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CBSE Class 10 Science Board Paper 2026 (31/1/1) with Solutions

PREVIOUS YEAR PAPER · CLASS X · SCIENCE (086) · BOARD EXAM 2026 · Q.P. CODE 31/1/1

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
3 hours	80	39 (A 16 · B 13 · C 10)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 39 questions. All questions are compulsory.
2. Question paper is divided into THREE sections – A, B and C. Section A : Biology (30 Marks); Section B : Chemistry (25 Marks); Section C : Physics (25 Marks).
3. The question paper has MCQs, VSAs, SAs, LAs and C/S-BQs. Marks are given against each question.
4. There are case based questions (CBQs) with three sub-questions and are of 4 marks each.
5. Divide your answer sheet into three sections as per question paper – Section A (Biology), Section B (Chemistry) and Section C (Physics). It is compulsory to answer each question in its respective section. Do not mix answers of one section into the other section.
6. Instructions are given with each section and question, wherever necessary.
7. There is no overall choice in the question paper. However, an internal choice has been provided in few questions. Only one of the choices in such questions must be attempted.
8. This is the official 2026 board paper (Q.P. Code 31/1/1). The step marks shown in the solutions are our marking scheme in the CBSE style; CBSE's own marking scheme may award steps differently.
9. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 3 hours before you look at them.

Questions: CBSE board examination 2026, Q.P. Code 31/1/1, as published by CBSE at cbse.gov.in; figures redrawn. Answers, step marks and worked solutions © Master Testing Agency. Free for personal practice; not for resale. Master Testing Agency is an independent test-prep publisher, not affiliated with, endorsed by or connected to the Central Board of Secondary Education (CBSE) or any other exam-conducting body.

Chapters: Full syllabus · **Topics:** Life Processes · Control and Coordination · How do Organisms Reproduce? · Heredity · Our Environment · Chemical Reactions and Equations · Acids, Bases and Salts · Metals and Non-metals · Carbon and its Compounds · Light – Reflection and Refraction · The Human Eye and the Colourful World · Electricity · Magnetic Effects of Electric Current

SECTION A

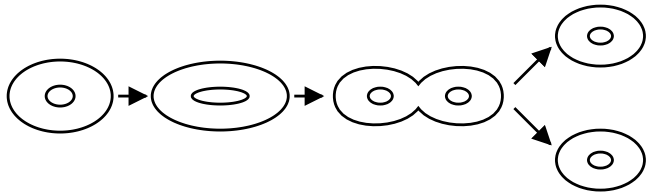
Biology (30 marks).

1. Which structure in a leaf is mainly responsible for gaseous exchange ? 1

(A) Xylem (B) Stomata

(C) Phloem (D) Cuticle

2. Identify the type of reproduction shown in the diagram given below : 1



(A) Budding (B) Fragmentation

(C) Spore Formation (D) Binary Fission

3. Identify the correct statement for *spirogyra*, *leishmania* and *hydra* : 1

(A) they reproduce sexually. (B) they are unicellular.

(C) they are multicellular. (D) they reproduce asexually.

4. Human brain has various parts or regions that help in different actions, responses and coordination. From the following, identify the part responsible for precision of voluntary actions : 1

(A) Cerebrum (B) Cerebellum

(C) Medulla (D) Pons

5. Pancreas secretes pancreatic juice which contain certain enzyme that helps in digestion of food. Choose the correct option from the following : 1

(A) Trypsin digests emulsified fats and lipase digests proteins. (B) Trypsin digests proteins and lipase digests emulsified fats.

(C) Trypsin and lipase both digests fats. (D) Trypsin digests proteins and lipase digests carbohydrates.

6. Sex is determined by different factors in various species. However, in human beings, it is determined genetically. Which amongst the following option(s) is/are correct for human beings ? 1

(i) Gamete carrying X chromosome from female parent.

(ii) Gamete carrying X chromosome from male parent.

(iii) Gamete carrying Y chromosome from male parent.

Options : (A) (ii) and (iii) (B) (i) only (C) (i) and (iii) (D) (iii) only

7. Which of the following group is not ‘biodegradable’ ? 1

(A) Vegetable peels, dead leaves, paper (B) Cow dung, leather bag, water

(C) Polythene bag, rubber band, ball pen (D) Paper, fruits, bones

8. **Assertion (A) :** Reflex actions do not involve thinking. 1
Reason (R) : Most reflex actions are controlled by the spinal cord.

(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, but 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.

9. **Assertion (A) :** In human beings, the respiratory pigment is haemoglobin present in red blood cells. 1
Reason (R) : Haemoglobin has a very high affinity for carbon dioxide.

(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, but 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.

