ATOMS AND MOLECULES (CHAPTER 3)

Laws of Chemical Combination:

Given by Lavoisier and Joseph L. Proust as follows:

1) **Law of conservation of mass:** Mass can neither be created nor destroyed in a chemical reaction. e.g., A + B → C + D Reactants → Products Mass of reactants = Mass of products
2) **Law of constant proportion:** In a chemical substance the elements are always present in definite proportions by mass.

E.g., in water, the ratio of the mass of hydrogen to the mass of oxygen is always 1: 8 respectively.

These laws lacked explanation. Hence, John Dalton gave his theory about the matter. He said that the smallest particle of matter is called 'atom'.

Dalton's Atomic Theory:

1) Every matter is made up of very small or tiny particles called atoms.
2) Atoms are not divisible and cannot be created or destroyed in a chemical reaction.
3) All atoms of a given element are same in size, mass and chemical properties.
4) Atoms of different elements are different in size, mass and chemical properties.
5) Atoms combine in the ratio of a small whole number to form compounds.
6) The relative number and kinds of atoms are constant in a given compound.

Atom:

Atoms are the smallest particles of an element which can take part in a chemical reaction.

Size of an atom: Atomic radius is measured in nanometres.

$$1nm = \frac{1}{10^9} m$$

$$\therefore \quad 1m = 10^9 \, nm$$

Atomic radii of hydrogen atom = 1×10^{-10} m.

Molecule:

It is the smallest particle of an element or a compound which can exist independently.

1) Molecules of an element constitute the same type of atoms.
2) Molecules may be monoatomic, diatomic or polyatomic.
3) Molecules of compounds join together in definite proportions and constitute a different type of atoms.

Atomicity:

The number of atoms constituting a Molecule is known as its atomicity.

Ions:

The charged particles (atoms) are called ions; they are formed by attaining positive charge or negative charge on it.

1) Negatively charged ion is called **anion** (Cl–).
2) Positively charged ion is called **cation** (Na+).

Valency:

The combining capacity of an element is known as its valency. Valency is used to find out how the atom of an element will combine with the atom of another element to form a chemical compound.

(Every atom wants to become stable, to do so it may lose, gain or share electrons.)

1) If an atom consists of 1, 2 or 3 electrons in its valence shell then its valency is 1, 2 or 3 respectively,
2) If an atom consists of 5, 6 or 7 electrons in the outermost shell, then it will gain 3, 2 or 1 electron respectively and its valency will be 3, 2 or 1 respectively.
3) If an atom has 4 electrons in the outermost shell than it will share this electron and hence its valency will be 4.
4) If an atom has 8 electrons in the outermost electron and hence its valency will be 0.

Chemical Formulae:

Rules:

1) The valencies or charges on the ion must balance.
2) Metal and non-metal compound should show the name or symbol of the metal first.
$$\text{e.g., Na+ Cl–} \rightarrow \text{NaCl}$$
3) If a compound consists of polyatomic ions. The ion is enclosed in a bracket before writing the number to indicate the ratio.
$$\text{e.g., } [SO_4]^{2-} \rightarrow \text{polyatomic radical}$$
$$H^{1+} SO_4^{2-} \rightarrow H_2SO_4$$
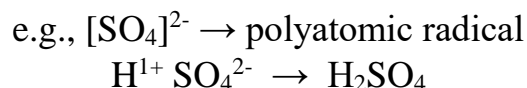
Molecular Mass:

It is the sum of the atomic masses of all the atoms in a molecule of the substance. It is expressed in atomic mass unit (u).

Formula Unit Mass:

It is the sum of the atomic masses of all atoms in a formula unit of a compound. The constituent particles are ions.

Mole Concept:

Definition of mole: It is defined as one mole of any species (atoms, molecules, ions or particles) is that quantity in number having a mass equal to its atomic or molecular mass in grams.

1 mole = 6.022 x 10^{23} in number

Molar mass = mass of 1 mole → is always expressed in grams and is also known as gram atomic mass.

1 u of hydrogen has → 1 atom of hydrogen 1g of hydrogen has → 1 mole of hydrogen

= 6.022 x 10^{23} atoms of hydrogen

- Number of moles of atoms = $\dfrac{\text{Mass of element in grams}}{\text{Gram atomic mass of the element}}$
- Number of moles = $\dfrac{\text{No. of atoms of element}}{\text{Avogadro' no of atoms}} = \dfrac{N}{N_A}$
- Number of moles of molecules = $\dfrac{\text{Mass of substance in grams}}{\text{Gram molecular mass of substance}}$
- Number of moles of molecules = $\dfrac{\text{No. of molecules of element}}{\text{Avogadro' no. of molecules}} = \dfrac{N}{N_A}$
- 1 mole of molecules = Gram molecular mass
- 1 mole of molecules = 6.023×10^{23} molecules
- Gram molecular mass = 6.023×10^{23} molecules
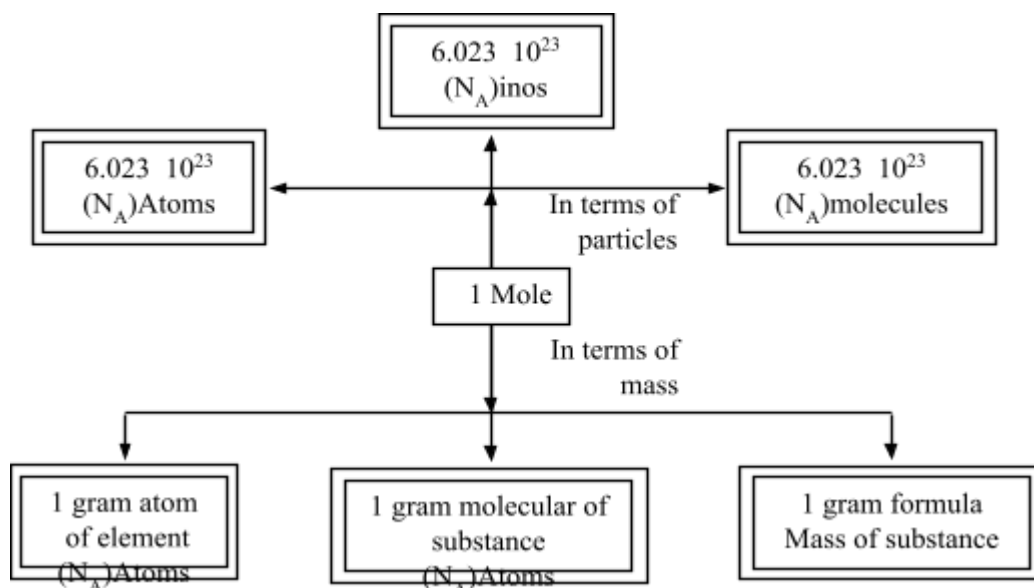
QUESTIONS

ASSERTION AND REASONING:
Directions: In the Question number from 1 to 5, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Q1.
Assertion: An atom is the smallest particle in an element that has the properties of the element.
Reason: Molecules are formed by the combination of two or more atoms.
Answer: - Option B

Q2.
Assertion: Atomic mass of aluminium is 27
Reason: An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atom.
Answer: - Option A

Q3.
Assertion: 1 mole of H2 and O2 each occupy 22.4 L at standard temperature and pressure.
Reason: Molar volume for all gases at the standard temperature and pressure has the same value.
Answer: - Option A

Q4.
Assertion: Atoms can neither be created nor destroyed .
Reason: Under similar conditions of temperature and pressure, equal volumes of gases does not contain equal number of atoms.
Answer: - Option C.

Q5.
Assertion: One mole of SO_2 contains double the number of molecules present in one mole of O_2.
Reason: Molecular weight of SO_2 is double to that O_2.
Answer: - Option D

TRUE OR FALSE:

1. Two elements sometimes can form more than one compound.
2. Noble gases are Diatomic .
3. The gram atomic mass of an element has no unit .
4. 1 mole of Gold and Silver contain same number of atoms .
5. Molar mass of CO_2 is 42g.
6. Oxygen molecule exists in the form of three molecules as O_2, O_3 and O_4.
7. Sodium shows valency of Na+ and Na.
8. Iron shows valency of Fe^{2+} and Fe^{3+}.
9. The formulae of cupric oxide and cuprous oxide are CuO and Cu_2O respectively.
10. The elements having one valency are called monovalent.
11. A group of atoms carrying a charge are called bivalent ions.
12. Atomicity of phosphorus is 5 and that of sulphur is 6.
13. A mole always represents 6.023×10^{22} atoms or molecules or ions of a substance.
14. A mole always represents for gases, 22.4 litres of volume at 0°C and 1 atmospheric pressure which is known as standard temperature and pressure (STP).
15. Mass of two moles of atoms or molecules is called molar mass

Answers (True/False)
Q(1) True Q(2)False Q(3) False Q(4)True Q(5)False Q(6)False Q(7)False Q(8)True
Q(9)True Q(10)True Q(11)False Q(12)False Q(13)False Q(14)True Q(15) False

MCQ(MULTIPLE CHOICE QUESTIONS)

1. Which of the following has the smallest mass?
    a. 6.023×1023 atoms of He
    b. 1 atom of He
    c. 2 g of He
    d. 1 mole atoms of He
2. Which of the following is a triatomic molecule?
    a. Glucose
    b. Helium
    c. Carbon dioxide
    d. Hydrogen
3. The volume occupied by 4.4 g of CO_2 at S.T.P
    a. 22.4 litre
    b. 2.24 litre
    c. 0.24 litre
    d. 0.1 litre
4. Mass of 1 mole of Nitrogen atom is
    a. 28 amu
    b. 14 amu
    c. 28 g
    d. 14 g
5. Which of the following represents 1 amu?

a. Mass of a C – 12 atom
b. Mass of a hydrogen atom
c. 1/12th of the mass of a C – 12 atom
d. Mass of O – 16 atom

6. Which of the following statement is incorrect?
   a. One gram of C – 12 contains Avogadro's number of atoms.
   b. One mole of oxygen gas contains Avogadro's number of molecules.
   c. One mole of hydrogen gas contains Avogadro's number of atoms.
   d. One mole of electrons stands for 6.023×10^{23} electrons.

