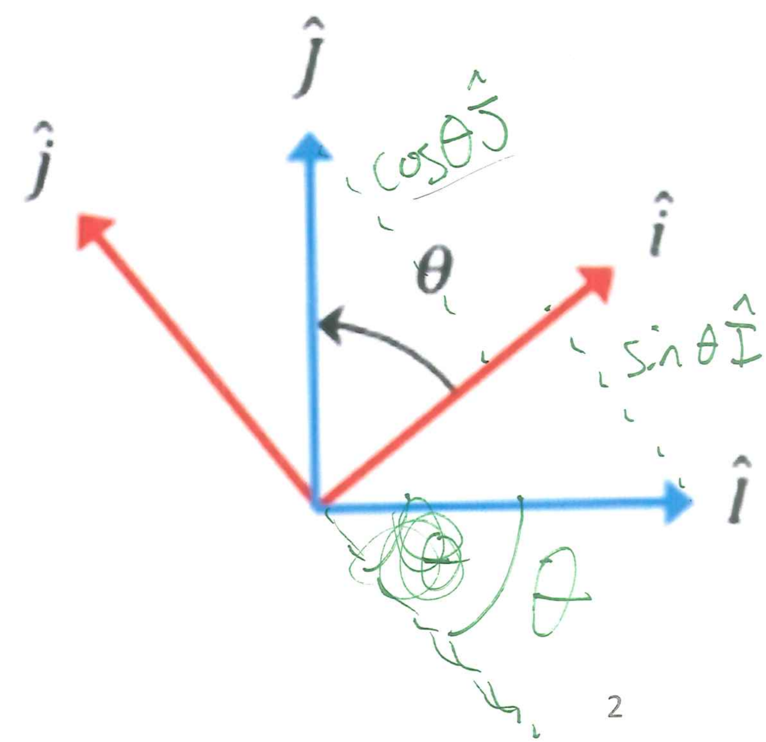
Question #1

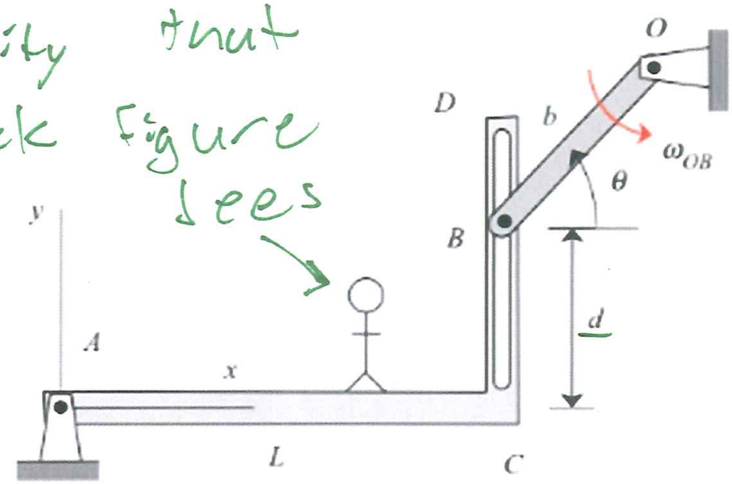
- Two sets of Cartesian coordinate axes with unit vectors of $\hat{\imath}$ and $\hat{\jmath}$,and $\hat{I}$and $\hat{J}$ are shown below.
- Choose the response below that most accurately represents the unit vector $\hat{\imath}$ in terms of the unit vectors $\hat{I}$ and $\hat{J}$:
  - (a) $\hat{\imath} = sin\theta\hat{I} + cos\theta\hat{J}$
  - (b) $\hat{\imath} = cos\theta\hat{I} + sin\theta\hat{J}$
  - (c) $\hat{\imath} = cos\theta\hat{I} - sin\theta\hat{J}$
  - (d) $\hat{\imath} = -sin\theta\hat{I} + cos\theta\hat{J}$
  - (e) None of the above



