"WORK AND ENERGY"

Worksheet: MODULE – 2/2

Q.1] What is power? What is its SI unit?
Answer. It is defined as the rate of doing work. Its unit is watt.

Q.2] Find the energy in kWh consumed in 10 hours by a machine of power 500 W.
Answer. W = P x t = 500 x 10 = 5000 Wh – 5 kWh.

Q.3] Define average power.
Answer.
When a machine or person does different amounts of work or uses energy in different intervals of time, the ratio between the total work or energy consumed to the total time is average power.

Q.4] Define potential energy.
Answer. It is defined as the energy possessed by a body by virtue of its position or change in shape

Q.5] Name the practical unit of power in engineering.
Answer. Horsepower.

Q.6] Illustrate the law of conservation of energy by discussing the energy changes which occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?
Answer. When the pendulum bob is pulled (say towards left), the energy supplied is stored in it is the form of PE on account of its higher position. When the pendulum is released so that it stars moving towards right, then its PE changes into KE, such that in mean position, it has maximum KE, and zero PE. As the pendulum moves towards extreme right, its -KE changes into PE such that at the extreme position, of has maximum PE and zero KE. When it moves from this extreme position to mean position, its PE again changes to KE. This illustrates the law of conservation of energy. Eventually, the bob comes to rest, because during each oscillation a part of the energy possessed by it transferred to air and- m overcoming friction at the point of suspension. Thus, the energy of the pendulum is dissipated in air.
The law of conservation of energy is not violated because the energy merely changes its form and is not destroyed.

Q.7] (a) What is meant by mechanical energy ? State its two forms. State the law of conservation of energy. Give an example in which we observe a continuous change of one form of energy into another and vice-versa.
Answer. It is the sum of KE and PE of an object. It states that energy can neither be created nor be destroyed. We observe a continuous change in energy in a simple pendulum and its: explanation. At the mean position, the energy is wholly kinetic while at the extreme position it is wholly potential. As the pendulum oscillates its energy continuously changes between kinetic and potential.

Q.8] (a) what is meant by potential energy? Is potential energy vector or scalar quantity?
(b) Give one example of a body having potential energy.
Answer.
(a) The energy possessed by a body by virtue of its position or configuration. It is a scalar quantity.
(b) Stretched string of a bow.

Q.9] The kinetic energy of an object of mass 'm' moving with a velocity of 5 ms-1 is 25 J. What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?
Answer Given: $v = 5ms^{-1}, m = ?, KE = 25J$

$$Using\ the\ expression\ KE = \frac{1}{2}mv^2, we\ have$$

$$m = \frac{2\,KE}{v^2} = \frac{2\ \times 25}{5^2} = 2kg$$

(i) When velocity is doubled i.e. $v = 10ms^{-1}, then\ we\ have$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (10^2) = 100\,J$$

(ii) When velocity is tripled i.e., $v = 15ms^{-1}, then\ we\ have$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (15^2) = 225\,J$$

Q.10] A certain household has consumed 250 units of energy during a month. How much energy is this in joule?

Answer.

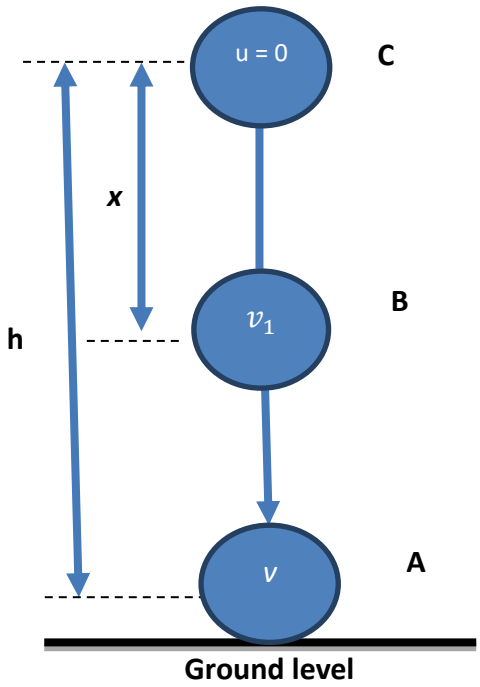
Energy consumed in a month = 250 units

= 250 kWh =250kW X 1h = 250 x 1000W x 3600 s

= 90, 00, 00,000 = 9 x 10^8J

Q.11] State the law of conservation of energy? Show that when a body falls from a certain height the total mechanical energy remains conserved.

Law of conservation of energy - Energy can neither be created nor be destroyed; it can only be transformed from one form to another.



- **At position C:**

  KE = 0

  PE = mgh

  Total Energy = 0 + mgh = mgh .... (1)

- **At position B:**

  Let v_1 be velocity of body, then u = 0, S = x.

  From equation: $v^2 = u^2 + 2$ a S

  $$v_1^2 = 0 + 2 \text{ g x} = 2gx$$

  Since $KE = \frac{1}{2}mv^2 = \frac{1}{2}mv_1^2 = \frac{1}{2}m \times 2gx$

  And $PE = mg(h-x) = mgh - mgx$

  Therefore $Total\ Energy = mgx + mgh - mgx$

  $$Total\ Energy = mgh \ldots. (2)$$

- **At position A:**

- Let velocity of body be v, then u = 0, S = h.

- From equation: $v^2 = u^2 + 2$ a S

$$v^2 = 0 + 2 \text{ g h} = 2 \text{ g h}$$

Since KE $= \frac{1}{2}mv^2 = \frac{1}{2}m \times 2 \text{ g h} = mgh$

And PE = 0

Therefore, Total Energy = mgh + 0 = mgh …. (3)

The total mechanical energy of the body at A, B and C (also at any other point in the path AB) is the same. So, the total mechanical energy of the body throughout the free fall is conserved.

Q.12] A body of mass 4 kg initially at rest is subjected to a force of 16 N. What is the kinetic energy acquired by the body at the end of 10 s?

Given: m = 4kg, F=16N, u=0, t=10s.

Now; a = $\frac{F}{m} = \frac{16}{4} = 4 \text{m}s^{-2}$

∴ Velocity v of the body after 10s is given by

V = u + at = 0 + 4 ×10 = 40 ms^{-1}

Hence, KE of the body at the end of 10s

KE = $\frac{1}{2}\ m\ v^2 = \frac{1}{2} \times 4 \times 40^2 = 3200J$

Q.13] When a body falls freely towards the earth, then its total energy……

Answer: Remains constant

Q.14] Which one of the following is not the unit of energy?

(a) joule (b) newton metre

(c) kilowatt (d) kilowatt hour

Answer: (c) kilowatt

Q.15] Commercial unit of energy is ……

Answer: kilowatt hour