NOTE: These sample exam problems are intended for use as talking points during the exam review session. We will NOT be providing solutions for these problems. WeeklyJoys has many sample exam problems with solutions for your use while studying for your exam.

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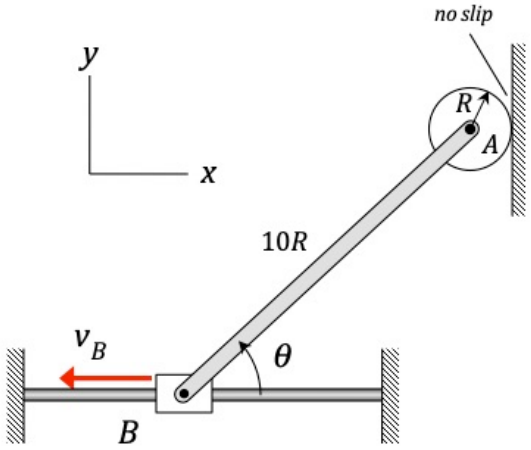
Examination No. 1 (REGULAR)

PROBLEM NO. 1 – 20 points



Given: Bar AB (of length $10R$) moves with end B sliding with *constant* speed v_B to the left on a flat, horizontal guide. A disk of radius R is pinned to end A of the bar, and is able to roll *without slipping* on a flat, vertical wall.

Find: For the position shown, do the following, with your answers in terms of, at most, R, θ and v_B.

PART A: Determine the *angular velocity of bar AB*. Write your answer as a vector.

PART B: Is the angular velocity of the disk clockwise or counterclockwise?

<u>*PART C*</u>: Determine the *angular acceleration of bar AB*. Write your answer as a vector.

<u>*PART D*</u>: Is the angular acceleration of the disk clockwise or counterclockwise?

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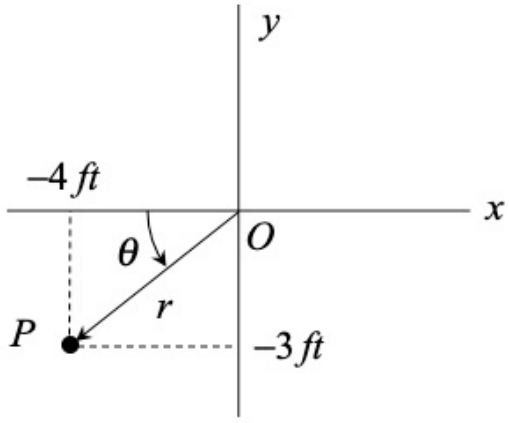
Examination No. 1 (REGULAR)

PROBLEM NO. 2 – 20 points



Given: Point P moves in the *xy*-plane. At the instant shown, the velocity and acceleration of P are known to be:

$$\vec{v} = \left(80\hat{i} + 60\hat{j}\right) ft/s$$

$$\vec{a} = \left(20\hat{j}\right) ft/s^2$$

respectively.

Find: For the position shown:

PART A: Determine $\dot{r}$.

PART B: Determine $\dot{\theta}$.

PART C: Determine $\ddot{r}$.

PART D: Determine $\ddot{\theta}$.

PART E: Determine the rate of change of speed of P.

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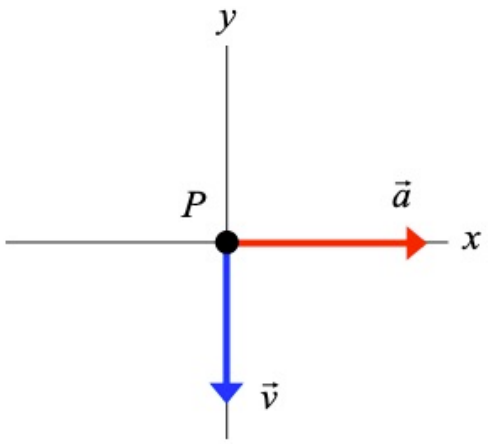
Examination No. 1 (REGULAR)

PROBLEM NO. 3 – 20 points TOTAL

NOTE: You are not required to show your work on Problem 3. There is no partial credit awarded for the different parts of the problem.



The velocity and acceleration of point P are shown above with $|\vec{v}| = 20 m/s$ and $|\vec{a}| = 10 m/s^2$

PART A (2 points) – circle the correct response

a) Point P is moving with *increasing* speed.

b) Point P is moving with *constant* speed.

