UP Board Examination,2024

Science (IJ)

(English Version)

Time: 3 hrs 15mins. **Total Score: 40**

Note:

(i) First 15 minutes are allotted for the candidates to read the question paper.

(ii) The question paper is divided into two parts-Part A and Part B.

(iii) Part A and Part B are divided into three sub-sections 1, 2 and 3.

(iv) In Part A of the question paper, there are Multiple Choice Type Questions. Select the correct alternative and then by a blue or black ballpoint pen, fill completely in the circle in OMR Answer-Sheet. Do not erase, cut or use whitener on the OMR Answer-Sheet after answering.

(v) 1 mark is allotted to each question in the multiple-choice type questions of Part A.

(vi) Part B has descriptive questions.

(vii) The allotted marks are given in each question.

(viii) All the questions of Sub-Sections of Part B are to be attempted all at a time. Start each Sub-Section from a new page.

(ix) All questions are compulsory.

Part-A

Q1. The image formed by a convex mirror is always: 1

(A) between the centre of curvature and the focus

(B) between the centre of curvature and infinity

(C) between the pole and the focus

(D) anywhere, depending upon the position of the object

Solution:

(C) between the pole and the focus

Convex mirrors always form virtual, erect, and diminished images between the pole and the focus, regardless of the object's position.

Q2. When light rays move away from the normal while going from one medium to another, then they move from

(A) a denser medium to a rarer medium

(B) a rarer medium to a denser medium

(C) a medium of low refractive index to a medium of high refractive index

(D) a transparent medium to an opaque medium

Solution:

(A) a denser medium to a rarer medium

When light travels from a denser medium (higher refractive index) to a rarer medium (lower refractive index), it bends away from the normal due to an increase in speed.

Q3. The focal length of a convex lens is 15cm. The image of an object placed 30 cm away from lens will be:

(A) Real, inverted, of the same size as the object at 30 cm towards the object

(B) Real, inverted, of the same size as the object at 30 cm on the other side of the lens.

(C) Real, inverted, of the same size as the object on the other side of object at 15cm.

(D) Virtual, erect, of the same size as the object at 15 cm towards the object.

Solution:

(B) Real, inverted, of the same size as the object at 30 cm on the other side of the lens.

Since the object is at **2F (30 cm)**, the image forms at **2F on the other side**, maintaining the same size.

Q4. When white light passes through a prism, the colour of the emergent light distant from the base of prism is:

(A) Red

(B) Yellow

(C) Blue

(D) Violet

Solution:

(A) Red

When white light passes through a prism, it undergoes dispersion, splitting into its constituent colors. Red deviates the least and appears farthest from the base, while violet deviates the most and is closest to the base.

Q5. Ampere-second is the unit of:

(A) Electrical energy

(B) Electromotive Force (e.m.f.)

(C) Charge

(D) Electric current

Solution:

(C) Charge

Ampere-second (A·s) = Current (A) × Time (s) = Charge (Coulomb, C).

Since 1 Coulomb = 1 Ampere × 1 Second, Ampere-second is the unit of electric charge.

Q6. Two wires of resistances R_1 and R_2 are connected to a cell in parallel. If the currents flowing in them are i_1 and i_2 and the heats produced in them are H_1 and H_2, respectively per second, the ratio of heat is :

(A) $\frac{H_1}{H_2} = \frac{R_2}{R_1}$

(B) $\frac{H_1}{H_2} = \frac{R_1}{R_2}$

(C) $\frac{H_1}{H_2} = \frac{i_1^2}{i_2^2}$

(D) $\frac{H_1}{H_2} = \frac{i_2}{i_1}$

Solution:

(C) $\frac{H_1}{H_2} = \frac{i_1^2}{i_2^2}$

According to **Joule's Law**, heat produced per second is $H=I^2R$.

