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Work Power and Energy

Q1. Define Work done.

Ans: WORK DONE:

When a force acts on a body, it moves the body in the direction of its displacement in science, it is said that work is done. OR

The product of force and displacement is called WORK.

Work = Force x Displacement

W = F.d

Work is scalar quantity and it depends upon force and displacement.

Q2. Give unit of work and energy in different systems.

Ans:

SYSTEMS UNITS OF WORK

M.K.S. System: Joule

S.I. System: Joule

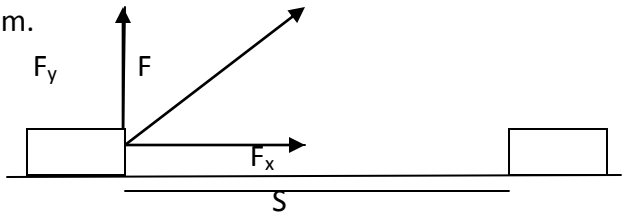
C.G.S System: Erg

F.P.S. or B.E. System: Lbs - Foot

Q3. Derive the equation of work done. Also explain maximum and minimum work done?

Ans: **DERIVATION FOR WORKDONE:**

Consider the following diagram.



In the above figure. Force "F" divided into two components vertical F_y and horizontal F_x. θ is the angle between them. So the dot product of F_x and displacement "S" is given by:

$W = F_x . S$ _____ (i)

We know that, $Cos\theta$ = base / hyp, $Cos\theta = F_x / F$

Put this $F_x = F Cos Cos\theta$ in equation (i)

$W = F Cos\theta S$

$W = FSCos\theta$

The above equation is called work done equation. Where $Cos\theta$ is an angle between F and S.

MAXIMUM WORKDONE:

When the angle between force and displacement is "0", then the work done is maximum.

$$W = FS \cos\theta = 0$$

$$W = FS \cos\theta \quad \text{since} \quad \cos 0 = 1$$

$$W = F.S\ (1)$$

$$W = FS$$

MINIMUM WORKDONE:

When the angle between Force and displacement is 90^{o}.

$$W = FS \cos\theta$$

$$W = FS \cos 90$$

$$W = FS\ (0)$$

$$W = 0$$

Q4. Define energy. Write its types?

Ans: ENERGY:

The ability of a body to do work or overcome resistance is called Energy. It is a scalar quantity. Its unit is same as work. i.e. Joule

Examples:

i. We use the chemical energy of coal, oil and gas released in the form of heat to drive steam turbines and internal combustion engines.

ii. .Electrical energy is used in electric heater which appears in the form of heat energy.

iii. Wind mills transfer the energy of wind into mechanical energy which is used for pumping water from the wall as well as for mill in grains or sawing timber.

iv. In Pakistan nuclear energy is used for the production of electricity.

TYPES OF ENERGY:

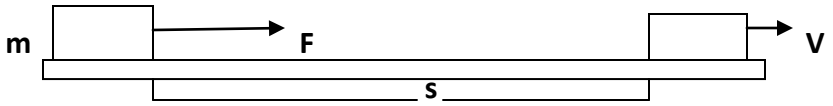
i. Mechanical energy.
ii. Chemical energy.
Iii. Electric energy.
iv. Heat energy.
v. Light energy.
vi. Nuclear energy.
vii. Solar energy.
Viii. Magnetic energy.
ix. Wave energy.
x. Geothermal energy.

Q5. What is meant by Kinetic energy? Prove that K.E = ½ mv^2?

Ans: DEFINITION:

The energy possessed by a body by virtue of its motion is called Kinetic energy it is denoted by K..E.. Kinetic energy of body depends upon the velocity of body, as the velocity is greater kinetic energy is also greater.

Equation for Kinetic Energy: $KE = \frac{1}{2}mV^2$



i. Let body having mass "m" at rest.

$$W = Fs$$

ii. Now acceleration "a" is produced by the application of force "F". So, according to Newton's 2nd Law.

$$F = ma$$

$$a = F/m \quad \_\_\_\_\_ 1$$

iii. When body starts from rest. Its initial velocity $V_i = 0$. So, according to equation of motion.

$$V_f^2 - V_i^2 = 2aS \quad \_\_\_\_\_ 2$$

Put the value of "a" and Vi in equation (ii)

$$V_f^2 - 0^2 = 2\,(F/m)\,S$$

$$V_f^2 = 2\,(F/m)\,S$$

$$\frac{1}{2}mV_f^2 = F\,S$$

$$FS = \frac{1}{2}mV_f^2$$

Where F.S is amount of work done which is changed into Kinetic Energy. So FS=K.E.

$$\text{And } V_f^2 = V_i^2$$

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

This equation is called equation of Kinetic energy

Q6. Define Potential Energy. Drive its equation?

