Total No. of Questions—**6**] [Total No. of Printed Pages—**8+3**

Seat No.	

[4956]-111

F.E. (Common) EXAMINATION, 2016
ENGINEERING MECHANICS
(2012 PATTERN)

Time : Two Hours **Maximum Marks : 50**

N.B. **:—** (*i*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4** and Q. No. **5** *or* Q. No. **6**.
(*ii*) Neat diagram must be drawn wherever necessary.
(*iii*) Figures to the right indicate full marks.
(*iv*) Assume suitable data, if necessary and clearly state.
(*v*) Use of cell phone is prohibited in the examination hall.
(*vi*) Use of electronic pocket calculator is allowed.

1. (*a*) The post is to be pulled out of the ground using two ropes A and B as shown in Fig. 1 (*a*). Rope A is subjected to a force of 600 N and is directed at 60° from the horizontal. If the resultant force acting on the post is be 1200 N vertically upward, determine the force T in rope B and the corresponding angle θ. [4]

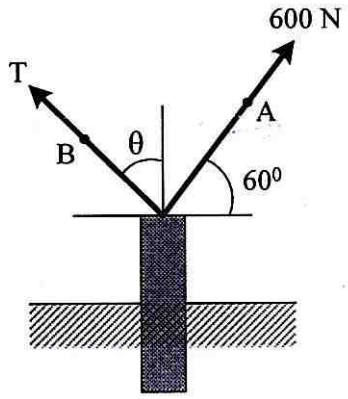

Fig. 1 (*a*)

P.T.O.

(*b*) If a block A of the pulley system is moving downward at 2 m/s while block C is moving down at 6 m/s, determine the relative velocity of block B with respect to C. Refer Fig. 1 (*b*). [4]

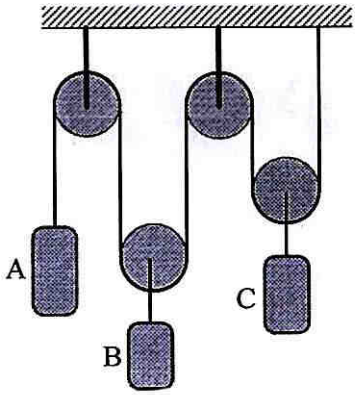

Fig. 1 (*b*)

(*c*) Water flows from a drain spout with an initial velocity of 0.75 m/s at an angle of 75° with the vertical as shown in Fig. 1(*c*). Determine the range of values of the distance *d* for which the water will enter the trough BC. [4]

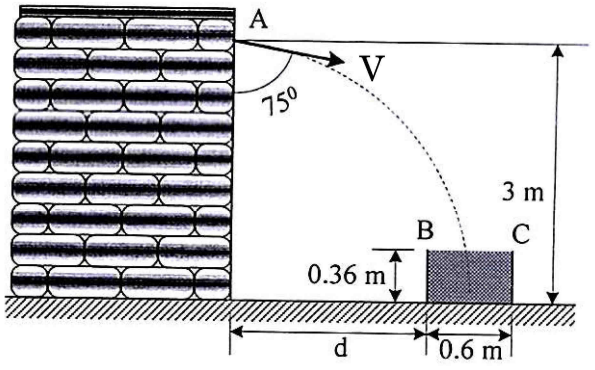

Fig. 1 (*c*)

(*d*) Block A has a weight of 300 N and block B has a weight of 50 N. Determine the speed of block A after it moves 1.5 m above the plane, starting from rest by work energy principle. Neglect the friction and mass of the pulleys. Refer Fig. 1 (*d*). [4]

