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FOCUS: Energy

ESSENTIAL QUESTION: Can you identify the meaning of the words "work" and "energy"?

What do we already know?

- A force is a push or pull applied to an object that may cause that object to change its ~~shape or~~ velocity.

How is force related to work?

- Work is done when a force acts upon an object and causes the object to move some distance in the same direction as the force.
  - Also called "displacement" (movement in the direction of a force).
- What does it mean to "do work" on an object?
  - Work is done on an object when the applied force causes displacement.
- If work is done, there is an object that must supply the force.

Examples:

Stocking Shelves = Work (force ↑, can of food moves ↑, displacement is ↑)

Who/what supplies the force? the person

Holding Boxes = No work (force is applied ↑, but the food does not move)

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Plowing a Field = Work (force pulls plow →, plow moves →, displacement is →)

Who/what supplies the force? ox

Throwing a Baseball = work (force is applied ←, baseball moves ←, displacement is ←)

Who/what supplies the force?
baseball player

Rollercoaster is pulled to the top of the first drop = Work (force is pulling ↗, rollercoaster moves ↗, displacement is ↗)

Who/what supplies the force?
Chain pulled by motor

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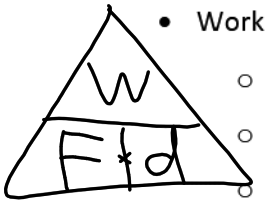
Weightlifter lifting a barbell = Work (force is pulling/pushing ↑, barbell moves ↑, displacement is ↑)

Who/what supplies the force? lifter

Weightlifter holding a barbell over his/her head = no work (force is pushing ↑, barbell is not moving!)

How is work calculated?



- Work = Force x Distance
  - The metric unit for force is Newtons (N)
  - The metric unit for distance is meters (m).
  - The metric unit for work is Nm = Joules (J).
- Ex 1: A fork lift picks up a load and raises it 3.75m off the floor. The load has a gravitational force of 1023N. How much work is done by the fork lift?

$W = F \cdot d = 1023N \times 3.75m = 3836.25Nm$

J

- Ex 2: How much work is done by a person who uses a force of 27.5N to push a grocery cart 12.3m?

$W = F \cdot d = 27.5N \times 12.3m = 338.25Nm$

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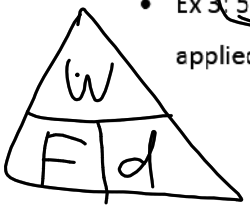


- Ex 3: 55, 000J of work is done to move a rock 25m. How much force was applied? $W = Fd$

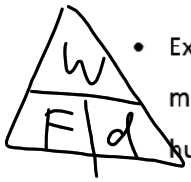
$$F = \frac{W}{d} = \frac{55{,}000\,\text{Nm}}{25\,\text{m}} = 2200\,\text{N}$$

- Ex 4: You and three friends apply a combined force of 486.5N to push a piano. The amount of work done is 1762.75 J. What distance did the piano move? (Round to the nearest hundredth)

$$d = \frac{W}{f} = \frac{1762.75\,\text{Nm}}{486.5\,\text{N}} = 3.62\,\text{m}$$

- Ex 5: Calculate the amount of work done when moving a 567N crate a distance of 20 meters.

$$W = F \times d = 567\,\text{N} \times 20\,\text{m} = 11{,}340\,\text{Nm}$$



- Ex 6: If it took a bulldozer 567.6 Joules of work to push a mound of dirt 30.5 meters, how much force did the bulldozer have to apply? (round to the nearest hundredth)

$$F = \frac{W}{d} = \frac{567.6\,\text{Nm}}{30.5\,\text{m}} = 18.61\,\text{N}$$

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- Ex 7: A front-end loader needed to apply 137 (f) Newtons of force to lift a rock. A total of 223 (w) Joules of work was done. How far was the rock lifted? (round to the nearest hundredth)

$d = \frac{w}{f}$ $d = \frac{223\ J/m}{137\ N} = 1.63\ m$

- Ex 8: A young boy applied a force of 2,550 Newtons (F) on his St. Bernard dog who is sitting on the boy's tennis shoes. He was unable to move the dog. (d) How much work did he do trying to push the dog? Explain how you came up with your answer. $W = F \times d$

$= 2,550\ N \times 0\ m = 0\ J$

146 N

20 sec.

$W = F \times d = 146N \times 0m = 0J$