10. What is the function of diaphragm in human respiratory system ? Where is it present in human body ? 2

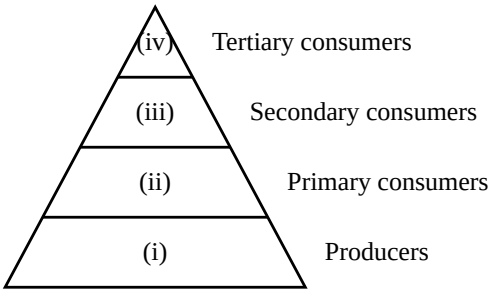
11. (a) State two differences between the act of chewing food and salivation on sight of food. 2

OR

(b) State two differences between pollination and fertilization.

12. Draw a neat diagram to show germination of pollen on the female reproductive part of the flower. 2
Name and label only the following parts :
(a) The part that receives the pollen grain.
(b) The structure that carries the male germ cell to reach the female germ cell.

13. Given below is a pyramid showing various trophic levels in an ecosystem : 3



(a) From the organisms listed below, identify which one is to be placed at which trophic level ? Deer, Grass, Lion, Snake, Rabbit
(b) Discuss the reason why primary consumers will have more energy as compared to secondary consumers ?
(c) Why is the base of the pyramid broad ?

14. Give differences between the following : 3

(a) Nephron and neuron

(b) Sensory nerve and motor nerve

(c) Consumers and decomposers

15. Mendel took garden pea plants with different characteristics, such as height to study the inheritance pattern of factors (genes). He crossed tall pea plant with short pea plant and obtained all the tall plants in the F_1 generation.

Answer the following questions :

(a) Why only tall pea plants were observed in F_1 progeny ? [1]

(b) By which method did Mendel obtain F_2 progeny ? [1]

(c) (i) Write one difference between dominant and recessive trait. [2]

OR

(c) (ii) Write two observations made by Mendel about F_1 progeny. [2]

16. (a) Given below are certain situations. Analyse each and describe its possible impact : 5

(i) A population of bacteria living in temperate waters whose temperature increased by global warming.

(ii) The sperm encounters the egg when it reaches the oviduct in human females.

(iii) Self pollination does not occur in a flower that contains only pistil.

(iv) Egg does not get fertilised in a human female.

(v) When the seed is placed under appropriate condition of water and air in the soil ?

OR

(b) Given below are certain situations. Analyse and describe what would happen when :

(i) Spores are liberated from blob-like structures of the bread mould?

(ii) Leaves of bryophyllum fall on wet soil ?

(iii) A pollen from different species land on the stigma of totally unrelated species ?

(iv) Copper-T is placed in the uterus of a human female ?

(v) *Spirogyra* breaks into smaller fragments upon maturation ?

SECTION B

Chemistry (25 marks).

17. (i) $AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$ 1

(ii) $K_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2KCl$

Which of the following options clearly describes both the reactions ?

(A) (i) is double displacement, (ii) is displacement reaction.

(B) Both, (i) and (ii) are displacement reactions and precipitation reactions.

(C) Both, (i) and (ii) are double displacement reactions and precipitation reactions.

(D) (i) is displacement, (ii) is double displacement reaction.

18. Which one of the following can be used as an acid-base indicator by a visually impaired (blind) student ? 1

(A) Turmeric

(B) Vanilla essence

(C) Methyl orange

(D) Litmus

19. The gases evolved on heating lead (II) nitrate crystals are : 1

(A) NO and O_2 (B) N_2 and NO_2

(C) NO_2 and H_2 (D) NO_2 and O_2

20. The formula of functional group for aldehyde is : 1

(A) –COOH (B) –CHO

(C) –C(=O)– (D) –OH

21. Which of the following is a poor conductor of electricity ? 1

(A) Pb (B) Cu

(C) Ag (D) Al

22. The natural sources of oxalic acid, lactic acid and methanoic acid respectively are : 1

(A) tomato, curd, ant-sting (B) tomato, orange, nettle-sting

(C) orange, milk, ant-sting (D) orange, sour milk, nettle-sting

23. When an element 'X' reacts with water, it starts floating. Identify the element 'X' : 1

(A) Potassium (B) Calcium

(C) Sodium (D) Iron

24. **Assertion (A) :** Carbon shares its valence electrons with other atoms of carbon or with atoms of other elements. 1

Reason (R) : The shared electrons belong to the outermost shells of both the atoms and lead to both atoms attaining the noble gas configuration.

(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, but 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.

