

Name: \_\_\_\_\_

Key

## Notes - 10.2 Kinematics of Rotation

1. Fill in the table below for the translational and rotation kinematic equations.

Translational	Rotational
$x = vt$	$\theta = \omega t$
$v = v_0 + at$	$\omega = \omega_0 + \alpha t$
$x = x_0 + v_0 t + \frac{1}{2}at^2$	$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
$v^2 = v_0^2 + 2a(x-x_0)$	$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

2. A deep-sea fisherman hooks a big fish that swims away from the boat pulling the fishing line from his fishing reel. The whole system is initially at rest and the fishing line unwinds from the reel at a radius of 4.50 cm from its axis of rotation. The reel is given an angular acceleration of 110 rad/s<sup>2</sup> for 2.00 s.

A. What is the final angular velocity of the reel? Show your work.

$$\omega = \omega_0 + \alpha t = 0 + (110 \frac{\text{rad}}{\text{s}^2})(2.00 \text{ s}) = \boxed{220 \frac{\text{rad}}{\text{s}}}$$

B. At what speed is fishing line leaving the reel after 2.00 s elapses? Show your work.

$$v = \omega r = (220 \frac{\text{rad}}{\text{s}})(4.50 \times 10^{-2} \text{ m}) = \boxed{9.90 \frac{\text{m}}{\text{s}}}$$

C. How many revolutions does the reel make? Show your work.

$$\begin{aligned} \theta &= \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2 = 0 + 0 + \frac{1}{2}(110 \frac{\text{rad}}{\text{s}^2})(2.00 \text{ s})^2 \\ &= 220 \text{ rad} \quad 220 \text{ rad} \left( \frac{1 \text{ rev}}{2\pi \text{ rad}} \right) = \boxed{35.0 \text{ rev}} \end{aligned}$$

D. How many meters of fishing line come off the reel in this time? Show your work.

$$x = \theta r = (220 \text{ rad})(4.50 \times 10^{-2} \text{ m}) = \boxed{9.90 \text{ m}}$$