WORK POWER AND ENERGY

Q.1Define and explain work? Also give its unit?

Ans. work:- when force acts on a body and body covers some distance in direction of force, then it is called work (OR) the product of force and displacement in its direction is called work.(OR) when a force displaces a body its own direction then it is called work.

Explanation:_ work done on a body depends upon applied force and displacement covered in its direction.

i.e work done = force x displacement

$w = \underset{f}{\rightarrow} x \underset{s}{\rightarrow}$ .....(i)

it also depends upon angle b/w force and displacement if there is any angle b/w then eq (i) can be written as,

w = fscosQ.....(ii)

if $Q = 0^0$ then $w = fscos0^0$ =>**w = f x s (1)** because cosQ = 1

if $Q.90^0$ then $w = fscos\ 90^0$ => w = f x s x o =>**w = 0** [sos90 = 0

if shows that work done will be equal to zero if force and displacement are perpendicular. Work is a scalar quantity and its unit is jual. If one Newton force acts on a body and displaces it to one meter then work done is equal to 1 joul.

Q.2 Define energy? Also give its different types?

Ans. energy:- The ability of a body to do work is known as energy it's unit same as work that is joul.

forms of energy:- different types of energy are given below.

(1) **Chemical energy:-** energy which is obtained during chemical reaction and burning of substances is called chemical energy eg burning of wood coal and petroleum etc.

(2) **Nuclear energy:-** that type of energy which produced during nuclear reaction is known as nuclear energy for example process of nuclear fission .

(3) **Radicand energy:=**the energy of electromagnetic waves is called radiant energy . for example radio waves micro waves x – rays etc have radiant energy.

(4) **Electrical energy:-**that type of energy with the help of which we can operate different electrical equipment is called electrical energy.

(5) **Internal energy:-**the energy of atoms and molecules which is usually in the formula kinetic energy and potential energy is called internal energy.

(6) **Mechanical energy:-**the energy produced by moving parts of a machine is called mechanical energy.

(7) **Kinetic energy:-** the energy produced in a body during motion is called kinetic energy.

(8) **Potential energy:-**energy possessed by a body by virtue of its position is called potential energy

(9) **Heat energy:-**a form of energy which tranllers from one body to another body due difference of their temperature is called heat energy.

(10)**Sound energy:-**the energy which gives sensation of hearing is called sound energy.

Q.3 Define and explain kinetic energy? Also derive K.E = ½ mv^2

Ans. Kinetic energy:-energy produced in a body during motion is called kinetic energy (K.E)

Kinetic energy of a body depends upon mass and velocity of a body if we want to stop or move a body then the work done in this form is equal to K.E

To prove :- K.E = ½ mv^2 : suppose a body of mass "m" is moving because of kicking and after covering it comes to state of rest the work done in this form is equal.

Work done = F x s ……..(i)

Now we find out values of "f" and "s" for equation (i)

We know from 2nd law :- f = ma ……..(ii)

By 3rd equation of motion we can find "s"

$2as = vf^2 - vi^2$……..(iii)

Now as vf = 0 vi = v an a = - a [are sign shout deceleration]

$2 \times a \times s = 0^2 - v^2$ => $-2as = -v^2$

$S = v^2/-2a$ => $s = v^2/2a$……..(iv)

Putting eq (ii) and eq (iv) in eq (i) we get.

Work done = ~~ma~~ x $v^2/2$~~a~~

Work done = $mv^2/2$ OR work done = ½ v^2

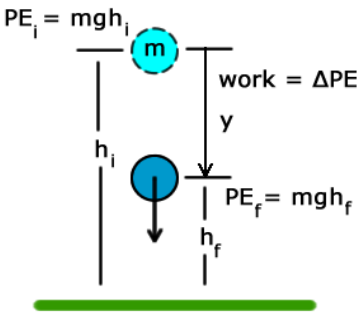
But work done in this case appears as K>E i.e k.E = ½ mv^2

Q.4 defines and explains potential energy? And prove P/E = mgh.

Potential energy: The energy possessed by a body by virtue of its position is known as potential energy (P.E).

