SCIENCE

Class IX

Time : **3 hrs** Max. Marks : **80**

GENERAL INSTRUCTIONS

1. The question paper comprises three sections-A, B and C. Attempt all the sections.
2. All questions are compulsory.
3. Internal choice is given in each section.
4. 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.
5. All questions in **Section B** are three-marks, short-answer type questions. These are to be answered in about 50-60 words each.
6. All questions in **Section C** are five-marks, long-answer type questions. These are to be answered in about 80-90 words each.
7. This question paper consists of a total of 30 questions.

Section {A} (Objective Type Questions, 1 Mark)

1. 'Epidermal cells of roots bear long hair-like parts called root hairs. Comment on how the presence of root hairs help the roots to perform their function well.

2. A boy stands on a box having 60 cm length, 40 cm breadth and 20 cm width in three ways. The pressure exerted by the box will be maximum when breadth and width form the base. Justify your answer.

3. Answer Q. Nos. 3(a)-3(d) *on the basis of your understanding of the following paragraph and the related studied concepts :*

A homogeneous mixture of two or more substances is called a true solution. It consists of solute and solvent. The particle size of a true solution is less than 1 nm. A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. A colloid is a mixture that is actually heterogeneous but appears to be homogeneous as the particles are uniformly spread throughout the solution.

3. (a) Among true solution, suspension and colloid, which one(s) are stable?

3. (b) Which type of mixture can be separated by filtration?

3. (c) Which type of mixture will not show Tyndall effect?

3. (d) In which type of mixture, the particles cannot be seen with the naked eye?

4. For Q. Nos. 4(i)-4(iv) *are based on the information given below. Study the information to answer the questions that follow :*

The diversity shown among the present day living organisms is an out come of billion of years of evolution during which many new species originated and many species became extinct. With such a huge repository of organisms, it would be almost impossible to study each and every living form separately at an individual level.

So, to study them in an effective way, different organisms are arranged in an systematic manner. This method of arranging organisms into groups or sets on the basis of certain similarities and differences is called classification. The most acceptable system of classification was proposed by Whittaker.

4. (i) Which amongst the following has specialised tissue for the conduction of water?

(a) Bryophyta (b) Pteridophyta

(c) Gymnosperms (d) Both (b) and (c)

4. (ii) Organisms belonging to phylum Echinodermata bear specialised locomotory organs.

(a) Muscular fat (b) Jointed legs

(c) Tubefeet (d) Parapodia

4. (iii) Name the scientist who introduced the system of nomenclature? What is the scientific name of the largest living bird?

4. (iv) Which amongst the five kingdoms of Whittaker's classification consists of all unicellular, prokaryotic organisms.

5. The density of water is

(a) 1000 kg / m^3 (b) 2000 kg / m^3

(c) 500 kg / m^3 (d) 900 kg / m^3

6. When we change feeble sound to loud sound we increase its

(a) frequency (b) amplitude

(c) velocity (d) wavelength

7. Which substance cannot be broken down by a chemical reaction?

(a) Ammonia (b) Argon

(c) Methane (d) Water

Or

The atoms of which of the following pair of elements are most likely to exist in free state?

(a) H and He (b) Ar and C (c) Ne and N (d) He and Ne

8. Growing of groundnut and wheat on the same field is known as

(a) organic farming (b) mixed cropping (c) inter cropping (d) crop rotation

Or

The method of obtaining fish from fish farming and not from natural resources is called

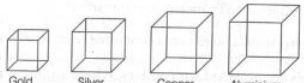
(a) capture fishing (b) culture fishery (c) mariculture (d) None of these

9. An object is put one by one in three liquids having different densities. The object floats with $\frac{1}{9}$, $\frac{2}{11}$ and $\frac{3}{7}$ parts of their volumes outside the liquid surface in liquids of densities d_1, d_2 and d_3, respectively. Which of the following statement is correct?