7. The volume occupied by 1 mole of a diatomic gas at S.T.P is
   a. 11.2 litre
   b. 5.6 litre
   c. 22.4 litre
   d. 44.8 litre

8. In the nucleus of $_{20}Ca^{40}$, there are
   a. 20 protons and 40 neutrons
   b. 20 protons and 20 neutrons
   c. 20 protons and 40 electrons
   d. 40 protons and 20 electrons

9. The gram molecular mass of oxygen molecule is
   a. 16 g
   b. 18 g
   c. 32 g
   d. 17 g

10. Formula of a compound formed by A^{2+} and B^- is
    a. A_2B
    b. A_2B_2
    c. AB
    d. AB_2

11. 1 mole of any substance contains _____ molecules.
    a. 6.023×10^{23}
    b. 6.023×10^{-23}
    c. 3.0115×10^{23}
    d. 12.046×10^{23}

12. Formula of compound formed by Al^{3+} and SO_4^{2-} is
    a. $Al_2(SO_4)_3$
    b. $Al(SO_4)_3$
    c. $Al_3(SO_4)_2$
    d. $AlSO_4$

13. If 12 g of C is burnt in the presence of 32 g of O_2, how much CO_2 will be formed?
    a. 40 g CO_2
    b. 44 g CO_2
    c. 30 g CO_2
    d. 22 g CO_2

14. Which of the following statements are not true about the atom?
    a. Atoms are not able to exist independently
    b. Atoms are the basic units from which molecules and ions are formed
    c. Atoms are always neutral in nature
    d. Atoms aggregate in large numbers to form the matter that we can see, feel or touch.
15. Calculate the number of aluminium ions which are present in 0.0051 g of aluminium oxide.
    a. 6.022×10^{15} Al^{3+} ions
    b. 6.022×10^{19} Al^{3+} ions
    c. 6.022×10^{14} Al^{3+} ions
    d. 6.022×10^{23} Al^{3+} ions

Answers:

1	b	2	c	3	b	4	d	5	c
6	c	7	c	8	b	9	c	10	d
11	a	12	a	13	b	14	d	15	b

CASE STUDY BASED QUESTIONS:

1. A student was asked by his teacher to verify the law of conservation of mass in the laboratory. He prepared 5% aqueous solutions of NaCl and Na_2SO_4. He mixed 10 mL of both these solutions in a conical flask. He weighed the flask on a balance. He then stirred the flask with a rod and weighed it after sometime. There was no change in mass. Read this narration and answer the questions given below:
    i. Was the student able to verify the law of conservation of mass?
    ii. If not, what was the mistake committed by him?
    iii. In your opinion, what he should have done?
    iv. What is the molar mass of Na_2SO_4?

Answers

   i. No, he could not verify the law of conservation of mass in-spite of the fact that there was no change in mass.
   ii. No chemical reaction takes place between NaCl and Na_2SO_4. This means that no reaction actually took place in the flask.
   iii. He should have performed the experiment by using aqueous solutions of $BaCl_2$ and Na_2SO_4. A chemical reaction takes place in this case and a white precipitate of $BaSO_4$ is formed.
   iv. 142 g/mol.

2. Kamla prepared aqueous solutions of barium chloride and sodium sulphate. She weighed them separately and then mixed them in a beaker. A white precipitate was immediately formed. She filtered the precipitate, dried it and then weighed it. After reading this narration, answer the following questions:

   i. Will the weight of the precipitate be the same as that of the reactants before mixing?
   ii. If not, what she should have done?
   iii. Which law of chemical combination does this support?
   iv. State the law of conservation of mass.

Answers

   i. No, it will not be the same.
   ii. She should have weighed the total contents of the beaker after the reaction and not the precipitate alone.
   iii. It supports the law of conservation of mass.
   iv. Mass can neither be created nor destroyed during a chemical reaction.

COMPREHENSION BASED QUESTIONS.

The term chemical formula of a compound is said to be the symbolic representation of its composition or it is a notation that shows the type and number of atoms in a molecule of a compound with the help of atomic symbols and numbers.

They provide information on the elements that constitute the molecules of a compound and the ratio in which the atoms of those elements combine to form the molecules.

Example: A molecule of water, which is a compound, contains two atoms of hydrogen and one atom of oxygen. Its chemical formula is H_2O

1. Write down the names of compounds represented the following formulae:
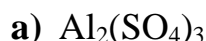
   a) $Al_2(SO_4)_3$
   Answer: $Al_2(SO_4)_3$ - Aluminium sulphate
   b) $CaCl_2$
   Answer: $CaCl_2$ - Calcium chloride

2. Define atomicity.State the atomicity of the following Phosphorus,chlorine,Argon,Hydrogen andOxygen

   Answer: The number of atoms constituting a molecule is known as its atomicity.

Name	Atomicity
Phosphorus	Tetra-atomic
Chlorine	diatomic
Argon	Monoatomic
Hydrogen	diatomic
Oxygen	diatomic

.

Chapter 4 (Structure of Atom)

A. Introduction:
1. Atom: smallest indivisible particle of matter (Dalton).
2. Cathode Rays: travel in straight path, made up of material particles, carry negative charge and produce heating effect.
3. Discovery of electron: J.J. Thomson (1897) using Cathode ray experiment.
    a) Charge :1.6×10^{-19} C (-1 unit)
    b) Mass: 9.1×10^{-31} kg
4. Discovery of Proton: Goldstein (1886) using Anode ray (canal ray) experiment.
    a) Charge : $+1.6 \times 10^{-19}$ C (+1 unit)
    b) Mass: 1.67×10^{-27} kg
5. Discovery of Neutron: James Chadwick (1932). Charge is 0 and mass is 1 u.

B. Models of Atom:
1. Thomson's Model of Atom.
2. Rutherford Model of Atom.
3. Bohr's Model of Atom.

C. Concepts of Atomic number and Mass number:
1. Symbol of atomic number is Z, which is equal to the number of protons/extra-nuclear electrons present in an element.
2. Mass number of an element (A) = number of protons + number of neutrons.
3. $_Z X^A$

D. Distribution of Electrons in different shells- Electronic Configuration of Elements
Shell 1 (K shell) n=1   contains maximum 2 electrons
Shell 2 (L shell) n=2   contains maximum 8 electrons
Shell 3 (M shell) n=3   contains maximum 18 electrons
Shell 4 (N shell) n=4   contains maximum 32 electrons

E. How to find Valency:
    a) If valence shell electrons are 1, 2 or 3 the valency is same as the number of electrons in valence shell. e.g. Sodium (Na) Z= 11 electronic config. 2,8,1
    The valence shell electrons are 1 so the valency of sodium is 1.

F. ISOTOPES:
Isotopes are the atoms of same element which have same atomic number but different mass numbers.
E.g. Hydrogen has 3 isotopes.
a. Protium $_1 H^1$
b. Deuterium $_1 H^2$
c. Tritium $_1 H^3$

Carbon has 2 isotopes

a. C-12 $_6C^{12}$
b. C-14 $_6C^{14}$

G. ISOBARS:

Such atoms of different elements which have different atomic numbers but same mass number are called as isobars.

E.g $_{18}Ar^{40}$ and $_{20}Ca^{40}$.

Assertion and Reasoning

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true

1. Assertion : Isotopes are electrically neutral.

   Reason : Isotopes are species with same mass number but different atomic numbers.

   Answer- C

2. Assertion : Atom is electrically neutral.

   Reason : A neutral particle, neutron is present in the nucleus of atom

   Answer- B

3. Assertion : In Rutherford's gold foil experiment, very few alpha -particles were deflected back

   Reason : Nucleus present, inside the atom is heavy.

   Answer- B

4. Assertion : The atoms of different elements having same mass number but different atomic numbers are known as isobars.

