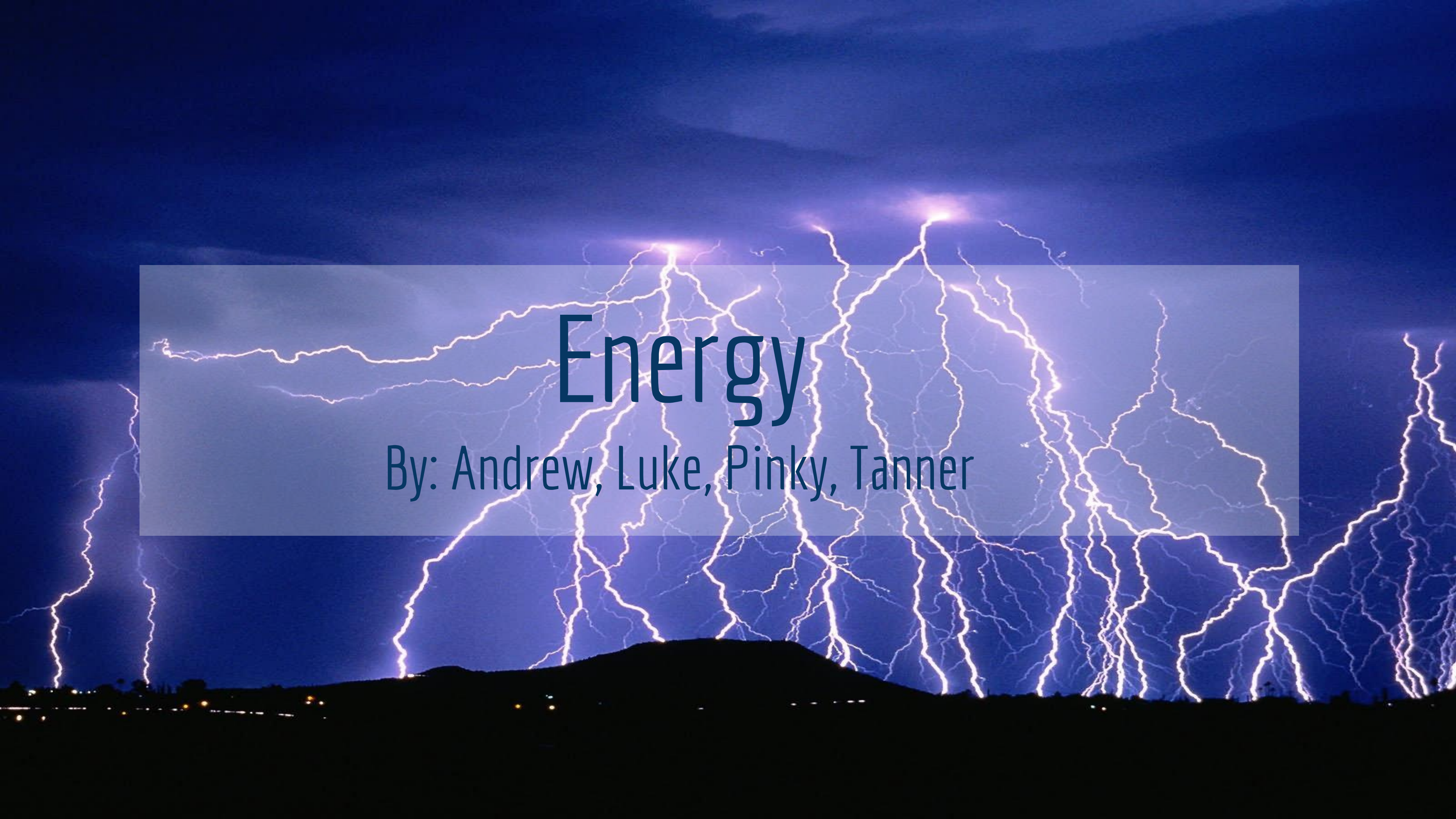


Energy

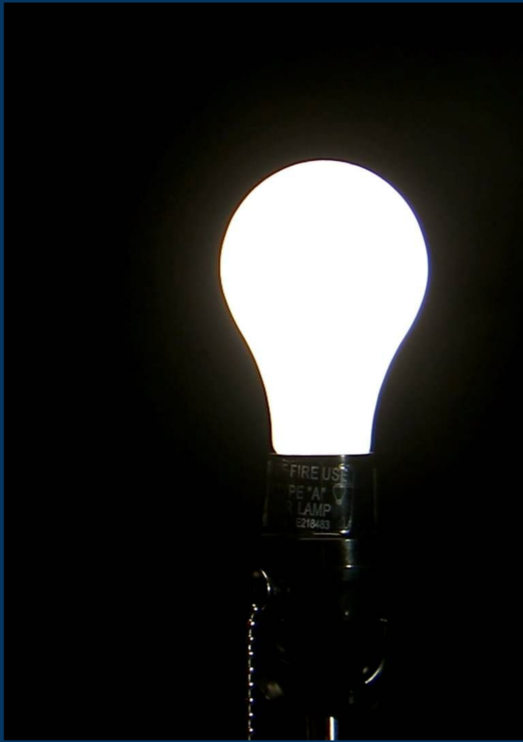
By: Andrew, Luke, Pinky, Tanner

What is Energy?

- Energy is the ability to do stuff
- Energy cannot be created or destroyed (it's conserved)
- Unit for Energy is Joules (J) or Newton-meters
- Energy is a scalar quantity, meaning it only has magnitude, not direction

Forms of Energy

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



What is Work?

- Work is the energy needed to enact a force through some displacement
