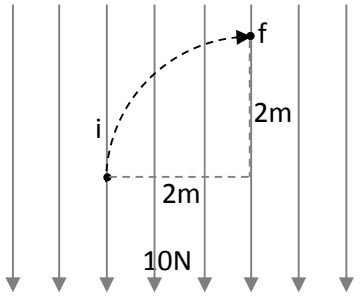
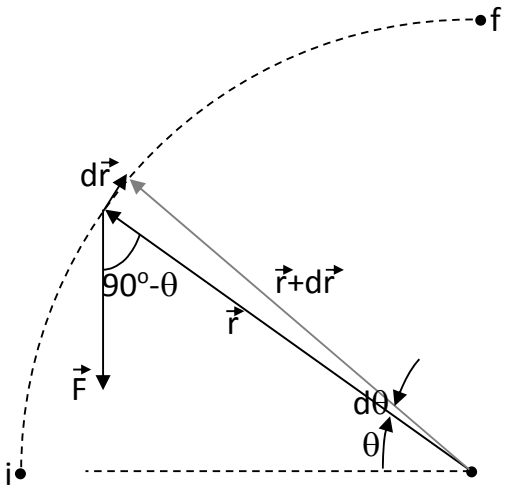
PHY 232 Fall 2017 Supplementary Work (will not be collected)

Class 2. Energy

Near earth surface the weight of an object is a constant, say, 10N downward.

The object is moved directly from i to f along a circular arc as shown in the diagram. What is the work done by the weight?




$$W_{i\to f} = \int_i^f \vec{F}\cdot d\vec{r}$$

$$\text{Angle between } \vec{F} \text{ and } d\vec{r} = (90^\circ - \theta) + 90^\circ = 180^\circ - \theta$$

$$\therefore\ W_{i\to f} = \int_i^f F\cdot dr\cdot\cos(180^\circ - \theta)$$

$$= -\int_i^f F\cdot dr\cdot\cos\theta \qquad [\cos(180^\circ - \theta) = -\cos\theta]$$

$$\text{But } dr = R\,d\theta \qquad R \text{ is the radius of the ciicular arc}$$

$$\therefore W_{i\to f} = -\int_{i}^{f} F\cdot dr\cdot\cos\theta = -\int_{0^o}^{90^o} F\cdot R d\theta\cdot\cos\theta$$

$$= -FR\int_{0^o}^{90^o}\cos\theta\, d\theta \qquad \text{[F and R are constant]}$$

$$= -FR\cdot\left[\sin\theta\right]_{0^o}^{90^o}$$

$$= -FR[1-0]$$

$$= -FR$$

Note that the radius of the circular arc is 2m, and $F = 10N$

$$\therefore \quad W_{i\to f} = -10\times 2 = \underline{\underline{-20\,J}}$$