CBSE Science - Grade X
Solution for 2022-23 Examination

Question paper Code: 31/3/1

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.

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.   *Identify the product 'X obtained in the following chemical reaction:*   [1]

$$CaCO_3 \xrightarrow{\Delta} \text{'}X\text{'} + CO_2$$

(A)   Quick lime
(B)   Gypsum
(C)   Lime Stone
(D)   Plaster of Paris

Solution: (A) Quick lime

Explanation: In this reaction, calcium carbonate breaks down into two products: Quick lime (CaO) and carbon dioxide (CO_2). So, the product 'X' obtained in the reaction is Quick lime (CaO).

2. *Select a pair of natural indicator from the following:* [1]
   (A) *Litmus and methyl orange*
   (B) *Turmeric and Litmus*
   (C) *Phenolphthalein and methyl orange*
   (D) *Methyl orange and Turmeric*

Solution: (B) Turmeric and Litmus

Explanation: Turmeric and litmus are natural indicators used to determine whether a substance is acidic, basic, or neutral. Turmeric changes colour from yellow to reddish-brown in basic solutions and litmus changes colour from blue to red in acidic solutions. They are both simple, natural ways to test the pH of a substance without the need for complex equipment.

3. *A chemical compound used in glass, soap and paper industries is* [1]
   (A) *Washing Soda*
   (B) *Baking Soda*
   (C) *Bleaching Powder*
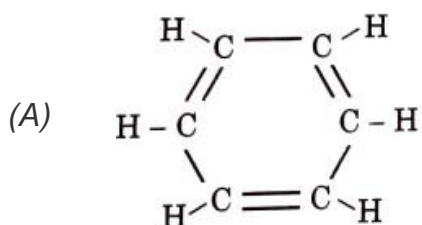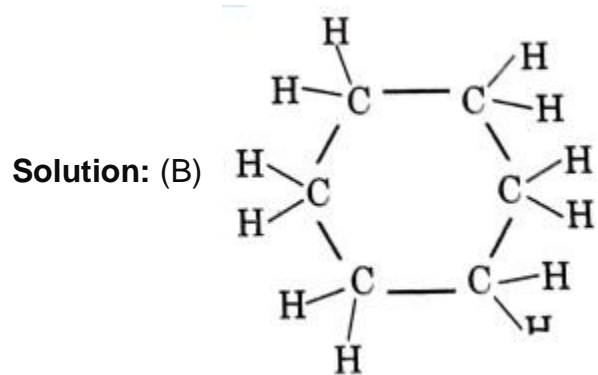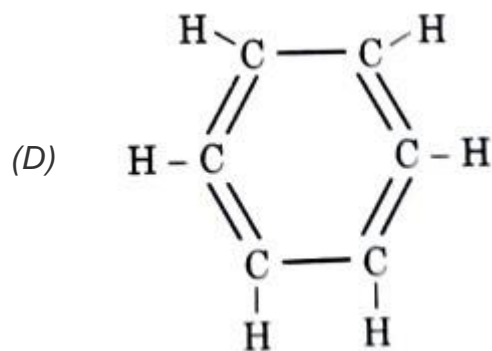   (D) *Common Salt*

Solution: (A) Washing Soda

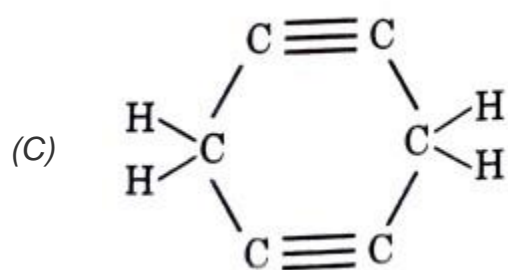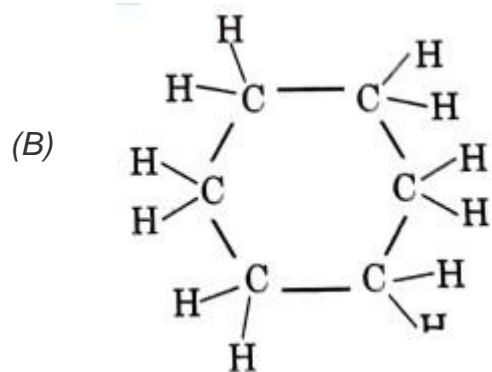**Explanation:** The chemical compound used in glass, soap, and paper industries is washing soda, also known as sodium carbonate.

4. *The structural formula of Cyclohexane is:* [1]

(A)

(B)

(C)

(D)

Solution: (B)

Explanation: Cyclohexane is C_6H_{12}, representing a six-carbon ring with each carbon atom bonded to two hydrogen atoms. It's a cyclic hydrocarbon, meaning it forms a closed ring structure. This molecule is a common example of a saturated hydrocarbon, meaning it contains only single bonds between carbon atoms, making it highly stable and relatively unreactive compared to unsaturated hydrocarbons like alkenes or alkynes.

5. *Consider the following Chemical equation:*

$$a \ Al_2O_3 + b \ HCl \rightarrow c \ AlCl_3 + d \ H_2O$$
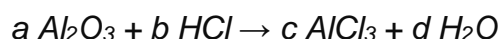
In order to balance this chemical equation, the values of a, b, c and d must be

[1]

(A)   *1, 6, 2 and 3*
(B)   *1, 6. 3 and 2*
(C)   *2, 6, 2 and 3*
(D)   *2, 6, 3 and 2*

Solution: (A) 1, 6, 2 and 3

Explanation: To balance the chemical equation we need to ensure that the number of atoms of each element is the same on both sides of the equation.

1. Start by counting the number of atoms of each element on each side of the equation.
   - Aluminium (Al): 2 on the left, 1 on the right.
   - Oxygen (O): 3 on the left, 1 on the right.
   - Hydrogen (H): 1 on the left, 2 on the right.
   - Chlorine (Cl): 1 on the left, 3 on the right.
2. To balance aluminium, multiply $AlCl_3$ by 2 on the right.
3. To balance chlorine, multiply HCl by 6 on the left.
4. Hydrogen is now balanced with 6 hydrogen atoms on the left.
5. Oxygen is already balanced with 3 O atoms in Al_2O_3 and 3 in H_2O.

