# Class IX
## SCIENCE FULL SYLLABUS – 3

**Time : 3 Hrs** **M.M – 80 Marks**

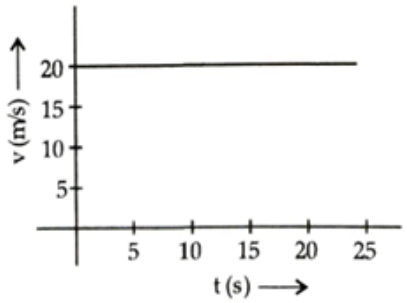
Q1. The numerical ratio of displacement and distance for a moving object is :
(A) Always less than 1 (B) Always equal to 1
(C) Always more than 1 (D) Equal to or less than 1. **[1]**

Q2. The work done on an object does not depend upon **[1]**
(A) Displacement (B) Force applied
(C) Angle between force and displacement (D) Initial velocity of the object.

Q3. Assertion (A): Velocity is the speed of an object in a particular direction. **[1]**
Reason (R): SI unit of velocity is same as speed..
(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.

Q4. In which of these conditions is the work done negative?
(i) Wind force making a boat move forward on water.
(ii) Brake force resisting the motion of a moving wheel.
(iii) Buoyant force slowing the sinking of an iron nail in water. **[2]**

Q5. The velocity – time graph shows the motion of a cyclist. Find (i) the cyclist's acceleration, (ii) his/her velocity after 20 s.




**OR**

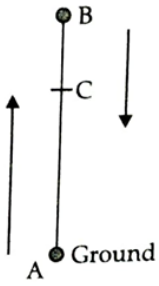
State why Newton's first law of motion is called law of inertia. **[2]**

Q6. (a) Define power. Derive its SI unit.
(b) An electric bulb is rated 15 watts. What does it mean?
(c) What is the energy consumed in joules if it is used for 10 minutes? **[3]**

Q7. A man's weight when taken at the poles is 600 N. Will his weight remain the same when measured at the equator? Will there be an increase or decrease in his weight? Explain. **[3]**

Q8. (a) State Archimedes' principle.
(b) State the laws of floatation.
(c) Why is it easier to swim in sea water than in river water? **[3]**

Q9. (a) A stone is thrown upwards from a point A, as shown in the figure. After reaching the highest point B it comes down. Explain the transformation of energy from A to B and B to A and also mention the type of energy possessed by the stone at point A, B and C of its journey.

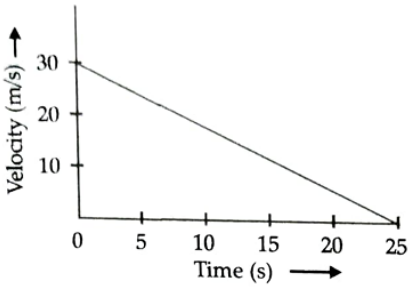



(b) A body of mass 20 kg is dropped from a height of 100 m. Find its K.E. and P.E. after
(i) 1st second (ii) 2nd second (iii) 3rd second. **[5]**

**OR**

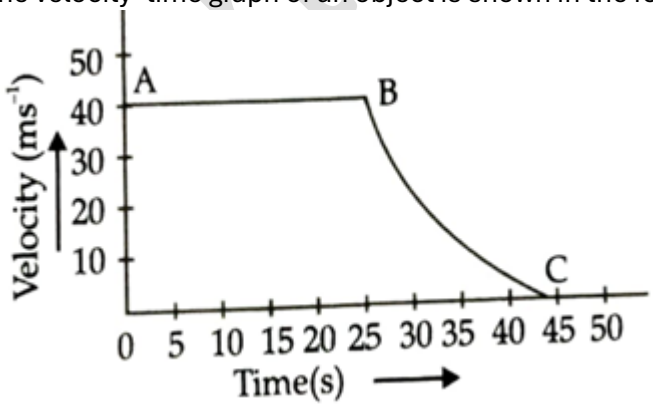
(a) State the law that provides the formula for measuring force and the law which provides the definition of force.

(b) Velocity–time graph of a 50 g marble rolling on a floor is given below. Find:
(i) time in which it stops.
(ii) negative acceleration produced on it.
(iii) positive force acting on the marble.




