

**CBSE Science - Grade X**  
**Solution for 2023-24 Examination**

**Question paper Code: 31/1/1**

**विज्ञान**  
**SCIENCE**

निर्धारित समय : 3 घण्टे

Time allowed : 3 hours

अधिकतम अंक : 80

Maximum Marks : 80

नोट	NOTE
(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 27 हैं ।	(I) Please check that this question paper contains 27 printed pages.
(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में 39 प्रश्न हैं ।	(II) Please check that this question paper contains 39 questions.
(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।	(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
(IV) कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।	(IV) Please write down the serial number of the question in the answer-book before attempting it.
(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।	(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

### **General Instructions:**

Read the following instructions very carefully and strictly follow them:

- (i) This question paper comprises **39** questions. **All** questions are compulsory.
- (ii) This question paper is divided into **five** sections **A, B, C, D, and E**.
- (iii) **Section A** - Questions No. **1** to **20** are multiple-choice questions. Each question carries **1** mark.
- (iv) **Section B**-Questions No. **21** to **26** are very short answer type questions. Each question carries **2** marks. Answers to these questions should be in the range of 30 to 50 words.
- (v) **Section C** - Questions No. **27** to **33** are short answer type questions. Each question carries **3** marks. Answers to these questions should be in the range of 50 to 80 words.
- (vi) **Section D** - Questions No. **34** to **36** are long answer-type questions. Each question carries **5** marks. Answers to these questions should be in the range of 80 to 120 words.
- (vii) **Section E** - Questions No. **37** to **39** are of 3 source-based/case-based units of assessment carrying **4** marks each with sub-parts.
- (viii) There is no overall choice. However, an internal choice has been provided in some sections. Only one of the alternatives has to be attempted in such questions.

## **SECTION A**

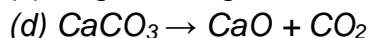
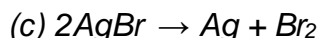
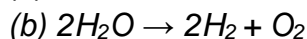
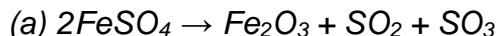
Select and write the most appropriate option out of the four options given for each of the questions no. **1** to **20**. **20×1=20**

1. When 2 mL of sodium hydroxide solution is added to few pieces of granulated zinc in a test tube and then warmed, the reaction that occurs can be written in the form of a balanced chemical equation as: [1]
- (a)  $\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2 \text{ O}$
  - (b)  $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$
  - (c)  $2\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2$
  - (d)  $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O}$

**Solution:** (b)  $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$

**Explanation:** When zinc is added in sodium solution sodium zincate ( $\text{Na}_2\text{ZnO}_2$ ) is formed along with hydrogen gas.

2. *Select from the following a decomposition reaction in which source of energy for decomposition is light:* [1]



**Solution:** (c)  $2\text{AgBr} \rightarrow \text{Ag} + \text{Br}_2$

**Explanation:**  $2\text{AgBr} \rightarrow \text{Ag} + \text{Br}_2$  is an example of a photochemical decomposition reaction. In a photochemical reaction, light energy is used to break chemical bonds and initiate the reaction.

3. *A metal and a non-metal that exists in liquid state at the room temperature are respectively:* [1]

(a) *Bromine and Mercury*

(b) *Mercury and Iodine*

(c) *Mercury and Bromine*

(d) *Iodine and Mercury*

**Solution:** (c) Mercury and Bromine

**Explanation:** Mercury is the metal which exists as a liquid at room temperature, while bromine is the non-metal which exists as a liquid at room temperature.

4. *Carbon compounds:* [1]

(i) *are good conductors of electricity.*

(ii) *are bad conductors of electricity.*

(iii) *have strong forces of attraction between their molecules.*

(iv) *have weak forces of attraction between their molecules.*

*The correct statements are:*

(a) *(i) and (ii)*

(b) *(ii) and (iii)*

(c) *(ii) and (iv)*

(d) *(i) and (iii)*

**Solution:** (c) (ii) and (iv)

**Explanation:** Carbon compounds are bad conductors of electricity and Carbon compounds have weak forces of attraction between their molecules.

5. Consider the following compounds: [1]

$FeSO_4$ ;  $CuSO_4$ ;  $CaSO_4$ ;  $Na_2CO_3$

The compound having maximum number of water of crystallisation in its crystalline form in one molecule is:

- (a)  $FeSO_4$
- (b)  $CuSO_4$
- (c)  $CaSO_4$
- (d)  $Na_2CO_3$

**Solution:** (d)  $Na_2CO_3$

**Explanation:** Number of water of crystallization in the mentioned compounds are

- (a) Ferrous sulphate- 7
- (b) Copper sulphate - 5
- (c) Calcium sulphate - 2 or half
- (d) Sodium Carbonate - 10

6. Oxides of aluminium and zinc are: [1]

- (a) acidic
- (b) basic
- (c) amphoteric
- (d) neutral

**Solution:** (c) amphoteric

**Explanation:** Some metal oxides, such as aluminum oxide, zinc oxide, etc., show both acidic as well as basic behavior. Such metal oxides can react with both acids as well as bases to produce salts and water. Metal oxides of this category are known as amphoteric oxides.

7.  $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

The reaction given above is a redox reaction because in this case: [1]

- (a)  $MnO_2$  is oxidised and  $HCl$  is reduced.
- (b)  $HCl$  is oxidised.
- (c)  $MnO_2$  is reduced.
- (d)  $MnO_2$  is reduced and  $HCl$  is oxidised.

**Solution:** (d)  $MnO_2$  is reduced and HCl is oxidised.

**Explanation:** Here HCl is oxidized to  $Cl_2$  and  $MnO_2$  is reduced to  $MnCl_2$ .

The reaction in which oxygen is either gained or hydrogen is lost by a substance is called oxidation reaction.

The reaction in which hydrogen is gained or oxygen is lost by a substance is called reduction reaction.

**8. Consider the following statements:** [1]

- (i) The sex of a child is determined by what it inherits from the mother.
- (ii) The sex of a child is determined by what it inherits from the father.
- (iii) The probability of having a male child is more than that of a female child.
- (iv) The sex of a child is determined at the time of fertilisation when male and female gametes fuse to form a zygote.

