Ref. No. : Ex/EE/AM/ME/T/1A/2019 (Old)

B.E. ELECTRICAL ENGINEERING FIRST YEAR FIRST SEMESTER (Old) - 2019

ENGINEERING MECHANICS

Full Marks 100 Duration 3 Hrs

Answer any five questions. Assume suitable values for any missing data. Parts of a question has equal distribution of marks.

1. Answer the following questions-
   a. Determine the moment of the 2kN force about point *O*.
   b. The horizontal motion of the plunger and shaft is arrested by the resistance of the attached disk which moves through the oil bath. If the velocity of the plunger is v_0 in the position A where $x = 0$ and $t = 0$, and if the deceleration is proportional to v so that $a = -kv$, derive expressions for the velocity v and position coordinate x in terms of the time t. Also express v in terms of x.

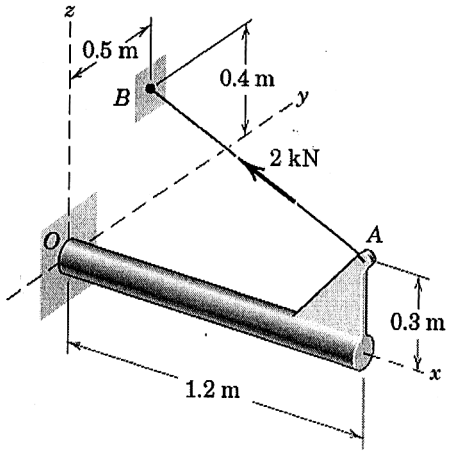

Fig 1a.

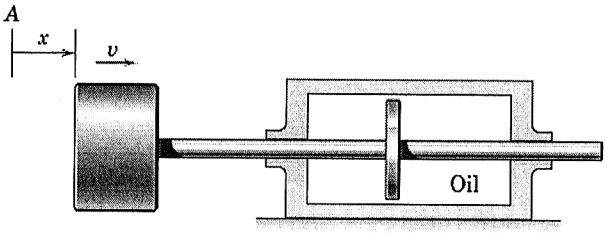

Fig 1b.

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2. Calculate the x and y components of the reaction forces in each component of the frame structure.

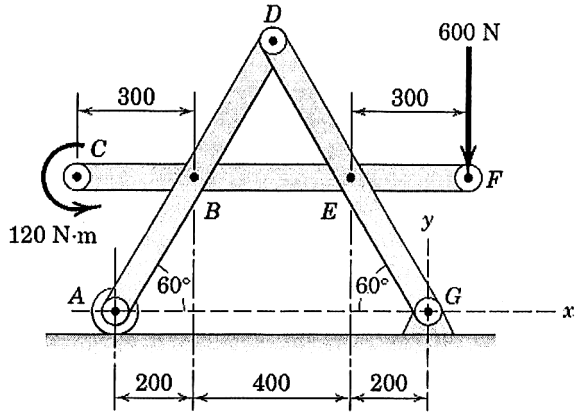

Fig 2.

3. The body is constructed of uniform slender rod which has mass $\rho = 10\text{kg/m}$ per unit length. Determine the magnitudes of the force and moment reactions at the fixed support O. Given $a = 0.75$ m.

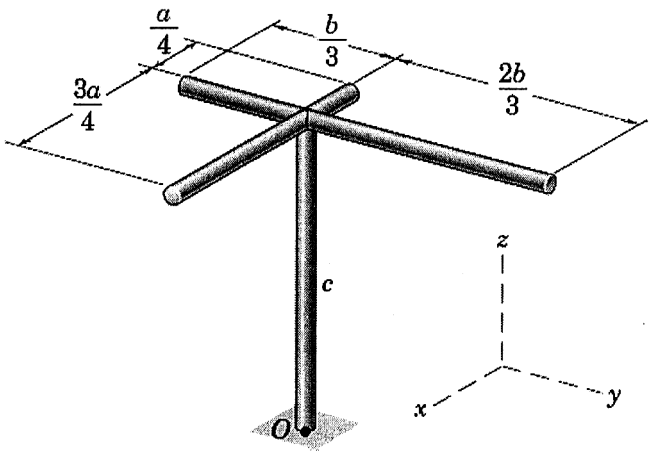

Fig 3.

4. Find the following properties of the shaded area showing all the derivations.

   a. Area moment of inertia about y axis, I_{yy}.

   b. Volume of revolution about x axis.

