Energy notes

August 16, 2017

Standard: S8P2a, S8P2b

Terms to know

- **Energy –** the ability to do work or cause change; measured in joules (J)
- **Energy transfer** – the movement of energy from one place to another without changing forms
- **Energy transformation –** the change of energy from one form to another (example: motion to heat)
- **Potential Energy**-stored energy or energy at rest or the energy based on an object's position.
- **Kinetic Energy** – the energy that an object has based on movement or motion

Terms to know

- **Gravitational potential energy (GPE) –** energy in an object due to its position in a gravitational field; calculated by multiplying an object's mass, height and force of gravity
- **Elastic potential energy –** potential energy found in springs and stretchy objects (like rubber bands) that is gained from movement from rest to another position

What is energy?

- Ability to work or cause change
- Often observed when it is moving
- Can be transferred or transformed
- Like mass/matter, it cannot be created or destroyed
- Any matter has energy if it can produce a change in itself or its surroundings

What is energy?

- **Since energy** is the ability to do work, like work it is measured in **Joules (J)**.
- The **Work/Energy Theorem** says that a change in energy is equal to a change in work.

What is energy transfer?

- Occurs when energy goes from one place to another
- Examples:
  - energy travels through a wire, it is transferred from atom to atom that make up that wire
  - energy is transferred from a golf club to the golf ball when the golf club hits the golf ball

What is energy transformation?

- Change in the “state” or form, of energy
- Example:
  - A stationary boulder at the top of a hill has potential energy; as it rolls down potential energy becomes kinetic energy
  - Can transform to heat, light, sound

What are the kinds of energy?

- Energy can be stored or in motion
- Two basic forms: potential and kinetic

What is potential energy?

- Stored energy
- Depends on an object's position
- Has the "potential" to cause a change
- Increases as height increases

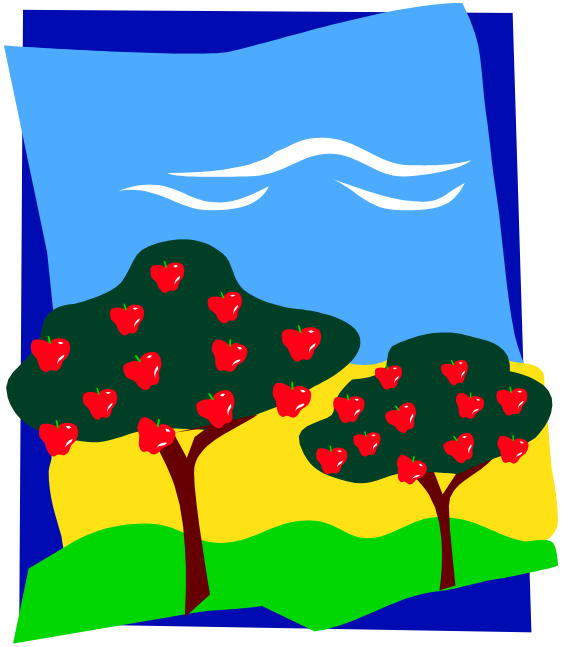
What are the types of potential energy?

- **Gravitational Potential Energy** = the ability of an object to do work because of its elevated position
- Equals height x weight
- Meters x Newtons
- OR mass times gravity times height (mgh)
- meters x kilograms x gravity.
- On Earth, gravitational acceleration is 9.8 m/s^2
- Elastic Deformation-potential energy from stretched or bent objects
- In springs it is calculated using Hooke's Law
- states that the force needed to extend or compress a spring by some distance is proportional to that distance

Why does potential energy increase with distance?

- F = ma (force = mass times acceleration)
- W = fd (work = force times distance)
- SO, objects that are elevated have a greater distance to fall
- Similarly, the greater you pull back on a rubber band or bow, the greater the distance
- Therefore the greater the work
- Energy IS the ability to do work
- More work = more need for energy

Examples of potential energy



Apples have GPE because they are up off of the ground.

The bow has elastic potential energy because it is pulled tight out of position.

When the spring is pushed together, it will have elastic potential.

