UNIT 8 Energy Sources And Transfer of Energy

Section A Multiple Choice Questions (M.C.Qs)

Tick mark (✓) the correct answer:

01. If force of 6N displaces an object 2m in the direction of force, then work done will be_____.
(a) 0 (b) 12 Joule (c) 3 Joule (d) Both b and c

02. If a body of mass 1 kg is moving with velocity of 1m/sec. then K.E of the body will be_____.
(a) Joules (b) Joules (c) Joule (d) 1 Joule
(Note: Here numerical values are missing in the textbook. Answer will be ½ joule)

03. If a machine performs 20 J of work in 10 sec. then it power is_____.
(a) 200 watt (b) 20 watt (c) 2 watt (d) 0.2 watt

04. A body of mass 1kg is lifted through a height of 1m. The energy possessed in the body will be_____.
(a) 1 J (b) 10 Joule (c) 100 Joule (d) 1000 Joule

05. The energy released during fission or fusion reaction is called_____.
(a) Solar energy (b) Geothermal energy (c) Tidal energy (d) Nuclear energy

06. Which is the renewable source of energy?
(a) Solar and wind (b) Coal (c) Natural gas (d) Petroleum

07. The ratio of output to input is called:
(a) Energy (b) Work (c) Power (d) Efficiency

08. Work done per unit time is called_____.
(a) Efficiency (b) Energy (c) Power (d) Force

09. Coal, gas and oil are all examples of_____.
(a) Tidal energy (b) Nuclear energy (c) Fossil fuel energy (d) Biomass energy

10. _____ is not a renewable source of energy.
(a) Solar energy (b) Coal (c) Wind energy (d) Geothermal energy

11. When a force makes something move, in Physics, it is called:
(a) work (b) power (c) kinetic energy (d) efficiency

12. The S.I. unit of work is:
(a) foot (b) pound (c) erg (d) joule

13. 1 joule = _____
(a) 1 Nm^{-1} (b) 10 Nm^{-1} (c) 1 Nm (d) 10 Nm

14. The ability to do work is defined as:
(a) power (b) energy (c) efficiency (d) potential energy

15. *The S.I. unit of energy is:*
(a) joule (b) watt (c) foot–pound (d) erg

16. *Mathematically, kinetic energy is represented by:*
(a) mv^2 (b) $\frac{1}{2} mv^2$ (c) mgh (d) $\frac{1}{2}$ mgh

17. *The energy that a body possesses by virtue of its position, shape or state of a system is known as:*
(a) kinetic energy (b) potential energy
(c) gravitational energy (d) geothermal energy

18. *Mathematically potential energy is given as:*
(a) mv^2 (b) $\frac{1}{2} mv^2$ (c) mgh (d) $\frac{1}{2}$ mgh

19. *Water stored in a dam is an example of:*
(a) kinetic energy (b) potential energy (c) chemical energy (d) geothermal energy

20. *Fossil fuels have stored:*
(a) potential energy (b) geothermal energy
(c) solar energy (d) chemical energy

21. *This kind of energy is stored in the Earth as its natural heat.*
(a) Geothermal energy (b) Chemical energy
(c) Nuclear energy (d) Potential energy

22. *Wood. organic material, garbage and sugarcane are sources of:*
(a) geothermal energy (b) chemical energy (c) biomass energy (d) solar energy

23. *Which one of the following has no unit?*
(a) Power (b) Work done (c) Energy (d) Efficiency

24. *Efficiency is :*
(a) $\frac{\text{output}}{\text{input}} \times 100$ (b) $\frac{\text{input}}{\text{output}} \times 100$ (c) $\frac{\text{input}}{100} \times$ output (d) input × output

25. *The rate of doing work is known as:*
(a) energy (b) efficiency (c) power (d) kinetic energy

26. *The amount of energy transferred per unit time is called as:*
(a) energy (b) efficiency (c) power (d) kinetic energy

27. *Power is a:*
(a) scalar quantity (b) vector quantity (c) Both 'a' & 'b' (d) None of these

28. *Unit of power is:*
(a) joule (b) watt (c) Nm (d) erg

29. $\frac{Joule}{sec}$ = _____
(a) Nm (b) watt (c) erg (d) pound

30. *1 hp* = _____
(a) 103 watt (b) 106 watt (c) 100 watt (d) 746 watt

Answers

1.	(b)	2.	(½ joule)	3.	(c)	4.	(b)	5.	(d)	6.	(a)	7.	(d)
8.	(c)	9.	(c)	10.	(b)	11.	(a)	12.	(d)	13.	(c)	14.	(b)
15.	(a)	16.	(b)	17.	(b)	18.	(c)	19.	(b)	20.	(d)	21.	(a)
22.	(c)	23.	(d)	24.	(a)	25.	(c)	26.	(c)	27.	(a)	28.	(b)
29.	(b)	30.	(d)										

Section B & C Short & Detailed Answer Questions

Introduction

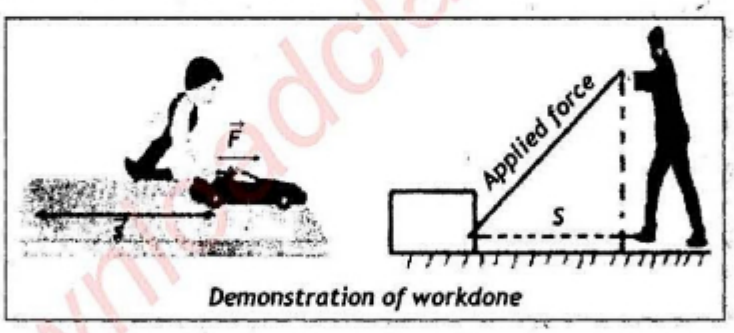
What source of energy is more beneficial? Why do we face the shortage of petroleum and gas in our country? Why people are replacing electric energy with solar energy? Why government is focusing its attention on the use of tidal, solar and wind energy? Why the waste material should be buried on Earth?
After learning this unit you will be able to answer these questions and some other similar questions.

