

**Maharashtra State Board**  
**Class IX Science and Technology**  
**Sample Paper – 1**  
**Solution**

**SECTION A**

1.

(A)

(a)

- i. If the force acting on an object and the displacement of the object are perpendicular to each other, then the work done by the force is **zero**.
- ii. According to Rutherford's model of an atom, the central part of the atom is **positively** charged.
- iii. **Loudness** is a measure of the response of the ear to sound.

(b)

- i. True.
- ii. True.

(B)

- i. **(c)** B–C: cyclist is stationary, C–D: cyclist is returning to where he started.

During B to C, the nature of the graph is a horizontal line which indicates that the cyclist is stationary. During C to D, he is returning to where he started.

- ii. **(b)** Decreases by 20%

The acceleration due to gravity on the Earth is given by  $g = GM/R^2$ .

From the above equation, we observe that acceleration is directly proportional to the mass of the Earth. So, if the mass of the Earth is decreased by 20% and R is kept constant, the value of g will also decrease by 20%.

- iii. **(b)** Sublimation

A change of the solid state directly to the gaseous state without changing into the liquid state is called sublimation.

- iv. **(b)** Reading increases

When we dip our finger in the water, the water exerts an upward thrust on the finger (Archimedes's principle). Because of Newton's third law of motion, the finger will exert an equal and opposite force on the water in the downward direction resulting in an increase of the weight of water. Thus, the reading of the spring balance will increase.

- v. **(b)** They compete with the crops for nutrients, space and sunlight.  
Unwanted plants which grow in the fields are known as weeds. These plants hamper the growth of crops as they compete with the crops for nutrients, space and sunlight.

## 2.

- i. Flora includes all the naturally occurring plant species in a particular area, whereas the fauna constitutes of all the animal species which are present in the particular area.

### **Coniferous forests:**

Flora: Fir, Pine

Fauna: Squirrel, Deer, Goat, Wolf, Robin, Sparrow

- ii. The upward force acting on an object immersed in a liquid is called buoyant force.

Factors affecting buoyant force:

1. Volume of object immersed in liquid
2. Density of liquid

- iii. Atomic mass of C = 12 and O = 16

$\therefore$  Molecular mass of carbon dioxide ( $\text{CO}_2$ ) =  $12 + (2 \times 16) = 44$

