Total No. of Questions : 6]

SEAT No. :

PD-4040

[Total No. of Pages : 6

[6401]-2407
F.E
ESC-104-CVL : ENGINEERING MECHANICS
(2024 Pattern) (Semester - I)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Neat sketches must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***
5) ***Use of electronic pocket calculator is allowed.***
6) ***Use of cell phone is prohibited in the examination hall.***

Q1) **Write the correct option for the following multiple choice questions :** **[5 × 2 = 10]**

i) The resultant magnitude of four forces 50 N, 100 N, 110 N and 180 N are acting along sides AB, BC, CD, and DA of a square ABCD is ____

a) 180 N b) 100 N

c) 50 N d) 110 N

ii) A simply support beam of span 1 m is loaded with uniformly varying load of 10 N/m to 20 N/m from left to right end, find the reaction at left end support.

a) 6.67 Upward b) 6.67 Downward

c) 8.33 Downward d) 8.33 Upward

iii) Find the maximum force P required to move a block of mass 800 N resting on a rough floor having $\mu_s = 0.25$.

a) 800 N b) 200 N

c) 600 N d) 400 N

iv) A car is travelling along a rectilinear motion with initial velocity of 40 m/s undergoes an acceleration of 4 m/s^2, find the velocity after 10s.

a) 40 m/s b) 60 m/s

c) 0 m/s^2 d) 80 m/s

v) The pendulum bob has a mass 10 kg and is released from rest when $\theta = 0$ with horizontal. If the length of cord is 1 m, determine the velocity of the bob at $\theta = 30°$.

a) 4.12 m/s b) 4.23 m/s

c) 3.13 m/s d) 9.81 m/s

P.T.O.

Q2) **Solve any two of the following :**

a) Find the resolve components of the force 300 N acting along the axis u and v as shown in **Fig. 2 a**. **[6]**

b) Determine the magnitude F and the angle θ of force F as shown in **Fig. 2 b** so that the resultant of the three forces acting on the point O is zero. **[6]**

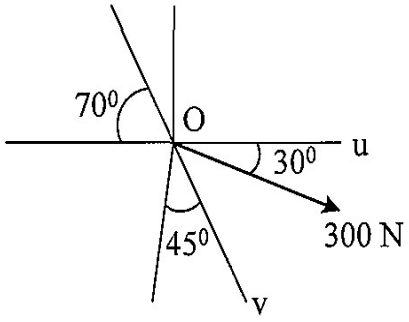

Fig. 2 a

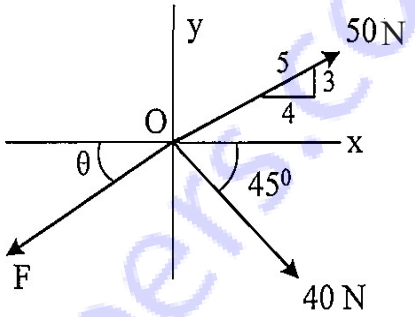

Fig. 2 b

c) A 150 × 300 mm plate is subjected to four forces as shown in **Fig. 2c**. Determine the resultant of the four forces with respected to point F. **[6]**

d) Locate the centroid of the shaded plane lamina with respect to orgin O as shown in **Fig. 2 d**. **[6]**

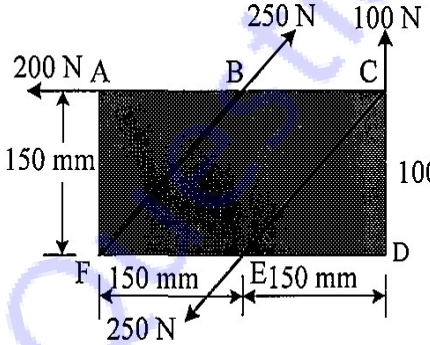

Fig. 2 c

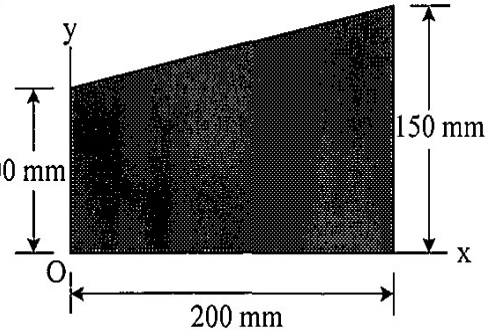

Fig. 2 d

Q3) **Solve any two of the following :**

a) A 1.5 m cable placed around a crate as shown in **Fig. 3 a**. If the mass of the crate is 300 kg, determine the tension in the cable. **[6]**

b) The wall crane is supported by smooth collar at B and pin at A as shown in **Fig. 3 b**. Determine the components of reaction at A and the horizontal reaction at B. **[6]**