The correct statements are:

- (a) (i) and (iii)
- (b) (ii) and (iv)
- (c) (iii) and (iv)
- (d) (i), (iii) and (iv)

**Solution:** (b) (ii) and (iv)

**Explanation:** Human males have a XY genotype and form two types of sperms carrying either X or Y sex chromosomes. A zygote formed by fusion of sperm with X and an egg cell results in a female child, whereas the fusion of a Y sperm leads to a male child.

**9. Chromosomes:** [1]

- (i) carry hereditary information from parents to the next generation.
- (ii) are thread-like structures located inside the nucleus of an animal cell.
- (iii) always exist in pairs in human reproductive cells.
- (iv) are involved in the process of cell division.

The correct statements are:

- (a) (i) and (ii)
- (b) (iii) and (iv)
- (c) (i), (ii) and (iv)
- (d) (i) and (iv)

**Solution:** (c) (i), (ii), and (iv)

**Explanation:** The chromosome is present in the nucleus of each cell, and it is packaged into thread-like structures. Structurally, each chromosome is composed of DNA that is tightly coiled around special proteins called histones. Typically, chromosomes are not

visible under the microscope. The only time they are visible is during the process of cell division.

- 10.** *In a nerve cell, the site where the electrical impulse is converted into a chemical signal is known as:* [1]
- (a) Axon
  - (b) Dendrites
  - (c) Neuromuscular junction
  - (d) Cell body

**Solution:** (c) Neuromuscular junction

**Explanation:** Information in a neuron travels in the form of electrical impulses. Dendrite in a neuron acquires information. This information travels in the form of electrical impulse through the axon to reach the nerve ending. At the nerve ending, it is converted to a chemical signal. This chemical crosses a gap called synapse/neuromuscular junction and reaches the next neuron generating an electrical impulse there.

- 11.** *A stomata closes when:* [1]
- (i) *it needs carbon dioxide for photosynthesis.*
  - (ii) *it does not need carbon dioxide for photosynthesis.*
  - (iii) *water flows out of the guard cells.*
  - (iv) *water flows into the guard cells.*
- The correct reason(s) in this process is/are:*
- (a) (i) only
  - (b) (i) and (iii)
  - (c) (ii) and (iii)
  - (d) (ii) and (iv)

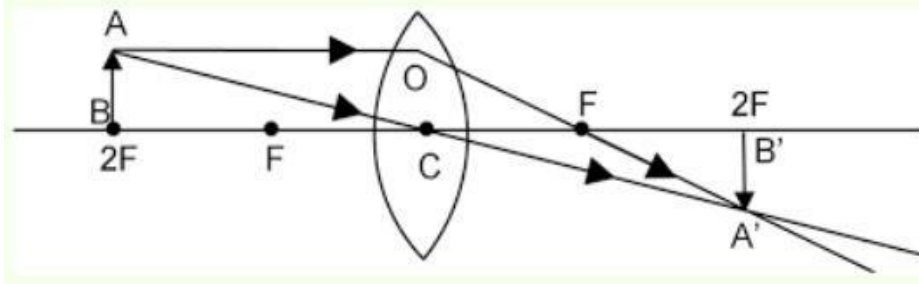
**Solution:** (c) (ii) and (iii)

**Explanation:** When a plant does not require additional carbon dioxide for photosynthesis, it can close its stomata to reduce water loss through transpiration. The turgor pressure in the guard cells decreases when water flows out, causing the cells to become flaccid and leading to stomatal closure. So, option (c) (ii) and (iii) is the correct answer.

- 12.** *At what distance from a convex lens should an object be placed to get an image of the same size as that of the object on a screen?* [1]
- (a) *Beyond twice the focal length of the lens.*
  - (b) *At the principal focus of the lens.*
  - (c) *At twice the focal length of the lens.*
  - (d) *Between the optical center of the lens and its principal focus.*

**Solution:** (c) At twice the focal length of the lens.

**Explanation:**



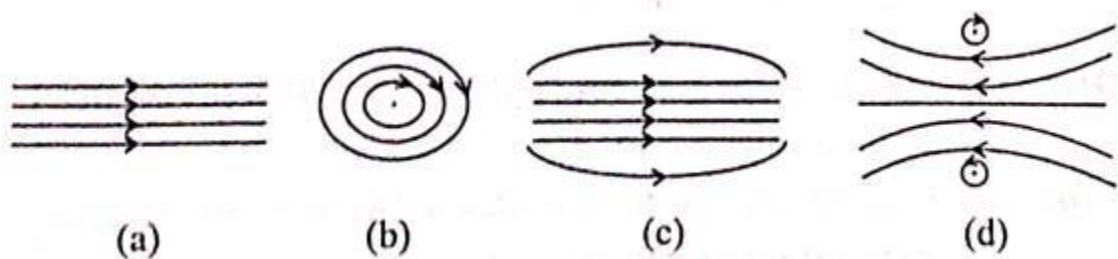
When the object is placed at twice the focal length, the image formed by the convex lens is real and of the same size as the object.

- 13.** The lens system of human eye forms an image on a light sensitive screen, which is called as: [1]
- (a) Cornea
  - (b) Ciliary muscles
  - (c) Optic nerves
  - (d) Retina

**Solution:** (d) Retina

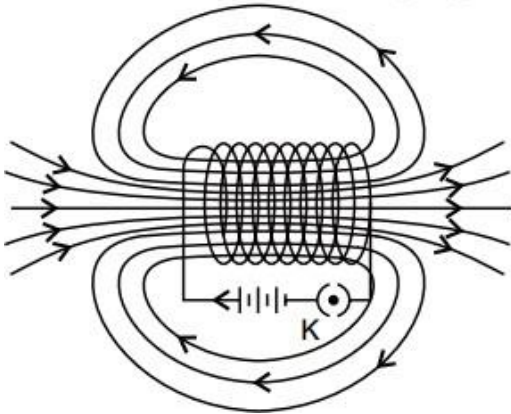
**Explanation:** The retina is the light-sensitive tissue at the back of the eye. The retina converts light into electrical impulses that are sent to the brain through the optic nerve.

