Total No. of Questions : 6]

SEAT No. :

PC-5207

[Total No. of Pages : 5

[6351]-117

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.**

i) Two concurrent forces of 30 N and 40 N act an angle of 60°, find the resultant force. **[2]**

a) 54.59 N b) 36.06 N

c) 50 N d) None of these

ii) A clockwise moment of magnitude 10 Nm is acting at the center of simply supported beam of span 2 m. Find the reactions at right support. **[2]**

a) 10 N Upward b) 10 N Downward

c) 5 N Downward d) 5 N Upward

iii) A block of weight 200 N is placed on rough horizontal plane. If the coefficient of static friction between the block and the horizontal plane is 0.3, determine the horizontal force required to just slide the block on the plane. **[2]**

a) 60 N b) 200 N

c) 100 N d) 30 N

iv) A motorist travelling at a speed of 72 kmph sees a traffic signal 200 m ahead of him turn red. Determine the acceleration so that he will just stop at the signal. **[2]**

a) 1 m/s^2 b) – 1 m/s^2

c) 0.5 m/s^2 d) – 0.5 m/s^2

P.T.O.

v) A boy of mass 50 kg stands in a lift. Determine the force exerted by the boy on the floor of the lift when the lift moves down with a constant acceleration of 9.81 m/s^2. **[2]**

a) Zero
b) 490.5 N
c) 981 N
d) None of these

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

a) Find magnitude and direction of the resultant force with respect to origin 'o' for concurrent force system shown in **Fig. 2 a.** **[6]**

b) Determine magnitude, direction and point of application of the resultant with reference to point A for the force system as shown in **Fig. 2 b.** **[6]**

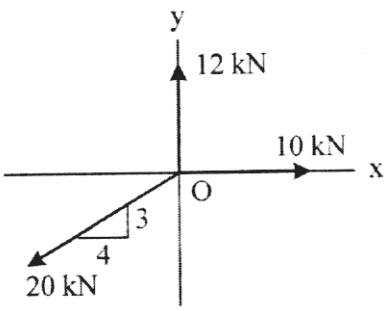

Fig. 2 a

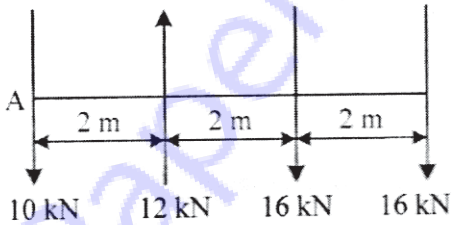

Fig. 2 b

c) Determine the magnitude and direction of resultant with reference to point A for the force system shown in **Fig. 2 c** if side of equilateral triangle is 1 m. **[6]**

d) Determine the y coordinate of centroid of the shaded area as shown in **Fig. 2 d.** **[6]**

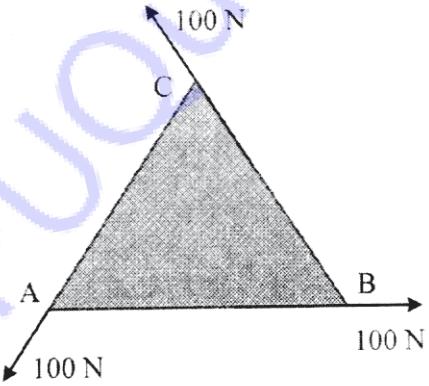

Fig. 2 c

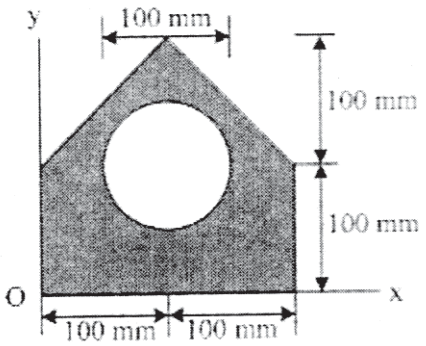

Fig. 2 d

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

a) Three cables are joined at the point C as shown in **Fig. 3 a.** Determine the tension in cable AC and BC caused by the mass of the 30 kg cylinder. **[6]**

b) The boom supports two vertical loads, F_1 and F_2 as shown in **Fig. 3 b.** 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 $F_1 = 2F_2$. **[6]**

c) Determine the force P shown in **Fig. 3 c** required to begin rolling the 100 mm radius uniform cylinder of mass 100 kg over the obstruction of height h =40 mm. **[6]**

