

Sample Paper

General Instructions

- (i) The question paper comprises four sections A, B, C, and D. There are 36 questions in the question paper. All questions are compulsory.
- (ii) (Section–A - question no. 1 to 20 - all questions and parts thereof are of one mark each. These questions contain multiple-choice questions (MCQs), very short answer questions, and assertion - reason type questions. Answers to these should be given in one word or one sentence.
- (iii) Section–B - question no. 21 to 26 are short answer type questions, carrying 2 marks each. Answers to these questions should be in the range of 30 to 50 words.
- (iv) Section–C - question no. 27 to 33 are short answer type questions, carrying 3 marks each. Answers to these questions should be in the range of 50 to 80 words.
- (v) Section–D - question no. 34 to 36 are long answer type questions carrying 5 marks each. Answers to these questions should be in the range of 80 to 120 words.
- (vi) There is no overall choice. However, internal choices have been provided in some questions. A student must attempt only one of the alternatives in such questions.
- (vii) Wherever necessary, neat, and properly labelled diagrams should be drawn.



Section A

1. There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number.

OR

Name the particles which determine the mass of an atom.

2. The number of electrons in the outermost shell of chlorine is 7. What is its valency and why?
3. Which of the following is a compound?
 - A. Air
 - B. Water
 - C. Soda water
 - D. Pond water
4. A man leaves his house at 5:30 a.m. for a morning walk and returns at 6:15 a.m. Find his displacement in this time.
5. A boy throws a ball up and catches it when the ball falls back. In which part of the motion is the ball decelerating?
6. A ball moving on a surface stops after travelling some distance. Does it violate the first law of motion? Explain.

OR

If a ball is moving on a frictionless horizontal surface and no forces are applied on it, will its speed decrease, increase or remain constant?

7. A battery lights a bulb. Describe the energy change involved in the process.
8. Why is a gravitational force between you and your friend too weak to be experienced, but that between earth and sun is extremely large, though they are separated by large distance?
9. An echo is returned in 6 seconds. What is the distance of the reflecting surface from the source? [given that speed of sound is 342 m/s.]

OR

Aditi clapped her hands near a cliff and heard the echo after 4 seconds. What is the distance of the cliff here if the speed of sound is taken as 342 m/s.

10. A cell will swell up if
 - A. The concentration of water molecules in the cell is higher than the concentration of water molecules in the surrounding medium
 - B. The concentration of water molecules in the surrounding medium is higher than the concentration of water molecules in the cell.

- C. The concentration of water molecules is same in the cell and in the surrounding medium
- D. The concentration of water molecules does not matter
11. In goitre, the thyroid gland enlarges and results in swelling in the throat region. Which epithelial tissue is involved in this condition?
12. Which gases are considered as the greenhouse gases in the atmosphere?
13. Plant tissues are mainly of two types_____ and _____.
14. DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of the reason (R).
 Assertion: Hydrogen has three isotopes ^1H , ^2H and ^3H .
 Reason: Isotopes are atoms with the same atomic number but the different mass number
- A. Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of the assertion
- 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. Assertion: Lysosomes are known as suicidal bags of a cell.
 Reason: They are kind of waste disposal system of cell
- A. Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of the assertion
- 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
16. The questions in this segment consists of two statements, one labelled as "Assertion A" and the other labelled as "Reason R".
 Assertion (A): Compression and rarefaction involve changes in density and pressure.
 Reason (R): When particles are compressed, density of medium increases and when they are rarefied, density of medium decreases.
 Choose the most appropriate Solution from the options given below:
- A. Both Assertion and reason are true, and the Reason is the correct explanation of the Assertion.
- B. Both Assertion and Reason are true, but Reason is not the correct explanation of the Assertion.
- C. Assertion is true but Reason is false.
- D. Both Assertion and Reason are false.



17. Answer question numbers (a) to (d) based on your understanding of the following paragraph and related studied concepts.

