Code No: R05010302 **Set No. 1**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A system of forces consists of
   i. Force P_1 = 3i + 5j – 6k acting through point (2,1,-3)
   ii. Force P_2 = 5i – 4j + 3k acting through point (1,4,2) and a moment

   M = 20i – 35j + 60k. The forces are in Newton (N) units, distances in 'm' units and the moment in 'N-m' units. Calculate
   i. The component of the resultant forces and its magnitude
   ii. The total moment of the system about the origin 'O'.
   iii. The moment of the system about the line through 'O' drawn in the 1^{st}octant which makes angles of 65^0 and 75^0 with X and Y axes respectively.

   (b) Write the Equilibrium equations for concurrent force system in space. [12+4]

2. The three flat blocks are positioned on the 30^0 incline as shown in Figure2, and a force P parallel to the incline is applied to the middle block. The upper block is prevented from moving by a wire which attaches it to the fixed support. The coefficient of static friction for each of the three pairs of mating surfaces is shown. Determine the maximum value which P may have before any slipping takes place. [16]

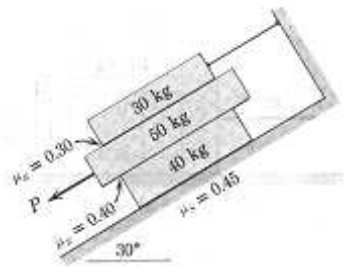


Figure 2

3. An open belt running over two pulleys 240 mm and 600mm diameters connects two parallel shafts 3000mm apart and transmits 4KW from the smaller pulley that rotates at 300 r.p.m. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10 N/mm width.
   Determine :

(a) Minimum width of the belt.

(b) Initial belt tension and

(c) Length of the belt required. [16]

4. (a) Explain the terms:
   i. Moment of inertia
   ii. Polar moment of inertia
   iii. Product of inertia.

   (b) Locate the centroid of the shaded area as shown in the Figure4b. [6+10]

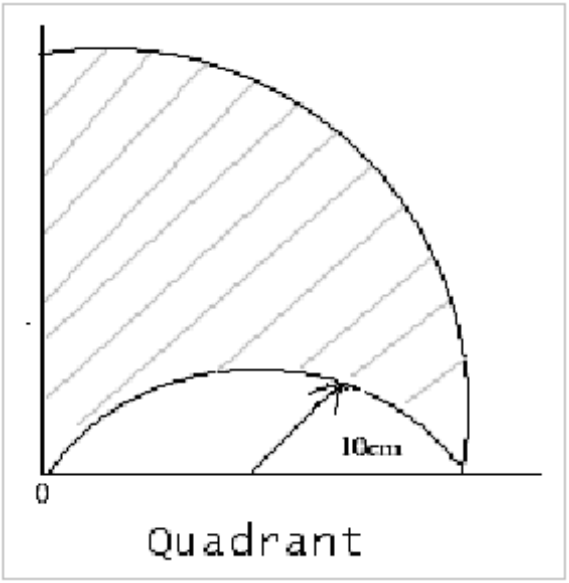


Figure 4b

5. The area shown in figure5 is revolved about x –axis to form a homogeneous solid of revolution of mass 'm'. Determine the mass moment of inertia of the solid about x-axis. [16]

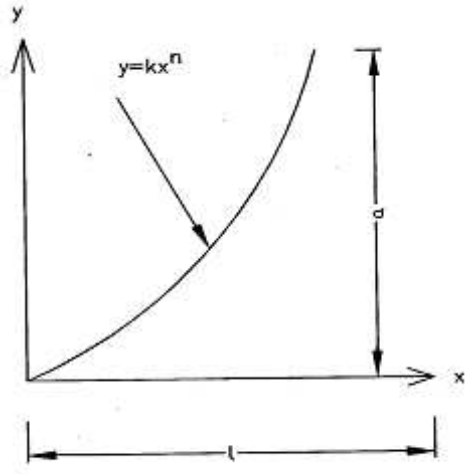


Figure 5

6. (a) A small grinding wheel is attached to the shaft of an electric motor which has a rated speed of 3000r.p.m . When the power is turned on, the unit reaches its rated speed in 5secs and when the power is turned off, the unit comes to rest in 60secs. Assuming the acceleration to be uniform, find the number of revolutions that the motor executes

   i. in reaching its rated speed and

   ii. to come to rest.