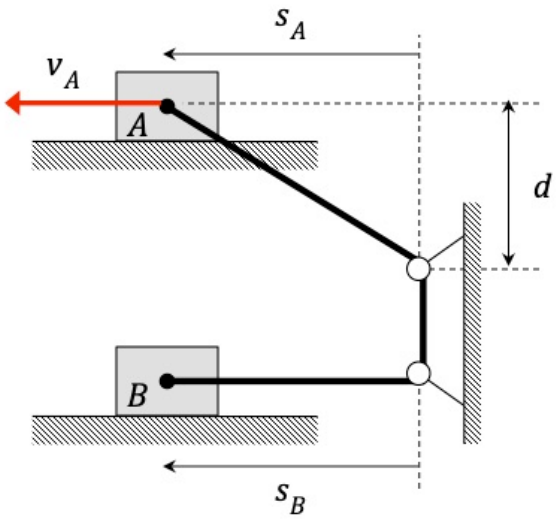
c) Point P is moving with *decreasing* speed.

PART B (2 points)

What is the radius of curvature of the path of P?

PART C (2 points)

Blocks A and B are connected by an inextensible cable, with the cable being pulled over two small, stationary pulleys. Block A moves to the left with a speed of v_A. Let v_B represent the speed of block B. Circle the correct response below for $s_A > 0$:



a) $v_B = 0$

b) $v_B < v_A$

c) $v_B = v_A$

d) $v_B > v_A$

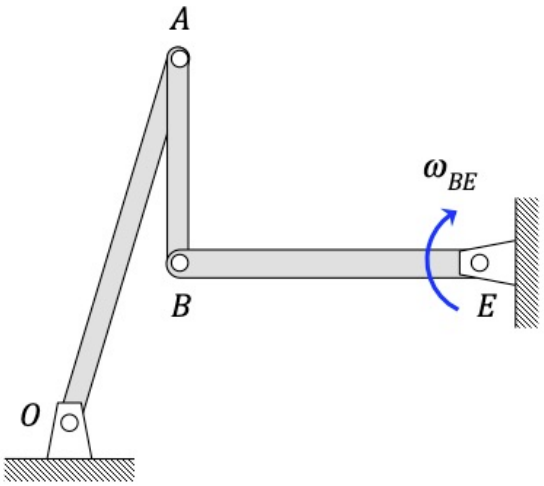
PART D (2 points)

Particle P moves in the *xy*-plane on the path described by $x = by^3$ where x and y are given in feet, and $b > 0$. It is known that $\dot{x} = 2\ ft/s = constant$ as P moves on this path. For a position where $y > 0$, circle the correct response regarding the *sign* of $\ddot{y}$:

a) $\ddot{y} > 0$

b) $\ddot{y} = 0$

c) $\ddot{y} < 0$



Link BE of the mechanism shown above is rotating in the clockwise sense. The figure provided of the mechanism above has been drawn to scale.

PART E (2 points)
For the position shown for the mechanism, circle the correct response:

a) Link AB is rotating clockwise
b) Link AB is not rotating
c) Link AB is rotating counterclockwise
d) More information is needed in order to answer this question.

PART F (2 points)
Let v_A and v_B represent the speeds of A and B, respectively. For the position shown for the mechanism, circle the correct response:

a) $v_A > v_B$
b) $v_A = v_B$
c) $v_A < v_B$
d) More information is needed in order to answer this question.

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Examination No. 1 (REGULAR)

PROBLEM NO. 3 (continued)

PART G (4 points)

Consider the linkage made up of links OA and AB, with the angular orientation of these links given by the angles θ_1 and θ_2. (Note that these angles are both measured from fixed, horizontal lines, as shown in the figure.) The *constant* rotation rates for these two links are given by $\dot{\theta}_1$ and $\dot{\theta}_2$. The following moving reference frame kinematics equation is to be used to describe the acceleration of point B:

$$\vec{a}_B = \vec{a}_A + \left(\vec{a}_{B/A}\right)_{rel} + \vec{\alpha} \times \vec{r}_{B/A} + 2\vec{\omega} \times \left(\vec{v}_{B/A}\right)_{rel} + \vec{\omega} \times \left(\vec{\omega} \times \vec{r}_{B/A}\right)$$