Question #2

- Link OB rotates CCW with a rate of ω_{OB}. End B of OB is constrained to move within a slot in a second link AD. An observer is attached to link AD. Choose the response below that correctly describes the velocity of B as seen by the observer on link AD:
  - (a) $\left(\vec{v}_{B/A}\right)_{rel} = -b\omega_{OB}\hat{\jmath}$
  - (b) $\left(\vec{v}_{B/A}\right)_{rel} = b\omega_{OB}\hat{\jmath}$
  - (c) $\left(\vec{v}_{B/A}\right)_{rel} = \dot{d}\hat{\jmath}$
  - (d) $\left(\vec{v}_{B/A}\right)_{rel} = 0$
  - (e) $\left(\vec{v}_{B/A}\right)_{rel} = b\omega_{OB}(\sin\theta\hat{\imath} - \cos\theta\hat{\jmath})$
  - (f) $\left(\vec{v}_{B/A}\right)_{rel} = b\omega_{OB}(\sin\theta\hat{\imath} + \cos\theta\hat{\jmath})$

velocity that stick figure sees



· B can only move up or down and the magnitude is $\frac{d(d)}{dt} = \dot{d}$

Question #3

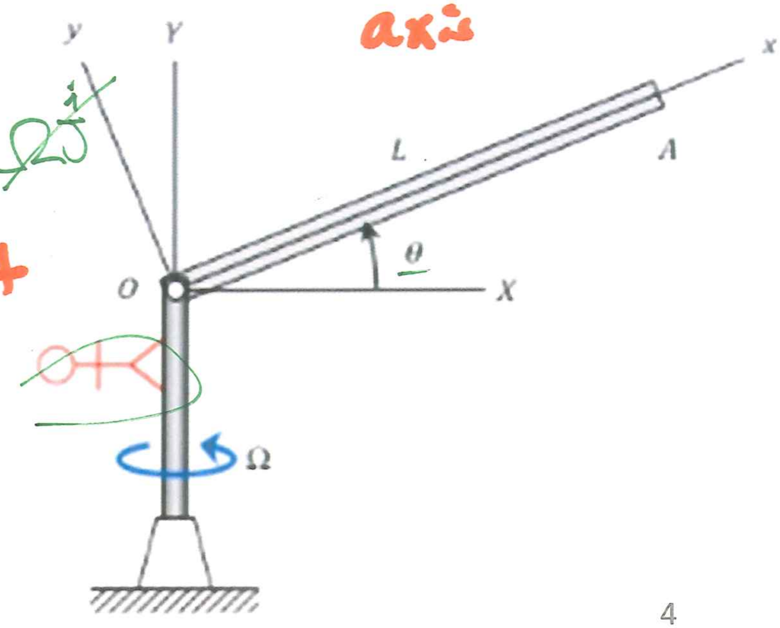
- A shaft rotates about a fixed, vertical axis with a constant rate of Ω. Arm OA is pinned to the rotating shaft, with the arm being raised at a constant rate of $\dot{\theta}$ .An observer is attached to the rotating shaft, as shown in the figure.
- Indicate the response below that most accurately describes the angular acceleration α of the observer when $\theta = 0$:
  - (a) $\vec{\alpha} = 0$
  - (b) $\vec{\alpha} = \Omega^2 \hat{j}$
  - (c) $\vec{\alpha} = \dot{\theta}^2 \hat{k}$
  - (d) $\vec{\alpha} = \Omega \dot{\theta} \hat{\imath}$
  - (e) $\vec{\alpha} = \Omega \dot{\theta} \hat{j}$
  - (f) $\vec{\alpha} = \Omega \dot{\theta} \hat{k}$
  - (g) None of the above

$\dot{\hat{J}}$ const b/c fixed axis

$\vec{\omega} = \Omega \hat{J}$

$\vec{\alpha} = \frac{d\vec{\omega}}{dt} = \cancel{\dot{\Omega}\hat{J}} + \cancel{\Omega\dot{\hat{J}}}$