   (b) A cord is wrapped around a wheel which is initially at rest as shown in (figure6b)

   Force is applied to the cord and is gives an acceleration a=6t $m/s^2$where t is in seconds. Determine

   i. The angular velocities of the wheel

   ii. The angular position of radial line OP as a function of time. [8+8]

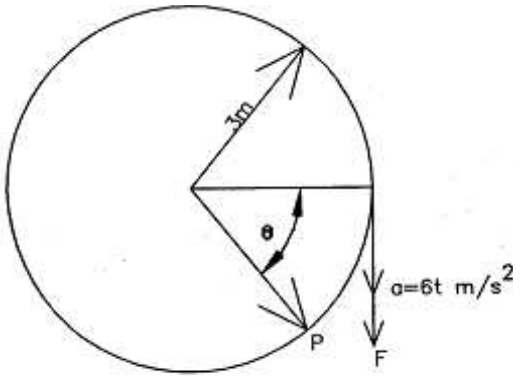


Figure 6b

7. (a) A homogeneous solid cylinder of weight 100 N whose axis is horizontal rotates about its axis, in frictionless bearings under the action of the weight of a 10N block which is carried by a rope wrapped around the cylinder. What will be angular velocity of cylinder two seconds after the motion starts? Assume the diameter of cylinder as 100cm.

   (b) A block of mass 5Kg resting on a 30^0 inclined plane is released. The block after travelling a distance of 0.5m along the inclined plane hits a spring of stiffness 15N/cm. Find the maximum compression of spring. Assume coefficient of friction between the block and the inclined plane is 0.2. As shown in the Figure 7b. [8+8]

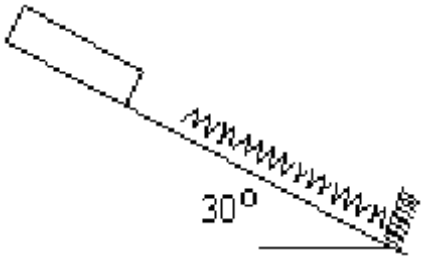


Figure 7b

8. A pendulum having a time period of 1 sec. is installed in a lift. Determine its time period when
   (a) the lift is moving upwards with an acceleration of $\frac{g}{10}$.
   (b) the lift is moving downwards with an acceleration of $\frac{g}{20}$. [16]

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Code No: R05010302 **Set No. 2**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) A Prismatic bar AB of weight 'W' is resting against a smooth vertical wall at 'A' and is supported on a small roller at the point 'D'. If a vertical force F is applied at the end 'B', Find the position of equilibrium as defined by the angle 'θ'.{As shown in the Figure1a}.

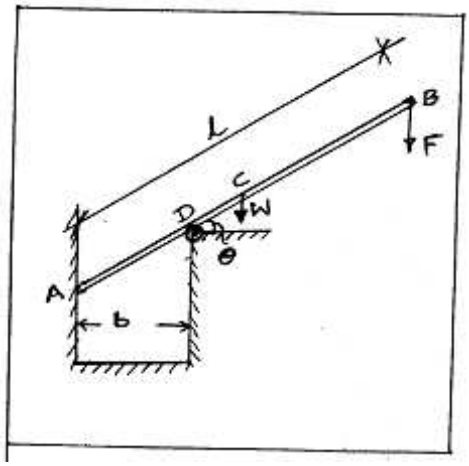


Figure 1a

(b) Two rollers of weights P and Q are connected by a flexible string DE and rest on two mutually perpendicular planes AB and BC, as shown in figure 1b. Find the tension ('T') in the string and the 'θ' that it makes with the horizontal when the system is in equilibrium. The following numerical data are given. P= 270 N, Q = 450 N, $\alpha = 30^0$. Assume that the string is inextensible and passes freely through slots in the smooth inclined planes AB and BC. [6+10]

