
CBSE Class 09 Science
Sample Paper 01 (2019-20)

Maximum Marks: 80

Time Allowed: 3 hours

General Instructions:

- i. The question paper comprises three sections - A, B and C. Attempt all the sections.
 - ii. All questions are compulsory. Internal choice is given in each section.
 - iii. All questions in Section A are one-mark questions comprising MCQ, VSA type and assertion-reason type questions. They are to be answered in one word or in one sentence.
 - iv. All questions in Section B are three-mark, short-answer type questions. These are to be answered in about 50 - 60 words each.
 - v. All questions in Section C are five-mark, long-answer type questions. These are to be answered in about 80 – 90 words each.
 - vi. This question paper consists of a total of 30 questions.
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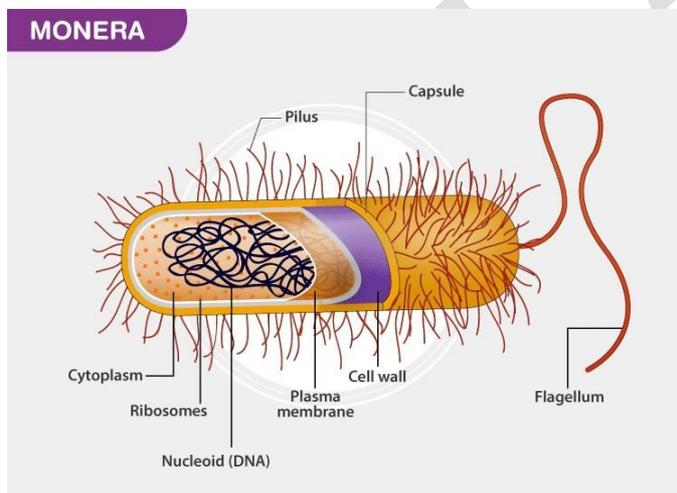
Section A

1. What is the maximum number of electrons which can be accommodated in 'N' shell?
2. What is the atomicity of ammonia?
3. **Cattle Breeding** Cross-breeding helps in the development of certain desired characteristics in animals like, Increased milk production, Resistance against diseases, Breeds that require less amount of quality feed.
Exotic breed cattle (long lactation) are interbred with the locally bred cattle (high resistance to the diseases) to produce high quality bred that contain both the characteristics. In order to obtain a good quality of milk from the cattle, it is important to manage shelter, food, breeding and disease control of cattle. Cattle are prone to various internal and external parasites, bacteria and virus which are likely to affect their milk production. Animals that produce milk are called **milch animals** (the females of the herd). Animals that are used for carrying out agricultural work like tilling, carting etc. are called **draught animals** (males and the females that are poor in milk-yielding varieties).



Answer the following questions:

- i. What are milch animals?
 - ii. What are the draught animals?
 - iii. How does cross-breeding help in cattle breeding?
 - iv. Mention the preconditions for a good yield of milk?
4. Kingdom Monera belongs to the prokaryote family. The organisms belonging to this kingdom do not contain a true nucleus. These are the oldest known microorganisms on earth. Their DNA is not enclosed within the nucleus. They are unicellular organisms found mostly in a moist environment. They are found in hot springs, snow, deep oceans or as parasites in other organisms. The monerans do not possess any membrane-bound organelles.



Answer the following questions:

- i. Why does the DNA of Monerans is not enclosed within the nucleus?
 - ii. Why are they regarded as primitive organisms?
 - iii. Where are they found commonly?
 - iv. Give the unique characteristics of Monerans.
5. Rocket works on the principle of _____.
- a. Newton's third law

- b. Newton's second law
- c. Newton's fourth law
- d. Newton's first law

OR

“Action and reaction are equal and opposite but even then they do not cancel each other” the above statement is

- a. partially false.
 - b. false
 - c. partially true
 - d. true
6. To compare the pressure exerted by the solid iron cuboid, a student took two cuboids having the same dimension and same nature of material. After performing the experiment with both the cuboids, she found
- a. $p_1 = 2p_2$
 - b. $p_2 = 3p_1$
 - c. $p_1 = p_2$
 - d. $p_2 = 2p_1$
7. In a watch P. E of wound spring is converted into
- a. Chemical energy
 - b. Kinetic energy
 - c. Mechanical energy
 - d. Electrical energy
8. The frequency of sound is 100 Hz. How many times does it vibrate in a minute?
- a. 6000 Hz
 - b. 600 Hz
 - c. 5000 Hz
 - d. 60 Hz

