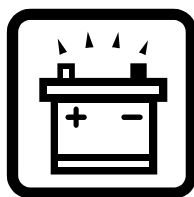


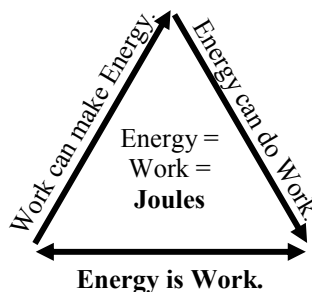
Energy, Work, and Power



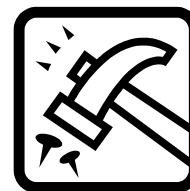
Energy

Energy is stored work.
A battery can store energy to make things work whenever you want.

Energy can cause forces,
which can cause motion,
which can do work.



Work



Work uses energy.
It takes energy to move things.
Energy can make things work.

Work can create energy.
A generator uses work to make energy,
which can be stored to do more work.

Work

Work is defined as a force applied (moved) through a distance.

$$\text{Work (in Joules)} \rightarrow W = Fd$$

Force (in newtons)
distance (in meters)

Work equals force times distance.

If you push harder (**more force**)
you do **more work**.

If you push longer (**more distance**)
you do **more work**.

To do work, a force has to be in the direction of the motion.

Half of this force does work (the half that pushes parallel to the motion).

1 N

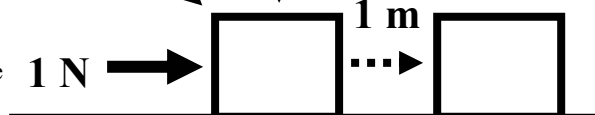
1 N

None of this force does work (none of it is parallel to the motion).

All of this force does work (it is all parallel to the motion).

1 N

1 m



*Ex: You push a 1000 newton car 5 meters.
How much work did you do?*

$$F = 1000 \text{ N}$$

$$d = 50 \text{ m}$$

$$W = ?$$

$$W = Fd$$

$$W = (1000 \text{ N})(50 \text{ m})$$

$$= 5,000 \text{ J (joules)}$$

(Doing 5,000 J of work takes 5,000 J of energy)

*Ex: How much work does a kid do while sitting?
The kid weighs 45 N.*

No work — the kid is not moving. ($d = 0$, $W = 0$)

Power

How fast you do work is called **power**. If you work faster, you use more power.

$$\text{Power (in watts)} \rightarrow P = \frac{W}{t}$$

Work (in joules)
Time (in seconds)

Power equals work divided by time.

Putting in the work equation: $P = \frac{Fd}{t}$

A machine that **works faster** (in less time) is **more powerful**.

A **more powerful** light bulb gives off the **same** amount of light (**work**), it **just** does it **faster**.

Ex: You do 120 joules of work in 2 seconds. How much power did you use?

$$W = 120 \text{ J}$$

$$t = 2 \text{ sec}$$

$$P = ?$$

$$P = W/t$$

$$= 120 \text{ J}/2 \text{ sec}$$

$$= 60 \text{ watts}$$

(same as a light bulb)

Ex: Two guys lift two 40 N rocks up a 5 m staircase. Bob does it in 10 seconds. Joe does it in 20 seconds. Compare their work and power.

Bob: $F = 40 \text{ N}$; $d = 5 \text{ m}$; $t = 10 \text{ s}$
 $W = Fd = 40\text{N}(5\text{m}) = 200 \text{ J}$
 $P = W/t = 200\text{J}/10\text{s} = 20 \text{ w}$

Joe: $F = 40 \text{ N}$; $d = 5 \text{ m}$; $t = 20 \text{ s}$
 $W = Fd = 40\text{N}(5\text{m}) = 200 \text{ J}$
 $P = W/t = 200\text{J}/20\text{s} = 10 \text{ w}$

They do the same amount of work (200 J), but Bob uses more power (20 w).

Name: _____

Period: _____

1. F or F_w = _____ 2. W or E = _____ 3. MA = _____ 4. p = _____ 5. d = _____ 6. P = _____	8 w 30 N 10 25 m 24 kgm/s 90 J	1. Energy 2. Power 3. Work 4. Joules	A. Uses energy and can create energy. B. The units for energy and work. C. The rate of doing work (faster work uses more of this). D. Has the ability to create forces; stored work.
More, Less, or the Same amount of Work?		Is the person doing work?	
____ You use more force to move an object. ____ You lift a 20 N object faster. ____ You raise an object a shorter height. ____ You move a lighter object. ____ You move an object farther.		____ When pushing a 1000 N car 20 meters? ____ When lifting a rock off the ground? ____ When holding a book in their hands? ____ When pushing hard against a brick wall? ____ When walking up the stairs?	
More or Less Power?		You do 45 J of work in 3 seconds. How much power do you use? _____ A car uses 2,500 Joules in 25 seconds. Find power. _____ A 60 watt light bulb runs for 5 seconds. How much energy does it use? _____ You push a 10 N object 10 meters. How much work was done on the object? _____ On the same object as in the previous question, you have to push with 15 N to move it 10 meters. How much work do you do? _____ What was the difference in the work to move the object and the work you do? Why was there a difference?	
____ An engine can lift an object faster. ____ Someone takes more time to push a car. ____ You take the same amount of time to do more work. ____ Same distance; same time; more force.			
You move a 25 N object 5 meters. How much work did you do? _____ You carry a 20 N bag of dog food up a 6 m flight of stairs. How much work was done? _____ You push down on a 3 N box for 10 minutes. How much work was done? _____ You use 35 J of energy to move a 7 N object. How far did you move it? _____			