

Work: The Scientific Definition

LEARNING TARGET	DESCRIPTION
9.1	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?

$$W = F d$$

Units? $N \cdot m = \text{Joules}$

Relationship?

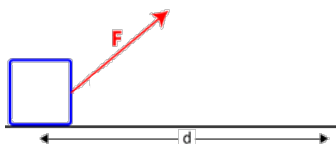
Directly Proportional

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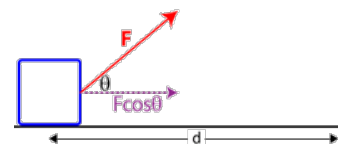
IMPORTANT

- 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.

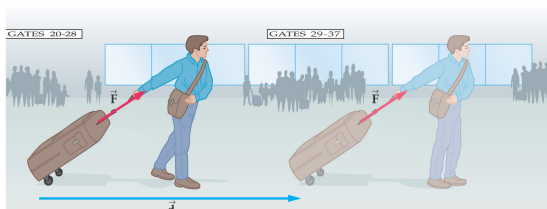


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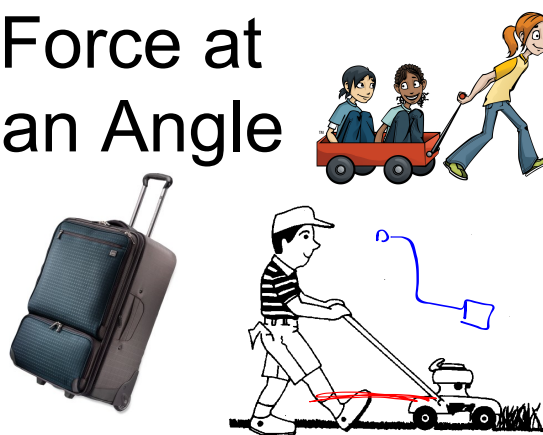


Force at an Angle to the Displacement



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

Force at an Angle



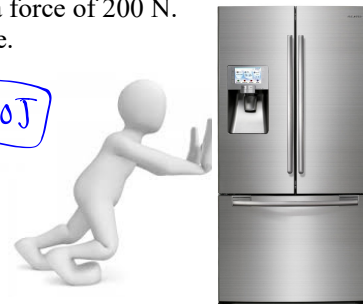
IN CLASS: WORKING EXAMPLES

1. An appliance salesman pushes a refrigerator 2.0 m across the floor by applying a force of 200.0 N. Find the work done.
2. Barry pulls a 30.0-kg wagon with a force of 500.0 N a distance of 20.0 m. The force acts at a 30.0° angle to the horizontal. Calculate the work done.

IN CLASS: WORKING EXAMPLES

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

$$W = F \cdot d = 400 \text{ J}$$

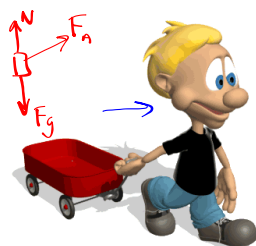


IN CLASS: WORKING EXAMPLES

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.

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

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



More Work?

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



More Work?

$\frac{L}{13}$ $\frac{P}{1}$ $\frac{S}{8}$

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

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

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

PRACTICE

PRACTICE PROBLEMS (1-3)