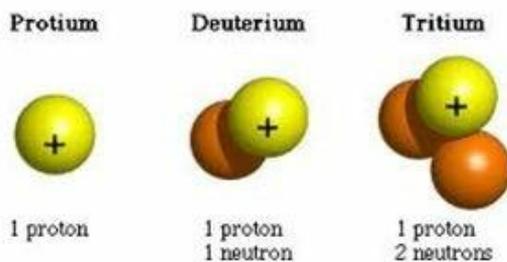
OR

What do we call the gravitational force between the earth and an object?

9. Which one of the following is a leguminous green fodder commonly available in

winter?

- a. Elephant grass
 - b. Cowpea
 - c. Rice and Jowar
 - d. Berseen and lucerne
10. What will be the boiling point of water at the top of a mountain where the atmospheric pressure is less than 1 atm?
- a. Less than 100°C
 - b. Exactly 373 K
 - c. 100°C
 - d. More than 100°C
11. Which one of the following is not a viral disease?
- a. AIDS
 - b. Typhoid
 - c. Influenza
 - d. Dengue
12. The nuclei of the three isotopes of hydrogen are as follows:



Which of these three isotopes of hydrogen shown above is found in nature?

- a. Deuterium
- b. Protium
- c. Tritium
- d. Protium, Deuterium and Tritium

OR

Match the following with correct response.

-
- (1) Boiling point of water
 - (2) Melting point of water
 - (3) Boiling point of Acetone
 - (4) Melting point of Aluminium

- (A) $660^{\circ}C$
- (B) 273K
- (C) 373K
- (D) $56^{\circ}C$

- a. 1-B, 2-D, 3-A, 4-C
- b. 1-D, 2-A, 3-C, 4-B
- c. 1-C, 2-B, 3-D, 4-A
- d. 1-A, 2-C, 3-B, 4-D

13. **Assertion:** We feel cool when we touch a piece of ice.

Reason: Our body temperature is higher than the temperature of ice.

- 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.

14. **Assertion:** Motion of satellites around their planets is considered as accelerated motion.

Reason: During their motion, the speed remains constant, while the direction of motion changes continuously.

- 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.

15. What factors may be responsible for losses of grains during storage?
16. Calculate the mass percentage of oxygen present in the following compounds and state the law of chemical combination associated. Given, H=1, O=16.
- (i) Water (H_2O) and (ii) Hydrogen peroxide (H_2O_2)

OR

If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

17. If an electric iron of 1200 W is used for 30 minutes every day, find the electric energy consumed in the month of April.
18. i. The circulation of carbon is important in nature. Give reasons for your answer.
ii. Explain any two processes involved in the cycling of nitrogen in the environment.

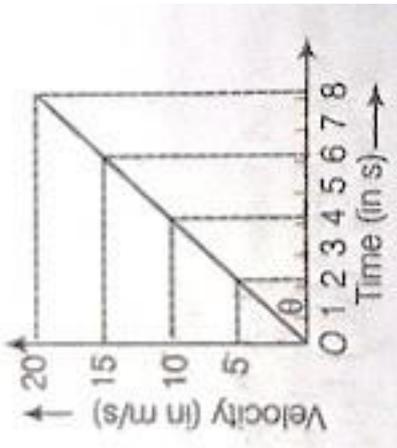
OR

While driving in the countryside, Kapil saw square panels attached on the street lights along the road. He found out that these were photovoltaic solar panels which tapped solar energy and converted it to electrical energy to make the street lights function. He liked this idea so much that he got similar solar panels installed at his residence also.

Answer the following questions based on the above information:

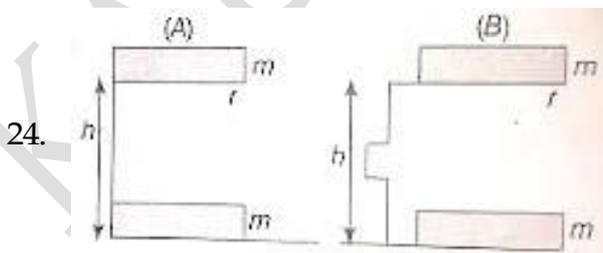
- i. In what respect is the installation of solar panels useful to Kapil?
- ii. Which values is Kapil promoting by installing solar panels?
- iii. How can Kapil promote similar values to others in the neighbourhood?

