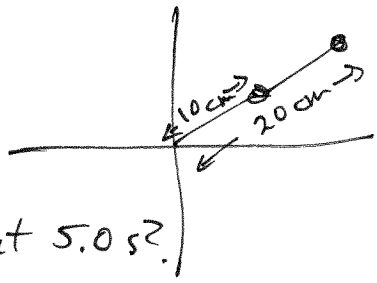
~~Rod~~ Chapter 10 Chapter 36

$\theta(t) = 20.0 \frac{rad}{s^2} t^2$



a) What is the instantaneous angular velocity at 5.0 s?

angular velocity is $\omega = \frac{d\theta}{dt} = \frac{d}{dt}(20t^2) = 40t$

at $t = 5s$ $\omega = 40.0 \frac{rad}{s^2}(5\,s) =$ **200 rad/s**

b) What is the angular acceleration at $t = 5.0$ s?

angular acceleration is $\alpha = \frac{d\omega}{dt} = \frac{d}{dt}(40 \frac{rad}{s^2} \cdot t) =$ **40 rad/s²**

This doesn't depend on time.

c) What is the tangential speed of the beads at $t = 5$ s?

$v_t = \omega r$ from part a) $\omega = 200$ rad/s

for bead #1 $r = 0.10$ m $v_t = \omega r = (200 \frac{rad}{s})(0.10 m) =$ **20 m/s**

for bead #2 $r = 0.20$ m $v_t = \omega r = (200 \frac{rad}{s})(0.20 m) =$ **40 m/s**

d) What is the tangential acceleration at 5 s?

for bead #1 $r = 0.10$ m $a_t = \alpha r = (40 \frac{rad}{s^2})(0.10 m) =$ **4 m/s²**

for bead #2 $r = 0.20$ m $a_t = \alpha r = (40 rad/s^2)(0.20 m) =$ **8 m/s²**

e) What is the centripetal acceleration at $t = 5$ s?

centripetal acceleration is $a_c = \frac{v^2}{r}$

for bead #1 $r = 0.10$ m $a_c = \frac{v^2}{r} = \frac{(20 m/s)^2}{0.10 m} =$ **4000 m/s²**

for bead #2 $r = 0.20$ m $a_c = \frac{v^2}{r} = \frac{(40 m/s)^2}{0.20 m} =$ **8000 m/s²**

Note: $a_c = \frac{v_t^2}{r} = \frac{(r\omega)^2}{r} = r\omega^2$

∴ doubling the radius doubles the centripetal acceleration.