- Work = Force Parallel x Displacement
  - $W = F_{\parallel} d$
  - $W = F \cdot d \cdot \cos\theta$
- Forces can be exerted but do no work
- Work is also measured in Joules
- Make sure you have correct units
  - FRQ may not give correct units

Negative Work

- Friction is **negative** work
- Usually, forces done to prevent motion are negative
- Make sure to check if work is positive or negative!

Kinetic Energy

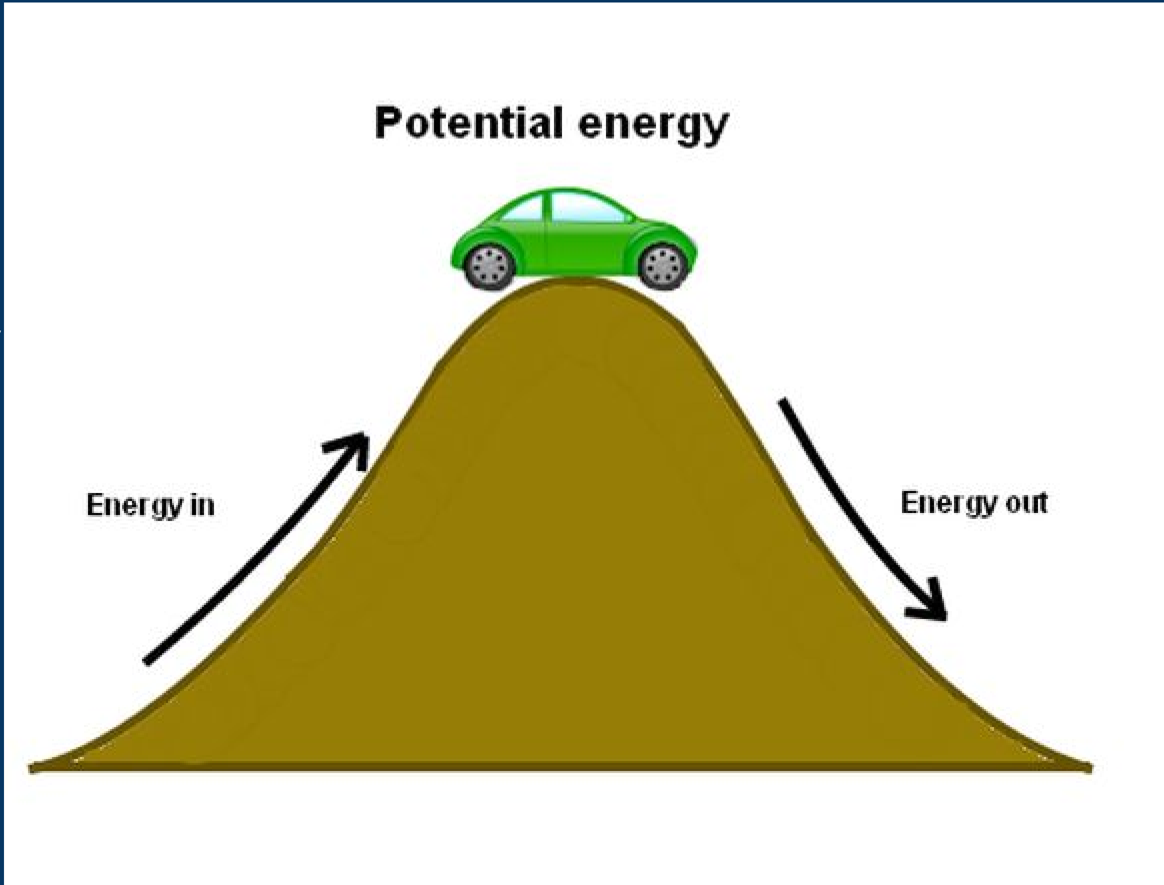
- Energy of motion
- $KE = \frac{1}{2} m v^2$
  - **Translational**, not rotational KE

