Answer on Question #43398-Physics-Mechanics-Kinematics-Dynamics

A 56.0 kg mass is sliding down a frictionless plane at a speed of 4.20 m/s. A force of 55.0N parallel to the plane acts on the mass to pull it up the plane. When the force has acted over a distance of 6.80 m, the mass has a speed of 5.40 m/s. What change in gravitational potential energy occurred while the force acted on the mass?

Solution

According to the Work Energy Theorem:

$$W = \Delta E_{\text{gravitational}} + \Delta K,$$

where $W = Fd$ is the work done by the action of force of 55.0N, $\Delta E_{\text{gravitational}}$ is the change in gravitational potential energy, $\Delta K = \frac{m}{2}(v_f^2 - v_i^2)$ is the change in kinetic energy.

The change in gravitational potential energy is

$$\Delta E_{\text{gravitational}} = W - \Delta K = Fd - \frac{m}{2}\left(v_f^2 - v_i^2\right) = 55.0\text{N} \cdot 6.80\text{ m} - \frac{56.0\text{ kg}}{2}\left(\left(5.40\frac{\text{m}}{\text{s}}\right)^2 - \left(4.20\frac{\text{m}}{\text{s}}\right)^2\right)$$
$$= 51.4\text{ J}.$$

Answer: 51.4 J.