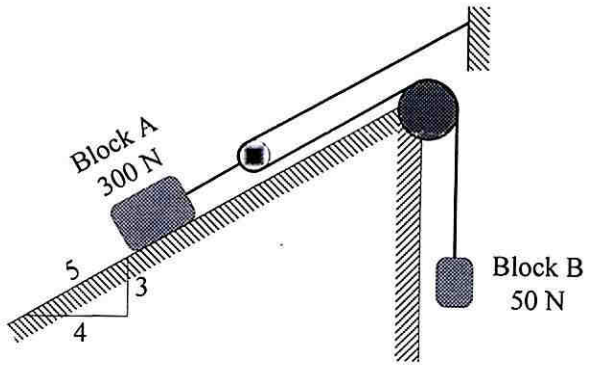

Fig. 1 (*d*)

Or

2. (*a*) A slender rod is welded into the shape as shown in Fig. 2(*a*) Locate the position of centroid of the rod with respect to origin O if AO = BO = CO = 50 mm : [4]

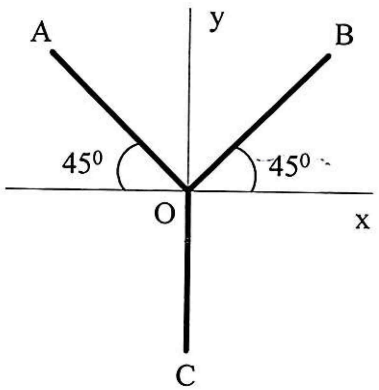

Fig. 2(*a*)

(*b*) Block B rest on smooth surface. If the coefficient of static and kinetic friction between A and B are μ_s = 0.4 and μ_k = 0.3 respectively, determine the acceleration of each block if a block A is push with a force F :

(*a*) 30 N

(*b*) 250 N. Refer Fig. 2 (*b*) [4]

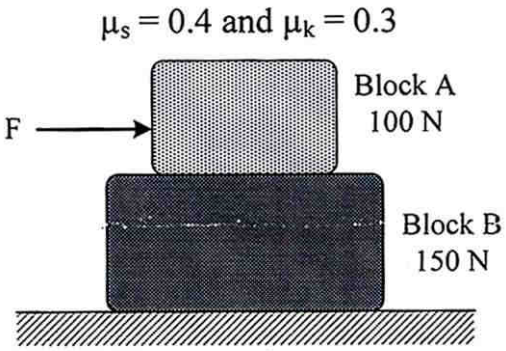

Fig. 2 (*b*)

(*c*) The man has a mass of 80 kg and sits 3 m from the center of the rotating platform. Due to the rotation his speed is increased from rest by 0.4 m/s^2. If the coefficient of static friction between his clothes and the platform is, μ_s = 0.3, determine the time required to cause him to slip. Refer Fig. 2 (*c*). [4]

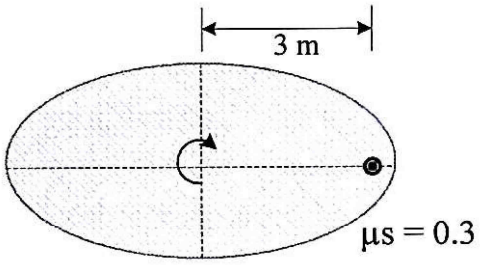

Fig. 2 (*c*)

(*d*) Each of the cable can sustain a maximum tension of 25 kN. If the uniform beam has a weight of 25 kN, determine the shortest time possible to lift the beam with a speed of 3 m/s starting from rest by impulse momentum principle. Refer Fig. 2 (*d*). [4]

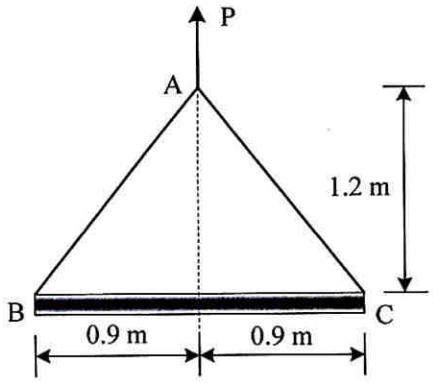

Fig. 2 (*d*)

