BAL BHARATI PUBLIC SCHOOL, PITAMPURA, DELHI – 110034

SUBJECT: -PHYSICS

CHAPTER: - Work, Energy and Power

Week:21 st DECEMBER to 24 th DECEMBER2020 **Number of Blocks: 1**

GUIDELINES FOR STUDENTS

Dear Students,

- There is only **1Assignment**.
  - Assignment: Based on Sub topics given below.
- Attempt the assignment in Physics notebook.
- **Video links** have been provided for better understanding of the concept through visuals. Watch the videos carefully as these will help you in doing the assignment.
- Read the lesson from **NCERT textbook** also.

SUB TOPICS:

- ENERGY
- FORMS OF ENERGY
- KINETIC ENERGY

INSTRUCTIONAL AIDS:

- YouTube links:
- https://youtu.be/VtE0d_Ycwp0 (6:02/11:48)
- https://youtu.be/T1z81IU-vdg (1.45:9:43)

NCERT Link:
http://ncertbooks.prashanthellina.com/class_9.Science.Science/index.html

LEARNING OUTCOMES:

By the end of this lesson ***each learner will be able to***

- Define kinetic energy to motion and calculate kinetic energy possessed by the objects.
- To derive the relationship between kinetic energy and work
- Derive the relation between momentum and kinetic energy.
- Solve numerical based on kinetic energy.

LESSON DEVELOPMENT:

Life is impossible without energy. The demand for energy is ever increasing. Where do we get energy from? The Sun is the biggest natural source of energy to us. Many of our energy sources are derived from the Sun. We can also get energy from the nuclei of atoms, the interior of the earth, and the tides.

The energy possessed by an object is thus measured in terms of its capacity of doing work. The unit of energy is, therefore, the same as that of work, that is, joule (J). 1 J is the energy required to do 1 joule of work. Sometimes a larger unit of energy called kilo joule (kJ) is used. 1 kJ equals 1000 J.

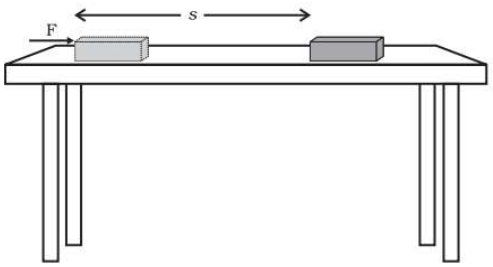
FORMS OF ENERGY

The various forms include potential energy, kinetic energy, heat energy, chemical energy, electrical energy and light energy.

KINETIC ENERGY

Kinetic energy is the energy possessed by an object due to its motion. The kinetic energy of an object increases with its speed. A falling coconut, a speeding car, a rolling stone, a flying aircraft, flowing water, blowing wind, a running athlete etc. possess kinetic energy. How much energy is possessed by a moving body by virtue of its motion? By definition, we say that the kinetic energy of a body moving with a certain velocity is equal to the work done on it to make it acquire that velocity.

Let us now express the kinetic energy of an object in the form of an equation.



- Consider an object of mass, m moving with a uniform velocity, u.
- Let it now be displaced through a distance s when a constant force, F acts on it in the direction of its displacement.
- The work done, W is F s (1)
- The work done on the object will cause a change in its velocity. Let its velocity change from u to v.
- Let a be the acceleration produced.
- We know the equations of motion the relation connecting the initial velocity (u) and final velocity (v) of an object moving with a uniform acceleration a, and the displacement, s is $v^2 - u^2 = 2a\ s$ (2)
- This gives

$$s = \frac{v^2 - u^2}{2a}$$

We know F = m a

Thus, using (Eq1) in Eq. (2), we can write the work done by the force, F as

We can write the work done by the force, F as

$$W = m\,a \times \left(\frac{v^2 - u^2}{2a}\right)$$

or

$$W = \frac{1}{2} m \left(v^2 - u^2\right) \quad (3)$$

If the object is starting from its stationary position, that is, u = 0, then

$$W = \frac{1}{2} m\, v^2 \quad (4)$$

It is clear that the work done is equal to the change in the kinetic energy of an object.