- 14.** The pattern of the magnetic field produced inside a current carrying solenoid is: [1]



**Solution:** (a)

**Explanation:** The magnetic field lines inside a solenoid run parallel to the axis of the solenoid.



**15.** Identify the food chain in which the organisms of the second trophic level are missing: [1]

- (a) Grass, goat, lion
- (b) Zooplankton, Phytoplankton, small fish, large fish
- (c) Tiger, grass, snake, frog
- (d) Grasshopper, grass, snake, frog, eagle

**Solution:** (c) Tiger, grass, snake, frog

**Explanation:** There should be a herbivore present on the second trophic level.

Grass, **[Herbivore]**, Frog, Snake, Tiger.

**16.** In which of the following organisms, multiple fission is a means of asexual reproduction? [1]

- (a) Yeast
- (b) Leishmania
- (c) Paramecium
- (d) Plasmodium

**Solution:** (d) Plasmodium

**Explanation:** Multiple fission is a method of asexual reproduction where a single parent cell divides into multiple daughter cells simultaneously. The nucleus of the Plasmodium cell undergoes multiple divisions, resulting in the simultaneous formation of several daughter cells.



**For Question number 17 to 20, two statements are given- one labeled as Assertion (A) and the other labeled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.**

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
- (b) Both Assertion (A) and Reason (R) are true and Reason (R) is **not** the correct explanation of the Assertion (A).
- (c) Assertion (A) is true, but Reason (R) is false.
- (d) Assertion (A) is false, but Reason (R) is true.

**17.** Assertion (A): Hydrogen gas is not evolved when zinc reacts with nitric acid.

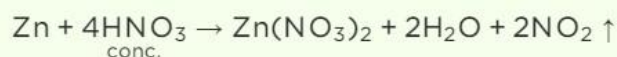
Reason (R): Nitric acid oxidizes the hydrogen gas produced to water and itself gets reduced. [1]

**olution:** (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

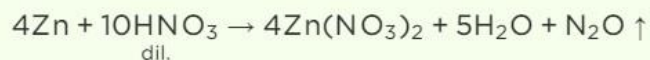
**Explanation:**

The following is the reaction of Zn with nitric acid:

Zn reacts with conc.  $\text{HNO}_3$  to form nitrogen dioxide:



Zn reacts with dil.  $\text{HNO}_3$  to form nitrous oxide:



Nitric acid is a strong oxidising agent. Nitric acid oxidises hydrogen gas into water.

**18.** Assertion (A): Accumulation of harmful chemicals is maximum in the organisms at the highest trophic level of a food chain.

Reason (R): Harmful chemicals are sprayed on the crops to protect them from diseases and pests. [1]

**Solution:** (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

**Explanation:** Both the assertion and reason are correct. The accumulation of harmful chemicals is indeed maximum in organisms at the highest trophic level due to the process of biomagnification. The reason for this is the use of chemicals in agriculture, which can persist in the environment and become more concentrated as they move up the food chain.

**19.** Assertion (A): The rate of breathing in aquatic organisms is much faster than in terrestrial organisms.

Reason (R): The amount of oxygen dissolved in water is very high as compared to the amount of oxygen in air. [1]

**Solution:** (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

**Explanation:** Since the amount of dissolved oxygen is fairly low compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms. Fishes take in water through their mouths and force it past the gills where the dissolved oxygen is taken up by blood.

The reason provided is a correct explanation for the assertion. The higher concentration of dissolved oxygen in water is a key factor influencing the respiratory rates of aquatic organisms.

**20.** Assertion (A): The rainbow is a natural spectrum of sunlight in the sky.

Reason (R): Rainbow is formed in the sky when the sun is overhead and water droplets are also present in air. [1]

**Solution:** (c) Assertion (A) is true, but Reason (R) is false.

**Explanation:**

The rainbow is indeed a natural spectrum of sunlight and the Sun must be behind you and the clouds cleared away from the Sun for the rainbow to appear.

## SECTION B

Questions no. 21 to 26 are very short answer type questions.

**21.** Name the type of chemical reaction in which calcium oxide reacts with water. Justify your answer by giving a balanced chemical equation for the chemical reaction. [2]

**Solution:** This is combination reaction

- A combination reaction is a reaction where two or more elements or compounds combine to form a single compound.
- Calcium oxide combines with water to form calcium hydroxide. Hence, it is a combination reaction.

- It is an exothermic reaction as a lot of heat liberates with a hissing sound during the reaction.

The balanced equation of calcium oxide with water is written as below:



**22.** State one role of each of the following in human digestive system: [2]

(i) Hydrochloric acid

(ii) Villi

(iii) Anal Sphincter

(iv) Lipase

**Solution:** (i) **Hydrochloric acid** creates an acidic medium which facilitates the action of the enzyme pepsin aiding in the digestion of proteins into smaller peptides.

(ii) **Villi** are finger-like projections in the small intestine that increase the surface area for nutrient absorption. They play a vital role in absorbing nutrients such as amino acids, fatty acids, and glucose into the bloodstream.

(iii) The **anal sphincter** muscles control the opening and closing of the anus. The exit of waste material from the anus is regulated by the anal sphincter.

(iv) **Lipase** is an enzyme that breaks down emulsified fats (lipids) into fatty acids and glycerol.

**23.** (A) How is the movement of leaves of a sensitive plant different from the downward movement of the roots? [2]

**OR**

(B) There is a hormone which regulates carbohydrate, protein and fat metabolism in our body. Name the hormone and the gland which secretes it. Why is it important for us to have iodised salt in our diet? [2]

**Solution:** (A) The movements of the leaves of the sensitive plant are touch sensitive and independent of growth, called Nastic movements. They take place immediately in response to the stimulus of touch (thigmotropism).

While the movement of the shoot towards light is growth related, takes place over a longer period of time. These movements where the stimulus is light is known as phototropism.

**OR**

(B) The hormone which regulates carbohydrates, protein and fat metabolism in our body is thyroxine. Thyroxine hormone is secreted by the thyroid gland.