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

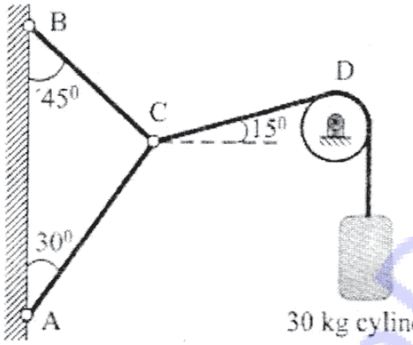

Fig. 3 a

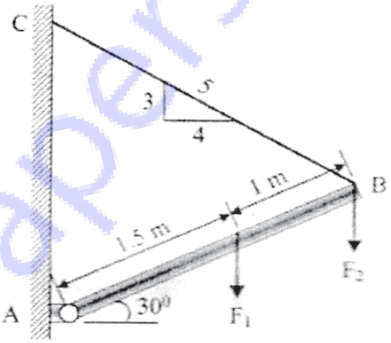

Fig. 3 b

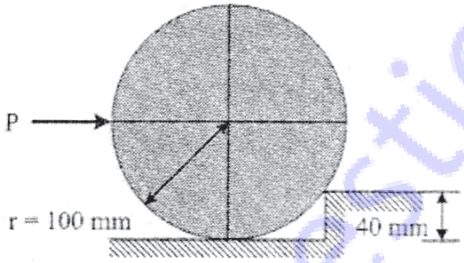

Fig. 3 c

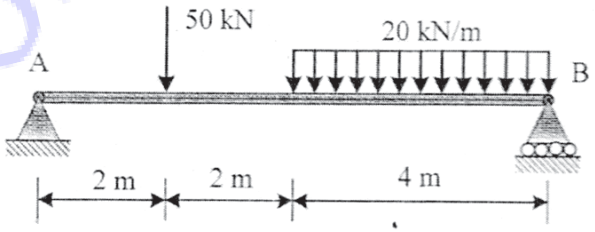

Fig. 3 d

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

a) Block of mass 10 kg rest on an inclined plane shown in **Fig. 4 a.** If the coefficient of static friction between block and plane is 0.25, determine the maximum force P to maintain equilibrium. **[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]**

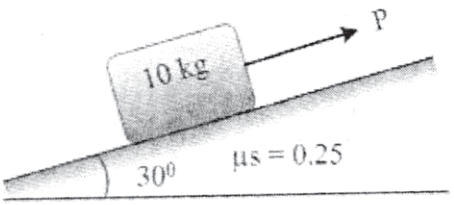

Fig. 4 a

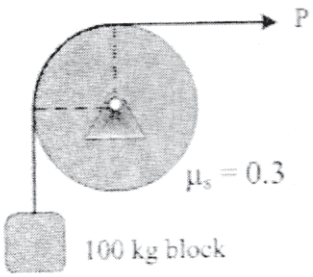

Fig. 4 b

c) The 15 m ladder has a uniform weight of 80 N. It rest against smooth vertical wall at B and horizontal floor at A. If the coefficient of static friction between ladder and floor at A is $\mu_S = 0.4$, determine the smallest angle θ with vertical wall at which the ladder will slip. **Refer Fig. 4 c.[6]**

d) Identify the zero force member and find forces in remaining members of the truss loaded and supported as shown in **Fig. 4 d**. **[6]**

