Sample Question Paper

2023–24

Class X
SCIENCE (086)

ANSWERS

SECTION – A

1. b.	2. c.	3. c.	4. c.	5. d.	6. d.	7. c.
8. b.	9. c.	10. b.	11. d.	12. a.	13. a.	14. a.
15. a.	16. d.	17. d.	18. a.	19. c.	20. c.	

SECTION – B

21. Calcium hydroxide reacts with carbon dioxide present in the air to form a thin layer of calcium carbonate on the walls. This is a combination reaction. The chemical reaction involved is as follows:

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

22. Reproduction is the process by which a living organism is able to produce more of its own kind. Reproduction ensures continuity of life and survival of a species on earth. Therefore it is essential for living organisms.

23. The pericardial fluid protects the heart from mechanical injury.

Four functions of blood include: (i) Transport of nutrients from the site of absorption to different organs of the body. (ii) Transport of respiratory gases from lungs to tissues. (iii) Transport of respiratory gases from tissues to lungs. (iv) Transport of waste substances to the organs concerned with their removal from the body.

OR

The glucose which enters the nephron along with the filtrate is reabsorbed by the tubular cells and sent to the capillaries surrounding the nephron.

24. a. Light speeds up or the speed of light increases when it travels from a medium of higher refractive index to a medium of lower refractive index. Therefore, speed of light increases when it travels from crown glass to water or from rock salt to water or from diamond to water.

b. Light slows down or the speed of light decreases when it travels from a medium of lower refractive index to a medium of higher refractive index. For example, when it travels from water to crown glass or from water to diamond.

25. The resistance is cut into five equal parts, which means that the resistance of each part is $R/5$. We know that each part is connected to each other in parallel, hence the equivalent resistance can be calculated as follows:

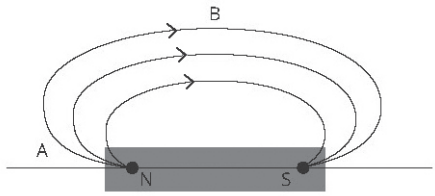
$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} = \frac{25}{R}$$

$$R' = \frac{R}{25}$$

$$R : R' = 25$$

OR

The relative strength of the magnetic field is shown by the degree of closeness of the field lines. The degree of closeness is more at A than at B. Therefore, the field is stronger at A where the field lines are crowded.



26. If the tiger has 30 J of energy, grass must have 3000 J of energy initially. This is because the tiger must have obtained only 10 % of energy from goat which must have obtained 300 J of energy from grass (10 % of energy possessed by plants). Hence the plants must have had 3000 J of energy.

SECTION – C

27. a. Combination reactions

Example: $N_2 + 3H_2 \rightarrow 2NH_3$

b. Decomposition reactions

Example: $MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

c. Displacement reactions

Example: $CuSO_4 + Zn \rightarrow Cu + ZnSO_4$

28. The stings of bees contain formic acid (HCOOH) which is neutralised by rubbing it with baking soda (sodium hydrogen carbonate) which is a mild base or a very dilute solution of ammonium hydroxide.

OR

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$

$Cu + H_2SO_4 \rightarrow$ No reaction

$Ag + H_2SO_4 \rightarrow$ No reaction

$Au + H_2SO_4 \rightarrow$ No reaction

29. The hindbrain has three main centres – cerebellum, pons and medulla oblongata. The cerebellum controls the body postures, balance and movement. Pons helps in respiration. Medulla oblongata contains vital centres for breathing, swallowing, sneezing, coughing and vomiting.

30. Autosomes are the somatic chromosomes which control the body characters or somatic characters of an individual.

	AUTOSOMES	SEX CHROMOSOMES
(i)	Determines somatic traits.	Determines gender of an individual.
(ii)	Males and females contain the same copy of autosomes.	Different in males and females by their size, form and behaviour.
(iii)	22 pairs of autosomes are homologous in humans.	Female sex chromosomes (XX) are homologous while male sex chromosomes (XY) are non-homologous.

