KINETIC AND POTENTIAL ENERGY

SCIENCE 10 – LESSON 2

QUESTION:

- How do you calculate Potential and Kinetic Energy?

- How can we measure Average Velocity and use this information to calculate efficiency?

ENERGY

- **Energy** = the measurement of the amount of work that can be done against a force.

- Energy can not be created or destroyed. The energy in the universe is finite. We say that all energy in a *closed system* is conserved.

TWO CATEGORIES OF ENERGY

POTENTIAL E

- POTENTIAL ENERGY (PE)
  - **Stored** energy of an object
- **PE = mgh**

  m = mass

  g = gravity (_____ m/s^2)

  h = height/position

- Units measured in **Joules**

KINETIC E

- KINETIC ENERGY (KE)
  - Energy of **Motion**
- **KE = ½mv^2**

  m = mass

  v = velocity

- Units measured in **Joules**

ENERGY

- Potential energy changes to kinetic energy when the object moves.

Therefore:

Potential Energy = Kinetic Energy

In order to change from one form to the other **Work** must be done!

Work = Force X Distance

ENERGY AND WORK CONNECTION

Work must be done!

Work = Force (Newtons**) X Distance (meters)**

- **Force = mass (kg) x acceleration (m/s^2)**

In order to do work on an object you must move it and change the objects velocity

In Science, we use standard units of measurements or a reference measurement

For Example, Distance we tend to measure in meters (m) and mass we measure in kilograms (Kg)

- Newtons (N) is a measurement of force

Other examples!

A **butt load** is a standard measurement in the 1800's to describe a full barrel of wine (570 L)

SAMPLE **CORE** WORK PROBLEM

Work = force x distance

Mr. Ocampo's 12,000 Newton Mazda is on its last leg. He tries to start the engine but it does not start. He decides to push the car to his friends house who is a mechanic 150m away. How much work does Mr. Ocampo do to get the car to his friends house?

W = F x D

W = 12 000 N x 150 m

W = 1800000 Joules

ENERGY AND WORK CONNECTION

- From your previous notes, How can you connect energy and work?

→ Both measured in the units joules

SAMPLE **CORE FORCE** PROBLEM

Force = m x a

Mr. Ocampo's 12,000 Newton Mazda is acted upon by gravity. Gravity is a force in which provides a constant acceleration on an object of **9.8m/s²**. This means at one second an object moves at 9.8 m/s, at two seconds it travels at 19.6m/s and at three seconds it travels at 29.4 m/s. In other words an object will get faster. However, because the ground is stopping us, we stop falling!

What is the force of gravity on Mr. Ocampo's car?

F = m x a

12 000 N = m (kg) x 9.8 m/s²

$$\frac{12\,000\ (N)}{9.8\ m/s^2} = m$$

1224.5 kg = m

PRACTICE CORE FORCE PROBLEM

- Mr. Ocampo moves a 22kg box by accelerating it 2.0 m/s^2 on a completely **<u>horizontal surface</u>**. How much Force does Mr. Ocampo apply to the box? Notice this Force is not a vertical force like gravity.

$F = m\,a$

$F = 22\,kg \cdot 2.0\,m/s^2$

$F = 44\,kg \cdot m/s^2 \longrightarrow \boxed{F = 44\,N}$

Answer = 44 N

If Mr. Ocampo did not accelerate the box, would have he applied any force? Yes or No and why?

NO, Force of an object is dependant on the acceleration applied to the object.

EXAMPLE OF A CORE PROBLEM FOR ENERGY

- Potential Energy
  - **PE = mgh**

A crane raises a 150kg object 15m to the 5th floor of a new tower. How much potential energy does the object have?

mass = 150 kg

gravity = 9.81 m/s²

height = 15 m

** Notice the units for each variable

mass is always measured in kilograms (kg) and

height is always measured in meters (m)

EXAMPLE OF A CORE PROBLEMS

A crane raises a 150kg object 15m to the 5th floor of a new tower. How much potential energy does the object have?

mass = 150 kg

gravity = 9.81 m/s^2

height = 15 m

Substitute the values into the formula:

PE = mgh

PE = (150kg)(9.81 m/s^2)(15 m)

PE = 22072.5 Joules (J)

EXAMPLE OF A CORE PROBLEM

- Mr. Ocampo lifts a heavy 12.0 kg box from the floor to a vertical height of 2.0m. What is the potential gravitational energy of the cat with respects to the floor?