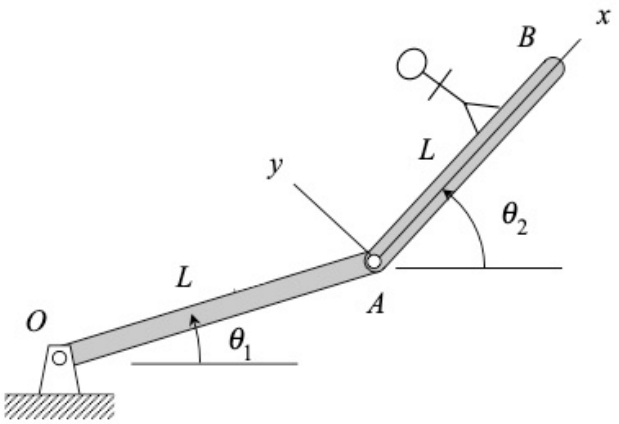
Using an <u>*observer attached to link AB*</u>, fill in the following terms below for this equation:

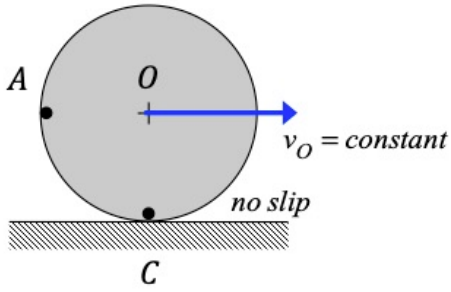
$\vec{\omega} =$

$\vec{\alpha} =$

$\left(\vec{v}_{B/A}\right)_{rel} =$

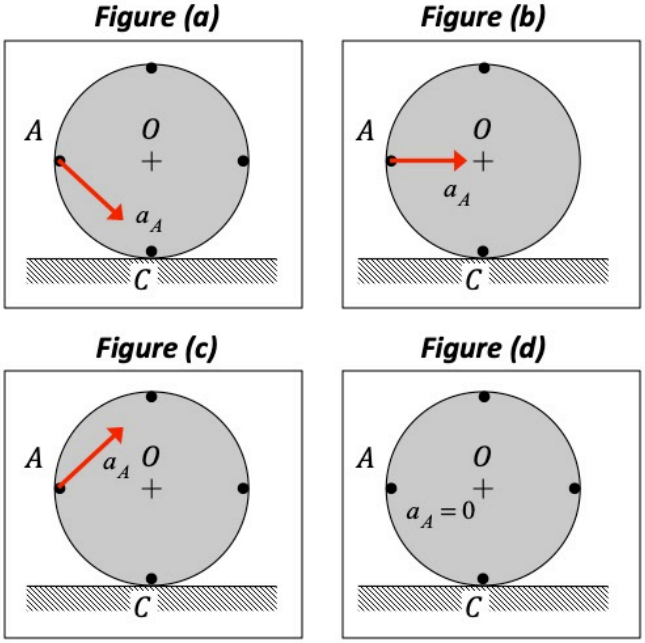
$\left(\vec{a}_{B/A}\right)_{rel} =$

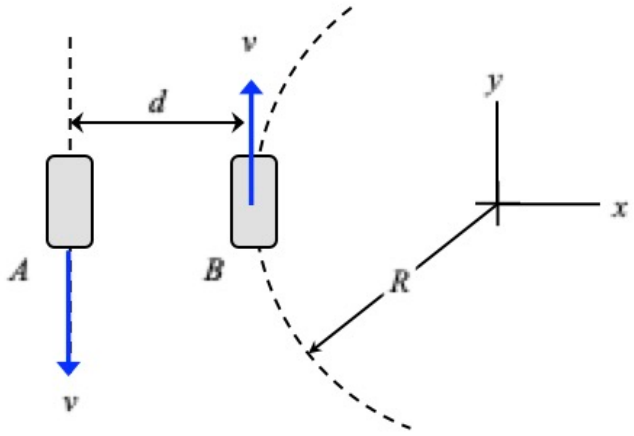




PART H (2 points)
A disk rolls without slipping on a horizontal surface with its center O moving with a constant speed of v_0. Circle the response below that shows the correct direction for the acceleration of point A on the circumference on the disk:

a) Figure a).
b) Figure b).
c) Figure c).
d) Figure d).
e) None of the above.





PART I (2 points)

Automobiles A and B travel of straight and circular paths, respectively, with the same speed *v* but in opposite directions. Let $\left(\vec{v}_{A/B}\right)_{rel}$ represent the velocity of A as seen by an observer on B, and $\left(\vec{v}_{B/A}\right)_{rel}$ represent the velocity of B as seen by an observer on A.

Choose the *TRUE/FALSE* response below that correctly describes the sizes of these two relative velocities:

$\left|\left(\vec{v}_{A/B}\right)_{rel}\right| = \left|\left(\vec{v}_{B/A}\right)_{rel}\right|$: *TRUE* or *FALSE*