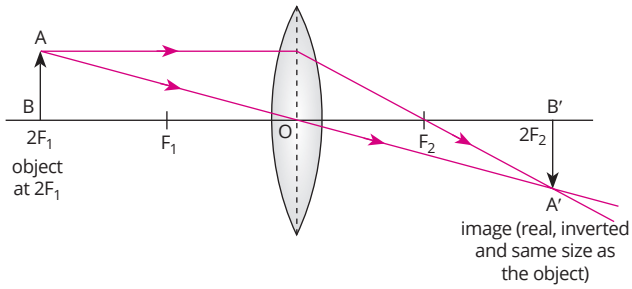
31. a. Convex lens

b. Given that the distance between the flame (object) and screen (image) is 4 m, therefore, $v + u = 4$ m. Since image is of the same size as the object, magnification is 1 and $v = u$. Therefore, $2u = 4$ m or $u = 2$ m, so the lens is to be placed at a distance of 2 m from the candle flame.

Using the lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{2} - \frac{1}{-2} \quad \text{or} \quad f = 1\text{ m}$$

c. Ray Diagram



32. a. In 1826, a German physicist, Georg Simon Ohm established a relationship between electric current (I) flowing through a conductor and potential difference (V) across its terminals. This relationship is known as Ohm's law.

According to Ohm's law, the electric current (I) flowing through a conductor between two points is directly proportional to the voltage (V) across the two points, provided the temperature and other physical conditions of the conductor remain the same, that is,

$$I \propto V \qquad or \qquad V = IR$$

here R is a constant for the conductor at a given temperature and is called its resistance.

b. Joule's law of heating, also known as the Joule's first law, states that the heat produced in a conductor due to the flow of electric current is directly proportional to the resistance of the conductor, the square of the current passing through it, and the time for which the current flows. Mathematically, Joule's law can be expressed as:

$Q = I^2Rt$

where:

- Q is the heat produced (in joules).
- I is the current passing through the conductor (in amperes).
- R is the resistance of the conductor (in ohms).
- t is the time for which the current flows (in seconds).

33. a. Miniature circuit breakers (MCB) are being used commonly because

- These are reusable and hence have less maintenance and replacement cost.
- They automatically switch off the electrical circuit because of their high sensitivity to abnormal current flow.
- In a faulty circuit, MCB trips to the OFF position and the user is not exposed to live electrical parts. It is hence, a safer option.

b. The values associated with Reema's suggestion:

- the precautionary principle.
- awareness.
- caring.

SECTION – D

34. a. Compound A is CH_3COOH (ethanoic acid). Ethanoic acid is used as a preservative in pickles.

b. $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

Compound B is $CH_3COOC_2H_5$ (ethyl ethanoate) formed by esterification. It is a sweet-smelling ester.

c. Esters undergo hydrolysis in the presence of a base to form alcohol and sodium salt of carboxylic acid. Sodium ethanoate when added to water reacts to form ethanoic acid.

d. By saponification reaction

$$\underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} \xrightarrow{NaOH} \underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Sodium ethanoate}}{CH_3COONa}$$

$$CH_3COONa + H_2O \rightarrow CH_3COOH + NaOH$$

e. Carbon dioxide gas is produced when ethanoic acid (compound A) reacts with washing soda (Na_2CO_3).

$$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2\uparrow$$

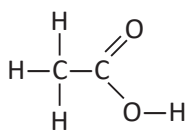
OR

a. Alkanes are saturated hydrocarbons in which the carbon atoms are linked by a single covalent bond. Compound D which is ethane is a saturated hydrocarbon.

b. The unsaturated cyclic compound is benzene (C_6H_6).

c. Compound B which is ethanoic acid is an organic acid as it has a carboxylic acid group –COOH.

The structural formula is:



d. Compound C is ethanol. On heating, it gives ethene as the major product. The reaction is shown below:

$$C_2H_5OH \xrightarrow[H_2SO_4]{Heat} C_2H_4 + H_2O$$

H_2SO_4 acts as a dehydrating agent and eliminates water from ethanol.

e. The reaction between compounds B and C, ethanoic acid and ethanol, gives an ester, ethyl ethanoate. It is sweet-smelling compound and used as artificial flavouring agent.

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$$

35. a. This surgical method in males is called vasectomy. In females the surgical method on this similar line is called tubectomy.

Surgical methods are irreversible and provide permanent form of birth control by blocking the vas deferens (in males) and fallopian tube (in females).

b. Structure 'X' is vas deferens and organ 'B' is testis.

c. The cells 'A' and 'D' are sperm and ovum respectively.

