3055 BA SANGAM COLLEGE

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Worksheet 8

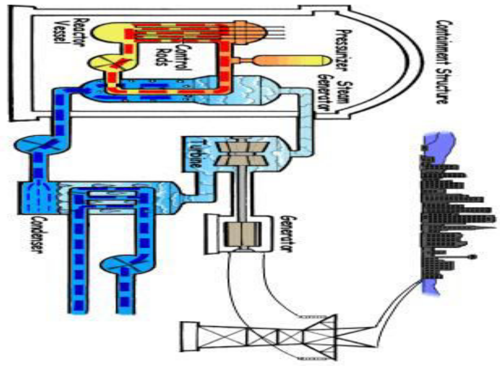
School: **Ba Sangam College** Year/Level: **11**

Subject: **Physics** Name of student:__________

Strand	2-Energy
Sub-strand	Forms of Energy, Hooke's Law
Content Learning Outcome	Objective: ➢ Understand different forms of energy(cont'd) ➢ Understand and apply Hooke's Law

2. Nuclear energy

- Nuclear power stations work in pretty much the same way as fossil fuel-burning stations, except that a "chain reaction" inside a nuclear reactor makes the heat instead.
- The reactor uses Uranium rods as fuel, and the heat is generated by nuclear fission: neutrons smash into the nucleus of the uranium atoms, which split roughly in half and release energy in the form of heat.
- Carbon dioxide gas or water is pumped through the reactor to take the heat away, this then heats water to make steam. The steam drives turbines which drive generators and produces electricity.



3. Radiant Energy

Radiant energy is the energy of electromagnetic waves. Radiant energy is sometimes used to refer to the electromagnetic waves themselves, rather than their energy (a property of the waves), Because electromagnetic (EM) radiation can be considered to be a stream of photons, radiant energy can be viewed as the energy carried by these photons. The sun provides radiant energy.

4. Electrical energy

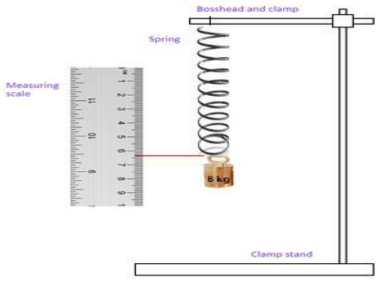
- Electrical energy is energy stored in a charged particle within an electric field. Electric fields are areas surrounding a charged particle that exert a force on another charged particle within the field.
- Electrical energy is a type of potential energy, or energy stored in an object due to the position of the object. In the case of electrical energy, the object is the charged particle, and the position is within the electric field.
- Another way of looking at electrical energy is electrical potential, which is measured in volts. Electrical energy is used to move charges through wires to create current, or electricity. Electricity is used to do work in our homes. Lightning involves the transformation of electrical energy into thermal energy and light energy.

5. Chemical energy

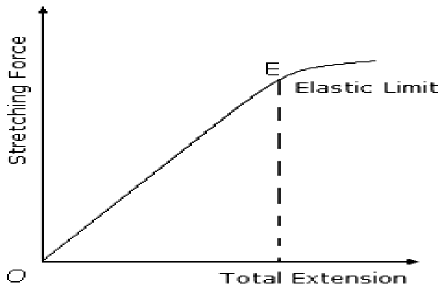
Chemical energy is energy that has been stored in chemical form, such as in fuels or sugars or as energy stored in car batteries. Gasoline is a chemical that combines with oxygen and a little heat to release the great amount of thermal energy stored in the chemical structure of the gasoline. Other such chemicals include sucrose, methane, ethanol, and methanol.

HOOKE'S LAW

Elasticity is the ability of a material to return to its original shape/length when the stretching force or the compressing force is no longer acting on it. **Hooke's law states that the force applied is proportional to the extension/compression of the spring provided the elastic limit is not exceeded.**



The graph of the force versus extension/compression therefore is given as:



If the elastic limit is not exceeded, $F \alpha x$. Thus the spring follows Hooke's law given by:

$$F = kx$$

Where: F- force applied (N)

k- spring constant (N/m)

x- extension/compression (m)

Note:

- Slope of F vs x graph gives spring constant, k.
- A spring having a spring constant of 100N/m means a force of 100N is required to extend/compress the spring by 1m/
- Different springs have different spring constants (N/m)

Elastic Potential Energy, E_p(J)

Is the energy stored in springs when it is either extended or compressed. The work done in stretching or compressing is equal to the elastic potential energy gained by the spring which is given by:

$$E_p = \frac{1}{2}kx^2$$

Note:

Elastic Potential energy is also found from the area under the graph of force versus extension/compression.

