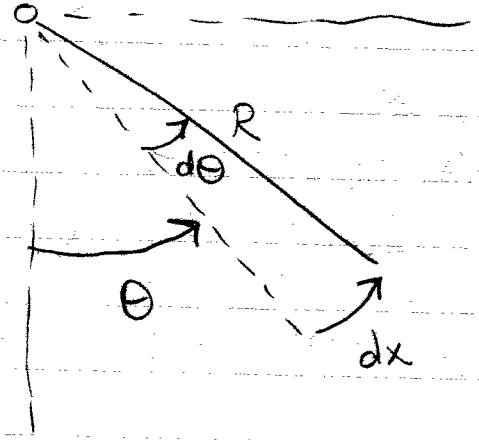
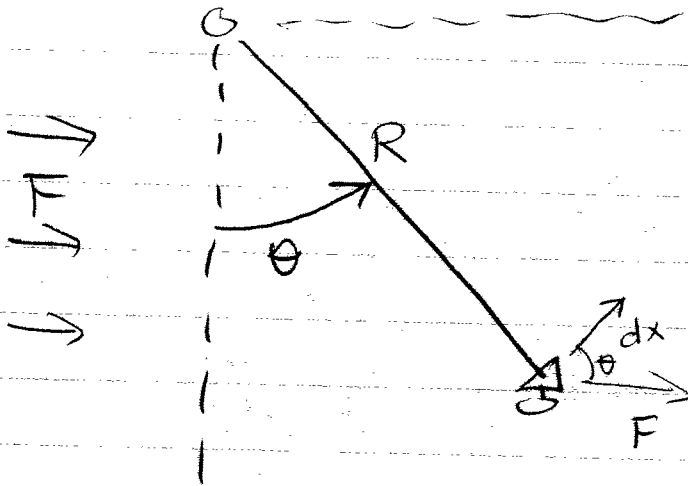
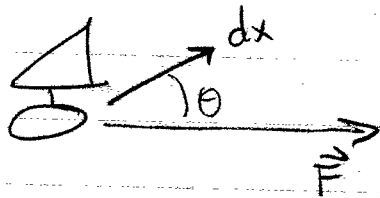


Iceboat: curved path



When boat takes little step dx , the angle between $d\vec{x}$ and \vec{F} is same angle θ as angle from starting pos.



$$\vec{F} \cdot d\vec{x} = |\vec{F}| |dx| \cos \theta$$

$$dW = \vec{F} \cdot d\vec{x} = |\vec{F}| |dx| \cos \theta \quad \text{just one little step}$$

But thanks to radians,

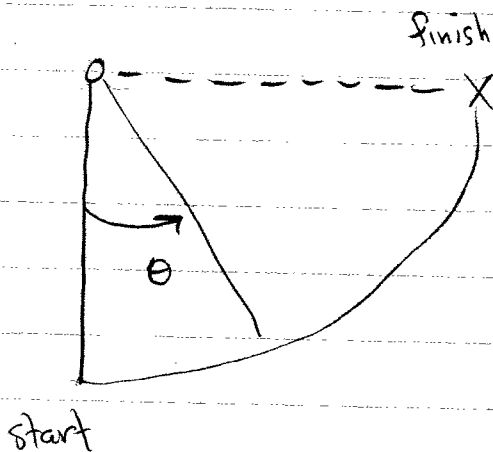
$$|dx| \approx R d\theta$$

And so we have work done along one little step

$$\begin{aligned}dw &= |F| |dx| \cos\theta \\ &= |F| |R d\theta| \cos\theta\end{aligned}$$

Now we integrate to get total work over all little steps

$$W = \int dw = \int |F| |R d\theta| \cos\theta$$



$$= FR \int_{\theta=0}^{\theta=\pi/2} \cos\theta d\theta$$

$$= FR \left[\sin\theta \right]_{\theta=0}^{\theta=\pi/2} = FR [1-0]$$

$$= FR = (150 \text{ N})(100 \text{ m})$$

$$= 15,000 \text{ N}\cdot\text{m}$$

Thus

$$v_f = \sqrt{\frac{2(15,000 \text{ N}\cdot\text{m})}{250 \text{ kg}}} = 10.95 \text{ m/s again}$$