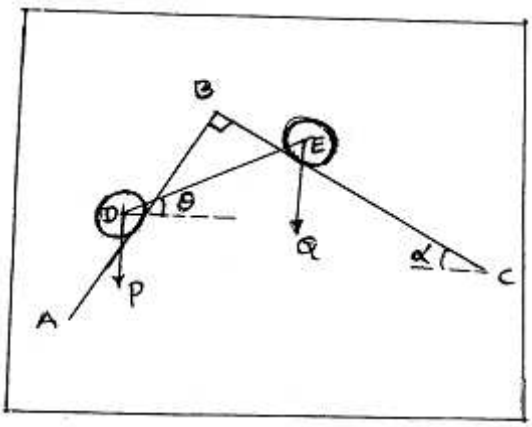


Figure 1b

2. (a) A block of weight $W_1 = 200$ N rests on a horizontal surface and supports on top of it another block of weight $W_2 = 50$ N . The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P, applied to the lower block as shown, that will be necessary to cause slipping to impend. The coefficient of static friction for all contact surfaces is $\mu = 0.3$.{As shown in the Figure2a}

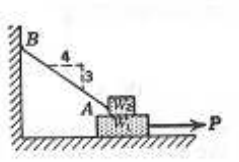


Figure 2a

(b) Two rectangular blocks of weights W_1 and W_2 are connected by a flexible cord and rest upon a horizontal and an inclined plane, respectively, with the cord passing over a pulley as shown in Figure2b. In the particular case where $W_1 = W_2$ and the coefficient of static friction μ is the same for all contact surfaces, find the angle α of inclination of the inclined plane at which motion of the system will impend. Neglect friction in the pulley. [8+8]

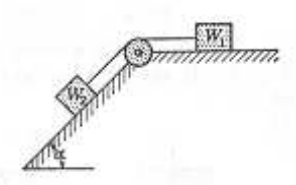


Figure 2b

3. (a) Distinguish between cone pulley and loose & fast pulley drive.

(b) A shaft rotating at 200 r.p.m drives another shaft at 300 r.p.m and transmits 6KW through a belt, the belt is 100mm wide and 10mm thick. The distance between the shafts is 4000mm the smaller pulley is 500mm in diameter calculate the stress in,

i. Open - belt and

ii. Crossed belt. Take $\mu = 0.3$. Neglect centrifugal tension. [6+10]

4. Determine the moment of inertia of a triangle about x – x axis as shown in figure 4. [16]

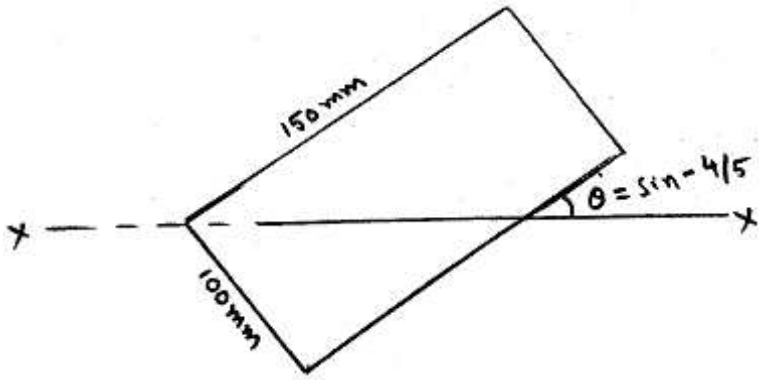


Figure 4

5. A cylinder of diameter 500 mm and height 1200 mm has mass density of 8000 kg/m^3. Find out the mass moment of inertia of the cylinder

   (a) with respect to the axis of the cylinder and

   (b) about a line which coincides with an end face of the cylinder and passing through the centre of this face. [16]

6. (a) A train is uniformly accelerated and passes successive kilometer stones with velocities of 18km/hr and 36km/hr respectively. Calculate the velocity when it passes the third kilometer stone. Also find the time taken for each of the two intervals of one kilometer.