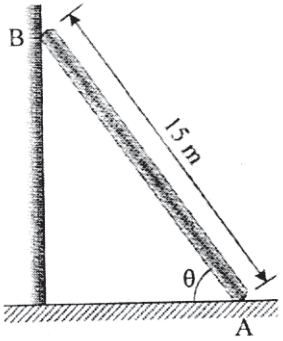

Fig. 4 c

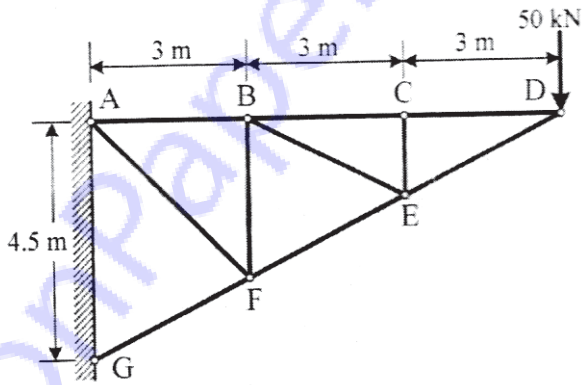

Fig. 4 d

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

a) A truck travels 164 m in 8 s and decelerated at a constant rate of 0.5 m/s^2. Determine (i) its initial velocity, (ii) its final velocity, (iii) the distance travel during the first 0.6 s. **[6]**

b) The acceleration of a particle is given by $a = 4t - 30$, where a is in m/s^2 and t is in seconds. If at $t = 0$, $v = 3$ m/s and s = – 5 m then determine the velocity and displacement at $t = 3$ s. **[6]**

c) A car is traveling along a circular curve that has a radius of 50 m. If its speed is 16 m/s and tangential component of acceleration a_t is 8 m/s^2, determine the magnitude of its total acceleration at this instant. **[6]**

d) The ball is kicked with an initial velocity $V_A = 8$ m/s at an angle $\theta_A = 40°$ with horizontal as shown in **Fig. 5 d**. Find the time of flight and maximum horizontal distance AB travel by ball. **[6]**

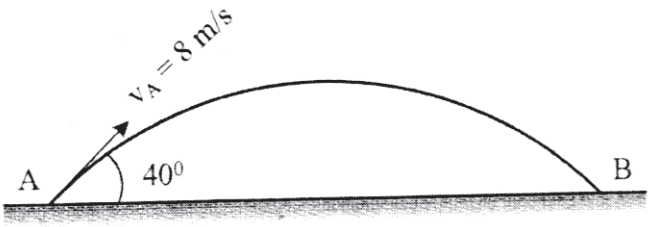

Fig. 5 d

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

a) An 80 kg block rests on a plane as shown in the **Fig. 6 a**. Find the acceleration with which block slides down using Newton's second law if coefficient of kinetic friction is, $\mu_k = 0.20$. **[6]**

b) The man has a mass of 80 kg and sits 3 m from the center of the rotating platform as shown in **Fig. 6 b**. 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, $\mu_s = 0.3$, determine the time required to cause him to slip. **[6]**

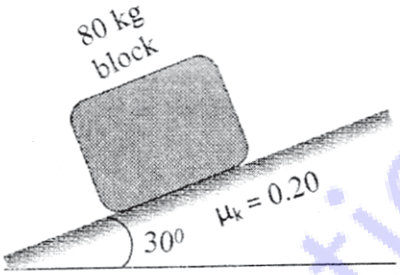

Fig. 6 a

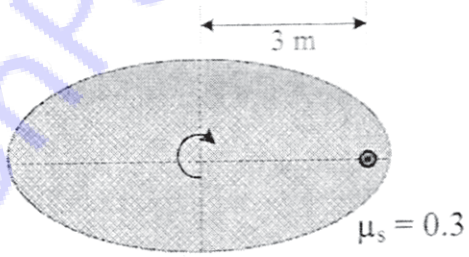

Fig. 6 b

c) The identical 1.2 kg collars A and B are sliding on a frictionless rod as shown in **Fig. 6 c**. Knowing that the coefficient of restitution, $e = 0.65$, determine the velocity of each collar after impact. **[6]**

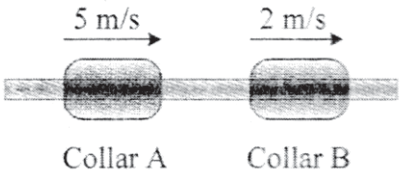

Fig. 6 c

d) A ball has a mass of 30 kg and is thrown.upward with a speed of 15 m/s. Determine the time to attain maximum height using impulse momentum principle. Also find the maximum height. **[6]**

▽▽▽▽