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Question Paper Code : 81645

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Third Semester

Mechanical Engineering

ME 3351 –ENGINEERING MECHANICS

(Common to Automobile Engineering/Civil Engineering/ Civil Engineering(Environmental Engineering)/Industrial Engineering/Industrial Engineering and Management/Material Science and Engineering/Mechanical Engineering (Sandwich)/Mechanical Engineering (Specialised in Automobile)/Mechanical Engineering (Specialised in Smart Manufacturing)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/ Robotics and Automation/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Two forces of magnitude 50 KN and 80 KN are acting on a particle, such that the angle between the two is 135°. If both the force is acting away from the particle, calculate the resultant and find its direction.
2. Write the equations of equilibrium of a coplanar system of forces.
3. State Varignon's theorem.
4. Find the moment of 100 N force acting at B about point A as shown in Figure. 1.

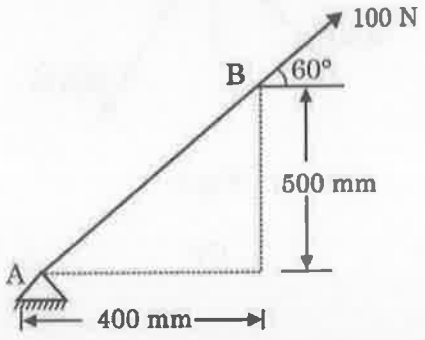

Fig 1

5. Locate the centroid and calculate the moment of inertia about centroidal axes of a semicircular lamina of radius 2 m.

6. Define polar moment of inertia.

7. A 180 N block is placed on a rough horizontal surface as shown in Fig 2. Knowing that block just slides for P = 60 N and θ = 20°, determine Coefficient of friction (μ).

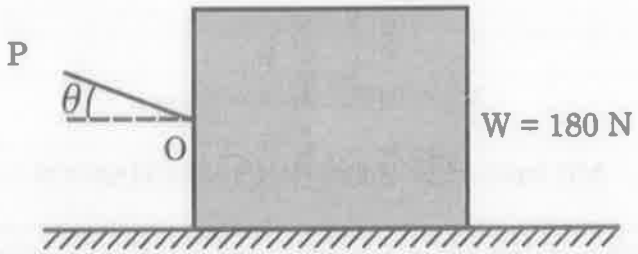

Fig 2

8. State the 'Laws of Dry Friction".

9. A car accelerates uniformly from a speed of 30 Km/hr to a speed of 75 Km/hr in 5 secs. Determine the acceleration of the car and the distance traveled by the car during 5 secs.

10. State the principle of Impulse and Momentum.

PART B — (5 × 13 = 65 marks)

11. (a) Find the x and y components of force system shown in Fig. 3 . Also find the resultant of the given forces in magnitude and direction.

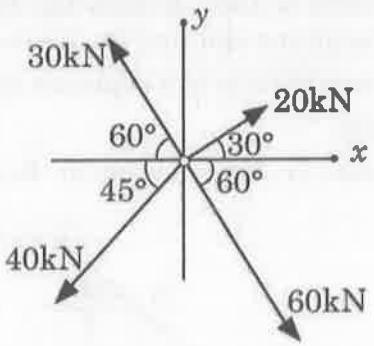

Fig 3

Or

(b) The frictionless pulley A shown in Fig. 4. Is supported by two bars AB and AC which are hinged at B and C to a vertical wall. The flexible cable DA hinged at D, goes over the pulley and supports a load of 25 kN at A. The angles between the various members are shown in the figure. Determine the forces in the bars AB and AC. Neglect the size of pulley and treat it as frictionless.

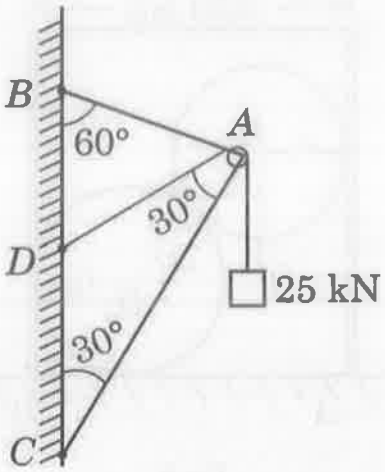

Fig 4

12. (a) A system of parallel non-concurrent forces is acting on a rigid bar AB as shown in fig 5. Reduce this system of forces to

(i) A single force R and a couple at A.

(ii) A single force R and a couple at B.

