Energy Presentation

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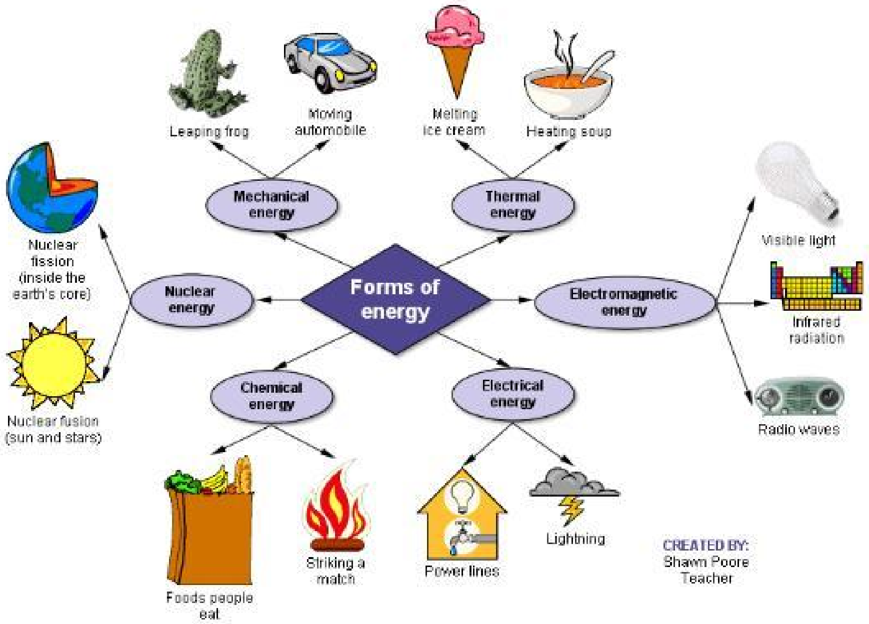
Review: What is energy?

- **Energy:** ability to do stuff
  - Scalar quantity
  - Conserved
- Energy cannot be created or destroyed, just shuffled around
- The unit for energy is joule (J)

The Different Forms of Energy

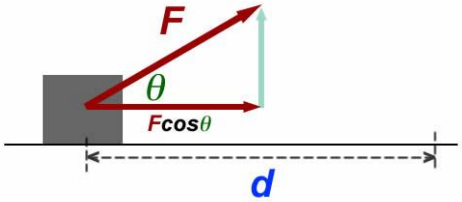
- Gravitational
- Elastic
- Heat
- Kinetic
- Chemical
- Electrical
- Nuclear
- Mass



Work

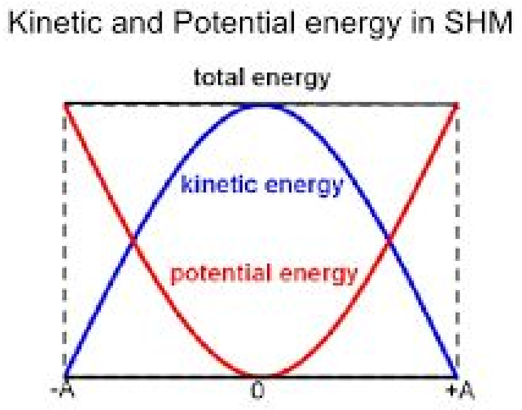
- **Work:** the energy needed to enact a force through some displacement
- W = F||d
    - Only the force parallel to the displacement does work
- W = Fd cosθ
- **Negative Energy:** forces done against motion do negative work

$$W = Fd\cos\theta$$



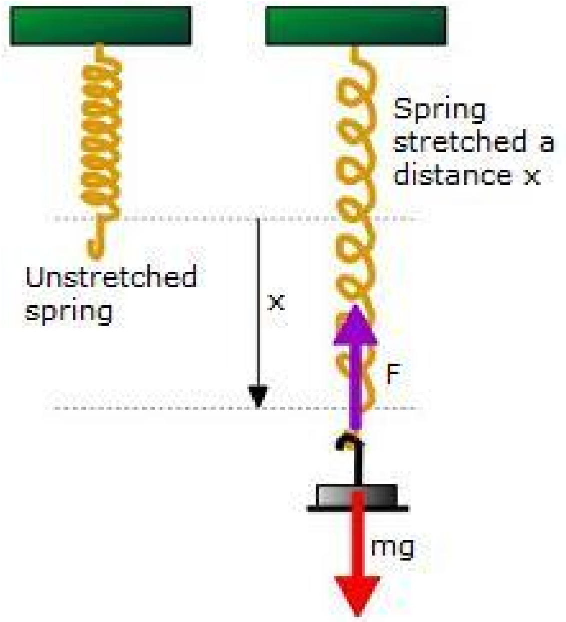
Kinetic Energy vs. Potential Energy

- **Kinetic Energy:** energy of motion
  - $KE = \frac{1}{2}mv^2$
- **Potential Energy:** how much energy an object by virtue of its position
  - Gravitational $PE_g = mgh$
  - The work done depends of the height and is independent of the path taken
- **Elastic Potential Energy:** $PE = \frac{1}{2} kx^2$



Spring Constant

- **Hooke's Law:** • FS = -kx
  - k= spring constant
  - x= stretch or compress displacement
  - Negative because force is opposite of displacement
- Measured in N/m