Work Energy Theorem

- $W_{Net} = KE_2 - KE_1$
- $W_{Net} = \Delta KE$
- Net Work done on an object is equal to change in its Kinetic Energy
- Reminder:
  - If positive work is done, kinetic energy is increased
  - If negative work is done, kinetic energy is decreased

Potential Energy

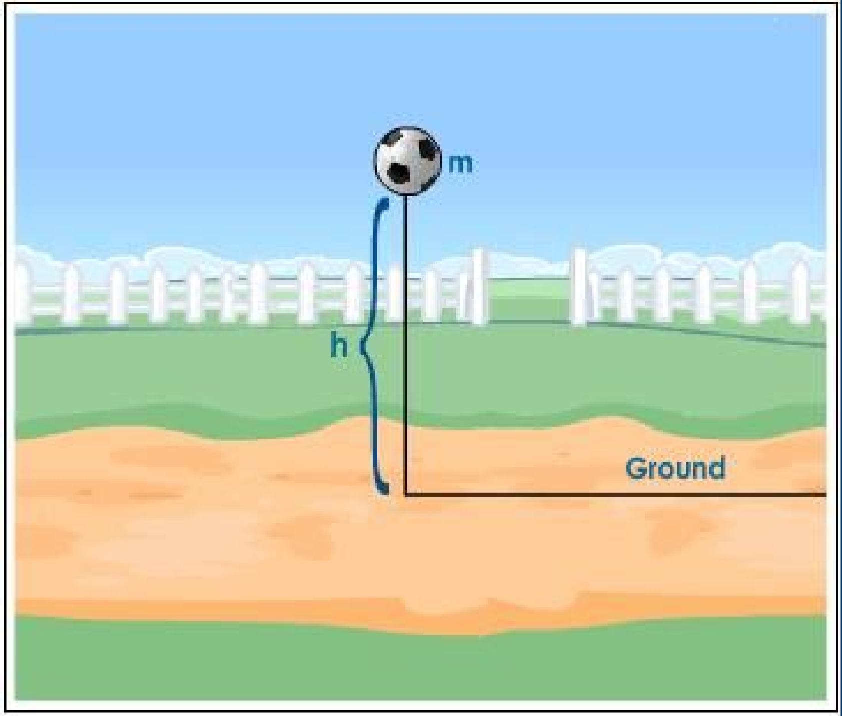
Potential energy is energy based on position or configuration.



Gravitational Potential Energy

Items held above the ground also have potential energy, in the form of Gravitational Potential Energy.

The potential energy of the item equals the force of gravity.