3. (*a*) The boom is intended to support two vertical loads, F_1 and F_2 as shown in Fig. 3 (*a*). If the cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads F_1 and F_2 if $F_1 = 2F_2$. Also determine the reaction at A : [6]

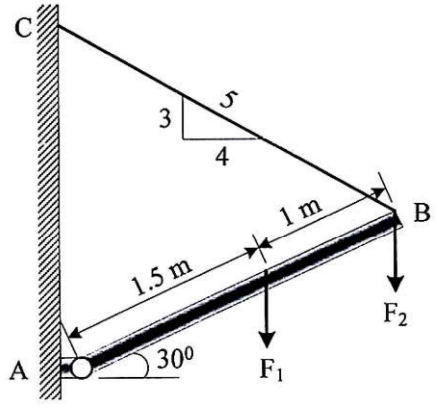

Fig. 3 (*a*)

(*b*) Three parallel bolting forces act on the rim of the circular cover plate as shown in Fig. 3 (*b*). Determine the magnitude, nature and point of application of the resultant force with respect to origin O. [6]

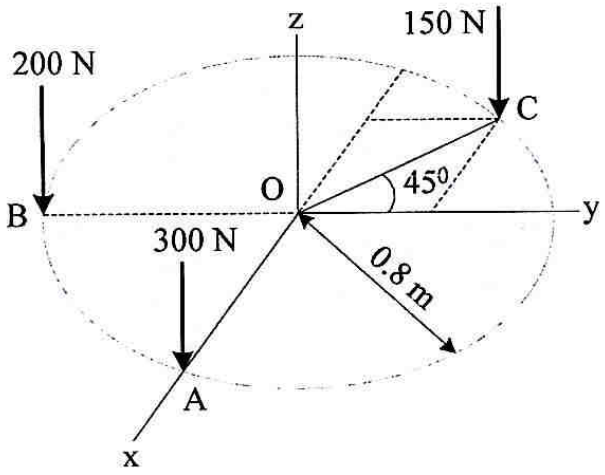

Fig. 3 (*b*)

(*c*) Determine reaction at A and B for the beam loaded and supported as shown in Fig. 3 (*c*). [5]

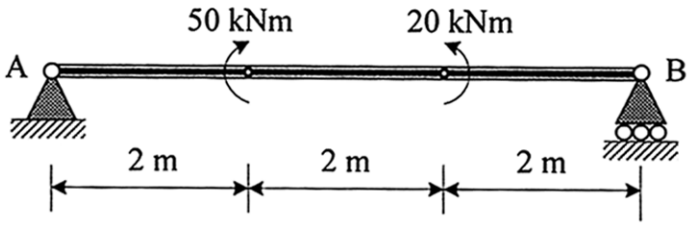

Fig. 3 (*c*)

Or

4. (*a*) The 30 kg pipe is supported at A by a system of five cords as shown in Fig. 4 (*a*). Determine the force in each cord for equilibrium. [6]

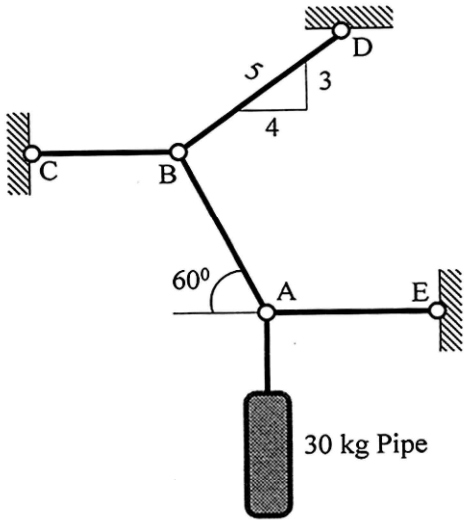

Fig. (*a*)

(*b*) A 90 N load is suspended from the hook shown in Fig. 4 (*b*). The load is supported by two cables and a spring having stiffness k = 500 N/m. Determine the force in the cables and the stretch of the spring for equilibrium. Cable AD lies in the *x-y* plane and cable AC lies in the *x-z* plane :