The covering or protective tissues in the animal body are epithelial tissues. Epithelium covers most organs and cavities within the body. It also forms a barrier to keep different body systems separate. The skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules are all made of epithelial tissue. Epithelial tissue cells are tightly packed and form a continuous sheet. They have only a small amount of cementing material between them and almost no intercellular spaces.

- (a) If there are no intercellular spaces between the cells of the epidermal layer, how does exchange or section of materials take place?
 - (b) Which type of epithelium would
 - (i) prevent wear and tear?
 - (ii) permit easy movement of molecules across the lining?
 - (c) Where would one find glandular epithelium?
 - (d) Discuss the role of ciliated columnar epithelium.
18. Read the following and answer any **four** questions from (a) to (e)
Name the process associated with the following
- (a) Dry ice is kept at room temperature and at one atmospheric pressure.
 - (b) A potassium permanganate crystal is in a beaker and water is poured into a beaker with stirring.
 - (c) An acetone bottle is left open and the bottle becomes empty.
 - (d) Milk is churned to separate cream from it.
 - (e) Setting of sand when a mixture of sand and water is left undisturbed for some time.
19. Read the following and answer any **four** questions from (a) to (e)
Write the chemical formulae of the following:
- (a) Magnesium sulphate
 - (b) Calcium oxide
 - (c) Sodium sulphide
 - (d) Aluminium phosphate
 - (e) Potassium chloride
20. Read the following and answer any **four** questions from (a) to (e)
When a bus goes from Delhi to Haridwar, it takes several turns along the way. To find the distance covered by the bus, we have to add the distances of all the segments of the road the bus travels on. However, to find the displacement of the bus, we need to know the straight-line distance between the bus stands at Delhi and Haridwar. But that is not



enough. We also need to know the direction of Haridwar as seen from (or with respect to) Delhi. To describe the displacement of a particle from one position to another, we must state the following: (a) how far the final position is from the initial position (straight-line distance), and (b) the direction in which the final position is as seen from the initial position.

- (a) Which of the following is/are true?
- A. Distance can be negative
 - B. Displacement can be zero.
 - C. Displacement can be negative
 - D. Both B and C are true
- (b) Which of the following is true for displacement?
- A. It cannot be zero
 - B. Its magnitude is greater than the distance travelled
 - C. It may be equal to the magnitude of distance travelled
 - D. It is always lesser than the magnitude of distance travelled
- (c) The numerical ratio of displacement to distance for a moving object is
- A. always less than 1
 - B. always equal to 1
 - C. always more than 1
 - D. equal or less than 1
- (d) In which of the following cases of motions, the distance moved, and the magnitude of displacement are equal?
- A. If the car is moving on straight road
 - B. If the car is moving in circular path
 - C. The pendulum is moving to and fro
 - D. The earth is revolving around the Sun
- (e) Bill runs 400 meters to Andy's house, turns around, and runs 400 meters back home. What is the distance covered by Bill?
- A. 0 meters
 - B. 400 meters
 - C. 800 meters
 - D. 1600 meters

Section B

21. Though the basic unit of both, a flower and a leaf is the cell, they are widely different in their appearance. Why?



OR

What are the two main components of blood? Why is blood considered as a type of connective tissue?

22. State the differences between meristematic tissue and permanent tissue
23. In the atmosphere, Oxygen is available as O_2 but not as O . Explain.

OR

Write any two uses of isotopes.

24. (a) Rusting of an article made up of iron is called _____.
(b) Define: (i) solute (ii) solvent
25. Two bodies of masses m_a and m_b are dropped from different heights 'a' and 'b'. Find the ratio of time taken by them to reach the ground in terms of 'a' and 'b'.
26. A ball of mass 0.5 kg moving with a velocity of 2 m/sec strikes a wall normally and bounces back with the same speed. If the time of contact between the ball and the wall is one millisecond, then find the average force exerted by the wall on the ball.