Mass of 0.4 mole of  $\text{CO}_2$  =  $0.4 \times 44$

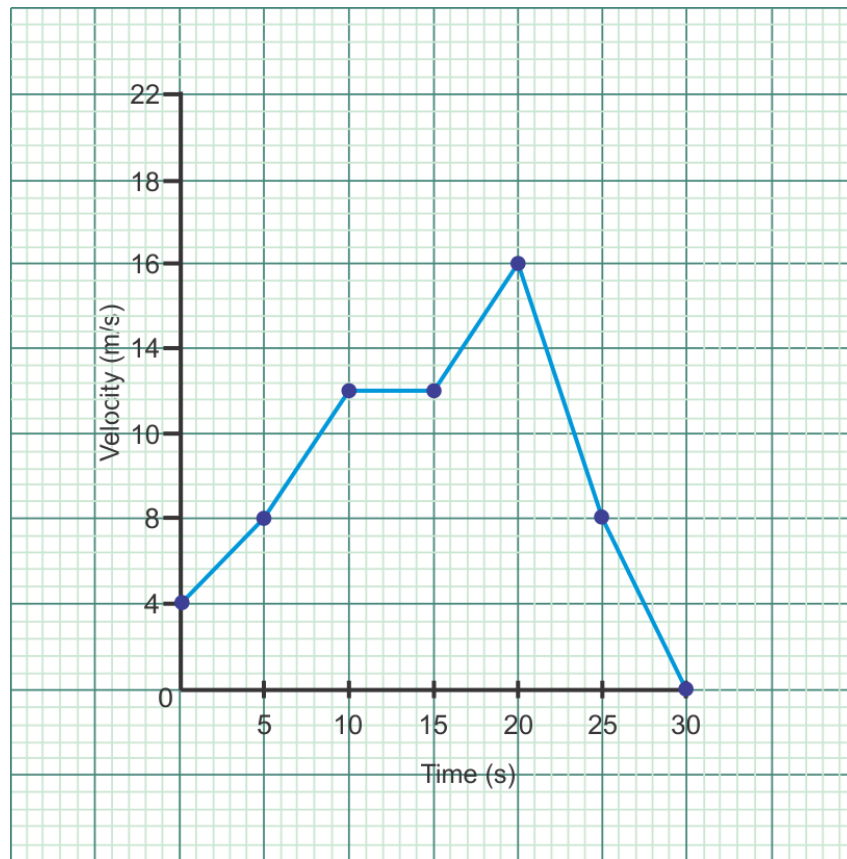
$$= 17.6 \text{ g}$$

Mass of 0.4 mole of  $\text{CO}_2$  is 17.6 g.

- iv.

- The composition of water is the same throughout, i.e. the atoms of elements hydrogen and oxygen constituting a water molecule are combined in a fixed ratio 2:1.
- The properties of water are totally different from those of its constituent elements, i.e. hydrogen and oxygen.
- Hence, water is a compound.

v. The velocity–time graph is as follows:



vi. The weight of a body of mass  $m$  on a planet is given by  $w_p = mg_p$ , where  $g_p$  is the acceleration due to gravity of the planet.

Acceleration due to gravity of the planet is given by

$$g_p = -\frac{Gm_p}{(R_p)^2}$$

where  $m_p$  and  $R_p$  are the mass and radius of the planet, respectively. The value of  $m_p$  and  $R_p$  are different for different planets. The ratio of  $m_p/R_p^2$  is not the same for all planets. Thus, the body will weigh differently on different planets even though its mass remains constant.

### 3.

- i. Consider a sound wave propagating through a medium with velocity  $v$ , such that its wavelength is  $\lambda$  and time period  $T$ . The frequency of the sound wave is the reciprocal of its time period  $T$ , i.e.

$$v = \frac{1}{T}$$

The speed of the wave is the distance covered by a wave in one time period.

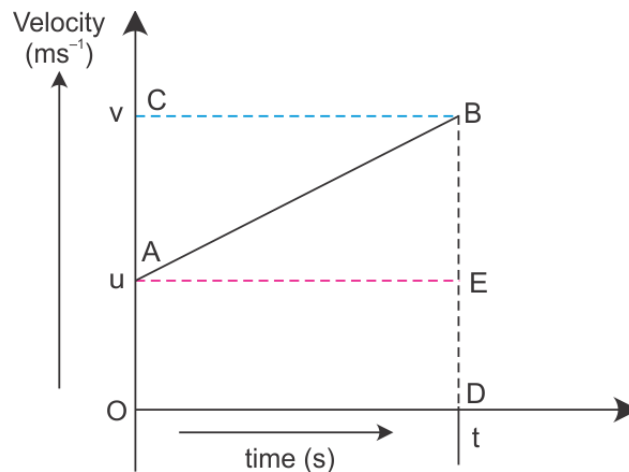
$$\begin{aligned} \therefore \text{Wave velocity, } v &= \frac{\text{Distance covered}}{\text{Time period}} \\ &= \frac{\text{Wavelength}}{\text{Time period}} \end{aligned}$$

or  $v = \frac{\lambda}{T}$

or  $v = v\lambda$

Hence, Wave velocity = Frequency  $\times$  Wavelength

- ii. Consider the linear motion of a body with an initial velocity  $u$ . Let the body accelerate uniformly and acquire a final velocity  $v$  after time  $t$ . The velocity-time graph is a straight line  $AB$  as shown below.



