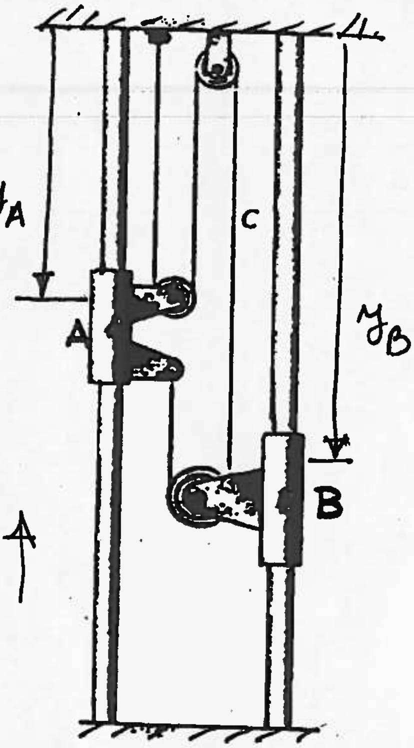
CONCORDIA UNIVERSITY
FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

ENGR 243/1	**DYNAMICS**	**SECTION: T**
Date: February 7, 2012	**MID TERM TEST 1**	**Time: 11:45-13:00 hrs.**
Instructor: R. Bhat	**ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 4 MARKS**	

1. In the position shown, collar B moves downward with a velocity of 0.3 m/s. Determine the velocity of the collar A.



$$2y_A + y_B + (y_B - y_A) = \text{constant}$$

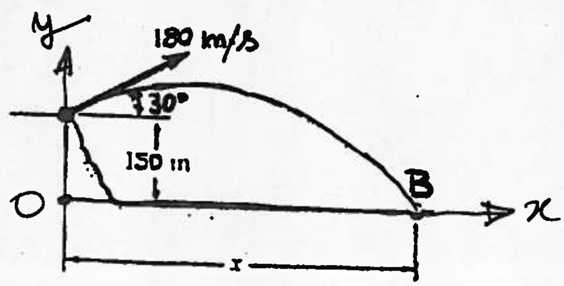
$$y_A + 2y_B = \text{constant}$$

$$v_A + 2v_B = 0$$

$$v_A = -2v_B = -2 \times 0.3$$

$$= -0.6 \text{ m/s OR } 0.6 \text{ m/s} \uparrow$$

2. A projectile is fired from the edge of a 150 m cliff with an initial velocity of 180 m/s at an angle of 30° with the horizontal. Neglecting air resistance, find the time when the projectile strikes the ground at B.