$\dot{\Omega}$ const



Question #4

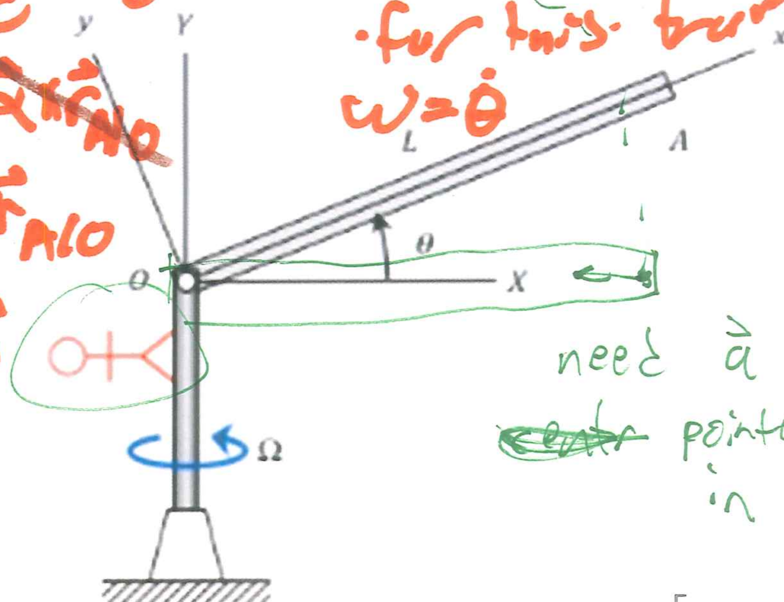
- A shaft rotates about a fixed, vertical axis with a constant rate of Ω. Arm OA is pinned to the rotating shaft, with the arm being raised at a constant rate of $\dot{\theta}$. An observer is attached to the rotating shaft, as shown in the figure.
- Indicate the response below that most accurately describes the acceleration of point A as seen by the observer $\left(\vec{a}_{A/O}\right)_{rel}$ when $\theta = 0$:
  - (a) $\left(\vec{a}_{A/O}\right)_{rel} = 0$
  - (b) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega^2\hat{\imath}$
  - (c) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega^2\hat{\jmath}$
  - (d) $\left(\vec{a}_{A/O}\right)_{rel} = -L\dot{\theta}^2\hat{\imath}$
  - (e) $\left(\vec{a}_{A/O}\right)_{rel} = -L\dot{\theta}^2\hat{\jmath}$
  - (f) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega\dot{\theta}\hat{\imath}$
  - (g) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega\dot{\theta}\hat{\jmath}$

·A is going in a circle around O

$\vec{a}_A = \cancel{\vec{a}_O} + \cancel{\vec{\alpha}\times\vec{r}_{A/O}} - \omega^2\vec{r}_{A/O}$

