BME-Second Year, First Semester Examination, 2023

Engineering Dynamics

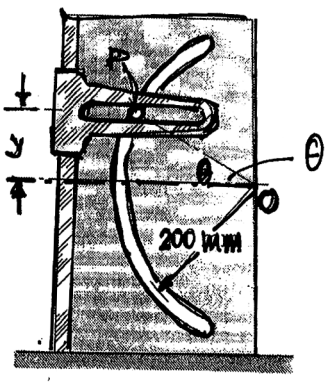
Full Marks: 100 **Time: 3.0 Hours**

Answer For Hundred (100) Marks by suitably selecting the questions

[Assume any missing data with proper justifications]

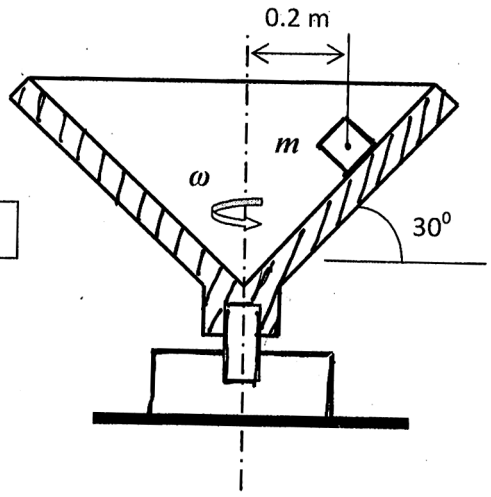
1) Refer **Fig Q1**. The guide with the horizontal slot is made to move up the vertical edge of the fixed plate at the constant rate $\dot{y} = 2\ m/s$ before reversing the direction of its motion at y=**175 mm**. Pin **P** is constrained to move in both the horizontal and circular slots whose radius is **200 mm**. Calculate the angular acceleration $\ddot{\theta}$ of line **OP** for the instant when y=**100 mm**. **15**

Fig Q1



2) Refer **Fig Q2**. The small object is placed on the surface of the conical dish at the radius shown. If the coefficient of friction between the object and the conical surface is **0.3**, for what range of angular velocities ω about the vertical axis will the block remain on the dish without slipping? Assume that speed changes are made slowly so that any angular acceleration may be neglected. **15**

Fig Q2



3) Refer **Fig Q3.** The **4.0 kg** sphere is rigidly mounted on the lower of the two hinged rods of negligible mass which lie in the vertical plane. The spring has an unstretched length of **800 mm** and a stiffness of **60 N/m**. If the assembly is released from rest in the position for which $\theta = 60^0$, determine the velocity v of the sphere when the position $\theta = 90^0$ is reached. **15**

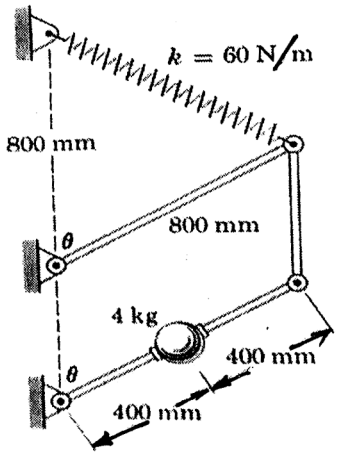
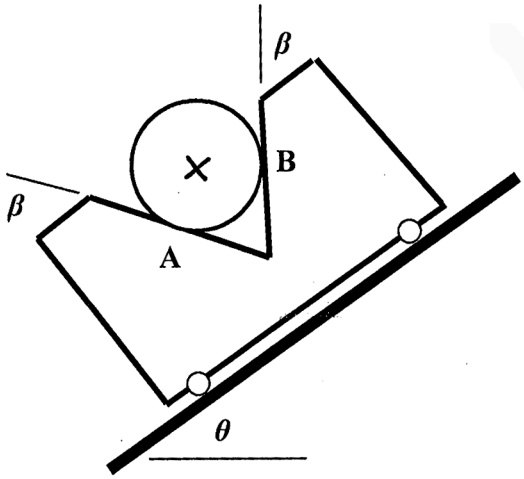


Fig Q3

4) Refer **Fig Q4**. The cylinder of mass m and supporting carriage are moved up an inclined plane assumed frictionless. Calculate the maximum acceleration in m/s^2 which the carriage may be given up the incline so that the cylinder does not loose contact at **B**. Take $\beta = 45^0$ and $\theta = 30^0$. **15**

Fig Q4



5) A mechanism is shown in **Fig Q5.** The crank rotates with a uniform angular velocity ω as shown. Find the angular velocity and angular acceleration of the roller which rolls without slipping on a horizontal rough surface at the instantaneous configuration as shown in the figure. **15**

