

B. E. MECHANICAL ENGINEERING EXAMINATION, 2022

(2nd Year, 2nd Semester)

ADVANCED ENGINEERING MECHANICS

Time : Three hours

Full Marks : 100

All questions carry equal marks

1. Refer Fig Q1. The collar at O and attached shaft OC rotates about the fixed x_0 axis at the constant rate $\Omega=4$ rad/s. Simultaneously, the circular disc rotates about OC at the constant rate $p=10$ rad/s. Using vector method -
 - (i) Determine the magnitude of the total angular velocity ω and the angular acceleration α of the disc.
 - (ii) Determine the velocity v_A and acceleration a_A of point A on the disc as it passes the position shown.

2. Refer Fig Q2. Prove that the moment of inertia of the rigid assembly of three identical balls each of mass m and radius r has the same value for all axes through O.

3. Refer Fig Q3. The 100 mm radius wheel has a mass of 3 kg and turns about its y' axis with an angular velocity $p=40\pi$ rad/s in the direction shown. Simultaneously the fork rotates about its x axis shaft with an angular velocity $\omega=10\pi$ rad/s as indicated.
 - (i) Calculate the angular momentum of the wheel about its centre O' .
 - (ii) Calculate the kinetic energy of the wheel.

4. Refer Fig Q4. The slender rod carries two offset particles each of mass m and rotates about the z axis with an angular velocity ω as indicated in the figure. Determine the x and y components of bearing reactions at A and B due to the dynamic imbalance of the shaft for the position shown in the figure. Use appropriate equations of dynamics.

5. Deduce Euler's equation for three dimensional rigid body motion.

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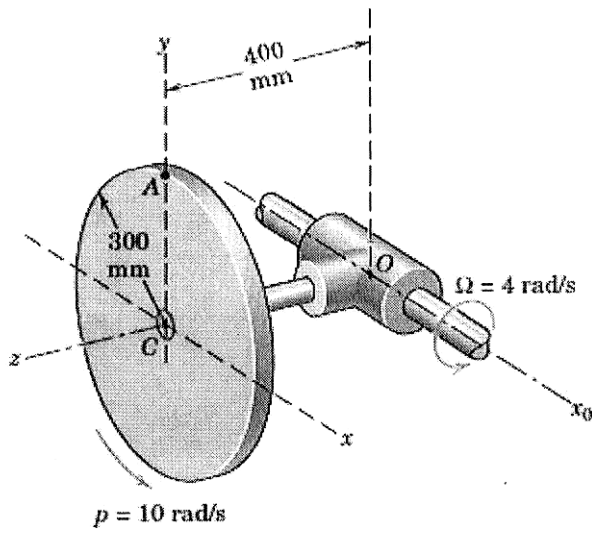


Figure Q1

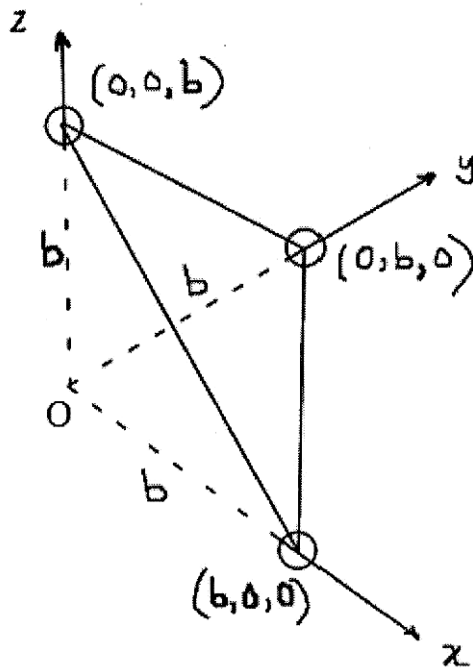


Figure Q2

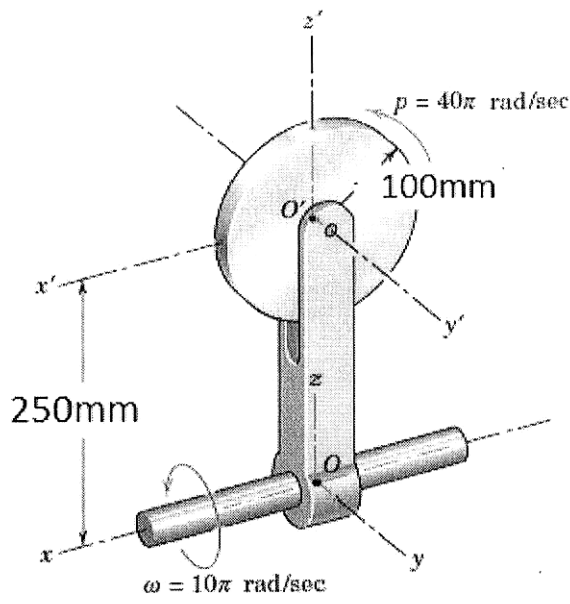


Figure Q3

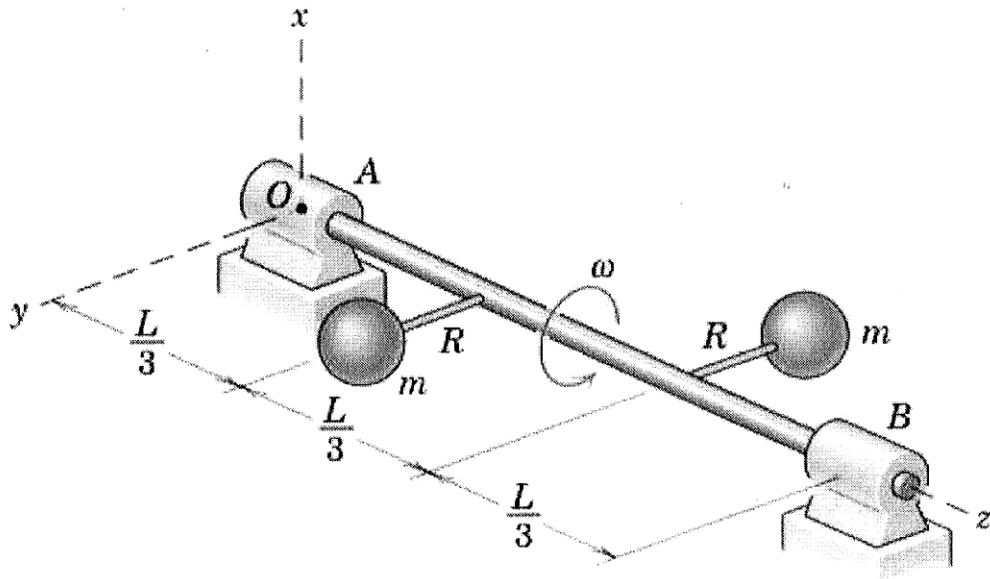


Figure Q4