Definition of force is given by Newton's first law.

Q10. Study the following graph and choose the correct options to answer the following questions given below:
The velocity–time graph of an object is shown in the following figure.



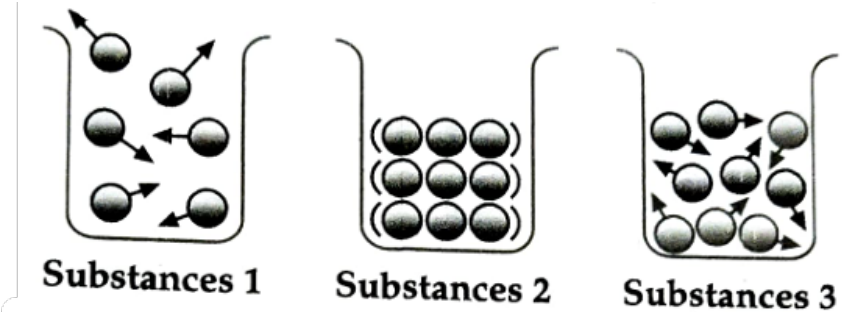

(a) State the kind of motion that object has, from A to B and from B to C.
(b) What does the area enclosed by the velocity–time graph represent?
(c) Identify the part of graph where the object has zero acceleration. Give reasons for your answer. **[4]**

**OR**

Identify the part of graph where the object has negative acceleration. Give reasons for your answer.

# CHEMISTRY

Q1. The picture shows the arrangement of particles in three different substances. **[1]**




Which of the following is true about the state of the three substances?

(A) Substance 1: Solid, Substance 2: Liquid, Substance 3: Gas
(B) Substance 1: Gas, Substance 2: Liquid, Substance 3: Solid
(C) Substance 1: Liquid, Substance 2: Gas, Substance 3: Solid
(D) Substance 1: Gas, Substance 2: Solid, Substance 3: Liquid

Q2. Rusting of an article made up of iron is called: **[1]**
(A) Corrosion and it is a physical as well as chemical change.
(B) Dissolution and it is a physical change.
(C) Corrosion and it is a chemical change.
(D) Dissolution and it is a chemical change.

Q3. In which of the following conditions, the distance between the molecules of hydrogen gas would increase? **[1]**
(i) Increasing pressure on hydrogen contained in a closed container.
(ii) Some hydrogen gas leaking out of the container.
(iii) Increasing the volume of the container of hydrogen gas.
(iv) Adding more hydrogen gas to the container without increasing the volume of the container.
(A) (i) and (ii) (B) (i) and (iv) (C) (ii) and (iii) (D) (ii) and (iv)

Q4. The formula and charge on ions of three different compounds are shown below. Two ions, $Zn^{2+}$ and $S^{2-}$, combine to form a compound. What should be the formula of the compound formed? **[1]**
(A) ZnS (B) $Zn_2S$ (C) $ZnS_2$ (D) $Zn_2S_2$

Q5. The number of electrons in an element X is 15 and the number of neutrons is 16. Which of the following is the correct representation of the element? **[1]**
(A) $^{31}_{15}X$ (B) $^{31}_{16}X$ (C) $^{16}_{15}X$ (D) $^{15}_{16}X$

Q6. Choose the correct statement of the following. **[1]**
(A) Conversion of solid into vapours without passing through the liquid state is called vaporisation.
(B) Conversion of solid into vapour without passing through the liquid state is called sublimation.
(C) Conversion of vapours into solid without passing through the liquid state is called freezing.
(D) Conversion of solid into liquid is called sublimation.

Q7. Two chemical species X and Y combine together to form a product P which contains both X and Y. X + Y → P; X and Y cannot be broken down into simpler substances by simple chemical reactions. Which of the following concerning the species X, Y and P are correct?
(i) P is a compound. (ii) X and Y are compounds.
(iii) X and Y are elements. (iv) P has a fixed composition. **[1]**
(A) (i), (ii) and (iii) (B) (i), (ii) and (iv)

(C) (ii), (iii) and (iv) (D) (i), (iii) and (iv)

Q8. Assertion (A): Particles of gas intermix with each other. **[1]**
Reason (R): The intermixing of particles of two different types of matter on their own is called diffusion.