6.   Which one of the following hydrocarbons is different from the others?   [1]

   (A) C_4H_{10}
   (B) C_7H_{14}
   (C) C_5H_{12}
   (D) C_2H_6

Solution: (B) C_7H_{14}
Explanation:
The hydrocarbon that is different from the others is C_7H_{14}.

C_4H_{10} represents butane, which has 4 carbon atoms and 10 hydrogen atoms.
C_5H_{12} represents pentane, which has 5 carbon atoms and 12 hydrogen atoms.
C_2H_6 represents ethane, which has 2 carbon atoms and 6 hydrogen atoms.
All of these hydrocarbons belong to the alkane family and follow the general formula C_nH_{2n+2} for saturated hydrocarbons.

7.   Which one of the following reactions is different from the remaining three?   [1]
   (A) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
   (B) $CaO + H_2O \rightarrow Ca(OH)_2$
   (C) $KNO_3 + H_2SO_4 \rightarrow KHSO_4 + HNO_3$
   (D) $ZnCl_2 + H_2S \rightarrow ZnS + 2HCl$

Solution: (B) $CaO + H_2O \rightarrow Ca(OH)_2$
Explanation:
$CaO + H_2O \rightarrow Ca(OH)_2$ is a combination reaction while the other three reactions are double displacement reactions.

8.   Select from the following a plant hormone which promotes cell division.   [1]

   (A)   Gibberellin
   (B)   Auxins
   (C)   Abscisic Acid
   (D)   Cytokinins

Solution: (B) Auxins
Explanation:
Auxins are majorly produced in the apices of the stem and root and help in their elongation. It plays an important role in cell division and differentiation by enhancing them.

9. *Part(s) of a flower which attracts insects for pollination is (are)* [1]

    (A) petals and sepals
    (B) anther and stigma
    (C) petals only
    (D) sepals only

Solution: (C) petals only
Explanation:
The part of the flower that attracts insects for pollination is the petals. They are the coloured parts of the flower.

10. *In an experiment to study the independent inheritance of two separate traits: shape and colour of seeds, the ratio of the different combinations in F_2 progeny would be* [1]

    (A) 1:3
    (B) 1:2:1
    (C) 9:3:3:1
    (D) 9:1:1:3

Solution: (C) *9:3:3:1*
Explanation:
Mendel's cross on pea plants produced an observable ratio of 9: 3: 3: 1 due to the independent inheritance of two distinct traits, seed shape, and colour.
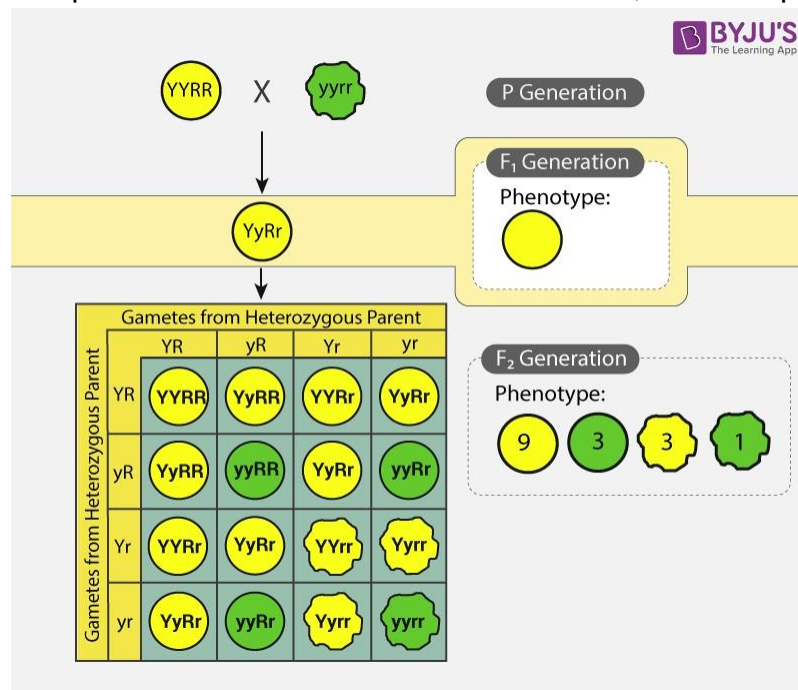
11. Which of the following statement(s) is (are) true about the human heart?   [1]

   (a) Right atrium receives oxygenated blood from lungs through pulmonary artery
   (b) Left atrium transfers oxygenated blood to left ventricle which sends it to various parts of the body
   (c) Right atrium receives deoxygenated blood from different parts of the body through vena cava.
   (d) Left atrium transfers oxygenated blood to the aorta which sends it to different parts of the body.

   (A) (b) only
   (B) (a) and (d)
   (C) (b) and (c)
   (D) (b) and (d)

Solution: (C) (b) and (c)
Explanation:
The left atrium receives oxygenated blood from the lungs through the pulmonary veins. The blood then flows into the left ventricle, which pumps it to the aorta. The aorta distributes the oxygenated blood to the body.
The right atrium receives oxygen-poor blood from the body and pumps it to the right ventricle. The right ventricle then pumps the oxygen-poor blood to the lungs

12. A cross between two tall pea plants resulted in offsprings having a few dwarf plants. The gene-combination of the parental plants must be   [1]

   (A)   Tt and Tt
   (B)   Tt and tt
   (C)   TT and tt
   (D)   TT and Tt

Solution: (A) Tt and Tt

Explanation: In the case of TT and Tt; all offspring would be tall (TT, Tt). In the case of option 'c' no gene for a dwarf is present, so all offspring will be tall. In the case of option 'd', one of the parent plants is dwarf, so it is incorrect. In the case of option 'b', most of the offspring will be tall and a few will be a dwarf

13. *The Phenomena of light involved in the formation of a rainbow in the sky are* [1]
    (A) *Refraction, dispersion and reflection*
    (B) *Refraction, dispersion and total internal reflection*
    (C) *Dispersion, scattering and reflection*
    (D) *Dispersion, refraction and internal reflection*

Solution: (B) Refraction, dispersion and total internal reflection

Explanation-The formation of rainbow involves all three phenomena: Refraction, dispersion, and total internal reflection. The sunlight shines on a water droplet. As the light passes into the raindrop the light bends, or refracts. Due to different speeds of different colours, white light gets dispersed into seven colours. Then total internal reflection happens on the other end of the drop, after which the rays finally refract to form the rainbow.