(a) $d_1 > d_2 > d_3$ (b) $d_1 > d_2 < d_3$ (c) $d_1 < d_2 > d_3$ (d) $d_1 < d_2 < d_3$

Or

These four metal cubes have the same mass but they have different dimensions.



The cubes are dropped from the same height, flat face down, into a bed of soft sand. Which metal cube will make the deepest impression in the sand?

(a) Gold cube (b) Silver cube (c) Copper cube (d) Aluminium cube

10. Bark of a tree which is protective in function, is impervious to water and gases. Which of the following chemicals helps it to achieve this characteristic?

(a) Suberin (b) Lignin (c) Pectin (d) Melanin

11. An organism has bilaterally symmetrical, cylindrical body, with three germ layers and a pseudocoelom. Identify the organism amongst the given options.

(a) Roundworm (b) Flatworm (c) Ringworm (d) Earthworm

12. Which of the following is the correct electronic configuration of Na?

(a) 2, 8, 1 (b) 8, 2, 1 (c) 2, 1, 8 (d) 2, 8, 2

Assertion-Reason Type Questions (Q. Nos. 13-14)

In each of the following questions, a statement of Assertion is given by the corresponding statement of Reason. Out of the given statements, choose the correct one.

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

(c) If Assertion is true, but Reason is false.

(d) If Reason is true, but Assertion is false.

13. Assertion The audible range of sound for human being is from 20 Hz to 20,000 Hz.

Reason For a human being, it is difficult to hear ultrasonic sound while easy to hear infrasonic sound.

14. Assertion Chloroplast is called the 'kitchen of the cell'.

Reason Chlorophyll pigment is present in chloroplast which helps in photosynthesis.

Section {B} (Short Answer Type Questions, 3 Marks)

15. (i) To empty an oil tin, two holes are made. Why?
(ii) The dimensions of wooden block are $2\text{m} \times 0.25\text{ m} \times 0.10\text{ m}$. If relative density of wood is 0.6, calculate mass of the block in kg. (Take, density of water $= 10^3\text{ kg m}^{-3}$)

16. What is intercropping? How is it beneficial to the farmers?

Or

Mention the measures that can be taken for weed control?

17. Four different mixtures in water are prepared by using charcoal powder, chalk powder, slaked lime and detergent powder. Which of these
(i) would not leave residue on filter paper after filtration?
(ii) would show Tyndall effect?
(iii) would leave residue on filter paper after filtration?

18. (i) A person jumping from a height on a concreted floor receives more injury than when jumping on a muddy floor. Why?
(ii) Bogies of trains are provided with buffers. Why?

Or

Glasswares are wrapped in straw during their transportation. Justify your answer.

19. Why is it that one is advised to avoid closed, crowded places like cinema halls during changing weather?

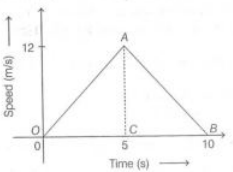
20. What are the characteristics of the particles of matter?

Or

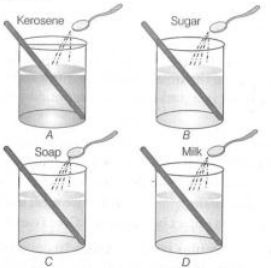
Explain about the plasma state of matter.

21. 'The plasma membrane of an animal cell bursts, when kept in a hypotonic solution. Analyse the consequences of the breakdown of plasma membrane.

22. The speed-time graph of a particle moving along a fixed direction is shown in the figure. Obtain the distance travelled by the particle between $t = 0$ s to $t = 10$ s. What is average speed of the particle over this interval?



23. The following substances are added to water in four separate beakers (as shown in the figure) and stirred will.



In beaker (*B*) only, by dissolving sugar in water, transparent and homogeneous solution is obtained while in the rest three beakers, heterogeneous solution is obtained.

Analyse the above given information and explain it in your own words.