(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.

Q9. The electronic configuration of an element 'X' is 2, 8, 2.
(a) Find the number of electrons present in the atom of element 'X'.
(b) Write its atomic number.
(c) Is element 'X' a metal or a non-metal?
(d) Find out the valency of the element 'X'. **[2]**

Q10. (a) How can we say that sugar is a pure substance whereas milk is not?
(b) Which of the following materials fall in the category of a pure substance?
(i) Ice (ii) Iron (iii) Wood (iv) Brick **[3]**

Q11. Give three reasons to justify that water is a liquid at room temperature.

**OR**

Atomic number and mass number of an element are 18 and 40 respectively. Identify the element and write the number of electrons and neutrons present in its atom. Show the schematic atomic structure of the atom. **[3]**

Q12. How the water changes into vapours at temperature below its boiling point? List the factors affecting evaporation. Mention two examples from daily life where evaporation causes cooling.

**OR**

(a) Explain the term diffusion. Illustrate with an activity that rate of diffusion increases with temperature.
(b) Name two compressed gases:
(i) used in our homes for cooking
(ii) supplied to hospital in cylinders. **[5]**

Q13. The table lists the properties of four substances. **[4]**

| Substance | Is it shiny? | How does it conduct electricity? |
|---|---|---|
| Substance 1 | Yes | Very good |
| Substance 2 | No | Very poor |
| Substance 3 | Yes | Medium |
| Substance 4 | No | Poor |

(a) Which of the substances is likely to be a metal?
(b) Which of the substances is likely to be a metalloid?

(c) Which of the substances is/are likely to be a non-metal? Why?

**OR**

Can substance 2 or substance 4 be used to prepare electric circuit wires? Why?

## BIOLOGY

Q1. Which of the following are covered by a single membrane? **[1]**

(A) Mitochondria (B) Vacuole (C) Lysosome (D) Both (B) and (C)

Q2. In desert plants, rate of water loss gets reduced due to the presence of: **[1]**

(A) Cuticle (B) Stomata (C) Lignin (D) Suberin

Q3. Cell theory was given by: **[1]**

(A) Schleiden and Schwann (B) Virchow (C) Hooke (D) Haeckel

Q4. The water conducting tissue generally present in gymnosperm is: **[1]**

(A) Vessels (B) Sieve tube (C) Tracheids (D) Xylem fibres

Q5. Voluntary muscles are found in: **[1]**

(A) Alimentary canal (B) Limbs (C) Iris of the eye (D) Bronchi of lungs

Q6. Cattle husbandry is done for the following purposes.

(i) Milk production (ii) Agricultural work (iii) Meat production (iv) Egg production

(A) (i), (ii) and (iii) (B) (ii), (iii) and (iv) (C) (iii) and (iv) (D) (i) and (iv) **[1].**

Q7. Oysters are cultivated in inland water bodies for food.

What else can be obtained from the cultivation of oysters? **[1]**

(A) Pearl (B) Sponge (C) Platinum (D) Sand

Q8. Assertion (A): Lysosomes are known as suicidal bag of cells. **[1]**

Reason (R): Lysosomes contain powerful enzymes capable of breaking down all organic material.

(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.

Q9. Assertion (A): Italian bee is commonly used for honey production. **[1]**

Reason (R): Italian bees have high honey collecting capacity, are stingless and breed very well.

(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.

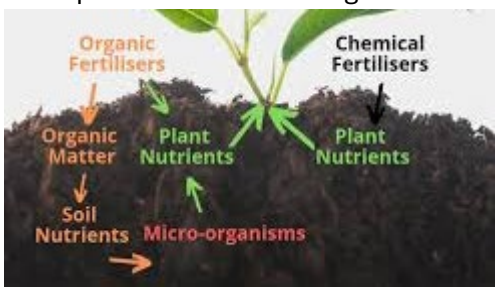
Q10. Write the main functions of cell wall. **[2]**

Q11. What is apical meristem? What is its function? **[2]**

**OR**

Give differences between cytoplasm and nucleoplasm.