Q.1 Define force.

Ans: Force is an agent which tends to change the state of an object.

Q.2 Define work. Write its formula and unit. Write down the factors on which work depends.

Ans: ***Work:*** Work is done only when a force makes something to move.



Demonstration of workdone

Thus work can be defined as:
The amount of work is the product of force and the distance moved in the direction of the force.

Unit of Work: The S.I unit of work is Joule other units of work can be Foot, Pound, Erg.

1 Joule = 1Nm

Formula: Suppose a constant force "F" acts on a body and motion takes place in a straight line in the direction of force then work done is equal to the product of the magnitude of force "F" and the distance "d" through which the body moves.

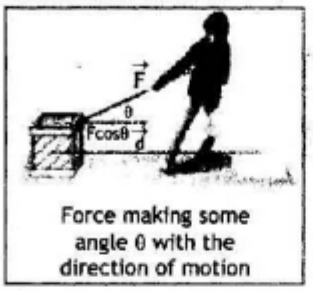
$$\text{Work done} = \text{Force} \cdot \text{distance}$$
$$W = F \cdot d$$

The fore "F" however may not act in the direction of motion of the body instead it makes some angle "θ" with it. In that case, we define the 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.
Suppose a constant force "F" acts on a body

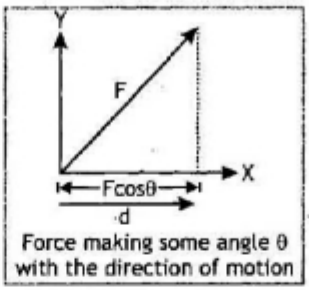
$$\text{Work} = (\text{component of the force}) \cdot (\text{distance})$$
$$W = (F\cos\theta)d$$

If $\theta = 0 \Rightarrow \cos\theta = 1$

then $\text{Work} = W = Fd$



Force making some angle θ with the direction of motion



Force making some angle θ with the direction of motion

Factors on which work done depends: There are two factors on which work depends:

(i) The work is directly proportional to the force applied to the body.

(ii) The work is directly proportional to the displacement of the body in the direction of the force.

Q.3 *Write down the names of any three units of work.*

Ans: (i) Joule (ii) erg (iii) the horsepower–hour (iv) the foot–pound, (v) the kilowatt–hour

Q.4 *At what angle between force and displacement the work done by a body will be maximum?*

Ans: The work done by a body will be maximum at an angle of 0°.

Q.5 *Define energy. What is the S.I. unit of energy?*

Ans: ***Energy:*** Energy is defined as the ability to do work.

S.I Unit of Energy: The S.I unit of energy is the joule (J).

Q.6 *Name the different forms of energy.*

Ans: ***Forms of Energy:*** There are many forms of energy. Some of them are:

(i) Kinetic energy (ii) Potential energy (iii) Electrical energy
(iv) Sound energy (v) Chemical energy (vi) Heat energy
(vii) Nuclear energy etc.

Q.7 *Define kinetic energy. Write its formula and unit. Write down the factors on which kinetic energy depends.*

Ans: ***Kinetic Energy:*** Kinetic energy of a body is defined as:

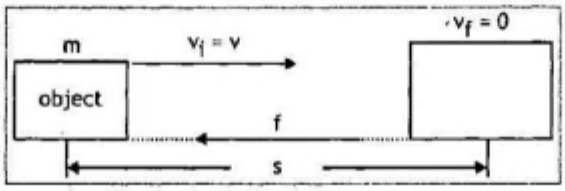
The energy possessed by an object due to its motion is called kinetic energy.

It is also defined as "The work required accelerating a body of a given mass from rest to its stated velocity". A moving body maintains its kinetic unless its speed changes.

S.I Unit of Kinetic Energy: The S.I unit of kinetic energy is the joule.

Expression for Kinetic Energy: Mathematically kinetic energy is given as:

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



The factors on which kinetic energy depends: As we know that kinetic energy is due to the motion of an object. Therefore for an object of mass m moving with speed v kinetic energy depends upon:

(i) The mass m of the object – the greater the mass, the greater its K.E.

(ii) The speed v of the object – the greater the speed, the greater the K.E.

More Information:
Sailing a boat, moving air, driving a car, running and walking are examples of Kinetic Energy.

Q.8 *Derive the relation, K.E = $\frac{1}{2}mv^2$.*

Ans: ***Derivation of the Equation, K.E = $\frac{1}{2}mv^2$.*** To obtain an expression for K.E we have to determine the work done by the body in motion. This work is equal to the kinetic energy of the body. Consider a body of mass 'm' placed on a horizontal surface initially at rest. When a force 'F' is applied it covers a distance 'S' and its final velocity becomes 'v'. Then work done is

$$W = F \cdot S \qquad \text{---------- (1)}$$

But by the second law of motion when a force acts on a body it produces acceleration in the direction of the force.