24. 'Nitrogen is an essential nutrient for all life forms. However, atmospheric nitrogen cannot be used by the life forms directly. Nitrogen-fixation can be achieved by biological and physical process. The biological processes of N_2-fixation is carried out by certain bacteria, while, physical processes like lightening can also fix atmospheric nitrogen that can be used by other life forms.

Think and analyse the above statement and discuss in your own words the role of nitrogen-fixing bacteria and lightening in nitrogen-fixation.

Section {C} (Long Answer Type Questions, 5 Marks)

25. Define mole. Describe relationship between mole, Avogadro number and mass.

Or

(i) How to write a molecular or chemical formula?
(ii) Give two differences between sodium atom and sodium ion.
(iii) Give some examples of molecules containing more than four atoms. What are these called?

26. (i) Thallophyta, bryophyta and pteridophyta are called 'cryptogams' whereas gymnosperms and angiosperms are called 'phanerogams'. Is the statement correct? Support your answer giving reason.
(ii) 'Cotyledons are called seed leaves'. Comment.

27. Name the pathogen and vector for malaria. What are the symptoms of this disease? Discuss the methods of prevention and control of malaria?

Or

(i) How are airborne diseases like common cold transmitted?
(ii) How does the immune system of our body function after the entry of microbes?

28. (i) The average atomic mass of a sample of an element X is 16.2u. What are the percentages of isotopes ${}^{16}_{8}X$ and ${}^{18}_{8}X$ in the sample?

(ii) An atom contains 3 protons, 3 electrons and 4 neutrons. Find its atomic number, mass number and valency.

29. The velocity of a body moving in a straight line is increased by applying a constant force F for same distance in the direction of the motion. Prove that the increase in the kinetic energy of the body is equal to the work done by the force on the body.

Or

(i) When do we call work done to be positive or negative?

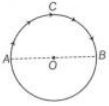
(ii) In the game of "tug of war" state the type of work done by winning and the losing teams.

(iii) Discuss whether or not work is done in the following cases :

(a) When we press a football. (b) When we push a table.

(iv) Can kinetic energy of an object be negative? Give reason.

30. An insect moves along a circular path of radius 10 cm with a constant speed. It takes 1 min to move from a point on the path to the diametrically opposite point, find (*i*) the distance covered, (*ii*) the speed, (*iii*) the displacement and (*iv*) the average velocity.



Answers

1. Epidermal cells of the roots, whose major function is water absorption, commonly bear long hair-like parts called root hairs. These greatly increase its total absorptive surface area, thus increasing water absorption. (1)

2. According to the definition of pressure $(p) = \frac{\text{force, } F}{\text{area, } A}$, i.e. pressure exerted by the box will be maximum when area is small. Now, as per question, when base is formed by breadth and width, area will be minimum, i.e. area of base having breadth × width is 800 cm^2 which is less compared to area of base having length × breadth (2400 cm^2) or length × width (1200 cm^2).
Thus, pressure exerted by the box will be maximum when breadth and width form the base. (1)

3. 3. (a) True solution and colloids are stable. (1)

3. (b) Suspension can be separated by filtration. (1)

3. (c) As the particle size is very small, true solutions do not show Tyndall effect. (1)

3. (d) In true solutions, the particles cannot be seen with the naked eye. (1)

4. 4. (i) (d) Both pteridophytes and gymnosperms are vascular plants, i.e. they possess specialised conducting tissues like xylem and phloem for the conduction of water and minerals. (1)

4. (ii) (c) Echinoderms possess a peculiar water driven tubefeet system that they use for locomotion or moving around. (1)

4. (iii) Carolus Linnaeus first introduced the system of nomenclature. The largest living bird is ostrich. Its scientific name is *Struthio camelus*. (1)

4. (iv) Kingdom Monera includes all unicellular prokaryotes. They do not have well-defined nucleus. Their mode of nutrition can be autotrophic or heterotrophic. (1)

5. (a) The density of water is 1000 kg / m^3. (1)

6. (b) The loudness or softness of a sound is determined by its amplitude. So, for a loud sound it must have higher amplitude. (1)