Taking the ratio: $\frac{H_1}{H_2} = \frac{i_1^2}{i_2^2}$

Q7. Unit of intensity of magnetic field is:

(A) Newton/Ampere.metre^2

(B) Newton/Ampere-metre

(C) Newton-Ampere.metre

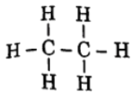
(D) Newton ^{2}/ Ampere-metre

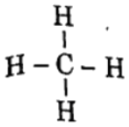
Solution:

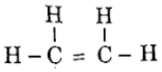
(B) Newton/Ampere-metre

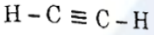
The unit of intensity of the magnetic field (H) is Ampere per meter (A/m). The unit of magnetic field (B) is Tesla (T) = Newton/(Ampere·meter).

Q8. The structural formula of methane is:

(A) 

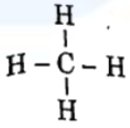
(B) 

(C) 

(D) 

Solution:

The structural formula for methane is

(B) 

Q9. The homologous series in the following is:

(A) C_2H_4, CH_4

(B) CH_4, C_2H_6

(C) C_2H_6, CH_3OH

(D) C_2H_4, C_2H_2

Solution:

(B) CH_4, C_2H_6

A homologous series is a group of organic compounds having the same functional group and following the general formula, with each successive member differing by $-CH_2$.

Methane (CH_4) and Ethane (C_2H_6) belong to the alkane series (C_nH_{2n+2}).

Q10. Chemical formula of Lead Nitrate is:

(A) $Pb(NO_3)_2$

(B) PbO

(C) $Pb(NO_2)_2$

(D) $PbNO_2$

Solution:

(A) $Pb(NO_3)_2$

Lead Nitrate consists of Lead (Pb^{2+}) and Nitrate (NO_3^-) ions.

The chemical formula is Pb $(NO_3)_2$, as two NO_3^- ions balance the +2 charge of lead.

Q11. The pH value of pure water is:

(A) 0

(B) 1

(C) 7

(D) 14

Solution:

(C) 7

Pure water is neutral, meaning its pH is 7 at 25°C.

Q12. Antimony is:

(A) Metal

(B) Non-metal

(C) Metalloid

(D) Alloy

Solution:

(C) Metalloid

Antimony (Sb) has properties of both metals and non-metals, making it a metalloid.

Q13. Complete the following chemical equation:

$$CH_3COOH + C_2H_5OH \xrightarrow[H_2SO_4]{Conc} \quad + H_2O$$

(A) CH_3OH

(B) C_2H_5OH

(C) $CH_3COOC_2H_5$

(D) CH_3CH_2COOH

Solution:

(C) $CH_3COOC_2H_5$

The given reaction represents esterification, where acetic acid (CH_3COOH) reacts with ethanol (C_2H_5OH) in the presence of concentrated H_2SO_4 to form an ester (ethyl acetate, $CH_3COOC_2H_5$) and water (H_2O).

Q14. Energy currency in cellular process is

(A) Mitochondria

(B) ATP

(C) Glucose

(D) Pyruvate

Solution:

(B) ATP

Adenosine Triphosphate (ATP) is the energy currency of the cell, providing energy for various cellular activities.

Q15. Bile juice is secreted by:

(A) Gall bladder

(B) Liver

(C) Pancreas

(D) Stomach

Solution:

(B) Liver

The liver secretes bile juice, which helps in fat digestion by emulsifying fats. It is stored on the gall bladder.

Q16. Pollen sac contains:

(A) Sepals

(B) Ovary

(C) Ovules

(D) Pollen grains

Solution:

(D) Pollen grains

Pollen sacs, present in the anther, contain pollen grains, which are the male reproductive cells in flowering plants.

Q17. Buds on leaf develop in:

(A) Mint

(B) Potato

(C) Bryophyllum

(D)All of the above

Solution:

(C) Bryophyllum

Bryophyllum reproduces asexually through buds on its leaves, which grow into new plants.

Q18. Example of unisexual flower is:

(A) Flower of Papaya

(B) Flower of Rose

(C) Flower of Mustard

(D) Flower of Mango

Solution:

(A) Flower of Papaya

Unisexual flowers have either male or female reproductive organs, like Papaya and Watermelon.

Q19. Normal blood pressure of a healthy human is:

(A) 140 / 80

(B) 120 / 80

(C) 135 / 100

(D) 125 / 115

Solution:

(B) 120/80

The normal blood pressure of a healthy adult human is 120 mmHg (systolic) / 80 mmHg (diastolic).