   Reason : The sum of protons and neutrons, in the isobars is always different

   Answer- C

5. Assertion : The size of the nucleus is very small as compared to the size of the atom.
   Reason : The electrons revolve around the nucleus of the atom.

   Answer- B

II. TRUE AND FALSE:

1. Cl-35 and Cl-37 have different valencies.
2. Co-60 is isotope of cobalt used for the treatment of cancer.
3. Mass of the atom is concentrated in the nucleus.
4. Protons and neutrons are also called as nucleons.
5. Natrium is a Latin name of Nitrogen.
6. Neon is an inert gas.
7. Charge on neutron is similar to proton.
8. If a metal ion M^{3+} contains 10 electrons, its atomic number is 7.
9. Mass of proton is nearly 16.7×10^{-27} kg.
10. Cathode rays travel in straight line.
11. The number of electrons in the M shell of Chlorine are 8.
12. Carbon dating is based on the application of C-14.
13. Electrons present in the outermost shell of an atom is called as Valence shell electrons.
14. The lowest energy state of an atom is called as excited state.
15. K shell in elements with atomic number 5, 6, 7 has 2 electrons in it.

Answers (True/False)
Q(1) False Q(2)True Q(3) True Q(4)True Q(5)False Q(6)True Q(7)False Q(8)True
Q(9)False Q(10)True Q(11)False Q(12)True Q(13)True Q(14)False Q(15) True

(I) Multiple Choice Questions (MCQ):

1. Which of following correctly represents the electronic distribution in Al atom.

    a. 3,8,1
    b. 2,8,2
    c. 2,8,3
    d. 8,2,2

2. The number of electrons in an element X is 15 and the number of neutrons is 16. Which of the following is correct representation of the element?

    a. $^{31}X_{15}$
    b. $^{31}X_{16}$
    c. $^{16}X_{15}$
    d. $^{15}X_{15}$

3. Rutherford's alpha particle scattering experiment showed that
    i. Electrons have negative charge

ii.   The mass and positive charge of the atom is concentrated in the nucleus

iii.   Neutrons exists in nucleus

iv.   Most of the space in atom is empty

Which statements are correct?

    a. i and iii

    b. ii and iv

    c. i and iv

    d. iii and iv

4. Which of the following is true for an element?

    i.   Atomic number = number of protons + number of electrons

    ii.   Mass number = number of protons + number of neutrons

    iii. Atomic mass = number of protons = number of neutrons

    iv. Atomic number = number of protons = number of electrons

    a. i and ii

    b. i and iii

    c. ii and iii

    d. ii and iv

5. The ion of an element has 3 positive charges. Mass number of an atom is 27 and the number of neutrons is 14. What is the number electrons in the ion?

    a. 13

    b. 10

    c. 14

    d. 16

6. Elements with 1 valency are

    a. Always metals

    b. Always metalloids

    c. Either metals or non-metals

    d. Always non- metals

7. An atoms with 3 protons and 4 neutrons will have a valency of

    a. 3

    b. 7

    c. 1

    d. 4

8. The first model of an atom was given by

    a. N Bohr

    b. E Goldstein

    c. Rutherford

    d. J J Thomson

9. Which of the following is correct about the electron?

    a. The charge on the electron is 1.60×10^{-19} C

    b. The mass of the electron is 9.1×10^{-31} kg

    c. There is no substance which does not contain electron

    d. All of the above statements are correct

10. Cu^+ and Cu^{2+} will have

a. Same number of protons and same number of electrons
b. Cu+ will have greater number of protons than in Cu^{2+}
c. Cu+ will have less number of protons than in Cu^{2+}
d. Cu^{2+} will have less number of electrons than Cu+

11. The number of electrons, protons and neutrons in Na+ respectively will be (Atomic no. of Na = 11, mass number of Na = 23).
    a. 11,11,12
    b. 10,11,12
    c. 11,11,11
    d. 10,11,13

12. An ion M^{3+} contains 10 electrons and 14 neutrons. The atomic number and mass number of the element M will be
    a. 10,24
    b. 13,24
    c. 13,27
    d. 10,27

13. Isotopes have
    a. Same number of electrons but different number of protons
    b. Same number of protons but different number of electrons
    c. Same number of protons but different number of neutrons
    d. Same number of neutrons but different number of protons

14. The rays which are emitted in the discharge tube from the plate connected to the negative of the induction coil are called as
    a. Anode rays
    b. Cathode rays
    c. Spike rays
    d. Roll over rays

15. Atomic mass unit (a.m.u) is
    a. $1/10^{th}$ of the mass of C-12 isotope
    b. $1/10^{th}$ of the mass of oxygen-16 isotope
    c. $1/12^{th}$ of the mass of C-12 isotope
    d. $1/12^{th}$ of the mass of oxygen-16 isotope

Answers:

1	c	2	a	3	b	4	d	5	b
6	c	7	c	8	d	9	d	10	d
11	b	12	c	13	c	14	b	15	C

V. CASE STUDY BASED QUESTIONS:

A. Dead Sea Scroll

Part of the Great Isaiah Scroll, one of the Dead Sea Scrolls

In 1947, scrolls were discovered in caves near the Dead Sea that proved to contain writing in Hebrew and Aramaic, most of which are thought to have been produced by the Essenes, a small Jewish sect. These scrolls are of great significance in the study of Biblical texts because many of them contain the earliest known version of books of the Hebrew bible. A sample of the linen wrapping from one of these scrolls, the Great Isaiah Scroll, was included in a 1955 analysis by Libby, with an estimated age of 1,917 ± 200 years. Based on an analysis of the writing style, palaeographic estimates were made of the age of 21 of the scrolls, and samples from most of these, along with other scrolls which had not been palaeo-graphically dated, were tested by two AMS laboratories in the 1990s. The results ranged in age from the early 4th century BC to the mid-4th century AD. In all but two cases the scrolls were determined to be within 100 years of the palaeo-graphically determined age. The Isaiah scroll was included in the testing and was found to have two possible date ranges at a 2σ confidence level, because of the shape of the calibration curve at that point: there is a 15% chance that it dates from 355 to 295 BC, and an 84% chance that it dates from 210 to 45 BC. Subsequently, these dates were criticized on the grounds that before the scrolls were tested, they had been treated with modern castor oil in order to make the writing easier to read; it was argued that failure to remove the castor oil sufficiently would have caused the dates to be too young. Multiple papers have been published both supporting and opposing the criticism.

Answer the questions:

1. The age of the scroll found in the caves near the Dead Sea can be done with the help of
   a. Radioactive C-12 dating
   b. Radioactive C-14 dating
   c. Radioactive N-14 dating
   d. Radioactive O-16 dating
2. Radio carbon dating technique is used to estimate the age of
   a. Rocks
   b. Soil

c. Fossils

d. Buildings

3. Radiocarbon dating is used to determine
   a. Height of an object
   b. The volume of an object
   c. Weight of an metal
   d. Age of an organic material

4. The half life of a radioactive substance is 4 months then the time spent in decaying ¾th of the substance would be:
   a. 3 months

   b. 4 months

   c. 8 months

   d. 12 months

B.

Atomicity and valency are two chemical terms that are often used regarding atoms and molecules. Atomicity is the number of atoms present in a molecule. Valency is the maximum number of electrons that an atom has to lose, gain or share in order to get stabilized. Therefore these are two distinct properties of atoms and molecules. The main difference between atomicity and valency is that atomicity explains a molecular property whereas valency describes an elemental property. Atomicity is the total number of atoms present in a molecule. According to this definition, molecules can be divided into groups depending on the atomicity of molecules. For example, molecules can be monoatomic, diatomic, triatomic or polyatomic. Monoatomic compounds are composed of a single atom. For example, inert gases such as Helium (He), Argon (Ar), etc. are monoatomic compounds. Diatomic compounds are composed of two atoms per one molecule. Valency can be defined as the maximum number of electrons that an atom can lose, gain or share in order to become stabilized. For metals and nonmetals, the octet rule describes the most stable form of an atom. It says that if the number of the outermost shell of an atom is completely filled with eight electrons, that configuration is stable. In other words, if the s and p sub-orbitals are completely filled, having ns^2np^6, it is stable. Naturally, noble gas atoms have this electron configuration. Therefore, other elements need to either lose, gain or share electrons in order to obey the octet rule. The maximum number of electrons involved in this stabilization process is called the valency of that atom.

1. Valency of ferrous and ferric is
   a. +2 and +4
   b. +2 and +3
   c. +1 and +2
   d. 0 and +2.

2. The group number, number of valence electrons, and valency of an element with the atomic number 15, respectively, are:

(a) 16, 5 and 2
(b) 15, 5 and 3
(c) 16, 6 and 3
(d) 15, 6 and 2

3. The chemistry of lithium is very similar to that of magnesium even though they are placed in different groups. Its reason is:

(a) Both are found together in nature
(b) Both have nearly the same size
(c) Both have similar electronic configuration
(d) The ratio of their charge and size (i.e. charge density) is nearly the same

4. An atom with 3 protons and 4 neutrons will have a valency of
(a) 3
(b) 7
(c) 1
(d) 4

Answers-

A- 1-b, 2-c, 3-d, 4-c

B- 1-b, 2-b, 3-d, 4-c

III. COMPREHENSION:

After the discovery of sub-atomic particles like electrons and protons, it was important to understand where these particles located within the atom are, i.e. what the model of the atom is. Different models have been put forward from time to time like Thomson's model, Rutherford's model and Bohr's model etc. Bohr's model gave a clear picture how the electrons are distributed around the nucleus in different shells.