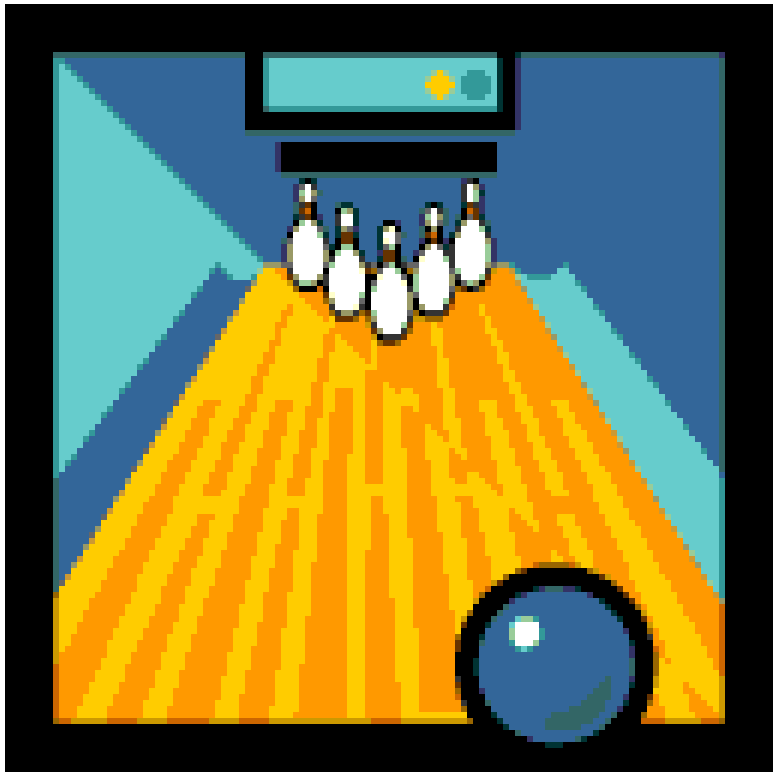
What is kinetic energy?

- Energy of movement
- The faster an object is moving, the greater is its kinetic energy
- Also depends on mass of an object
- ALL moving objects have kinetic energy

What is kinetic energy?

- **Kinetic Energy**-energy of motion
  - KE = $1/2mv^2$ (mass is measured in kilograms and velocity in meters/second.
  - K.E. units = Joules
- Kinetic Energy can never be more than the potential energy put into a system. Kinetic energy is given up during impact.

Examples of kinetic energy



What is the conservation of energy?

- In a system, energy changes forms but does not get lost or gained
- Can change form (potential to kinetic; kinetic to heat or sound)

Energy is constantly changing!

- Energy is constantly changing from the potential to the kinetic state and back again.
- At the top of a hill, when a roller coaster is standing still, its potential energy is at the maximum
- As the roller coaster goes down the hill, potential energy becomes kinetic
- As the roller coaster goes up the next hill, the kinetic energy becomes potential again

How can we calculate potential and kinetic energy?

- Need to understand the energy involved in movement when we start doing more advanced calculations (effect of friction, forces of motion, etc.)
- In real life, understanding this will help put into perspective need for care in activities such as driving

Terms to know

- **Velocity: rate at which an object is moving and the direction in which is it moving**
  - **Measured in m/s (meters per second)**
  - **Speed**
- **Gravitational acceleration: rate at which an object is being moved by gravity**
  - **9.8 m/s^2 (meters per second squared)**
  - **Constant rate**

Formulas to know

- Gravitational potential energy:
  - GPE = mass x gravitational accel. x height

    (kg) (9.8 m/s^2) (m)

- Kinetic energy:
  - KE = ½ mass x velocity^2

    (kg) (m/s)^2

- Result of both is Joules (J)
- Joules are kg·m^2/s^2
  - kilogram meter squared per second squared

Steps to solving the problems

- Identify which formula to use
- Write down the formula
- Look for the numbers you need in the equation (e.g. kinetic energy, look for velocity)
- Start filling in the numbers in the correct places in the formula
- Do the math!

Do not forget!!!

- Do one step at a time in your math work
- Write down all of your work
- Check to see if you need to convert information from one unit to another
  - Examples: 1 tonne = 1000 kg

    1 km = 1000 m
  - If you must convert, convert first then plug into the formula

Example problem

- What is the kinetic energy of a bowling ball with a mass of 6 kg rolling at 5 m/s?
- STEPS:
  - KE = ½ mass x velocity^2

    = ½ (6kg) x (5 m/s)^2

    = 3 kg x 25 m^2/s^2

    = 75 kg m^2/s^2 or 75 J

Example problem #2

- Find the gravitational potential energy of a diver with a mass of 30,000 g standing on a diving board 10m high.
- STEPS:
  - GPE = mass x gravitational accel. X height
  - Mass must be converted to kg (30,000 g = 30 kg)
  - GPE = 30 kg x 9.8 m/s^2 x 10 m

    = 2940 kg m^2/s^2 or 2940 J

Congratulations! You are finished taking notes

You will be taking notes

See the attached notebook paper and fill in using the information.

- SOURCES OF INFORMATION
- Blue text book (page 230-232)
- SEPUP book (page D31)
- Coach book (page 70)
- You will
  - Identify if it is a potential or kinetic form
  - Give a definition or explanation of the form
  - Give one real world example

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