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Work

Q1. Define Work. Give if formula and unit

WORK

a force is said to do work if, when acting, there is a displacement of the point of application in the direction of the force.

FORMULA

$W = F.d$

$W = F\ d\ Cos\Theta$

UNIT

It S.I unit is joules.

Q2. Define energy.

ENERGY:

Ability of a body to do work is known as Energy.

Q3. Differentiate between Kinetic energy and potential energy.

K.E	P.E
Energy possess by body by virtue of its motion is known as kinetic energy	Energy possess by body by virtue of its position is known as kinetic energy
Its formula is : $K.E = 1/2mV^2$	Its formula is : P.E = mgh
It value increase with the increase in velocity	It value increase with the increase in altitude(height)

Q4. State law of conservation of energy

STATEMENT:

Energy can neither created nor destroyed but it can change from one form to another.

Q5. Write short note on

FOSSIL FUEL ENERGY

Fossil fuel energy is formed from decayed plants and animals that have been converted to crude oil, coal, natural gases or heavy oils by exposure to heat and pressure in the Earth's crust over hundreds of millions of years. Fossils fuels have stored chemical energy. This energy is converted by oxidation through burning. Thus, on burning a fossil fuel like charcoal, produce heat energy and light energy

HYDROELECTRIC ENERGY

Hydro electricity is the term referring to electricity generated by hydro power by using gravitational force of falling or flowing water. Most common type of hydroelectric power plants uses a dam on a river to store water in a reservoir. Water releases from the reservoir flows through a turbine, spinning it, which in turn runs a generator to produce electricity

SOLAR ENERGY

The energy radiated from the sun is known as solar energy. This is the most available source of energy throughout Pakistan. There are many devices which are capable of absorbing solar energy, which is then converted into electrical energy or heat energy. These devices may be photovoltaic solar panels and solar cells. Which convert the sun rays into electricity for different uses

NUCLEAR ENERGY

The energy released during a nuclear reaction such as fission or fusion reaction. All radioactive materials store nuclear energy. For example, Uranium, Radium etc. It is released from the nucleus in the form of radiation in addition to heat and light. A nuclear power plant utilizes nuclear energy to produce steam to turn a turbine and generate electricity

GEO THERMAL ENERGY

Geothermal energy is stored in the Earth as its natural heat. Deep in the Earth, there is hot molten part called magma. Water closes to magma changes to steam due to high temperature. This thermal energy is conducted to the surface of Earth. This energy is called geothermal energy

WIND ENERGY

The energy obtained by the wind is called wind energy. It is generated by wind mills. A wind mill consists of a turbine which rotates due to wind. Kinetic energy is produced due to the motion of turbine. Wind turbines convert this kinetic energy into the mechanical power. A generator converts that mechanical power into electricity.

BIO MASS ENERGY

Biomass is the organic material that comes from plants and animals. Biomass consists of stored energy from Sun, garbage, wastes, sugarcane etc. Solid biomass, such as wood, organic material and garbage, can be burned directly to produce heat

TIDAL ENERGY

It is a form of hydro power that converts the energy obtained from tides into useful form of power; mainly electricity as the Earth uses the gravitational forces of both the moon and the sun every day to move vast quantities of water around the oceans and seas producing tides and, in this way, energy is produced called tidal energy

Q6. Differentiate between Renewable and non-renewable energy sources.

Renewable	Non- Renewable
The renewable sources can be consumed and used again and again.	Non-renewable resources are limited and will finish once used
Solar energy, wind energy, tidal energy and geothermal energy are renewable sources.	Coal, petroleum and natural gases are nonrenewable sources
Most renewable resources have low carbon emissions and low carbon footprint	Non-renewable energy has a comparatively higher carbon footprint and carbon emissions.
Renewable resources cannot be depleted over time	Non-renewable resources deplete over time

Requires a large land/ offshore area, especially for wind farms and solar farms	Comparatively lower area requirements

Q7. Define efficiency. Give formula for efficiency

EFFICIENCY

The ratio of output to the input is called efficiency.

