KINEMATICS OF PARTICLES

- **SPACE CURVILINEAR MOTION**

ASSIGNMENT 4 : Due: Thursday 19th September, 2024

INSTRUCTIONS: Please show your working clearly and use the SI units for all your calculations.

Question 1

2/181 At the bottom of a vertical loop in the x-y plane at an altitude of 400 m, the airplane has a speed of 600 km/h with no horizontal x-acceleration. The radius of curvature of the loop at the bottom is 1200 m. For the radar tracking at O, determine the recorded values of $\ddot{R}$ and $\ddot{\phi}$ for this instant.
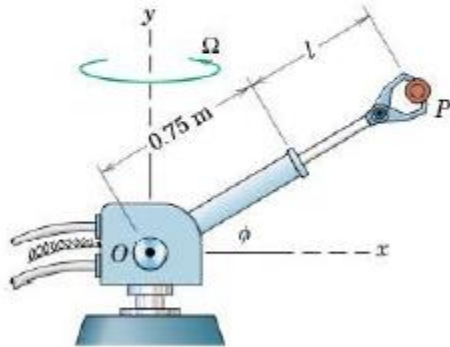
Ans. $\ddot{R} = 34.4$ m/s^2, $\ddot{\phi} = 0.01038$ rad/s^2
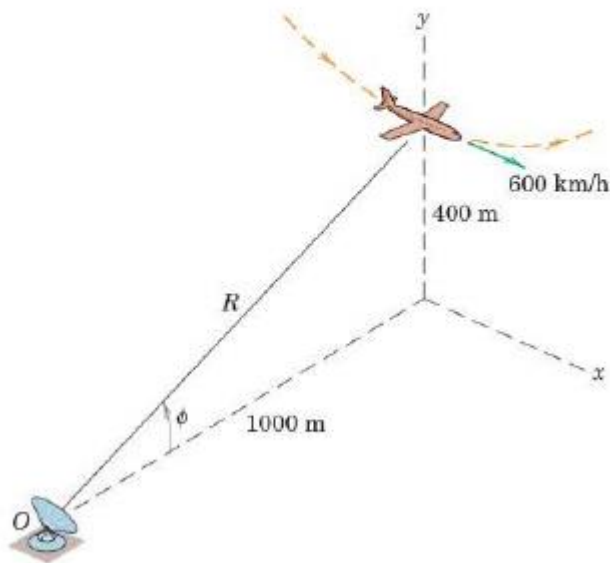
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Question 2

2/182 The robotic device of Prob. 2/162 now rotates about a fixed vertical axis while its arm extends and elevates. At a given instant, $\phi = 30°$, $\dot{\phi} = 10$ deg/s = constant, $l = 0.5$ m, $\dot{l} = 0.2$ m/s, $\ddot{l} = -0.3$ m/s², and $\Omega = 20$ deg/s = constant. Determine the magnitudes of the velocity **v** and the acceleration **a** of the gripped part P.
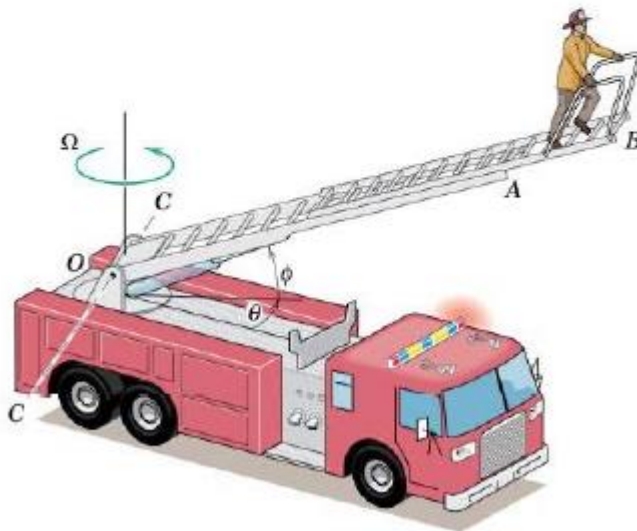

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Question 3

2/183 The base structure of the firetruck ladder rotates about a vertical axis through O with a constant angular velocity $\Omega = 10$ deg/s. At the same time, the ladder unit OB elevates at a constant rate $\dot{\phi} = 7$ deg/s, and section AB of the ladder extends from within section OA at the constant rate of 0.5 m/s. At the instant under consideration, $\phi = 30°$, $\overline{OA} = 9$ m, and $\overline{AB} = 6$ m. Determine the magnitudes of the velocity and acceleration of the end B of the ladder.

Ans. $v = 2.96$ m/s, $a = 0.672$ m/s^2

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