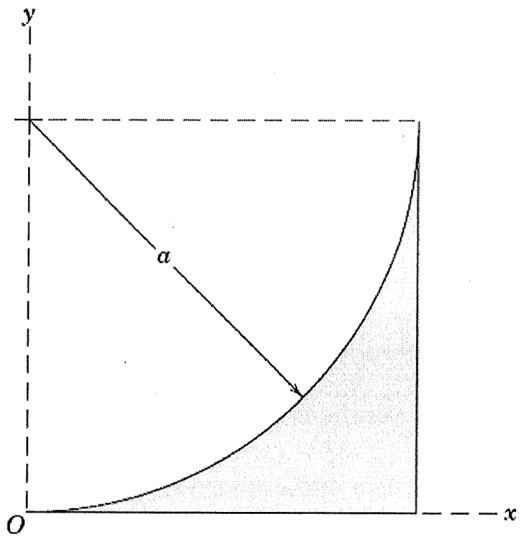

Fig 4.

5. Answer the following questions-

   a. The pilot of an airplane carrying a package of mail to a remote outpost wishes to release the package at the right moment to hit the recovery location A. What angle θ with the horizontal should the pilot's line of sight to the target make at the instant of release? The airplane is flying horizontally at an altitude of 100 m with a velocity of 200 km/h.

   b. The 30-Mg aircraft is climbing at the angle $\theta = 15°$ under a jet thrust T of 180 kN. At the instant represented, its speed is 300 km/h and is increasing at the rate of 1.96 m/s^2. Also θ is decreasing as the aircraft begins to level off. If the radius of curvature of the path at this instant is 20 km, compute the aerodynamic forces **normal** to and **opposite** to the flight direction.

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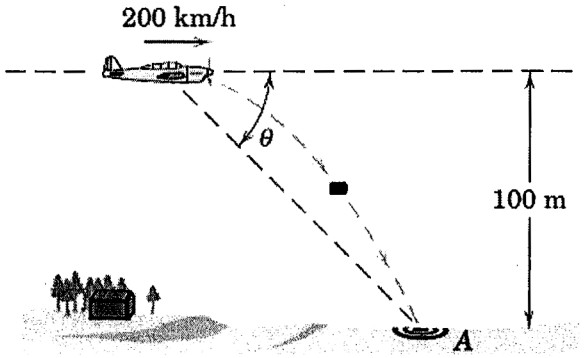

Fig 5a.

Fig 5b.

6. Answer the following questions-

   a. The 2-kg collar is released from rest at A and slides down the inclined fixed rod in the vertical plane. The coefficient of kinetic friction is 0.40. Calculate (a) the velocity v of the collar as it strikes the spring and (b) the maximum deflection x of the spring.

   b. If the coefficients of static and kinetic friction between the 20-kg block A and the 100-kg cart B are both essentially the same value of 0.50, determine the acceleration of each part for (a) $P = 40$ N and (b) $P = 60$ N.

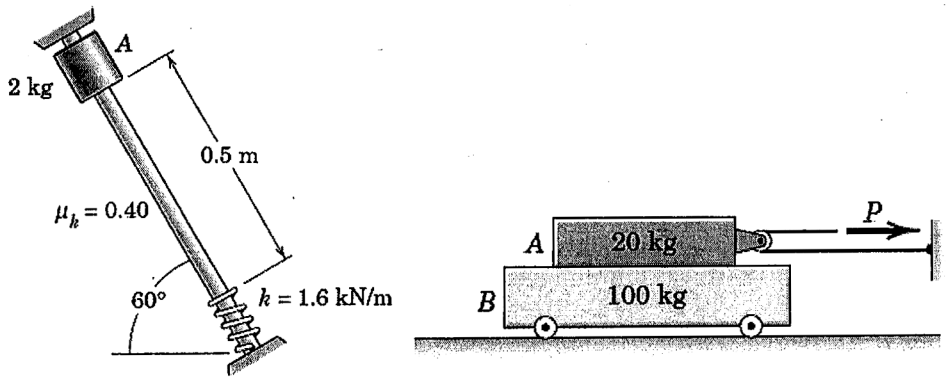

Fig 6a.

7. Write short notes on the following with derivation-

   a. Principal of impulse and momentum method.

b. Parallel axis theorem of area moment of inertia.

c. Velocity and acceleration of a particle in a curvilinear motion using polar $(r - \theta)$ coordinate system.

d. Moment of a couple is a free vector.