7. (b) Argon is present in its elemental form which cannot be broken down further, while others are compounds. Ammonia is formed by the elements nitrogen and hydrogen. Methane is formed by the elements carbon and hydrogen and water is formed by the elements hydrogen and oxygen. (1)

Or

(d) He and Ne exist in free state as both of them are noble gases. (1)

8. (b) Mixed cropping is growing two or more crops simultaneously on the same piece of land, e.g. wheat + gram, groundnut + wheat, etc. (1)

Or

(b) The method of obtaining fishes by fish farming is known as culture fishery. (1)

9. (d) In a liquid of higher density more part of the object remains outside the liquid. Since, the order of part of their volume of the object outside the liquid is given by (i.e. part of the object outside the liquid ∝ density of liquid)

$$\frac{1}{9} < \frac{2}{11} < \frac{3}{7}$$

Thus, the order of densities in increasing order is $d_1 < d_2 < d_3$ (1)

Or

(a) According to the question, mass of all the four metal cubes are same. As, force applied = weight of the cubes, i.e. $F = w = m \times g$

$\because$ $m_1 = m_2 = m_3 = m_4$

Hence, $F_1 = F_2 = F_3 = F_4$

But area of gold cube is minimum and pressure is related with area by the formula, $p = \frac{\text{Force}}{\text{Area}}$.

Hence, pressure on ground will be maximum in case of gold. So, gold cube will make the deepest impression in the sand as its area is least. (1)

10. (a) Bark of a tree is formed of a protective tissue called cork (or phellem). It consists of a chemical called suberin in their walls which makes them impervious to gases and water. (1)

11. (a) Roundworm has bilaterally symmetrical, cylindrical body with three germ layers and a pseudocoelom. It is called so because they appear circular in cross section and are unsegmented. (1)

12. (a) The atomic number of Na is 11 and its electronic configuration is 2, 8, 1. (1)

13. (c) A human being can hear only audible range of frequency (20 Hz to 20,000 Hz) but cannot hear infrasonic and ultrasonic sound. Hence, Assertion is true, but Reason is false. (1)

14. (a) Chloroplast is a type of plastid that contains a green pigment chlorophyll. This pigment helps the plants to prepare their own food by the process of photosynthesis. Therefore, it is also known as the "kitchen of the cell." (1)

15. (i) If only one hole is made in the tin, the oil does not come out because pressure inside the tin is less than the outside atmospheric pressure. When two holes are made, air continues to enter the tin through the second hole and the pressure inside the tin becomes equal to the atmospheric pressure. Hence, the oil comes out easily as the two holes maintain the pressure inside the tin. (1)

(ii) Given, relative density of wood $= 0.6 = \frac{\text{Density of wood}}{\text{Density of water}} = \frac{\text{Density of wood}}{10^3 \text{ kg m}^{-3}}$

$\therefore$ Density of wood $= 0.6 \times 10^3$ kg m^{-3}

Volume of wood $= 2 \times 0.25 \times 0.10\ m^3 = 0.05\ m^3$

As we know, mass of wooden block = Density × Volume $= 0.6 \times 10^3 \times 0.05$ kg $= 0.030 \times 10^3$ kg (2)

16. Intercropping is growing of two or more crops simultaneously on the same field in a definite pattern. A few rows of one crop (e.g. soybean) alternate with a few rows of a second crop (e.g. maize). The crops are selected, so that their nutrient requirements are different.