   (b) A ball projected vertically upwards attains a maximum height of 400 metres. Calculate the velocity of projection and compute the time of flight in air. At what altitude will this ball meet a second ball projected vertically upwards 4 seconds later with a speed of 120 metres per second? [8+8]

7. (a) A homogeneous sphere of radius of a=100 mm and weight W=100 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed n=180rpm, in 12 revolutions, find the acting moment. .

   (b) A block starts from rest from'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane.
   As shown in the Figure7b. [8+8]

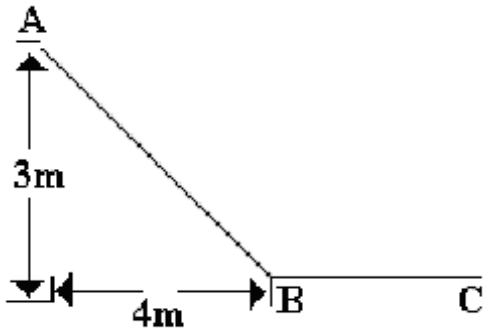


Figure 7b

8. The circular disc shown in the figure8 has a radius r=150 mm and weight of 225 N. The observed frequency of torsional vibration is 1 oscillation/sec. When another body is attached to the same shaft the observed frequency of torsional vibration is 1.2 oscillations/sec. Find the moment of inertia of the second body with respect to the axis of the shaft. [16]

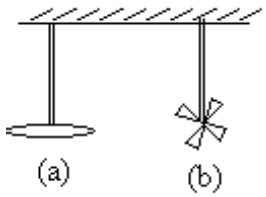


Figure 8

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Code No: R05010302 **Set No. 3**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define free body diagram, Transmissibility of a force and resultant of a force.
   (b) Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in Figure1b. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [6+10]

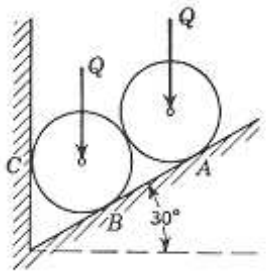


Figure 1b

2. (a) A solid right circular cone of altitude h= 305 mm and reduces of base r = 75 mm has its center of gravity 'C' on its geometric axis at the distance $\frac{h}{4}$ above the base. This cone rests on an inclined plane AB, which makes an angle of 30^0 with the horizontal and for which the coefficient of friction is μ = 0.5. A horizontal force 'P' is applied to the Vertex 'O' of the cone of the figure2a as shown. Find the maximum and minimum values of P consistent with equilibrium of the cone. If the weight (W) = 405 N.

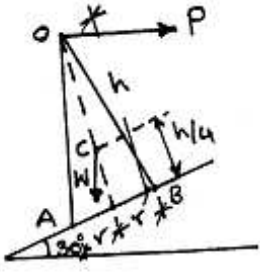


Figure 2a

   (b) What must be the angle α between the plane faces of a steel wedge used for splitting logs if there is to be no danger of the wedge slipping out after each blow of the sledge? [12+4]

3. (a) Derive an expression for length of an open belt in standard form.