Iodised salt in the diet is important because it contains iodine which is essential for the synthesis of thyroxine hormone by the thyroid gland. In case, iodine is deficient in our diet there is a possibility of suffering from goitre.

24. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position of the image formed by the mirror. [2]

**Solution:** Given that,

$$u = -10 \text{ cm} \quad f = +15 \text{ cm} \quad v = ?$$

According to the mirror formula,

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

where,  $u$  = the distance between the object and the pole of the mirror,

$v$  = the distance between the image and the pole of the mirror,

and  $f$  = focal length

$$\Rightarrow \frac{1}{v} = \frac{1}{15} - \frac{1}{-10}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{15} + \frac{1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{2+3}{30} = \frac{5}{30}$$

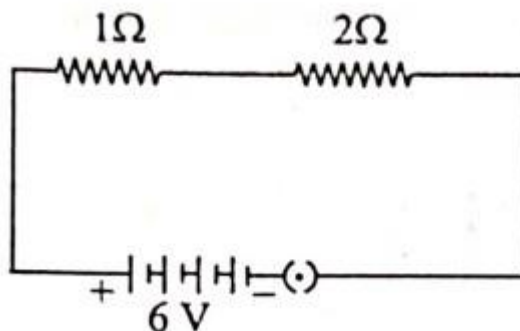
$$\Rightarrow v = \frac{30}{5} = 6 \text{ cm}$$

So, when an object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm, the image will be formed at a distance of 6 cm behind the mirror.

25. (A) Show how you would connect three resistors each of resistance  $6 \Omega$ , so that the combination has a resistance of  $9 \Omega$ . Also justify your answer. [2]

**OR**

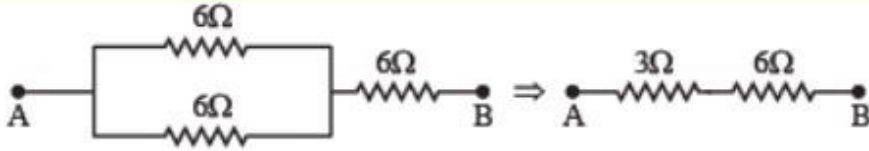
- (B) In the given circuit, calculate the power consumed in watts in the resistor of  $2 \Omega$ :



[2]

**Solution:**

- (A) To get a resistance of  $9 \Omega$  from three resistors of  $6 \Omega$ , connect two resistors in parallel and the other in series with this combination.



If we connect the resistors in series, then the equivalent resistance will be the sum of the resistors, i.e.,  $6\ \Omega + 6\ \Omega + 6\ \Omega = 18\ \Omega$ , which are not desired. If we connect the resistors in parallel, then the equivalent resistance will be  $\frac{1}{R} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$ , that is  $R = 2\ \Omega$  is also not desired. Hence, we should either connect the two resistors in series or parallel.

**(B)**

Total resistance,  $R = 1 + 2 = 3\ \Omega$  .....(resistors in series)

Potential difference,  $V = 6\ V$

Current  $I = \frac{V}{R} = \frac{6\ V}{3\ \Omega} = 2\ A$

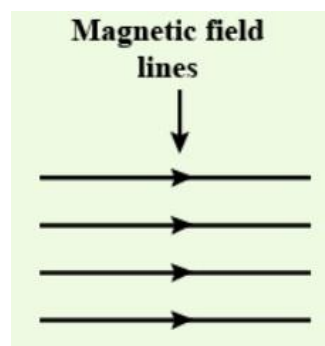
Power used in  $2\ \Omega$  resistor =  $I^2 R = (2)^2 \times 2 = 8\ W$

- 26.** (i) Two magnetic field lines do not intersect each other. Why? [1]  
(ii) How is a uniform magnetic field in a given region represented? Draw a diagram in support of your answer. [1]

**Solution:**

(i) If magnetic field lines intersect each other, then at the intersection point there will be two directions of the same field which is not possible. Hence the field lines do not cross or intersect each other.

(ii) Uniform magnetic field is represented by parallel magnetic field lines in the same direction.



## SECTION C

Questions no. 27 to 33 are short answer type questions.

27. Write one chemical equation each for the chemical reaction in which the following have taken place:

(i) Change in colour

(ii) Change in temperature

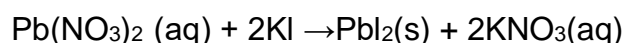
(iii) Formation of precipitate

Mention colour change/temperature change (rise/fall)/compound precipitated along with the equation. [3]

**Solution:**

**(i) Change in colour:**

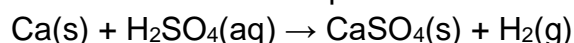
The reaction between lead nitrate solution and potassium iodide solution.



In this reaction colour changes from colourless to yellow due to formation of  $\text{PbI}_2$

**(ii) Change in temperature:**

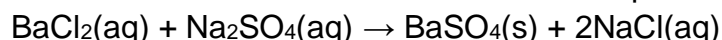
The action of dilute sulphuric acid on calcium.



In this reaction, heat evolves.

**(iii) Formation of precipitate:**

The action of barium chloride on sodium sulphate.



Here,  $\text{BaSO}_4(\text{s})$  is a white precipitate.

28. (i) The pH of a sample of tomato juice is 4.6. How is this juice likely to be in taste? Give reason to justify your answer.

(ii) How do we differentiate between a strong acid and a weak base in terms of ion-formation in aqueous solutions?

(iii) The acid rain can make the survival of aquatic animals difficult. How? [3]

**Solution:**

(i) Tomato juice with a pH of 4.6 is considered slightly acidic. The taste of tomato juice at this pH level is likely to be tangy or slightly sour. This is because acidic substances tend to impart sourness or tanginess to foods and beverages.

(ii) Strong Acids : Ionize fully in water to give  $\text{H}^+$  ions in large numbers.

Weak Base : Ionize partially in water to give  $\text{OH}^-$  ions in small numbers.

