Name: _____

Period: _____

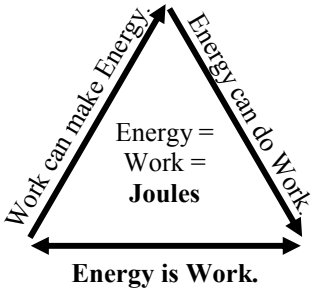
Energy, Work, and Power

Energy and work are interconnected—one can make the other.

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.

Work (in Joules) → **W = Fd** ← Force (in newtons), distance (in meters)

Work equals force times distance.

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

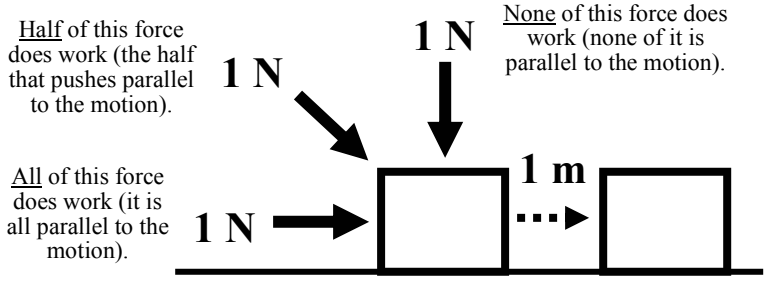
If you push longer (**more distance**) you do **more work.**

To do work, a force has to be <u>in the direction of the motion</u>.

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

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

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



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

F = 1000 N d = 50 m W = ?	W = Fd W = (1000 N)(50 m) = 5,000 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.

Power (in watts) → $P = \frac{W}{t}$ ← 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 J t = 2 sec P = ?	P = W/t = 120 J/2 sec = 60 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. <u>Compare</u> their work and power.

Bob: F = 40 N; d = 5 m; t = 10 s	Joe: F = 40 N; d = 5 m; t = 20 s
W = Fd = 40N(5m) = (200 J)	W = Fd = 40N(5m) = (200 J)
P = W/t = 200J/10s = (20 w)	P = W/t = 200J/20s = (10 w)

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

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1. F or F_w = _____	8 w
2. W or E= _____	30 N
3. MA = _____	10
4. p = _____	25 m
5. d = _____	24 kgm/s
6. P = _____	90 J

1. Energy	A. Uses energy and can create energy.
2. Power	B. The units for energy and work.
3. Work	C. The rate of doing work (faster work uses more of this).
4. Joules	D. Has the ability to create forces; stored work.

More, Less, or the Same amount of 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.

More or Less Power?

___ 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?

Is the person doing work?

___ 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?

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?