Q12. The picture shows how organic manure and chemical fertilizer are used by plants. .**[2]**




(a) Which of the two, organic manure and chemical fertiliser, provides food for the soil microorganism?
(b) Which of the two, organic manure and chemical fertiliser, is not harmful for the environment? Why?

Q13. Where are chromosomes present in the cell? What is their chemical composition? How many pairs of chromosomes are present in humans? **[3]**

Q14. Describe the structure, function and location of the nervous tissue. **[3]**

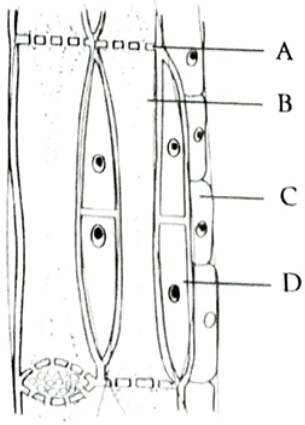
Q15. (a) Explain the terms: **[5]**
(i) Endocytosis, (ii) Plasmolysis.

(b) What will happen if the organisation of a cell is damaged due to certain physical or chemical reasons?
(c) How do substances like $CO_2$ and water move in and out of the cell?

**OR**

Identify the type of tissues in the following:
(a) Vascular bundle
(b) Inner lining of the intestine
(c) Lining of kidney tubule
(d) Iris of the eye
(e) Muscles of the heart

Q16. Study the given diagram and answer the following questions. **[4]**




(a) Name the tissue shown in the diagram.
(b) Which tissues together make vascular bundles?
(c) Identify the parts A, B, C and D.

**OR**

What will happen if phloem at the base of the branch is removed?

**Class IX**
**SCIENCE FULL SYLLABUS – 3**
**SOLUTIONS**
**PHYSICS**

1. **(D)**
   *Explanation:* Displacement of an object can be less than or equal to the distance covered by the object, because the magnitude of displacement is not equal to distance. However, it can be same, if the motion is along a straight line without any change in direction.

2. **(D)**
   *Explanation:* We know that, $W = F \cdot d\cos\ \theta$.
   Here, $F$= force applied on the object, $d$= displacement and $\theta$is angle between force and displacement.
   So, the work done on an object does not depend upon the initial velocity of the object.

3. **(B)**
   *Explanation:* Velocity is the speed of an object moving in a direction, or the displacement of an object in unit time. Speed, on the other hand, is the distance travelled by an object in the given time. SI unit of velocity is same as speed i.e., m/s.

4. Negative work is done when the displacement is in the opposite orientation of the force delivered. So, the work done is negative in:
   (ii) Brake force resisting the motion of a moving wheel.
   (iii) Buoyant force slowing the sinking of an iron nail in water.

5. $a = 0$because velocity is constant.
   $v = 20$ m/s(same reason as above)

   **OR**

   Inertia is the tendency of the object to resist change in its state. Newton's first law of motion also states the same, *i.e.,* the object will remain in its present state unless an external force is applied. That is why Newton's first law is called law of inertia.

6. **(a)** Power is the rate of doing work.
   $\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{1\text{ Joule}}{1\text{ second}} = 1$ watt or 1 W
   **(b)** If the power of an electric bulb is 15 W, it consumes 15 Joules of energy per second.
   **(c)** Energy consumed by the bulb in 10 minutes =
   $15\text{ W} \times 600 = 9000$ Joules

7. No, his weight will not remain same as that at the poles. There will be a decrease in his weight at the equator. As the radius of the Earth increases from the poles to the equator, the value of 'g' becomes greater at poles decreasing towards equator. Also, the force of gravity decreases from poles to the equator.

8. **(a)** Archimedes' principle, states that when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the liquid displaced by it.
   **(b) Laws of floatation:**
   **(i)** When the weight of the object is more than the buoyant force exerted by a fluid on the object, then the object sinks.
   **(ii)** When the weight of the object is less than the buoyant force exerted by the fluid on the object, then the object floats.
   **(c)** Sea water has a higher density than river water. So, it will exert higher buoyant force than river water

on the same object. So, in order to swim, less amount of water needs to be displaced to balance our weight. Therefore, it is easier to swim in sea water.