14. *In case of four wires of same material, the resistance will be minimum if the diameter and length of the wire respectively are* [1]
    (A) *D/2 and L/4*
    (B) *D/4 and 4L*
    (C) *2D and L*
    (D) *4D and 2L*

Solution: (B) 4D and 2L

Explanation: $R = \dfrac{\rho l}{A} = \dfrac{\rho l}{\pi(D^2/4)} = \dfrac{4\times\rho l}{\pi(D^2)}$

When diameter = D/2 and Length = L/4, Resistance, $R = \dfrac{4\times\rho(l/4)}{\pi((D/2)^2)} = \dfrac{4\times\rho l}{\pi(D^2)}$

When diameter = D/4 and Length = 4L, Resistance, $R = \dfrac{4\times\rho(4l)}{\pi((D/4)^2)} = \dfrac{256\times\rho l}{\pi(D^2)}$

When diameter = 2D and Length = L, Resistance, $R = \dfrac{4\times\rho(l)}{\pi((2D)^2)} = \dfrac{\rho l}{\pi(D^2)}$

When diameter = 4D and Length = 2L, Resistance, $R = \dfrac{4\times\rho(2l)}{\pi((4D)^2)} = \dfrac{\rho l}{2\times\pi(D^2)}$

So, resistance will be minimum for the wire having diameter 4D and length 2L.

15. *A food chain will be more advantageous in terms of energy if it has* [1]
    (A) *2 trophic levels*
    (B) *3 trophic levels*
    (C) *4 trophic levels*
    (D) *5 trophic levels*

Solution: (A) 2 trophic levels
Explanation: A food chain with 2 trophic levels (producer and primary consumer) is the most advantageous in terms of energy transfer as it has the least energy loss.

16. *Consider the following statements about ozone*
    (a) Ozone is poisonous gas.
    (b) Ozone shields the earth's surface from the infrared radiation from the sun.
    (c) Ozone is a product of UV radiations acting on oxygen molecules.
    (d) At the lower level of the earth's atmosphere, ozone performs its most essential function.

    The correct statements are   [1]

    (A)   (a) and (b)
    (B)   (a) and (c)
    (C)   (b) and (c)
    (D)   (b) and (d)

Solution: (B) (a) and (c)
Explanation: (a) Ozone is a poisonous gas in the lower atmosphere (troposphere), where it can be harmful to human health.
(c) Ozone is formed by the action of ultraviolet (UV) radiation on oxygen molecules in the upper atmosphere (stratosphere).

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): A piece of Zinc metal gets reddish brown coating when kept in copper sulphate solution for some time.*
    Reason (R):   Copper is more reactive metal than Zinc.   [1]

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

Explanation:

Assertion (A) states that a piece of zinc metal develops a reddish-brown coating when immersed in copper sulphate solution. This is true and occurs due to a displacement reaction where zinc atoms from the metal react with copper ions in the solution to form metallic copper on the surface of the zinc.

Reason (R) claims that copper is more reactive than zinc. However, this is false. In reality, zinc is more reactive than copper. The reactivity series of metals places zinc higher than copper, indicating that zinc can displace copper from its compounds in solution but not vice versa.

18. *Assertion (A): Offsprings produced by asexual reproduction are genetically similar to the parents.*
    Reason (R):   Asexual reproduction involves a single parent.   *[1]*

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

Explanation: When an offspring is produced by a single parent without the involvement of gamete formation, the reproduction is called asexual reproduction. As a result, the offspring produced are not only similar to one another but are also exact copies of their parents.

19. *Assertion (A): Red light signals are used to stop the vehicles on the road.*
    Reason (R):   Red coloured light is scattered the most so as to be visible from a large distance.   *[1]*

Solution: (C) (A) is true and (R) is false.
Explanation: Red light signals are used to stop vehicles on the road. This is because the red colour has a longer wavelength compared to other colours in the visible spectrum and hence, is scattered the least.

20. *Assertion (A): The waste we generate daily may be biodegradable or non-biodegradable.*
    Reason (R):   The waste generated, if not disposed off properly may cause serious environmental problems.   *[1]*

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

Explanation: The reason is not the cause but is a solution to the problem of waste disposal.

SECTION B

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

21. *When magnesium ribbon is burnt in air, an ash of white colour is produced. Write chemical equation for the reaction giving the chemical name of the ash produced. State the type of chemical reaction giving justification for your answer.* [2]

Solution:
When magnesium ribbon is burnt in air, it undergoes a combustion reaction, producing magnesium oxide (MgO) as the ash. The chemical equation for this reaction is:

$$2Mg + O_2 \rightarrow 2MgO$$
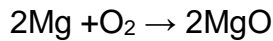
The ash produced, magnesium oxide (MgO), is a white powder.

22. *here are auxins synthesized ? How do they promote phototropism?* [2]

Solution:
Auxin is the hormone which is usually synthesised in the young tip of roots and shoots. When light is coming from one side of the plant it diffuses towards the shady side of the shoot which stimulates the cells to grow longer resulting in the bending of shoot towards the light thus auxin promotes phototropism.