Example 1

A force of 20N applied to a linear spring stretches it from 10cm to 20cm. Assuming that the mass of the spring is negligible, calculate:

i) the amount of extension of the spring

ii) the spring constant

iii) the gain in elastic potential energy

Solution

i) $x =$ 20cm – 10cm = 10cm = 0.1m

ii) $F = kx$

$$k = \frac{F}{x} = \frac{20N}{0.1m} = \underline{200N/m}$$

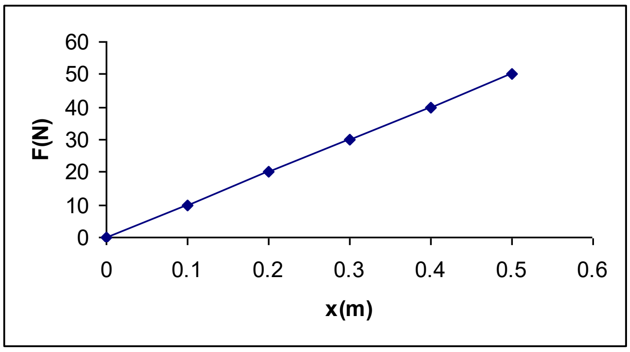
A force of 200N is required to extend the above spring by 1m.

iii) $E_p = \frac{1}{2} k x^2 = \frac{1}{2} (200) (0.1)^2$

$= \underline{\underline{1\ J}}$

Example 2

Year 11 Physics students of Ba Sangam College performed an experiment on Hooke's Law. Shown below is the Force against Extension graph obtained after carrying out the experiment.



i) Determine the spring constant.

ii) Calculate the elastic potential energy stored when stretched to 0.5m.

iii) What is the elastic potential energy gained by the spring when stretched from 0.3m to 0.5m.

Solution

i) Spring constant is found from the slope of F vs x graph

$$k = \text{slope} = \frac{rise}{run} = \frac{50}{0.5} = \underline{100N/m}$$

ii) $E_p = \frac{1}{2} k x^2 = \frac{1}{2} (100) (0.5)^2 = 12.5J$

iii) $E_{p\,gained} = \frac{1}{2} k x^2 = \frac{1}{2} (100) (0.5)^2 - \frac{1}{2} (100) (0.3)^2 = 8\ J$

OR

$E_{p\,gained}$ = Area under graph = $A_{trapezium}$ = ½ (a+b)h = ½ (30 + 50) (0.5 – 0.3) = 8J

ACTIVITY

1. A spring which has a natural length of 20 cm. When a 6 N weight is hung on it, the spring stretches to 32 cm.

(a) The spring constant is:

A. 0.5 N/m B. 5 N/m C. 50 N/m D. 250 N/m (2 marks)

(b) If the 6 N weight is replaced by a 5 N weight, what is the new length?

A. 10 cm B. 24 cm C. 28 cm D. 30 cm

Note: Same spring is used, thus same spring constant.

(2 marks)

2. A spring of length 10cm stretches to 22 cm when a force of 4 N is applied to it. If it obeys Hooke's law, its total length when a force of 6 N is applied is

A. 28 cm B. 42 cm

C. 50 cm D. 56 cm

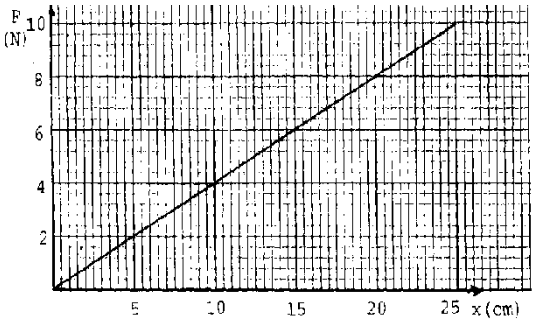
(2 marks)

3. A spring is compressed a distance of 14 cm if a force of 35 N acts on it. Calculate:

i) the spring constant in (N/m) (1 mark)

ii) The energy stored in the spring if it is compressed to 14cm. (2marks)

4. Hooke's Law is illustrated by the force-extension graph of a spring as shown below.

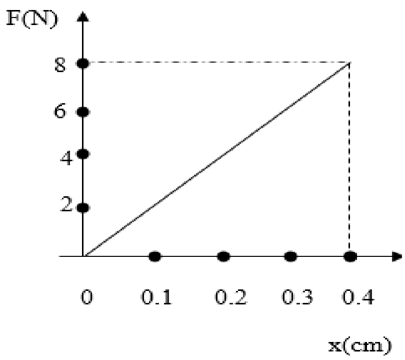


Find:

i) the ***force constant*** (spring constant) of the spring in N/m (2 marks)

ii) the spring is extended to 5 cm. How much more work will be done to extend the spring from 5cm to 25 cm? (2 marks)

5. In an attempt to verify the Hooke's Law, two year 11 students did an experiment and plotted a graph of Force versus Extension, for an elastic spring.

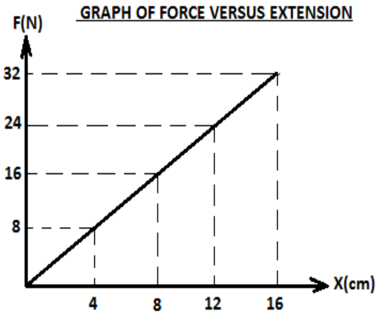


From the graph given above, calculate:

i) the spring constant. (1mark)

ii) the elastic potential energy stored in spring when extended to 0.3m. (2marks)

6. Study the graph below and answer the questions that follows:



i) State Hooke'sLaw (1 mark)

ii) Find the spring's constant in N/m from the above graph. (1 mark)

iii) Find the elastic potential energy of the spring when it is stretched to 16cm. (2 marks)

THE END