Answer the following questions choosing the correct option in each case:
Q1) Which of the following is correct about the Thomson's model of an atom?

a)The positive charge is present in the centre and electrons are present around it to neutralize the positive charge.

b) It is a sphere of positive electricity in which were embedded number of electrons sufficient to neutralize the positive charge.

c) It is a sphere of negative charge and positive charges were present on the boundary of the sphere to neutralize the negative charge.

d) None of the above is correct.

Q2)Which of the following is not correct about Bohr's model?

a) Electrons are revolving around the nucleus in stationary state

b) Energies of 1st , 2nd , 3rd and 4th shell are in the order of E1>E2>E3>E4

.c)Ground state of an atom means a state of the atom with lowest energy

d) Electrons absorb only discrete amounts of energy to jump from one shell to another shell and not any energy.

Answers-

1-b

2-b

CHAPTER – 10
GRAVITATION

Gravity is one of the most basic forces in the universe. It plays a fundamental role not only in the structure of our solar system but also in the way objects behave on Earth.

Gravitation

Gravitation is the force of attraction between two objects in the universe. Gravitation may be the attraction of objects by the earth.

This force is proportional to the product of masses of the objects and inversely proportional

to the square of the distance between them. It is independent of medium.

Gravitational force GMm/r2

Eg :- If a body is dropped from a certain height, it falls downwards due to earth's gravity. If a body is thrown upwards, it reaches a certain height and then falls downwards due to the earth's gravity.

- Gravitation may be the attraction between objects in outer space.

Eg :- Attraction between the earth and moon.

Attraction between the sun and planets.

GRAVITY

- A natural force that pulls all objects toward the center of the earth
- keeps the moon orbiting
- It holds stars together . . .
- And binds galaxies together for billions of years ….Prevents Planets from losing their atmospheres.

2.**Universal law of gravitation**:

- The universal law of gravitation states that, 'Every object in the universe attracts every other object with a force which is directly proportional to product of the masses and inversely proportional to the square of the distance between them.'

F = Gravitational force
G = Universal gravitational constant
d = Distance between M and m

$$F = G\frac{Mm}{d^2}$$

- The SI unit of G is N m2 kg−2 and its value is 6.673 ×10−11N m2 kg−2
- The strength of the gravitational attraction between two objects depends on two factors:
- How big the objects are (how much mass they have) and
- How far apart they are.

3. Free Fall

- With negligible air resistance, falling objects can be considered freely falling. objects of different shapes accelerate differently (stone vs feather)

4 .To calculate the value of" g"(acceleration due to gravity)

- The acceleration due to gravity is denoted by g.
- The unit of g is same as the unit of acceleration ms−2
- From the second law of motion, force is the product of mass and acceleration. F = ma
- For free fall, force is the product of mass and acceleration due to gravity. F=mg or mg=GMm/r2

Or Ggm/r2

where M is the mass of the Earth and d is the distance between the object and the earth.

- For objects near or on the surface of the earth d is equal to the radius of the earth R
- F=mg or mg =GMm/r2

Or gGM/r2

5. Mass and Weight:

- Mass is a fundamental, universal property. You have the same amount of mass no matter where you are in the Universe.

- Weight is not fundamental its value depends on circumstances in the Universe. Weight is a force. It is the resultant gravitational force exerted on a body with mass m by all the other bodies on the Universe.
  Weight = F_g = G m M_e/ R^2 = mg
  where M_e is the mass of the Earth and R is the radius of the Earth.

6. Weight Of The Object On Moon

- The mass of the moon is less than the mass of the earth. So the moon exerts lesser force on the objects than the earth.
- The weight of an object on the moon is one sixth (1/6th) of its weight on the earth.
- The weight of an object on the earth is the force with which the earth attracts the object and the weight of an object on the moon is the force with which the moon attracts the object.

Celestial body	Mass (kg)	Radius (m)
Earth	5.98 x 10245	6.37 x 106
Moon	7.36 x 1022	1.74 x 106

QUESTION

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

Q1 Assertion (A): The direction of acceleration is always towards the Earth.

Reason (R): The value of "g" is 9.8 m/s2

Answer: (B)

Q2 Assertion : When distance between two bodies is doubled and also mass of each body is doubled, then the gravitational force between them remains the same.

Reason : According to Newton's law of gravitation, product of force is directly proportional to the product mass of bodies and inversely proportional to square of the distance between them.

Answer: (a)

Q 3 Assertion : The density of a liquid depends upon the nature and temperature of the liquid.

Reason : The volume of the liquid depends upon temperature.

Answer: (a)

Q4 Assertion : Space rockets are usually launched in the equatorial line from west to east.

Reason : The acceleration due to gravity is minimum at the equator.

Answer: (B)

Q5 Assertion : It si the gravitational force exerted by the sun and the moon on the sea water that

causes to the formation of tides in the sea

Reason : Gravitational force of attraction is a weak force.

Answer: (a)

CCT QUESTION

The universe has a lot of forces, a lot of pushes and pulls. We're always pushing or pulling something, even if only the ground. But it turns out that in physics, there are really only four fundamental forces from which everything else is derived: the strong force, the weak force, the electromagnetic force, and the gravitational force. The gravitational force is a force that attracts any two objects with mass. We call the gravitational force attractive because it always tries to pull masses together, it never pushes them apart. In fact, every object, including you, is pulling on every other object in the entire universe! This is called Newton's Universal Law of Gravitation.

Q1 . A body of mass 1kg on the surface of earth is attracted by the earth with a force which is equal to
a. 9.8N
b. 6.67x 1011
c. 1 N
d. 9.8m/s

Q2 . What is the gravitational force between two objects?
a. attractive at large distances only
b. attractive at small distances only

c. attractive at all distances
d. attractive at large distances but repulsive at small distances

Q3 The value of g
a. Increases as we go above the earth surface
b. Decreases as we go to the centre of the earth
c. Remains constant

d. Is more at equator and less at poles

Q4 . The gravitational force causes
a. Tides
b. Motion of moon
c. None of them
d. Both a and b

comprehensive question
The universal law of gravitation states that, 'Every object in the universe attracts every other object with a force which is directly proportional to product of the masses and inversely proportional to the square of the distance between them.'

F = Gravitational force
G = Universal gravitational constant
d = Distance between M and m

$$F = G \frac{Mm}{d^2}$$

Q1 The mass of the earth is 6 × 1024 kg and that of the moon is 7.4 × 1022 kg. If the distance between the earth and the moon is 3.84×105 km, calculate the force exerted by the earth on the moon. (Take G = 6.7 × 10–11 N m2 kg-2)
I 3.03x 10^{30} N
ii 2.02 × 10^{20} N
iii 20.20 x 10^{20} N
iv 2.002 x 10^{30} N
ANSWER (2)

Q2 The gravitational force between two objects is F. If masses of both objects are halved without changing distance between them, then the gravitational force would become
1)   F/2
2)   F
3)   2 F
4)   F/4
ANSWER (4)
Q3   In the relation F = Gmm/d2, the quantity G
1)   is greater at the surface of the earth
2)   depends on the value of g at the place of observation
3)   is universal constant of nature
4)   is used only when the earth is one of the two masses
ANSWER (3)

Q4
 Law of gravitation gives the gravitational force between
1)   any two bodies having some mass
2)   two charged bodies only
3)   the earth and Sun only
4)   the earth and a point mass only

ANSWER (1)

MCQ

Q1 Two particles are placed at some distance. If the mass of each of the two particles is doubled, keeping the distance between them unchanged, the value of gravitational force between them will be
1. Unchanged
2. ¼ times
3. ½ times
4. 4 times

Answer 4

Q2 A boy is whirling a stone tied to a string in a horizontal circular path. If the string breaks, the stone
(a) will continue to move in the circular path
(b) will move along a straight line towards the centreof the circular path
(c) will move along a straight line tangential to the circular path
(d) will move along a straight line perpendicular to the circular path away from the boy
ANSWER (4)

Q3 Acceleration due to gravity of the Earth increases with
(a) decrease in the height from the surface of the Earth
(b) increase in the height from the surface of the Earth.
(c) increase in the depth from the surface of the Earth.
(d) increase in the temperature of the Earth.

