

Maharashtra State Board

Class IX Science and Technology

Sample Paper – 2

Solution

SECTION A

1.

(A)

(a)

- i. When you compress a spring, the potential energy of the spring **increases**.
- ii. The mass number of potassium and argon is 40; hence, they are known as **isobars**.
- iii. The slope of a distance–time graph indicates **speed** of a moving body.

(b)

- i. True.
- ii. True.

(B)

- i. **(d)** Fly off along the tangent to its circular path.
At any instance, the direction of velocity of the stone is along the tangent to the circle drawn at that point.
- ii. **(b)** πr , $2r$
Distance travelled in half of the circular track is equal to the circumference of the semi-circle.
 \rightarrow Distance travelled = $\frac{1}{2}(2\pi r) = \pi r$
Displacement of the cyclist is the distance between point A and point B, i.e. the diameter of the circular track.
 \rightarrow Displacement = $2r$
- iii. **(d)** Diffusion
Diffusion refers to the process by which different particles intermingle with each other as a result of their kinetic energy.
- iv. **(d)** amplitude
The loudness of sound depends on the amplitude of the sound. Thus, greater the amplitude of sound waves, louder the sound.
- v. **(b)** All the snakes will die
In a food chain consisting of grass, caterpillar, frog and snake, if all the frogs die because of poisoning, all the snakes will die.

2.

i.

Autotrophs	Heterotrophs
Organisms which can prepare their own food using inorganic material from the environment. Example: Green plants	Organisms which cannot prepare their own food and depend on others (producers) for their food. Examples: Animals, human beings
Autotrophs use CO ₂ and release O ₂ in the environment.	Heterotrophs use O ₂ and release CO ₂ in the environment.

ii. The slope of the velocity–time graph gives the value of acceleration.

$$\text{Here, slope} = \frac{20}{5} = 4 \text{ m/s}^2$$

i.e. Acceleration, $a = 4 \text{ m/s}^2$

Given that mass, $m = 200 \text{ g} = 0.2 \text{ kg}$

$$\text{Force} = \text{Mass} \times \text{Acceleration}$$

$$= 0.2 \times 4$$

$$\text{Force} = 0.8 \text{ N}$$

iii. SI unit of work is joule.

CGS unit of work is erg.

Relation between joule and erg:

$$1 \text{ joule} = 1 \text{ N} \times 1 \text{ m}$$

$$\text{But } 1 \text{ N} = 10^5 \text{ dyne}$$

$$\text{And } 1 \text{ m} = 100 \text{ cm} = 10^2 \text{ cm}$$

$$\text{Hence, } 1 \text{ joule} = 10^5 \text{ dyne} \times 10^2 \text{ cm}$$

$$= 10^7 \text{ dyne} \times \text{cm}$$

$$= 10^7 \text{ erg}$$

$$\text{Thus, } 1 \text{ joule} = 10^7 \text{ erg}$$

iv. A cork floats in water, while the iron nail sinks because the density of cork is less than that of water. Thus, the upthrust of water on the cork is greater than the weight of the cork. Hence, it floats.

On the other hand, the density of the iron nail is more than water, and the upthrust of water on the iron nail is less than that of the weight of the iron nail. Thus, it sinks.

v. There are 6.022×10^{23} iron atoms in one mole of iron.

$$2.4 \times 10^{24} \text{ iron atoms present in} = \frac{2.4 \times 10^{24}}{6.022 \times 10^{23}} = 4$$

Therefore, there are 4 moles of iron.

vi.

Colloid	Suspension
1. A colloid is a heterogeneous mixture in which the size of the particles is less than the size of the particles in a suspension.	1. A suspension is a heterogeneous mixture in which the size of the particles is more than the size of the particles in a colloid.
2. Both dispersed phase and dispersion medium are liquid.	2. The dispersed phase is solid and the dispersion medium is liquid.
3. The colloid particles cannot be seen with the naked eye.	3. The suspended particles can be seen with the naked eye.
4. A colloid is quite stable. The particles are spread uniformly throughout the solution.	4. A suspension is unstable. The solute particles do not dissolve but remain suspended in the solution.
5. Examples: Milk, smoke, blood	5. Examples: Mixture of sand and water, mixture of wheat flour and water

3.

i.

- Avogadro experimentally found that one mole of any substance always contained 6.022×10^{23} particles.
- This number is called Avogadro's number and is denoted by N_0 .
- 1 mole of a substance is equal to 6.022×10^{23} particles, i.e. atoms, molecules or ions of the substance.

$$1 \text{ mole (of anything)} = 6.022 \times 10^{23} \text{ in number}$$

- A mole is a word used to describe a collection of particles, i.e. atoms, molecules or ions.