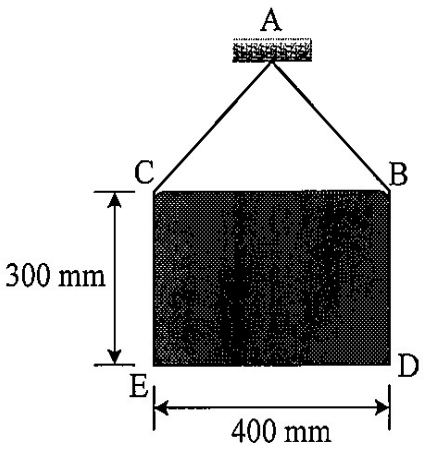

Fig. 3 a

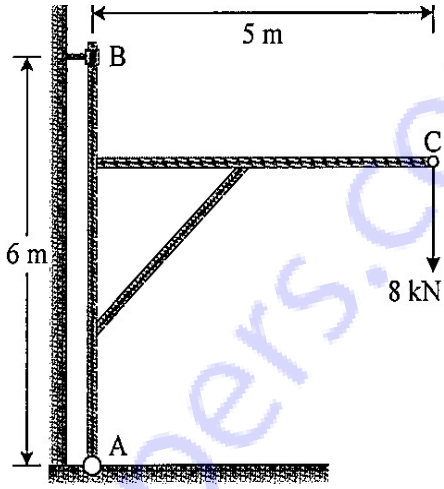

Fig. 3 b

c) A cylinder of mass 100 kg rest between the inclined plane as shown in **Fig. 3 c**. Determine the normal reaction at A and B. **[6]**

d) Determine the support reaction at A and B for the simply supported beam loaded and supported as shown in **Fig. 3 d**. **[6]**

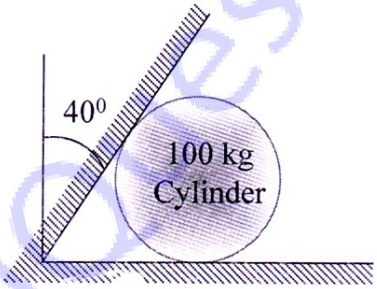

Fig. 3 c

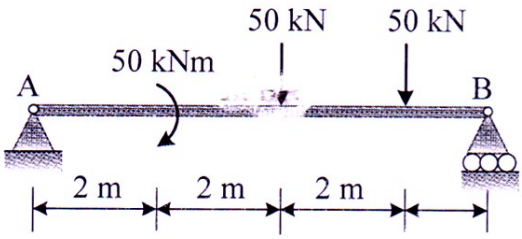

Fig. 3 d

Q4) **Solve any two of the following :**

a) Determine the horizontal force P needed to just start moving the 30 kg block up the plane as shown in **Fig. 4 a.** Take $\mu_s = 0.25$ **[6]**

b) A flexible cable which supports the 100 kg block is passed over a fixed circular drum shown in **Fig. 4 b** subjected to a force P to maintain equilibrium. If the coefficient of friction between the cable and drum is $\mu_s = 0.3$, determine the range of P. **[6]**

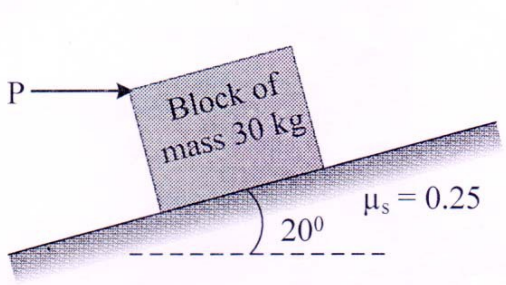

Fig. 4 a

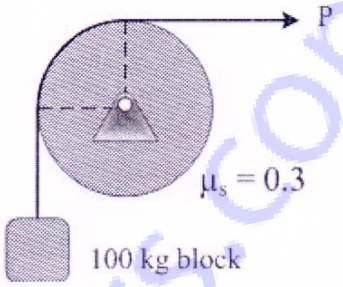

Fig. 4 b

c) The 15 m ladder has a uniform weight of 80 N and rest against the smooth wall at B shown in **Fig. 4 c**. If the coefficient of statics friction at A is $\mu_A = 0.4$. Determine the smallest angle θ at which the ladder will not slip.**[6]**

d) Determine the forces in each member of the truss in terms of external loading as shown in **Fig. 4 d**. **[6]**