$$F = ma$$

And by using the third equation of motion i.e. $v_f^2 - v_i^2 = 2aS$

When $v_i = 0$, $v_f = v$ $S = ?$

$$\therefore \quad v^2 - 0 = 2aS$$

$$\text{or} \quad S = \frac{v^2}{2a}$$

Putting the value of 'F' and 'S' in equation (1), we get:

$$\text{Work} = \text{K.E} = \text{F.S} = ma \times \frac{v^2}{2a}$$

$$\therefore \quad \text{K.E} = \frac{mv^2}{2}$$

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

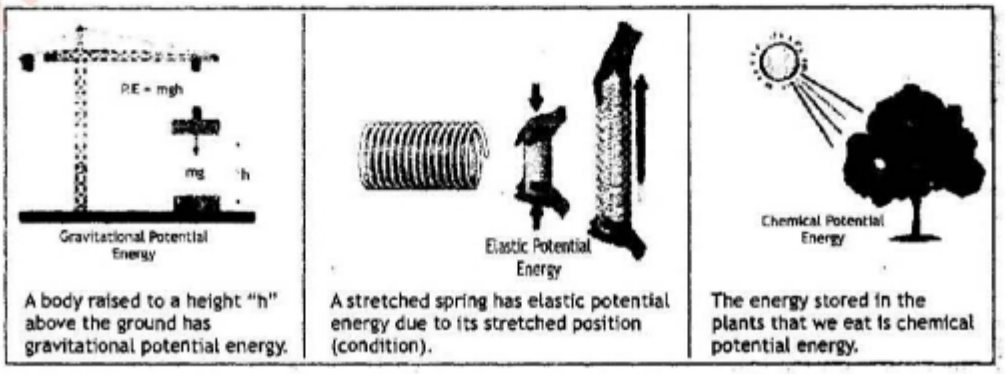
Q.9 *Define potential energy and its types. Write its expression and unit.*

Ans: ***Potential Energy:*** The energy that a body possesses by virtue of its position, shape or state of a system is called potential energy.

It is also defined as the work done store in a body in lifting it to a height "h". The potential energy changes only when its position relative to ground changes; otherwise it remain the same.

Examples: A book lying on the table and the water stored in a dam have potential energies.

Types of Potential Energy: There are different types of potential energy. Like gravitational potential energy, elastic potential energy and chemical potential energy.



A body raised to a height "h" above the ground has gravitational potential energy.

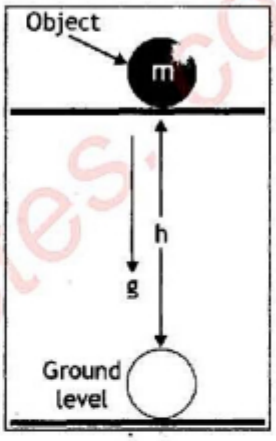
A stretched spring has elastic potential energy due to its stretched position (condition).

The energy stored in the plants that we eat is chemical potential energy.

Unit of Potential Energy: S.I unit of potential energy is Joule (J).
Expression of Potential Energy: Mathematically potential energy is given as:
P.E = mgh

Q.10 *Define gravitational Potential Energy. Derive its equation, P.E = mgh.*

Ans: ***Gravitational Potential Energy:*** The potential energy possessed by a body in the gravitational field is called the gravitational potential energy.



Derivation of Gravitational Potential Energy, P.E = mgh: To derive the expression for gravitational potential energy, let us consider an object of mass "m" which is raised 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
We know that W = F.d, therefore P.E = F.d
We also know that F = mg, hence P.E = mg.d
Here d = h (height), therefore P.E = mg.h
Therefore equation becomes: **P.E = mgh**

Q.11 *Give the energy changes when a ball is dropped from a height of 7m to the ground.*

Ans: ***Potential Energy of an Object:*** The potential energy of an object at some height with respect to gravity is:

$$P.E = mgh$$

where P.E is the initial potential energy in joules (J)
m is the mass of the object in kg-mass
g is the acceleration due to gravity (9.8 m/s^2)
h is the height above the ground in m

When the object reaches the ground, h = 0 and thus the final potential energy is:

$$P.E_f = 0$$

Note: In reality, there is still a gravitational force on the object at the surface of the Earth, so the object has gravitational potential energy at that point. But since the object cannot go anywhere, we say its P.E from gravity is zero.

Kinetic Energy of Falling Object: Kinetic energy (KE) is the energy of motion. Since the object is not moving at the initial position, the initial KE is:

$$K.E_i = 0$$

Once the object is released, it accelerates downward. When the object reaches the ground, its kinetic energy is:

$$K.E_f = \frac{1}{2} mv_f^2$$

where $K.E_f$ is the kinetic energy at the ground in joules (J)
v_f is the downward velocity of the object at the ground in m/s

Total Energy for Falling Object: The total energy of the object is:

$$T.E = P.E + K.E$$

The total energy is a constant value, provided no external forces besides gravity act on the object. Thus, the initial total energy equals the final total energy:

$$T.E_i = T.E_f$$
$$P.E_i + K.E_i = P.E_f + K.E_f$$

When the object is simply dropped,

$$mgh + 0 = 0 + \frac{1}{2} mv_f^2$$

$$mgh = \frac{1}{2} mv_f^2$$

Final Velocity for Falling Object: From that equivalence, we can determine the final velocity of the dropped object. Divide by m and multiply by 2:

$$v_f^2 = 2gh$$

$$v_f = \sqrt{2gh}$$

Summary: Potential energy with respect to gravity is PE = mgh. When the object is dropped, thrown downward or projected upward, its kinetic energy becomes KE = $\frac{1}{2} mv^2$, along with a factor of the initial velocity. The sum of the P.E and K.E is the total energy (T.E), which is a constant. Equating the initial total energy with the final total energy, we can determine the final velocity of the object.

Q.12 State the law of conservation of energy.

Ans: ***Law of Conservation of Energy:*** Energy neither be created nor it can be destroyed but it can be converted from one form to another form. This is called the law of conservation of energy.

Q.13 Describe the different forms of energy.

Ans:

(i) ***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.
Fossil fuels have stored chemical energy. This energy is converted by oxidation through burning. Thus, burning a fossil fuel like charcoal, produce heat energy and light energy.