23. *(a) List any two pairs of visible contrasting characters of garden pea plants used by Mendel for his experiments stating the dominant and recessive characters in each pair.* [2]

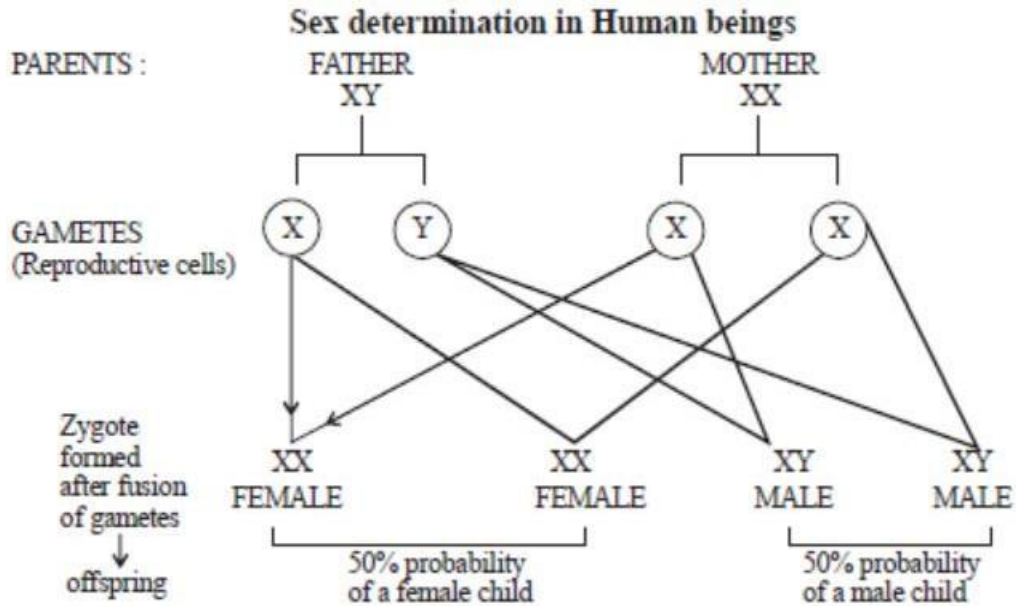**OR**

(b) In human beings, the probability of getting a male or a female child is 50%. Explain with the help of a flow diagram only. [2]

Solution: (a) Mendel used seven characters for his experiments
The two contrasting characters are
i) Height of the plant (Tall and Dwarf)
ii) Colour of flower (Violet and white)

(b) If a Y bearing sperm fertilizes the egg, the zygote will be a male (XY) and when X bearing sperm fertilizes the egg, the resulting zygote will be female (XX). Since the ratio of the X chromosome and the Y chromosome in a male gamete is 50:50. The statistical probability of male or female infants is also 50:50.

Sex determination in Human beings

PARENTS :

FATHER
XY

MOTHER
XX

GAMETES
(Reproductive cells)

X   Y   X   X

Zygote
formed
after fusion
of gametes
↓
offspring

XX
FEMALE

XX
FEMALE

XY
MALE

XY
MALE

50% probability
of a female child

50% probability
of a male child

24. *When do we say that a particular person is suffering from hypermetropia? List two causes of this defect. Name the type of lens used to correct this defect.* [2]

Solution: We say a person is suffering from hypermetropia, also known as farsightedness, when they can clearly see the faraway objects but have difficulty focusing on nearby objects.

The two causes of hypermetropia are:
(i) the focal length of the eye lens is too long, or
(ii) the eyeball has become too small.

This defect can be corrected by using a convex lens of appropriate power.

25. *(a) Draw a labelled diagram to show the pattern of magnetic field lines produced due to a current carrying straight conductor. Mark on it the direction of current in the conductor and the direction of magnetic field lines.* [2]
### OR
(b) Name the device used to magnetise a piece of magnetic material. Draw a labelled diagram to show the arrangement used for the magnetisation of a cylinder made of soft iron. [2]

Solution: (a)
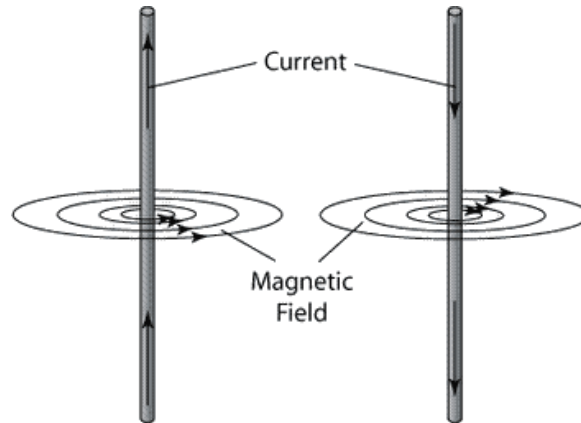
The magnetic field lines around a straight current-carrying conductor are concentric circles with centre at the conductor.

(b) The device used to magnetise a piece of magnetic material is called a solenoid or an electromagnet.
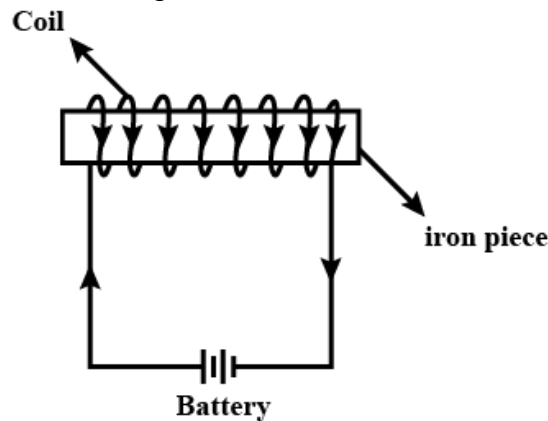
26. *What are decomposers? List two consequences of their absence in an ecosystem.*

[2]

Solution: Decomposers:
Decomposers are creatures that break down dead or decaying species. They perform decomposition, breaking down complex particles into small particles. In return, these produce particles that act as nutrients for the producers.

Consequences of absence of decomposers:
1. As decomposers are involved in the decomposition process, their absence would halt the decomposition process.
2. Accumulation of dead and decaying substances in nature.
3. Finally, the environment would be devoid of all-natural resources.

SECTION C

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

27. State reasons for the following :   [3]
(a) Zinc oxide is an amphoteric oxide.
Solution: Zinc oxide is an amphoteric oxide as it reacts with both acids and alkalis to give salt and water.

