Warm Up: Work and Energy

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1 Memory Bank

- $v_f^2 = v_i^2 + 2a\Delta x$ ... Kinematic equation without time.

- $W = \vec{F} \cdot \Delta\vec{x}$ ... Definition of work

- $\vec{F} = k\Delta\vec{x}$ ... Hooke's Law, or the force of a spring

- $W = \frac{1}{2}k(\Delta x)^2$ ... Work done to compress or stretch a spring by Δx.

- $KE = \frac{1}{2}mv^2$ ... Definition of Kinetic Energy

- $W = KE_f - KE_i$ ... Work-energy theorem

2 Work-Energy Theorem

1. In Fig. 1 below, we see a spring that is compressed by $\Delta\vec{x}$. (a) If the spring ($k = 300$ N/m) is compressed a distance of 5 cm to launch a 250 gram object, what is the speed of the object as it leaves the spring? *Hint: look at the Work-energy theorem in the memory bank.* (b) How high does the object rise, if it is shot straight upwards?

2. Recall the kinematic equation without time (memory bank). (a) Rearrange the equation so that the velocity terms are on the left side, and divide both sides by 2. (b) Multiply both sides by mass, m. (c) Show that the right side is equal to the work done on m, and that we have proved a version of the work-energy theorem.
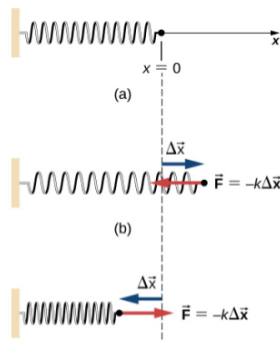

Figure 1: When a spring is compressed by a distance Δx, this requires a force $\vec{F} = k\Delta\vec{x}$ because the spring presses back with $\vec{F} = -k\Delta\vec{x}$.