(ii) ***Hydroelectric Energy:*** Hydroelectricity is the term referring to electricity generated by hydropower by using the gravitational force of falling or flowing water.
The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir. Water releases from the reservoir flow through a turbine, spinning it, which in turn runs a generator to produce electricity.

(iii) ***Solar Energy:*** The energy radiated from the sun is known as solar energy. This is the most available source of energy throughout Pakistan. Many devices 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. Also, solar heaters are used to converted solar energy "sun rays" into heat energy to heat water tanks and indoor spaces.

(iv) ***Nuclear Energy:*** This energy is released during a nuclear reaction such as a 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.

(v) ***Geothermal Energy:*** Geothermal energy is stored in the Earth as its natural heat. Deep in the Earth, there is a hot molten part called magma. Water, close 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.
A geothermal power plant utilizes geothermal energy to drive an electrical generator. Geothermal well can be built by drilling deep near hot rocks at different places, where hot molten magma is very close, water is then pushed down into the well. The rocks quickly heat the water and change it into steam. The steam is used for heating purposes or to generate electricity.

(vi) ***Wind Energy:*** The energy obtained by the wind is called wind energy. It is generated by

windmills. A windmill consists of a turbine that rotates due to wind. Kinetic energy is produced due to the motion of the turbine. Wind turbines convert this kinetic energy into mechanical power. A generator converts that mechanical power into electricity.

Application:
(a) It is being used as a source of energy for sailing ships in oceans.
(b) It is being used by windmills to pump water.
(c) It is being used by windmills to grind grain.
(d) It is used to turn wind turbines to produce electricity.

(vii) ***Biomass Energy:*** Biomass is the organic material that comes from plants and animals. Biomass consists of stored energy from the Sun, garbage, wastes, sugarcane etc. Solid biomass, such as wood, organic material and garbage, can be burned directly to produce heat. Biomass can also be converted into a gas called biogas and into liquid biofuels such as ethanol and biodiesel.

(viii) ***Tidal Energy:*** It is a form of hydropower that converts the energy obtained from tides into a useful form of power, main 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.

Q.14 What is biomass?

Ans: See 'Short & Detailed Answer Questions' – Q.13 (vii)

Q.15 Write down the name of fossil fuel.

Ans: Names of fossil fuel are: (i) Coal (ii) Natural gas (iii) Oil (iv) Charcoal

Q.16 Which type of energy is stored deep in the Earth?

Ans: See 'Short & Detailed Answer Questions' – Q.13 (v)

Q.17 What are renewable energy sources and non-renewable energy sources?

Ans: ***Renewable Energy Source:*** Renewable sources can be consumed and used again and again. Solar energy, wind energy, tidal energy and geothermal energy are renewable sources. Since a very earlier age, people have tried to consume renewable sources of energy for their survival, such as wind and water for milling grain and solar for lighting.

More Information:
- Wind energy is a clean fuel source.
- It does not pollute the air.
- Wind turbines do not produce atmospheric emission that causes greenhouse gasses.

Non-Renewable Sources: Non-renewable resources are limited and will finish once used. Coal, petroleum and natural gases are nonrenewable sources. About 150 years ago scientists invented a new technology to extract energy from the ancient fossilized remains of plants and animals. This super-rich but limited source of energy (coal, oil and natural gas) replaced wood, wind and water as the main source of fuel. They are being used at a faster rate than they can be restored and, therefore cannot be renewed.

Q.18 Write down the names of any three renewable energy sources.

Ans: (i) Solar Energy (ii) Wind Energy (iii) Tidal Energy (iv) Geothermal Energy

Q.19 Write down the name of any three non-renewable energy sources.

Ans: (i) Coal (ii) Natural Gas (iii) Petroleum

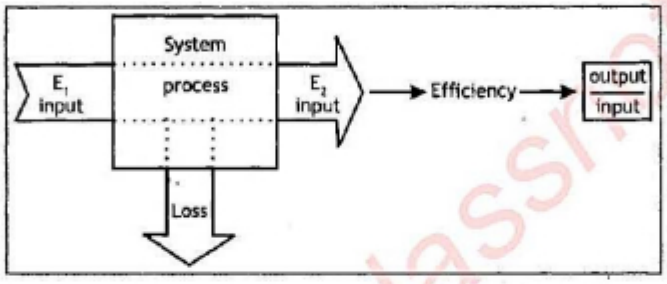
Q.20 Define input and output.

Ans: Every machine needs some energy to perform work.
Input: Whatever energy is given to a machine is called input.
Output: And the work done by the machine is called output.
For example, when we supply electric energy as input to the electric motor in washing machines and drilling machines.

More Information:
The coastal belt of Pakistan is about 1045 km long with the best resources for utilizing and producing tidal energy.

Q.21 Define efficiency. Write down its expression.

Ans: ***Efficiency:*** A system in which some energy 'E_1' is supplied to it as 'input' and the system returns some energy 'E_2' as output has some efficiency. This efficiency is defined as:
The ratio of output to the input is called Efficiency. Efficiency is denoted by "η".



As it is the ratio of two energies therefore it has no unit. No machine is 100% efficient because some energy is always wasted in the form of heat, sound or light etc.

$$\text{Efficiency} = \frac{\text{Energy as output } (E_2)}{\text{Energy as input } (E_1)}$$

$$\therefore \quad \eta = \frac{E_1}{E_2} \times 100$$

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100$$

More Information:
We get
- chemical energy from fuel, gas and battery
- thermal energy from heat
- nuclear energy from nuclear fission and fusion
- electrical energy from the movement of electrons in an atom
- mechanical energy from walking, running
- sound energy from sound waves

Q.22 Define power. Write its expression and unit.