Conservative vs. Nonconservative Forces

- **Conservative:** forces for which the work done does NOT depend on the path taken but only on the initial and final positions
  - Gravitational, elastic, electric
  - Potential Energy can only be a conservative force since it is associated with position
- **Nonconservative:** do depend on the path taken
  - friction, air resistance, tension, push or pull from a person

Law of Conservation of Energy

The total energy is neither increased nor decreased in any process. Energy can be transformed from one form to another, and transferred from one body to another, but the total amount remains constant

Mass Energy

- Mass depends on
  - How the parts are arranged
  - How the parts move within the bigger object

$$E=mc^2$$

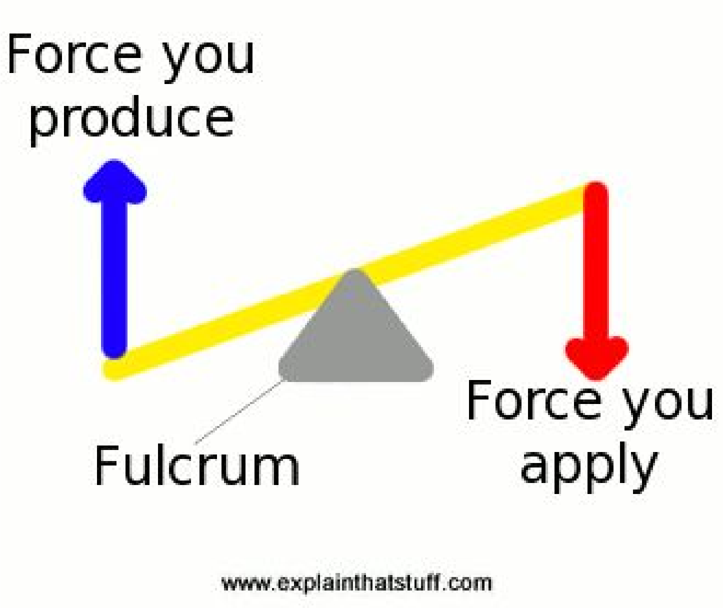
- c= speed of light = 3.00 x 10^8 m/s
- m= amount of energy

Power

- **Power:** rate at which work is done or the rate at which energy is transformed
- P=W/t
  - P=W/t=Fd/t=Fv
- Measured in Watts (W)

Machines

- Work in = work out
- **Mechanical Advantage:** • MA = Fout/Fin
- **Lever:** rotates around a fulcrum
  - MA= Fout/Fin= Lin/Lout
  - L= length
- **Ramps**
  - MA= Fout/Fin = L/h
- **Pulleys:** sacrifice displacement to achieve greater force
  - MA= Fout/Fin= # of pulleys = din/dout
  - d= distance



Efficiency

$$\text{Efficiency} = \frac{\text{Useful Energy Output}}{\text{Energy Input}} \times 100\%$$

$$\text{Efficiency} = \frac{\text{Useful Power Output}}{\text{Power Input}} \times 100\%$$

- Answer comes out to be a percent

3 Common Mistakes

1. Mistaking parallel forces for perpendicular forces and vice versa
2. Not taking into account all of the forces acting on an object
3. Mixing up conservative forces and non conservative forces.

FRQ problem solving

- Figure out what the problem is asking for. From that use the correct equation. For instance, if a problem involves a spring, use Hooke's Law. Write that equation down before you start solving. **Make sure you know the difference between parallel and perpendicular forces. As well as conservative and nonconservative forces.** Drawing a Free Body Diagram will help distinguish between parallel and perpendicular. It can also help with figuring out and noting all the forces acting on the system.

FRQ problem solving

- You can assume that gravity will be 9.81 m/s^2 and that the speed of light will be 3.00 x 10^8 m/s. Every other value will need to be given or solved. Write down the values you know, as well as the unknowns.
- Convert Units of time, mass, and/or length/height if needed. Make sure time is in **seconds**, mass is in **kilograms**, and length/height is in **meters**.
- From that you essentially just need to plug and chug. Double check to make sure you used the correct units for your final answer.

Question 1

Work is defined as:

A. The increase in the speed or rate of a moving object.
B. The speed in a given direction
C. When a force applied on an object causes that object to change position.
D. A force between different objects known to accelerate objects toward the center of Earth.

Question 2

The Millennium Falcon has been pulled into The Empire by The Tractor Beam and Obi Wan Kenobi must go to pull the lever that shuts down the tractor. The lever is 4 meters long. The the fulcrum is 100 centimeters away from the handle of the lever. The opposing force is 10,000 N, which is 3 meters away from the fulcrum. Approximately how much force does Obi Wan need to apply to the lever?

A. 5,000 N
B. 7,500 N
C. 6,700 N
D. 3,330 N

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Question 3

Which SI Unit is work measured in?

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B. Nm

C. J

D. W

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Question 4

Richard’s car ran out of gas. He is 1 km away from the nearest gas station. He pushes his car with a force of 6000 N how much work has he done?

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B. 8,000,000 J
C. 6,000,000 J
D. 4,000,000 J

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Question 5

Richard finally arrived at the gas station! How much power did he put into pushing the car given that it took him one hour?

A. 2,000 W
B. 1,600 W
C. 3,000 W
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