ANSWER (A)

Q4 An apple falls from a tree because of the gravitational attraction between the earth and the apple. If F1 is the magnitude of the force exerted by the earth on the apple and F2 is the magnitude of the force exerted by the apple on the earth, the

(a) F1 is very much greater than F2

(b) F2 is very much greater than F1

(c) F1 and F2 are equal

(d) F1 is only a little greater than F2

Answer: (c)

Q5 The earth and the moon are attracted to each other by gravitational force. The earth attracts the moon with a force that is:

(a) More than that exerted by the moon

(b) Same as that exerted by the moon

(c) Less than that exerted by the moon

(d) Not related to that exerted by the moon

Answer: (b)

Q6 A ball weighing 4 kg of density 4000 kgm-3 is completely immersed in water of density103 kgm-3. What will be the buoyant force acting on it?

(a) 100 N

(b) 10 N

(c) 1600N

(d) 16 N

Answer: (b)

Q7 Two objects of different masses falling freely near the surface of moon would:
(a) Have different accelerations
(b) Undergo a change in their inertia
(c) Have same velocities at any instant
(d) Experience forces of same magnitude
Answer: (c)

 Q 8 The atmosphere is held to the earth by:

(a) gravity

(b) wind

(c) clouds

(d) earth's magnetic field
ANSWER (A)

Q 9 Two objects of different masses falling freely near the surface of the moon would

(a) have same velocities at any instant

(b) have different acceleration

(c) experience forces of same magnitude

(d) undergo a change in their inertia

ANSWER (A)

Q10When a mango falls from a mango tree then

(a) only the Earth attracts the mango.

(b) only the mango attracts the Earth.

(c) both the mango and the Earth attract each other.

(d) both the mango and the Earth repel each other.

ANSWER (C)

STATEMENT TRUTH AND FALSE

Q1 Two masses m and M are kept at a distance r. The ratio of the force exerted on m due to M and that of M due to m is equal to 1:1

(a) Truth (b)false

Answer (a)

Q2 Variation of acceleration due to gravity g with distance r from the centre of earth with (r > Re) is best given as g $\propto 1/r^2$

(a)Truth (b) false

Answer (a)

Q3 Earth moves in a circular motion around the Sun because of **static** force.

(A) TRUTH (B) FALSE

ANSWER (B)

Q4 Mass is a fundamental, universal property. You have the same amount of mass no matter where you are in the Universe.

(A) TRUTH (B) FALSE

ANSWER (A)

Q5The mass of the moon is less than the mass of the earth

(A) TRUTH (B) FALSE

ANSWER (A)

Q6 A stone is dropped from a cliff. Its speed after it has fallen 100 m is 98 ms-1

(A) TRUTH (B) FALSE

ANSWER (B)

Q7 The value of acceleration due to gravity increases from pole to equator

(A) TRUTH (B) FALSE

ANSWER (B)

Q8 The value of G depends on: distance between the bodies

(A) TRUTH (B) FALSE

ANSWER (B)

Q9 The value of G one-sixth on moon as compared to that on the earth. The above statement is

(A) TRUTH (B) FALSE

ANSWER (B)

Q10 The value of acceleration due to gravity is the same at all places.

(A) TRUTH (B) FALSE

ANSWER (A)

STUDY MATERIAL

CLASS IX

SCIENCE

WORK   & ENERGY

1. Work Done By A Constant Force

- Work is a scalar quantity equal to the product of the displacement x and the component of the force Fx in the direction of the displacement..
- Work is defined as a force acting upon an object to cause a displacement
- Mathematically, work can be expressed by the following equation.
  W=F x d cos q (cos 00·1)
- where F - force, d - displacement, and the angle (theta) is defined as the angle between the force and the displacement vector
- Three things are necessary for the performance of work:
- There must be an applied force F.
- There must be a displacement x.
- The force must have a component along the displacement

Negative Work

The friction force f opposes the displacement

Positive Work
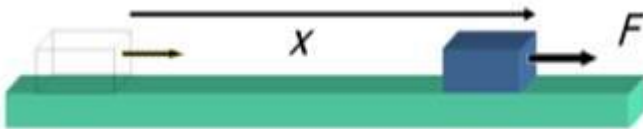
Force F contributes to displacement x.

2. Energy And Its Forms

The metric system unit of energy is the joule (J), after James Joule.

• Mechanical energy is the energy which is possessed by an object due to its motion or its stored energy of position

Forms of Energy

• **Kinetic energy** : is the energy of motion

Energy which a body possesses because of its motion, which occurs anywhere from an atomic level to that of a whole organism

Examples of Kinetic Energy: This is not an all-inclusive list.

- Electrical – The movement of atoms
- Electromagnetic or Radiant – The movement of waves
- Thermal or Heat – The movement of molecules
- Motion – The movement of objects
- Sound – The movement through waves

Engineers generally refer to thermal/heat energy as "internal energy" and use "kinetic energy" strictly in reference to motion. Potential Energy (Stored energy or gravitational energy)

- The capacity to do work by virtue of position or configuration

- an object can store energy as the result of its position or elastic source
- Potential Energy is maximum at the maximum HEIGHT

Energy transformation involves the conversion of one form of energy into another form. Examples of energy transformation include:

• Chemical – Food is consumed and converted into motion for playing sports or taking a test.

• Radiant – Sunlight is consumed by plants and converted into energy for growth.

• Electrical – Energy transferred to an oven is converted to thermal energy for heating our food.

Now you know the basic forms of energy. The next question is "What are the energy sources?"

There are renewable and nonrenewable sources of energy. A renewable energy source is a form of energy that is constantly and rapidly replenished by natural processes.

Examples of **renewable energy sources** include:

• Biomass – The use of a living or once living organism as fuel

• Hydropower – The energy produced from the movement of water

• Geothermal – The use of heat from within the Earth or from the atmosphere near oceans to warm houses or other buildings

• Wind – The use of wind to generate electricity

Solar – The use of the sun as a source of heat; for instance, to heat a room within a house, etc.
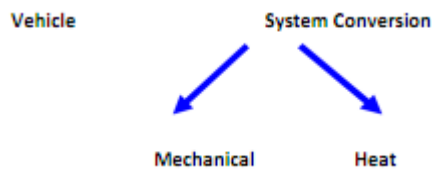
Energy Conversion

Fossil fuels Chemical → Heat → Mechanical → Electrical

Solar cells Sunlight → Electrical

Wind turbines Kinetic → Mechanical → Electrical

Hydroelectric Gravitational potential → Mechanical → Electrical

Nuclear Nuclear → Heat → Mechanical → Electrical

3. Potential energy of an object at a height

An object increases its energy when raised through a height.

The potential energy of an object at a height depends on the ground level or the zero level

4. Law Of Conservation Of Energy

The principle of Conservation of Mechanical Energy

The total mechanical energy (E = KE+PE) of an object remains constant as the object moves, provided that the net work done by external non-conservative forces is zero, Wnc=0J

Total mechanical energy: the sum of kinetic energy and gravitational potential energy

E=KE+PE

5. Rate of Doing Work & Commercial Unit Of Energy POWER

Rate at which work is performed or energy is expended P=Wt

Watt is the base unit of Power .One watt is equal to 1 joule of work per second

Types of Power

- Electrical Power

Uses electrical energy to do work

- Mechanical Power

Uses mechanical energy to do work (linear, rotary)

- Fluid Power

Uses energy transferred by liquids (hydraulic) and gases (pneumatic)

• Power is the rate that we use energy.

• Power = Work or Energy / Time

• P = W/t = F × d/t = F v

• The unit joule is too small .The bigger unit of energy called kilowatt hour (kW h)

1 kW h is the energy used in one hour

QUESTIONS

ASSERTION AND REASON:

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

Q 1. Assertion : Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.

Reason : Gravitational forces are conservative forces.

Answer: (c)

Q2 Assertion : The work done by a force can be either positive or negative.

Reason : The work done will be equal to the product of the force and displacement.

Answer: (B)

Q3 Assertion : The energy transferred to an object is stored as potential energy if it is not used to

cause a change in the velocity or speed of the object.

Reason : The potential energy possessed by the object is not the energy present in it by

virtue of its position or configuration.

Answer: (c)

Q4 Assertion: Work done by the gravitational force through a certain distance is constant irrespective of the fact that the body has a uniform or accelerated motion.
Reason : Gravitational force is a conservative force

Answer: (B)

Q 5 Assertion : No work is done when a woman carrying a load on her head, walks on a level road with a uniform velocity.

Reason : No work is done if force is perpendicular to the direction of displacement.

Answer: (a)

MCQS:-

Q1 Question: A child on a skateboard is moving at a speed of 2 m/s. After a force acts on the

child, her speed is 3 m/s. What can you say about the work done by the external force on

the child?

a) positive work was done

b) negative work was done

c) Zero work was done

d) Infinite work was done

Answer: positive work was done

Q2 9800 joule of energy was spent to raise a mass of 50kg, the mass was raised to

a height of

 (a) 20m

(b) 980m

(c) 10m

(d) none of these

Answer : A

Q3 A car is accelerated on a levelled road and attains a velocity 4 times of its initial velocity. In this process the potential energy of the car

(a) does not change

(b) becomes twice to that of initial

(c) becomes 4 times that of initial

(d) becomes 16 times that of initial

Answer: (a) does not change

Q4 In case of negative work the angle between the force and displacement is

(a) 0°

(b) 45°

(c) 90°

(d) 180°

Answer: (d) 180°

Q5 An iron sphere of mass 10 kg has the same diameter as an aluminium sphere of mass is 3.5 kg. Both spheres are dropped simultaneously from a tower. When they are lo m above the ground, they have the same.