(b) Sodium metal is stored in bottle filled with kerosene oil.
Solution: Sodium is a very reactive metal. It is kept in kerosene to prevent it from coming in contact with oxygen and moisture. If this happens, it will react with the moisture present in air and form sodium hydroxide which is a highly exothermic reaction.

(c) In the reactions of nitric acid with metals, generally hydrogen gas is not evolved.

Solution: Hydrogen gas is not evolved when a metal reacts with nitric acid because nitric acid is a strong oxidizing agent; it oxidizes the hydrogen to produce water.

28. (a) State giving reason the reduction process to obtain the following metals from their compounds
   (i) Mercury
   (ii) Copper and
   (iii) Sodium   [3]
(b) State giving reason for the change in appearance observed when each of the following metal is exposed to atmospheric air for some time :
   (i) Silver,
   (ii) Copper and
   (ii) Iron   [3]
Solution:
(a)
(i) and (ii) Low reactive metals like copper and mercury are placed at the bottom of the reactivity series and are extracted by heating their ores alone. We should note that ores of copper can be extracted by both: reduction with carbon (copper (I) oxide) and heating alone (copper (I) sulphide).
(iii) Sodium is highly reactive metal and placed at the top of the reactivity series. This metal is extracted by electrolytic reduction of their molten chlorides or oxides because it is not reduced by other reducing agents like coke, carbon monoxide etc.

(b)

(i) The silver article becomes black after sometimes when exposed to air because silver reacts with sulphur which is present in the atmosphere and then forms silver sulphide.
(ii) Copper corrodes by oxidation in which it reacts with oxygen to form copper oxide, which further reacts with carbon dioxide and forms copper carbonate, which is the green colour that forms on the surface of copper which is known as verdigris. Thus copper loses its lustre.
(iii) Iron when exposed to moist air forms a reddish brown layer of iron oxide, which is known as rust.

29. *We water the soil but it reaches the topmost leaves of the plants. Explain in brief the process involved.* [3]
Solution:
- Water is moved through xylem vessels to the apical parts of the plant body by transpiration pull and root pressure.
- Root pressure is the pressure applied by cortical cells on cell sap present in the xylem to move to the top of the plant.
- Transpiration pull is the suction force applied to the water column due to transpiration that causes loss of water in the form of water vapour.
- The xylem vessels act as capillary tubes when water evaporates from the surface of the leaves.
- Because of this capillary action water is drawn up from the roots and pulled towards the top portions of the plant.

30. *(a) Last two constituents of the Central Nervous System (CNS). How are these components protected from injuries?*
(b) Write two limitations of the use of electrical impulses [3]
Solution: (a) The constituents of the central nervous system (CNS) are the brain and the spinal cord. The brain sits inside a fluid-filled balloon-like structure for shock absorption and this entire set-up is protected by a hard bony skull. Both the brain and the spinal cord are protected by bone: the brain by the bones of the skull, and the spinal cord by vertebrae , a set of ring-shaped bones. They're both cushioned by layers of membranes (called meninges) and cerebrospinal fluid.

(b) The limitations that nerve impulses have are as follows:
1) The impulses can move only in one direction. This is because the nerves are structured to allow unidirectional flow.
2) The electrical impulses are quite short acting. The message is only sent in the presence of the stimulus.

31. *Name and explain the phenomenon of light due to which the path of a beam of light becomes visible when it enters a smoke filled room through a small hole. Also state the dependence of colour of the light we receive on the size of the particle of the medium through which the beam of light passes.* [3]

Solution: The phenomenon of light due to which the path of a beam of light becomes visible when it enters a smoke filled room through a small hole is known as the tyndall effect.

The colour of the scattered light depends on the size of the scattering particles. Very fine particles scatter mainly blue and violet lights and the scattered light appears bluish.

On the other hand, particles of larger size scatter light of longer wavelengths. If the size of the scattering particles is large enough, then, the scattered light may even appear white.

32. *Explain in brief the function of an electric fuse in a domestic circuit. An electric heater of current rating 3 kW:220 V is to be operated in an electric circuit of rating 5 A. What is likely to happen when the heater is switched 'ON'? Justify your answer with necessary calculation.* [3]

Solution: A fuse is a safety device connected in series with an electric circuit to prevent damage due to overloading and short circuit. When the current in the circuit exceeds its specified limit, excess heat is produced which melts the fuse wire immediately. Thus, the circuit gets broken and no current passes through it. This prevents other appliances as well as the circuit from getting damaged.

We know that, Power, P = VI
Given, P = 3 kW = 3000 W
V = 220 V

Now, $I = \dfrac{P}{V}$

$$\Rightarrow I = \frac{3000}{220} = 13.636\,A$$

So, the electric heater draws approximately 13.64 A of current when operating at its rated power and voltage.

However, the electric circuit is rated for only 5 A. So, when the heater is switched on, it will try to draw more current (13.64 A) than the circuit is designed to handle (5 A). This will likely cause an overload in the circuit.

33. *(a) State Ohm's law. Write formula for the equivalent resistance R_p of the parallel combination of three resistors of values R_1, R_2 and R_3.*
    (b) Find the resistance of the following network of resistors:
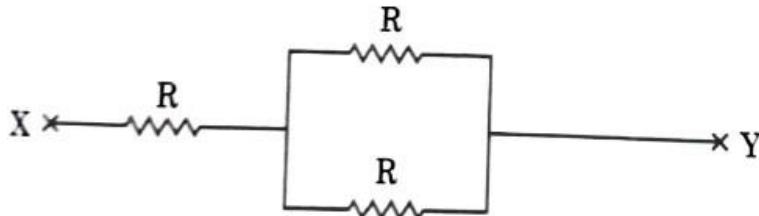

[3]

Solution:
(a)
Ohm's law states that the voltage across a conductor is directly proportional to the current flowing through it, provided all physical conditions and temperature remain constant.