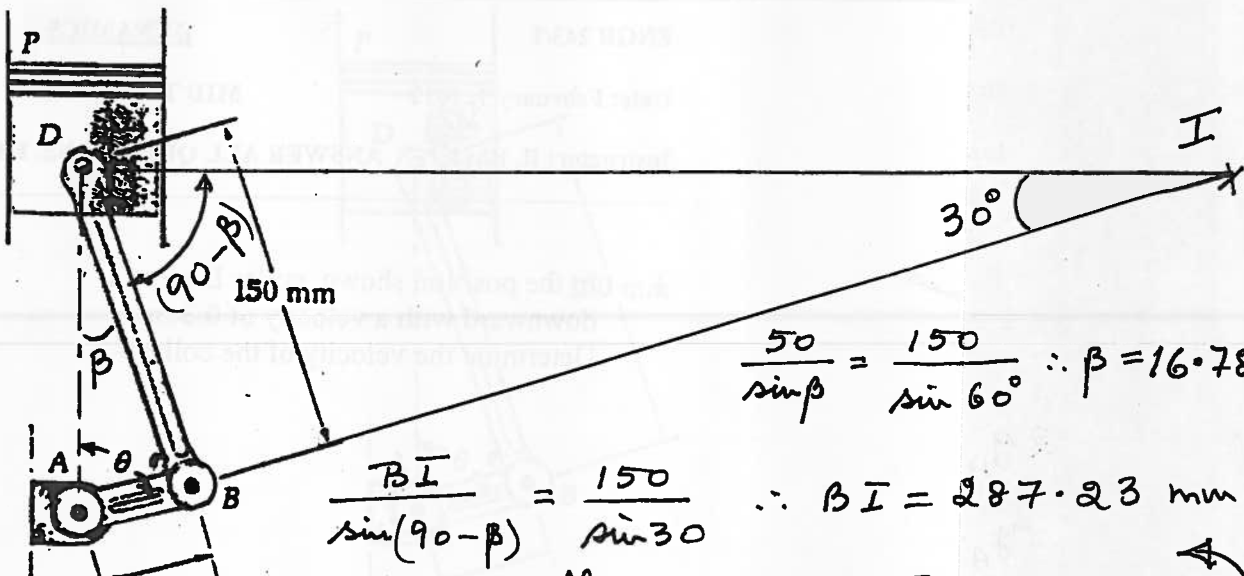


$$y = y_0 + (v_0)_y t + \frac{1}{2} a_y t^2 = 150 + (180 \sin 30)t - \frac{9.81}{2} t^2$$

i.e. $4.905 t^2 - 90t - 150 = 0$

$$t = \frac{90 \pm \sqrt{90^2 + 4 \times 4.905 \times 150}}{2 \times 4.905} = \underline{19.91 \text{ s}}$$

3. Knowing that crank AB rotates about point A with a constant angular velocity of 94.25 rad/s clockwise, determine the angular velocity of the connecting rod BD when $\theta = 60^\circ$, using its instantaneous center of rotation.



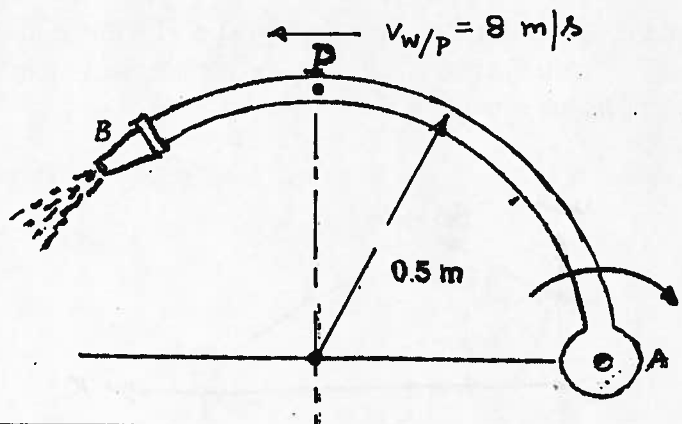
$$\frac{50}{\sin\beta} = \frac{150}{\sin 60^\circ} \quad \therefore \beta = 16.78^\circ$$

$$\frac{BI}{\sin(90-\beta)} = \frac{150}{\sin 30} \quad \therefore BI = 287.23 \text{ mm.}$$

$$\omega_{DB} = \frac{v_B}{BI} = \frac{50\times 94.25}{287.23} = 16.41 \text{ rad/s}$$

4. Find the angular acceleration of the connecting rod BD in Problem 4, when $\theta = 60^\circ$. Use the angular velocity of link BD obtained in Problem ~~4~~ 3

5. Water flows through a curved pipe AB that rotates with a constant clockwise angular velocity of 9.425 rad/s. If the velocity of water relative to the pipe is 8 m/s, determine the coriolis component of the acceleration of the water particle at P, in both magnitude and direction.



$$\bar{a}_c = 2\bar{\omega}_{Pipe} \times \bar{v}_{w/P}$$

$$= 2\times 9.425 \times 8 \uparrow$$

$$= 150.8 \text{ m/s}^2 \uparrow$$

Problem 4

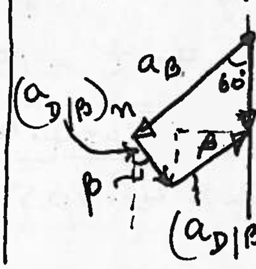
$a_B = (a_B)_n = 444.15$ m/s 60°

$(a_B)_t = 0$

$(a_{D/B})_n = 40.39$ m/s β

$(a_{D/B})_t = 0.15\,\alpha_{DB}$ β

$$\bar{a}_D \updownarrow = \bar{a}_B \overset{60}{\swarrow} + (a_{D/B})_n \overset{\beta}{\searrow} + (a_{D/B})_t \overset{\beta}{\nearrow}$$



$$(a_{D/B})_t \cos\beta = a_B \sin 60 - (a_{D/B})_n \sin\beta$$

$$= \alpha_{DB}\cos\beta$$

$$\alpha_{DB} = 2597 \text{ rad/s}^2$$