(a) acceleration

(b) momenta

(c) potential energy

(d) kinetic energy

Answer: (a) acceleration

Q6 Water stored in a dam possesses

(a) no energy

(b) electrical energy

(c) kinetic energy

(d) potential energy

Answer: (d) potential energy

Q 7 A rocket rises up in the air due to the force generated by the fuel. The work done by the:

(a) fuel is negative work and that of force of

gravity is positive work

(b) fuel is positive work and that of force of

gravity is negative work

(c) both fuel and force of gravity do positive work

(d) both fuel and force of gravity do negative

work

Answer : B

Q8 A man is carrying the heavy luggage from one platform to the other of a Railway station but still according to the logics of science his work done is said to be zero. Can you opt out the correct reason?

(a) The force is acting along the direction of displacement of luggage

(b) The force is acting perpendicular to the direction of displacement of luggage

(c) The force is acting opposite to the direction of displacement of luggage

(d) None of these

Answer : B

Q 9 A car is accelerated on a leveled road and attains a velocity 4 times of its initial velocity. In this process, the kinetic energy of the car

(a) Becomes twice to that of the initial

(b) Becomes four times to that of the initial

(c) Remains the same

(d) Becomes 16 times to that of the initial

Answer: (d)

Q 10 The momentum of a bullet of mass 20 g fired from a gun is 10 kg m/s. The kinetic energy of this bullet in kJ will be:
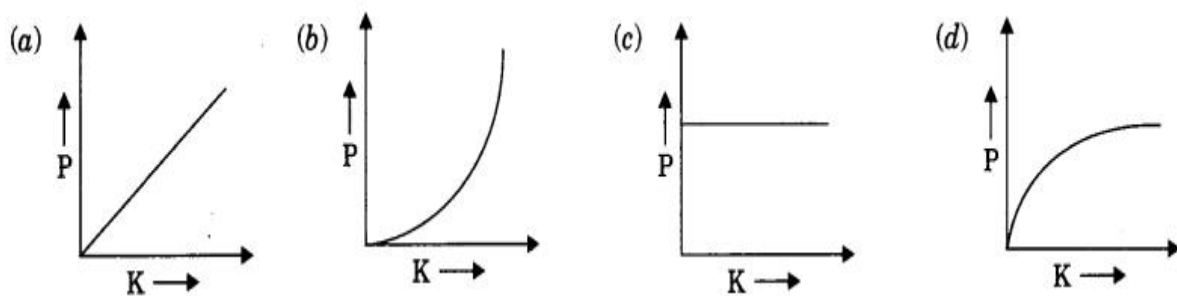
(a) 25

(b) 2.5

(c) 0.25

(d) 5

Answer: (b)

Q11 Which of the following graphs best represents graphical relation between momentum P and kinetic energy K for a body in motion?

Answer: (d)

Q12 The form of energy possessed by a flying bird is:
(a) Kinetic energy
(b) Potential energy
(c) Both kinetic and potential energy
(d) Can't say
Answer: (c)

Q13 A man of mass 50 kg jumps to a height of 1 m. His potential energy at the highest point is(g = 10 m/s2):
(a) 50 J
(b) 500 J
(c) 5 J
(d) 5000 J
Answer: (b)

Q14 . The type of energy possessed by a simple pendulum, when it is at the mean position is:
(a) Kinetic energy
(b) Potential energy
(c) Kinetic + Potential energy
(d) Sound energy
Answer: (A)

Q15 A body is falling from a height h. After it has fallen to a height of $h/2$, it will possess:
(a) Only kinetic energy
(b) Half kinetic and half potential energy
(c) Only potential energy
(d) More kinetic and less potential energy

Answer: (D)

CASE STUDY QUESTION

Read the following and answer any four questions from (i) to (iv)

The following diagram shows that a simple pendulum consisting of a bob of mass 100 gm. Initially the bob of the pendulum is at rest at 'O'. It is then displaced to one side at A. The height of 'A' above 'O' is 5 cm. (Take g = 10 m/s2)
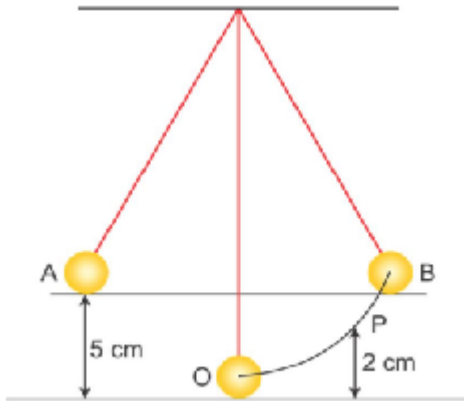
Q1 What is the value of potential energy of bob at 'A' and where does it come from ?

(a) 0.05 J (b) 0.5 J (c) 0.0005 J (d) 50 J

Q2 What is the value of total energy of the bob at position A ?

(a) 1 J (b) 0.05 J (c) 5 J (d) 50 J

PE = mgh

= 0.1 x 10 x 5 x 10-2

= 0.05 J

The work done in raising the bob through a height of 5 cm (against the

gravitational attraction) gets stored in the bob in the form of its potential energy.

At position A, PE = 0.05 J, KE = 0

So, Total energy = 0.05 J

Q3 What is the value of kinetic energy of the bob at mean position 'O' ?

(a) 10 J (b) 5 J (c) 0.05 J (d) 50.0 J

At mean position, potential energy is zero,

hence KE at O = 0.05 J

Q4 What is the value of kinetic energy and potential energy of the bob at the position

'P' whose height above 'O' is 2 cm ?

(a) P.E. = 0.2 J and K.E. = 0.3 J (b) P.E. = 2.0 J and K.E. = 3.0 J

(c) P.E. = 0.002 J and K.E. = 0.003 J (d) P.E. = 0.02 J and K.E. = 0.03 J

PE at P = mgh

= 0.1 x 10 x 2 x 10-2

= 0.02 J

K.E = Total energy – PE

= 0.05 – 0.02

= 0.03 J

CASE STUDY QUESTION

Read the following and answer any four questions from (i) to (iv)

Q2 The concept of work in physics is much more narrowly defined than the common use of the word. Work is done on an object when an applied force moves it through a distance. In our everyday language, work is related to expenditure of muscular effort, but this is not the case in the language of physics. A person that holds a heavy object does no physical work because the force is not moving the object through a distance. Work, according to the physics definition, is being accomplished while the heavy object is being lifted but not while the object is stationary. Another example of the absence of work is a mass on the end of a string rotating in a horizontal circle on a frictionless surface. The centripetal force is directed toward the center of the circle and, therefore, is not moving the object through a distance; that is, the force is not in the direction of motion of the object. (However, work was done to set the mass in motion.) Mathematically, work is W = F · x, where F is the applied force and x is the distance moved, that is, displacement. Work is a scalar. The SI unit for work is the joule (J), which is newton-meter or kg m/s 2.

Q1 When a body falls freely towards the earth, then its total energy:
(a) increases

(b) decreases

(c) remains constant

(d) first increases and then decreases

Q2 A car is accelerated on a levelled road and attains a velocity 4 times of its initial velocity
In this process the potential energy of the car:
(a) does not change

(b) becomes twice to that of initial

(c) becomes 4 times that of initial

(d) becomes 16 times that of initial

Q3 . In case of negative work the angle between the force and displacement is:
(a) 0

(b) 450

(c) 900
(d) 1800

Q4 . An iron sphere of mass 10 kg has the same diameter as an aluminium sphere of mass is
3.5 kg. Both spheres are dropped simultaneously from a tower. When they are 10 m
above the ground, they have the same:
(a) acceleration
(b) momenta
(c) potential energy
(d) kinetic energy

QUESTION ON COMPREHENSIONS

ENERGY

Q1 In physics, energy is the quantitative property that must be transferred to an object in
order to perform work on, or to heat the object. Energy is a conserved quantity; the law of
conservation of energy states that energy can be converted in form, but not created or
destroyed. The SI unit of energy is the joule, which is the energy transferred to an object by the
work of moving it a distance of 1 metre against a force of 1 newton. Common forms of energy
include the kinetic energy of a moving object, the potential energy stored by an object's
position in force field (gravitational, electric or magnetic), the elastic energy stored by
stretching solid objects, the chemical energy released when a fuel burns, the radiant energy
carried by light, and the thermal energy due to an object's temperature. Mass and energy are
closely related. Due to mass–energy equivalence, any object that has mass when stationary
(called rest mass) also has an equivalent amount of energy whose form is called rest energy,
and any additional energy (of any form) acquired by the object above that rest energy will
increase the object's total mass just as it increases its total energy. For example, after heating
an object, its increase in energy could be measured as a small increase in mass, with a sensitive
enough scale. The total energy of a system can be subdivided and classified into potential
energy, kinetic energy, or combinations of the two in various ways. Kinetic energy is
determined by the movement of an object – or the composite motion of the components of an
object – and potential energy reflects the potential of an object to have motion, and generally
is a function of the position of an object within a field or may be stored in the field itself.

