Code No: R19ES1204 **R19** SET - 1

**I B. Tech II Semester Regular Examinations, December - 2020**
**ENGINEERING MECHANICS**
**(**Com. to ME, Chem E, Pet E, Agri E**)**

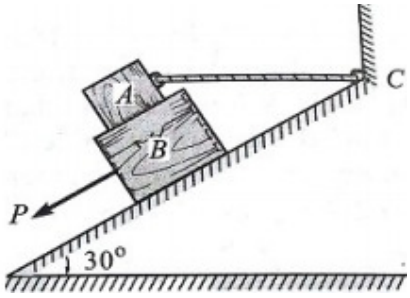
Time: 3 hours Max. Marks: 75

**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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1. a) Derive the expressions of parallelogram law of forces. (7M)

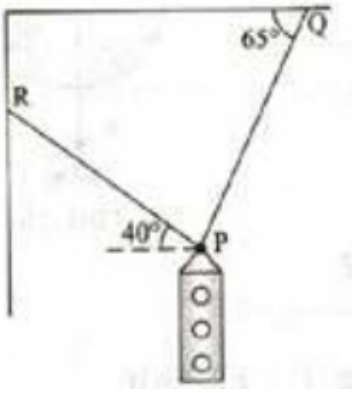
   b) Block A of mass 30 kg rests on block B of mass 40 kg as shown in figure Block A is restrained from moving by a horizontal rope tied at point C, what force P applied to the plane inclined at $30^o$ with horizontal is necessary to start block B down the plane. Take coefficient of friction for all surfaces as 0.35. (8M)




Figure

Or

2. a) A traffic signal of mass 50kg is hung with the help of two strings, as shown in figure. Find the forces induced in both the strings. (10M)

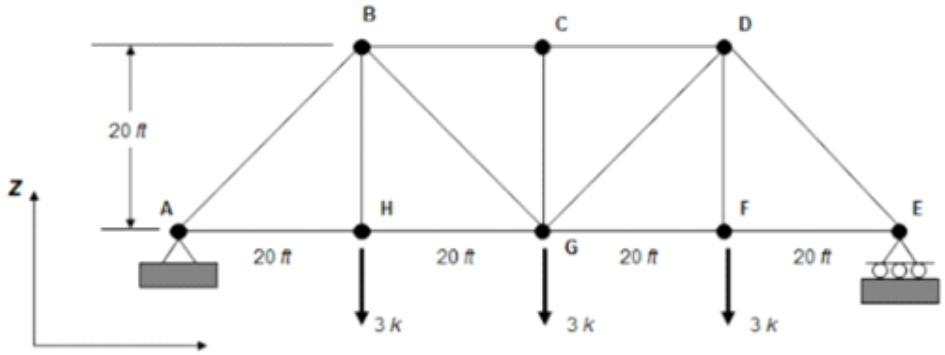



Figure

   b) Explain the differences between coefficient of friction and angle of friction. (5M)

3. a) State and prove Lami's theorem. (5M)
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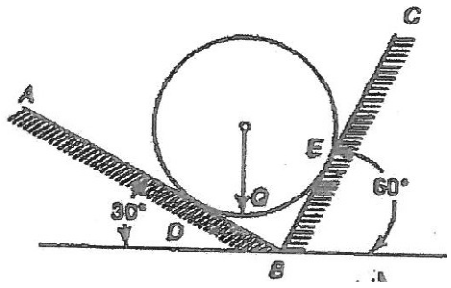
b) By using method of sections solve the following truss and find out all reactions. (10M)




Figure

Or

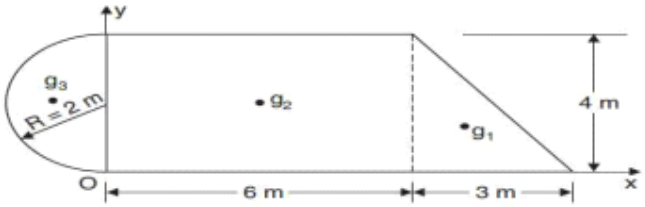
4. a) A ball of weight Q=53.4N rests in a right angled trough, as shown in figure. Determine the forces exerted on the sides of the trough at D and E if all surfaces are perfectly smooth. (8M)




Figure

b) Explain the procedure to find forces in members of truss by using method of sections, By considering an example. (7M)