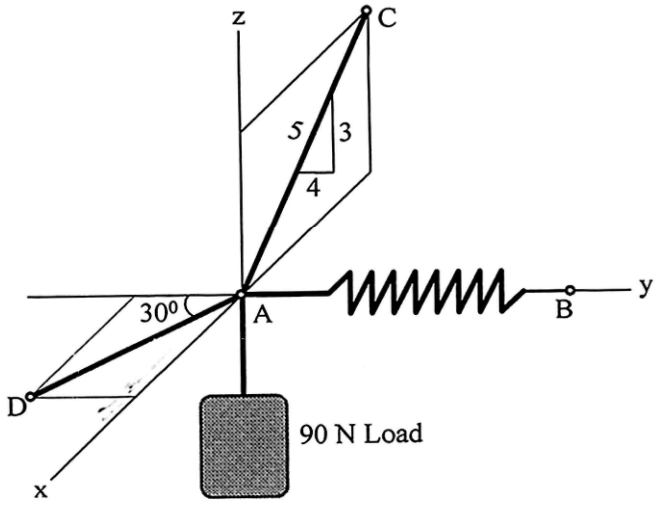

Fig. (*b*)

(*c*) A simply supported beam loaded and supported is as shown in Fig. 4 (*c*). If the reactions at supports are equal in magnitude, determine the overhang **a**. [5]

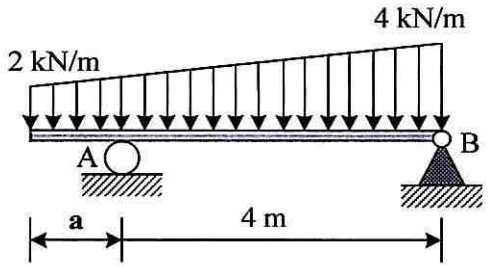

Fig. 4 (*c*)

5. (*a*) A uniform hoop of weight W is suspended from the peg at A and a horizontal force P is slowly applied at B as shown in Fig. 5 (*a*). If the hoop begins to slip at A when $\theta = 30°$, determine the coefficient of static friction between the hoop and the peg. [6]

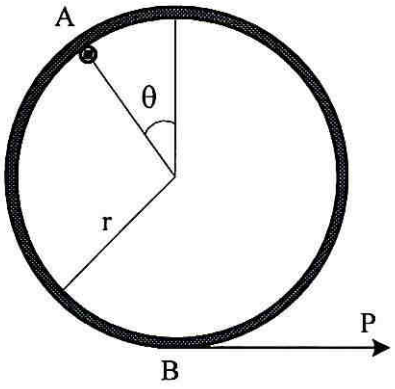

Fig. 5 (*a*)

(*b*) Determine the force in each member of the truss as shown in Fig. 5 (*b*) and tabulate the result with magnitude and nature of force in the members. [6]

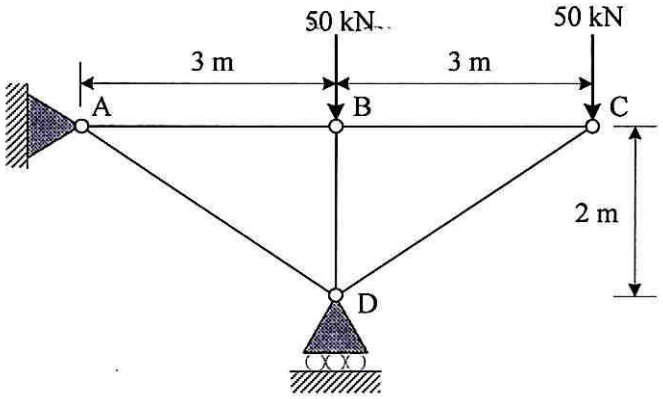

Fig. 5 (*b*)

