Problem 7.33

A 3.00 kg object has a velocity of $\vec{v} = \left[(6.00)\hat{i} - (1.00)\hat{j}\right]$m/s.

(Note: The book's solution manual didn't use this velocity and got different answers.)

a.) What is its kinetic energy?

Minor note: One of the nice things about dealing with energy is that potential energy functions and kinetic energy quantities are SCALARS. That means that mostly, you don't have to deal with component. That is the case here. The net kinetic energy is half the mass times the magnitude of the velocity quantity squared. As the velocity magnitude equals:

$$\begin{aligned} |\vec{v}| &= \left[v_x^2 + v_y^2\right]^{1/2} \\ &= \left[(6.00\ \text{m/s})^2 + (-1.00\ \text{m/s})^2\right]^{1/2} \\ &= 6.08\ \text{m/s} \end{aligned}$$

we can write:

$$\begin{aligned} KE &= \frac{1}{2}mv^2 \\ &= \frac{1}{2}(3.00\ \text{m})(6.08\ \text{m/s})^2 \\ &= 55.5\ \text{J} \end{aligned}$$

b.) What is the net work done on the object if its velocity changes to

$$\vec{v}_2 = \left[(8.00)\hat{i} + (4.00)\hat{j}\right]\text{m/s?}$$

The new velocity magnitude is:

$$\begin{aligned} |\vec{v}_2| &= \left[v_x^2 + v_y^2\right]^{1/2} \\ &= \left[(8.00\ \text{m/s})^2 + (4.00\ \text{m/s})^2\right]^{1/2} \\ &= 8.94\ \text{m/s} \end{aligned}$$

The Work/Energy Theorem then maintains that:

$$\begin{aligned} W_{net} &= \Delta KE \\ &= KE_2 - KE_1 \\ &= \frac{1}{2}mv_2^2 - KE_1 \\ &= \frac{1}{2}(3.00\ \text{m})(8.94\ \text{m/s})^2 - (55.5\ \text{J}) \\ &= 64.4\ \text{J} \end{aligned}$$