Ans: ***Power:*** When we run up and cover the distance in 5 seconds or take a slow walk up the same distance in 20 seconds. We are doing the same amount of work; however, we are doing it at a different rate. When we run-up, we are working much faster and we have higher power than when we walk up.
This quantity that tells us the rate of doing work is called power. Thus, power is defined as:

More Information:
1kg of 4% enriched fuel-grade uranium releases energy equivalent to the combustion of nearly 100 tons of high-grade coal or 60 tons of oil.

The rate of doing work. Or The amount of energy transferred per unit time.

Mathematically,

$$\text{Power} = P = \frac{\text{workdone}}{\text{time taken}}$$

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

Since work and time are scalar quantities. Therefore, power is also a scalar quantity.

Unit of Power: In S.I unit of power is

$$\frac{\text{joule}}{\text{sec}} = \text{watt}$$

Thus S.I unit of power is watt which is defined as:

The power of a body is said to be one watt if it does work at the rate of one Joule second.

Large units of power are Kilowatt (kW), Megawatt (MW), Horse Power (hp) etc.

More Information:

1 kW = 1000 W = 10^3 watt
1 MW = 1000000 W = 10^6 Watt
1 hp = 746 Watt

Q.23 *Name the physical quantity which gives the rate of doing work.*

Ans: This quantity that tells us the rate of doing work is called power.

Q.24 *Is energy a vector quantity?*

Ans: No, energy can be specified by magnitude alone and it has nothing to do with the direction. Energy is, therefore, a scalar quantity.

Q.25 *Describe the importance of solar energy in Pakistan.*

Ans: ***Importance of Solar Energy in Pakistan:*** Energy triggers economic prosperity. Energy generation is heavily dependent on fossil fuels in Pakistan. Due to the huge population and current progress in industrialization, these sources are not fulfilling the existing energy needs of the country. Meanwhile, they have adverse environmental impacts and are economically unsuitable to electrify remote areas. Consequently, there is a need to look for alternate energy sources. Pakistan is looking for alternate energy.

Solar energy is the best renewable energy option for Pakistan in terms of price, life span, operation and maintenance cost. Fortunately, Pakistan is among those countries in which the sun warms the surface throughout the year and therefore has a strong potential for solar power generation.

Energy plays a key role in the development of modern economies. All human activities i.e., education, health care, agriculture and employment require energy for proper functioning. A country cannot succeed without proper utilization of energy. It is considered the main component of a country's economy. Pakistan is a developing country. Due to recent development and to support its large population and industry, the country needs a huge amount of energy to keep all things on track. However, there is a shortage of energy supply and the country is in its worst energy crisis. The gap between electricity demand and supply has been increased in the past few years and is highly obvious during the summer season which has resulted in the complete shutdown of power for 10–12 h in urban areas and 16–18 h in rural areas.

Energy shortage problems not only affect the lives of individuals but also hindering the economic development of the country. All sectors including agricultural, industrial, transport, domestic and energy generation have been affected severely due to long power outages and caused huge economic loss to the country. The current share of renewable energy is insufficient in the total energy mix of Pakistan. The country fulfils its energy needs by utilizing fossil fuels. Huge dependency on fossil fuels not only has a burden on the national economy but also has led to

different environmental hazards like the greenhouse effect, CO_2 emissions, global warming and irregular weather patterns. Moreover, natural resources are being exhausted due to the overuse of fossil fuels. Hence, there is a need to develop a new energy economy. In this new economy, renewable energy sources (wind, solar and biomass) will be utilized to produce energy which can decrease the fossil import bill on one hand, and lessen the climatic challenges on the other hand. Energy demand is increasing by more than 9% annually in Pakistan. It is expected that energy demand will increase 8-fold by 2030 and 20–fold by 2050 in Pakistan

Advantages of Solar Energy:

(i) Solar is an inexhaustible source.
(ii) It generates ample electricity.
(iii) It reduces pollution.
(iv) Sun generates energy. As a result, climate damage reduces.
(v) The use of solar energy ensures that fossil fuel prices are lower.

Scientific Reasons

01. ***According to the definition of work in physics, Urwa did not perform any work if she made an assignment on her laptop in three hours. Why?***

Ans: In Physics, work is defined as the measure of the displacement of an object or a point. In this case, Urwa made an assignment on her laptop in three hours but she did not cover any distance in the direction of force, she was sitting in one place. Therefore, according to the definition of work in physics, Urwa did not perform any work.

02. ***Why power is a scalar quantity?***

Ans: Power is defined as the energy (or work) per unit time. Since time is not considered as a vector quantity, and neither energy nor work because the work is not directional. ... So, the power is a scalar quantity because it has a unit magnitude but no direction.

03. ***Why does a hydrogen-filled balloon possess potential energy?***

Ans: A hydrogen–filled balloon flies high in the sky and possesses potential energy due to its height. It has done work to reach there which is stored as energy.

04. ***Why fossil fuel energy is called a non-renewable source?***

Ans: Fossil fuels are called a non-renewable source because these fuels are limited in amount and take millions of years to form and once it gets vanished it will be impossible to get these fuels back.

Differences

01. ***What is the difference between renewable and non–renewable energy sources?***

Ans: ***Following are major differences between renewable and non–renewable resources:***

	Renewable Energy Sources	*Non–renewable Energy Sources*
Depletion	Renewable resources cannot be depleted over time.	Non–renewable resources deplete over time.
Sources	Renewable resources include sunlight, water, wind and also geothermal sources such as hot springs and fumaroles.	Non–renewable energy includes fossil fuels such as coal and petroleum.