(iii) Acid rain lowers the pH of water, directly harming aquatic animals by damaging their gills and skin. It mobilizes toxic metals like aluminum, which can poison aquatic organisms. Acidic conditions disrupt reproduction, affecting spawning success and offspring viability. Additionally, it alters habitats and food chains, leading to reduced biodiversity and population declines among aquatic species.

**29.** (i) *Why is respiratory pigment needed in multicellular organisms with large body size?*

(ii) *Give reasons for the following:*

(a) *Rings of cartilage are present in the throat.*

(b) *Lungs always contain a residual volume of air.*

(c) *The diaphragm flattens and ribs are lifted up when we breathe in.*

(d) *Walls of alveoli contain an extensive network of blood vessels.* [3]

**Solution:** (i) When the body size of animals is large, the diffusion pressure alone cannot take care of oxygen delivery to all parts of the body. Instead, respiratory pigments take up oxygen from the air in the lungs and carry it to tissues which are deficient in oxygen before releasing it.

(ii)

(a) Rings of cartilage are present in the throat. These ensure that the air-passage does not collapse.

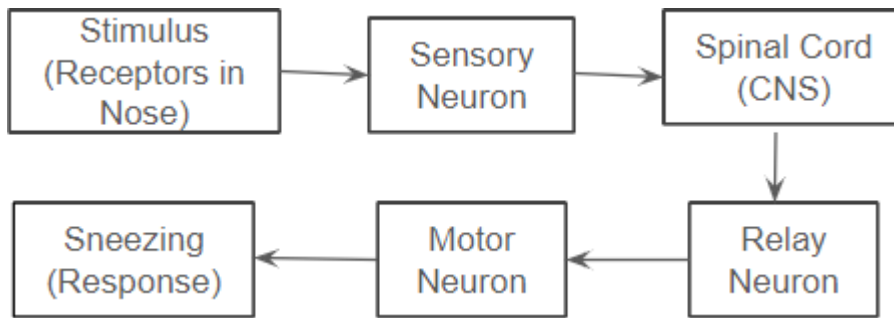
(b) The lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and for the carbon dioxide to be released.

(c) When we breathe in, we lift our ribs and flatten our diaphragm which increases the chest cavity. Because of this, air is sucked into the lungs and fills the expanded alveoli.

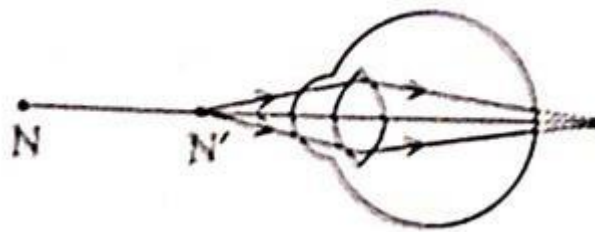
(d) The extensive network of blood vessels in the walls of alveoli maximizes the surface area for efficient gas exchange between oxygen in the air sacs and the bloodstream in the lungs.

**30.** *Define reflex action. With the help of a flow chart show the path of reflex action such as sneezing.* [3]

**Solution:** Reflex action is a sudden and involuntary response to stimuli. It helps organisms to quickly adapt to an adverse circumstance that could have the potential to cause bodily harm or even death.



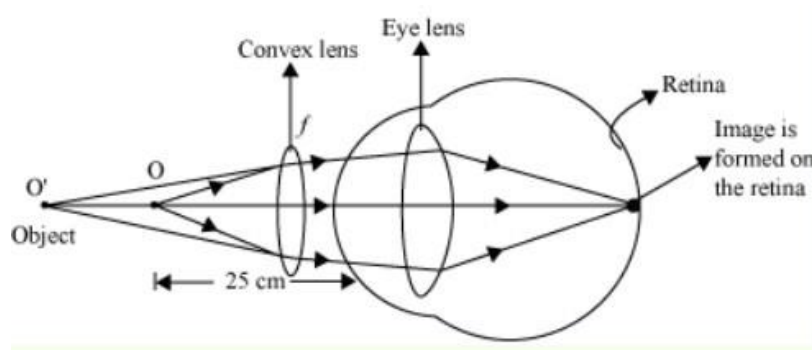
31. Study the diagram given below and answer the questions that follow:



- (i) Name the defect of vision represented in the diagram. Give reason for your answer.
- (ii) List two causes of this defect.
- (iii) With the help of a diagram show how this defect of vision is corrected. [3]

**Solution:**

- (i) Hypermetropia as the image is formed beyond the retina.
- (ii) The focal length of the eye lens is too long. The eyeball becomes too small.
- (iii) A hypermetropic eye is corrected by using a convex lens such that the lens will bring the image back to the retina. Depending on how much the focal length has been altered due to the effects of hypermetropia, powered convex lenses can correct this problem.





- 32.** Name and state the rule to determine the direction of a:
- (i) magnetic field produced around a current carrying straight conductor.
  - (ii) force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it.
- [3]

**Solution:**

(i) Maxwell's right-hand thumb rule: It states that if we imagine holding the wire with our right hand and the thumb represents the direction of the current flow, the rest of the curled fingers determine the direction of the magnetic field around it.

(ii) Fleming's left hand rule: Fleming's left hand rule states that if we arrange our thumb, forefinger and middle finger of the left-hand perpendicular to each other, and the forefinger points in the direction of magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

- 33.** (A) *Plants → Deer → Lion*

*In the given food chain, what will be the impact of removing all the organisms of second trophic level on the first and third trophic level? Will the impact be the same for the organisms of the third trophic level in the above food chain if they were present in a food web? Justify.*

**OR**

(B) *A gas 'X' which is a deadly poison is found at the higher levels of atmosphere and performs an essential function.*

*Name the gas and write the function performed by this gas in the atmosphere. Which chemical is linked to the decrease in the level of this gas? What measures have been taken by an international organization to check the depletion of the layer containing this gas?*

[3]

**Solution: (A)**

- Impact on the First Trophic Level (Plants): With no herbivores (Deer) to consume the plants, the plant population might increase.
- Impact on the Third Trophic Level (Lion): With the removal of the primary consumers (Deer), the predators at the third trophic level (Lion) would face a reduction in their food source. This might lead to a decline in the Lion population due to insufficient prey availability.
- Impact in a Food Web: In a food web, Lions might have alternative prey options, reducing the severity of the impact. Food web flexibility allows organisms at higher trophic levels to adapt to changes in prey availability.

