ENME 232: Dynamics
Quiz 1

Name: Solution
Student ID:

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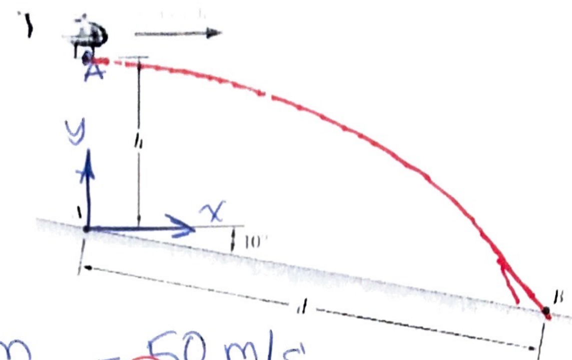
1. (10 points) A helicopter is flying with a constant horizontal velocity of 180 km/h and is directly above point A when a loose part begins to fall. The part lands 6.5 s later at point B on an inclined surface. Determine the distance d between points A and B, and the initial height h.



$$\frac{180\ km}{h} = \frac{180 \times 1000\ m}{60 \times 60\ s} = 50\ m/s \quad (2)$$

Horizontally

$$x_B = x_A + v_{Ax} t_{AB} \quad (1)$$

$$d \cos 10 = 0 + 50 \times 6.5 \quad (2)$$

$$\boxed{d = \frac{325}{0.985} = 329.95\ m} \quad (1)$$

(4)

Vertically

$$y_B = y_A + v_{Ay} t_{AB} - \frac{1}{2} g t_{AB}^2 \quad (1)$$

$$-d \sin 10 = h + 0 - \frac{1}{2}(9.81)(6.5)^2 \quad (2)$$

$$-57.3 = h - 207.24$$

$$\boxed{h = 149.94\ m} \quad (1)$$

(4)

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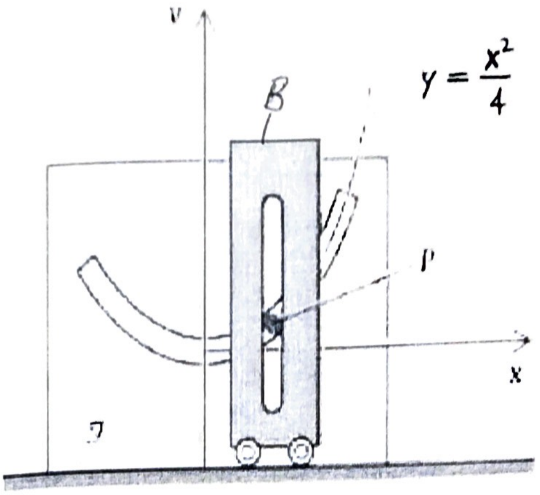
1. (10 points) The pin P shown in the Figure moves in a parabolic slot cut in a reference frame, and is guided by the vertical slot in body B. If $x = 0.05t^2$ m, find the acceleration of point P at $t = 5$ s. Also, find the time(s) when the x and y components of the acceleration are equal.



$x = 0.05t^2$

$\dot{x} = 0.1t$

$\ddot{x} = 0.1$

@ $t = 5$ s $\rightarrow$ $x = 1.25$ m

$\dot{x} = 0.5$ m/s

$\ddot{x} = 0.1$ m/s^2

$y = \frac{x^2}{4} = \frac{(0.05t^2)^2}{4} = 0.000625\,t^4$

$\dot{y} = 0.0025\,t^3$

$\ddot{y} = 0.0075\,t^2$

@ $t = 5$ s $\rightarrow$ $y = 0.39$ m

$\dot{y} = 0.3125$ m/s

$\ddot{y} = 0.1875$ m/s^2

$a_x = \ddot{x} = 0.1$ m/s^2

$a_y = \ddot{y} = 0.1875$ m/s^2

$|\vec{a}| = \sqrt{a_x^2 + a_y^2}$

$\boxed{|\vec{a}| = 0.2125 \text{ m/s}^2}$

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When does $a_x = a_y$?

$0.1 = 0.0075t^2 \Rightarrow \boxed{t = 3.65 \text{ s}}$

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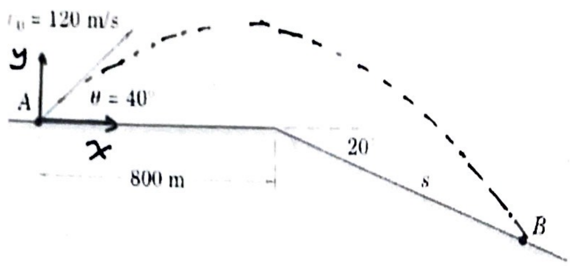
1. (10 points) A projectile is launched from point A with the initial conditions shown in the figure. Determine the distance s on the incline, and the time of flight t.



Horizontally A - B

$$x_B = x_A + v_{A_x} t_{AB}$$

$$800 + S\cos 20 = 0 + 120 \cos 40\, t$$

$$\boxed{800 + 0.94\, S = 91.93 t} \quad \text{---}(1)$$

Vertically A-B

$$y_B = y_A + v_{Ay} t_{AB} - \frac{1}{2} g\, t_{AB}^2$$

$$-S \sin 20 = 0 + 120 \sin 40\, t - \frac{1}{2}(9.81)\, t^2$$

$$\boxed{-0.342\, S = 77.13 t - 4.905 t^2} \quad \text{---}(2)$$

From (2)

$$S = -225.53 t + 14.34 t^2 \rightarrow \text{substitute in } (1)$$

$$800 - 211.99 t + 13.564 t^2 = 91.93 t$$

$$13.564 t^2 - 303.92 t + 800 = 0$$

Solve for t: $t_1 = 19.19\, S \Rightarrow S = 1025.7$ m

$t_2 = 3.05\, S \Rightarrow S = -552.8$ m

X

$\therefore$ The answer is $\boxed{S = 1025.7\, m}$ ###