Systolic pressure (120 mmHg): Pressure during heart contraction.

Diastolic pressure (80 mmHg): Pressure when the heart relaxes.

Q20. Which of the following constitutes a food chain?

(A) Grass, Wheat and Mango

(B) Grass, Goat and Human

(C) Goat, Cow and Elephant

(D) Grass, Fish and Goat

Solution:

(B) Grass, Goat and Human

A food chain shows the transfer of energy from producers to consumers.

Grass (Producer) → Goat (Primary Consumer/Herbivore) → Human (Secondary Consumer/Omnivore).

Part-B

Sub-Section 1

Descriptive questions:

Q21. The image the length of the object. Determine (i) the distance of image from the mirror, and (ii) the focal length of the mirror. 4

Solution:

Given u=-25cm

m=-v/u=1/2
(i) v=u/2=25/2=12.5
(ii) Then formula to calculate focal length 1/f=1/v+1/u

=2/25-1/25=1/25 or f = 25 cm

Q22. (i) On placing a concave lens in the path of convergent rays, they focus on the axis in the back, 20 cm from the lens.

(ii) In the absence of a lens, where do the rays focus? The focal length of lens is 30 cm. 4

Solution:

In the absence of the concave lens, the convergent rays would focus at their original focal point.

Given that the concave lens causes the rays to focus 20 cm behind the lens and has a focal length of -30 cm, we can use the lens formula:

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

where:

f=−30f = -30f=−30 cm (concave lens has a negative focal length),

v=20v = 20v=20 cm (image distance behind the lens),

u is the object distance (the original focus of the rays without the lens).

$$\frac{1}{-30} = \frac{1}{20} - \frac{1}{u}$$

$$\frac{1}{u} = \frac{1}{20} - \frac{1}{-30}$$

$$\frac{1}{u} = \frac{1}{20} + \frac{1}{30}$$

$$\frac{1}{u} = \frac{3}{60} + \frac{2}{60} = \frac{5}{60} = \frac{1}{12}$$

U=12cm

In the absence of the concave lens, the rays would have focused 12 cm in front of the lens.

Q23. How can the three resistances 2Ω, 3Ω, and 6Ω be connected, so that (i) total resistance of 4Ω is obtained, and (ii) total resistance of 1Ω is obtained?

Solution:

(i) **To get 4Ω:**

Connect **3Ω and 6Ω in parallel:**

$$Rp = \frac{1}{3} + \frac{1}{6} = 2\Omega$$

Connect this **in series with 2Ω**:

$$R_{total} = 2\Omega + 2\Omega = 4\Omega$$

(ii) **To get 1Ω:**

Connect **2Ω, 3Ω, and 6Ω all in parallel**:

$$R1 = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = 1\Omega$$

Q24. Write (i) the name, (ii) working, and (iii) colours of the insulation of the wires used in the domestic electrical distribution. 6

Solution:

Name of Wires:

- Live wire (Phase wire)
- Neutral wire
- Earth wire

Working of Wires:

- Live wire: Carries current from the power source to the appliances.
- Neutral wire: Completes the circuit by carrying current back to the power source.

- Earth wire: Provides safety by directing leakage current to the ground, preventing electric shocks.

Colours of Insulation:

- Live wire: Red or Brown
- Neutral wire: Black or Blue
- Earth wire: Green or Yellow-Green

OR

On which factors does the magnetic field due to a current carrying conductor depend? Write and explain the name of the law used to find the direction of the magnetic field. 6

Solution:

1. The magnetic field produced by a current-carrying conductor depends on the following factors:
2. **Current (I):** The strength of the magnetic field increases with an increase in the current passing through the conductor.
3. **Distance from the Conductor (r):** The magnetic field decreases as the distance from the conductor increases.
4. **Medium Surrounding the Conductor:** The nature of the surrounding medium affects the strength of the magnetic field. Magnetic materials can influence the field intensity.
5. **Shape of the Conductor:** The magnetic field pattern depends on whether the conductor is a straight wire, a loop, or a coil (solenoid).