**OR**

**(B)**

- Gas 'X' mentioned in the question is Ozone. It shields the surface of the earth from ultraviolet (UV) radiation from the Sun. This radiation is highly damaging to organisms, for example, it is known to cause skin cancer in human beings.
- This decrease has been linked to synthetic chemicals like chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers.
- In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels. It is now mandatory for all the manufacturing companies to make CFC-free refrigerators throughout the world.

### **SECTION D**

*Questions no. 34 to 36 are long answer type questions.*

**34.** (A) (i) Define a homologous series of carbon compounds.

(ii) Why are the melting and boiling points of  $C_4H_8$  higher than that of  $C_3H_6$  or  $C_2H_4$ ?

(iii) Why do we **NOT** see any gradation in chemical properties of a homologous series compounds?

(iv) Write the name and structures of (i) aldehyde and (ii) ketone with molecular formula  $C_3H_6O$ .

**OR**

(B) (i) Write the name and structure of an organic compound 'X' having two carbon atoms in its molecule and its name is suffixed with '-ol'.

(ii) What happens when 'X' is heated with excess concentrated sulphuric acid at 443 K? Write a chemical equation for the reaction stating the conditions for the reaction. Also state the role played by concentrated sulphuric acid in the reaction.

(iii) Name and draw the electron dot structure of hydrocarbons produced in the above reaction. [5]

**Solution:**

**(A)**

(i) Homologous series may be defined as a series of similarly constituted compounds in which the members possess similar chemical characteristics and the two consecutive members differ in their molecular formula by  $-CH_2$ .

(ii)  $C_4H_8$ ,  $C_3H_6$  and  $C_2H_4$  belong to the same homologous series because each compound differs by  $-CH_2$  units with the preceding one and each compound belongs to the same functional group.

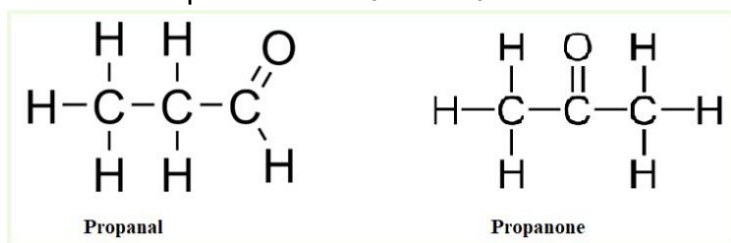
In homologous series, the molecular masses of succeeding members are higher than the preceding members. As the molecular mass increases, the melting and boiling points also increase. So, melting and boiling points of  $C_4H_8$  are higher than the others in the given series.

(iii) We do not observe gradation in chemical properties of homologous series compounds because they share a similar functional group and exhibit a regular increase in molecular size and mass with each successive member. This consistent structural pattern results in similar chemical behavior among homologs. Although physical properties such as boiling points and melting points may vary gradually due to increasing molecular size, chemical properties, including reactivity and functional group behavior, remain relatively constant within a homologous series. This uniformity arises from the consistent presence and arrangement of functional groups, which dictate the compounds' chemical behavior.

(iv) The aldehyde and ketone that can be represented by molecular formula  $C_3H_6O$  are propanal and propanone respectively.

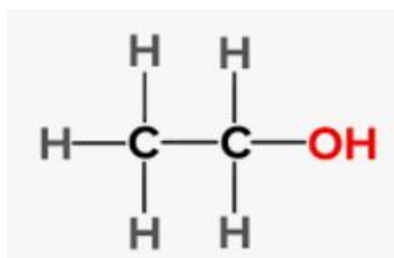
Aldehyde - Propanal -  $CH_3CH_2CHO$

Ketone - Propanone -  $CH_3COCH_3$

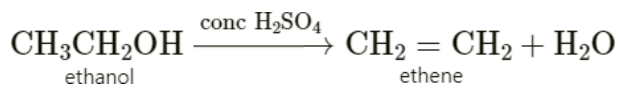


**OR**

(i) The name and molecular formula of a carbon compound having its name suffixed with "-ol" and having two carbon atoms in a molecule is ethanol and  $CH_3CH_2OH$ , respectively. Structure of ethanol is:

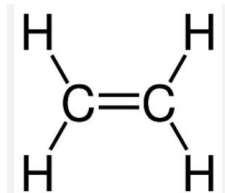


(ii) When ethanol is heated with excess of conc.  $H_2SO_4$ , it leads to dehydration of it giving ethene.



(iii) Name of hydrocarbons produced in the above reaction is ethene.

Structure of ethene:



**35.** (A) (i) Name three techniques/devices used by human females to avoid pregnancy. Mention the side effects caused by each.

(ii) What will happen if in a human female (a) fertilisation takes place, (b) an egg is not fertilised?

**OR**

(B) (i) Draw a diagram showing spore formation in *Rhizopus* and label the (a) reproductive and (b) non-reproductive parts. Why does *Rhizopus* not multiply on a dry slice of bread?

(ii) Name and explain the process by which reproduction takes place in *Hydra*. [5]

**Solution: (A) (i)**

1. Hormonal Contraceptives:

- **Alter hormonal balance to prevent egg release and fertilization.**
- Side effects may include nausea, headaches, and mood changes due to hormonal changes.

2. Intrauterine Devices (IUDs):

- Placed in the uterus to prevent pregnancy.
- Side effects can include cramping, heavier periods, and irritation of the uterus.