At  $t = 0$ , initial velocity =  $u = OA$

At  $t = t$ , final velocity =  $v = OC$

The distance  $S$  travelled in time  $t =$  area of the trapezium  $OABD$

$$s = \left(\frac{1}{2}\right) \times (OA + DB) \times OD$$

$$s = \left(\frac{1}{2}\right) \times (u + v) \times t$$

Since  $v = u + at$ ,

$$s = \left(\frac{1}{2}\right) \times (u + u + at) \times t$$

$$s = ut + \left(\frac{1}{2}\right) at^2$$

iii.

- In the solution of potassium permanganate in water, the constituents of potassium permanganate and water are uniformly mixed throughout.
- The properties and composition are the same throughout the mixture. Hence, potassium permanganate solution is a homogeneous mixture.
- In a mixture of oil and water, the constituents are not uniformly mixed throughout the mixture. They form two distinct, separate layers of oil and water.
- The properties and composition of a heterogeneous mixture are not the same throughout. Hence, a mixture of oil and water is a heterogeneous mixture.

iv.

- (a) The work done is positive when the force acting on the body and the displacement of the body have the same direction.
- (b) The work done is negative when the force acting on the body and the displacement of the body are in the opposite directions.
- (c) The work done is zero when there is no displacement of the body due to the applied force or when the force acting on the body and the displacement of the body are perpendicular to each other.

v.

- Soil provides the substratum for the growth of plants.
- It contains water and mineral nutrients (e.g. sodium and potassium) required by plants.
- Soil also provides a dwelling place for burrowing animals such as rats, snakes and earthworms, which even swallow the mud containing dead organic matter.
- In deserts, soil provides support to plants such as prickly pear and date palms.
- Even water bodies have some soil at the bottom which is required by the organisms living there.

vi.

- (a) Grass → Grasshopper → Lizard → Crow
- (b) Algae → Protozoa → Small fish → Large fish
- (c) Maize → Goat → Man

#### 4.

##### i. **Risks to ecosystems:**

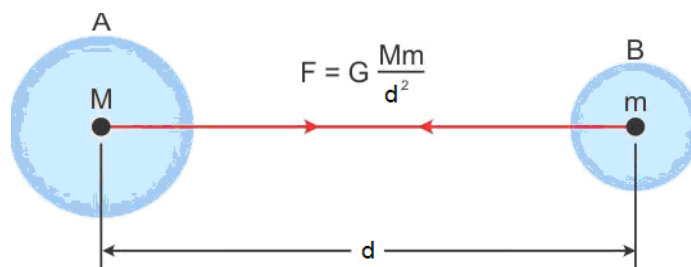
- Because of rapid industrialisation and a scientific approach towards life, our natural resources and rich heritage have begun dwindling greatly.
- Imbalance in nature has posed several serious challenges such as climate change, vector-borne diseases, decay in wildlife and its resources, and food and water shortage.
- Exploitation of natural resources has resulted in ecological degradation, which is the greatest threat to the proper functioning of an ecosystem.

##### **Restoring and conserving ecosystems:**

- Establish a balance between organisms and the environment
- Preserve the charm of our ecosystem
- Assist nature and not disturb its integrity
- Protect our native natural resources such as wildlife, rivers and forests
- Inculcate radical changes in our thoughts to save our natural resources

##### ii.

- (a) Every object in the Universe attracts every other object with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them. The force is along the line joining the centres of two objects.



Let two objects A and B of masses M and m lie at a distance d from each other. Let the force of attraction between two objects be F.

According to the universal law of gravitation, the force between two objects is directly proportional to the product of their masses.

$$F \propto Mm$$

The force is also inversely proportional to the square of the distance between them.

$$F \propto \frac{1}{d^2}$$

Thus, we have

$$F \propto \frac{Mm}{d^2}$$

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

Here,  $G$  is the constant of proportionality and is known as the universal constant of gravitation.

(b) Consider two objects of mass  $m$  separated by a distance  $d$ .