Example:

How many molecules will be present in 2 grams of hydrogen gas (H_2)?

$$\begin{aligned} 1 \text{ mole of hydrogen molecules} &= \text{molecular mass of hydrogen} \\ &= 2 \text{ grams} \end{aligned}$$

We know that 1 mole of hydrogen molecules contains 6.022×10^{23} hydrogen molecules.

\therefore 2 grams of hydrogen gas will also contain 6.022×10^{23} hydrogen molecules.

Similarly, 18 grams of water contain 6.022×10^{23} molecules or 44 grams of carbon dioxide contain 6.022×10^{23} molecules.

ii.

Given that

$$P = 40 \text{ W}$$

$$t = 15 \text{ days} \times \frac{10 \text{ hours}}{\text{day}} = 150 \text{ hours}$$

Cost of energy consumed at the rate of Rs 3 per unit

Energy consumed = Power \times time

$$= 40 \text{ W} \times 150 \text{ hours}$$

$$= \frac{40 \times 150 \text{ kWh}}{1000}$$

$$= 6 \text{ kWh}$$

Energy consumed = 6 units

Thus, energy consumed by the bulb = 6 kWh = 6 units

Cost of using electricity = 6 units \times Rs 3 per unit = Rs. 18

Hence, the cost of using electricity is Rs. 18.

iii. SONAR is Sound Navigation and Ranging. It is the technique used to determine the distance and location of underwater objects such as submarines and icebergs using ultrasonic waves. It can be used to determine the depth of the sea. In SONAR, a transmitter and detector are installed on a ship. The transmitter produces and transmits ultrasonic waves which travel through water to the bottom of the sea. The reflected waves from the sea bed are received by the detector which converts them into an electrical signal. If t is the time recorded between the transmissions of waves, the time taken by the waves to cover the distance between the ship and the bottom of the sea is $t/2$. If v is the speed of the waves in seawater, then $d = v t/2$ gives the depth of the sea.



iv. The accumulation of harmful chemicals in the body of living organisms at different trophic levels in a food chain is called biological magnification.

Yes, the concentration of these harmful chemicals will be different at different levels of the ecosystem.

It will be maximum at the last trophic level, which is mostly the top carnivores (quaternary consumers).

v.

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}}$$

When area = 0.02 m² and pressure = 15000 N/m²

$$\begin{aligned}\text{Thrust} &= \text{Pressure} \times \text{Area} \\ &= 15000 \times 0.02\end{aligned}$$

$$\text{Thrust} = 300 \text{ N}$$

When thrust = 2000 N and area = 40 m²

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}} = \frac{2000}{40}$$

$$\text{Pressure} = 50 \text{ N/m}^2$$

Thrust (N)	Area (m²)	Pressure (N/m²)
<u>300</u>	0.02	15000
2000	40	<u>50</u>

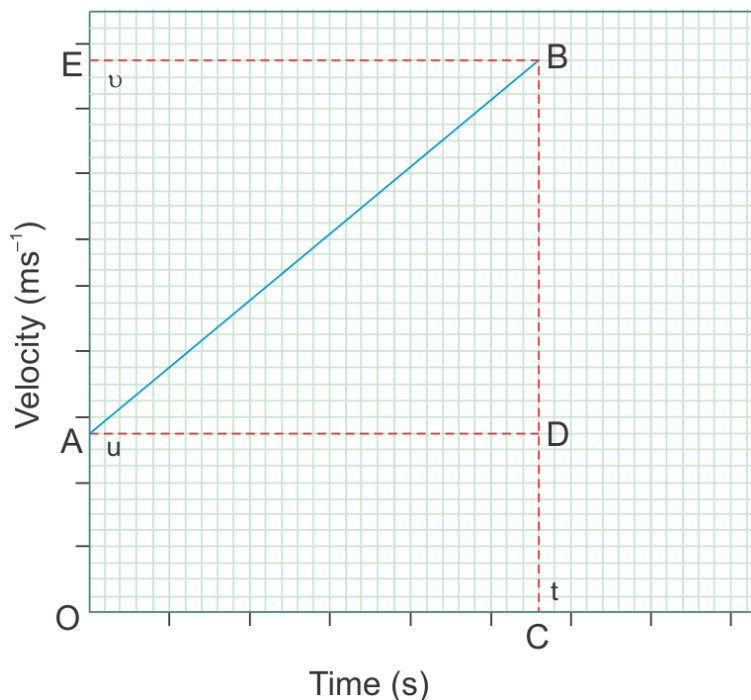
vi.