If u = 0, the work done will be

$$\frac{1}{2} m\, v^2 .$$

Thus, the kinetic energy possessed by an object of mass, m and moving with a uniform velocity, v is

$$E_k = \frac{1}{2}\, m\, v^2$$

Relation between momentum and kinetic energy.

$E_k = ½\ mv^2$ ...(i)

Where m is mass of body, which is moving with velocity v. We know that linear momentum (p) of a body which is moving with a velocity v is given by

p = mv ...(ii)

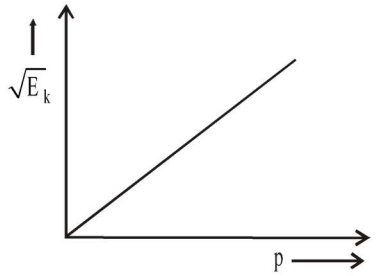
So from eqs. (i) and (ii), we have

$$E_k = \frac{p^2}{2m} \quad \text{...(iii)}$$

This is the relation between momentum and kinetic energy.

The graph between $\sqrt{E_k}$ and p is a straight line

$\because p = \sqrt{2m E_k}$



Practice Assignment

Q1 Find the velocity of a body of mass 100 g having a kinetic energy of 20 J.

Solution:

Here, mass of the body, m = 100 g = 0.1 kg

Kinetic energy, K.E. = 20 J = 20 Nm = 20 kg $(m/s)^2$

Kinetic energy = 1/2 mv^2

$$\Rightarrow \quad v = \sqrt{\frac{2 \times \text{kinetic energy}}{m}}$$

$$= \sqrt{\frac{2 \times 20 \text{ kg m}^2/\text{s}^2}{0.1 \text{ kg}}} = \mathbf{20 \text{ m/s}}$$

Q2.The speed of a vehicle of mass 500 kg increases from 36 km/h to 72 km/h. Calculate the increase in its kinetic energy.

Solution:

Given mass, m = 500 kg

The given unit of speed is km/h. It is to be converted into m/s.

1 km/h = 1×1000 metre/ 3600 second =518m/s

Initial speed, u = 36 km/h = 36 × 518 m/s = 10 m/s

Final speed, v = 72 km/h = 72 × 518 m/s = 20 m/s

∴ Gain in KE = Final KE – Initial KE

$$= \frac{1}{2} mv^2 - \frac{1}{2} mu^2 = \frac{1}{2} m \times (v^2 - u^2)$$

$$= \frac{1}{2} \times 500 \times [(20)^2 - (10)^2]$$

$$= \frac{1}{2} \times 500 \, [400 - 100]$$

$$= \frac{1}{2} \times 500 \times 300$$

$$= 75000 \text{ joule}$$

$$= \mathbf{7.5 \times 10^4 \, J}.$$

Q3. A rocket is moving up with a velocity v. If the velocity of this rocket is suddenly tripled, what will be the ratio of two kinetic energies?

Answer:

Initial velocity = v, then final velocity, v' = 3v

Initial kinetic energy = $12mv^2$

Final kinetic energy (KE) = $1/2\ mv'^2 = 12\ m(3v)^2 = 9(1/2mv2)$

$(KE)_{initial} : (KE)_{final} = 1 : 9.$

Q4.A light and a heavy object have the same momentum, find out the ratio of their kinetic energies. Which one has a larger kinetic energy?

Answer:

Linear momentum of first object, $p_1 = m_1v_1$ and of second object, $p_2 = m_2v_2$

But, $p_1 = p_2$

or, $m_1v_1 = m_2v_2$

If $m_1 < m_2$ then $v_1 > v_2$

$$(\text{K.E.})_1 = \frac{1}{2}(m_1v_1)v_1 = \frac{1}{2}p_1v_1$$

and $$(\text{K.E.})_2 = \frac{1}{2}(m_2v_2)v_2 = \frac{1}{2}p_2v_2$$

So, $$\frac{(\text{K.E.})_1}{(\text{K.E.})_2} = \frac{\frac{1}{2}p_1v_1}{\frac{1}{2}p_2v_2} = \frac{v_1}{v_2}$$

But, $$v_1 > v_2$$

Therefore, $(K.E.)_1 > (K.E.)_2$

Now solve the following assignment:

ASSIGNMENT 2

Textual questions: page152

Question 16 and17 (Back Exercise NCERT)