Environmental Impact	Most renewable resources have low carbon emissions and a low carbon footprint.	Non-renewable energy has a comparatively higher carbon footprint and carbon emissions.
Cost	The upfront cost of renewable energy is high. For instance, generating electricity using technologies running on renewable energy is costlier than generating it with fossil fuels.	Non-renewable energy has a comparatively lower upfront cost.
Infrastructure Requirements	Infrastructure for harvesting renewable energy is prohibitively expensive and not easily accessible in most countries.	Cost-effective and accessible infrastructure is available for non-renewable energy across most countries.
Area Requirements	Requires a large land/ offshore area, especially for wind farms and solar farms.	Comparatively lower area requirements.

02. ***Differentiate between kinetic energy and potential energy.***

Ans: ***Difference Between Kinetic Energy and Potential Energy***

	Kinetic Energy	***Potential Energy***
1.	Kinetic energy is the kind of energy present in a body due to the property of its motion.	Potential Energy is the type of energy present in a body due to the property of its state & position.
2.	It can be easily transferred from one body to another.	It is not transferable.
3.	The determining factors for kinetic energy are speed or velocity and mass.	Here, the determining factors are height/ distance and mass.
4.	Flowing water is one of the examples of kinetic energy.	Water present at the top of a hill is an example of potential energy.

Section D — Numerical

Worked Examples of the Textbook

01. ***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.

Solution:

Step 1: Write the known quantities and point out quantities to be found.

F = 50 N d = 200 m θ = 0° W = ?

Step 2: Write the formula and rearrange if necessary.

$W = F \cdot d = Fd\cos\theta$

Step 3: Put the value in the formula and calculate.

$W = (50\ N)(200\ m)(\cos 0°)$

$W = 10000\ J$

Hence, the work done is 10000 Joules.

02. ***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?***

Solution:

Step 1: Write the known quantities and quantities to be found.

$m = 400\ \text{gram} = \frac{400}{1000}\ kg = 0.4\ kg$ $v = 4\ ms^{-1}$ K.E = ?

Step 2: Write the formula and rearrange if necessary.

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

Step 3: Put the value in formula and calculate.

$$K.E = \frac{1}{2} \times 0.4\ kg \times (4\ ms^{-1})^2 = 3.2\ J$$

Hence, kinetic energy is possessed by the ball is 3.2 joules.

(03.) ***A ball of mass 50 gram is raised to a height of 7m from the ground. Calculate its gravitational energy.***

Solution: *Step 1:* Write down known quantities and quantities to be found.

$m = 50\ gm = \frac{50}{1000} kg = 0.05\ kg$ $\quad h = 7\ m$

$g = 10\ ms^{-1}$ $\quad P.E = ?$

Step 2: Write down the formula and rearrange if necessary.

$P.E = mgh$

Step 3: Put values in the formula and calculate.

$P.E = 0.05\ kg \times 10\ ms^{-1} \times 7\ m = 3.5$ Joules

Hence, the gravitational potential energy of the ball is 3.5 Joules.

(04.) ***Calculate the power of a machine if the machine performs 900 joules of work in 30 minutes.***

Solution: *Step 1:* Write down known quantities and quantities to be found.

$W = 900\ J$ $\quad t = 30\ min = 30 \times 60\ s = 1800\ s$ $\quad P = ?$

Step 2: Write down the formula and rearrange if necessary.

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

Step 3: Put value in the formula and calculate.

$$P = \frac{900J}{1800s} = 0.5\ W$$

Hence, power of the machine is 0.5 Watt.

Solved Numerical

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

Solution: *Data:* $d = 20\ m$ $\quad F = 30\ N$ $\quad \theta = 60°$ $\quad W = ?$

Working Formula: $W = Fd\cos\theta$

Calculation: $W = (30)(20)\cos 60°$

$W = (30)(20)(0.5) = (600)(0.5) = \boxed{300\ N}$ Ans.

(02.) ***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?***

Solution: *Data:* $d = 50\ m$ $\quad F = 30\ N$ $\quad \theta = 0°$ $\quad W = ?$

Working Formula: $W = Fd\cos\theta$

Calculation: $W = (30)(50)\cos 0°$

$W = (30)(50)(1) = (1500)(1) = \boxed{1500\ N}$ Ans.

(03.) ***What is the work done by Usman if a bar of weight 100N is brought by him from A to B, and then brought back to A?***

Solution: *Data:* $F = w = 100\ N$

$d = 0$ (∵ the bar is brought from A to B and then back to A)

W = ?

Working Formula: W = Fd

Calculation: W = (100)(0) = **0** Ans.

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

Solution: *Data:* m = 50 kg v = 2 ms^{-1} K.E = ?

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

Calculation: $K.E = \frac{1}{2}(50)(2)^2 = \frac{1}{2}(50)(4) = \frac{1}{2}(200) =$ **100 J** Ans.

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

Solution: *Data:* m = 10 kg h = 2m g = 10 ms^{-2} P.E = ?

Working Formula: P.E = mgh

Calculation: P.E = (10)(10)(2) = (100)(2) = **200 J** Ans.

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

Solution: *Data:* m = 3 kg h = 4 m g = 10 ms^{-2} P.E = ?

Working Formula: P.E = mgh

Calculation: P.E = (3)(10)(4) = (30)(4) = **120 J** Ans.

07. ***Calculate the efficiency of a machine that consumes 200J of energy and performs 50J of work.***

Solution: *Data:* E_1 = 200 J E_2 = 50 J η = ?

Working Formula: $\eta = \frac{E_2}{E_1} \times 100$

Calculation: $\eta = \frac{50}{200} \times 100 = 0.5 \times 100 =$ **25%** Ans.

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

Solution: *Data:* η = 70% E_2 = 100 J E_1 = ?