Section C

27. State the functions of: (a) Parenchyma (b) Collenchyma (c) Sclerenchyma

OR

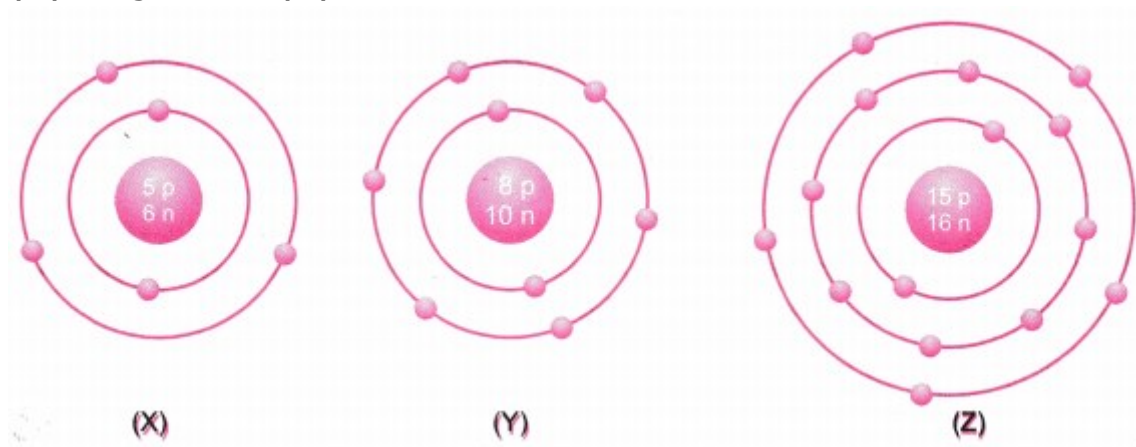
Explain any three reasons to justify that prevention of diseases is better than their cure.

28. (a) List any three differences between a prokaryotic and eukaryotic cell.
(b) Write the composition of a chromosome. Name the part of the cell where it is formed
29. Near coastal areas, wind blows from sea towards the land during the day while wind current moves from land to the sea during the night. Explain giving reason.
30. A diver of 50 kg jumps from a platform 20 m, high into a pool. If the diver comes to rest in 0.8 seconds after hitting the surface of the water, then what is the force that the water exerts on the diver?
31. a) Name the property of a substance to check its purity?
(b) Alloys cannot be separated by physical means, though it is considered a mixture, Why?
32. How do colloid, solution and suspension differ from each other?

33. A stone dropped from the top of a tower of height 300 m splashes into a pond of water at its base. When will the sound of the splash be heard at the top?
(Velocity of sound = 340 m/s and $g = 10 \text{ m/s}^2$)

Section D

34. a) What information do you get from the figures about the atomic number, valency of atoms X, Y and Z? Give your Solution in a tabular form.
(b) Write the molecular formulae for the following compounds:
(i) Copper (II) bromide
(ii) Aluminium (III) nitrate
(iii) Calcium (II) phosphate
(iv) Magnesium (II) acetate



OR

- (i) State the method of determining the valency of an element if its atomic number is given.
(ii) Determine the valency of the following elements, the atomic numbers of which are given in parenthesis:
Chlorine (17), Sulphur (16), Aluminium (13)
35. a) Differentiate between
(i) Nucleus and nucleoid
(ii) Plant cell and animal cell
(b) What is osmosis?
36. (a) A ball with radius $r=0.22\text{m}$ is submerged in syrup at a depth of 4m. What is the total force from pressure acting on the ball?
($g=10\text{ms}^{-2}$ $\rho_s=1370 \text{ kgm}^{-3}$ $P_{\text{atm}}=100\text{kPa}$)
(b) Two asteroids in space are in close proximity to each other. Each has a mass of $6.69 \times 10^{15} \text{ kg}$. If they are 100,000m apart, what is the gravitational acceleration that they experience?

- (c) A stone of density 3000 kg/m^3 is submerged in water. If the mass of stone in air is 150 kg , calculate the force required to lift the stone. $g = 10 \text{ m/s}^2$



Hints & Solutions

Section A

1. **Solution:** Atomic number of the element is 15, as the number of protons in the atom of an element represents the atomic number of that element.