FORMULA

$$E = \frac{output}{input} \times 100$$

Q8. Define power. Give it formula and unit

POWER

The rate of doing work is known as power

FORMULA

$$P = \frac{W}{t}$$

UNIT

In SI system unit of power is Watt (joules/sec).

Q9. Derive K.E = ½ mV^2

Let's take an object of mass m which is at rest. A force F is applied to it in such a way that its final velocity becomes V and the displacement made by it in the direction of the applied force is S.

The object has gained kinetic energy due to the motion caused by the applied force. So, we can say that the work done by the force **F** on the object equals the kinetic energy gained by the object.

Work Done on the object by the force

$$W = FS \text{ ----- } 1$$

According to newton 2nd law

$$F = ma$$

By using third equation of motion

$$2\,a\,S = Vf^2 - Vi^2$$

But,

$Vf = V$

$Vi = 0$

then,

$$2aS = V^2 - 0^2$$

$$S = \frac{V^2}{2a}$$

Putting F and S in eq 1

W = FS

$$W = ma \times \frac{V^2}{2a}$$

$$W = m \times \frac{V^2}{2}$$

W = work done = K.E

$$K.E = \frac{1}{2}mV^2$$

Q10. Derive P.E = mgh

Derivation of Gravitational Potential Energy

To derive the expression for gravitational potential energy, let us consider an object of mass "m" which is raised up through height "h" from the ground. The work done in lifting it to height "h" is stored in it as its gravitational potential energy "P·E", i.e.

P·E = Work done

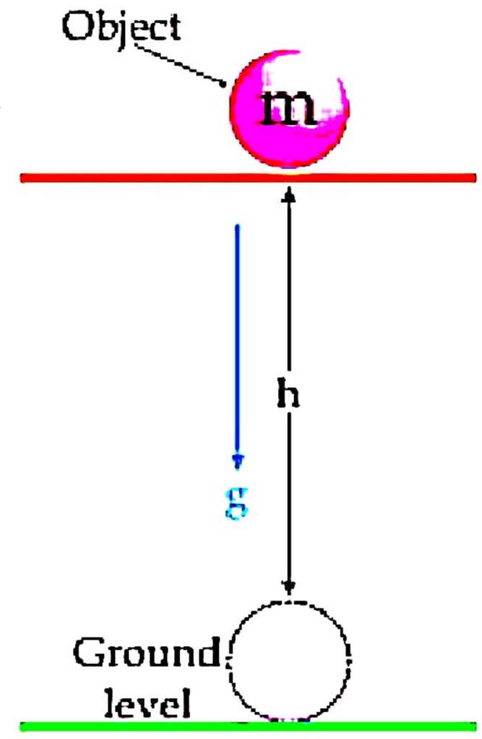
P·E = W

P·E = F·d

P·E = (mg)·h

Therefore equation becomes:

P·E = mgh



An object of mass 'm' raised to height 'h'.

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Numerical Problems

Numerical # 1

How much work is needed to move horizontally a body 20m by a force of 30N, the angle between the body and the horizontal surface is 60°?(cosθ = 0.5)

Data

d = 20m

F = 30 N

θ = 60°

W = ?

Solution

W = Fdcosθ

W = 30 x 20 x cos60°

W = 600 x 0.5

W = 300 j

Numerical # 2

Find the work done when a force of 50N is applied to move a trolley at a shopping mall through a distance of 200m? Assume the angle to be of 0° between the force and the distance the trolley moved.

Cos0° = 1

Data

F = 50N

D = 200m

θ = 0°

W = ?

Solution

W = Fdcosθ

W = 50 x 200 x cos0°

W = 1000 x 1

W = 1000 j

Numerical # 3

How much work is done, if a crate is moved at a distance of 50m, when a force of 30N is applied along the surface.

Data

d = 50 m

F = 30N

W = ?