On applying the universal law of gravitation, we have

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

1. When the mass of both bodies is ' $m$ ' and force is  $F_1$ :

$$F_1 = G \frac{m \times m}{d^2} = G \frac{m^2}{d^2}$$
$$\rightarrow F_1 = F$$

2. When the mass of one body is doubled,  $m_1 = 2m$  and  $m_2 = m$ :

$$F_2 = G \frac{2m \times m}{d^2} = 2 \left[ G \frac{m^2}{d^2} \right]$$
$$\rightarrow F_2 = 2F$$

3. When the mass of both bodies is doubled,  $m_1 = 2m$  and  $m_2 = 2m$ :

$$F_3 = G \frac{2m \times 2m}{d^2}$$
$$= G \frac{4m^2}{d^2}$$
$$= 4 \left[ G \frac{m^2}{d^2} \right]$$
$$\rightarrow F_3 = 4F$$

## SECTION B

5.

(A)

(a)

i. Mercury

Mercury is in the liquid state, whereas the others are in the gaseous state.

ii. Syringe

A syringe is a type of biomedical waste, while the rest are classified as e-waste.

(b)

Phylum	Organism
i. Mollusca	(b) Octopus
ii. Chordata	(d) Amphibians
iii. Porifera	(a) Sycon

(B)

i. **(a)** They lose their nuclei and most organelles in the cytoplasm.

Sieve tubes are tubular cells with perforated walls. As these cells mature, they lose their nuclei and most organelles in the cytoplasm.

ii. **(c)** Few, small and temporary in animal cells, while they are single and large in plant cells.

Vacuoles are storage sacks found in plants and animals. They are few, small and temporary in animal cells, while they are single and large in plant cells.

iii. **(d)** A living, elastic, delicate membrane of about 70 Å thickness

The plasma membrane is a thin membrane which separates the interior of the cell from the external environment. It is a living, elastic, delicate membrane of about 70 Å thickness.

iv. **(d)** To dispose domestic, industrial, e-waste and biomedical waste

Incineration is an industrial combustion process designed to reduce, unwanted material to simple solid and gaseous residue. It is used to dispose domestic, industrial, e-waste and biomedical waste.

v. **(d)** Ammonium chloride

Ammonium chloride is a sublimable substance.

***[Please note that the explanation provided is to help you in learning. You may not be required to write an explanation in your answers to these questions.]***



## 6.

- i. Atomic number (Z) is the number of protons present in an atom. The atomic mass of an element is equal to the sum of the number of protons and neutrons present in the nucleus of the element. It is called the mass number and is denoted by (A).
- ii. Functions of the endoplasmic reticulum:
  - Intracellular transport
  - Provides a supportive framework to the cell
  - Synthesis and transport of proteins and fat
  - Transport of ribosomal proteins
- iii. Phloem fibres are dead cells which are found in the phloem tissue. Structurally, these cells are elongated and tapering with thickened cell walls. The cells function in providing mechanical strength to the plant.
- iv. Molecular mass of sulphuric acid ( $\text{H}_2\text{SO}_4$ ) = Sum of the atomic masses of hydrogen, sulphur and oxygen  
$$= (\text{Atomic mass of H}) \times 2 + (\text{Atomic mass of S}) \times 1 + (\text{Atomic mass of O}) \times 4$$
$$= (1 \times 2) + (32 \times 1) + (16 \times 4)$$
$$= 2 + 32 + 64 = \mathbf{98 \text{ u}}$$
Molecular mass of sulphuric acid = 98 u.
- v. Monocotyledons: Maize, Sugarcane and Coconut  
Dicotyledons: Pea, Neem and Apple
- vi. Pathogens which are transmitted through the air spread in through droplets. When an infected or carrier individual coughs or sneezes, the organisms are expelled through droplets of saliva or mucus.  
Examples: Tuberculosis, pneumonia, swine flu

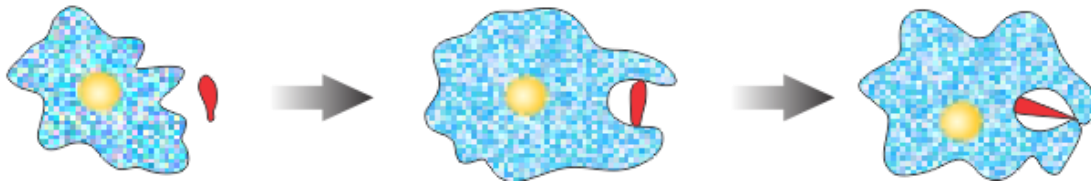
## 7.