It is beneficial to the farmers as it ensures maximum utilisation of the nutrients supplied and also restricts the spread of pests and diseases. (3)

Or

Weed control can be done by the following methods

(i) By the use of pesticides, herbicides and fungicides which are chemicals sprayed on crop plants or used for treating seeds and soil. They can also be controlled by mechanical removal. (1)

(ii) By preventive methods such as proper seed bed preparation, timely sowing of crops. Intercropping and crop rotation also help in weed control. (1)

(iii) Summer ploughing in which fields are ploughed deep in summers to destroy weeds and pests. (1)

17. (i) Detergent solution and slaked lime solution (called lime water) will not leave any residue on the filter paper after filtration because both are soluble in water. (1)

(ii) Detergent solution will show Tyndall effect as it forms colloidal solution. (1)

(iii) Charcoal powder solution and chalk powder solution will leave residue on filter paper as these are not soluble in water. (1)

18. (i) This is because on a concrete floor the momentum of the person reduces to zero in a smaller time interval and so the floor exerts a large force on his feet. On the other hand, when the person jump on a heap of sand, then his feet are embedded into the sand to same extant and thus his momentum reduces to zero in a longer time interval. Hence, the force exerted by the sand on the feet of the person is much smaller. Thus, person gets less injury. (2)

(ii) Buffers increase the time duration of jerks during shunting. This reduces the force with which bogies pull each other and severe jerks are avoided. (1)

Or

During transportation, the glasswares may break, if they collide with each other due to jerks. When they are wrapped in straw, the force produced due to jerk is transmitted to them through the pieces of straw in a longer period of time. Thus, the change in momentum of the glasswares takes place in a longer period of time. Therefore, a very small force is experienced by them during jerks and hence they will not break. (3)

19. During changing weather, we are advised to avoid crowded places because changing season is the time when infectious agents are most prevalent. Closed crowded places provide the moist conditions that favour the growth of pathogens. Thus, chances of contracting an infection increase. Moreover, an individual may also come in contact with an infected person, thus increasing his/her vulnerability to catch a disease. (3)

20. The characteristics of the particles of matter are following :

(a) Matter consists of tiny particles which cannot be seen by an individual with naked eye.

(b) The particles of matter have spaces between them.

(c) The particles of matter attract each other with a force called intermolecular forces of attraction. The forces of attraction are maximum in solids and minimum in gases. Liquids have intermolecular forces between solids and gases.

(d) The particles of a matter are not stationary but are continuously moving.

(e) The intermolecular forces decrease with the increase in intermolecular spaces and *vice-versa*.

(f) Kinetic energy of the molecule increases with the rise in temperature. $\left(\frac{1}{2}\times 6 = 3\right)$

Or

Scientists are reported to have discovered a new state of matter which is called plasma state.

This state does not fit into any of the previously known three states of matter. Hence, it is often called the fourth state of matter. Plasma state consists of highly ionised gas in which the particles exist in super energetic and super excited states. (1)

The discovery of plasma has found some practical applications which are given below :

You must have seen fluorescent tubes and neon sign bulbs. The fluorescent tube contains helium or some other gas. When electric current is passed through the gas, it produces glowing plasma, having a characteristic colour depending upon the nature of the gas.

Plasma is produced in the sun and in the stars due to high temperature. It is the presence of plasma that makes them glow. (2)

21. If the plasma membrane of a cell breaks or bursts, it would result in the following

- All the useful substances will move out of the cell because the membrane is selectively permeable and the transportation of materials will be disturbed.
- The cell will loose its normal shape.
- This may ultimately lead to the death of the cell. (3)

22. The distance travelled by the particle between 0 s to 10 s = Area of ΔOAB

$$= \frac{1}{2}\times OB \times AC = \frac{1}{2}\times 10 \times 12 = 60 \text{ m} \quad (2)$$

The average speed in time interval, $t = 0$ s to $t = 10$ s $= \dfrac{\text{Distance travelled}}{\text{Time}} = \dfrac{60}{10} = 6 \text{ m/s}$ (1)