Working Formula: $\eta = \frac{E_2}{E_1} \times 100$

Calculation: $70 = \frac{100}{E_1} \times 100$

$\frac{70}{100} = \frac{100}{E_1}$

$0.7 = \frac{100}{E_1}$

$0.7E_1 = 100$

$E_1 = \frac{100}{0.7} =$ **142.85 J** Ans.

09. ***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?***

Solution: *Data:* For Machine 'A': E_2 = 200 J E_1 = 400 J η = ?
For Machine 'B': E_2 = 300 J E_1 = 450 J η = ?

Working Formula: $\eta = \frac{E_2}{E_1} \times 100$

Calculation: For Machine 'A': $\eta = \frac{200}{400} \times 100 = 0.5 \times 100 = 50\%$

For Machine 'B': $\eta = \frac{300}{450} \times 100 = 0.666 \times 100 = 66.66\%$

Therefore, machine 'B' is more efficient. Ans.

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

Solution: *Data:* W = 600 J t = 50 min = 50 × 60 sec = 3000 sec P = ?

Working Formula: $P = \frac{W}{t}$

Calculation: $P = \frac{600}{3000} = \boxed{0.2\ W}$ Ans.

11. ***Convert 20 watts into horsepower.***

Solution: We know that 746 Watt = 1 hp

$1\ \text{Watt} = \frac{1}{746}\ \text{hp}$

$20\ \text{Watt} = \frac{1}{746} \times 20\ \text{hp} = 0.00134 \times 20\ \text{hp} = \boxed{0.0268\ \text{hp}}$ Ans.

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

Solution: *Data:* W = 40 J t = 10 sec P = ?

Working Formula: $P = \frac{W}{t}$

Calculation: $P = \frac{40}{10} = \boxed{4\ W}$ Ans.

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

Solution: *Data:* w = mg = 400 N t = 5 sec h = 2 m P = ?

Working Formula: $P = \frac{W}{t}$

Calculation: To find work done, Work done = W = F.d = w.d = 400 × 2 = 800 J

$P = \frac{800}{5} = \boxed{160\ W}$ Ans.

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

Solution: *Data:* W = 250 J t = 1 hour = 1 × 60 × 60 sec = 3600 sec P = ?

Working Formula: $P = \frac{W}{t}$

Calculation: $P = \frac{250}{3600} = \boxed{0.0069\ W}$ Ans.

15. ***A car of mass 50 kg moving with velocity 10 ms^{-1} in the direction of the force. Calculate is Kinetic Energy.***

Solution: *Data:* m = 50 kg v = 10 ms^{-1} K.E = ?

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

Calculation: $K.E = \frac{1}{2}(50)(10)^2 = \frac{1}{2}(50)(100) = \frac{1}{2}(5000)$

$K.E = \boxed{2500\ \text{Joules}}$ Ans.

16. ***A body of mass 10 kg is dropped from a height of 20 m on the ground. What will be its potential energy, if g = 9.8m/sec^2?***

Solution: *Data:* m = 10 kg h = 20 m g = 9.8m/sec^2 P.E = ?

Working Formula: P.E = mgh

Calculation: P.E = (10)(9.8)(20) = (98)(20) = $\boxed{1960\ \text{Joules}}$ Ans.

17. ***A man pushes a car 18m with a force of 2N in 4 seconds. Calculate the power of the man.***

Solution: *Data:* d = 18 m F = 2 N t = 4 sec P = ?

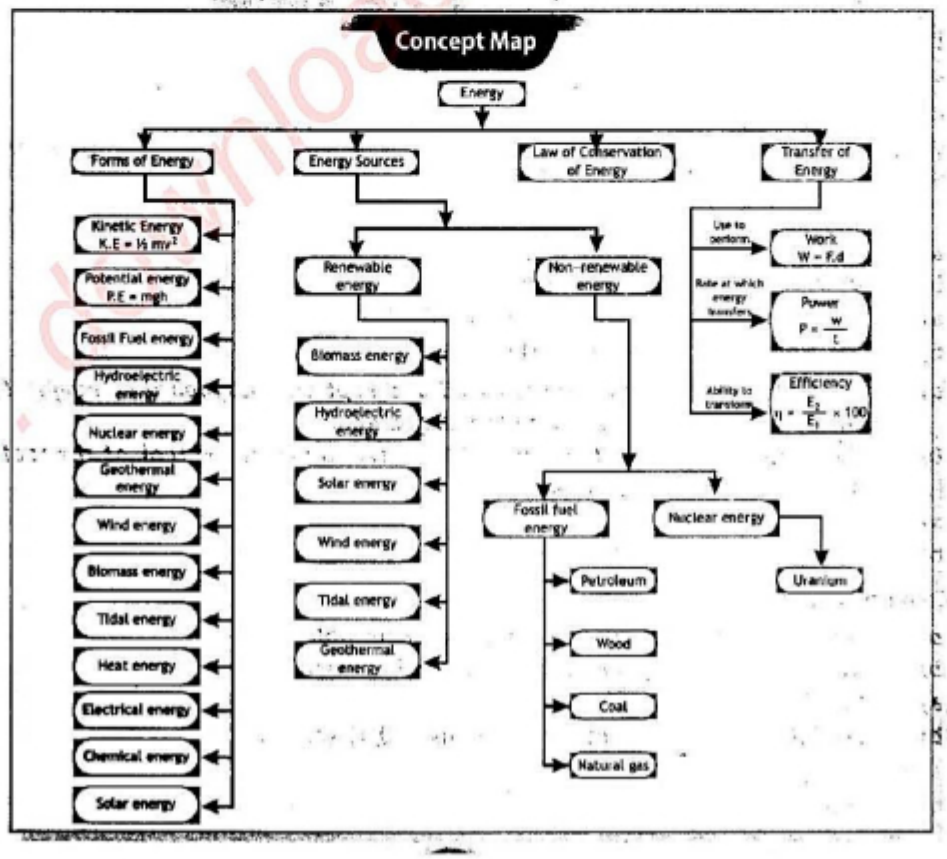
Working Formula: $P = \frac{W}{t}$

Calculation: To calculate power, we need to know the work done and the time.
We know that work done = W = F.d
Therefore, W = (2)(18) = 36 J
Now, putting this value in the working formula, we get:

$$P = \frac{36}{4} = \boxed{9\ W}$$ Ans.