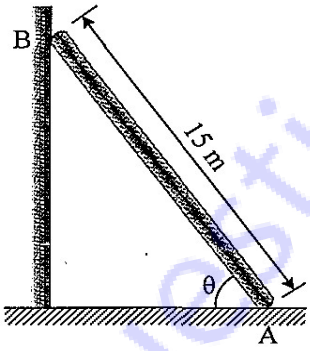

Fig. 4 c

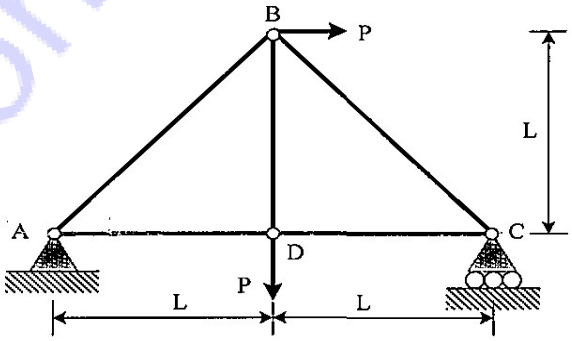

Fig. 4 d

Q5) **Solve any two of the following :**

a) A motorist enters a freeway at 36 kmph and accelerate uniformly to 90 kmph. From the odometer in the car, the motorist knows that she traveled 0.2 km while accelerating. Determine a) the acceleration of the car and b) the time required reach 90 kmph. **[6]**

b) The velocity of a particle is given by $v = 20t^2 - 100t + 50$, where v is in m/s and t is in seconds. Determine the velocity of particle when acceleration is zero. **[6]**

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. 5 c**. Determine the range of values of the distance d for which the water will enter the trough BC. **[6]**

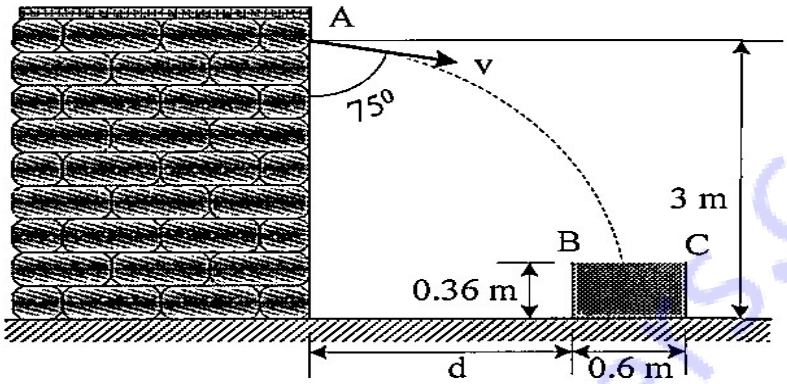

Fig. 5 c

d) The truck travels at a speed of 4 m/s along a circular road that has a radius of 50 m. For a short distance from s = 0, its speed is then increased by $a_t = (0.05s)$ m/s^2, where s is in meters. Determine the speed and magnitude of its acceleration when it has moved s = 10 m. **[6]**

Q6) **Solve any two of the following :**

a) The initial velocity of the block at A is 9 m/s. The coefficient of kinetic friction between the block and the plane is $\mu_k = 0.30$ as shown in **Fig. 6 a.** Find the time it takes for the block to reach at B with zero velocity. **[6]**

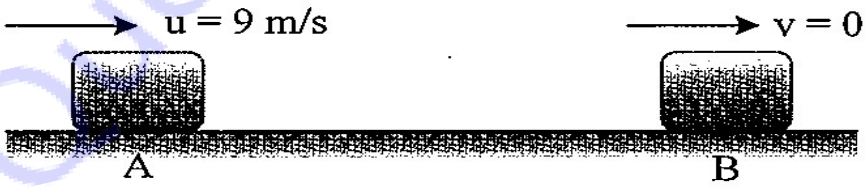

Fig. 6 a

b) A ball has a mass of 30 kg is thrown upward with a speed of 15 m/s. Determine the time and distance traveled by the ball before stopping. Use impulse momentum principle. **[6]**

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 work done by her weight and the work of the normal force which the floor exerts on her when the elevator descends 6 m. **[6]**

d) Disk A has a mass of 250 g and is sliding on a smooth horizontal surface with an initial velocity of 2 m/s. It makes direct collision with disk B, which has a mass of 175 g and is originally at rest as shown in **Fig 6 d.** If both disks are of the same size and the collision is perfectly elastic, determine the velocity of each disk just after collision. **[6]**

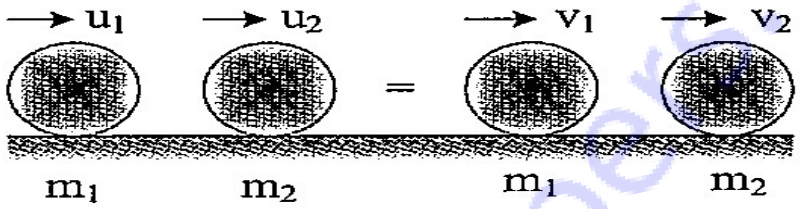

Fig 6 d

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