9. **(a)** While going up, K.E. → P.E. and while coming down P.E. → K.E.
A → K.E.
B → P.E.
C → K.E. + P.E.
Total Energy = $mgh$
= $20 \times 10 \times 100$
= $2 \times 10^4$ J

**(b)**
**(i) After 1st second:**
$v = u + gt = 10 \times 1$
= 10 m/s( $u = 0$ )
K.E. = $\frac{1}{2}mv^2$
= $\frac{1}{2} \times 20 \times 10 \times 10 = 1000$ J
P.E. = T.E. − K.E. = $20{,}000 - 1000 = 19{,}000$ J
**(ii) After 2nd second:**
$v = 20$ m s$^{-1}$
K.E. = $\frac{1}{2}mv^2 = \frac{1}{2} \times 20 \times 20 \times 20 = 4000$ J
P.E. = T.E. − K.E.
= $20{,}000 - 4{,}000 = 16{,}000$ J
**(iii) After 3rd second:**
$v = 30$ m s$^{-1}$
K.E. = $\frac{1}{2} \times 20 \times 30 \times 30 = 9000$ J
P.E. = T.E. − K.E.
= $20{,}000 - 9{,}000 = 11{,}000$ J

**OR**

**(a)** Formula for measuring force is given by Newton's 2nd law. It states that the rate of change of momentum of an object is directly proportional to the force applied and takes place in the same direction as that of the force. Second law of motion gives a method to measure the force acting on an object as force is the product of its mass and acceleration.
Definition of force is given by Newton's first law. It states that an object continues to be in a state of rest or a body in motion will remain in uniform motion along a straight line unless acted upon by an unbalanced force.
**(b)** From graph
**(i)** $t = 25$ s
**(ii)** $a = \frac{(30-0)}{25} = 1.2$ m/s$^2$
**(iii)** $F = ma$

$= \left(\frac{50}{1000}\right) \times 1.2 = 0.06$ N

10. **(a)** Uniform motion from A to B and non-uniform motion from B to C.
**(b)** Displacement
**(c)** AB because velocity remains constant from A to B.

**OR**

BC because velocity decreases from B to C.

## CHEMISTRY

1. **(D)**
   *Explanation:* In solids, molecules are tightly packed as compared to liquid and gas. Substance 3 is solid as molecules are closely packed. Molecules in liquids are slightly loose while molecules in gases are very loosely packed. Hence, substance 2 is liquid and substance 1 is gas.

2. **(C)**
   *Explanation:* Rusting of an article made up of iron is called corrosion. Corrosion is a chemical change because rust is a chemical compound (hydrated iron oxide), which is totally different from elemental iron (Fe).

3. **(C)**
   *Explanation:* Some hydrogen gas leaking from the container leaves some vacant space inside the container. So, hydrogen gas molecules inside the container will occupy all the space available and the distance between the molecules of hydrogen gas will be increased. Similarly, on increasing the volume of the container of hydrogen gas, more space will be available inside the container and hydrogen gas molecules will occupy all the space available. As a result, the distance between the molecules will be increased. So, option (ii) and (iii) will increase the distance between the molecules of hydrogen gas. On the other hand, on increasing pressure, hydrogen molecules will come closer and the distance between them will be decreased. Also, on adding more hydrogen gas molecules without increasing the volume of container will decrease the distance between molecules.

4. **(A)**
   *Explanation:* Two ions, $Zn^{2+}$ and $S^{2-}$, will form compound ZnS, as each of them has valency 2.

5. **(A)**
   *Explanation:* Given that, number of electrons in element X = 15 and number of neutrons = 16.
   Atomic number = Number of protons = Number of electrons in neutral atom = 15
   Mass number = number of protons + number of neutrons
   = 15 + 16 = 31
   So, correct representation of element is $^{31}_{15}X$.

6. **(B)**
   *Explanation:* The conversion of liquid into gas (vapour) is called vaporisation. The conversion of liquid into solid is called freezing. The conversion of solid into liquid is called melting.