Mass number of element = number of protons + number of neutrons
 $= 15 + 16 = 31$

OR

The particles which actually determine the mass of an atom are protons and neutrons.

2. **Solution:** The valency of chlorine is 1 because the valency of an element is either equal to the number of valence electrons in its atom or equal to the number of electrons required to complete 8 electrons in the valence shell. Since chlorine is a non-metal so valency of non-metal = $8 - \text{the number of valence electrons in its atom}$ which is $8 - 7 = 1$.

3. **Solution:** B

Solution: Water is a compound formed by the elements- hydrogen and oxygen. Air, pond water, soda water are examples of mixtures.

4. **Solution:** The position of the man at 6.15 a.m. is the same as his position at 5.30 a.m. Thus, the distance of the final position from the initial position is zero, and hence, his displacement is zero.
5. **Solution:** As the ball goes up, its speed decreases. As it comes down, its speed increases. Thus, it decelerates while going up.
6. **Solution:** The first law states that when a body in motion stays in motion and a body at rest stays at rest until an external force is applied. But in the case of rolling the ball, the ball stops after some time because frictional force is acting on the ball every time which keeps on reducing its speed.

OR

According to the first law of motion, the ball will continue to move with constant speed if no external force acts on it.

7. **Solution:** When the bulb is connected to the battery the chemical energy of the battery is converted into the electrical energy. When a bulb receives this electrical energy it converts it into light and heat energy. The figure below shows the energy transformation in a more descriptive way.

Chemical Energy $\rightarrow$ Electrical Energy $\rightarrow$ Light Energy + Heat Energy



8. **Solution:** From Newton's law of gravitation, the gravitational force between two bodies is directly proportional to the product of their masses.

As the masses of earth and sun are very large as compared to the mass of me and my friend, the gravitational force between them is much greater than between me and my friend.

9. **Solution:** Given

Speed of sound (u) = 342 m/s

Time taken for hearing the echo (t) = 6 s

Now

$$\text{speed} = \frac{(\text{distance})}{\text{time}}$$

$$\text{distance} = 342 \times 6 = 2052 \text{ m}$$

In 6s, sound has to travel twice the distance between the source and reflecting surface. Therefore, the distance of the reflecting surface from the source is $2052/2 = 1026 \text{ m}$

OR

Given

Speed of sound (u) = 346 m/s

Time taken for hearing the echo (t) = 4s

Now

Now

$$\text{speed} = \frac{(\text{distance})}{\text{time}}$$

$$\text{distance} = 342 \times 4 = 1368 \text{ m}$$

In 4 s, sound has to travel twice the distance between the cliff and aditi. Therefore, the distance between the cliff and aditi is $1368/2 = 684 \text{ m}$

10. **Answer** – B

Solution: The concentration of water molecules in the surrounding medium is higher than the concentration of water molecules in the cell

11. **Solution** - Glandular epithelium is affected in goitre

12. **Solution** - carbon dioxide, methane, nitric oxide and nitrous oxide

13. **Solution:** meristematic and permanent.

14. **Solution:** A

15. **Solution:** (B)



Solution: Lysosomes contain powerful digestive enzymes capable of breaking down all the organic materials. Hence, during cellular disturbance, they digest the damaged cell organelles.

16. **Answer:** A

Solution: A compression is a region of medium in which particles come closer i.e., distance between the particles becomes less than the normal distance between them. Thus there is a temporary decrease in volume and as a consequence increase in density of medium. Similarly, in rarefaction, particles get farther apart and a consequent decrease in density.

Hence, option A is the correct Solution.

17. **Solution:** (a) Exchange and secretion of materials takes place by movement of molecules across the epithelium which is determined by the permeability of different types of epithelia.

(b) (i) Skin – Stratified squamous epithelium

(ii) Simple squamous.

(c) In the alimentary canal.

