UNIT-8 ENERGY SOURCES AND TRANSFER OF ENERGY
STRUCTURED QUESTIONS

WORK

1. a) Define work?

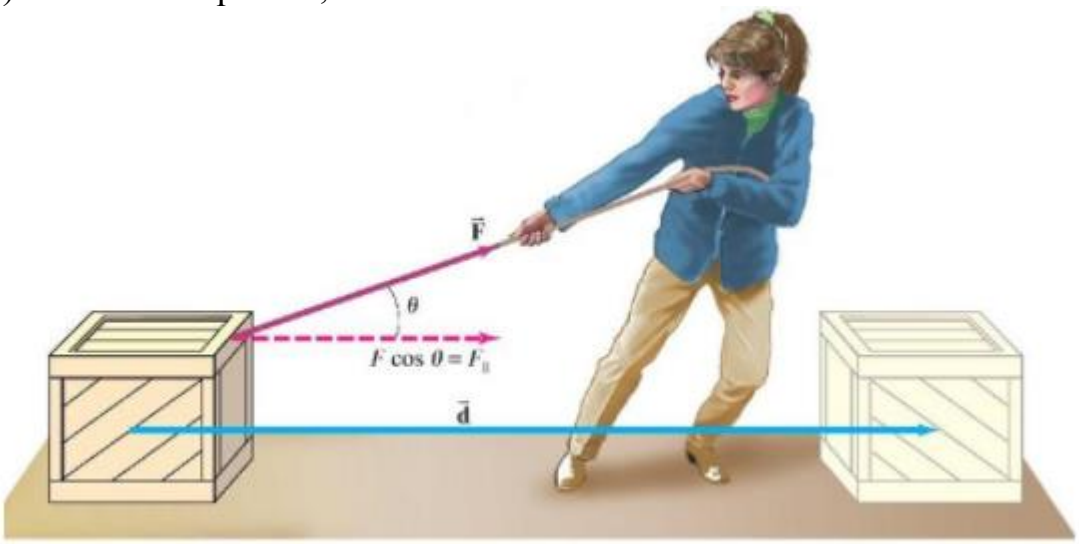
b) Derive the equation; work = Fd cosθ.

ANS:

work

work by the force as the product of the component of the force along the line of motion and the distance "d"; the body moves along that line

b) Derive the equation; work = Fd cosθ.



Suppose a constant force "F" acts on a body

Work = (component of force) (distance)

W = (F cosθ) d

W = (F cosθ) d

W = F d cosθ

2. 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 60º?

SOLUTIONS

W = F d cosθ

W = (30) (20) cos60º

W = (30) (20) (0.5)

W = 300 J

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.

SOLUTIONS

$W = F\ d \cos\theta$

$W = (30)\ (50)\ \cos 0^o$

$W = (30)\ (50)\ (1)$

$W = 1500\ J$

4. What is the work done by Usman? If a bar of weight 100 N is brought by him from A to B, then brought back to A.

SOLUTIONS

Work from **A** → **B** :

The force applied is vertical weight (100 N) .

If Usman lifts the bar vertically , then $\theta = 0°$

Let's assume the vertical displacement = h

$W = F\ d \cos\theta$

$W = (100)\ (h)\ \cos 0^o$

$W = 100\ h\ J$

Work from **B** → **A** :

He lowers the bar back

The force applied is vertical weight (100 N) .

Force and displacement are in opposite directions , so $\theta = 180°$

$W = F\ d \cos\theta$

$W = (100)\ (h)\ \cos 180^o$

$W = (100)\ (h)\ (-1)$

$W = -100\ h\ J$

Total work done

W = work from A → B + work from B → A

$W = 100\ h - 100\ h = 0\ J$

The net work done by Usman on the bar is **zero** .

ENERGY FORMS

5. a) Define Kinetic energy

b) Derive the equation.