7. **(D)**
   *Explanation:* In this reaction, X and Y cannot be broken down into simpler substances by chemical reactions; therefore, X and Y are elements. A compound is a substance made up of two or more elements chemically combined in a fixed proportion by mass; therefore, P is a compound, having a fixed composition.

8. **(A)**
   *Explanation:* Particles of a gas are loosely packed. So, they move randomly due to space between them and intermix with other particles present there.

9. **(a)** 12
   **(b)** Atomic number = 12
   **(c)** "X" is a metal as it has two outer electrons that it can loose quickly.
   **(d)** Valency of 'X' is +2.

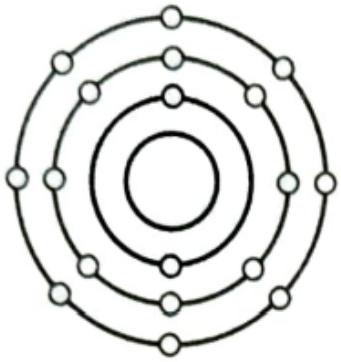
10. **(a)** Sugar is a pure substance because it cannot be separated and is formed of only single type of molecule. In the case of milk, it can be separated by physical process into its components. It has components like water, fat and proteins, etc.

**(b)** Ice and iron are pure substances as they contain particles of only one kind of matter while wood and brick contain more than one kind of matter.

11. At room temperature, water is liquid because it has the following characteristics of liquid:
**(i)** At room temperature, water has no shape but has fixed volume.
**(ii)** It takes the shape of the container in which it is kept.
**(iii)** It can flow.

**OR**

Name of element: Argon
Number of electrons = 18
Number of neutrons = 22 (40 − 18)
Structure: 2, 8, 8



12. The phenomenon of change of a liquid into vapour at a temperature below its boiling point is called evaporation. Fractions of particles at the surface having higher kinetic energy, are able to break away from the forces of attraction of other particles and get converted into vapour.
**Factors which affect rate of evaporation:**
(i) Surface area
(ii) Temperature
(iii) Humidity
(iv) Wind speed
Two examples from daily life where evaporation causes cooling:
Sprinkling of water on the roof, cooling of water kept in earthen pots, etc.

**OR**

**(a)** Diffusion is the process resulting from random motion of molecules by which there is a net flow of matter from a region of high concentration to a region of low concentration. During diffusion particles of one substance occupy the vacant space present between the particles of the other substance.
**Activity:**
**(i)** Take 5 g of copper sulphate each in three beakers.
**(ii)** Pour 100 ml of distilled water slowly in one of the beakers.
**(iii)** Cover this beaker with a watch glass.
**(iv)** Pour 100 ml of cold water in the second beaker slowly.
**(v)** Place the third beaker containing 100 ml of water on a tripod stand for heating.
**(vi)** Observe the diffusion process which begins in all the beakers.
**(vii)** Record the time taken for the dissolution of copper sulphate in all the three cases.
**Conclusion:** The rate of diffusion of copper sulphate in water is in the order:
Beaker 3 > Beaker 2 > Beaker 1.
It illustrates with that rate of diffusion increases with increase in temperature.
**(b)** Gas used in our home for cooking:
(i) Liquified Petroleum Gas (LPG)

Gas supplied to hospital in cylinder:
(ii) Oxygen.

13. **(a)** Substance 1, as it is shiny and conducts electricity very well.
**(b)** Substance 3
**(c)** Substance 2 / substance 4, as not shiny and poor conductor of electricity.

**OR**

No, substance 2 or substance 4 cannot be used to prepare electric circuit wires as they are bad conductors of electricity.

## BIOLOGY

1. **(D)**
*Explanation:* Vacuole and lysosome are covered by a single membrane while mitochondria and plastid have double membrane.

2. **(A)**
*Explanation:* Cuticle minimises the water loss through transpiration (with the help of stomata) and also reduces pathogen entry.

3. **(A)**
*Explanation:* Schleiden (1836) and Schwann (1834) gave the cell theory which states that all the plants and animals are composed of cells and cell is the basic unit of life.

4. **(C)**
*Explanation:* The gymnosperms are characterised by the presence of tracheids as their major conducting tissue.

5. **(B)**
*Explanation:* Voluntary muscles are the muscles, which are under our complete control. Example includes the muscles that control working and movement of limbs.