- i. Mixed cropping is a technique in which two or more crops are planted in the same field simultaneously. In this technique, the two plants complement each other in their nutrient needs such that the nutrients needed by one crop are not needed by the other crop. This maintains the soil's fertility and prevents the exhaustion of the nutrients from the soil.  
Wheat and tur are cultivated by this method.
- ii. Waste such as animal manure, plant leaves, bark and flowers which is generated from plants and animals is called agricultural waste, farm waste or garden waste.

### Sources of agricultural waste:

- Agricultural residue: It includes plant parts left after obtaining usable portions, which can be used as animal feed.
- Bagasse: It includes plant residue left after extracting sugarcane juice, which can be used as firewood or in the paper industry.
- Pesticides and fertilisers: These collect inside the soil and are washed off with water, used for irrigation or along with rainwater, causing water and soil pollution.
- Animal waste: It includes cow dung and other faecal matter, which can be used to make manure.

iii. The process by which the cell engulfs some of its extracellular fluid (ECF), including material dissolved or suspended in it, is known as endocytosis. The flexibility of the cell membrane enables the cell to engulf by extending out and pinching off, forming a membrane-bounded vesicle called an endosome. *Amoeba* acquires its food by endocytosis.



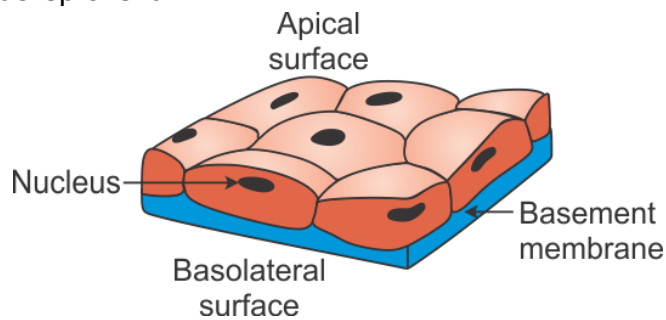
iv. Rules given by Bohr–Bury for the distribution of electrons:

- The maximum number of electrons present in a shell is given by the formula  $2n^2$ , where  $n$  is the orbit number or energy level index.  $n$  can have values from 1, 2, 3... and so on.
- Hence, the maximum number of electrons in different shells:  
First orbit or K-shell will be  $= 2 \times 1^2 = 2$   
Second orbit or L-shell will be  $= 2 \times 2^2 = 8$   
Third orbit or M-shell will be  $= 2 \times 3^2 = 18$   
Fourth orbit or N-shell will be  $= 2 \times 4^2 = 32$  and so on.
- Electrons are not accommodated in a higher shell unless all the inner shells are filled.

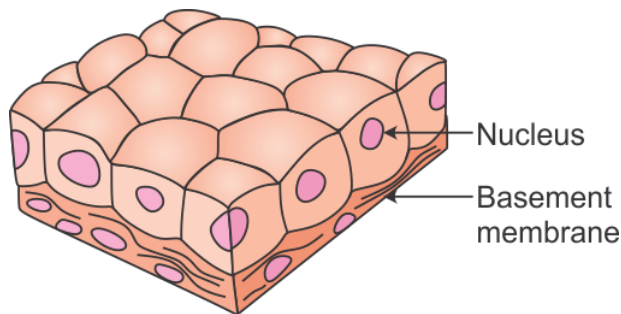
v. Characters of members of Class Amphibia:

- Amphibians live partly in freshwater and partly on land.
- Their skin is smooth, moist and without protective scales.
- They are cold-blooded.
- They have five-fingered limbs.
- They have a three-chambered heart.

vi. Simple squamous epithelium



Cuboidal epithelium



8.

i.