OR

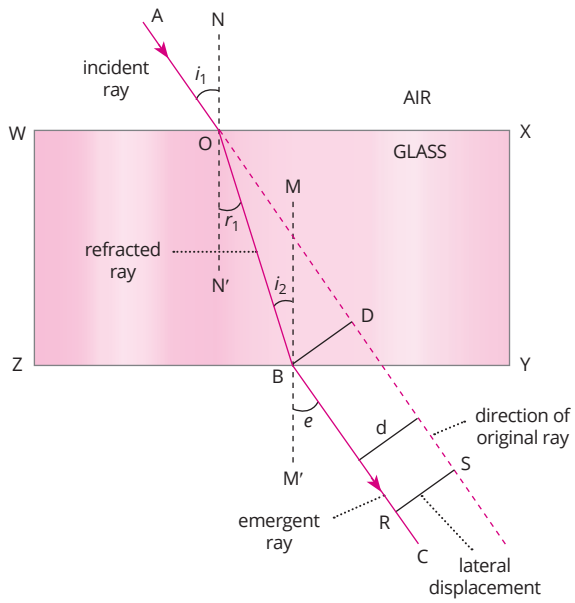
a. Adrenaline is the hormone responsible for these changes. It is secreted by adrenal gland (adrenal medulla). Adrenal gland also produces noradrenaline. Noradrenaline functions together with adrenaline.

b. The thyroid gland secretes thyroxine. Thyroxine stimulates the rate of cellular oxidation and metabolism.

36. a. A lens is a piece of transparent, optical material bounded by two refracting surfaces which are usually spherical, or one surface spherical and the other plane.

CONVEX LENS	CONCAVE LENS
A convex lens is thicker in the middle and thinner at the edges.	A concave lens is thinner in the middle and thicker at the edges.
A parallel beam of light passing through this lens converges at a point after refraction.	A parallel beam of light passing through this lens appears to diverge from a point after refraction.
It is a converging lens.	It is diverging lens.
It has a real focus.	It has a virtual focus.

b. Diagram of refraction of light through a rectangular glass slab



c. Given,

Power, P = +5D and we know that,

Power, $P = \frac{1}{f}$, where f is the focal length of the lens.

Substituting values in the above formula, we get

$f = \frac{1}{+5}$

f = 0.2 m

f = 0.2 × 100 cm

f = 20 cm.

Hence, if the power of lens is +5 diopter, the focal length is 20 cm.

OR

a. Two characteristics of concave lenses are:

- Diverging nature: Concave lenses are thinner at the centre and thicker at the edges, causing them to diverge or spread out incoming parallel rays of light. This divergence is the result of the refractive index of the lens material being less than that of the surrounding medium, such as air.
- Virtual, upright images: When parallel rays of light pass through a concave lens, they appear to diverge from a common point behind the lens, known as the focal point. This makes the image formed by a concave lens virtual, meaning it cannot be projected onto a screen. The image is also upright, which means it has the same orientation as the object.

b. The focal length of a concave lens is the distance from the lens to its focal point. It is typically denoted as *f*. The focal length is a measure of how quickly the rays of light converge or diverge. In a concave lens, a shorter focal length means stronger divergence, and a longer focal length means weaker divergence. The focal length is negative because in a concave lens, the focal point is located on the same side as the incoming light. The negative sign signifies the virtual nature of the image.

c. The diverging nature of concave lenses is responsible for their use to correct near-sightedness (myopia) by spreading out the incoming light rays before they reach the eye's lens, which helps focus the image properly on the retina. The focal length of a concave lens determines the magnification of the image. A shorter focal length results in a greater divergence of rays, leading to a larger virtual image, while a longer focal length produces a smaller virtual image. This property is used in various optical applications, such as magnifying glasses and microscopes, where the size of the image is important. The property of formation of upright images is used in magnifying glasses and peep holes.

SECTION – E

37. Compound A is acetic acid with molecular formula $C_2H_4O_2$.

(i) It reacts with sodium to form sodium acetate which is compound B.

(ii) The hydrogen gas evolved during the reaction burns with a pop sound.

(iii) Further, when acetic acid reacts with methanol in the presence of an acid, it forms methyl acetate which is a sweet-smelling substance with the molecular formula, $C_3H_6O_2$. So, compound D is methyl acetate and C is methanol. Addition of NaOH to methyl acetate gives back sodium acetate and methanol.

a. Hence,

Compound A is CH_3COOH (acetic acid).

Compound B is CH_3COONa (Sodium acetate).

Compound C is CH_3OH (Methanol).

Compound D is CH_3COOCH_3 (Methyl acetate).

b. IUPAC names of 'A', 'B', 'C' and 'D':

Compound A is Ethanoic acid.

COMPOUND B IS Sodium ethanoate.

Compound C is Methanol.