Explanation:- this type of energy is produced in different cases. For example when a body is raised up to certain height or when an elastic spring is string is stretched then these bodies will posses potential energy the energy of a body by virtue of its hight "h" from surface of earth is gravitational potential energy because in the case we have to do some work against gravity on lifting the object and that work appears as potential energy

To prove:- P.E mgh :- suppose we have a body of mass "m" light to a certain hight "h" from the surface of the earth as shown in fig. now on lifting the mass we have to do some work against gravity which is given by: Work done = F x s ……(i)



Now we find out value of values of "F" and "s" for equation (i) so, we know that:- F = w = mg => F = = mg……..(ii)

And here the distance covered "s" is equal to hight "h" to which the body is raised i.e s = h ……..(iii)

Now putting values of "F "ε "s" in eq (i) we get

Work done = mg x h

Work done = mgh

And the work done in this case appears as P.E i.e P.E = mgh

Q.5 State and explain law of conservation of energy with the help of examples?

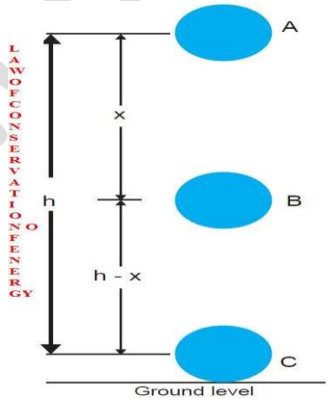
Ans. Law of conservation of energy :- this law states that energy can neither be created nor destroyed, it can be converted from one form to another form or it can be trash ferried from one body to another body but the total amount of energy remains constant.

Explanation:- Law of conservation of energy can be explained with the help of following examples.

1. A diver bend diving board because of chemical energy stored in his body and also because of this elastic potential energy stored in diving board which Is then converted into kinetic energy for the diver by giving him an upward push.
2. When water is stored at certain hight. Then they have P.E when these water are allowed to fall on turbines to produce electrical energy their P.E is converted to k.E.
3. A battery has chemical energy when a lamp is connected to it the chemical energy is converted to heat and light energy in the filament of lamp.

Q.6 Explanation of law of Conservation by 2nd method.

Ans. This law states that energy can neither be created nor destroyed but can be convert from one from to another form or transferee form one body to another body"



Explanation: - we can show it by following experiment. Let suppose we have a body of mass of mass: m: which raised up to a hight: h: from the surface of earth. We find out its total energy at points A,B and C.

At point A:- total energy at point "A" is given by;

$(E_t)_a = (P.E)_A + (K.E)_A$ 1

Now P.E at A is mghie $(P.E)^a = mg$

And as there is no motion so, K.E = 0

Putting these values in eq (i) we get

$(E_t)_A = mgh + 0 \Rightarrow (ET)_A = mgh$.....(2)

At point B;- total energy $(E_t)_B$ at "B" is given by

$(E_T)_B = (P.E)_B$..... 3

Now P.E at "B" $(P.E)_B = mg(h - x) \Rightarrow (P.E)_b = mgh - mgx$.....4

And k.E at "B" $(k.E)_B = 1/2mv^{2-}$ 5

We find value of "v" for eq (5) by 3rdeq: motion

$2as = vf^2 - vi^2$ where a = g s = x vf = v ε vi = 0

50, $2gx = v^2 - vi^2\ 0^2 \Rightarrow v^2 = 2gx$

Putting value of v^2 in eq (5) we get

$(K.E)_B = \frac{1}{2}\ m\cancel{2}gx \Rightarrow (K.E)_b = mgx$.....(6)

Putting eq (4) ε (6) in eq (3) we get $(E_T)_B = mgh \div \cancel{mg}x + \cancel{mg}x$

So, $(R_T)_B = mgh$.....7

At point c :- total energy at c $(E_T)_c$ is given by:- $(E_T)c = (P.E)_c + (K.E)_c$.....(8)

At point c $(p.E)_c = 0$ because object is on ground.

And $(K.E)_c = \frac{1}{2}\ mv^2$.....(9)

We find v by 3rd equation of motion.