(d) The hair-like cilia allow movement pushing down of substances and tall columnar cells facilitate movement across the epithelial layer.

18. (a) **Solution:** Sublimation

(b) **Solution:** Dissolution/ diffusion

(c) **Solution:** Evaporation/ diffusion

(d) **Solution:** Centrifugation

(e) **Solution:** Sedimentation

19. (a) **Solution:** MgSO_4

(b) **Solution:** CaO

(c) **Solution:** Na_2S

(d) **Solution:** $\text{Al}_2(\text{PO}_4)_3$

(e) **Solution:** KCl

20. (a) **Answer:** D

Solution: Displacement can be zero, positive and negative.

(b) **Answer:** C

Solution: Displacement can be equal to or less than the magnitude of distance travelled

(c) **Answer:** D

Solution: Displacement is the shortest distance between two points. Distance is the total distance covered by the body while it travels between the two points. Therefore, displacement is always equal to or less than distance and hence their ratio will be equal to or less than one.

(d) **Answer:** A

Solution: When an object moves in one direction only, then distance is equal to the displacement.

(e) **Answer:** C

Solution: The total distance covered by bill is $400+400 = 800\text{ m}$

Section B

21. **Solution -** Different cells have different sizes and appearances to perform different functions. For example, chloroplasts and chromoplasts vary in size and perform different functions in the plant body. Chloroplasts are the site for photosynthesis while chromoplasts are responsible for the colour of flowers and fruits.

OR

Solution: - The two main components of blood are plasma and blood corpuscles. Blood is considered as a type of connective tissue because blood has a fluid matrix i.e. plasma which flows between different organs of the body and contains blood cells suspended in it.

22. **Solution:**

Meristematic tissue	Permanent tissue
Cells of meristematic tissue divide repeatedly.	Cells of permanent tissue do not divide and are derived from the meristematic tissue.
The cells are not differentiated.	The cells are differentiated.
The cells are isodiametric.	The cells are variable in shape.
Vacuoles are not present.	In mature cells, large vacuoles are present.

23. **Solution:** Oxygen has electronic configuration 2, 6. The valence shell of oxygen has 6 electrons so its valency is 2. It wants to accept two electrons to complete its octet to get stability. So, it combines with another oxygen atom to complete its octet. In the O_2 molecule, both O atoms have a complete octet. So O_2 is more stable than an O atom. Hence Oxygen is available as O_2 in the atmosphere.

OR

Solution: Two uses of isotopes are-

- i. Radioactive isotopes are used as tracers in medicine to detect the presence of tumors, blood clots in the human body.
- ii. They are used in industry to detect leakage in underground oil, gas, or water pipelines.

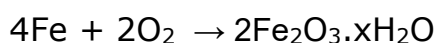
24. **Solution:**

(a) Rusting of an article made up of iron is called corrosion and it is a chemical change.

Corrosion is a chemical change because in such change chemical properties or composition of the original substance changes resulting in the formation of at least one new substance.

For example the Formation of rust

The chemical reaction showing rusting of iron is shown below.



(Hydrated iron oxide or rust)

(b) (i) The solute is the component that gets dissolved in a solvent to form a solution. It is present in a smaller amount when compared to the solvent.

(ii) The solvent is the component that dissolves a solute to form a solution. The solvent is present in a larger amount when compared to the solute.

25. **Solution:** The bodies will fall under the action of gravity, therefore from second equation of motion

$$a = ut + \frac{1}{2}gt_a^2$$

$$a = 0 + \frac{1}{2}gt_a^2$$

$$t_a = \sqrt{\frac{2a}{g}}$$

Similarly for body B,

$$b = 0 + \frac{1}{2}gt_b^2$$

$$t_b = \sqrt{\frac{2b}{g}}$$

Therefore, the ratio of time taken

$$\frac{t_a}{t_b} = \frac{\sqrt{a}}{\sqrt{b}}$$

26. **Solution:** we know from Newton's second law of motion that the rate of change in momentum is equal to the force. Then