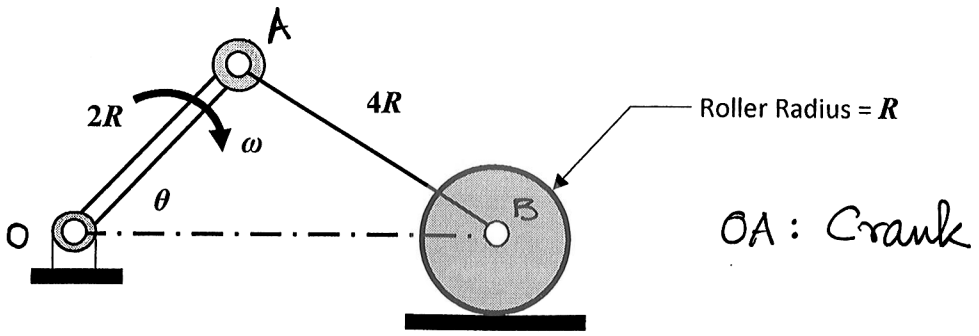


Fig Q5

6) A uniform, slender and homogenous rod **AB** of mass M as shown in the **Fig Q6** is released from rest in the vertical plane. The end **B** is fitted with a light roller which moves freely in a smooth inclined plane. Calculate the angular acceleration and the acceleration of the centre of mass of the rod at the time of release. **20**

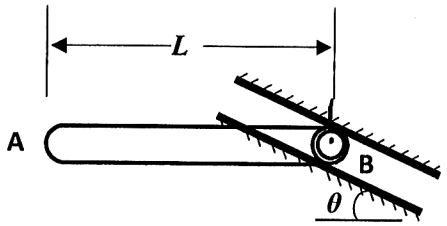


Fig Q6

7) Refer **Fig Q7**. The mass of the cylinder assembly is **100 kg**. The outer rims are provided to roll on the horizontal rail. The mass of the block suspended by an inextensible light string wrapped securely on the hub of the cylinder assembly, is **10 kg**. The radius of the hub of the cylinder assembly is **100 mm and the radius of the rim of the assembly is 200 mm**. The system is initially at rest. The coefficient of friction between the cylinder and horizontal rail surface is **0.5**. What is going to happen to the system i.e., will remain at rest, will move by slipping, will move by rolling. In case it moves, find the **angular acceleration** of the cylinder. Assume centroidal radius of gyration of the assembly to be $50\sqrt{2}$ mm

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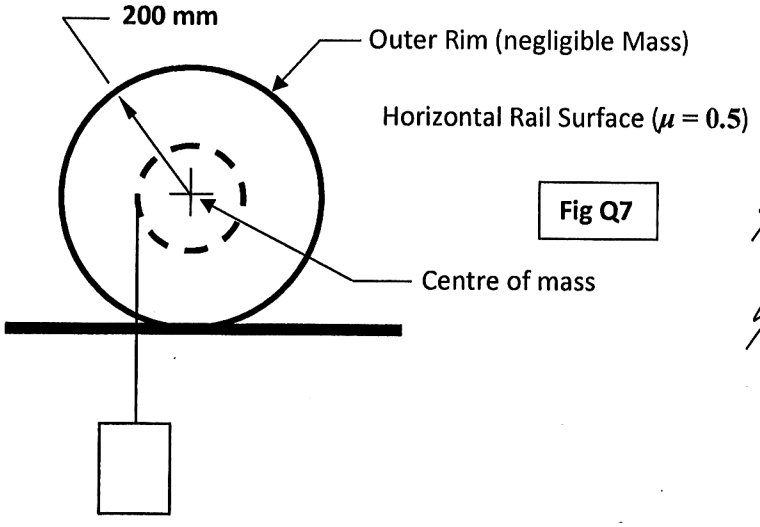
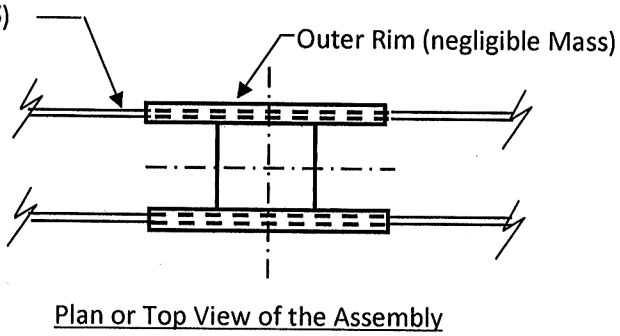


Fig Q7



Plan or Top View of the Assembly

8) If the arm of the mechanism show in **Fig Q8** rotates about a horizontal axis through **O** and if the collar **C** has a mass m, find the tension developed in the string at its attachment to **C** as a function of θ. The angular velocity of **OB** is $\omega = \dot{\theta} = constant$. Also assume when $\theta = 0$, $r = 0$ also. What is the maximum speed $\dot{\theta}_{max}$ for a given θ, of the arm before the tension goes to zero? **20**

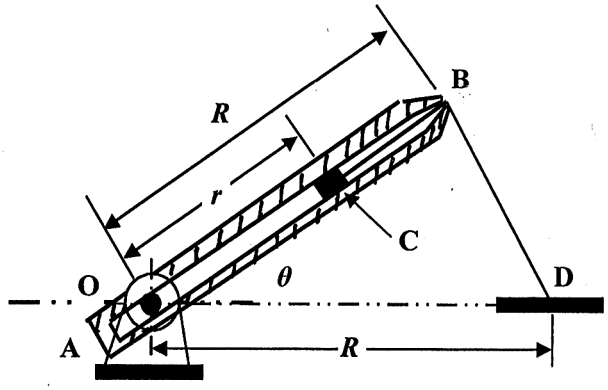


Fig Q8