ANS:

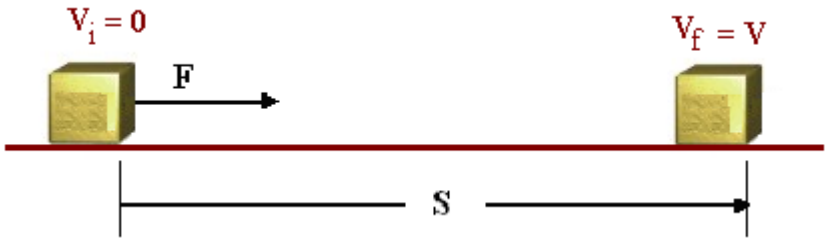
KINETIC ENERGY

The energy a body possesses by its motion is called its kinetic energy. It is a scalar quantity

(b)Derive the equation

DERIVATION

Consider a body of mass m is placed on a horizontal surface. Suppose a force F is applied on an object and it produces displacement S in the direction of force Along x-axis as shown in figure



The work done is given by

W = F S _____ (i)

If F is the only force acting, then Newton's second law of motion tells us that

F = ma _____ (ii)

Since the acceleration is constant, we can use kinematics equation for constant acceleration.

$$2as = V_f^2 - V_i^2$$

$$2as = v^2 - 0$$

$$S = \frac{v^2}{2a} \quad \text{_____ (iii)}$$

Substituting the expression of S from equation (iii), and F = ma in equation (i)

$$W = (ma)\left(\frac{v^2}{2a}\right)$$

$$W = \frac{1}{2}mv^2$$

The work done is equal to the change in quantity $\frac{1}{2}mv^2$. This quantity is called kinetic energy of the object.

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

This is an expression for Kinetic energy.

6. What will be the Kinetic energy of a boy of mass 50kg driving a bike with velocity of 2ms^{-1}.

DATA

m = 50 kg

v = 2 ms^{-1}

K.E = ?

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

$$K.E = (0.5)(50)(2)^2$$

$$K.E = (0.5)(50)(4)$$

$$K.E = 100\,J$$

7. a) Define Potential Energy

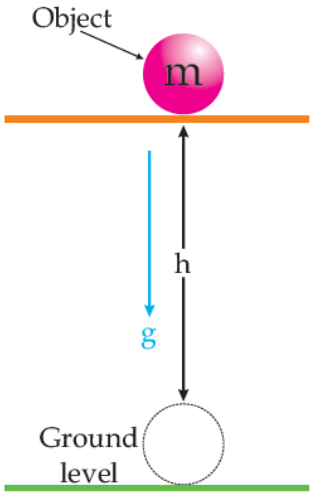
b) Derive the equation. PE = mgh

POTENTIAL ENERGY

The Energy a body possesses by its position in a field of force is called potential energy. **It is a scalar quantity.**

DERIVATION

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, as shown in Fig.
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, the equation becomes:

P·E = mgh

8. a) 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
P.E = ?

SOLUTIONS

P.E = mgh
P.E = (10) (9.8) (2)
P.E = 196 J

b) Calculate the potential energy of 3kg water raised to the tank at the roof of a home 4m high. (Assume g=10ms^{-2})

DATA

m = 3 kg
h = 4 m
P.E = ?

SOLUTIONS

P.E = mgh
P.E = (3) (9.8) (4)
P.E = 117.6 J

CONVERSION OF ENERGY

9. a) Why fossil fuel energy is called nonrenewable source?

ANS

Fossil fuel energy is called a **non-renewable source** because fossil fuels like **coal, petroleum, and natural gas** take **millions of years** to form under the Earth.
We are using them much faster than they can be formed again. So, once they are used up, they cannot be replaced in a short time.

9 b) Define solar energy and its importance in Pakistan?

ANS:

Solar energy is the energy obtained from the sun's light and heat. It can be converted into electricity using **solar panels (photovoltaic cells)** or used directly for heating and other purposes.

Importance of Solar Energy in Pakistan

1. **Abundant Sunlight**
   Pakistan receives a lot of sunshine throughout the year, especially in areas like Sindh, Balochistan, and southern Punjab. This makes solar energy a very suitable source of power.
2. **Reduces Energy Shortage**
   Pakistan often faces electricity shortages and load-shedding. Solar energy can help produce more electricity and reduce pressure on the national grid.
3. **Useful for Rural Areas**
   Many remote villages are not connected to the national grid. Solar energy can provide electricity for lighting, water pumps, schools, and health centers in these areas.
4. **Environmentally Friendly**
   Solar energy is clean and renewable. It does not produce harmful smoke or greenhouse gases, so it helps reduce pollution and climate change.
5. **Supports Agriculture**
   Solar-powered tube wells and water pumps can help farmers irrigate crops at a lower cost.