(b) A belt is running over a pulley of diameter 1200 mm at 200 r.p.m. The angle of contact is 165^0 and coefficient of friction between the belt and pulley is 0.3 If the maximum tension in the belt is 3000 N, find the power transmitted by the belt. [6+10]

4. Determine the moment of inertia of a triangle about x – x axis as shown in figure 4. [16]

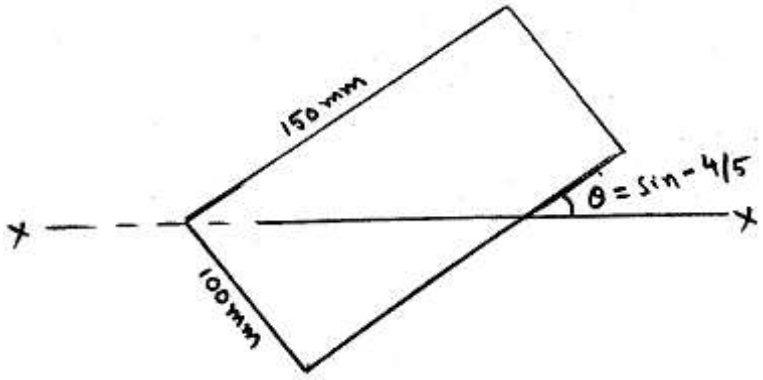


Figure 4

5. (a) Define mass moment of inertia and explain Transfer formula for mass moment of inertia.

   (b) Derive the expression for the moment of inertia of a homogeneous sphere of radius 'r' and mass density 'w' with reference to its diameter. [8+8]

6. (a) The motion of a disk rotating about a fixed point is given by the relation $\theta = 2(1 + e^{-3t})$ where θ is in radians and 't' is in seconds. Determine the angular coordinates, velocity and acceleration of the disk when

      i. t=0 and

      ii. t=2secs.

   (b) A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 12m short when the angle of projection is 15^0 while it overshoots the mark by 24m when the angle of projection is 45^0. Find the angle of projection to hit the mark neglecting the resistance of air. Take g = 9.81 m/s^2. [8+8]

7. If W_a:W_b:W_c is in the ratio of 3:2:1 , find the accelerations of the blocks A, B, and C. Assume that the pulleys are weightless. {As shown in the Figure7}. [16]

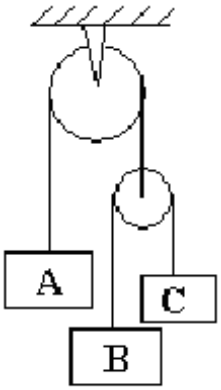


Figure 7

8. Determine the period of vibration of a weight 'P' attached to springs of stiffness k_1 and k_2, in two different cases as shown in the figure 8. [16]

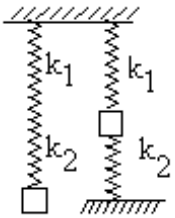


Figure 8

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Code No: R05010302 **Set No. 4**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A ladder supported at A and B, as shown in figure1a, a vertical load W can have any position as defined by the distance 'a' from the bottom. Neglecting friction, determine the magnitude of the reaction R_b at B. Neglect the weight of the ladder.

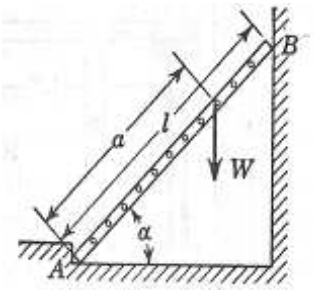


Figure 1a

(b) A rigid bar AB is supported in a vertical plane and carries a load Q at its free end as shown in figure1b. Neglecting the weight of the bar compute the force (S) induced in the horizontal string CD. [8+8]

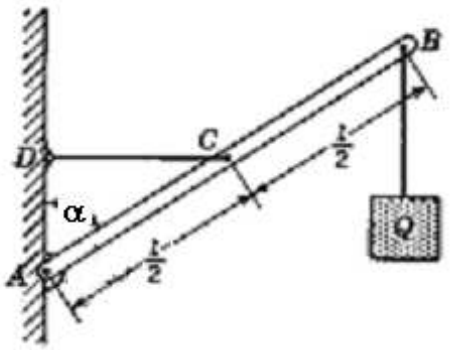


Figure 1b

2. The two 5^0 wedges shown in Figure2 are used to adjust the position of the column under a vertical load of 5 kN. Determine the magnitude of the forces P required to raise the column if the coefficient of friction for all surfaces is 0.40. [16]