(a) Bacteria and fungi are examples of decomposers.

(b) Decomposers are essential components of the ecosystem. They decompose the dead remains of plants and animals and their waste organic products into simpler, inorganic substances. The latter are released into the environment for their reuse as raw material by the producers. These therefore provide space for new life to settle in the biosphere.

4.

i.



At $t = 0$, the initial velocity is u and then it increases to v (at point B) in time t .

- (a) Draw a perpendicular line BC and BE from point B on the time and velocity axis, respectively, so that $OA = u$, $OE = BC = v$. Also draw a line AD parallel to the time axis, so that $OC = AD = t$. Then the change in velocity in time t is $BC - OA = BC - CD = BD$. But $BC = v$ and $CD = OA = u$. Hence, $BD = v - u$.

From the velocity-time graph, the acceleration of the object is

$$a = \frac{\text{Change in velocity}}{\text{Time taken}} = \frac{BD}{AD} = \frac{BD}{OC} = \frac{v - u}{t}$$

$$\therefore at = v - u$$

$$v = u + at$$

- (b) According to the velocity-time graph, the total distance covered by the object is obtained by the area under the graph. Hence, the distance 's' travelled by the object is

$$\begin{aligned} \text{Distance } s &= \text{Area of the trapezium OABC} \\ &= \text{Area of the rectangle OADC} + \text{Area of ADB} \\ &= OA \times OC + \frac{1}{2} (AD \times BD) \end{aligned}$$

$$\text{But } OA = u, OC = t$$

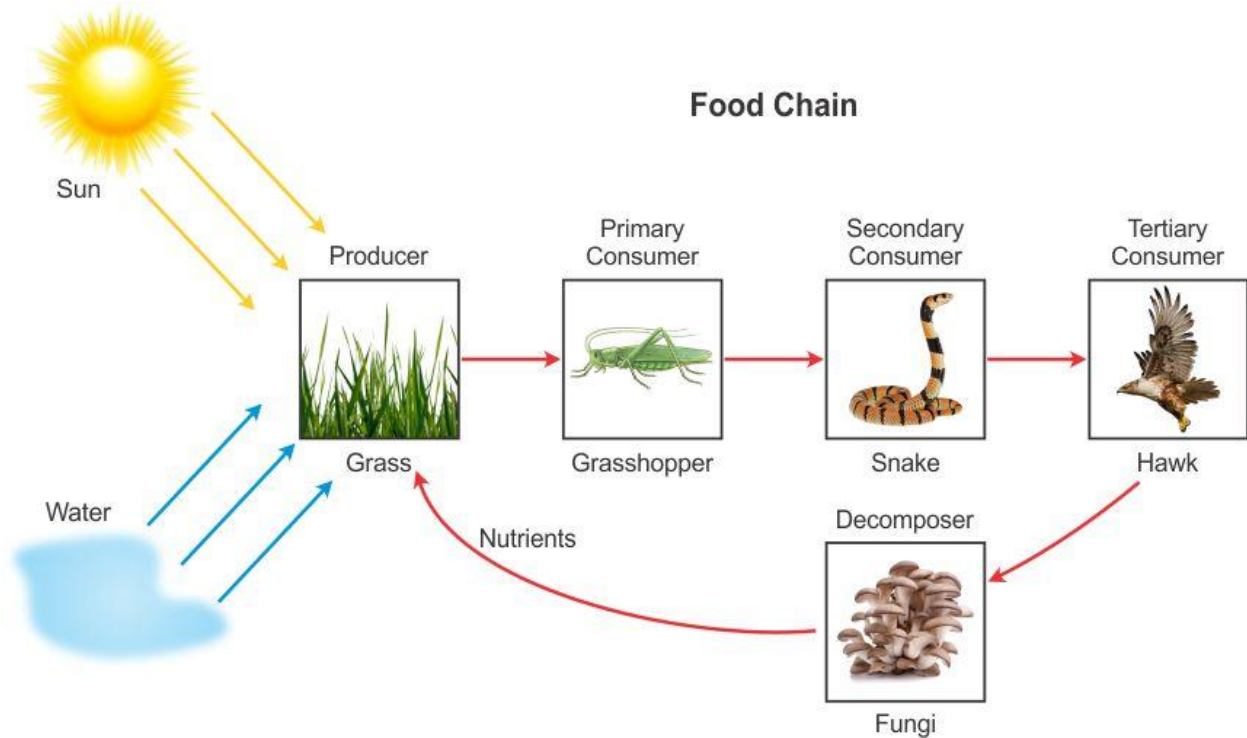
$$\therefore AD = OC = t$$

$$BD = \text{Change in velocity} = v - u = at$$

$$\rightarrow s = ut + \frac{1}{2} (at \times t)$$

$$\rightarrow s = ut + \frac{1}{2} at^2$$

ii. The sequential process of eating and being eaten is called a food chain.