Law Used to Find the Direction of the Magnetic Field:

6. The **Right-Hand Thumb Rule** is used to determine the direction of the magnetic field around a current-carrying conductor.

Right-Hand Thumb Rule:

- If you hold a current-carrying conductor in your right hand with the **thumb pointing in the direction of the current**, then the **fingers curl in the direction of the magnetic field lines**.

- This rule helps visualize the circular magnetic field lines around a straight conductor.

Sub-Section 2

Q25. Write the structural formulae of the following compounds 1+1+1+1=4

(i) Ethanoic acid

(ii) Methanal

(iii) 1-Chloropropane

(iv) Nitromethane

Solution:

(i) Ethanoic acid - CH_3COOH

(ii) Methanal- CH_2O

(iii) 1-Chloropropane-C_3H_7Cl

(iv) Nitromethane- CH_3NO_2

Q26. (i) Explain electrochemical series and write its application.

(ii) What do you mean by alloys? Write the names and uses of two main alloys of copper.

Solution:

(i) Electrochemical Series and Its Applications

The electrochemical series is a list of elements or electrodes arranged in order of their standard electrode potentials (E° values). It helps predict the ease of oxidation or reduction of different elements.

Elements with higher negative E° values are more reactive and act as strong reducing agents.

Elements with higher positive E° values are less reactive and act as strong oxidizing agents.

Applications of the Electrochemical Series:

Predicting the Reactivity of Metals: Metals higher in the series are more reactive and can displace metals lower in the series from solutions.

Determining Oxidizing and Reducing Strength: Higher E° values indicate stronger oxidizing agents, while lower E° values indicate stronger reducing agents.

Electrochemical Cell Design: Used to calculate the cell potential (E° cell) in batteries and fuel cells.

Electrolysis Predictions: Helps determine which ions will be discharged first during electrolysis.

Corrosion Prevention: Helps in understanding and preventing metal corrosion.

(ii) Alloys and Two Main Copper Alloys with Uses

An alloy is a homogeneous mixture of two or more metals, or a metal with a non-metal, to improve properties such as strength, resistance to corrosion, and hardness.

Two Main Copper Alloys and Their Uses:

- Brass (Copper + Zinc)
- Uses: Used in electrical fittings, musical instruments, and decorative items.
- Bronze (Copper + Tin)
- Uses: Used in making statues, coins, and ship propellers due to its corrosion resistance.

Q27. (i) Write the IUPAC name of the following compounds:

(a) HCHO

(b) CH_3-CH =CH_2

(ii) Write a short note on the valency of carbon.

Solution:

(i) The IUPAC name of the following compounds are:

(a) HCHO- Methanal

(b) CH_3-CH =CH_2 - Propene

(ii) The valency of carbon is 4 because it has four valence electrons in its outermost shell (electronic configuration: 2, 4). To achieve a stable noble gas

configuration (octet rule), carbon either shares its four electrons with other atoms through covalent bonding or forms compounds by bonding with elements like hydrogen, oxygen, and nitrogen.

Examples of Carbon Compounds Based on Valency:

- Methane (CH_4) – Carbon forms four single covalent bonds with hydrogen.
- Carbon Dioxide (CO_2) – Carbon forms two double bonds with oxygen.
- Ethene (C_2H_4) – Carbon forms double bonds with another carbon atom and single bonds with hydrogen.

(iii) Baking Powder is a mixture of baking soda (sodium bicarbonate) and a weak acid like tartaric acid. The chemical formula of baking soda (main component) is $NaHCO_3$ (Sodium Bicarbonate).

When baking powder is heated, sodium bicarbonate ($NaHCO_3$) decomposes to produce carbon dioxide (CO_2) gas, which causes baked goods to rise.

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + CO_2 + H_2O$$

Carbon dioxide (CO_2) gas is released, making dough or batter rise and become fluffy.

Water (H_2O) in vapor form helps in leavening.

Sodium carbonate (Na_2CO_3) remains as a residue, which is neutralized by the acidic component in baking powder (like tartaric acid) to prevent a bitter taste.