5. a) Determine the centroid of the area shown in figure with respect to the axis shown. (8M)

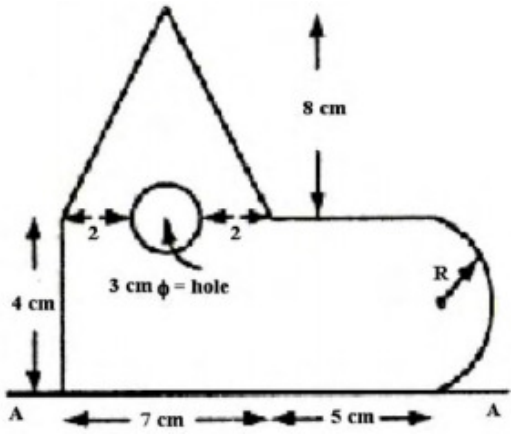



Figure

b) Derive the expression to determine moment of inertia of a semicircular area about its diametral axis. (7M)

Or

6. Find the moment of inertia of thin plates about AA - axis shown in the figure. Assume a thickness of 8 mm. (15M)




Figure

7. A stone is thrown from the top of building upward at an angle of $40^0$ with the horizontal with an initial speed of 30 m/sec. The height of the building above ground level is 30 m. Determine: (15M)
(i) The greatest height reached by the stone above the ground level.
(ii) The horizontal distance from the point of projection to the point where the stone strikes the ground.
(iii) The velocity with which the stone strikes the ground.
(iv) Time of flight

Or

8. a) A projectile fired from the edge of a 150 m high cliff with an initial velocity of 180 m/s at an angle of elevation of 30° with the horizontal. Neglecting air resistance find : (8M)
(i) The greatest elevation above the ground reached by the projectile ; and
(ii) Horizontal distance from the gun to the point, where the projectile strikes the ground.

b) Explain the terms translation, rotation and plane motion of a rigid body. how are these motions are produced. (7M)

9. a) A block of mass 10 kg slides 5m down a $30^0$ inclined plane from rest and enters a horizontal plane. How far along the horizontal plane will it reach before coming to rest? The coefficient of kinetic friction between block and incline is 0.2 and between block and horizontal plane is 0.25. Solve using Work–energy principle. (8M)

b) Define impulse, momentum and impulse-momentum principle. What are the applications of these principles? (7M)

Or

10. a) Derive the kinetic energy of a body in fixed axis rotation. (7M)

b) A cricket ball is bowled horizontally with a velocity of 20 m/sec. The ball was hit with a velocity of 48 m/sec at angle of $30^0$ with the horizontal. Find the force exerted by the bat if the impact lasts for 0.02 sec and weight of ball is 1N. (8M)

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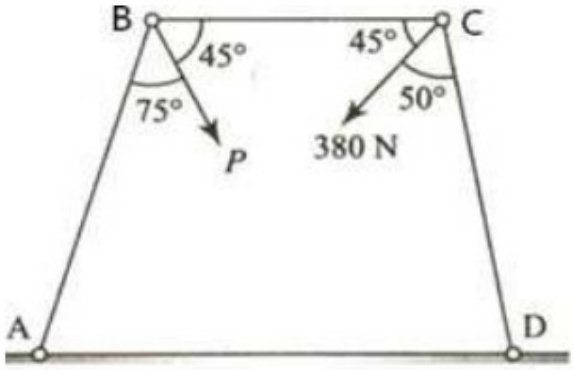
**I B. Tech II Semester Regular Examinations, December - 2020**
**ENGINEERING MECHANICS**
(Com. to ME, Chem E, Pet E, Agri E)

Time: 3 hours Max. Marks: 75

**Answer any five Questions one Question from Each Unit**
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1. a) In the four bar mechanism ABCD, as shown in figure, determine the force P for equilibrium. (9M)




Figure

b) Define the following terms: (i) Limiting Force of Friction (ii) Co-efficient of Friction (iv) Angle of Friction. (6M)

Or

2. a) The following forces act at a point. (8M)
(i) 20N inclined at $30^0$ towards north of East
(ii) 25N towards North
(iii) 30N towards North West, and
(iv) 35N inclined at $40^0$ towards South of West.
Find the magnitude and direction of the resultant of force.

b) How will you distinguish between static friction and dynamic friction? State their laws. (7M)