10. Write notes on Tidal energy and Geothermal energy.

ANS:

TIDAL ENERGY

Tidal energy is the energy obtained from the rise and fall of sea tides. Tides are caused by the gravitational pull of the moon and the sun on the Earth's oceans. This movement of water can be used to generate electricity.

HOW IT WORKS

Tidal power plants use turbines placed in tidal streams or dams called **barrages** . When seawater moves in and out during high and low tides, it turns the turbines, which generate electricity.

Advantages

- It is a **renewable** source of energy.
- It produces **clean electricity** with little air pollution.
- Tides are **predictable** , so energy production can be planned.

Disadvantages

- Tidal power plants are **expensive** to build.
- They can affect marine life and coastal ecosystems.
- Energy generation depends on tidal movement.

GEOTHERMAL ENERGY

Geothermal energy is the heat energy found inside the Earth. This heat comes from hot rocks, magma, and naturally occurring steam or hot water beneath the Earth's surface.

How it works

In geothermal power plants, steam or hot water from underground reservoirs is brought to the surface. The steam turns turbines connected to generators, producing electricity. Geothermal heat can also be used directly for heating buildings, greenhouses, and water.

Advantages

- It is a **renewable** and reliable source of energy.
- It produces very little pollution.
- It can provide electricity throughout the day and night.

Disadvantages

- It is only available in areas with suitable underground heat.
- Drilling and plant construction can be costly.
- It may release small amounts of gases from underground.

11. a) What is wing energy?

ANS:

Wind energy is the energy produced by the movement of air (wind). Wind turbines use this moving air to rotate their blades, and this rotation is converted into **electricity** by a generator.

b) Write any three applications of wind energy ?

ANS:

Three applications of **wind energy** are:

1 **Generating electricity** using wind turbines.

2 **Pumping water** from wells or underground sources, especially in rural areas.

3 **Sailing boats and ships** by using wind power to move them.

12. a) Write the name of any one radioactive element which is used as source of nuclear energy.

ANS:

Uranium is a radioactive element used as a source of nuclear energy. Uranium is a naturally occurring radioactive element found in rocks and soil. The isotope **Uranium-235 (U-235)** is especially important because it can undergo **nuclear fission** .

b) Write the names of any one device that can convert solar energy into heat energy.

ANS:

One device that converts solar energy into heat energy is a Solar water heater or solar cooker

c) Write the names of any two devices that can convert solar energy into electrical energy.

ANS:

Two devices that convert solar energy into electrical energy are:

1 Solar panel (photovoltaic cell / solar cell)

2 Solar power plant

RENEWABLE AND NON-RENEWABLE ENERGY SOURCES

13. Write a note on renewable energy sources?

ANS:

Renewable energy sources are natural sources of energy that can be used again and again because they are continuously replenished by nature. They do not get exhausted easily and are cleaner than fossil fuels like coal, oil, and gas.

Examples of Renewable Energy Sources

1. **Solar Energy**
   Energy from the sun, used to produce electricity through solar panels or heat through solar heaters.
2. **Wind Energy**
   Energy from moving air, used by wind turbines to generate electricity.
3. **Hydropower**
   Energy from flowing or falling water, used in dams to produce electricity.
4. **Biomass Energy**
   Energy obtained from organic materials such as plants, animal waste, and crop residues.
5. **Geothermal Energy**
   Heat energy from inside the Earth, used for electricity generation and heating.
6. **Tidal Energy**
   Energy from the rise and fall of sea tides, used to generate electricity in coastal areas.

Importance of Renewable Energy

- They are **clean and environment-friendly** .
- They help reduce **air pollution** and greenhouse gases.
- They help solve energy shortages.
- They are useful for remote and rural areas.

14. Write a note on non-renewable energy sources?

ANS:

Non-renewable energy sources are sources of energy that are present in limited amounts in nature and cannot be replaced quickly once they are used. They take millions of years to form, so they may become exhausted with continuous use.

EXAMPLES

1. **Coal**
   Coal is a fossil fuel used in power plants, industries, and homes for heating and electricity generation.
2. **Petroleum (Oil)**
   Petroleum is used to make petrol, diesel, kerosene, and other fuels for vehicles, machines, and industries.
3. **Natural Gas**
   Natural gas is used for cooking, heating, electricity generation, and as a fuel in vehicles.
4. **Nuclear Fuel**
   Radioactive elements such as **uranium** are used in nuclear power plants to produce electricity.