Ans: POTENTIAL ENERGY:

The energy possessed by a body by virtue of its position or mechanical condition is called its Potential Energy. The work done against already present force on body is called potential energy.

EXAMPLES:

i. If we move a body against gravitational force then the work done is called Potential Energy.

ii. In winding of the spring of a clock, we do certain amount of work on it i.e., we spend certain amount of energy. This energy is stored in the spring in the form of Potential Energy.

DERIVATION:

Consider a body whose mass “m” and which is at vertical height “h” from the ground. so the weight of a body.

$$W = mg$$

The work done is raising the body through the height “h” is

$$W = F \times h \quad \_\_\_\_\_ 1$$

But here weight is just equal to force. So,

$$F = mg$$

Put the value of “F” in equation 1.

$$W = F\ h$$

$$W = mgh$$

Where “W” is according potential energy of the body. So, W = P.E

$$P.E = mgh$$

This is called equation of potential energy.

Q7. Differentiate between Kinetic Energy and Potential Energy?

Ans:

KINETIC ENERGY	**POTENTIAL ENERGY**
1. The energy possessed by body by virtue of its motion is called Kinetic Energy.	1.The energy possessed by a body by virtue of its position is called Potential Energy.
2. Kinetic energy is depending upon the velocity of body.	2. It is increased with increase in height.
3.It can be calculated by the following formula. $KE = \frac{1}{2}m\mathrm{V}^2$	3 It can be calculated by the following formula P.E = mgh
4. It is directly proportional to the mass and square of velocity.	4. It is directly proportional to mass, Gravitation and height.

Q8. What is meant by Law of Conversation of Energy? Give examples.

Ans: LAW OF CONSERVATION OF ENERGY:

Statement:

"Energy may change its form but it can neither be created nor be destroyed."

Examples:

i. When an electric current passes, through a ceiling fan, the fan starts rotating. Electrical energy is converted into mechanical energy.

ii. In an automobile, burning of diesel and petrol releases chemical energy which makes the automobile to move and showing that chemical energy is changed into heat Kinetic Energy.

Iii .The chemical energy stored in foods is converted into heat energy as a result of digestion in the body. This energy keeps our bodies warm and allows us to do work.

Q9. What is meant by Inter Conversation of Energy?

Ans: INTER CONVERSATION OF ENERGY:

Suppose a body having mass "m" placed at a height of "h" in the position of rest So, its kinetic energy is zero. So its potential energy is. mgh

$$\textbf{Total energy = PE + K. E}$$

$$\textbf{E = mgh + 0, E = mgh}$$

Suppose the body is released from the height "h", Now the height of body.

$$\textbf{BC = h – x}$$

In this case we use equation of motion to calculate velocity.

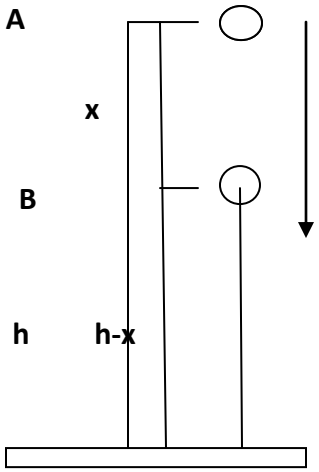
AT POSITION "A"

Vi = 0, S = x, Vf = Vi, a = g

$$\textbf{V}_f^2 \textbf{ - V}_i^2 \textbf{ = 2aS}$$

$$\textbf{2gx = V}^2\textbf{- 0}$$

$$\textbf{V}^2 \textbf{ = 2g x}$$



AT POSITION "B"

$$\textbf{K.E = ½ mv 2 \_\_\_\_\_ 1}$$

Put the value of V^2 in equation 1.

$$\textbf{K.E = ½ m 2gx}$$

$$\textbf{K.E = mgx}$$

Potential energy at Point "B"

$$\textbf{P.E. = mg (h-x)}$$

So total energy at point "B" is,

$$\textbf{T.E = K.E + P.E.}$$

$$\textbf{T.E = mgx + mg (h-x), T.E = mgx + mgh – mgx}$$

$$\textbf{T.E = mgh}$$

Q10. Explanation Law of Conversation of Energy with the help of simple pendulum?

Ans: EXPLANATION:

Consider the motion of simple pendulum. When it reaches at extreme position the velocity is zero and as well as K.E = 0 but P.E is maximum. Similarly, when bob passing through the mean position then its K.E. is maximum while P.E. is zero. During vibratory motion of simple pendulum, energy changes continuously from one form to another form. But the total energy remains constant.