19. Where will you find more number of ribosomes-in cancer cells or in fat cells?
20. Differentiate between voluntary and involuntary muscles. Give one example of each.
21. Write the steps you would use for making tea. Use the words solution, solvent, solute, dissolve, soluble, insoluble, filtrate and residue.
22. A solid weighs 15 gm in air and 13 gm when completely immersed in a liquid of relative density 0.8. Find
- the volume of solid
 - the relative density of solid.
23. The motion of a body of mass 5 kg is shown in the velocity-time graph.



Find from the graph

- The acceleration.
- The force acting on the body.
- The change in momentum of the body in 2 s after the start.



- What is meant by potential energy of a body?
- A body of mass m is raised to a vertical height h through two different paths A and B.

What will be the potential energy of the body in the two cases? Give reason for your answer.

OR

Complete the following table.

Element	Atomic Number	Protons	Element	Neutrons	Mass Number
A	17		17	18	
B		14	14	14	
C		9	9		19

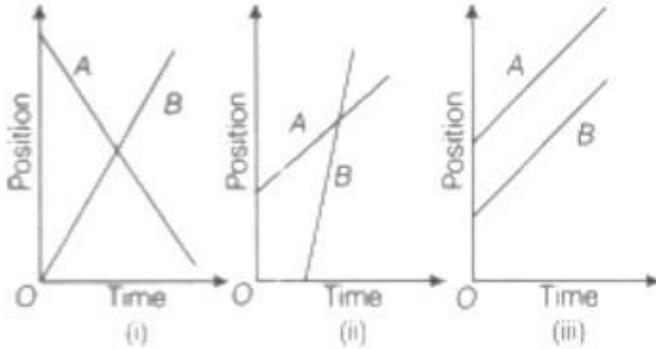
25. i. Distinguish among the true solution, suspension and colloid in a tabular form under the following heads:
- Stability
 - Filterability
 - Type of mixture
- ii. Give the expression for the concentration of a solution. How will you prepare a 10% solution of glucose by mass in the water?

OR

Which separation techniques will you apply for the separation of the following?

- Sodium chloride from its solution in water.
- Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.
- Small pieces of metal in the engine oil of a car.
- Different pigments from an extract of flower petals.
- Butter from curd.
- Oil from water.
- Tea leaves from tea.
- Iron pins from sand.
- Wheat grains from husk.
- Fine mud particles suspended in water.

26. The position-time graphs of two objects A and B in three different situations for a particular duration are shown as below:



- i. In which situation the distance between them will remain same?
 - ii. In which situation they are moving in opposite directions?
 - iii. Is the velocity of object A positive or negative in situation (ii)?
 - iv. Are they crossing each other in any situation (s)? If so, why?
27.
 - i. Describe adipose tissue with the help of diagram.
 - ii. How is adipose tissue different from blood tissue?
28. A person is suffering from watery diarrhoea, effortless vomiting without nausea and loss of several litres of fluid takes place within hours.
- i. Name the disease and its causal organism.
 - ii. Suggest some preventive measures to avoid this disease.
 - iii. Can the spread of this disease be controlled? If yes, how?

OR

Give the point of differences between non-chordates and chordates.

29.
 - i. Write the formula to find the magnitude of the gravitational force between the earth and an object on the earth's surface.
 - ii. Derive how does the value of gravitational force F between two objects change when
 - a. distance between them is reduced to half and
 - b. mass of an object is increased four times.
30. If $Z = 3$, what would be the valency of the element? Also, name the element.

OR

i. One mole of carbon atoms weighs 12 g. Find the mass of 1 atom of carbon in grams

[Avogadro's number = 6.022×10^{23} per mole]

ii. Calculate the mass of the following:

a. 0.5 mole of N_2 gas

b. 0.2 mole of O -atoms

c. 4 moles of aluminium atom

[Given, N = 14 u, O = 16 u, Al = 27 u,

Avogadro's number = 6.022×10^{23} per mole]

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Solution

Section A

1. The maximum number of electrons present in a shell is given by the formula $2n^2$, where 'n' is the orbit number or the energy level (1, 2, 3, ...)