Importance

- They are widely used for producing electricity.
- They provide fuel for transport and industries.
- They are easy to store and transport.
- They currently meet a large part of the world's energy needs.

15. What is the difference between renewable of nonrenewable energy sources?

ANS:

RENEWABLE ENERGY SOURCES	NON-RENEWABLE ENERGY SOURCES
These sources are naturally replenished again and again.	These sources are limited and cannot be replaced quickly.
They do not get exhausted easily.	They can be exhausted after continuous use.
They are mostly clean and environment-friendly.	They often cause pollution and environmental damage.
Examples: solar, wind, hydropower, geothermal, biomass, tidal energy.	Examples: coal, petroleum, natural gas, uranium.
They are suitable for long-term use.	They are not suitable for long-term use because they are limited.
Their energy supply may depend on natural conditions like sunlight, wind, and water flow.	Their energy supply is usually more constant but depends on available fuel reserves.

16. Make a table of renewable and non-renewable energy sources from the following: Uranium, Solar, Coal, Wind, Natural gas, Tidal, Biomass, Hydroelectricity.

RENEWABLE ENERGY SOURCES	NON-RENEWABLE ENERGY SOURCES
Solar	Uranium
Wind	Coal
Tidal	Natural gas
Biomass	
Hydroelectricity	

EFFICIENCY

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

DATA

Input energy = 200 J

Out put work = 50 J

$$Efficiency = \frac{out\ put\ work}{input\ energy} \times 100$$

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

$$Efficiency = 25\%$$

18. Write a note on efficiency.

ANS:

Efficiency refers to the ability to achieve maximum output with minimum input, time, effort, or resources. It is an important concept in many fields such as economics, management, engineering, and daily life.

In simple terms, efficiency means **doing things in the best possible way without wasting resources** . For example, a machine is efficient if it produces more work while using less energy. Similarly, an organization is efficient if it achieves its goals using minimum cost and time.

Importance of Efficiency

- Reduces waste of resources
- Saves time and money
- Improves productivity
- Increases profit and performance
- Helps in sustainable development

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

DATA

Efficiency = 70%

Out put = 100 J

Input = ?

$$Efficiency = \frac{out\ put\ work}{input\ energy} \times 100$$

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

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

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

$$input = 142.85\ J$$

20. 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

Machine A

Out put = 200 J

Input = 400 J

$$Efficiency = \frac{out\ put\ work}{input\ energy} \times 100$$

$$Efficiency = \frac{200}{400} \times 100$$

$$Efficiency = 50\ \%$$

DATA

Machine B

Out put = 300 J

Input = 450 J

$$Efficiency = \frac{out\ put\ work}{input\ energy} \times 100$$

$$Efficiency = \frac{300}{450} \times 100$$

$$Efficiency = 66.7\%$$

Machine B is more efficient of machine A

POWER

21. a) Define power.

ANS:

Power is defined as the rate at which the work is done. It is a scalar quantity

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

DATA

Energy = 600 J

Time = 50 minutes

Time = 50 x 60 = 3000 seconds

$$P = \frac{Energy}{time}$$

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

$$P = 0.2\ Watt$$

22. a) Convert 20watt into horse power.

ANS

Using mechanical horsepower:

$$1\ hp = 746\ Watt$$

Convert 20watt into horse power

$$horse\ power = \frac{20}{746}$$

$$horse\ power = 0.053\ hp$$

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

DATA

Work = 40 J

Time = 10 s

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

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

$$power = 4\ Watt$$

23. a) Define Watt.

ANS

One watt is defined as the transfer of **1 joule of energy per second**

$$1\ watt = 1\ joule\ per\ second$$

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

DATA

W = 400 N

t = 5 s

h = 2 m

$$power = \frac{W\ h}{t}$$

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

$$power = \frac{800}{5}$$

$$power = 160\ Watt$$

24. **a) Write down the names of any two larger units of power.**

ANS:

Two larger units of power are:

1. **Kilowatt (kW)**
2. **Megawatt (MW)**

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

DATA

energy = 250 J

t = 1 h

t = 3600 seconds

$$power = \frac{energy}{time}$$

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

$$power = 0.0694\ Watt$$