Solution

W = Fd

W = 30 x 50

W = 1500

Numerical # 4

A ball of mass 400 gram, strikes the wall of velocity 4m/sec. How much is the kinetic energy of the ball at the time it strikes the wall?

Data

m = 400gm = 400÷1000 = 0.4kg

v = 4m/s

K.E = ?

Solution

K.E = ½ mV^2

K.E = ½ x 0.4 x 4^2

K.E = 0.2 x 16

K.E = 8 J

Numerical # 5

If LED screen of mass 10kg is lifted up and kept it on a cupboard of height 2m. Calculate the potential energy stored in the LED screen.

Data

m = 10 kg

h = 2 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 10 x 9.8 x 2

P.E = 196 J

Numerical # 6

Calculate the potential energy of 3kg water raised to the tank at the roof of a home 4m high.

Data

m = 3 kg

h = 4 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 3 x 9.8 x 4

P.E = 117.6 J

Numerical # 6

A ball of mass 50 gram is raised to a height of 7m from the ground. Calculate its gravitational potential energy?

Data

m = 50gm = 50 ÷ 1000 = 0.05kg

h = 7 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 0.05 x 9.8 x 7

P.E = 3.43 J

Numerical # 7

Calculate the efficiency of a machine which consumes 200J of energy and performs 50J of work.

Data

Consume energy = input = 200J

Perform energy = output = 50J

E = ?

Solution

$$E = \frac{Output}{Input} \times 100$$

$$E = \frac{50}{200} \times 100$$

$$E = 25\%$$

Numerical # 8

Calculate the power of a machine. If the machine performs 900 joules of work in 30 minutes.

Data

W = 900j

t = 30min = 30 x 60 = 1800 sec

P = ?

Solution

$$P = \frac{W}{t}$$

P = 900/1800

P = 0.5 watt

Numerical # 9

If the efficiency of a machine is 70% and its output is 100 J then calculate its input.

Data

E = 70%

Output = 100j

Input = ?

Solution

$$E = \frac{Output}{Input} \times 100$$

$$70 = \frac{100}{Input} \times 100$$

$$Input = \frac{100}{70} \times 100$$

Input = 7000 J

Numerical # 10

Which machine is more efficient, machine "A" which has an output of 200J after consuming 400J of energy or machine "B" which has an output of 300J after consuming 450J of energy?

Data

Output (A) = 200 J

Input (A) = 400 J

Output (B) = 300 J

Input (B) = 440 J

E(A) = ?

E(B) = ?

Solution

$$E = \frac{Output}{Input} \times 100$$

$$E(A) = \frac{200}{400} \times 100$$

E(A) = 50%

$$E(B) = \frac{300}{450} \times 100$$

E(B) = 66.67%

machine "B" Has more efficiency

Numerical # 11

The energy of 600J dissipated by a bulb in 50 minutes. Find the power of the bulb.

Data

W = 600 J

t = 50 min = 50 x 60 = 3000 sec

P = ?

Solution

$$P = \frac{W}{t}$$

$$P = \frac{600}{3000}$$

P = 0.2 watt

Numerical # 12

Calculate the power of a machine, if it does 40 Joules of work in 10 sec.

Data

W = 40 J

t = 10 sec

P = ?

Solution

$$P = \frac{W}{t}$$

$$P = \frac{40}{10}$$

P = 4 watt

Numerical # 13

A student of weight 400N takes 5 sec to climb up an obstacle of height 2m. Calculate the power consumed?

Data

W = 400N

t = 5 sec

h = 2 m

P = ?

Solution

$$P = \frac{Work}{time} = \frac{Fd}{t} = \frac{Wh}{t}$$

$$P = \frac{400 \times 2}{5}$$

P = 160 watt

Numerical # 14

If a machine consumes 250J of energy per hour then what will be its power?

Data

W = 250 J

t = 1hour = 1 x 3600 = 3600 sec

P = ?

Solution

$$P = \frac{W}{t}$$

$$P = \frac{250}{3600}$$

P = 0.069 watt