

**COMBINED FIRST AND SECOND SEMESTER B.TECH  
(ENGINEERING) DEGREE EXAMINATION, MAY 2010**  
PTEN/EN09 105 - ENGINEERING MECHANICS  
(Common to all branches)  
(2009 admissions)

Time : Three hours

Maximum: 70 marks

**Part A**

Answer all questions

1. State parallelogram law of forces.
2. Define angle of repose.
3. State perpendicular axis theorem.
4. Define impulse-momentum principle.
5. State the equation of motion for translation.

(5 × 2 = 10 marks)

**Part B**

Answer any four questions

6. A ball Q of weight 12 N rests in a right angled trough as shown in Figure 1. Determine the forces exerted on the sides of the trough at D and B if all surfaces are perfectly smooth.

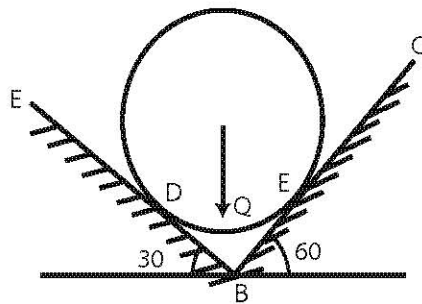


Figure 1

7. A block of weight 150 N is resting on a rough inclined plane as shown in Figure 2. The block is tied up by a horizontal string which has a tension of 50 N. Find (i) the frictional force on the block (ii) the normal reaction of the inclined plane (iii) the coefficient of friction between the surfaces of contact.

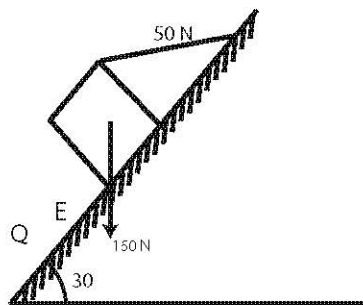


Figure 2

8. Derive the mass moment of inertia of a sphere.
9. A block weighing 100 N, rests on a horizontal plane as shown in Figure 3. Find the magnitude of the force P, require to move the block at an acceleration of  $2 \text{ m/sec}^2$  towards right. Take the coefficient of friction between the block and the plane as 0.25.

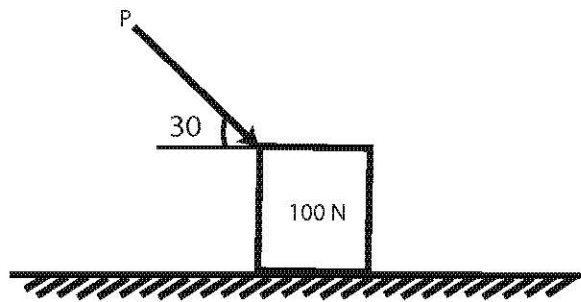


Figure 3

10. A bullet of mass 30 g moving horizontally with a velocity of 450 m/sec strikes a wooden block of weight 45 N, resting on a rough horizontal floor. The bullet is embedded into the block and then both block and bullet move as a single unit. Calculate the distance moved. Take  $\mu = 0.45$ .
11. The 15 kg uniform cylinder having 150 mm radius shown in Figure 4 is rolled up the  $20^\circ$  incline with an initial speed of 15 m/sec. Determine the maximum distance that the cylinder will roll up the incline. Assume that no slipping occurs.

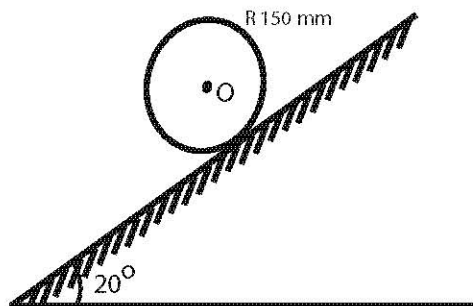


Figure 4

(4 × 5 = 20 marks)

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**Part C**

Answer section (a) or (b).

Each carries 10 marks

12. (a) ABCD is weightless rod under the action of four forces P, Q, S and T as shown in Figure 5. If  $p = 10\text{ N}$ ,  $Q = 4\text{ N}$ ,  $S = 8\text{ N}$  and  $T = 12\text{ N}$ , calculate the resultant in magnitude and direction. Also locate its point of application with respect to the end A of the rod.

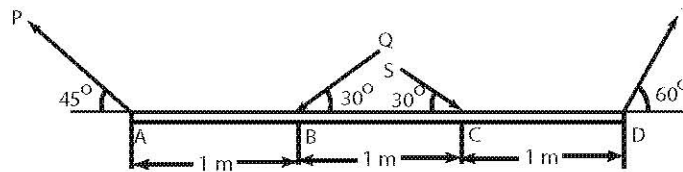


Figure 5

Or

- (b) A fine light string ABCDE whose extremity A is fixed, has weights  $W_1$  and  $W_2$  attached to it B and C. It passes round small smooth peg at D carrying a weight of 40 N at the free end E as shown in Figure 6. If in the position of equilibrium, BC is horizontal and AB and CD makes  $150^\circ$  and  $120^\circ$  with BC. With BC, find (i) tension in the portion AB, BC and CD of the string; and (ii) magnitudes of  $W_1$  and  $W_2$ .