OR

Write short notes on the following:

(i) Double displacement reaction

(ii) Neutralization reaction

(iii) Addition reaction

Solution:

(i) Double Displacement Reaction:

- A **double displacement reaction** is a chemical reaction in which the **ions of two compounds exchange places** to form two new compounds.

- It generally occurs in **aqueous solutions** and often results in the formation of a **precipitate, gas, or water**.

Example:

$$AgNO_3 + NaCl \rightarrow AgCl \downarrow + NaNO_3$$

(ii) Neutralization Reaction:

- A **neutralization reaction** is a reaction between an **acid and a base** to form **salt and water**.
- The **H^+ ions from the acid** react with the **OH^- ions from the base**, forming water.

Example:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

(iii) Addition Reaction:

- An **addition reaction** occurs when **two or more reactants combine** to form a single product.
- This reaction is **common in unsaturated hydrocarbons** (alkenes and alkynes) where new atoms are added to the double or triple bonds.

Example:

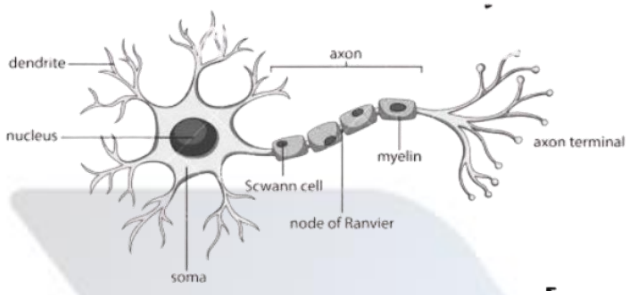
$$C_2H_4 + H_2 \rightarrow C_2H_6$$

Sub-Section 3

Q28. Draw a labelled diagram of the structure of Neuron and describe its functions.

2+2=4

Solution:



A **neuron** is the basic structural and functional unit of the nervous system. It is responsible for transmitting signals in the form of electrical and chemical impulses throughout the body.

Structure of a Neuron

- **Dendrites** – Branch-like structures that receive signals from other neurons and send them to the cell body.
- **Cell Body (Soma)** – Contains the nucleus and other organelles, maintaining the neuron's functions.
- **Axon** – A long, thin fiber that carries nerve impulses away from the cell body.
- **Myelin Sheath** – A fatty layer covering the axon that insulates it and speeds up nerve impulse transmission.
- **Nodes of Ranvier** – Gaps in the myelin sheath that help in fast conduction of nerve impulses.
- **Axon Terminals** – The ends of the axon that transmit signals to the next neuron, muscle, or gland through chemical messengers called neurotransmitters.

Functions of a Neuron

- **Receiving Signals** – Dendrites receive electrical or chemical signals from other neurons or sensory receptors.
- **Processing Information** – The cell body processes the incoming signals and generates a response.
- **Transmitting Impulses** – The axon carries electrical impulses from the cell body to other neurons or target organs.
- **Communication with Other Neurons** – Axon terminals release neurotransmitters to transfer signals to the next neuron, muscle, or gland.

Q29. What do you mean by sex chromosomes? Explain the process of sex determination in humans.

Solution:

Sex chromosomes are a pair of chromosomes that determine an individual's sex. In humans, these chromosomes are designated as X and Y. Females typically have two X chromosomes (XX), while males have one X and one Y chromosome (XY).
The process of sex determination in humans is a result of the combination of sex chromosomes during fertilization. When a sperm carrying either an X or a Y chromosome fertilizes an egg carrying an X chromosome, the resulting zygote will have a genetic makeup of either XX (female) or XY (male).
The father's sperm determines the sex of the offspring because males carry both X and Y sperm, while females only carry X eggs. Therefore, if an X sperm fertilizes the egg, the offspring will be female (XX), whereas if a Y sperm fertilizes the egg, the offspring will be male (XY). This process of sex determination is dependent on the combination of sex chromosomes received from the parents during fertilization.