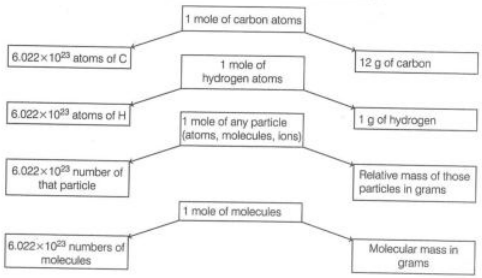
23. When sugar dissolved in water, transparent and homogenous solution is formed because the particles are uniformly distributed throughout the solution. Such solution is also called a true solution. Whereas in kerosene-water, soap-water and milk-water, the solution is heterogenous because the particles are not completely distributed throughout the solution. Such solutions are called colloidal solution that is actually heterogeneous but appears to be homogeneous. (3)

24. (i) The 'nitrogen-fixing' bacteria may be either free-living (*e.g. Azotobacter*) or associated with some species of dicot plants as symbionts (*e.g. Rhizobium* in root nodules of legumes). These bacteria reduce the nitrogen gas present in the atmosphere to nitrates and nitrites which can then be used by plants. (1½)

(ii) Lightening is a physical process of nitrogen-fixation. The energy produced during lightening helps to combine a small quantity of nitrogen with the oxygen in the atmosphere forming nitrogen oxides. The latter dissolves in rainwater to give nitric and nitrous acids and fall on land. These are then utilised by various life forms. (1½)

25. A mole of atom is a collection of atoms where total mass is the number of grams equal to the atomic mass. A mole represents a definite number of particles, *viz*-atoms, molecules, ions or electrons. This definite number is called the Avogadro number which is equal to 6022×10^{23}. (2)

The relationship between mole, Avogadro number and mass is as follows:



(3)

Or

(i) A molecular formula is a representation of a chemical compound using a set of symbols for the atoms of elements present in a molecule of the compound and shows the actual number of atoms of each element of the compound. (1)

(ii)

Sodium atom	Sodium ion
Na has 11 electrons in its shells.	Na^+ has 10 electrons in its shell.
Na is neutral.	Na^+ is a positively charged particle on cation.

(2)

(iii) Molecules which contain more than four atoms are called polyatomic molecules, e.g. sulphur (S_8), ethyl alcohol (C_2H_5OH). (2)

26. (i) The reproductive organs of thallophytes, bryophytes and pteridophytes are inconspicuous or hidden. Therefore, they are called cryptogams (Cryptogamae means hidden reproduction). They produce naked embryos after fertilisation that are called spores.

On the other hand in phanerogams (Gk. *Phaneros* = visible) plants produce seeds and have well-differentiated reproductive tissues. In these plants, seeds consist of embryo along with the stored food. The stored food serves the purpose of initial growth of the embryo during germination. (3)

(ii) Cotyledons are also called 'seed leaves' because they are structures present in the seeds which act as food reserve for the growing plant. In many cases, they emerge and become green when the seeds germinate. (2)

27. Malaria is caused by the protozoan pathogen *Plasmodium*. This disease spreads through the bite of a insect vector, i.e. the female *Anopheles* mosquito, which feeds on human blood. (1)

The symptoms of malaria are

(i) Fever, headache, nausea and muscular pain.

(ii) Each malarial attack is of 6-10 hours duration and consists of the three stages. These three stages are

(a) **Cold stage** Feeling extreme cold and shivers.

(b) **Hot stage** High fever, fast respiration and heartbeats are increased.

(c) **Sweating stage** It is due to the sweating that the temperature of the body goes down. (2)

The only way to prevent and control malaria is to take precaution against mosquito bites. Preventive measures against malaria can be achieved by the following methods

(i) Mosquito repellent should be used to prevent mosquito bite.

(ii) Mosquito larvae can be killed by sprinkling kerosene oil in open drainage, water coolers or any uncovered waterbodies. Adult mosquitoes can be killed by spraying insecticides, e.g. BHC, malathion.

(iii) Using mosquito nets while sleeping.

