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Department of Mechanical-Eng and Electro-mechanical
Rational Mechanics

2nd Year

Series 03:

EXERCISE 1

The fixed hydraulique cylinder ***C*** imparts a constant upward velocity ***v*** to the collar ***B***, which slips freely on rod ***OA*** shown in the figure 1. **Determine** the resulting angular velocity ω_{OA} in terms of ***v***, the displacement ***s*** of point ***B***, and the fixed distance ***d***.

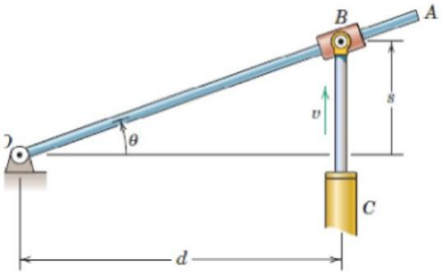

Figure.1

EXERCISE 2

A cylinder of radius ***R* = 20 cm** rolls on a flat surface with absolute angular speed **ω =*12* rad/s** under the conditions shown in the figure 2 (In cases (ii) and (iii), you may think of the 'flat surface' as a conveyor belt). In each case

(a) Write the condition of pure rolling.

(b) Find the velocity of the center ***C*** of the cylinder.

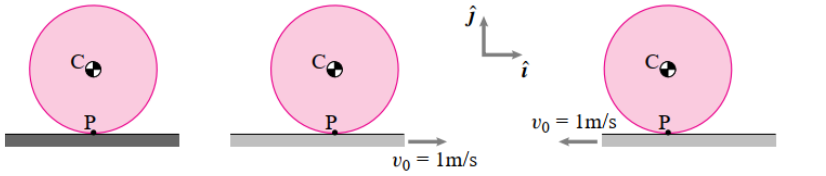

Figure.2 (i) Fixed base (ii) Base moves to the right (iii) Base moves to the left

EXERCISE 3

The bowling ball shown rolls without slipping on the horizontal ***xz*** plane with an angular velocity $\boldsymbol{\omega} = \omega_x \mathbf{i} + \omega_y \mathbf{j} + \omega_z \mathbf{k}$ shown in the figure 3. Knowing that

$\boldsymbol{v_A}$ = (4.8 m/s) **i** – (4.8 m/s) **j** + (3.6 m/s) **k** and

$\boldsymbol{v_D}$ = (9.6 m/s) **i** + (7.2 m/s) **k**. **Determine**

(a) Angular velocity of the bowling ball.

(b) The velocity of its center ***C***.

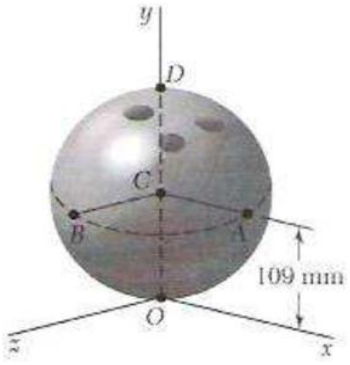

Figure.3

EXERCISE 4

A ***60 mm*** radius disk spins at constant rate ω_2 ***=4 rad/s*** about an axis held by housing attached to the horizontal rod that rotates at the constant rate ω_1 ***=5 rad/s***. Knowing that θ***=30°***, **determine** the acceleration of point ***P*** on the rim of the disk (figure 4)

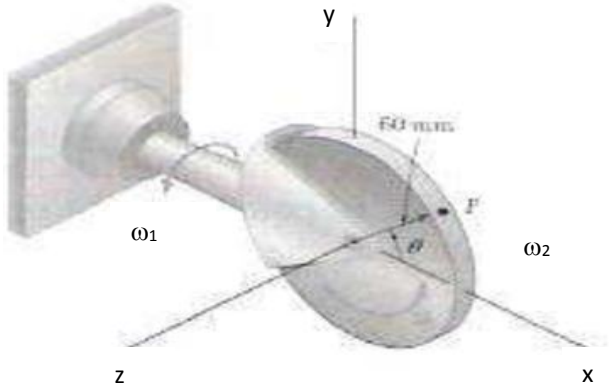

Figure.4

EXERCISE 5

A square plate of side ***360 mm*** is hinged at ***A*** and ***B*** to a clevis. The plate rotates at the constant rate ω_2 ***= 4 rad/s*** with respect to the clevis, which it self rotates at the constant ω_1 ***= 3 rad/s***, about the ***Y*** axis. For the position shown in the figure 5, **determine**

a) The velocity of corner ***D***,

b) the acceleration of corner ***D***.

Figure.5