Summary

- Work is the product of force and the distance W= F.S
- The ability to do work is called energy. SI unit of energy is Joule (J).
- The energy possessed by an object due to its motion is called Kinetic Energy, K.E = 1/ 2 mv^2.
- Energy due to the position of an object is called Potential Energy, P.E = mgh.
- Energy exists in many different forms such as nuclear energy, heat energy, electrical energy, chemical energy, light energy, etc.
- Solar energy, wind energy, tidal energy, geothermal energy, biomass energy and hydroelectric energy are examples of renewable sources of energy.
- Wood, coal, petroleum, natural gas and Uranium are examples of non–renewable sources of energy.
- The ratio of output to the input is called efficiency.
- The work done in unit time is called power. S.I unit of work is Watt.



End of Unit Questions Solution

SECTION – A: MULTIPLE CHOICE QUESTIONS

Tick Mark (✓) the correct answer:
See "Multiple Choice Questions (M.C.Qs)" – (1) to (10)

SECTION – B: STRUCTURED QUESTIONS

Work

01. (a) *Define work?*
(b) *Derive the equation: work = Fd cosθ.*

Ans: For (a) & (b), see 'Short & Detailed Answer Questions' – Q.2

02. *How much work is needed to move horizontally a body 20 m by a force of 30 N, the angle between the body and the horizontal surface is 60°?*

Ans: See 'Solved Numerical' – Q.1

03. *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?*

Ans: See 'Solved Numerical' – Q.2

04. *What is the work done by Usman, if a bar of weight 100N is brought by him from A to B, and then brought back to A.*

Ans: See 'Solved Numerical' – Q.3

Energy Forms

05. (a) *Define Kinetic energy.*
(b) *Derive the equation.*

Ans: (a) See 'Short & Detailed Answer Questions' – Q.7
(b) See 'Short & Detailed Answer Questions' – Q.8

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

Ans: See 'Solved Numerical' – Q.4

07. (a) *Define Potential Energy.*
(b) *Derive the equation, PE = mgh*

Ans: (a) See 'Short & Detailed Answer Questions' – Q.9
(b) See 'Short & Detailed Answer Questions' – Q.10

08. (a) *If LED screen of mass 10kg is lifted and kept on a cupboard of height 2m. Calculate the potential energy stored in the LED screen.*
(b) *Calculate the potential energy of 3kg water raised to the tank at the roof of the home 4m high. (assume $g = 10ms^{-2}$)*

Ans: (a) See 'Solved Numerical' – Q.5
(b) See 'Solved Numerical' – Q.6

Conversion of Energy

09. (a) *Why fossil fuel energy is called a non-renewable source?*
(b) *Define solar energy and its importance in Pakistan.*

Ans: (a) See 'Scientific Reasons' – Q.4
(b) See 'Short & Detailed Answer Questions' – Q.13 (iii) & Q.25

10. *Write notes on Tidal energy and Geothermal energy.*

Ans: See 'Short & Detailed Answer Questions' – Q.13 (viii) & (v)

PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

11. (a) ***What is wind energy?***
(b) ***Write any three applications of wind energy?***

Ans: See 'Short & Detailed Answer Questions' – Q.13 (vi)

12. (a) ***Write the name of any one radioactive element which is used as a source of nuclear energy.***
(b) ***Write the names of any one device that can convert solar energy into heat energy.***
(c) ***Write the names of any two devices that can convert solar energy into electrical energy.***

Ans: (a) Uranium
(b) a solar cooker, a solar heater
(c) (i) Photovoltaic or solar cells (ii) Photovoltaic or solar panels

Renewable and Non-renewable Energy Sources

13. ***Write a note on renewable energy sources.***

Ans: See 'Short & Detailed Answer Questions' – Q.17

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

Ans: See 'Short & Detailed Answer Questions' – Q.17

15. ***What is the difference between renewable and non-renewable energy sources?***

Ans: See 'Differences' – Q.1

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

Ans:

Renewable Energy Sources	Non-renewable Energy Sources
Solar	Uranium
Wind	Coal
Tidal	Natural Gas
Hydroelectricity	Biomass

Efficiency

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

Ans: See 'Solved Numerical' – Q.7

18. ***Write a note on efficiency.***

Ans: See 'Short & Detailed Answer Questions' – Q.21

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

Ans: See 'Solved Numerical' – Q.8

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?***

Ans: See 'Solved Numerical' – Q.9

Power

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

Ans: (a) See 'Short & Detailed Answer Questions' – Q.22
(b) See 'Solved Numerical' – Q.10

22. (a) ***Convert 20 watts into horsepower.***
(b) ***Calculate the power of a machine, if it does 40 Joules of work in 10 sec.***

Ans: (a) See 'Solved Numerical' – Q.11 (b) See 'Solved Numerical' – Q.12

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

Ans: (a) See 'Short & Detailed Answer Questions' – Q.22 (the 2nd last para)
(b) See 'Solved Numerical' – Q.13

24. (a) ***Write down the names of any two larger units of power.***
(b) ***If a machine consumes 250J of energy per hour then what will be its power?***

Ans: (a) kilowatt, Megawatt and horsepower (b) See 'Solved Numerical' – Q.14