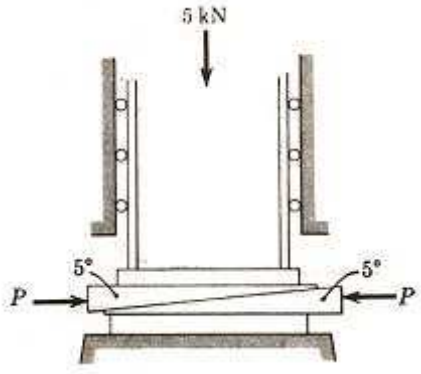


Figure 2

3. An open belt running over two pulleys 1500 mm and 1000 mm diameters connects two parallel shafts 48000 mm apart. The initial tension in the belt when stationary is 3000N. If the smaller pulley is rotating at 600 r.p.m and coefficient of friction between the belt and pulley is 0.3. Determine the power transmitted taking centrifugal tension into account. The mass of belt is given as 0.6703 kg/m length. [16]

4. (a) Explain the transfer formula for product of inertia
   (b) Find the moment of inertia for the shaded area parallel to x – axis. As shown in the Figure4b. [6+10]

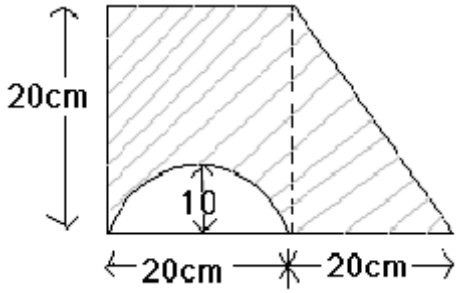


Figure 4b

5. (a) Define mass moment of inertia and explain Transfer formula for mass moment of inertia.
   (b) Derive the expression for the moment of inertia of a homogeneous sphere of radius 'r' and mass density 'w' with reference to its diameter. [8+8]

6. (a) A car starts from the rest on a straight road and travels with uniform acceleration of $0.8\text{m}/s^2$ for the first 10sec and then travels with uniform velocity for the next 30 sec. It then decelerates at the rate of $0.5\text{m}/s^2$ and comes to rest. Determine
      i. Total time taken to complete the trip
      ii. Total distance travelled
   (b) A fighter plane is directly over an antiaircraft gun at time t=0 and at an altitude of 1800m. The plane is moving with a speed of 600 km/hour. A shell

is fired at time t=0 in an attempt to hit the plane. If the muzzle velocity is 1000m/sec, find out the angle at which the gun should be held. [8+8]

7. (a) A homogeneous sphere of radius of a=100 mm and weight W=100 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed n=180rpm, in 12 revolutions, find the acting moment. .

   (b) A block starts from rest from'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane.
   As shown in the Figure7b. [8+8]

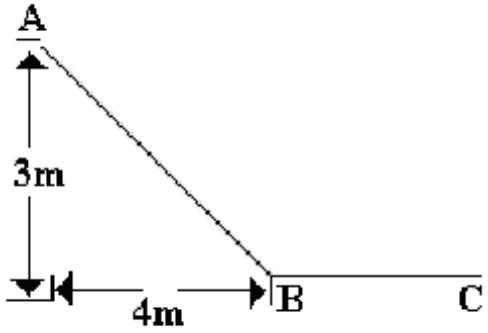


Figure 7b

8. Determine the frequency of torsional vibrations of the disc shown in figure 8 if both the ends of the shaft are fixed and diameter of the shaft is 40mm. The disc has a mass of 600Kg, and a radius of gyration of 0.4m.Taking modulus of rigidity for the shaft material as 85GN/m^2.l_1=1m, and l_2= 0.8m. [16]



Figure 8

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