3. a) A light string ABCDE whose extremity A is fixed, has weights $W_1$ and $W_2$ attached to it at B and C. It passes round a small smooth peg at D carrying a weight of 300 N at the free end E as shown in figure. If in the position of equilibrium, BC is horizontal and AB and CD makes 150° and 120° with BC, find (i) Tension in the portion AB,BC and CD of the string and (ii) Magnitude of W1 and W2. (8M)

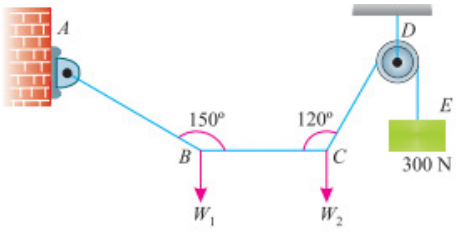
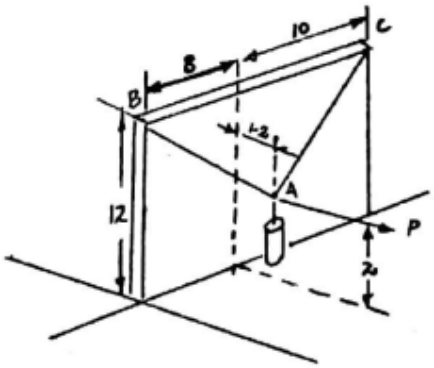



Figure
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b) List the types of loads, supports and beams available with neat sketch. (7M)

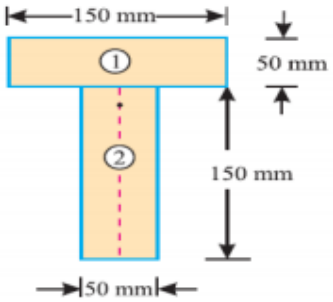
Or

4. A 200 kg cylinder is hung by means of two cables AB and AC, which are attached to the top of a wall. A horizontal force P perpendicular to the wall holds the cylinder in the position shown in figure. Determine the magnitude of P and the tension in each cable. (15M)




Figure

5. a) Find the moment of inertia of a T-section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X-X and Y-Y axes through the centre of gravity of the section as shown in figure. (8M)

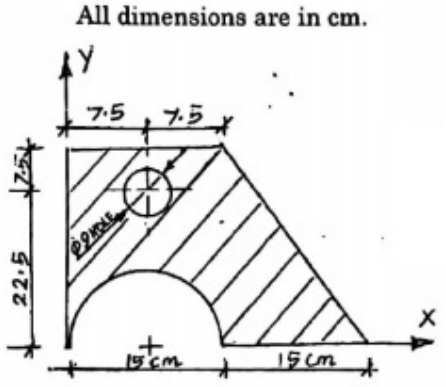



Figure

b) Determine the centroid of the quarter circle whose radius is R. (7M)

Or

6. a) Find the centroid of the lamina shown in figure. (8M)




Figure

b) Find the area moment of inertia of an equilateral triangle of side 'a' with respect to one of its side. (7M)

7. a) Motion of a particle along a straight line is given by equation $a= t^2-2t+2$ where a = acceleration is $m/s^2$, t = time in seconds, After 1 second the distance travelled by the particle and the velocity of the particle were found to be 14.75 m and 6.33m/s. Find the (i) distance travelled, (ii) Velocity and (iii) acceleration of the particle after 2 seconds. (9M)

b) Distinguish between (i) rectilinear and curvilinear motion (ii) displacement and distance (iii) rotation and rolling (6M)

Or

8. a) A car starts from rest on a curved road of 300 m radius and accelerates at a constant tangential acceleration of 0.5 $m/sec^2$. Determine the distance the car will travel when its total acceleration is 0.8 $m/sec^2$. Determine the time taken for this operation. (8M)

b) Derive the three basic relations between velocities, acceleration and time for a uniformly accelerated body. (7M)

9. a) State and explain work energy principle. What are its applications? (8M)

b) A block of 1500 N weight is pushed with a force of 300 N on a horizontal plane, the coefficient of friction between block and plane being 0.1. How much time will be required before the bloc reaches a velocity of 16 m/sec after starting from rest. For how long the block will continue after removal of pushing force? Use impulse-momentum equation. (7M)

