Total No. of Questions : 6]

SEAT No. :

P3559

[Total No. of Pages : 4

[4856] - 24

F.E. (Common)

ENGINEERING MECHANICS

(2008 Pattern)

Time : 2 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Attempt Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6.***
2) ***Neat diagram must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary and clearly state.***
5) ***Use of cell phone is prohibited in the examination hall.***
6) ***Use of electronic pocket calculator is allowed.***

Q1) a) Determine the magnitude and direction of the resultant force of three forces as shown in **Fig. 1a**. **[6]**

b) A 200 N block rests on a horizontal plane as shown in **Fig. 1b**. Find the magnitude of the force P required to give an acceleration of 3 m/s^2 to the right. Take the Coefficient of kinetic friction between the block and the plane as $\mu_k = 0.25$. **[6]**

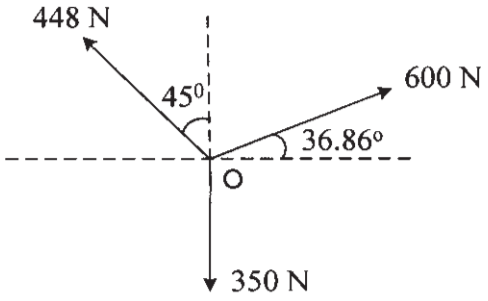


Fig. 1a

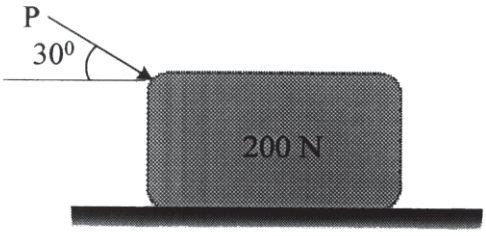


Fig. 1b

OR

Q2) a) Locate the position of centroid of the shaded area with respect to origin O as shown in **Fig. 2a**. **[6]**

P.T.O.

b) The motion of a particle is defined by the relation $x = t^3 - 6t^2 + 9t + 5$, where x is expressed in meters and t in seconds. Determine : **[6]**

i) the time at which the velocity is zero,

ii) the position and acceleration at t = 5 s.

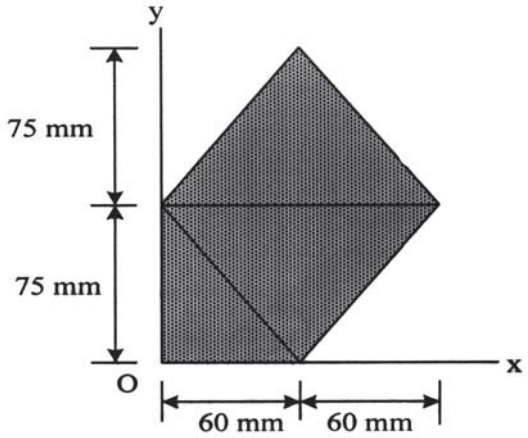


Fig. 2 a

Q3) a) A rectangular concrete mat foundation supports four columns loaded as shown in **Fig. 3a**. Determine the magnitude and point of application of the resultant of the four forces with respect to A. **[7]**

b) A 500 N crate is hoisted using the rope AB and AC as shown in **Fig. 3b**. Each rope can withstand a maximum tension of 2500 N before it breaks. If AB always remains horizontal, determine the smallest angle θ to which the crate can be hoisted. **[6]**

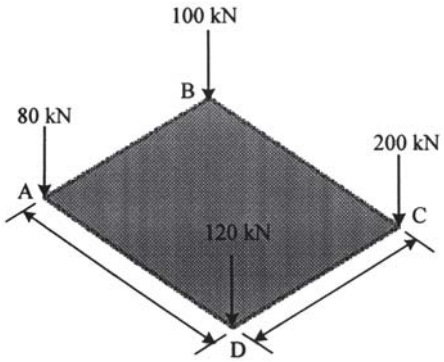


Fig. 3a

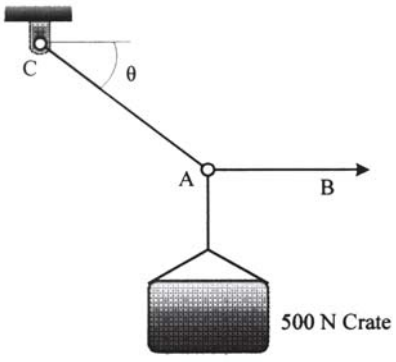


Fig. 3 b

c) The path of a particle P is an Archimedean spiral. The motion of the particle is defined by the relations r = 10t and θ = 2πt, where r is expressed in meters, t in seconds and θ in radians. Determine the velocity of the particle at t = 0 and 0.25 s. **[6]**

OR

Q4) a) Determine the support reaction at A and B for beam AB loaded and supported as shown in **Fig. 4a**. **[6]**

b) A rectangular plate is supported by three cables at A as shown in **Fig. 4b**. Knowing that the tension in cable AB is 140 N, determine the weight of the plate. **[7]**