The value of n for N shell is 4. So, the maximum number of electrons = $2 \times (4)^2 = 2 \times 16 = 32$

N shell (n = 4) can accommodate a maximum of **32 electrons**.

2. Atomicity of ammonia (NH_3) is 4 because one molecule of NH_3 has 1 nitrogen atom and 3 hydrogen atoms.
3. i. Animals that produce milk are called **milch animals** (the females of the herd).
ii. Animals that are used for carrying out agricultural work like tilling, carting etc. are called **draught animals** (males and the females that are poor in milk-yielding varieties).
iii. Cross-breeding helps in the development of certain desired characteristics in animals like,
a. Increased milk production,
b. Resistance against diseases.
c. Breeds that require less amount of quality feed.
iv. In order to obtain a good quality of milk from the cattle, it is important to manage shelter, food, breeding and disease control of cattle.
4. i. The DNA of Monerans is not enclosed within the nucleus because they do not have a true nucleus.
ii. They are regarded as primitive organisms due to the absence of a true nucleus.
iii. They are found in hot springs, snow, deep oceans, or as a parasite in other organisms.
iv. The unique characteristics of Monerans as follows:
a. Absence of true nucleus,

- b. Found in a moist environment,
- c. Do not possess any membrane-bound organelles.

5. (a) Newton's third law

Explanation: Newton's third law of motion is: For every action, there is an equal and opposite reaction.

OR

(b) false (d) true **Explanation:** Action and reaction are equal and opposite but even they do not cancel each other because they act in opposite directions and on two different bodies. Hence the statement is correct.

6. (c) $p_1 = p_2$

Explanation: $P_1 = P_2$ as dimensions and material of cuboid are same. Force exerted by each cuboid having same area of contact is same.

7. (b) Kinetic energy

Explanation: A wound up watch spring has elastic potential energy due to its wound up state. As the spring unwinds, the PE stored in it changes into kinetic energy which does work in moving the hands of the watch.

8. (a) 6000 Hz

Explanation: Frequency of sound is the number of vibrations per second.

Here, frequency = 100 Hz. One minute = 60 seconds.

So, number of vibrations in one minute = $60 \times 100 = 6000$ Hz.

OR

It is called force of gravity.

9. (d) Berseem and lucerne **Explanation:** There are certain fodder crops like berseem, lucerne, turnip, etc. which can be grown with adequate moisture while in others the production potential can be realized fully with irrigation. Lucerne is adapted to relatively dry conditions and it may tolerate heat as well as cold. The best sowing time of the crop is mid-October to early November.

10. (a) Less than 100°C

Explanation: At an atmospheric pressure of exactly 760 mm Hg (1 atm), the

temperature at which a liquid boils is called the normal boiling point of the liquid. For water, the vapour pressure reaches the standard atmospheric pressure of 1 atmosphere at 100°C. So the normal boiling point of water is 100°C (212°F or 373K). As the altitude increases, the boiling point of water reduces. The boiling point of water at a high altitude is less than 100 degrees. So, boiling point of water at the top of a mountain where the atmospheric pressure is less than 1 atm less than 100 degrees.

11. (b) Typhoid **Explanation:** Typhoid, fever, cholera, tuberculosis, anthrax are caused by Bacteria. Common cold, influenza, dengue, fever, AIDS are caused by viruses.
12. (d) Protium, Deuterium and Tritium
Explanation: Hydrogen (Protium) -1, Deuterium -2, Tritium -3 are three isotopes of hydrogen.

OR

(c) 1-C, 2-B, 3-D, 4-A

Explanation:

(1) Boiling point of water - (C) 373K ($373-273 = 100^\circ \text{C}$)

(2) Melting point of water - (B) 273K ($273-273 = 0^\circ \text{C}$)

(3) Boiling point of Acetone - (D) 56°C

(4) Melting point of Aluminium - (A) 660°C

13. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Explanation: If two objects have different temperatures, heat will flow from the warmer object to the colder one. When we touch ice we feel cold because of the melting and evaporation of the ice. When we touch the ice, the ice quickly absorbs the heat of our hand, melts and evaporates with the heat. So we feel cold when we touch the ice.

14. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Explanation: Satellites revolve around their planets in almost circular orbits with constant speed. Thus, during their motion, the speed remains constant, while the

direction of motion changes continuously. As a result, there is a change in their velocity. Therefore, the motion of satellites around their planets is considered as accelerated motion.