Q30. Write four differences between producers and consumers. 1+1+1+1=4

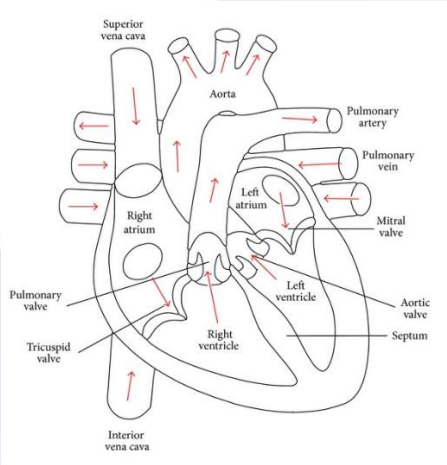
Solution:

Producers	Consumers

Organisms that produce their own food using sunlight or chemical energy.	Organisms that depend on other organisms for food.
Autotrophic (make their own food through photosynthesis or chemosynthesis).	**Heterotrophic** (obtain food by consuming plants or other animals).
Examples are green plants, algae, and phytoplankton.	Examples are herbivores (deer, rabbits), Carnivores (lions, tigers), Omnivores (humans, bears).

Q31. Describe the structure of the human heart with the help of labelled longitudinal. section diagram of the human heart. 2+4=6

Solution:



The human heart is a muscular, four-chambered organ that pumps blood throughout the body. It is in the thoracic cavity, slightly tilted towards the left. The heart is divided into two halves—right and left, each having an atrium (upper chamber) and a ventricle (lower chamber).

Atria (Right and Left Atrium):

The right atrium receives deoxygenated blood from the body through the superior and inferior vena cava.

The left atrium receives oxygenated blood from the lungs via the pulmonary veins.

Ventricles (Right and Left Ventricle):

The right ventricle pumps deoxygenated blood to the lungs through the pulmonary artery for oxygenation.

The left ventricle pumps oxygenated blood to the entire body through the aorta.

Valves:

- Tricuspid Valve: Between the right atrium and right ventricle to prevent backflow of blood.
- Bicuspid (Mitral) Valve: Between the left atrium and left ventricle to ensure one-way blood flow.
- Pulmonary Valve: Between the right ventricle and pulmonary artery to control blood flow to the lungs.
- Aortic Valve: Between the left ventricle and aorta to regulate oxygenated blood flow to the body.

Blood Vessels:

- Vena Cava: Brings deoxygenated blood from the body to the right atrium.
- Pulmonary Artery: Carries deoxygenated blood from the right ventricle to the lungs.
- Pulmonary Veins: Bring oxygenated blood from the lungs to the left atrium.
- Aorta: Distributes oxygen-rich blood from the left ventricle to the entire body.

Septum:

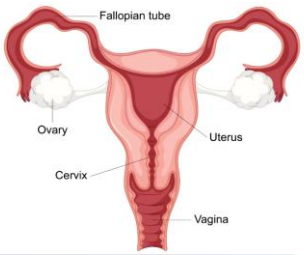
The interatrial septum separates the two atria, and the interventricular septum separates the two ventricles, preventing mixing of oxygenated and deoxygenated blood.

OR

Describe the female reproductive system of human beings with diagram.

3+3=6

Solution:



The female reproductive system in humans is a complex structure responsible for producing eggs (ova), facilitating fertilization, and supporting fetal development. It consists of internal and external organs. The internal organs include ovaries, fallopian tubes, uterus, and vagina. The ovaries are two small, oval-shaped glands that produce ova (eggs) and secrete hormones like estrogen and progesterone. Each ovary releases an egg once a month during ovulation. Fallopian tubes are narrow tubes that connect the ovaries to the uterus and serve as the site for fertilization. If fertilization occurs, the fertilized egg travels down the fallopian tube and implants in the uterus, a muscular organ where the fetus develops during pregnancy. The cervix, the lower part of the uterus, opens into the vagina, which acts as the birth canal and facilitates the entry of sperm during reproduction. External genitalia include the labia, clitoris, and vaginal opening, which protect the internal reproductive organs. The menstrual cycle regulates the female reproductive system, ensuring the maturation and release of eggs and preparing the uterus for possible pregnancy.