Compound D is Methyl ethanoate.

OR

The chemical equation related to the step (i) reaction can be given as:

$2CH_3COOH + 2Na \rightarrow 2CH_3COONa + H_2(g)$

(A) (B)

The chemical equation related to the step (iii) reaction can be given as:

$CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$

(A) (C) (D)

The chemical equation related to the step (iv) reaction can be given as:

$CH_3COOCH_3 + NaOH \rightarrow CH_3COONa + CH_3OH$

(D) (B) (C)

38. a. bb

b. Blue eyed

c. 1 : 1

OR

Phenotype of the father – BB or Bb, phenotype of mother- bb

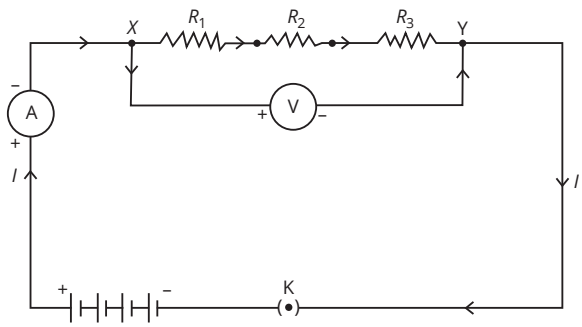
Blue eye colour trait can only be expressed in homozygous condition (bb). Therefore, it is recessive in nature.

We need data of at least three generations to identify whether a trait is dominant or recessive.

39. a. **Step 1:** Construction of circuit

- Connecting three resistances R_1, R_2, and R_3 in series combination across the battery of voltage V.
- Adding an ammeter in series and a voltmeter in parallel combination in the circuit.

Step 2: Circuit diagram



Step 3: Observation

- Take the reading of the potential difference between R_2 and R_3 in the absence of R_1.
- Take the reading of the potential difference between R_1 and R_3 in the absence of R_2.
- In each case, the ammeter reading is the same, that is, current remains the same in the circuit.

Step 4: Calculation

- From the Ohm's law, we know that, $V = IR$, where V = voltage, I = current, and R = resistance.
- The current in terms of voltage and resistance of each resistor is $I = \frac{V}{R}$.
- From the observation, the ratio of voltage and potential is the same. Thus, the current flowing in the circuit is the same.

b. i. Equivalent resistance $(R_E) = \frac{R_1 \times R_2}{R_1 + R_2} + R_3$

$$= \frac{24\,\Omega \times 24\,\Omega}{24\,\Omega + 24\,\Omega} + 12\,\Omega$$

$$= 12\,\Omega + 12\,\Omega = 24\,\Omega$$

The current through $12\,\Omega$ resister,

$$I = \frac{V}{R_E} = \frac{6}{24} = 0.25\,\text{A}$$

ii. The difference in the readings of A_1 and A_2 = 0 (As they are connected in series.)

OR

a. Electric power (P) is defined as the rate of doing electrical work, or the rate at which electrical energy is consumed in an electric circuit, that is

$$\text{Electric Power} \quad (P) = \frac{\text{Electircal work done}}{\text{Time taken}}$$

$$\text{or } P = \frac{E}{t}$$

$$\text{or } P = \frac{V \times I \times t}{t}$$

(Since $E = V \times I \times t$)

$$\text{or } P = V \times I$$

Electric power in terms of I and R

$V = I \times R$ (using Ohm's law)

Substituting the value of V in the equation

$$P = V \times I$$

$$P = (I \times R) \times I = I^2R$$

b. For Bulb 1,

Power $P = 100\,\text{W}$, Voltage, $V = 220\,\text{V}$, Resistance = R_1

We know,

$$P = \frac{V^2}{R_1}$$

$$100 = \frac{220 \times 220}{R_1}$$

$$R_1 = \frac{220 \times 220}{100} = 484\,\Omega$$

For Bulb 2,

Power $P = 60\,\text{W}$, Voltage, $V = 220\,\text{V}$, Resistance = R_2

Again using

$$P = \frac{V^2}{R_2}$$

$$60 = \frac{220 \times 220}{R_2}$$

$$R_2 = \frac{220 \times 220}{60} = 806.7\,\Omega$$

As the resistances are connected in parallel,

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{484} + \frac{1}{806.7}$$

So, total resistance

$$R = 302.5\,\Omega$$

We know,

$$V = I \times R$$

$$220 = I \times 302.5$$

$$I = \frac{220}{302.5} = 0.73\,\text{A}$$