$$F = \frac{m(v - u)}{t}$$

Now since the ball rebounded the initial and final directions of the ball are opposite. Therefore, if the velocity of the ball is V ,

$$F = \frac{m(V - (-V))}{t}$$

$$F = \frac{(2 \times 0.5 \times 2)}{10^{-3}} = 2000 \text{ N}$$

Section C

27. **Solution:** a) Parenchyma: i. It serves as a packing tissue to fill the spaces between other tissues and maintain the shape and firmness of the plant. ii. It stores food, performs photosynthesis and secretion in plants.
(b) Collenchyma: i. These cells provide mechanical support to growing parts of the plants. ii. When these cells contain chloroplast, they perform photosynthesis.
(c) Sclerenchyma: i. These cells are usually found associated with other cell types and give mechanical support to the plants. ii. They provide strength, rigidity, flexibility, and elasticity to the plants.

OR

Solution: (i) Once someone gets a disease, his or her body functions get damaged and may never recover completely. (ii) The treatment of a disease takes time so the person is likely to be bedridden for sometime, even if he is given proper treatment. (iii) The person suffering from an infectious disease can serve as the medium for further spread of infection to other people.

28. **Solution:** (a) Differences between a prokaryotic and eukaryotic cell:
- Prokaryotic cell
- (i) It is small in size.
 - (ii) The nuclear region is not well-defined.
 - (iii) Single chromosome is found.
- Eukaryotic cell
- (i) It is large in size.
 - (ii) The nuclear region is well-defined and is surrounded by a nuclear membrane.
 - (iii) More than one chromosome is present.

(b) A chromosome is composed of DNA and proteins. It is formed in the nucleus during cell division.

29. **Solution:** During the day, air above the land gets heated up faster and starts rising. As this air rises, a region of low pressure is created and the air over the sea moves into this area of low pressure. The direction of the wind would be from the sea to the land. During the night, both land and sea start to cool. Since water cools down slower than the land, the air above water would be warmer than the air above land so the wind current moves from land to the sea.

30. **Solution:** We can use the equation for conservation of energy to calculate the velocity of the diver as he hits the water:

$$E = U_i + K_i = U_f + K_f$$

Cancel out initial kinetic and final potential energies, and plug in our expressions:

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

Cancel out mass and rearranging for final velocity:

$$v = \sqrt{2gh_i}$$

$$v = \sqrt{2 \times 10 \times 20} = 20 \text{ m/s}$$

We know that the diver then decelerates from this velocity to zero in 0.8 seconds, so we can calculate the acceleration:

$$a = \frac{v_f - v_i}{t} = \frac{20 - 0}{0.8} = 25 \text{ m/s}^2$$

Newton's second law to calculate the force on the diver:

$$F = ma = (50) (25 \text{ m/s}^2) = 1250\text{N}$$

31. **Solution:** (a) A pure substance has a fixed melting point or boiling point at constant pressure. The purity of a substance can be tested by checking its melting point or boiling point. If a substance is impure i.e. it contains traces of another substance, the melting and boiling point of that substance will change.
- (b) Alloys are homogeneous mixtures of metals and cannot be separated into their components by physical methods. But still, an alloy is considered as a mixture because it shows the properties of its constituents and can have variable composition.

32. **Solution:**

Solution	Colloid	Suspension
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1. It is homogeneous in nature.	1. Heterogeneous in nature.	1. Heterogeneous in nature.
2. Particle size is less than 10^{-7} cm.	2. Colloidal particle size is between 10^{-4} to 10^{-7} cm.	2. Particle size is 10^{-3} to 10^{-5} .
3. It does not scatter light.	3. It scatters a beam of light.	3. It scatters a beam of light.
4. True solutions pass through filter paper.	4. They also pass through a filter paper.	4. Suspended particles do not pass through filter paper.

33. **Solution:** Time after which the splash is heard at the top is equal to the sum of the time t_1 taken by the stone to fall down and the time t_2 taken by the sound to travel from bottom to top.

