Name: _____

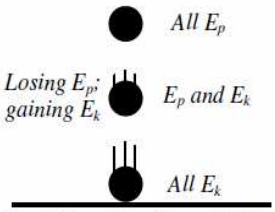
Period: _____

3.2

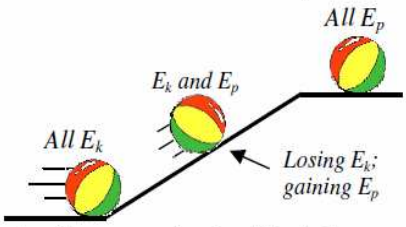
Energy Transfers: Work and Power

Energy Transfers

Energy has to come from somewhere. Energy comes from other forms of energy. This is known as ***energy transfer.***



Falling objects lose Potential Energy (E_p) and gain Kinetic Energy (E_k).



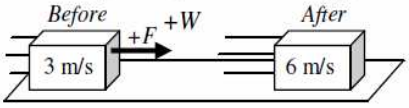
As objects go up they lose Kinetic Energy (E_k) and gain Potential Energy (E_p).

In fire, chemical energy becomes thermal energy (heat) and radiant energy (light).

Work

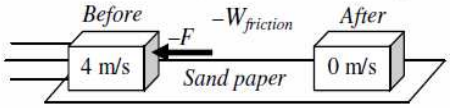
Work is energy transferred by **forces**. Any force that changes an object's energy is doing work.

Work (forces) can add energy.



*A force can do **positive work**, increasing an object's kinetic **energy**.*

Work (forces) can remove energy.



*Friction can do **negative work**, decreasing an object's kinetic **energy**.*

Work (*in Joules*) → **W = Fd** ← Force (*in Newtons*); ← distance (*in meters*)

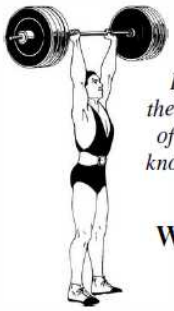
Work equals force times distance.

Ex: A 1000 Newton force pushes a car 5 meters. How much work was done?

F = 1000 N d = 50 m W = _____	W = Fd W = (1000 N)(50 m) = 5,000 J (joules) *(5,000 J of work gives 5,000 J of E_k to the car.)*

Work is Energy

Sometimes you don't know the work done, but you know the result of the work. The work done = the change of energy.



If we calculate the potential energy of the weights, we know the work done to lift them.

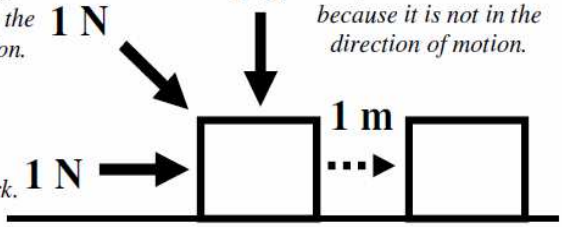
$W_{done} = E_{gained}$

$W = E_p$

If the object is not moving no work is being done.

If the person does not move the nail, d = 0, so W = 0. No work is done on the nail and the nail's energy doesn't change.

Only <u>part</u> of this force does work: the horizontal portion.



This force does no work because it is not in the direction of motion.

All of this force does work.

Only forces parallel to the motion do work.

Power

Power is *how fast* you do work or transfer energy. If you work faster, you use more power.

Power (*in watts*) → $P = \frac{W}{t}$ ← Work (*in joules*); ← Time (*in seconds*)

Power equals work (or energy) divided by time.

Ex: A force does 120 joules of work in 2 seconds. How much power did it use?