(a) Valency is the combining capacity of an atom. It is calculated by using the number of valence electrons present in an atom. The electrons present in the last shell of an atom which take part in chemical bond formation is known as valence electrons. The number of electrons which an atom has in its last orbit can be found out by writing the electronic configuration of an atom. So, the electronic configuration expresses the valence electrons which are related to the valency of an atom.

(b) Mass number = Number of protons + Number of neutrons

Hence, mass number of A =  $6 + 6 = 12$

mass number of B =  $6 + 8 = 14$

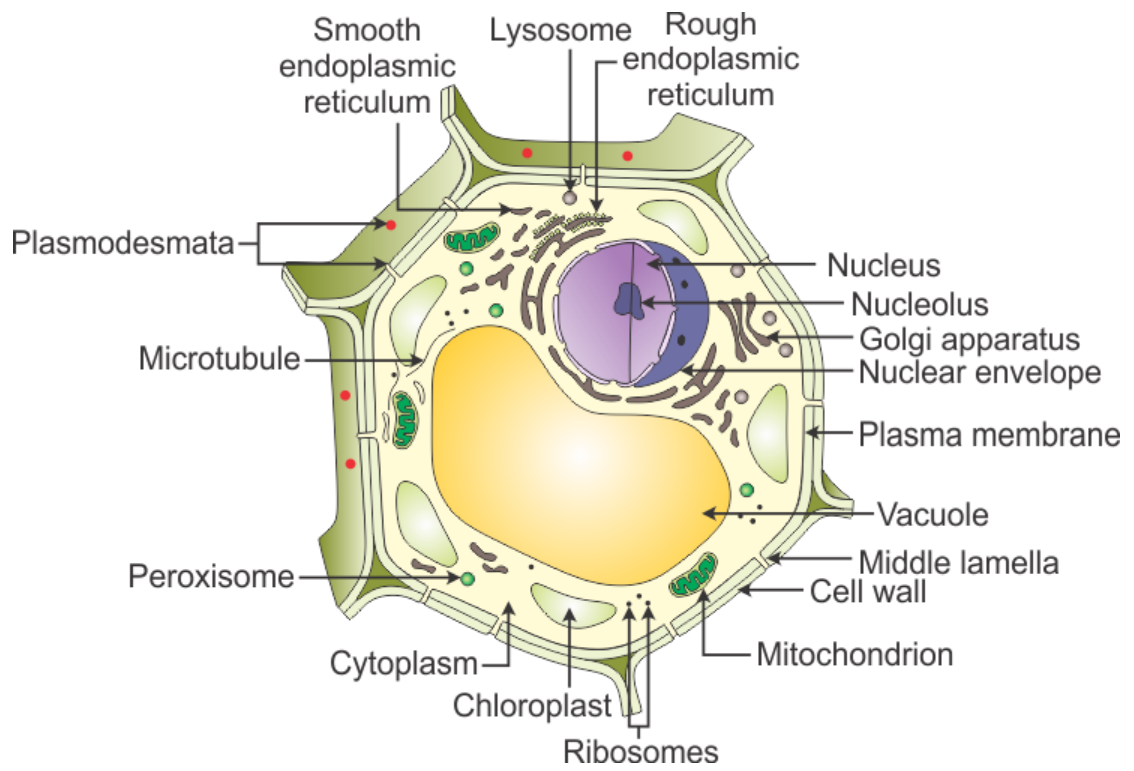
Two atomic species have the same number of protons but different number of neutrons.

In other words, the two species have the same atomic number but different mass number.

Such atoms are called isotopes.

The atoms A and B represent the same element carbon with atomic number 6.

ii.  
(a)



**Plant cell**

(b) Adenosine triphosphate molecules (ATP)  
Mitochondria release ATP