15. **Factors that may be responsible for losses of grains during storage are:-** abiotic factors: Unfavourable conditions of humidity and temperature.

biotic factors: Insects, rodents, bacteria, fungi etc that feed on grains.

16. According to Law of chemical combination;

(i) Atomic mass of hydrogen atom = 1u

Atomic mass of oxygen = 16u

molecular mass of Water (H_2O) = $1 \times 2 + 1 \times 16 = 18u$

the mass percentage of oxygen present in the Water (H_2O) = (mass of oxygen in Water (H_2O)/molecular mass of Water (H_2O)) $\times 100$

$$= (16/18) \times 100$$

$$= 88.89\%$$

(ii) Hydrogen per oxide (H_2O_2)

Atomic mass of hydrogen atom = 1u

Atomic mass of oxygen = 16u

molecular mass of $H_2O_2 = 1 \times 2 + 16 \times 2 = 2 + 32 = 34u$

the mass percentage of oxygen present in the $H_2O_2 =$ (mass of oxygen in H_2O_2 / molecular mass of H_2O_2) $\times 100$

$$= (16/34) \times 100$$

$$= 47.05\%$$

the mass percentage of oxygen present in the $H_2O_2 = 47.05\%$

OR

K shell ($n = 1$) can accommodate a total 2 electrons ($2n^2$ electrons). L shell ($n = 2$) can accommodate a maximum 8 electrons ($2n^2 = 2 \times 2^2 = 8$ electrons).

If K and L shells of an atom are full, then the total number of electrons in the atom will be $2 + 8 = 10$.

17. Given, Power of electric iron, $P = 1200 \text{ W} = \frac{1200}{1000} = 1.2 \text{ kW}$
Time, $t = \frac{30}{60} = 0.5 \text{ h}$

Electric energy consumed in a day = Power \times time = $(1.2 \times 0.5) \text{ kWh}$

Electric energy consumed in month of April (i.e. 30 days), $E = (1.2 \times 0.5) \times 30 = 18 \text{ kWh}$.

18. i. Circulation of carbon is important in nature because it moves carbon, a life-sustaining element from the atmospheres, etc., into organisms and vice versa. If the balance between these two is disturbed it leads to serious consequences, such as global warming.
- ii. Two processes involved in the cycling of nitrogen are
- Nitrogen-fixation:-** The first step of nitrogen cycle involves nitrogen-fixation. In this process, inert nitrogen molecules are converted to nitrates or nitrites by nitrogen-fixing bacteria.
 - Ammonification:-** It is the process of production of ammonia (compound of nitrogen). It occurs by the decomposition of dead plants and animals.

OR

- Conservation of energy, financial savings, conservation of natural resources.
- Environmental care, savings, promotion of use of alternative sources of energy.
- Creating awareness about advantages of use of renewable sources of energy, motivating the neighbours for use of technology for better quality of living.

19. Ribosomes are found in greater number in actively dividing cells which are the cancer cells as they need more amount of proteins for the formation of new cells.

20.

Voluntary Muscles	Involuntary Muscles
The voluntary muscles can be moved according to our conscious will.	The involuntary muscles do not move according to our will.
These muscles are mostly attached to the bones and help in body movement. Hence, they are also called skeletal muscles.	These muscles are mostly attached to visceral organs like the alimentary canal.
They show striation (alternate light and dark bands); hence, they are also called striated muscles.	They do not show striation; hence, also called smooth muscles or unstriated muscles.
The cells of this tissue are cylindrical.	The cells of this tissue are long with pointed ends (spindle-shaped).
E.g. Muscles of the limbs	E.g. Muscles of the heart / Iris of the eye

21. Steps that would be used for making tea are as follows:-

(1) The **solvent** used for making tea is water. Take some amount of **solvent** in a pan and heat it over a burner.

(2) After the solvent is sufficiently warm, add a little amount of sugar to the **solvent**. Sugar is used as a **solute** to provide a sweet taste to the **solvent**.

(3) The **solute** will dissolve completely in the **solvent** and form a true **solution**.

(4) Add some tea leaves to the true **solution**. The chemical substances present in the tea leaves are soluble and will **dissolve** in the solution.

(5) Pour some milk into the pan. The milk will **dissolve** in the **solution**.