(iv) Wire-gauze should be used on doors and windows of houses to prevent entry of mosquitoes. (2)

Or

(i) Airborne diseases like common cold are transmitted through the little droplets thrown out by an infected person during sneezing or coughing. These droplet contain infectious agents. Someone standing close to an infected person can breathe in these droplets and the microbes present in them can start a new cycle of infection. (2)

(ii) When virus, bacteria or other microbes enter our body, they begin to multiply and cause infection. As a result of infection, the cells of our body get damaged and signs and symptoms specific to an illness appear. Our immune system comes into action in response an to infection. It recruits many cells to the affected tissue and kill the disease causing microbes. This process causes inflammation, due to which swelling, pain and fever occur. (3)

28. (i) Let the percentage of $^{16}_{8}X = x$. Then, the percentage of $^{18}_{8}X = (100 - x)$ ...(i)

Average atomic mass of $X = 16.2$ u

According to the given data, $16 \times \frac{x}{100} + 18 \times \frac{(100-x)}{100} = 16.2 \Rightarrow \frac{16x}{100} + \frac{1800-18x}{100} = 16.2$

$16x + 1800 - 18x = 1620 \quad \Rightarrow -2x = -1800 + 1620 \Rightarrow x = \frac{180}{2} = 90$

$\therefore$ Percentage of $^{18}_{8}X = 100 - 90 = 10\%$ and percentage of $^{16}_{8}X = x = 90\%$

or isotope $^{16}_{8}X = 90\%$; Isotope $^{18}_{8}X = 10\%$ (3)

(ii) Atomic number = Number of protons = 3

Mass number = Number of protons + Number of neutrons = 3 + 4 = 7

Electronic configuration of the atom is $\overset{K}{2}\ \overset{L}{1}$.

Hence, its valency is 1. (2)

29. Consider an object of mass m moving with a uniform velocity u. Let it now be displaced through a distance s, when a constant force F acts on it in the direction of its displacement.

From the third equation of motion, $v^2 = u^2 + 2as$

$\Rightarrow \quad v^2 - u^2 = 2as \quad \Rightarrow s = \frac{v^2 - u^2}{2a}$ ...(i)

We know that, work done by F is (1)

$W = Fs\cos\theta = Fs$ (Since, force and displacement are in same direction, so $\theta = 0°$.)

$W = ma \times s$ ($\because F = ma$)

$= ma \times \left(\frac{v^2 - u^2}{2a}\right)$ (From Eq (i))

$W = \frac{1}{2}m(v^2 - u^2)$ ...(ii)

If the object is starting from its stationary position, (2)

i.e. $u = 0$, from Eq (ii), we get

$$W = \frac{1}{2}mv^2$$

It is clear that the work done is equal to the increase in the kinetic energy of an object. (2)

Or

(i) If the direction of force and displacement is same, i.e. the angle between force and displacement is 0° (or acuteangle), then the work done will be positive. (½)

If the force and displacement are opposite to each other, i.e. the angel between force and displacement is 180° (or obtuse angle), then work done will be negative. (½)

(ii) In the game of "tug of war" work done by the winning team is positive and the work done by the losing team is negative. (1)

(iii) (a) In pressing a football, we change its volume. Therefore, work is done against the pressure of the gas inside the bladder of the football. (1)

(b) When we push a table, we do work against the force of friction between the legs of the table and the floor. (1)

(iv) No, the kinetic energy of an object cannot be negative because both m and v^2 are always positive.

i.e. $KE = \frac{1}{2}mv^2$ = Positive (1)

30. Suppose the insect was at A initially and it moves along ACB to reach the diametrically opposite point B in 1 min.

(*i*) $\therefore$ The distance moved in 1 min $= \pi r = 3.14 \times 10 = 31.4$ cm (1)

(*ii*) $\therefore$ Speed $= \frac{\text{Distance}}{\text{Time}} = \frac{31.4}{1} = 31.4$ cm/min (1)

(*iii*) $\therefore$ Displacement, $AB = 2r = 2 \times 10 = 20$ cm (1)

(*iv*) $\therefore$ Average velocity,

$$v_{av} = \frac{\text{Displacement}}{\text{Time}} = \frac{20\text{ cm}}{1\text{ min}} = 20\text{ cm/min}$$

(2)