

Work: The Scientific Definition

| Learning Target | Description |
|-----------------|---|
| 10.1 | I can define, analyze, and calculate the amount of work done by a force in a closed system. |



What does it mean to work?



Pop Quiz: Is it Work?

1. Pushing on a wall until you are exhausted
2. A book falls off a table onto the ground
3. A waiter carries a tray at shoulder level across a room at a constant speed
4. A rocket accelerates through space

def·i·ni·tion

Work is the process of moving an object by applying a force.

Ingredients of Work

Mathematically, work can be expressed by the following equation:

$$W = F d$$

Work

Vector or Scalar?

$$W = \vec{F} \cdot \vec{d}$$

Units? $1 \text{ N} \cdot \text{m} = 1 \text{ J (Joule)}$

Relationship?

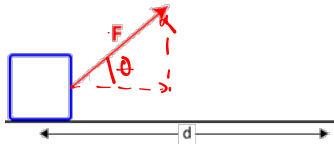
Direct Proportional

Pop Quiz: Is it Work?

1. Pushing on a wall until you are exhausted
2. A book falls off a table onto the ground
3. A waiter carries a tray at shoulder level across a room at a constant speed
4. A rocket accelerates through space

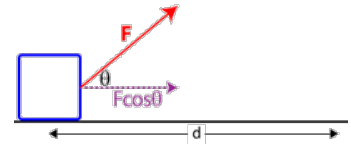
IMPORTANT

- Only the force applied in the direction of the object's displacement counts!
- If the force and displacement vectors aren't in exactly the same direction, find the component.

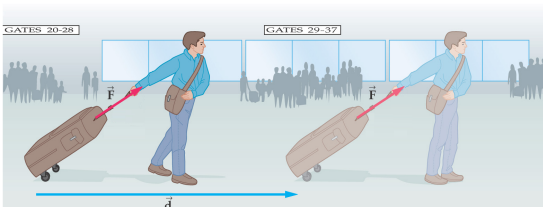


IMPORTANT

- Only the force applied in the direction of the object's displacement counts!
- If the force and displacement vectors aren't in exactly the same direction, find the component.

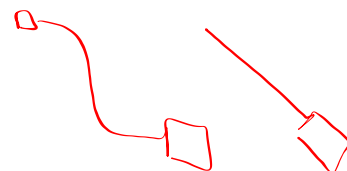
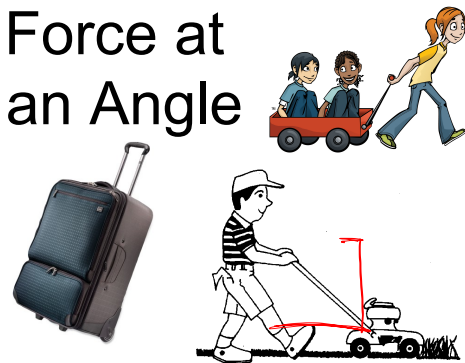


Force at an Angle to the Displacement



$$W = F \cdot d \cos \theta$$

Force at an Angle



WORKING EXAMPLES

1. An appliance salesman pushes a refrigerator 2 m across the floor by applying a force of 200 N. Find the work done.
2. Barry pulls a 30-kg wagon with a force of 500 N a distance of 20 m. The force acts at a 30° angle to the horizontal. Calculate the work done.

WORKING EXAMPLES

An appliance salesman pushes a refrigerator 2 meters across the floor by applying a force of 200 N. Find the work done.



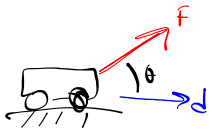
$$W = F \cdot d \cos \theta$$

$$W = (200\text{N})(2\text{m}) \cos 0^\circ$$

$$W = 400\text{ J}$$

WORKING EXAMPLES

Barry pulls a 30-kg wagon with a force of 500 N a distance of 20 m. The force acts at a 30° angle to the horizontal. Calculate the work done.



$$W = F \cdot d \cos \theta$$

$$W = (500\text{N})(20\text{m}) \cos 30^\circ$$

$$W = 9000\text{ J}$$

More Work?

You want to load a box into the back of a truck.



More Work?

$\frac{L}{0} \frac{P}{7} \frac{S}{6}$

$W = F \cdot d \cos \theta$
 $W = mgh$

$W = F \cdot d \cos \theta$
 $W = (mg \sin \theta) L$

$\sin \theta = \frac{h}{L}$

$W = mg \left(\frac{h}{L} \right) L$
 $W = mgh$

PRACTICE

**UNIT 9 PROBLEMS
(1-8)**