Using,

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

We get,

$$S = \frac{1}{2}gt_1^2$$

$$t_1 = \sqrt{\frac{2s}{g}} = \sqrt{\frac{(2 \times 300)}{10}} = 7.75 \text{ s}$$

Also,

$$t_2 = \frac{\text{Height of the tower}}{\text{velocity of sound}} = \frac{300}{340} = 0.885 \text{ s}$$

$$\text{Total time} = t_1 + t_2 = (7.75 + 0.88)\text{s} = 8.6 \text{ s}$$

Section D

34. **Solution:**

(a)

	Atomic No.	Mass No.	Valency
X	5	11	3
Y	8	18	2
Z	15	31	3, 5

- (b) (i) CuBr_2
(ii) $\text{Al}(\text{NO}_3)_3$
(iii) $\text{Ca}_3(\text{PO}_4)_2$
(iv) $\text{Mg}(\text{CH}_3\text{COO})_2$

OR

Solution: (i) The number of electrons gained, lost or shared to make the octet of electrons (in the outermost shell), gives us directly the combining capacity of the element, that is, the valency.

(ii) Elements	Atomic no.	Electronic configuration	Valency
Chlorine	17	2, 8, 7	- 1
Sulphur	16	2, 8, 6	- 2
Aluminium	13	2, 8, 3	+ 3

35. **Solution:**

(a) (i)

Nucleus	Nucleoid
A nucleus is a membrane-bound structure in which eukaryotes assemble their genetic materials.	Nucleoid is a particular area in which prokaryotes assemble their genetic materials.
A nucleus is well organised and is large.	Nucleoid is poorly organised and is small.
A nucleus is engirdled by a double layer membrane known as nuclear membrane which separates the nucleus from other organelles.	Nucleoid lacks a protective membrane.
A nucleus comprises several chromosomes.	Nucleoid usually contains only one chromosome.

(ii)

Plant Cell	Animal Cell
Cell shape is Square or rectangular in shape	Cell shape is Irregular or round in shape
Cell wall is present	Cell wall is absent
Nucleus is present and lies on one side of the cell	Nucleus is present and lies in center of the cell
This has few large or a single, centrally positioned vacuole	Vacuole are usually small and numerous

(b) Osmosis is the movement of water molecules from a region of higher water concentration to a region of lower water concentration across a semipermeable membrane.

36. **Solution:** (a) The total pressure on the ball includes both hydrostatic and atmospheric pressure:

$$P_T = P_{atm} + P_h$$

$$P_h = \rho_h gh = 1370 \times 19 \times 4 = 54.8 \text{ kPa}$$

$$\therefore P_t = 100\text{kPa} + 54.8\text{kPa} = 154.8 \text{ kPa}$$

The force on the ball

$$F = P_t A = P_t 4\pi(0.2)^2 = 154.8 \times 0.5027$$

$$F = 78 \text{ kN}$$

(b) From universal law of gravitation

$$F = G \frac{m_1 m_2}{r^2}$$

$$F = 6.67 \times 10^{-11} \frac{(6.69 \times 10^{15})(6.69 \times 10^{15})}{(10^5)^2}$$

$$F = 2.99 \times 10^{11} \text{ N}$$

From Newton's second law of motion

$$F = ma$$

$$2.99 \times 10^{11} = 6.69 \times 10^{15} a$$

$$a = 4.47 \times 10^{-7} \text{ m/s}^2$$

(c)

$$\text{Volume of stone} = \frac{\text{mass}}{\text{density}} = \frac{150}{3000} = 0.05 \text{ m}^3$$

Buoyant force

$$F_b = V_{\text{immersed}} \times \rho_w \times g = 0.05 \times 1000 \times 10$$

$$F_b = 500 \text{ N}$$

Therefore, force needed to lift the stone

$$F_{\text{net}} = W - F_b = mg - 500$$

$$F_{\text{net}} = 1500 - 500 = 1000 \text{ N}$$