 Questions on Energy

1. When an arrow is shot from a bow, it has kinetic energy in it. Explain briefly from where
does it get its kinetic energy?

 2. State the energy changes in the following casesa) an electromagnet, b) burning coal, c)
steam engine, d) photosynthesis in green leaves

3. Name the mechanical energy which is put to use.

4. Is it possible that no transfer of energy may take place even when a force is applied to a
body?

5. In what does the temperature of water at the bottom of a waterfall differ from the temperature at the top? Explain.

Q2 . WORK

In physics, work is the product of force and displacement. 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. For example, when a ball is held above the ground and then dropped, the work done on the ball as it falls is equal to the weight of the ball (a force) multiplied by the distance to the ground (a displacement). When the force" F" is constant and the angle between the force and the displacement "s" is Ө, then the work done is given by W= Fs cos Ө. Work transfers energy from one place to another or one form to another. The SI unit of work is the joule (J). The work W done by a constant force of magnitude F on a point that moves a displacement s in a straight line in the direction of the force is the product of W=Fs. For example, if a force of 10 newtons (F= 10 N) acts along a point that travels 2 metres (s= 2m), then W= Fs= (10N) (2m) = 20J. This is approximately the work done lifting 1 kg object from ground level to over a person's head against the force of gravity. The work is doubled either by lifting twice the weight the same distance or by lifting the same weight twice the distance.

Questions on Work

1. A coolie carrying a load on his head and moving on a frictionless horizontal platform does not work. Explain.

2. A satellite revolves around the Earth in a circular orbit. What is the work done by the force of gravity?

3. The work done by a fielder when he takes a catch in a cricket match is negative. Explain.

4. Is work a scalar or vector quantity? Why?

5. A man lifts a box of 50 kg mass to a height of 2m in 2minutes, while another man lifts the same box to the same height in 5 minutes. Compare the work done by both.

TRUTH AND FALSE

Q1 Mechanical energy is the energy which is possessed by an object due to its motion or its stored energy of position.

TRUTH   B) FALSE

ANSWER (A)

Q2 Potential Energy is maximum at the maximum HEIGHT

   A)TRUTH   B) FALSE

ANSWER (A)

Q3 The potential energy of an object at a height depends on the Sea level.

(a) TRUTH (B) FALSE

ANSWER (B)

Q4 Rate at which work is performed or energy is expended P=W/t

(a)Truth (b) false

Answer (a)

Q5 Work is defined as a force acting upon an object to cause a displacement

(a) Truth (b) false
   Answer (a)

Q6 When a body falls freely towards the earth, then its total energy increases
(a) Truth (b) false

Answer (b)

Q7 In case of negative work the angle between the force and displacement is 0°
   (a) Truth (b) false

   Answer (b)

Q8 When a coil spring is compressed, the work is done on the spring. The elastic potential energy is increases
   (a) Truth (b) false
      Answer (a)

Q9 Energy can neither be created Nor destroyed it can only transformed from one form to another.
(a) Truth (b) false
Answer (a)

Q10 A microphone converts: Sound energy into mechanical energy in stereo system
   (a) Truth (b) false
   Answer (B)

Q11 Work is said to be done when a sailboat is moving due to wind energy..
   (a) Truth (b) false
   Answer (a)

Q12 Two persons P and Q do same amount of work. The person Q does the work in tp seconds and person Q in tq seconds. the ratio of power delivered by them is t_p/t_q
   (a) Truth (b) false

   Answer (a)

Q13 The angle between force and displacement is 2 Q. 90^0 value of Q is work done zero

   (a) Truth (b) false

   Answer (B)

Q14 2 mg is the force required to lift a block of mass 2m

(a) Truth (b) false

Answer (a)

Q15 A machine does 2000 joule of work in 400 seconds. the power of machine is 5w

(a) Truth (b) false

Answer (a)

CHAPTER: -- Why do we fall ill.

Health

Health is a state of complete physical, mental and social well-being.

Disease

Any disturbance in the structure or function of any organ or part of body. It may be caused

due to the attack of pathogens (virus, bacteria), lack of nutritious diet/balanced diet and lack of public health services.

Types of Disease

Diseases are basically of two types. They are:-

(i) Acute Disease

The disease which lasts for only a short period of time is called Acute Disease. For example: Influenza (Flu), Common cold, etc.

(ii) Chronic Disease: The disease which lasts for a long period of time is called Chronic Disease. For example: TB, Cancer, etc.

S. No.	Acute Disease	Chronic Disease
1.	They are short duration diseases.	They are long lasting diseases.
2.	Patient recovers completely after the cure.	Patient does not recover completely.
3.	There is no loss of weight or feeling of tiredness afterward.	There is often loss of weight of feeling of tiredness.
4.	There is short-duration loss of work and efficiency.	There is a prolonged loss of work and efficiency.

Difference between Acute Disease & Chronic Disease

Causes of Diseases:

Causes of diseases are explained below:

Immediate and Contributory Cause: -
Immediate cause: The organisms that enter our body and cause the disease are termed as an immediate cause. For example, virus, bacteria, protozoa etc.
Contributory cause: The secondary factors which led these organisms enter our body are termed as a contributory cause. For example, dirty water, contaminated food, improper nourishment, poor standard of living, etc.

Infectious and Non-infectious Cause: -
Infectious causes: They include the agents like microbes or micro-organisms as the immediate causes which spread the disease from an infected person to a healthy person.
Non-infectious causes: The disease which does not spread by contact between infected and healthy person through air and water, is called non-infectious disease.

Infectious and Non-infectious Diseases: -
Infectious Diseases: The diseases which spread due to infection by microorganisms are called infectious diseases. When a disease-causing organism enters our body it causes infection, it multiplies and grows in the body called host and micro-organisms multiplies in the host body.
For example: Tuberculosis, tetanus, Common cold, AIDS, etc.

Non-infectious Diseases: The disease which does not spread by contact between infected and healthy person through air and water, is called non-infectious disease.
For example: Cancer, genetic abnormalities, high blood pressure, etc.

Means of Spreading Infectious Diseases:

S. No.	Type of Disease	Example
1.	Air borne Diseases	Common cold, influenza, measles, tuberculosis.
2.	Water borne diseases	Cholera, typhoid, hepatitis.
3.	Sexual Diseases	AIDS, Syphilis.
4.	Animal born Disease	Rabbis.

Antibiotics

These are the chemicals (medicine, drugs) that block biochemical pathways important for bacteria. They are used for diseases caused by bacteria.

Antibiotics do not work against viral infections as the viruses do not have their own biochemical mechanisms but depend upon that of the host.

Principles of treatment
1. To reduce the effects of the diseases
By taking medicines to bring down the effects of the disease like fever, pain, etc. and by taking complete rest to conserve the body's energy.

2. To kill the cause of the disease
By taking suitable antibiotics and drugs which kill the disease-causing microbes.

Principles of Prevention 1.
General method:
They involve (a) Preventing exposure against microbes (b) By boosting the immune system

(a) Preventing exposure against microbes can be done in the following ways:

For air-born microbes we can prevent exposure by avoiding overcrowded places. For water-borne microbes we can prevent exposure by not using contaminated water.

For vector-borne infections we can prevent exposure by providing a clean environment.

(b) By boosting the immune system:

Our immune system plays an important role in fighting against the microbes that enter our body. Strengthening the immune system can help in preventing many diseases.

So, proper nourishment or healthy diet that includes all the necessary nutrients as well as vitamins and minerals is necessary for better functioning of our immune system.

2. Specific method

It involves the prevention method directed against a particular disease. It is done by immunisation which is the process of introducing a weakened pathogen inside the body of the host to make his/her immune system to produce antibodies against that particular disease so that the next time even if the disease will strike the host's body with full vigour, the body will be able to protect itself with the help.

QUESTIONS: M.C.Q

1. Which one of the following is not a viral disease?

(a) Dengue
(b) AIDS
(c) Typhoid
(d) Influenza

Answer: (c) Typhoid

Q2. Which one of the following is not a bacterial disease?

(a) Cholera
(b) Tuberculosis
(c) Anthrax
(d) Influenza

Answer: (d) Influenza

Q3Which of the following can make you ill if you come in contact with an infected person? (a) High blood pressure
(b) Genetic abnormalities (c)
Sneezing
(d) Blood cancer.

Answer-(c) Sneezing.

Q4. Which one of the following disease is not transmitted by mosquito?

(a) Brain fever
(b) Malaria
(c) Typhoid
(d) Dengue

Answer: (c) Typhoid

Q5. Antibiotics are ineffective against the viral infections. For each type of the viral infection, human body produces its own antiviral protein that is released from the infected and dying host cells. What is this protein called?

