

Line Master 8B-4 Work and Energy

Example	Is Work Done?	Explanation
1. A crane lifts a steel beam from the ground to the second floor of a building.	Yes	The crane lifts the mass through a vertical distance in the same direction as the force that it applies.
2. A person carries a heavy box down a hallway from one room to another.	No	The person applies a force upward, but the crate is moving with the person horizontally.
3. A book falls from a shelf to the floor.	Yes	The force of gravity moves the book through a vertical distance in the direction of the force.
4. A toboggan slides down a hill.	Yes	The force of gravity acts down the hill, and the toboggan moves in that direction.
5. A weight lifter holds a 200-kg mass motionless above his head.	No	Work requires movement through a distance.

Example	Type of Energy Change	Work Done by...
1. An arrow is shot from a bow.	Potential to kinetic	The bow string
2. A boulder falls from a cliff.	Potential to kinetic	Gravity
3. A car comes to a stop after the driver applies the brakes.	Kinetic to potential	The brakes — friction

Example	Force (N)	Work (J)
1. A 2.0-kg book is lifted from the floor to the desk 0.80 m from the floor.	$F = mg$ $F = (2.0 \text{ kg})(9.8 \text{ N/kg})$ $F = 19.6 \text{ N}$	$W = Fd$ $W = (19.6 \text{ N})(0.80 \text{ m})$ $W = 15.7 \text{ J}$
2. A crane lifts a 4500-kg concrete pillar to a height of 44 m.	$F = mg$ $F = (4500 \text{ kg})(9.8 \text{ N/kg})$ $F = 44\,100 \text{ N}$	$W = Fd$ $W = (44\,100 \text{ N})(44.0 \text{ m})$ $W = 1\,940\,400 \text{ J}$
3. The brakes of a car apply a force of 15 000 N to bring the car to a stop in a distance of 80 m.	$F = 15\,000 \text{ N}$	$W = Fd$ $W = (15\,000 \text{ N})(80 \text{ m})$ $W = 1\,200\,000 \text{ J}$
4. A helicopter does 50 000 J of work to lift off from the ground to a height of 200 m.	$F = W/d$ $F = 50\,000 \text{ J}/200 \text{ m}$ $F = 250 \text{ N}$	$W = 50\,000 \text{ J}$