Or

10. a) Distinguish between impulse and impulsive force. Derive the relation between impulse and momentum. (8M)

b) A car was in motion along a straight level road. The brakes were applied and the car skidded for a total distance of 60 m before coming to halt. The coefficient of friction between tyres and road was 0.5. Calculate the speed of the car just before brakes were applied. (7M)

Code No: R19ES1204 **R19** SET - 3

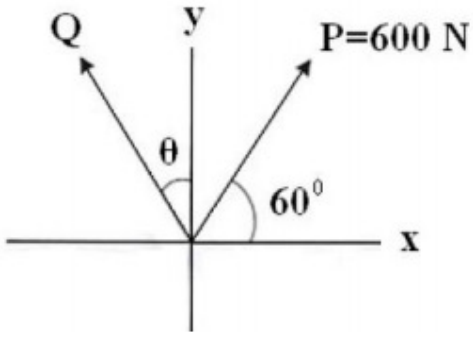
**I B. Tech II Semester Regular Examinations, December - 2020**
**ENGINEERING MECHANICS**
**(**Com. to ME, Chem E, Pet E, Agri E)

Time: 3 hours Max. Marks: 75

**Answer any five Questions one Question from Each Unit**
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1. a) The resultant of two forces P and Q is 1200 N vertical. Determine the force Q and the corresponding angle for the system of forces as shown in figure. (8M)

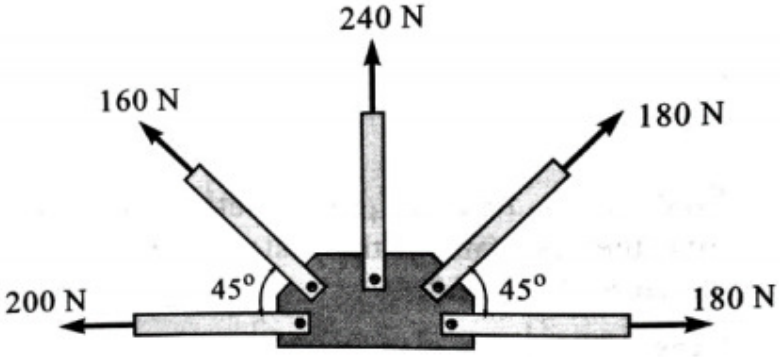



Figure

b) State the laws of friction. (7M)

Or

2. a) A gusset plate of roof truss is subjected to forces as shown in figure. Determine the magnitude of the resultant force and its orientation measured counter clockwise from the positive x-axis. (8M)

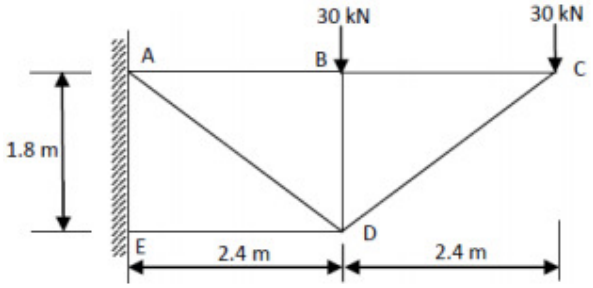



Figure

b) With neat sketch explain cone of friction. (7M)

3. a) Explain free body diagram with an example. (5M)
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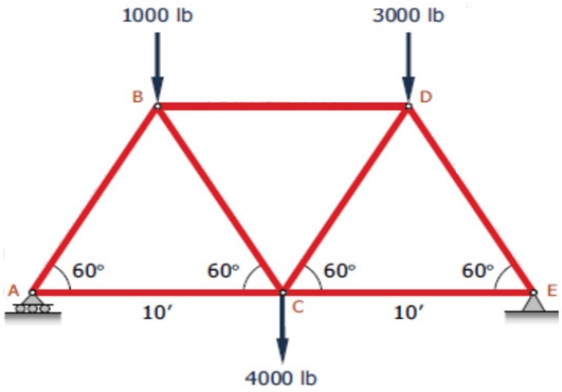
b) Find the forces in the members of a truss as shown in figure. (10M)




Figure

Or

4. a) By using method of joints solve the following truss. (8M)