(a) Interferon
(b) Leis mania
(c) Ascaris
(d) Pertussis

Answer: (a) Interferon

Q6. Which one of the following has a long term effect on the health of an individual?

(a) Common cold
(b) Chicken pox
(c) Chewing tobacco
(d) Stress

Answer: (c) Chewing tobacco

7. Making anti-viral drugs is more difficult than making anti-bacterial medicines because
(a) viruses make use of host machinery
(b) viruses are on the border line of living and non-living
(c) viruses have very few biochemical mechanisms of their own (d) viruses have a protein coat

Answer: (c) viruses have very few biochemical mechanisms of their own

8. Which one of the following causes kala-azar?
(a) Ascaris
(b) Trypanosoma
(c) Leishmania
(d) Bacteria

Answer: (c) leishmania

9. Which one of the following is not important for individual health?
(a) Living in clean space

(b) Good economic condition
(c) Social equality and harmony
(d) Living in a large and well-furnished house

Answer: (d) Living in a large and well-furnished house

10. You are aware of Polio Eradication Programme in your city. Children are vaccinated because
(a) vaccination kills the polio causing microorganisms
(b) prevents the entry of polio causing organism
(c) it creates immunity in the body
(d) all the above

Answer: (c) it creates immunity in the body

11. Choose the odd one out from the list of diseases given below w.r.t their causative agent.

(a) Measles.

(b) Rabies.

(c) Smallpox

(d)Pneumonia.

Answer: - (d) Pneumonia.

12. Why do male Anopheles do not cause malaria?

(a) They feed on juice of plants.

(b) Their population is very less.

(c) They are killed by female Anopheles after mating.

(d) They harbour material parasites in their salivary glands.

Answer: -- (a) They feed on juice of plants.

13. among the option given below, a non-infectious disease.

(a) Tuberculosis.

(b)Cancer.

(c) Pneumonia.

(d)Cholera.

Answer: - (b) Cancer.

14. Which of the following is the target organ of pneumonia.

(a) Liver.

(b) Brain.
(c) Lungs.

(d) Skin.

Answer: - (c) Lungs.

15, the mode of transmission of tuberculosis is.

(a)Contaminated water.

(b) Inhalation of droplets through air

(c) Bite of infected animal.

(d) Sexual contact.

Answer: - b) Inhalation of droplets through air

ASSERTION AND REASONING QUESTIONS: --

In each of the following questions, a statement of Assertion is given by the corresponding statement of Reason. Of the statements, mark the correct answer as

**1. Assertion- Arthritis is a chronic disease. Reason-
It lasts for longer time.**

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

(c) If Assertion is true, but Reason is false

(d) If Assertion is false, but Reason is true

(e) If Assertion and Reason both are false.

Answer—(a)

2. **Assertion: Chronic diseases affect our health.
Reason: Chronic diseases last for long time.**

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion

(b) Both Assertion and Reason are correct but Reason is not correct explanation of Assertion

(c) Assertion is correct but Reason is false

(d) Assertion is false but Reason is correct.

Answer (a)

3. Assertion: Polio is known to cause paralysis and crippling in large number of children's every year.

Reason: Government has started a polio eradication programme

(a) **If both Assertion and Reason are true and Reason is the correct explanation of Assertion**

(b) **If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion**

(c) **If Assertion is true, but Reason is false**

(d) **If Assertion is false, but Reason is true**

(e) **If Assertion and Reason both are false**

Answer-(b)

4. Assertion: ORS is given to the patients suffering from cholera.

Reason: ORS contain water, minerals and sugar to avoid dehydration.

(a) **If both Assertion and Reason are true and Reason is the correct explanation of Assertion**

(b) **If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion**

(c) **If Assertion is true, but Reason is false**

(d) **If Assertion is false, but Reason is true**

(e) **If Assertion and Reason both are false**

Answer-(a)

5. Assertion: -Lung cancer is more common in industrial workers.

Reason: - Industrial smoke contain carcinogenic pollutants

(a) **If both Assertion and Reason are true and Reason is the correct explanation of Assertion**

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

(c) If Assertion is true, but Reason is false

(d) If Assertion is false, but Reason is true

(e) If Assertion and Reason both are false

Answer-(a)

TRUE AND FALSE QUESTION: --

1. In acute diseases patient cannot recover completely after treatment.

    (a) True
    (b) False

Answer- (b) False

2. Common cold is a communicable disease.

    (a) True

    (b) False

Answer - (a) True

3. Cholera is not a water borne disease.

    (a) True

    (b) False

Answer- (b) False

4. In principle of treatment-reduce the effects of the disease or kill the cause of disease.

    (a) True

    (b) False

Answer-(a) True

5. Dengue is spread by Aedes mosquitoes.

    (a) True

    (b) False

  Answer-(a) True

6. Polio and Dengue are viral diseases.

    (a) True.

    (b) False.

  Answer: - (a) True

7. Tuberculosis is a water-borne disease.

    (a) True

    (b) False.

  Answer: - (b) False

8. Typhoid is caused by a virus named Mycobacterium tuberculosis.

    (a) True.

    (b) False

  Answer: - (b) False

9. Influenza is transmitted through the air.

    (a) True.

    (b) False

  Answer: - (a) True.

  10...HIV breaks down the body's immune system.

    (a) True.

    (b) False

  Answer: - (a) True.

11. Diseases which are present since birth are called congenital disease.

      (a) True

      (b) False

  Answer: - (a) True

12. BCG vaccine is used for Cholera disease.

(a) True

(b) False

  Answer :-(b) False

 13. On the basis of symptoms, physicians look for signs of disease.

      (a) True

      (b) False

 Answer: - (a) True

14. Diseases which are present since birth are called congenital disease.

 (a) True

 (b) False

Answer: - (a) True

15. Pulse polio immunization program me was launched in 1995-96 with an aim to eradicate polio disease from the world.

(a) True.

(b) False

Answer: - (True)

CASE STUDY QUESTION: -

Q1. Two HIV infected siblings, vini and prabhat were expelled from their school. Only after the intervention of an NGO, they were readmitted. Read the above and answer the following questions.

(I). which disease are the two children suffering from?

(a) HIV

(b) Cancer

(c)Tuberculosis.

(d) AIDS.

Answer-(d) AIDS.

(II). which of the following mode of transmission of this disease?

(a)Blood transfusion.

(b) By eating with infected person.

(c) By wearing clothes of infected person.

(d) Carrier mother to her foetus.

Answer: - Both (a) and (d)

(III). which is the casual organism of this disease?

(a)Culex mosquito.

(b) Plasmodium.   (c)

Human Immuno virus (d)

None of these.

Answer(c) Human Immuno Virus

(IV)It was diagnose that patient has lost the power of fighting against in any infection. Name the disease from which the patient suffering from

(a) Typhoid.
(b) Tuberculosis
(c) Jaundice
(d) AIDS.
Answer(d) AIDS

Q2. Shashank and Vipul are the two close friends, who spend most of their time together. Shashank observed that Vipul is behaving differentially since last week.

He gets tired and sit on the bench after playing for 5-10 minutes. Shashank asked Vipul if he was not feeling well. Vipul just looked at Shashank with his pale eyes and complained of nausea and vomiting. Shashank advised him to visit the doctor. Read the above and answer the following questions.

(I). from which disease Vipul is suffering?

   (a)Typhoid

(b) Lung cancer.

(c) Jaundice.

(d) Hepatitis.

Answer: - (c) Jaundice.

(II). which causative organism is responsible for it?

(a) Bactria.

(b) Protozoan.

(c) Virus.

 (d)Fungus.

Answer: - (c) Virus.

(III). which organ is infected with Jaundice.

(a) Liver.

(b) Kidney.

(c)Lung.

 (d)Stomach.

Answer: -Liver

(IV) Which of the following organism cause Jaundice?

   (a) Plasmodium.
   (b) Leishmania.
   (c) Hepatitis Virus
   (d) None of these

Comprehensions Question; --

1.Many animals which live around us in the environment can transmit diseases (germs) from sick person to a healthy person (another potential host). These animals act as an intermediate and are known as vectors (carrier of the disease or infection), e.g. Mosquitos such as *Anopheles* (female) – malaria, Culex-filariasis, Aedes-yellow fever, dengue. Flies such as housefly-typhoid, cholera etc. fly-sleeping sickness, sand-fly-kala-azar. In many species of mosquitos, the female needs highly nutritious food in the form of blood in order to be able to lay mature eggs. Hence, mosquitos feed on many warm-blooded animals including humans. In this way, they transfer diseases from one person to another person.

(i)Name the insect which act as vector of malaria.

      (a) House fly.
      (b) Bacteria.
      (c) Anopheles Mosquito. (d) None of these.

     Answer; - (c) Anopheles mosquito.

(ii)Why female anopheles mosquito suck blood?

      (a) For causing disease.
      (b) For survival
      (c) For highly nutritious food (d) None of these.
       Answer;-(c) For highly nutritious food