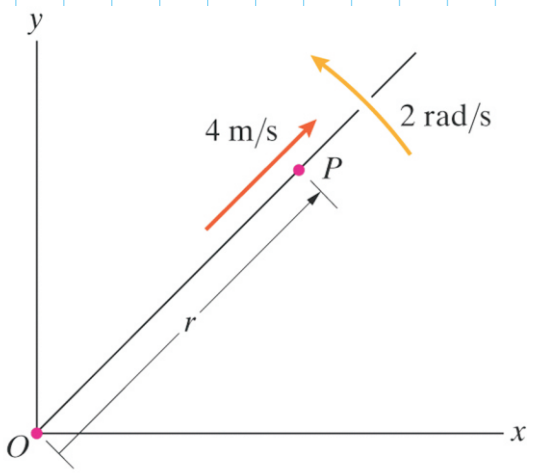
Name

Date

Week: _____ **Problem:** _____

Given:

The radial line rotates with a constant angular velocity of 2 rad/s. Point P moves along the line at a constant speed of 4 m/s. Determine the magnitude of the velocity and acceleration of P when $r = 2$ m.



Required:

Solution:

Solution: The angular velocity of the line is

$$\frac{d\theta}{dt} = \omega = 2 \text{ rad/s},$$

from which $\frac{d^2\theta}{dt^2} = 0$.

The radial velocity of the point is

$$\frac{dr}{dt} = 4 \text{ m/s},$$

from which $\frac{d^2r}{dt^2} = 0$.

The vector velocity is

$$\mathbf{v} = \left(\frac{dr}{dt}\right)\mathbf{e}_r + r\left(\frac{d\theta}{dt}\right)\mathbf{e}_\theta = 4\mathbf{e}_r + 4\mathbf{e}_\theta \text{ (m/s)}.$$

The magnitude is

$$\boxed{|\mathbf{v}| = \sqrt{4^2 + 4^2} = 5.66 \text{ m/s}}.$$

The acceleration is

$$\mathbf{a} = [-2(4)]\mathbf{e}_r + [2(4)(2)]\mathbf{e}_\theta = -8\mathbf{e}_r + 16\mathbf{e}_\theta \text{ (m/s}^2\text{)}.$$

The magnitude is

$$\boxed{|\mathbf{a}| = \sqrt{8^2 + 16^2} = 17.89 \text{ m/s}^2}$$