All food chains begin with green plants or producers. So, the plants or the producers constitute the first trophic level. Example: Grass

The herbivores or primary consumers which feed on plants constitute the second trophic level. Example: Grasshopper

The herbivores are next fed upon by the carnivores or secondary consumers. They constitute the third trophic level. Example: Snake

Finally, the large carnivores, also called the top carnivores or tertiary consumers, form the fourth trophic level. Example: Hawk

The large carnivores die and form the feed of decomposers. The decomposers feed on these dead animals and plants. Example: Fungi

There is transfer of food from one organism to the other forming a chain.

SECTION B

5.

(A)

(a)

i. Arsenic

Arsenic is a metalloid, whereas the others are metals.

ii.

(b)

Column A	Column B
i. Apiculture	(c) Honey bees
ii. Pisciculture	(b) Fish
iii. Sericulture	(d) Silkworms

(B)

i. **(d)** Smallest cell is that of *Mycoplasma gallisepticum* which is about 0.1 μm in diameter

The largest known cell is an ostrich egg which is 18 cm in diameter, while the smallest cell is that of *Mycoplasma gallisepticum* which is about 0.1 μm in diameter.

ii. **(a)** Voluntary, and show the presence of alternating light and dark striations under the microscope

The skeletal muscles are attached to the bone and help in body movement. These cells are voluntary and they show the presence of alternating light and dark striations under the microscope.

iii. **(b)** Layers for laying eggs and boilers for meat

Poultry farming involves the rearing of fowl for meat and eggs. The different types of fowls include layers for laying eggs and boilers for meat.

iv. **(c)** Choked sewers because of solid waste such as plastic bags

On 26th July 2005, Mumbai suffered heavy floods. The main cause for this was choked sewers because of solid waste such as plastic bags.

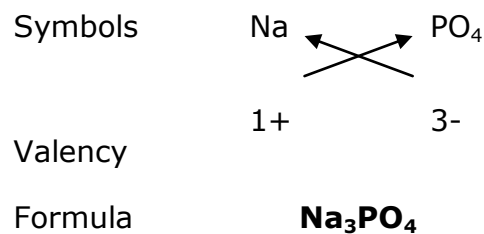
v. **(b)** displacement

This is an example of single displacement reaction as iodine gets displaced by chlorine.

[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. Formula of sodium phosphate



The formula of sodium phosphate is Na₃PO₄.

ii. Hazards of e-waste:

- E-waste contains metals such as mercury and lead which pollute the soil and water and are toxic for the organisms living there.
- E-waste contains plastic which is non-biodegradable and accumulates, thus polluting the environment.
- Mercury in e-waste causes mercury poisoning in humans.

iii. Gaseous waste produced in cement industries consists of fly ash. It consists of fine solid particles of non-combustible ash carried out of a bed of solid fuel by a draft. It can be used to make a variety of building materials such as bricks, concrete and roofing sheets.

iv.

- A black surface absorbs about 98% of the incident heat radiation falling on it.
- This increases the temperature of the contents in the solar cooker about to 140°C, and hence, the food is cooked properly.
- Thus, we paint the outer side of the container of a solar cooker with black paint.

v. Functions of lysosomes:

- Intracellular digestion
- Destroy foreign substances
- Rapidly destroy organelles when the cell is old or injured
- Formation of bones by digesting cartilages

vi. Malaria is caused by the protozoan parasite *Plasmodium*. When a female Anopheles mosquito bites a healthy person, the parasite enters the blood, and the person suffers from malaria.

The diseases caused by protozoa are sleeping sickness and amoebic dysentery.

7.

i.

(a) Mass number = No. of protons + No. of neutrons

So, mass number of X = $17 + 18 = 35$

Mass number of Y = $17 + 20 = 37$

X and Y are isotopes of the same element because the number of protons is the same (same atomic number) in both.

(b) Numbers of electrons = 6

K	L
2	4

Name of the element = Carbon with atomic number 6

ii.