(6) Bring the **solution** to a boil and switch off the burner. The tea leaves will remain **insoluble** in the **solution**.

(7) Filter the **solution** with a strainer to separate the **insoluble** tea leaves.

(8) After filtration, the tea **solution** will be obtained as a **filtrate**. The tea leaves that remain as **residue** can be thrown away.

22. i. Let V be the volume of the solid.

Weight of liquid displaced = volume of the liquid displaced density of liquid $g = V \times 0.8 \text{ gm}$

Loss in weight of the solid when immersed in liquid = $15 - 13 = 2 \text{ gm}$

But the weight of the liquid displaced is equal to the loss in weight of solid when immersed in liquid.

Therefore, $v \times 0.8 = 2$ or $V = \frac{2}{0.8} = 2.5 \text{ cm}^{-3}$

ii. density of solid = $\frac{\text{mass}}{\text{Volume}} = \frac{15}{2.5} = 6 \text{ gcm}^{-3}$.

Hence relative density of solid is 6.

23. i. Acceleration = Slope of the line of the velocity-time graph,

$$a = \frac{v_2 - v_1}{t - t_1} = \frac{5 - 0}{2 - 0} = \frac{5}{2} = \frac{10}{4} = \frac{15}{6} = 2.5 \text{ m/s}^2$$

ii. The force acting on the body is given by

$$F = ma = 5 \times 2.5 = 12.5 \text{ N}$$

iii. \therefore Change in momentum = $mv - mu$ [$\because u = 0$ and $v = 5 \text{ m/s}$]

$$= 5 \times 5 - 5 \times 0$$

$$= 25 \text{ kg-m/s}$$

24. i. Energy possessed due to the position of a body is called potential energy.

ii. The work done against gravity in both cases is mgh . It is independent of the path along which the body is moved and it depends only on the initial and final positions of the body.

OR

A: Atomic number = Number of protons = 17;

Mass number = Number of protons + number of neutrons

$$= 17 + 18 = 35$$

B: Atomic number = Number of protons = 14;

Mass number = Number of protons + number of neutrons

$$= 14 + 14 = 28$$

C: Atomic number = Number of protons = 9;

Mass number = Number of protons - number of neutrons

$$= 19 - 9 = 10$$

Element	Atomic Number	Protons	Element	Neutrons	Mass Number
A	17	17	17	18	$17 + 18 = 35$
B	14	14	14	14	$14 = 14 = 28$
C	9	9	9	$19 - 9 = 10$	19

25. i. Distinctions between true solution, suspension and colloid are:

Property	Solution	Suspension	Colloid
Stability	It is stable. Constituting particles do not settle down on keeping undisturbed.	It is unstable. Constituting particles settle down on keeping undisturbed.	It is quite stable. Constituting particles do not settle down on keeping undisturbed.
Filterability	Particles cannot be separated by filtration. Means passes through filter paper.	Particles are large, so they can be easily separated by ordinary filtration. Means do not pass through filter paper.	It cannot be separated by ordinary filter paper but can be separated by ultrafiltration. Means passes through filter paper.
Type of mixture	Homogeneous	Heterogeneous	Heterogeneous but appears to be homogeneous.

ii. Concentration is defined as the number of moles (amount of substance) per unit volume (often liters/ dm^3)

The methods by which the concentration of a solution can be expressed are:

a) Mass by mass% of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

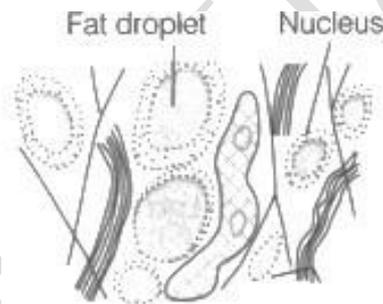
b) Mass by volume % of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

Thus, a 10 per cent solution of glucose can be prepared by dissolving 10 g of

glucose in 90 g of water.