Potential Energy Formula

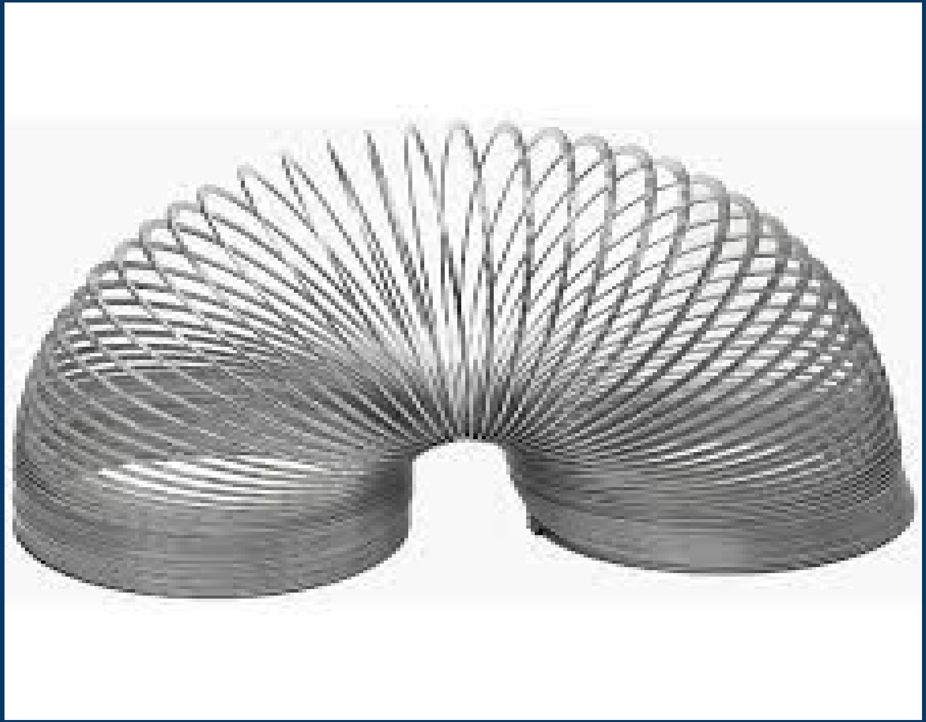
Potential Energy

PE=mass x gravity x height

Elastic Potential Energy

The work needed to stretch a spring

PEe=½ kx2



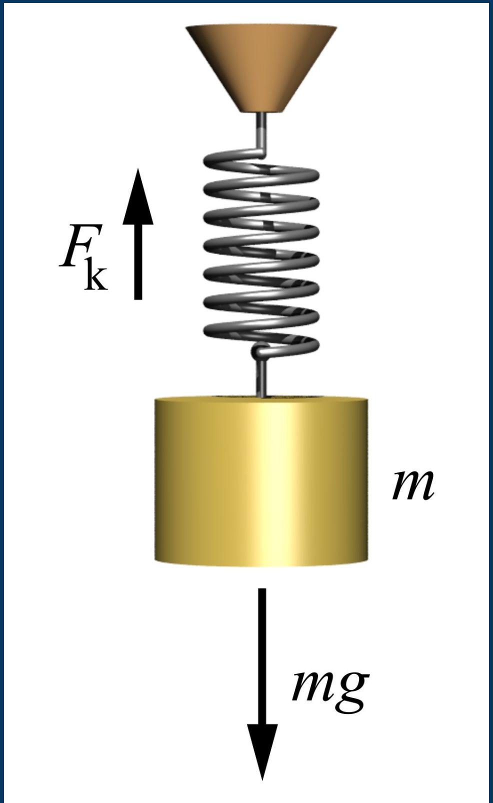
Spring Force

Spring Force = -kx

Hooke's Law

k = Spring Constant

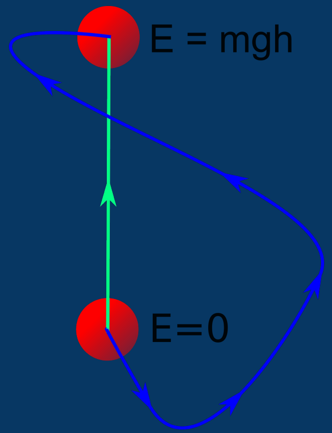
x = Stretched or Compressed Displacement