The equivalent resistance, R_p of the parallel combination of three resistors of values R_1, R_2 and R_3 is given by:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

(b)
The resistance of the following network of resistors can be calculated as:
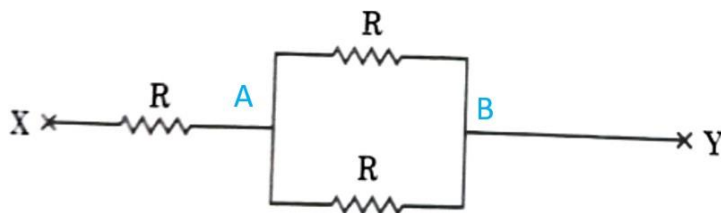
The equivalent resistance between points A and B can be calculated as:

$$\frac{1}{R_{AB}} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$$

$$\Rightarrow R_{AB} = \frac{R}{2}$$

The equivalent resistance between points X and Y can be calculated as:

$R_{XY} = R + R_{AB}$

$R_{XY} = R + R/2 = 3R/2$

SECTION D

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

34. *(a)*

(i) Five solutions A,B,C,D,and E when tested with pH paper showed pH as 4,1,1 3,7and 10 respectively.Which solution is

(1)Strongly acidic (2) Strongly alkaline (3) Weakly acidic (4)Neutral and (5)Weekly alkaline . Arrange the solutions in increasing order of H+ ion concentration.

(ii) Write the name and formula of (1) an acidic salt and (2) a basic salt giving the name of the parent acid and parent base used to form the salt in each case

[5]

OR

(b)

Name and state in brief the process which is used to prepare sodium hydroxide from sodium chloride. In this process along with the main product two gases 'X' and 'Y' are also given off at the two electrodes.Name 'X' and 'Y' specifying the name of their respective electrode at which each gas is obtained. One of these gases when reacts with dry calcium hydroxide produces a compound 'Z' which is widely used in water treatment plants and textile industries. Name Z and write chemical equation for the reaction involved in its formation.

[5]

Solution: (a)
(i) From the given pH 4, 1,13,7, and 10 we can say that;
A - Weakly acidic
B- Strongly acidic
C- Strongly alkaline
D-Neutral
E-Weakly alkaline

The pH can be arranged in the increasing order of the concentration of hydrogen ions as:
C <E < D< A < B

(ii)

(1) The salts produced when a strong acid is reacted with weak base are known as acidic salts.

NH_4Cl(ammonium chloride) is an acidic salt as it is produced from HCl (strong acid) and NH_3 (weak base).

(2) Sodium carbonate(Na_2CO_3) is a basic salt as it is formed by the neutralisation between NaOH (strong base) and H_2CO_3 (weak acid).

(b) The chloralkali process. During the chlor - alkali process, hydrogen gas(X) is liberated at the cathode and chlorine gas(Y) is liberated at the anode.
Chlorine gas produces bleaching power when it reacts with lime water
$(Ca(OH)_2)$(Z). Bleaching powder is used as a bleaching agent in chemical industries.

$$a(OH)_2(s) + Cl_2(g) \rightarrow CaOCl_2(s) + H_2O(l)$$
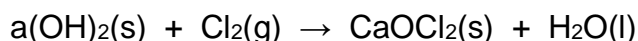
35. *(a)*
   (i) *What are spores? On which structures are they formed? How do they overcome unfavourable conditions? Name the organism which multiplies with the help of these structures.*
   (ii) *Give two reasons why some plants are grown by the method of vegetative propagation. List two methods used to grow plants vegetatively.*

   [5]

   OR

   (b)
   (i) *Study the diagram given below and name the parts marked as A. B and C. What happens when B reaches C in the ovary? Mention its significance*
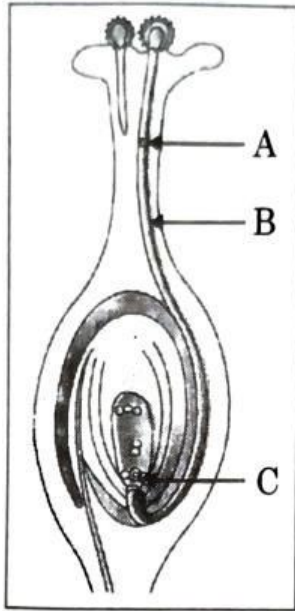
(ii)   Write the post fertilisation changes that occur in a flower.

[5]

Solution: (a)

(i) Spores are produced by plants and fungi for the purpose of asexual reproduction. Plants and organisms enter into the sporophyte stage of their life cycle upon unfavourable conditions to produce spores from the sac-like structure known as sporangium. The spores are dispersed in favourable conditions to distant places.

(ii) Some plants cannot produce viable seeds. Plants like them develop from vegetative parts like stems, roots, or leaves. Thereby, they become genetically identical to their parents. This is why some plants are propagated only by vegetative methods.There are many different types of vegetative propagation that all involve different methods and plant structures used to produce offspring. Grafting, layering, cuttings, stolons, suckering, tuber production, and tissue culture are all common examples of vegetative propagation.

(b)

(i) A is Pollen grain, B is Pollen tube and C is Egg cell. The egg cell. After fertilisation with the male gametes, the egg cell forms the zygote.

(ii) After fertilization, the following changes are observed in a flower: There is the formation of a diploid zygote and it develops into an embryo, which forms the future plant. The endosperm cells serve as a source of nutrition for the developing embryo. The ovule becomes the seed.

36. *(a)*

(i) Draw a ray diagram to show the path of the refracted ray in each of the following cases:
A ray of light incident on a concave lens
(1) parallel to its principal axis, and
(2) is directed towards its principal focus.