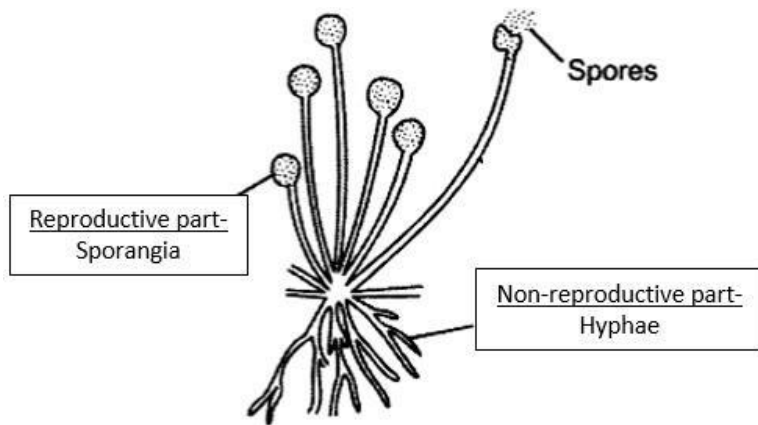
3. Surgical Methods:

- Block vas deferens in males or fallopian tubes in females.
- Risks of infections and complications if not performed properly.
- Can be misused for sex-selective abortions, impacting the female-male sex ratio and child sex ratio in society.

(ii) (a) If the egg is fertilized it leads to pregnancy.

(b) if the egg is not fertilized it leads to menstruation.

**OR**



**Spore formation in *Rhizopus***

**(B) (i)**

In the case of the dry slice of bread, it provides nutrients but due to lack of moisture, the bread mould cannot grow.

**(ii) Budding in Hydra -**

- Hydra utilizes regenerative cells for reproduction through budding.
- In Hydra, budding involves repeated cell division at a specific site, leading to the development of a bud.
- The buds grow into tiny individuals through further cell division.
- When fully mature, these buds detach from the parent body. The detached buds become new, independent individuals.

**36. (A) (i) Define electric power. Express it in terms of potential difference ( $V$ ) and resistance ( $R$ ).**

*(ii) An electric oven is designed to work on the mains voltage of 220 V. This oven consumes 11 units of electrical energy in 5 hours. Calculate :*

- (a) power rating of the oven*
- (b) current drawn by the oven*
- (c) resistance of the oven when it is red hot*

**OR**

*(B) (i) Write the relation between resistance  $R$  and electrical resistivity  $\rho$  of the material of a conductor in the shape of cylinder of length  $l$  and area of cross-section  $A$ . Hence derive the SI unit of electrical resistivity.*

*(ii) The resistance of a metal wire of length 3 m is 60  $\Omega$ . If the area of cross-section of the wire is  $4 \times 10^{-7} \text{ m}^2$ , calculate the electrical resistivity of the wire.*

*(iii) State how would electrical resistivity be affected if the wire (of part 'ii') is stretched so that its length is doubled. Justify your answer. [5]*

**Solution:**

**(A) (i)** Electric power: It is the rate of doing work by an energy source or the rate at which the electrical energy is dissipated or consumed in the electric circuit. So,

$$\text{Power } P = \frac{\text{Electric energy dissipated}}{\text{Time}}$$

$$P = VI = \frac{V^2}{R}$$

where ,

P is the electric power,

V is the potential difference (voltage), and

R is the resistance.

**(ii)** Given:

Mains voltage,  $V = 220 \text{ V}$

Electric energy consumed,  $H = 11 \text{ units}$

Time,  $t = 5 \text{ h}$

**(a)** As we know that a kWh is equivalent to one unit of electrical energy consumed by any electrical appliance.

Now, energy consumed,  $H = Pt$  where  $P = \text{Power}$  and  $t = \text{time}$

$$\Rightarrow 11 \text{ units} = P \times 5 \text{ h}$$

$$\Rightarrow 11 \text{ kWh} = P \times 5 \text{ h}$$

$$\Rightarrow 11000 \text{ Wh} = P \times 5 \text{ h}$$

$$\Rightarrow P = 2200 \text{ W}$$

**(b)**  $P = V \times I$

$$I = \frac{P}{V} = \frac{2200}{220} = 10 \text{ A}$$

**(c)**  $R = \frac{V}{I} = \frac{220}{10} = 22 \Omega$

**(B)(i)** The resistance  $R$  of a conductor in the shape of a cylinder of length  $l$  and area of cross-section  $A$  is given as:

$$R = \rho \frac{l}{A}$$

where  $\rho$  is the electrical resistivity of the material of the conductor. Thus resistivity,

$$\rho = \frac{RA}{l}$$

$\therefore$  SI unit of resistivity  $\rho$  shall be  $\frac{\Omega \times m^2}{m} = \Omega \cdot m$

**(ii)** Here  $l = 3 \text{ m}$ ,  $R = 60 \Omega$ ,  $A = 4 \times 10^{-7} \text{ m}^2$

$$\rho = \frac{RA}{l}$$

$$\rho = \frac{60 \times 4 \times 10^{-7}}{3} = 8 \times 10^{-6} \Omega \cdot m$$

**(iii)** Electrical resistivity of a substance does not depend on its length or area of cross-section. It depends on the nature of the material and temperature. Hence, there will be no change in its resistivity.

## SECTION E

Questions no. **37** to **39** are case-based/data-based questions with 3 short sub-parts. Internal choice is provided in one of these sub-parts.

**37.** The metals produced by various reduction processes are not very pure. They contain impurities, which must be removed to obtain pure metals. The most widely used method for refining impure metals is electrolytic refining.

(i) What is the cathode and anode made of in the refining of copper by this process? [1]

(ii) Name the solution used in the above process and write its formula. [1]

(iii) (A) How copper gets refined when electric current is passed in the electrolytic cell? [2]

**OR**

(iii) (B) You have two beakers 'A' and 'B' containing copper sulphate solution.

What would you observe after about 2 hours if you dip a strip of zinc in beaker 'A'?

and a strip of silver in beaker 'B'? Give reason for your observations in each case. [2]

**Solution:**

(i) The cathode is made up of pure copper metal. The anode is made up of impure copper metal.

(ii) An aqueous solution of salt of the same metal is used as an electrolyte which is copper sulphate.

(iii)

(A) On passing current through the electrolyte, the pure metal from the anode ionises and dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited on the cathode. The soluble impurities go in the solution whereas the insoluble impurities settle down at the bottom of the anode and are known as anode mud. In this way, the pure metal from anode goes into electrolyte and from electrolyte it goes to the cathode.