6. **(A)**
*Explanation:* Human beings domesticate cattle for milk production, agricultural work, meat production, transportation and leather, etc.

7. **(A)**
*Explanation:* Oysters are cultivated for obtaining pearls.

8. **(A)**
*Explanation:* During the disturbance in cellular metabolism lysosomes may burst and the enzymes digest their own cell. Therefore, lysosomes are also known as suicide bags. Lysosomes are able to do this because they contain powerful enzymes capable of breaking down all organic material.

9. **(A)**
*Explanation:* An Italian bee, *Apis mellifera*, is commonly used for honey production. It has high honey collecting capacity, is stingless, breeds very well and stays in bee hive for long period.

10. **(i)** Cell wall provides shape as well as rigidity to the cell.
**(ii)** It protects the protoplasm.
**(iii)** Growth of cell wall determines the growth of cell.

11. Apical meristems are the meristematic tissues which are found at the growing tips of stems and roots. They increase the length of the stems and roots and are responsible for the growth of plant.

**OR**

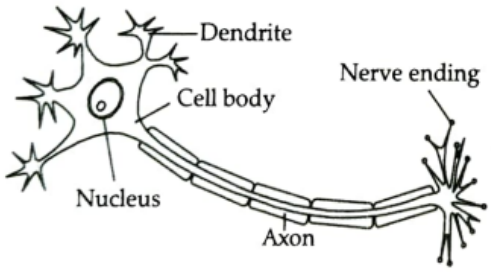
Differences between cytoplasm and nucleoplasm:

| S. No. | Cytoplasm | Nucleoplasm |
|---|---|---|
| (i) | Cytoplasm is the protoplasm which lies outside the nucleus, *i.e.*, between the nucleus and the cell membrane. | It is the part of protoplasm that lies inside the nucleus. |
| (ii) | It contains various organelles and inclusions. | It is a colloidal substance having similar composition to cytoplasm, but contains more of nucleotides. |
| (iii) | It contains a number of inorganic substances forming clear solution as well as organic substances lipids, protein and carbohydrates. | It contains chromatin material. |

12. (**a) Organic manure**
**(b)** Organic manure is not harmful for the environment as it is biodegradable.

13. Chromosomes are present in the nucleus of a cell. Their chemical composition is of DNA, proteins. Humans have 23 pairs of chromosomes.

14. **Structure:** The nervous tissue is made up of neurons which consist of a cell body with a nucleus and cytoplasm. From the cell body, long thin hair-like parts called dendrites arise.




Function: On stimulation, the nerve cells transmit the stimulus very rapidly from one place to another within the body.
**Location:** Nervous tissues are located in the brain, spinal cord and nerves.

15. **(a)**
**(i) Endocytosis:** The flexibility of the cell membrane enables the cell to engulf food and other materials from its external environment. Such process is known as endocytosis.
**(ii) Plasmolysis:** When a living plant cell loses water through osmosis, there is shrinkage or contraction of the contents of the cell away from the cell wall. This phenomenon is known as plasmolysis.
**(b)** When the organisation of a cell gets damaged, lysosomes will burst and their enzymes will eat up their own cell organelles. Therefore, lysosomes are also known as the "suicide bags of the cell"
**(c)** Gases like $CO_2$ and $O_2$ move in and out of the cell by diffusion from their higher concentration to lower concentration. Water enters the cell by endosmosis through semi-permeable plasma membrane from its higher concentration to lower concentration. Similarly, water moves out of the cell by exosmosis when a cell is placed in a hypertonic solution.

**OR**

**(a)** Complex tissues
**(b)** Columnar epithelium
**(c)** Cuboidal epithelium
**(d)** Involuntary muscular tissues
**(e)** Cardiac muscles

16. **(a)** Phloem

**(b)** Vascular Bundles are composed of xylem and phloem together.

**(c)** A – Sieve plate, B – Sieve tube, C – Phloem parenchyma, D – Companion cell

**OR**

If the phloem at the base of branch is removed, then lower area of the branch will not receive food from the leaves. But the plant will not die, as it will continue to receive food from other branches as food can move in phloem in both directions.