$2as = vf^2\ vi^2$

Putting a= g s = h vf = v εi vi = 0 we get
$2gh = v^2$ in eq (9) we get
$(k.E)_c = ½ m2gh$ $(k.E)_c = mgh$
Putting values of (p.E), ε (K.E) in eq (8) we get
$(E_T) = 0 + mgh = (E_T)_c = mgh$……(10)
So, from eq (2) eq (7) and eq (10) it is clear that energy does not change but remains constant.

Q.7 Discuss the relation b/w mass and energy?

Ans. Mass and energy are deeply related to each other Einstein has established the relationship between mass and energy in mathematical form according to Einstein mass and energy are interchangeable that is mass can be converted to energy and energy can be converted to mass.
Einstein mathematical relationship between mass and energy is given as: $E = mc^2$
In "E" is energy and "m" is mass of mother where as "c" is a constant it is conservation factor which is known as velocity of light and its value is equal to3 x 10^8/sec.

Q.8 discusses the electrical energy production from fuel?

Ans. We use different type of fuels like petrol gas and coal etc. to produce electrical energy in power station. We burn these fuel under boiler in which water is boiled where steam is produces this steam is allowed to turbines on a high pressure which rotate the dynamo and produced electrical energy.
The produced electrical energy is feuded to transformer which falls or raises the level of voltage according to our desire and the transformer feed the power to transmission lines which transmit the electrical power form ne place to another place i.e to cities, villages and homes.

Q.9 Define and explain efficiency?

Efficiency:-the ratio b/w output and input of a machine is called efficiency.
Explanation:- during the operation of a machine some energy is supplied to that machine or engine which drives it. For example we supply electrical energy to on electric motion. Similarly we supply diesel to diesel engine but it is observed that on engine cannot convert the who input into use full work because on engine has to supply some of input energy is wasted which is transferred or radiates to the surrounding in the form heat therefore, A machine has never 100% efficiency but less than 100% the efficiency can be find by following felled. Efficiency = $\mathcal{M}\ \frac{out\ put}{input}$ x 100

Q.10 Define power give its unit? Also prove that $\overrightarrow{P}.\overrightarrow{F}.\overrightarrow{v}$

Ans. Power:- the rate of doing work is called power OR the rate of conservation of energy is called power mathematically we can writhe It as;

Power = work/time =>p = w/t

Also Power = energy/time => p = E/t

The unit of power is watt. One watt is equal to on joul per sec ie 1w = 1joul /sec

To prove that $\overrightarrow{P}.\overrightarrow{F}.\overrightarrow{v}$

As we know that; p = w/t……(i)

We also know that w = $\underset{f}{\rightarrow}$ **x** $\underset{s}{\rightarrow}$**……..(ii)**

puttingeq (ii) in eq(i) we get p = $\underset{f}{\rightarrow}$ **x** $\underset{s}{\rightarrow}$**/t**

⇨ P = $\underset{f}{\rightarrow}\frac{\vec{s}}{t}$ … … … … . . (iii)

Since $\underset{v}{\rightarrow}$ **=**$\underset{s}{\rightarrow}$/t so, eq (iii) becomes as; p = $\underset{F.}{\rightarrow}\underset{v}{\rightarrow}$

CONCEPTUAL QUESTIONS

Q.1 for answer (sec q 10 at page 47) only proof of $\vec{P}.\vec{F}.\vec{v}$

Q.2 what type of energy conservation can be observed in water dams?

The stored water in dame's possessing potential energy when these water are allowed to run turbines. The P.E of water converted to K.E when turbine runs the K.E is converted into mechanical energy. Turbines run generators which converts mechanical energy to electrical energy.

Q.3what happens to K.E of a bullet when it penetrates into a sand bag?

Ans. When a bullet penetrates into a sand bag. The sand opposes it motion by a retarding force so K.E o air molecule. And some is transferred to the K.E of bullet is used against the regarding force of sand.

Q.4 A meteor enters into earth's atmosphere and burns. What happens to its kinetic energy?

Ans. When a meteor enters into earth's atmosphere it burns and its K.E is converted into heat an light energy. And some is transferred to the K.E of air molecule.

Q.5 what do you understand by term energy transformation support your answer by two examples?

Ans. Energy transformation is a process which converts energy from one form to another form it example are given.

1. When electrical energy is given to an electric motor it converts it to mechanical energy.
2. When fuel are burnt in an engine it converts fuel energy to mechanical energy.