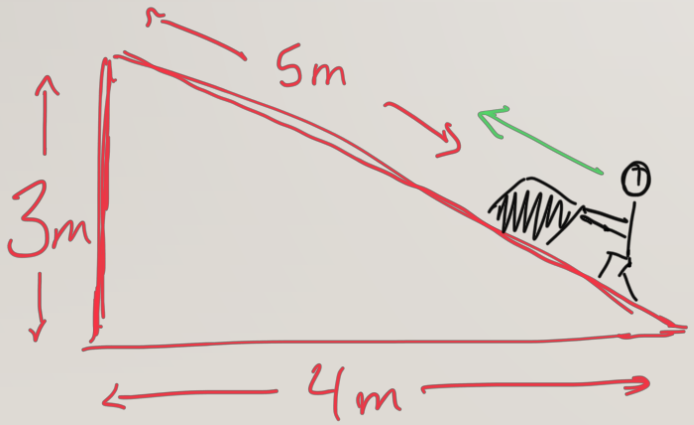
$$PE = mgh$$
$$PE = (12)(9.81)(2)$$
$$PE = 235.44\ J$$

EXAMPLE OF A MASTERY PROBLEM

- Potential energy

PE = mgh (Read the question carefully and only use the information that is needed)

A 200kg object is pushed to the top of an incline as shown in the diagram? If the force applied along the incline is 600N, what is the potential energy of the object at the top of the incline?



m = 200 kg

F = 600 N

g = 9.81m/s²

h = 3 m

PE = mgh

PE = (200kg)(9.81 m/s²)(3m)

PE = 5886 J

EXAMPLE OF A CORE PROBLEM

- Kinetic Energy
  - **KE = ½ mv²**

Mr. Ocampo is out on a run with basketball team. Assuming Mr. Ocampo weighs 80kg and running at a uniform speed (not getting faster or slower) of 5 m/s, what is his kinetic energy?

mass = 80 kg

Velocity = 5 m/s

***Notice the units for velocity will always be meters per second (m/s)

EXAMPLE OF A CORE PROBLEM

- Kinetic Energy
  - **KE = ½ mv²**

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mass = 80 kg

Velocity = 5 m/s

KE = ½ mv² ← velocity (speed) is squared.

KE = ½ (80 kg)(5 m/s)² ← Bedmas

KE = 1000 J

square 5 first

EXAMPLE OF A CORE / MASTERY PROBLEM

- Potential Energy
  - **KE = ½ mv²**

units should be converted to kg 1kg = 1000g

Mr. Ocampo throws a basketball that weighs 500g and with a kinetic energy of 1000 J. What is the speed of the shot?

mass = 0.500 kg

KE = 1000 J

$KE = \frac{1}{2} mv^2$

$(1000\ J) = \frac{1}{2} (0.500\ kg)(v)^2$

$\sqrt{(1000\ J) / 0.25kg} = \sqrt{v}$

63.25 m/s = v

APPLY WHAT YOU UNDERSTAND!

- A good strategy for studying and checking understanding is to create questions of your own.

Take the time to create a question for both a CORE potential and kinetic Energy problems.

For your question, also create and answer key.

I will choose three questions from three different students to use on your next class quiz.

EXAMPLE OF A SCHOLARLY QUESTION

- Given that **Work = force x distance**, and **Force** of a given object is its mass times the acceleration of its movement (F = m x a). What is the energy exerted by a 1000kg car in Joules if it has 0 m/s² acceleration and travels for 3km.

1Km = 1000m

3000m

F = m x a

F = (1000 kg) x 0 m/s²

F = 0 N

connect

W = F x d

W = 0 N x 3000 m

W = 0 J

Scholarly questions are about connections. In order to achieve an A in this class you will need to connect multiple concepts and skills together.