$\vec{a}_A = -\dot{\theta}^2 L\hat{\imath}$

·for this frame $\omega = \dot{\theta}$



need $\vec{a}$ ~~center~~ pointed in

Question #5

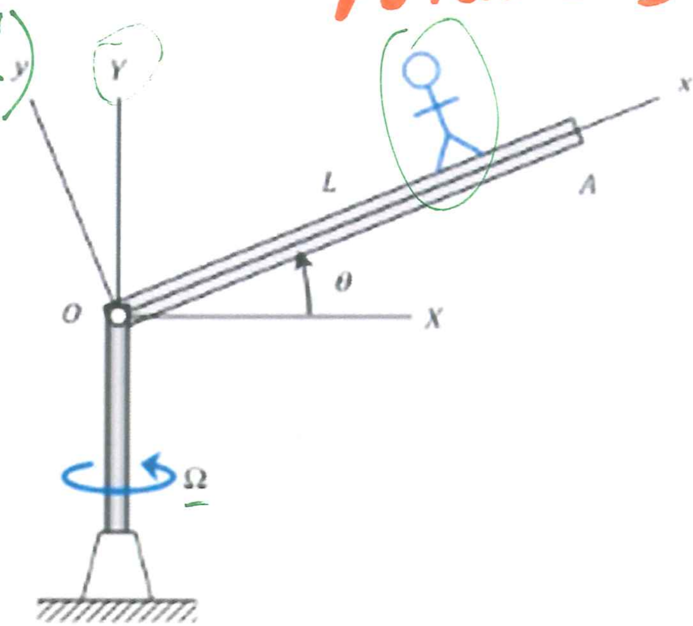
- Same problem as above EXCEPT the observer is now on arm OA, as shown in the figure below.
- Indicate the response below that most accurately describes the angular acceleration α of the observer when $\theta = 0$:
  - (a) $\vec{\alpha} = 0$
  - (b) $\vec{\alpha} = \Omega^2\hat{j}$
  - (c) $\vec{\alpha} = \dot{\theta}^2\hat{k}$
  - (d) $\vec{\alpha} = \Omega\dot{\theta}\hat{\imath}$
  - (e) $\vec{\alpha} = \Omega\dot{\theta}\hat{j}$
  - (f) $\vec{\alpha} = \Omega\dot{\theta}\hat{k}$
  - (g) None of the above

$\vec{\omega} = \Omega\hat{J} + \dot{\theta}\hat{k}$ has 2 diff. rotations

$\dot{\hat{k}}$

$\frac{d\vec{\omega}}{dt} = \dot{\theta}([\Omega\hat{J} + \dot{\theta}\hat{k}]\times\hat{k})$

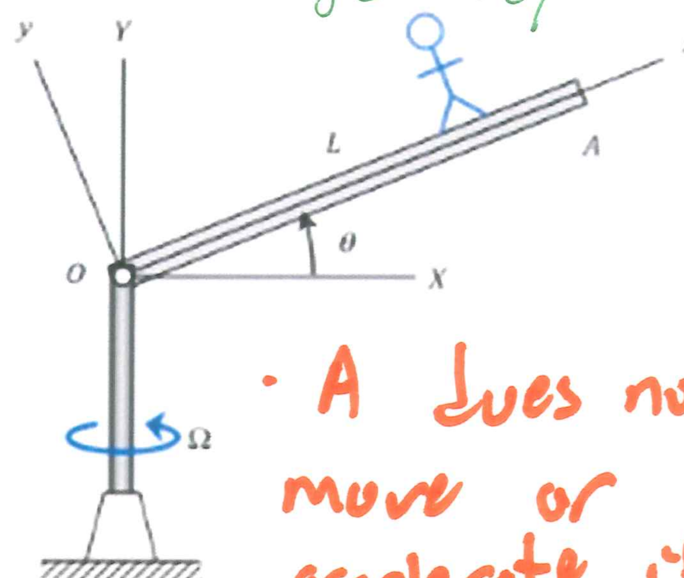
$\vec{\alpha} = \Omega\dot{\theta}\hat{\imath}$



Question #6

- Same problem as above EXCEPT the observer is now on arm OA, as shown in the figure below.
- Indicate the response below that most accurately describes the acceleration of point A as seen by the observer $\left(\vec{a}_{A/O}\right)_{rel}$ when $\theta = 0$:
  - (a) $\left(\vec{a}_{A/O}\right)_{rel} = 0$
  - (b) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega^2\hat{\imath}$
  - (c) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega^2\hat{\jmath}$
  - (d) $\left(\vec{a}_{A/O}\right)_{rel} = -L\dot{\theta}^2\hat{\imath}$
  - (e) $\left(\vec{a}_{A/O}\right)_{rel} = -L\dot{\theta}^2\hat{\jmath}$
  - (f) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega\dot{\theta}\hat{\imath}$
  - (g) $\left(\vec{a}_{A/O}\right)_{rel} = -L\Omega\dot{\theta}\hat{\jmath}$

· you are on the same rigid body



· A does not move or accelerate if you are on OA