Q.6 for ans(see Q9 page 46 (efficiency).

Q .7 for ans (se Q.5 page 45 – q.5 page 46)

Q.8 what kind of energy is possessed in the following cases?

a) A stone laying on the top of a root b) Flaying airplane. C) Flaying airplane.
b) A wound up spring of a toy car
c) A speeding train?

a) A stone laying on the top of a root posses gravitational potential energy
b) Flying airplane posses K.E energy due to motion and P.E due to its position.
c) A wound up spring of a boy car posses elastic P.E?

Q. 9 in each of the following situation the system consists of a ball and earth describe the work done and changes in energy forms. A) you throw a ball horizontally B) horizontally thrown by a fielder c)a ball is thrown vertically and t comes to rest at top of its flight (d) the ball back to earth where you catch?

Ans. (a) when a ball is thrown vertically then there is no work done by gravity and no change in energy

b) Same as (a)

c) When a ball is thrown vertically some work is done against gravity and at the top of it flight its K.E is changes to P.E

d) When the ball falls back its P.E is converted to k>E and work is done by force of gravity.

Q.10 for ans see Q8 at page 46 and compare question)

Q.11 which would have a greater effect on the k.E of an object doubling the mass or doubling the velocity?

Ans. When mass is doubled then energy increases two times ie K.E ½ (~~2~~m) (v^2) => $(K.E)_2 = mv^2$ or $(K.E)_2 = 2$ (K.E) when velocity is doubled then energy increases 4 time ie K.E = ½ (m) $(2v)^2$ => $(K.E)_2$ => $(K.E)_2 = 4$ (K.E)

Numerical problems

(1) A 2kg object is released from rest from a hight of 10m above the ground calculate:-

i. The initial potential energy at the moment of release?
ii. The K.E at the moment it reaches 4m above ground?
iii. The speed of the object just before impact with ground?

After the impact the object finally comes to rest? Explain what happens to the lost K.E?

Solution:- Mass of object = m = 2k

Hight = h = 10m

(1) P. E at hight h = mgh

P . E 2 x 10 x 10

P.E = 200 Jouls

When

(2) k. E h = 4

k.E = ½ mv^2 .....(i)

we find "V" by 3rd eq of motion

$2as = vf^2 - vi^2$.....(ii)

A = g = 10 m/sec^2 s = 6m

Vf = v ε vi = 0

Putting these values in eq (iii)

$2 \times 10 \times 6 = v^2 - 0$

$120 = v^2 \Rightarrow v^2 = 120$m

Putting these values in eq (i)

k.E = ½ x ~~2~~ x 120

k.E = 120 joul

(3) speed of objet .according to law of conservation of energy

K.E at bottom = P.E at hight

$1/2$~~m~~v^2 = ~~m~~gh

$V^2 = 2gh \Rightarrow \sqrt{v^2} = \sqrt{2gh}$

$V = \sqrt{2gh} = \sqrt{2 \times 10 \times 10}$

$V = \sqrt{200} =$ v 14. 1 m/sec

(4)after impact when It comes to rest its K.E is transferred to surrounding.

(2) In the following situation calculate the power involved?

(i) A force of 50N moves a body through a distance of 10m in 5 sec?

(ii) an object of mass 1kg is lifted up vertically throuy 5m in 10sec?

Solution :-

(i) force = F = 50N 5 =n 10 t = 5sec P =?

As p = w/t => p = f x s /t

P = ~~10~~^{2} x 50 /~~5~~ => p = 2 x 50 = 100

(ii) m = 1kg h 5m

t = 10sec power = p =?

Now energy in this is P.E

I.e p = P.E/t

p = mgh/t

p = 1 x ~~10~~ x 5/~~10~~ => P = 5w

(3)A rubber ball of 0.12 kg is held at a hight of 2.5m above the ground and then released

(i) Calculate the K.E of ball ground.

(ii) Calculate velocity of ball just before it hits the ground.

Solution:-mass of ball = m = 0.12kg hight from ground = h = 2.5m

(i) K.E just before lilting ground = K.E =?

(ii) Velocity before lilting ground = v = ?

(i) K.E = ½ mv ^{2}……(i) we find out value of v by 3rd equation.