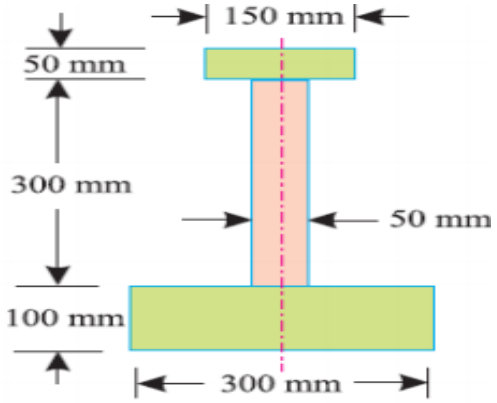



Figure

b) Five strings are tied at a point and are pulled in all directions, equally spaced from one another. If the magnitude of the pulls on three consecutive strings is 50 N, 70 N and 60 N respectively, find graphically the magnitude of the pulls on two other strings. (7M)

5. a) Determine the centriod for triangular lamina, having a base "b" and height "h". (5M)

b) An I-section as shown in figure has the following dimensions in mm units: Bottom flange = 300 × 100, Top flange = 150 × 50, Web = 300 × 50 Determine mathematically the position of center of gravity of the section. (10M)

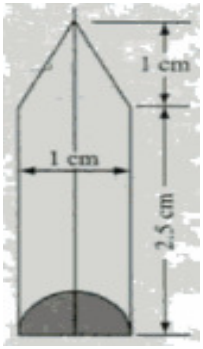



Figure

Or

6. a) State and Prove the parallel axis theorem in the determination of moment of inertia of areas with the help of a neat sketch. (7M)

   b) Locate the centre of the gravity of an idealized bullet of 1 cm diameter with a cone in the front and a hemisphere cut from the back as shown in figur. Assume the material to be homogeneous. (8M)




Figure

7. a) Define position vector, velocity and acceleration in a typical curvilinear motion. (6M)

   b) A particle is thrown vertically up with a velocity of 20 m/sec. Three seconds later a second particle is shot up with a velocity of 30 m/sec. Determine the height and time at which the two particles cross each other. (9M)

Or

8. a) Derive expressions for normal and tangential accelerations. (7M)

   b) The motion of a particle is given by the equation $x= t^3-3t^2-9t+81$. Determine the location, time and acceleration of the particle when its velocity becomes zero. (8M)

9. a) A block of mass 10 kg is dragged up an inclined plane by a rope inclined at $20^o$ to the plane while the plane is inclined at $30^0$ to the horizontal. Find the velocity of the block after 5 seconds if dragged from rest. Take coefficient of kinetic friction between the block and plane as 0.25. Also assume that a force of 150 N is applied through the rope for dragging the block upwards the plane. Apply impulse moment equation. (10M)

   b) State and derive work energy equation. (5M)

Or

10. a) Explain about fixed axis rotation and plane motion? (8M)

    b) A filed gun of weight 40 kN fires a shell of weight 600 N at a velocity of 300 m/sec. what is the velocity of recoil of the gun? What force is required to stop the gun in a distance of 0.5m? Calculate the time required to stop the gun. (7M)

Code No: R19ES1204 **R19** SET - 4

**I B. Tech II Semester Regular Examinations, December - 2020**
**ENGINEERING MECHANICS**
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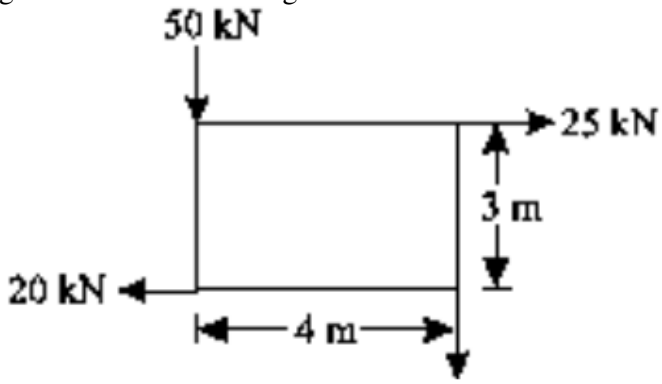
Time: 3 hours Max. Marks: 75

**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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1. a) Define and explain the moment of a force. State its applications. (5M)

   b) A system of forces is acting at the corners of a rectangular block as shown in figure. Determine the magnitude and direction of the resultant force. (10M)



