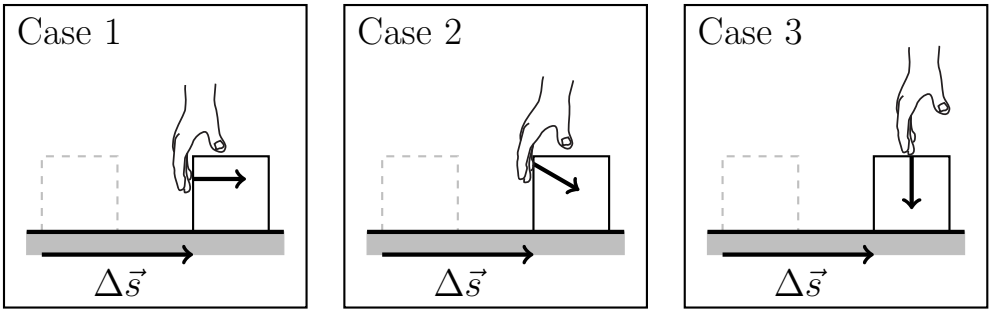
Studio 6: Work and Kinetic Energy

Warm-Up Activity

A block is moving to the right (displacement $\Delta\vec{s}$) while a hand exerts a force of magnitude F_0 on the block.

- In each case, is the work done by the hand *positive*, *negative*, or *zero*?
- How does the absolute value of the work compare in the three cases?



A Deeper Model for Interactions

- Quantities
  - Energy E
  - Work $W = \int_{r_i}^{r_f} \vec{F} \cdot d\vec{r}$
  - Kinetic Energy $K = \frac{1}{2}mv^2$
- Laws
  - Work-energy theorem $W_{\text{net,ext}} = \Delta E_{\text{total}}$

S6-1: Reversing a Block

- A block is initially moving to the right on a level, frictionless surface. The system consists of only the block.
- A hand exerts a constant horizontal force on the block that causes the block to slow down (stage 1), then move in the opposite direction while speeding up (stage 2).
- For each stage:
  - Draw a free-body diagram for the block.
  - Determine whether the work done by each force is positive, negative, or zero.
  - Fill in the table:

	Displacement		Force by Hand		$W_{\text{by hand}}$	$W_{\text{net,ext}}$
	Direction	Sign	Direction	Sign	Sign	Sign
Stage 1						
Stage 2						

S6-2: Pushing Boxes Together

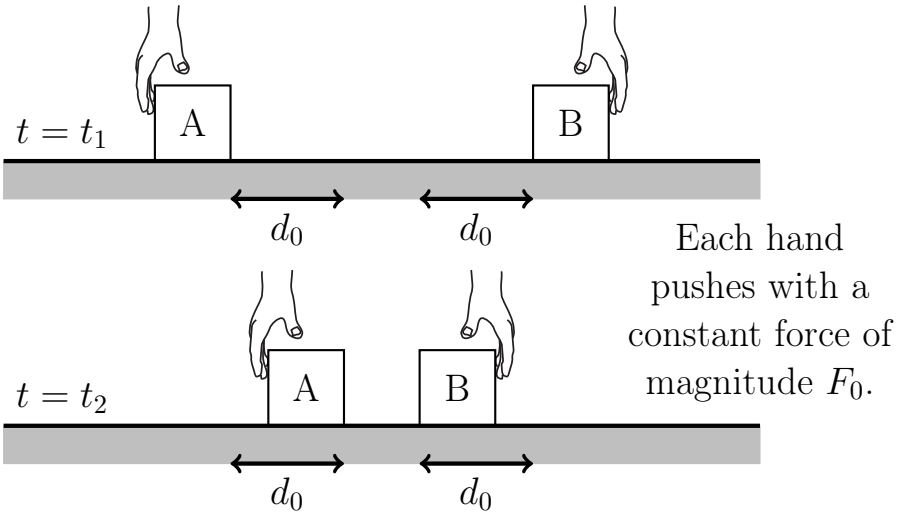
Two identical blocks, A and B, are initially at rest on a level, frictionless surface. System AB consists of **both blocks**.
At time $t = t_1$, hands begin to push the blocks toward each other.
Each hand exerts a constant horizontal force of magnitude F_0.
At time $t = t_2$, each block has moved a distance d_0 from its initial position.

(1) Determine if the **change in kinetic energy** of system AB is *positive*, *negative*, or *zero*.

(2) Determine if the work done by **each force** is *positive*, *negative*, or *zero*.

(3) Determine if the **net work** on system AB is *positive*, *negative*, or *zero*.

(4) Check to see if your answers are consistent with the work-energy theorem.



S6-3: Dragging a Box

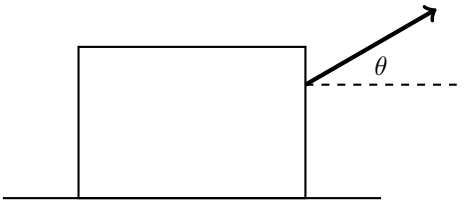
- You are pulling a box with known mass m at the angle shown below. The box moves from $x = 0$ to $x = d$. Find the work done by the rope in each of the following situations:

  (A) The tension is constant.

  (B) The tension decreases linearly from $3T_0$ to T_0.

- If the box began at rest, find the final speed of the box in each of the situations above.

- Don't forget to make sense of your answers!



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.