(iii) A single force R and a couple at C.

(iv) A single force R and a couple at D.

(v) A single force R and its position.

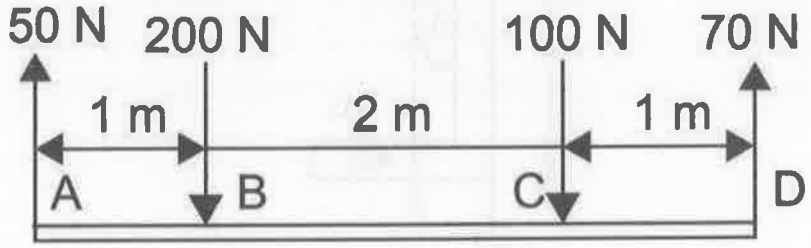

Fig 5

Or

(b) A hollow right circular cylinder of radius 800 mm is open at both ends and rests on a smooth horizontal plane as shown in Fig. 6. Inside the cylinder, there are two spheres weighing 1 kN and 3 kN and with radii 400 mm and 600 mm respectively. The lower sphere rests on the horizontal plane. Neglecting friction, find the minimum weight W of the cylinder for which it will not tip over.

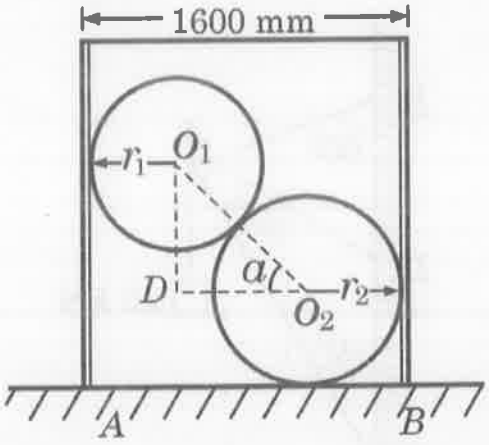

Fig 6

13. (a) Compute the second moment of area of the channel section shown in Fig. 7 about centroidal axes $x-x$ and $y-y$.

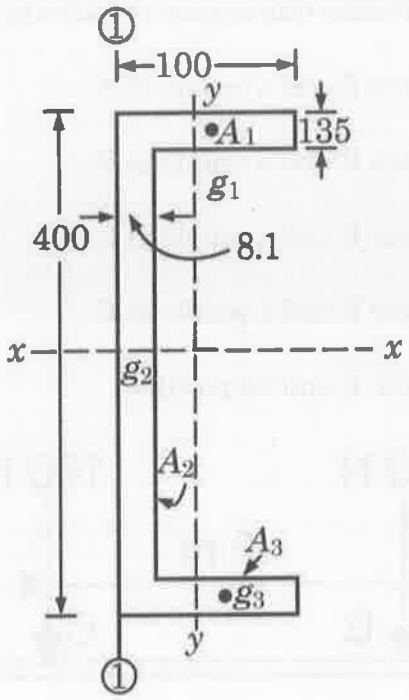

Fig 7

Or

(b) A concrete block of size 0.60 m × 0.75 m × 0.5 m is cast with a hole of diameter 0.2 m and depth 0.3 m as shown in Fig. 8. The hole is completely filled with steel balls weighing 2500 N. Locate the centre of gravity of the body. Take the weight of concrete = 25000 N/m³.

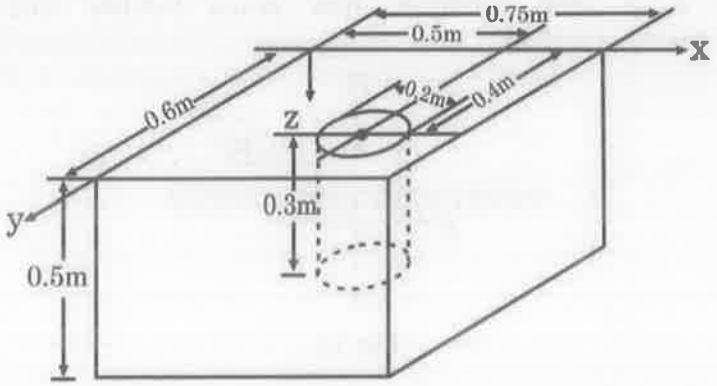

Fig 8

14. (a) The coefficient to rolling resistance of a cylinder on a flat surface is 1.3 mm. At what inclination of the surface, the cylinder of radius r = 300 mm will start rolling down as shown in Fig. 9.