(a) Classification of diseases on the basis of the extent of occurrence:

- Endemic diseases
- Epidemic diseases
- Pandemic diseases
- Sporadic diseases

(b) Pandemic disease: When the occurrence of the disease is worldwide, it is known as a pandemic disease. Example: AIDS

Sporadic disease: When a disease occurs in a single, scattered case, it is known as a sporadic disease. Examples: Malaria, cholera

iii. A neuron consists of three parts—cyton, dendrites and axon.

The cyton is also called the cell body. It is the broad part of the neuron and contains a central nucleus and cytoplasm. From the cyton arises several thin, short, branched processes called dendrites. The axon is a single, long, cylindrical process arising from the cyton.

iv. Phylum Arthropoda:

- Their body is divided into head, thorax and abdomen.
- Appendages are jointed.
- They are triploblastic, bilaterally symmetrical organisms with a reduced body cavity.
- Members of Phylum Arthropoda have a complete digestive system and an open circulatory system.
- In Arthropods, respiration takes place via the body surface, gills, trachea or book lungs.
- They have paired excretory glands, and some have excretory organs called Malpighian tubules.

(any three)

v.

Plant cell	Animal cell
Plant cells have an outer, rigid cell wall.	Animal cells lack a cell wall.
Plastids are present.	Plastids are absent.
Large, central and permanent vacuole is present.	Small and many vacuoles are present. These may be temporary.
Generally larger than the animal cell.	Animal cell is smaller.

vi.

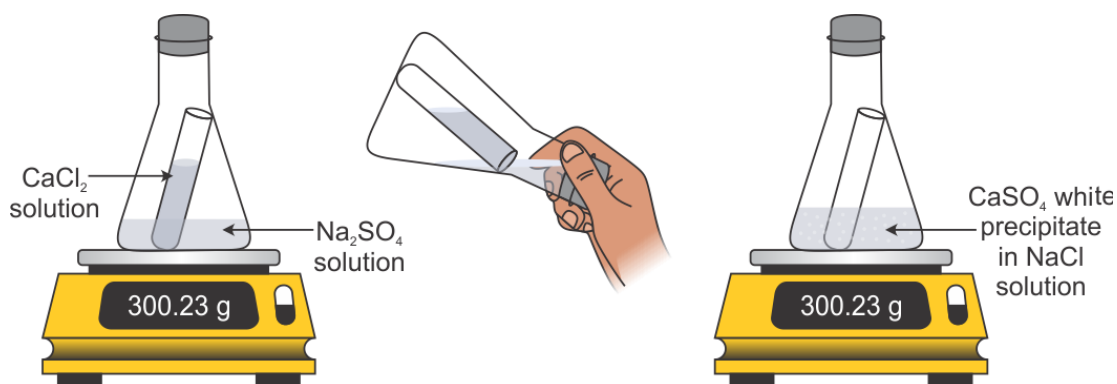
- Human cells have a well-defined nucleus, enclosed by a nuclear membrane.
- They contain several lengths of genetic material (DNA) wound around certain proteins.
- They contain several cell organelles such as mitochondria, endoplasmic reticulum and Golgi body.
- They contain larger ribosomes.
- Because human cells possess all the characteristics of a eukaryotic cell, humans are eukaryotic organisms.

8.

- i. **Principle:** Law of conservation of mass states that mass can neither created nor destroyed in a chemical reaction.

Total mass of the reactant = Total mass of the product

Diagram:



Technique:

- Take a solution of calcium chloride in a flask labelled A and a solution of sodium sulphate in a test tube labelled B.
- Tie a thread to the test tube and carefully lower it in the flask. Cork the flask to make it airtight.
- Weigh the flask on a balance. It weighs 300.23 grams.
- Tilt and swirl the flask and allow the contents of the test tube to come in contact with the contents of the flask.

Observation:

- Calcium chloride reacts with sodium sulphate to form a white precipitate of calcium sulphate and a solution of sodium chloride.
- Weigh the flask again. There will be no change in the weight of the flask. It again weighs 300.23 grams.

Conclusion:

- When chemical reactions are carried out in a closed container, there is no change in the mass.
- The total mass of the reactants is equal to the total mass of the products.

ii.

Characteristics	Chondrichthyes	Osteichthyes
Endoskeleton	Commonly known as cartilaginous fish as they have a cartilaginous endoskeleton.	Commonly known as bony fish as they have a bony endoskeleton.
Body size	Large-sized fish	Comparatively smaller
Mouth position	Ventral	Terminal (anterior)
Type of scales	Placoid scales	Scales absent; cycloid scales if present
Number of gills present	5–7 pairs of gills, not covered by operculum	4 pairs of gills, covered by operculum
Caudal fin	Heterocercal	Homocercal
Excretory waste	Urea	Ammonia