Lecture 16: Power

Announcements

- Homework **and** Get-Ready Assignments on Gradescope
  - Regrade requests can be used to ask for clarification on feedback you have received.
  - This week's homework is long, in order to keep next week's homework shorter.
- Project Peer Review
  - Complete your feedback by Friday at the latest.
  - Please offer criticisms with care and respect; you are trying to help your peers improve their work.
  - You should write 1-2 paragraphs for each peer review.
  - Point out things that were done well, and things that can be improved.
    - Giving positive comments on what works and should be kept is just as important as suggesting revisions and giving constructive criticism.
  - Scientific communication is a major goal of this work, so don't be shy about asking (nicely) for things to be explained better.
    - If you don't understand something, don't be shy about admitting it.
    - If you do understand something, but think it could be explained better, remark on this as well.

A Deeper Model for Interactions

- Quantities
  - Energy E
  - Kinetic Energy $K = \frac{1}{2}mv^2$
- Laws
  - Work-energy theorem $W_{\text{net,ext}} = \Delta E_{\text{total}}$

Power

- When the energy of a system changes, we sometimes want to know how *fast* it changes.
- *Power* is the time rate of change of energy:

$$P = \frac{dE}{dt}.$$

- Power is measured in watts (W).

L16-1: The Winch – Part 1

A winch acts a constant force $F_0 = 18,000$ N on a metal block ($m = 500$ kg) to accelerate it across level ground from rest to a final speed of $v_f = 6$ m/s.

- What is the block's change in total energy?
- How far did the winch move the block?
- How much power does this winch use?

L16-1: The Winch – Part 2

You want to use the winch to lift the block into the air at a constant speed: $v = 2$ m/s.

- What force should you set the winch for?
- How far does the winch move the block from $t = 0$ s to $t = 30$ s?
- How much work does the winch do in $\Delta t = 30$ s?
  - Is anything else doing work on the block?
- How much power does the winch use now?

Energy Analysis

- Understanding: Identify a system and the types of energy within the system.
- Calculating: Is your system's energy conserved or not? Once you know, use the work-energy theorem!
- Sensemaking: All the sensemaking strategies you have will work, but a new strategy is sometimes useful: Solve Multiple Ways.
  - You have kinematics and force techniques at your disposal, so you can solve problems with these and compare their results to the results of your energy approach.

Main Ideas

- Energy is a powerful, ubiquitous concept that can help us solve a wide array of physics problems.
- Energy is a *scalar*—it is not a vector.
- There are different forms of energy, and energy can be transferred between objects and between forms.