OR

- i. Evaporation and crystallization
 - ii. Sublimation
 - iii. Filtration
 - iv. Chromatography
 - v. Centrifugation
 - vi. By using separating funnel
 - vii. Filtration
 - viii. Magnetic separation
 - ix. Winnowing
 - x. Loading and decantation
26. i. In the graph (iii), the distance between them will be same.
ii. In the graph (i), they are moving in opposite directions.
iii. Velocity of object A is positive in situation (i) because the slope of s-t graph is positive.
iv. Yes, in situations (i) and (ii) they are crossing each other because in these two cases, the s-t graph of A and B intersect each other.
27. i. Digrammatic representation of Adipose tissue



Adipose tissue is a fat-storing connective tissue. Its matrix is packed with large oval fat cells or adipocytes. The fat cells are arranged into globules separated by collagen and elastic fibres. It mainly stores reserve fat. It acts as an insulator and works as a shock absorber for visceral organs. It acts as shock-absorbing cushions around the heart, kidneys, eyeball, etc.

- ii. Differences between adipose and blood tissue are as follows:

--	--

Adipose Tissue	Blood Tissue
1. Adipose tissue is a type of loose connective tissue located mainly beneath the skin.	1. Blood tissue is a fluid connective tissue containing the plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets.
2. The matrix contains fibres.	2. The matrix does not contain fibres.
3. It stores and metabolises fats.	3. It helps in the transport of substances and respiratory gases.

28. i. The person is suffering from cholera and it is caused by bacterium *Vibrio cholerae*.
- ii. Preventive measures to avoid this disease are:
- Boiled water and cooked food should be taken in cholera prone areas. Good personal hygiene and proper sanitation in the community is necessary for protection against cholera.
 - People should be immunised by cholera vaccine. One dose of immunisation lasts for about six months.
- iii. Control measures for this disease are:
- For prevention, dehydration therapy with ORS (Oral Rehydration Solution) should be done.
 - Antibiotics such as tetracycline kill the bacteria of cholera.

OR

Non-chordates	Chordates
1. Vertebral column is absent. 2. Central nervous system is solid and ventral. 3. If heart is present, it is dorsal. 4. Haemoglobin, if present is dissolved in plasma. 5. The anus is posterior, so no post-anal tail. e.g., Protozoa, Arthropoda, Annelida.	1. Vertebral column is present 2. It is hollow and dorsal. 3. Heart is ventral. 4. Haemoglobin is present in the red blood corpuscles. 5. A post-anal tail is present. e.g., Pisces, Aves, Reptilia, Mammals.

29. i. Formula to find the magnitude of gravitational force:

$$F = \frac{GMm}{R^2} .$$

where, M = mass of the earth

m = mass of the object

R = distance between centres of the earth and an object.

and universal gravitational constant, $G = 6.67 \times 10^{-11} \text{ N-m}^2/\text{kg}^2$

ii.

a. Let gravitational force be F when the distance between them is R,

$$F = \frac{GMm}{R^2} \dots\dots (i)$$

Now, when the distance reduces to half,

$$F' = \frac{GMm}{\left(\frac{R}{2}\right)^2} = \frac{4GMm}{R^2} = 4F$$

i.e. the force of gravitation becomes 4 times the original value.

b. When the mass becomes 4 times,

$$F' = \frac{GM(4m)}{R^2} = 4F$$

i.e. the force of gravitation becomes 4 times the original value.

30. When atomic number $Z = 3$, the element will have 3 protons in its nucleus.

Since the atom is electrically neutral, the number of electrons in its shells will be equal to the number of protons.

The element will have 3 electrons in its different shells.

The maximum number of electrons that can be accommodated in the first orbit ($n = 1$)

or K-shell will be $= 2n^2 = 2$

So, the 3 electrons in the element would be distributed as 2, 1.

The number of valence electrons (i.e. electrons in the outermost shell) is 1.

Valency = number of valence electrons (for 4 or lesser valence electrons)

The element can easily give away its outermost single electron for achieving a duplet (Helium) configuration.

The valency of the element is 1. The given element is Lithium (Li).

OR

i. 1 mole of carbon atom = 6.022×10^{23} atoms

6.022×10^{23} atoms of carbon weigh = 12g

1 atom of carbon weigh = $\frac{12}{6.022 \times 10^{23}}$

= 1.99×10^{-23} g

ii.

a. $n = 0.5$ mol; $M = 14 \times 2 = 28$ g; $m = ?$

$m = n \times M = 0.5 \times 28 = 14.0$ g

b. $n = 0.2$ mol; $M = 16$ g; $m = ?$

$m = n \times M = 0.2 \times 16 = 3.2$ g

c. $n = 4$ mol; $M = 27$ g; $m = ?$

$m = n \times M = 4 \times 27 = 108$ g