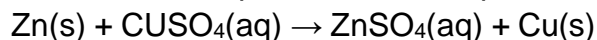
**OR**

(iii)

(B) For beaker 'A'

When a zinc strip is dipped into a copper sulphate solution, copper is obtained along with zinc sulphate solution.

The chemical equation can be depicted as:



Displacement reaction:

When an element displaces another element from its compound, a displacement reaction occurs.

In the reaction of zinc with copper sulfate, zinc is a more reactive element than copper. Thus it will displace copper from its compounds.

For beaker 'B'

There will be no reaction when silver (Ag) reacts with copper sulphate ( $\text{CuSO}_4$ ) solution as silver is a less reactive metal.



Activity series:

The activity series is a listing of metals categorized in the order of their decreasing activities.

In the activity series, Silver lies below Copper, thus it will not displace copper from its solution.

As a result, there will be no displacement reaction.



**38.** Mendel worked out the rules of heredity by working on garden pea using a number of visible contrasting characters. He conducted several experiments by making a cross with one or two pairs of contrasting characters of pea plant. On the basis of his observations he gave some interpretations which helped to study the mechanism of inheritance.

(i) When Mendel crossed pea plants with pure tall and pure short characteristics to produce  $F_1$  progeny, which two observations were made by him in  $F_1$  plants? [1]

(ii) Write one difference between dominant and recessive trait. [1]

(iii) (A) In a cross with two pairs of contrasting characters

**RRYY                      X                      rryy**  
**(Round Yellow)                      (Wrinkled Green)**

Mendel observed 4 types of combinations in  $F_2$  generation. By which method did he obtain  $F_2$  generation? Write the ratio of the parental combinations obtained and what conclusions were drawn from this experiment. [2]

**OR**

(iii) (B) Justify the statement: "It is possible that a trait is inherited but may not be expressed." [2]

**Solution: (i)**

- **Dominance** - All the plants were tall. This meant that only one of the parental traits was seen, not some mixture of the two.
- **No Blending** - There were no halfway characteristics in this first generation, or  $F_1$  progeny - no 'medium-height' plants.

**(ii)**

- Dominant traits are always expressed when the allele is dominant, even if only one copy of the dominant trait exists.
- Recessive traits are expressed only if both the connected alleles are recessive. If one of the alleles is dominant, then the associated characteristic is not expressed.

**(iii) (A)**

- $F_2$  generation was obtained by self-fertilization.
- Ratio of parental combination - 9.3.3.1
- Conclusions drawn from this experiment - Law of independent assortment. It states that - "When two pairs of traits are combined in a hybrid, one pair of characters segregates independently of the other pair of characters."

**OR**

**(iii) (B)** The statement "It is possible that a trait is inherited but may not be expressed" is justified by the concept of recessive traits. In cases of inheritance, an individual may carry a recessive allele for a trait without expressing it phenotypically. The presence of a

dominant allele can mask the expression of the recessive allele. Only when an individual inherits two copies of the recessive allele (homozygous recessive) does the trait become expressed.

- 39.** Study the data given below showing the focal length of three concave mirrors A, B and C and the respective distances of objects placed in front of the mirrors:

Case	Mirror	Focal Length (cm)	Object Distance (cm)
1	A	20	45
2	B	15	30
3	C	30	20

- (i) In which one of the above cases the mirror will form a diminished image of the object? Justify your answer. [1]
- (ii) List two properties of the image formed in case 2. [1]
- (iii) (A) What is the nature and size of the image formed by mirror C? Draw a ray diagram to justify your answer. [2]

**OR**

- (iii) (B) An object is placed at a distance of 18 cm from the pole of a concave mirror of focal length 12 cm. Find the position of the image formed in this case. [2]

**Solution:**

- (i) In case - 1, a diminished image will be formed.

Focal length = 20 cm

⇒ Radius of curvature = 40 cm

Now, object distance = 45 cm

This means that the position of the object is beyond the centre of curvature, hence the nature of the image is real, inverted and diminished.

- (ii) Given: Focal length = 15 cm

⇒ Radius of curvature = 30 cm

Also, object distance = 30 cm

This means the object is placed at the centre of curvature. So, the properties of image formed will be:

Nature of image = Real and inverted

Size of object = equal to that of the object

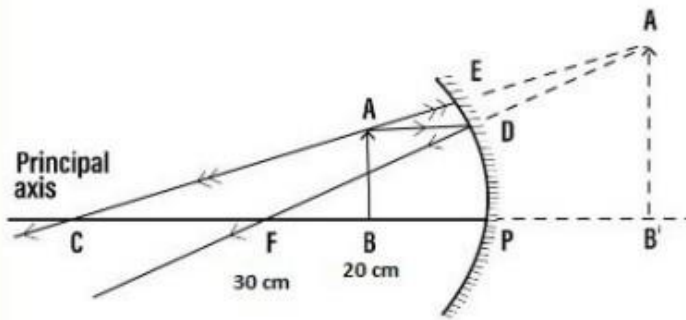
(iii) (A)

Given: Focal length = 30 cm , Object distance = 20 cm

This means that the position of the object is between pole and principal focus.

Hence, nature of image = virtual and erect

Size of the image = Enlarged



OR

(iii) (B)

Object distance,  $u = -18 \text{ cm}$  (negative sign as the object is placed in front of the mirror)

Focal length,  $f = -12 \text{ cm}$  (focal length taken as negative for concave mirror)

From mirror formula ,

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} - \frac{1}{-18}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} + \frac{1}{18}$$

$$\Rightarrow \frac{1}{v} = \frac{18-12}{-18 \times 12}$$

$$\Rightarrow \frac{1}{v} = \frac{6}{-18 \times 12} = \frac{-1}{36}$$

$$\Rightarrow v = -36 \text{ cm}$$

Negative sign of image distance indicates that the image is on the same side as the object.

$$\text{Magnification} = \frac{-v}{u} = \frac{-(-36)}{-18} = -2$$

Hence, from the value of magnification, it is identified that the image is real, inverted, and magnified. The position of the image is in front of the mirror.