(*c*) Determine the horizontal and vertical component of reactions at A and B for the frame loaded and supported as shown in Fig. 5 (*c*). [5]

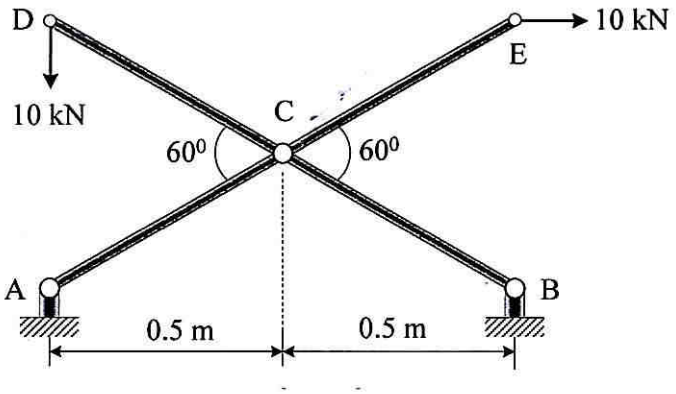

Fig. 5 (*c*)

Or

6. (*a*) The uniform pole of length l and mass m is leaned against the vertical wall as shown in Fig. 6 (*a*). If the coefficient of static friction between supporting surfaces and the ends of the pole is 0.25, calculate the maximum angle θ at which the pole may place before it starts to slip. [6]

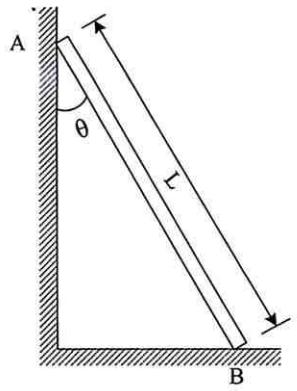

Fig. 6 (*a*)

(*b*) Cable ABCD supports the 4 kg block E and 6 kg block F as shown in Fig. 6(*b*). Determine the maximum tension in the cable and the sag of point B. [6]

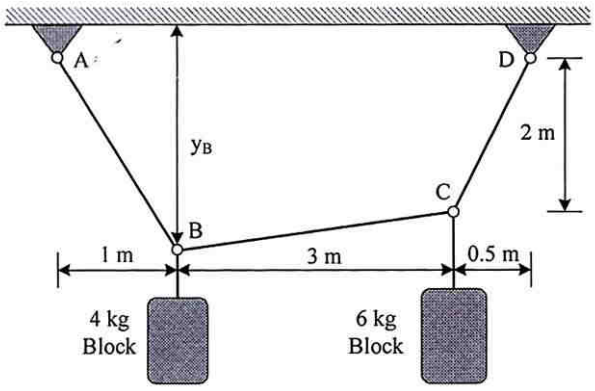

Fig. 6 (*b*)

(*c*) The homogeneous semi-cylinder has a mass m and mass center at G as shown in Fig. 6 (*c*). Determine the largest angle θ of the inclined plane upon which it rest so that it does not slip down the plane. The coefficient of static friction between the plane and the cylinder is 0.3. [5]

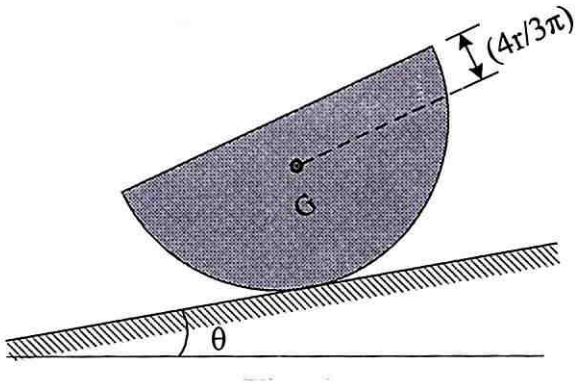

Fig. 6 (*c*)