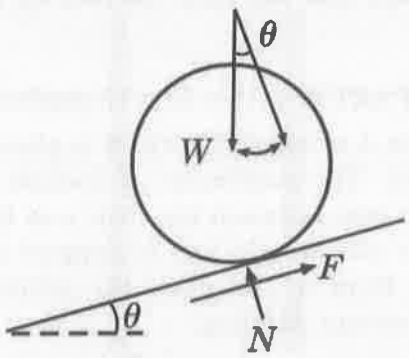

Fig 9

Or

(b) Determine force P required to start the movement of the wedge as shown in Fig. 10. The angle of friction for all surfaces of contact is 15°.

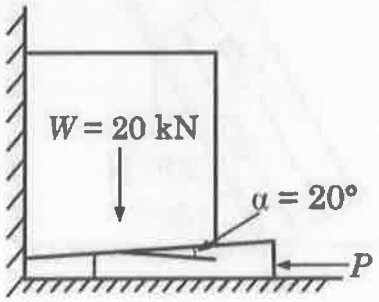

Fig 10

15. (a) A block weighing 2500 N rests on a level horizontal plane for which coefficient of friction is 0.20. This block is pulled by a force of 1000 N acting at an angle of 30° to the horizontal as shown in Fig 11. Find the velocity of the block after it moves 30 m starting from rest. If the force of 1000 N is then removed, how much further will it move? Use work-energy method.

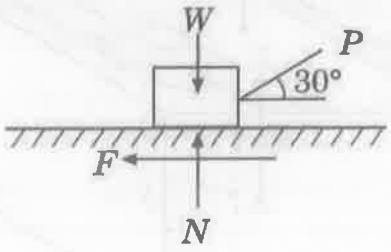

Fig 11

Or

(b) An elevator cage of a mine shaft weighing 8 kN, when empty, is lifted or lowered by means of a wire rope. Once a man weighting 600 N, entered it and lowered with uniform acceleration such that when a distance of 187.5 m was covered, the velocity of the cage was 25 m/s. Determine the tension in the rope and the force exerted by the man on the floor of the cage.

PART C — (1 × 15 = 15 marks)

16. (a) A ladder of length 4 m weighing 200 N is placed against a vertical wall as shown in Fig. 12. The coefficient of friction between the wall and the ladder is 0.2 and that between the floor and the ladder is 0.3. The ladder in addition to its own weight has to support a man weighing 600 N at a distance of 3 m from A. Calculate the minimum horizontal force to be applied at A to prevent slipping.

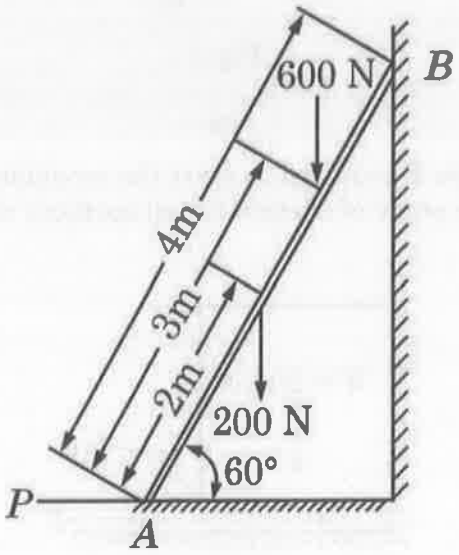

Fig 12

Or

(b) Determine the centroid of the built-up section shown in Fig. 13 and find the moment of inertia and radius of gyration about the horizontal centroidal axis.

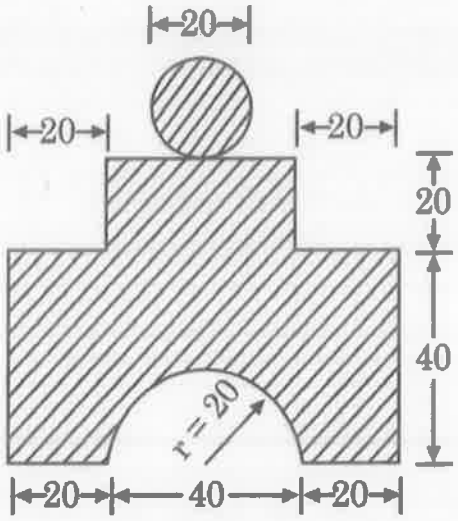

Fig 13