2as = vf^2 - vi^2 for which a = g = vf = v 10m/sec^2 vi = 0 s = 4 = 2.5

So, 2 x 10 x m2.5 = v^{2+} - ^{v}2+ - 0^2

⇨ 50 = v^2 putting value in eq (i)

K.E =½ x 0.12 x ~~50~~^{25} => K.E - = 0.12 x 25

K. E = 3Jouls

(iii) we can find velocity by 3rdeq: if motion

2as = $vf^2 - vi^2$

Putting a = g = 10 s = h = 2.5 vf = v vi = 0 vi = 0 we get

2 x 10 x 2.5 = $v^2 - 0^2$

$\sqrt{v2} = \sqrt{50}$ => v = 7.1 m /sec

(4)two bodies of equal masses moves with uniform velocities "v" find the ratio of their K.E?

Solution? :-

$M_1 = m = m$ $v^1 = v$ $v^2 = 3k$

Ratio b/w K.E (i) $(K.E)_1 : (K.E)_2$ =?

We know ratio of K.E is given by: $(K.E)_1/(K.E)_2$……(i)

Now we find $(K.E)_1$ and $(K.E)_2$ for eq(i), so.

$(K.E)_1 = 1/2m_1v_1^2$ => $(K.E)_1 = ½ mv^2$

Also $(K.E)_2 = ½ m_2 v_2$ => $(k.E)_2 = ½(m) (3v)^2$

$(k.E)_2 = ½m_2v_2$ =>

(K.E)2in eq (i) we get

$\frac{(K.e)1}{(K.E)} = \frac{1/2mv2}{9/2mv2} = 1/9$

$(K.E)1 : (K.E)2 = 1:9$

(5) A man whose mass is 75kg walks up a flight of 12 step each 20cm high in 5 sec find the power he develops in watts?

Solution:-

Mass of man = 75kg
No of steps = 12
Hight of one step = 20cm
Hight of 12 steps = h = 12 x 20 = 24 cm = 2.4m
Taken time = t =5sec
Power developed = p =? As we know that p = t
But energy in this case is P.E so. P = P.E /t

- ⇨ P = PE/t =>p = mgh/t
- ⇨ P = 75 x ~~10~~^{2}x 2.4/~~5~~ => p = 75 x 2 x 2.4
- ⇨ P 360w

(6)A mason of 600 N weights is climbing a loader 10m high. Find his P.E at middle of the loader.

Solution: -weight of mason = w = 600 N
Hight of loader r = h_1 = 10m
Hight to middle of loader = h_2 = 10/2 = 5m
P.E at h2 = P.E =?
As we know that that;
P.E = mgh => P.E = wh_2 [w = mg]
H = h_2

- ⇨ P.E = 600 x 5 = 3000 joule;

(1) A ball of weight 100 N is moving on a frictionless surface with a velocity of 10m/sec complete its K.E = ?

Solution:-weight of = w= 100N => m = w/g = 10~~0~~/1~~0~~ = 10kg
Velocity of moving ball = v = 10m/sec
K.E =?
Since K.E = ½ mv^2 => K.E = ½ x 10^5 x 10^2
k.E = 5 x 10 x 10 => K.E = 500 joul

(8) A car of mass 800kg accelerates uniformly from rest to a speed of 25/sex in 10se what is its power?

Solution:- Mas of car = m 800kg
Velocity of car = v = 25m/sec
Time = t = 10sec power = p =?
As we know that p = E/t
But energy in this case is K.E so, p = K.E/t
P = ½ mv^2 /t => p mv^2 /2 x t

- ⇨ P = ~~800~~^{40} x 25 x 25 /~~2~~ x 1~~0~~ => p = 40 x 25 x25
- ➢ P = 25000W

(9)A gril does work of 800j in lifting a 40kg bucket from a well if the acceleration due to gravity is 10/sec^2 calculate the depth of well?

Solution:-work done = 800joul g = /sec^2
Mass of bucket = 40 kg depth of well = h = ?
The work done in this case is equal to P.E i.e
Work done = P.E = mgh

- ⇨ Work done = mgh => h = work done /mg
- ⇨ H = ~~800~~/1~~0~~ x ~~40~~ => h = 2m