(ii) A 4 cm tall object is placed perpendicular to the principal axis of convex lens of focal length 24 cm. The distance of object from the lens is 16 cm. Find the position and size of image formed. [5]

OR

(b)
(i) Draw a ray diagram to show the path of the reflected ray in each of the following cases:
A ray of light incident on a convex mirror
*(1) parallel to its principal axis, and*
(2) is directed towards its principal focus

(ii) A 1.5 cm tall candle flame is placed perpendicular to the principal axis of a concave mirror of focal length 12 cm. If the distance of the flame from the pole the mirror is 18 cm, use mirror formula to determine the position and size the image formed. [5]
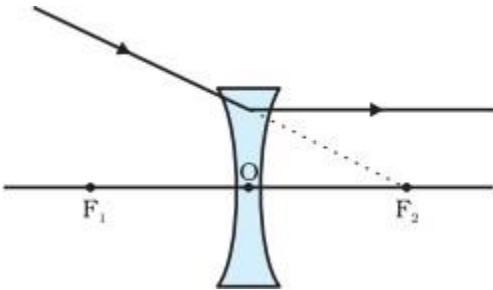
Solution:
(a) (i) A ray of light incident on a concave lens
(1) parallel to its principal axis:
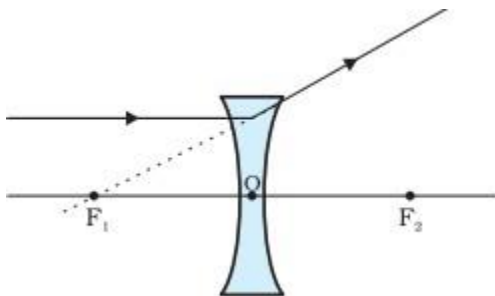
(2) is directed towards its principal focus.

(ii)

Given, height of the object, $h_o = 4$ cm
focal length of the convex lens, $f = 24$ cm
Distance of the object from the lens, $u = -16$ cm, negative because the object is on the left of the lens.
Let v be the image distance and h_i be the height of the image.

According to the lens formula,

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

$$\Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{24} - \frac{1}{16} = \frac{2-3}{48} = \frac{-1}{48}$$

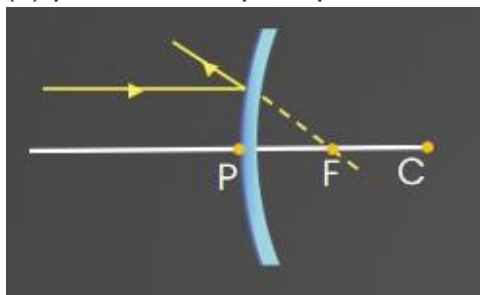$$\Rightarrow v = - 48 \; cm$$

Also, we know that, magnification,

$$m = \frac{h_i}{h_o} = \frac{v}{u}$$

$$\Rightarrow h_i = \frac{v}{u} \times h_o = \frac{-48}{-16} \times 4 = 12 \; cm$$

Hence, the position of the image is 48 cm on the same side as the object, the size of the image is 12 cm, and the nature of the image formed is erect and magnified.

(b) (i) *A ray of light incident on a convex mirror*
(1) parallel to its principal axis
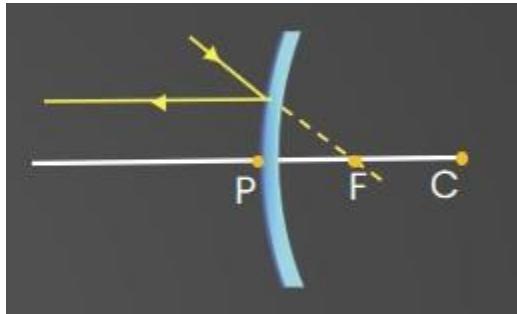
(2) is directed towards its principal focus

(ii)

Hence, the position of the image is 36 cm on the same side as the object, the size of the image is 3 cm, and the nature of the image formed is real, inverted and magnified.

Given, height of the candle flame, h_o = 1.5 cm
Focal length of the concave mirror, f = - 12 cm
Distance of the flame from the pole of the mirror, u = -18 cm.
Let v be the distance of the image of the flame and h_i be the height of the image of the flame.

According to the lens formula,

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

$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-12} + \frac{1}{18} = \frac{-3+2}{36} = \frac{-1}{36}$

$\Rightarrow v = - 36 \ cm$

Also, we know that, magnification,

$m = \frac{h_i}{h_o} = \frac{-v}{u}$

$\Rightarrow h_i = \frac{-v}{u} \times h_o = \frac{36}{-18} \times 1.5 = \ - 3 \ cm$

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. *More than throe million carbon compounds have been discovered in the field of chemistry. The diversity of these compounds is due to the capacity of carbon atoms for bonding with one another as well as with other atoms. Most of the carbon compounds are poor conductors of electricity and have low melting and boiling points. [4]*

(a) Write the molecular formula of first two members of homologous [1]

(b) Given below are the formulae of some functional groups:

(i)   *(ii)*
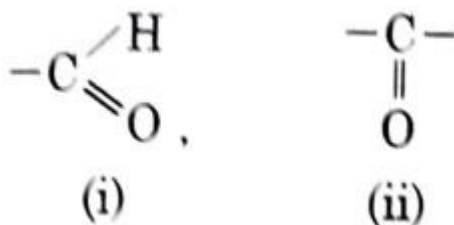
Write the name of these functional groups. [1]

(c) (i) What would be observed on adding a 5% alkaline potassium permanganate drop by drop to some warnm ethanol taken in a test tube ? State the role of $KMnO_4$, in the reaction and write the chemical equation for the reaction involved.

. [2]

OR

(ii) Write the name of the compound formed when ethanol is heated at 443 K temperature with excess of conc. H_2SO_4. What is the role of conc. H_2SO_4 in the reaction ? Write the chemical equation for the reaction involved.
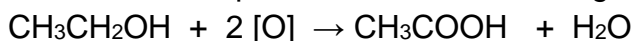
[2]

Solution:

(a) The homologous series of straight-chained alkanes begins methane (CH_4), ethane(C_2H_6)

(b) The name of the functional groups is
(i) Aldehyde   (ii) Ketone

(c)

   (i)On adding 5% alkaline potassium permanganate solution drop by drop to some warm ethanol, we would observe that the purple color of potassium

permanganate starts disappearing. The product formed by this process is ethanoic acid that can turn blue litmus red.