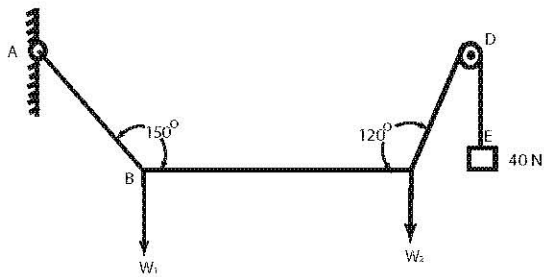


Figure 6

13. (a) A cantilever truss supported on rollers at E and hinged at A is loaded as shown in Figure 7. Determine the reactions at A and E.

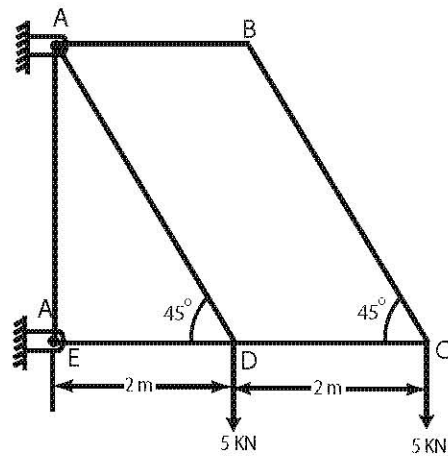


Figure 7

Or

- (b) find the moment of inertia about the centroidal axes for the section shown in Figure 8.

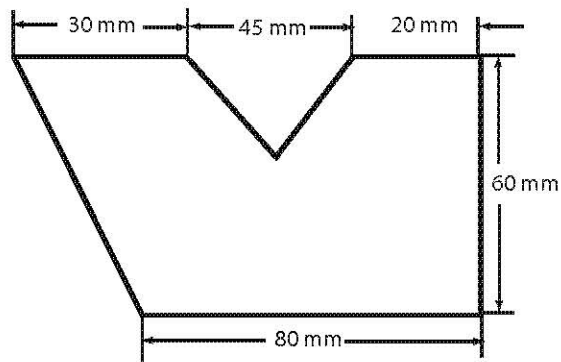


Figure 8

14. (a) Two blocks A and B of weight 80 N and 60 N are connected by a string and passes over a frictionless pulley as shown in Figure 9. Determine the acceleration of blocks A and B and the tension in the string.

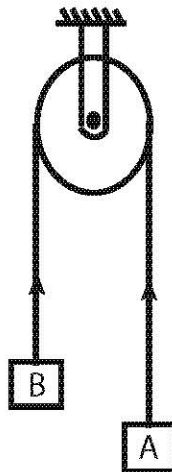


Figure 9

Or

- (b) A projectile is fired from the edge of a 150 m height cliff with an initial velocity of 180 m/sec at angle of elevation of  $30^\circ$  with the horizontal. Neglecting a resistance, find (i) the greatest elevation above the ground reached by the projectile; and (ii) the horizontal distance from the gun to the point where the projectile strikes the ground.
15. (a) Load A is connected to a double by one of the two in-extensible cables as shown in Figure 10. The motion of the pulley is controlled by the cable B, which has a constant acceleration of  $1 \text{ m/sec}^2$  and an initial velocity of  $1.5 \text{ m/sec}$ , both directed to the right. Determine (i) number of revolutions executed by the pulley in 5 seconds; (ii) the velocity and change in position in load A after 5 seconds.

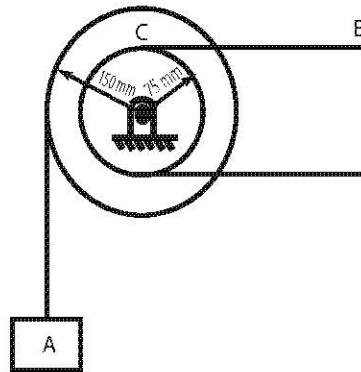


Figure 11

Or

- (b) A composite pulley of weight 500 N and radius of gyration of 0.4 m is attached with two blocks A and B of weights 1000 N and 2000 N respectively as shown in Figure 11. Determine the angular acceleration of the pulley and the tension in the strings by using D'Alembert's principle.

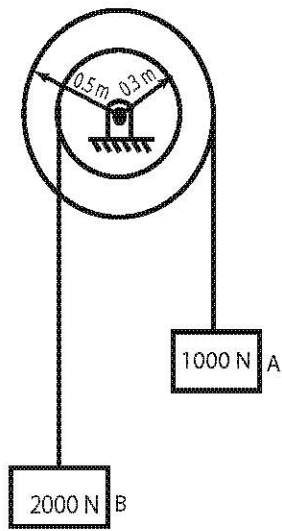


Figure 10

(4 × 10 = 40 marks)