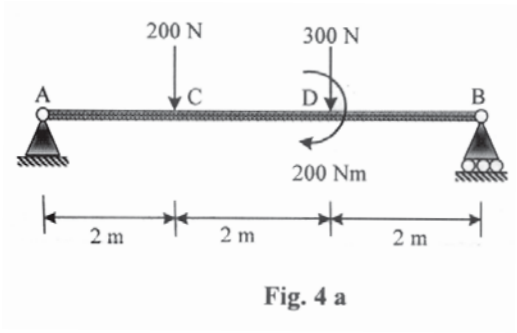
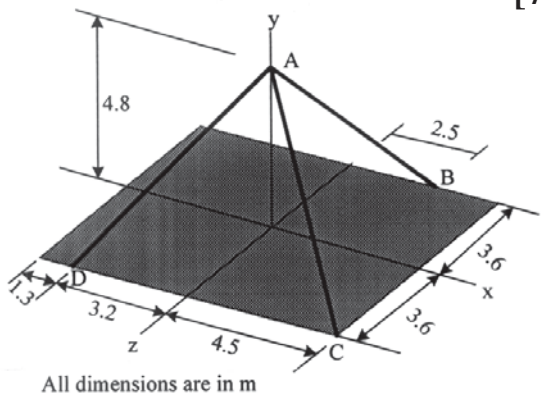


Fig. 4 a



All dimensions are in m

Fig. 4 b

c) The small ball of mass m and its supporting wire AB become a simple pendulum when the horizontal cord BC is severed. Determine the ratio k of the tension T in the supporting wire immediately after the cord is cut to that in the wire before the cord is cut. Refer **Fig. 4c**. **[6]**

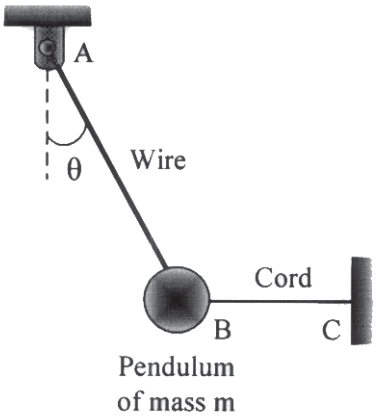


Fig. 4 c

Q5) a) Find the magnitude and nature of the forces in the members of the truss loaded and supported as shown in the **Fig. 5a** and tabulate the result. **[6]**

b) A block of weight 500 N rest on an inclined plane which makes an angle of 30º with horizontal as shown in **Fig. 5b**. If the coefficient of friction between the block and plane is $\mu_s = 0.2$, determine the range of force P to impend the motion. **[7]**

c) A woman having a mass of 70 kg stands in an elevator which has a downward acceleration of 4 m/s^2 starting from rest. Determine the work done by her weight and the work done of the normal force which the floor exerts on her when the elevator descend 6 m. **[6]**

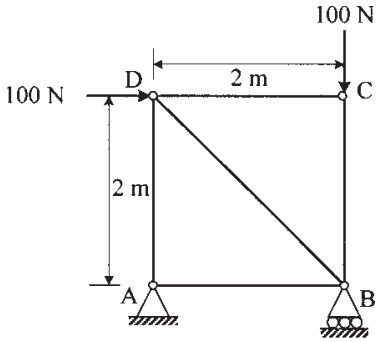


Fig. 5 a

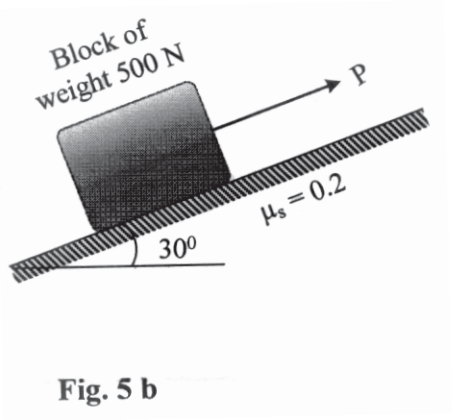


Fig. 5 b

OR

Q6) a) Determine the reactions at A, D and tension in BC of the rope ABCD loaded and supported as shown in **Fig. 6a**. **[6]**

b) A ladder AB of weight 250 N and length 6 m rest against a smooth vertical wall and rough horizontal wall as shown in **Fig. 6b**. Determine the slope of the ladder θ with vertical to maintain equilibrium if the coefficient of static friction at floor and ladder is $\mu_s = 0.25$. **[7]**

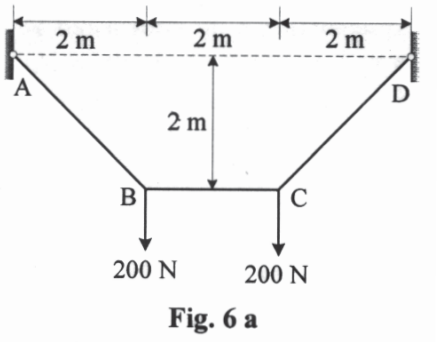


Fig. 6 a

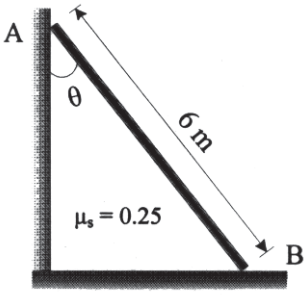


Fig. 6 b

c) The velocities of two steel balls before impact are as shown in the **Fig. 6b**. If after impact the velocity of ball B was observed to be 2.5 m/s to the right, determine the coefficient of restitution between the balls. **[6]**

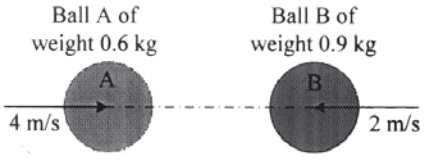


Fig. 6 c

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