Role of alkaline in the conversion of an alcohol to corresponding carboxylic acid

- Alkaline $KMnO_4$ is used as an oxidizing agent in the reaction involving the conversion of an alcohol to corresponding carboxylic acid.
- $KMnO_4$ is a very powerful oxidizing agent.
- Under controlled conditions, $KMnO_4$ oxidizes primary alcohol to carboxylic acids. It first oxidizes the primary alcohol to aldehyde which is further oxidized to carboxylic acid. Hence some amount of aldehyde is also formed during the process.
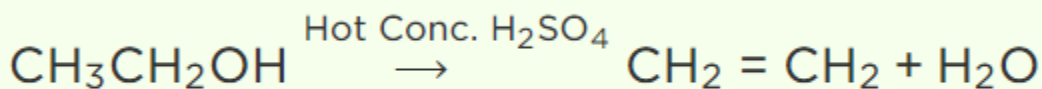
The chemical equation for the reaction is given below:
$$CH_3CH_2OH + 2\,[O] \rightarrow CH_3COOH + H_2O$$
OR

(ii) The compound formed is ethene.
Sulphuric acid acts as a dehydrating agent. The reaction involved is:

$$CH_3CH_2OH \xrightarrow{\text{Hot Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

38. *Human digestive system is a tube running from mouth to anus. Its main function is to break down complex molecules present in the food which cannot be absorbed as such into smaller molecules. These molecules are absorbed across the walls of the tube and the absorbed food reaches each and every cell of the body where it is utilised for obtaining energy.*

Answer the following questions:
   (a) *Name the glands present in the buccal cavity and write the components of food on which the secretion of these glands act upon.*   [1]
   (b) *Two organs have a sphincter muscle at their exit. Name them.*   [1]
   (c) *What will happen if :*
   (i) *mucus is not secreted by the gastric glands*
   (ii) *Villi are absent in the small intestine*   [2]
   OR

(c) "Bile juice does not contain any enzyme, yet it has important roles in digestion."
*Justify the statement.* [2]

Solution:
   (a) Salivary glands is present in the buccal cavity and saliva contains an enzyme
        called salivary amylase that breaks down starch which is a complex molecule
        to give simple sugar
   (b) Esophageal sphincter and Pyloric sphincter.

   (c) (i) Gastric glands in the stomach release hydrochloric acid, enzyme pepsin
        and mucus. Mucus protects the inner lining of the stomach from the action of
        hydrochloric acid and enzyme pepsin. If mucus is not released, it will lead to
        erosion of the inner lining of the stomach leading to acidity and ulcers.
         (ii) This large surface area allows for efficient uptake of nutrients. This
        efficiency is increased even more because each cell in the villi has microvilli on
        their surface. Hence the absence of this villis will decrease nutrient and digested
        food absorption by intestinal walls leading to severe nutritional disorders.

OR
        (c) Bile is a digestive juice secreted by the liver. Although it does not contain any
digestive enzymes, it plays an important role in the digestion of fats. Bile juice has bile
salts such as bilirubin and biliverdin. These break down large fat globules into smaller
globules so that the pancreatic enzymes can easily act on them. This process is known
as emulsification of fats. Bile juice also makes the medium alkaline and activates lipase.

39. *In a domestic circuit five LED bulbs are arranged as shown. The source voltage is*
     220 V and the power rating of each bulb is marked in the circuit diagram. Based on
     the following circuit diagram, answer the following questions:
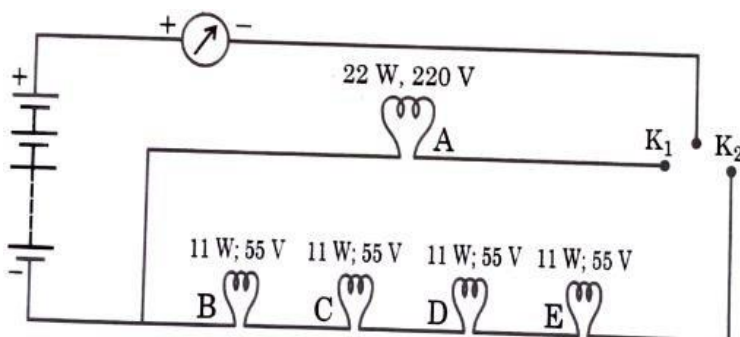
(a)   *State what happens when*   [1]
         (i) key K₁ is closed.
         (ii) key K₂ is closed
(b)   *Find the current drawn by bulb B when it glows.*   [1]
(c)   *Calculate*   [2]
         (i) the resistance of bulb B, and
         (ii) total resistance of the combination of four bulbs B, C, D and E.

OR

(c) What would happen to the glow of all the bulbs in the circuit when keys K₁ and K₂ both are closed and the bulb C suddenly gets fused? Give reason to justify your answer.   [2]

Solution:
(a)
(i) When key K_1 is closed, bulb A will glow.
(ii) When key K_2 is closed, bulbs B, C, D and E will glow.

(b) Given bulb B has a rating of 11 W, 55 V.

We know that, P = VI

$$\Rightarrow I = \frac{P}{V} = \frac{11}{55} = \frac{1}{5}A$$

(c)
(i) Resistance through bulb B can be calculated using Ohm's law.
We know that, V = IR
For bulb B, I = ⅕A and V = 55 V
Thus,

$$R = \frac{V}{I} = \frac{55}{(1/5)} = 275\ \Omega$$

(ii) Total resistance of the combination of four bulbs B, C, D and E can be calculated as:

$R_{eq} = R_B + R_C + R_D + R_E$

Also, bulb B, C, D and E, all have same voltage and power rating, thus, they will have same resistance,
So, $R_B = R_C = R_D = R_E = 275$ ohm
Thus, $R_{eq} = 275 + 275 + 275 + 275 = 1100$ ohm

OR

(c) When keys K_1 and K_2 are both closed and bulb C suddenly gets fused, then, the circuit consisting of bulbs B, C, D and E will break and they all will stop glowing as they all are connected in series.

However, bulb A, which is connected in parallel with the voltage source, will continue glowing with the same brightness.