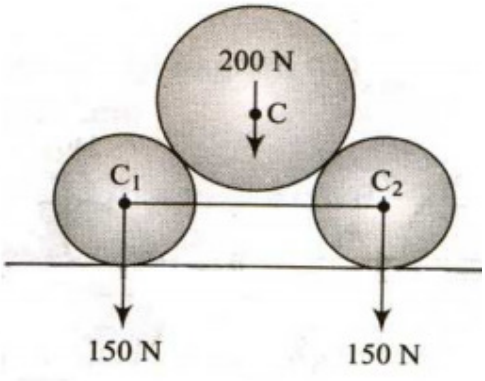

Figure

Or

2. a) An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° the force acting parallel to the plane. If the angle of inclination of the plane is made 20° the effort required, again applied parallel to the plane, is found to be 230 N. Find the weight of the body and the coefficient of friction. (8M)

   b) Classify different types of Force Systems. Explain in brief. (7M)

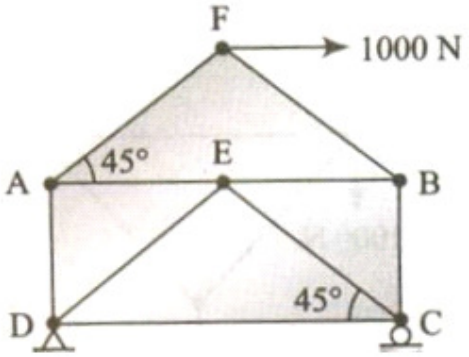
3. Two identical iron spheres each of radius 5cm and weight 150 N is connected with a string of length 16cm, and rest on a horizontal smooth floor. Another sphere of radius 6cm and weight 200N rest over them. Determine the tension in the string and reaction at all contact surfaces [shown in figure] (15M)




Figure

Or
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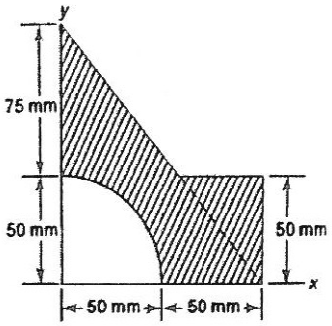
4. a) Determine the induced axial force in the bottom tie member DC of loaded frame shown in figure. (9M)




Figure

b) State the conditions of equilibrium of a system of forces acting on a body as applicable to (i) graphical method (ii) analytical method. (6M)

5. a) With respect to coordinate axes x and y, locate the centroid C of the shaded area as shown in figure. (9M)



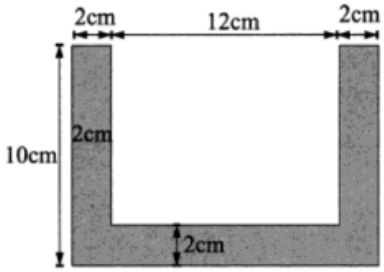

Figure

b) Explain the terms: (6M)
(i) Moment of inertia
(ii) Polar moment of inertia
(iii) Product of inertia

Or

6. a) Determine centriod for the rectangle lamina, having a width of "b" and height of "h". (8M)

b) Find the moment of inertia of a section, shown in figure about x-axis through the centroid of the section. (7M)




Figure

7. a) Explain the terms displacement, velocity and acceleration connected to rectilinear translation. (8M)

   b) A stone is dropped into a well. It is heard to strike the water after 5 seconds. Find the depth of the well assuming sonic velocity in air =360 m/sec. (7M)

Or

8. a) State the advantages and applications of work-energy theorem? (8M)

   b) A bullet fired at a speed of 300 m/sec penetrates a log of wood to a depth of 450 mm. If the bullet moving at the same speed is fired into a similar piece of wood 200mm thick. determine the velocity of emergence of the bullet. Assume the resistance to be uniform in both the cases. (7M)

9. A body weighting 196.2 N slides up a $30^0$ inclined plane under the action of an applied force 300 N acting parallel to the inclined plane. The coefficient of friction μ is equal to 0.2. The body moves from rest. Determine: (15M)
   (i) acceleration of the body
   (ii) distance travelled by body in four seconds
   (iii) velocity of body after four seconds
   (iv) kinetic energy of the body after four seconds
   (v) work done on the body in four seconds
   (vi) Impulse applied in four seconds

Or

10. a) What is the energy of the motion for a rigid body rotating about a fixed axis? (7M)

    b) A truck of weight 20 kN is travelling at 45 km/hr on a level road. It is brought to rest in 20 meter, what is the average force of resistance acting on the truck. (8M)