(a) A uniform ladder, of length 31 and weight W, rests against *A* smooth vertical wall. The foot of the ladder rests on a rough horizontal floor, so that ladder makes an angle $\tan^{-1}4$ with the horizontal floor. Given that the ladder is in the verti.es; plane which is perpendicular to the wall, find the least possible value of μ, the coefficient of friction between the floor and the ladder, if the ladder is in equilibrium.

Given that the coefficient of friction between the ladder and the ground is 2/15 .find

how far up from the up from the foot of the ladder a person, of weight W, can climb without the ladder supping.

sin −1 3/5

7. i) A car, of mass 1500kg. starts from rest and climbs up a road inclined at an angle to the horizontal. With an acceleration of 3/10 ms^{-1} The coefficient of friction between the

road and the tyres of the ear is ¼ Calculate the tractive force of the engine. Find also, the

rate at which the engine of the car is working 5 seconds from the start of motion.

A pump working at me rate of 8.04 kW, raises 1800kg of water per minute from a depth of 25m. Determine the speed at which the water is delivered. (Take g as $10ms^{-2}$)

(a) In a certain town there axe 1- ' handicapped citizens, 900 of whom are blind while 600 are dumb. It is known that 5^0 c of those who are blind but not dumb, 75% of those who are dumb but not blind and 85% oi those who are both dumb and blind, have the AIDS-Virus. A handicapped citizen is selected at random. Find the probability that the citizen

has the AIDS-Virus.

is blind given that he has the AIDS-Virus,

(e) is either blind or has the AIDS-Virus.

8. is dumb given that he does not have the AIDS-Virus.