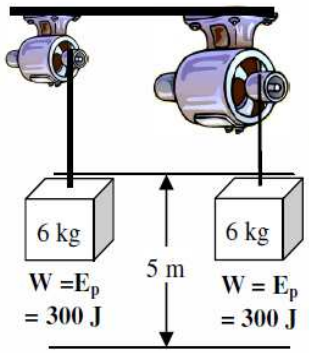
W = 120 J t = 2 sec P = ____	P = W/t = 120/2 = 60 watts *(same as a light bulb)*

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

Same work, more time, less power

t = 30 sec

Power = 300J/30 sec = **10 W**



Same work, less time, more power

t = 10 sec

Power = 300J/10 sec = **30 W**

*A **more powerful** motor can do the **same** amount of **work**, it **just** does it **faster**.*

Both of these motors do the same amount of work: lifting a 6 kg object up 5 m. The work the motors performed gives potential energy to the objects:

$W = E_p = mgh$

$= 6(5)(10)$

$= 300$ J.

All sections marked with a ⚡ are considered essential concepts and must be completed to receive full credit on WS.

1. Energy	A. The units for work and energy.
2. Joules	B. Stored or gained work.
3. Work	C. Energy changing from one form to another.
4. Power	D. Energy transferred by forces. Product of force and distance.
5. Energy Transfer	E. How fast work is done.

Potential Energy (E_p), Kinetic (E_k) Energy, or Work (W)

____ An object is pushed for 3 m.

____ An object is going 6 m/s.

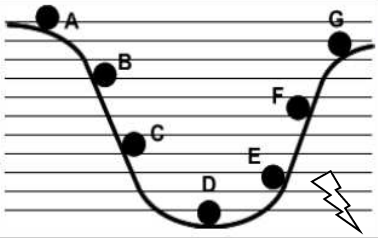
____ Slowing down an object.

____ An object on top of a 3 meter table.

____ Friction stopping an object from moving.

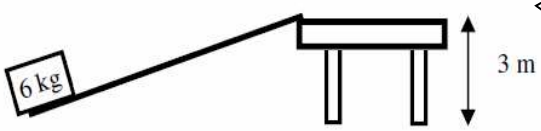
What kind of energy is lost from A to D?

What kind of energy is lost from D to G?



To help a bicyclist get to the top of a hill, they speed up. Using energy, explain why this helps.

If the bicyclist starts at rest, how do they get up the hill?



What kind of energy will it have at the top? Calculate it.

Where does this energy come from?

Motor A does 240 J of work in 24 seconds. Calculate power.

Motor B does 240 J of work in 8 seconds. Calculate power.

Which motor did more work?

Which motor was more powerful?

True or false: "*A more powerful motor does more work*"?

Is energy increased or decreased?

___ An object speeds up.

___ An object is lowered back to the ground.

___ Friction slows down an object.

___ An object sits motionless on a table.

___ An object is lifted up from the ground.

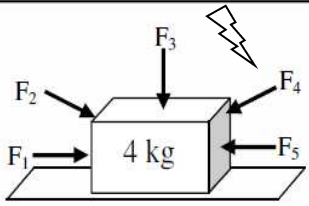
Figure out the Energy Transfers.
Thermal; Nuclear; Radiant; Mechanical; Chemical; Electrical

Eating food allows you to move.

A gas stove boiling water.

Which forces are doing work on the object?

Which forces are not doing work on the object?



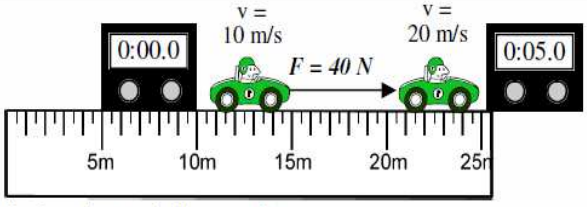
A person holds onto a 25 N object for 2 minutes 3 m above the ground. How much work is done on the object?

A 30 N force pushes a 20 kg box 5 m across the floor. How much work is done on the box?

What did the above work become?

A 25 N force pushes a box up a ramp to the back of a truck. If the force does 200 J of work, how long is the ramp?

Where does the work go?



Calculate the work done on the car.

Calculate the power of the force.

What did the work become?