Conservative Forces

Work done against gravity does not depend on the path

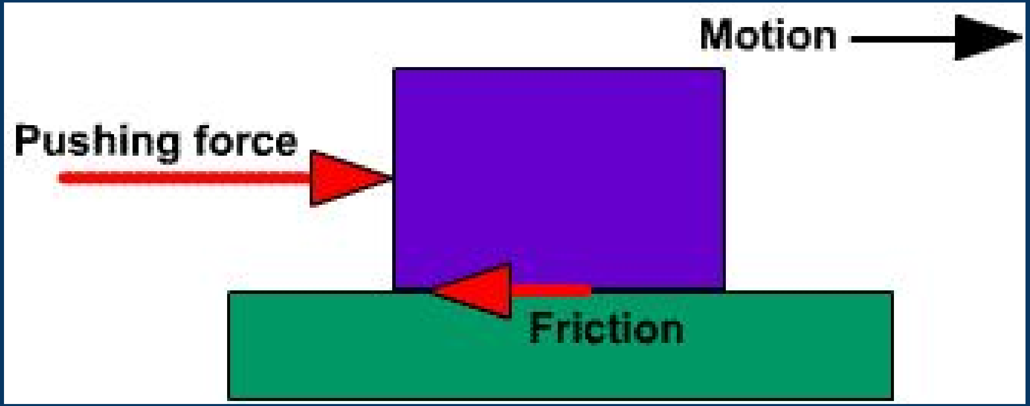
Forces that do not depend on the path are called conservative forces



Nonconservative Forces

Nonconservative forces do depend on the path taken.

Examples: Friction, tension, pushing or pulling



Work Energy Theorem

- Can be derived from the Newton's Second Law

Other Forms of Energy:

Electric, nuclear, thermal, and chemical energy

At the nuclear level these are all either potential or kinetic energy

-When heated up individual molecules speed up (KE)

-Energy in food (PE) which is released through chemical reactions

Energy Transformation:

Free Fall: Gravity -9.81 m/s

Stone at rest PE^g

Speed + / Height - PE^g + KE

About to hit ground KE

Pole Vault Example

Running	KE
Flex the pole	PE (+ KE)
lift off ground	PEE + KE (+ PEg)
projectile through air	KE + PEg
land	Sound and heat

Work is done by the person and the pole on the person (when energy is transferred from one object to another or if heat is transferred between two objects

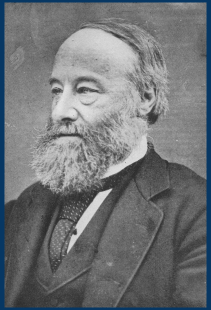
Law of Conservation of Energy

Law of conservation of energy: Energy is neither created nor destroyed

Dissipative Forces: Including friction decrease the total mechanical energy

Friction loses energy as heat, but if you include the thermal energy, it’s conserved

$W_{NC} = \Delta KE + \Delta PE$



Mass Energy:

A hydrogen atom has less mass than the combined masses of the proton and electron that make it up

Taking E=Mc2

Mass Depends on: 1. How those parts are arranged

2. How those parts move within the bigger object

A clock with moving internal components has more energy than the same clock that has no moving internal parts

Mass is: An indicator of how hard an object is to accelerate

or how much gravitational force that object will feel

As soon as you turn on a flashlight, its mass begins to drop immediately

The Sun's mass also drops just by virtue of the fact it shines

What you've been weighing has been the total energy of the particles and objects all along

Mass Energy Cont.

-The mass of a hydrogen atom is less than the combined masses of the proton and electron that make it up because potential energy can be negative

- If simply left to their own devices objects will always go from high PE to low PE

-For the most part all atoms have less mass than than the combined masses of the protons, neutrons, and electrons that make them up

- An O2 molecule weighs less than two oxygen atoms floating free

Mass Energy Cont.

-Protons and neutrons are made up of quarks and their mass is derived from the PE of the quarks

-Electrons and quarks are the smallest units

-All in all mass is a property of an object and is not the amount of something but the energy of something

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