25. (a) What are amphoteric oxides ? [1] 2

(b) Categorise the following based on their nature : ZnO, Na_2O, CO_2 [1]

26. (a) Name the substance oxidised and reduced in the following reaction : $ZnO + C \longrightarrow Zn + CO$ [1] 3

(b) Balance the following chemical reaction : $Pb(NO_3)_2 + KI \longrightarrow PbI_2 + KNO_3$ [1]

(c) Give one example each of electrolytic decomposition and decomposition by sunlight. [1]

27. (a) Explain chlor-alkali process with chemical equation. Name the products formed at anode and cathode. 3

OR

(b) Write the preparation of following compounds with balanced chemical equation :
(i) Baking soda
(ii) Bleaching powder
(iii) Plaster of Paris

28. Read the following passage and answer the questions given below :

Most of metals occur in combined state in form of ores. Carbonate ores are converted into oxides by calcination and sulphide ores by roasting. Oxides are reduced with suitable reducing agent like carbon to get free metal. Highly reactive metals like – Al, Mg are also used as reducing agents to obtain metal from their oxides. Most reactive metals are obtained by electrolytic reduction of their molten ores. Alloying is a very good method of improving the properties of a metal. We can get desired properties by this method. The electrical conductivity and melting point of an alloy is less than that of pure metals.

(a) Why carbonate or sulphide ores are converted to oxides before extraction of metal from it ? [1]

(b) Write a reaction in which Aluminium is used as a reducing agent to obtain metal from its oxide. [1]

(c) (i) How is copper obtained from its ore (Cu_2S) ? Give equations of the reactions. [2]

OR

(c) (ii) (I) Why highly reactive metals cannot be obtained from their oxides by using carbon as a reducing agent ? [1] (II) Why solder, an alloy of lead and tin, is used for welding electrical wires together ? [1] [2]

29. (a) (i) Give reasons for the following : [3] 5
(I) Covalent compounds are poor conductor of electricity.
(II) Soap does not form lather in hard water.
(III) Carbon shows catenation but silicon does not.
(ii) Write chemical equations for the following : [2]
(I) Oxidation of ethanol by acidified $K_2Cr_2O_7$.
(II) Hydrogenation of ethene.

OR

(b) Mohan heated ethanol with a compound ‘X’ in the presence of a few drops of conc. H_2SO_4 and observed a sweet smelling compound ‘Y’ is formed. When ‘Y’ is treated with sodium hydroxide it gives back ethanol and a compound ‘Z’.
(i) Identify ‘X’, ‘Y’ and ‘Z’.
(ii) Write the role of conc. H_2SO_4 in the reaction.
(iii) Write the chemical equations involved and name the reactions.

SECTION C

Physics (25 marks).

30. A convex lens of focal length 15 cm, is forming a real image. If the size of image is same as the size of object, then position of object and position of image will be, respectively : 1

(A) − 15 cm and − 15 cm from lens

(B) − 15 cm and + 15 cm from lens

(C) − 30 cm and + 30 cm from lens

(D) − 30 cm and − 30 cm from lens

31. When you look at an object very close to your eyes, the : 1

(A) Ciliary muscles of your eye contract and the eye lens becomes thick.

(B) Ciliary muscles of your eye get relaxed and the eye lens becomes thick.

(C) Ciliary muscles of your eye contract and the eye lens becomes thin.

(D) Ciliary muscles of your eye get relaxed and the eye lens becomes thin.

32. **Assertion (A) :** When rays of white light pass through a prism, on emerging they give spectrum of seven colours. 1

Reason (R) : It is due to the scattering of light that red light bends minimum and violet light bends the maximum.

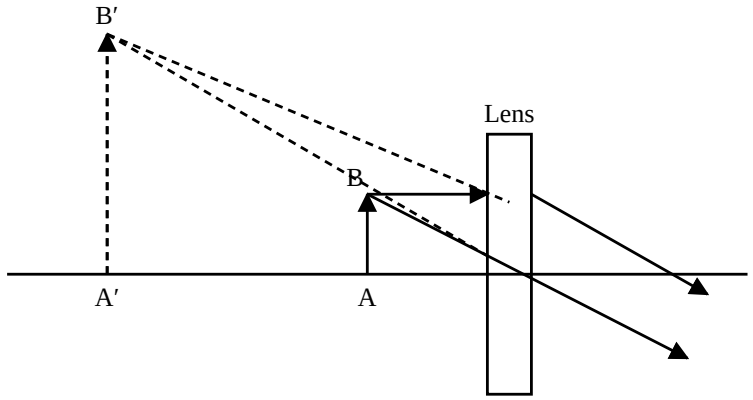
(A) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both, Assertion (A) and Reason (R) are true, but 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.

33. The given figure shows image formation by a lens. Analyse the figure and answer the following questions : 2



(a) What is the type of lens used for image formation in the given ray diagram ?

(b) If the real image is formed at a distance of 30 cm from the lens and the size of image is twice the size of the object, then where was the object placed ?

34. (a) The resistance of a wire of 0.01 cm radius and 1.0 cm length is 7 Ω. Calculate its resistivity. 2

OR

(b) An electric heater is rated 220 V; 11 A. Calculate the power consumed if the heater is operated at 200 V.

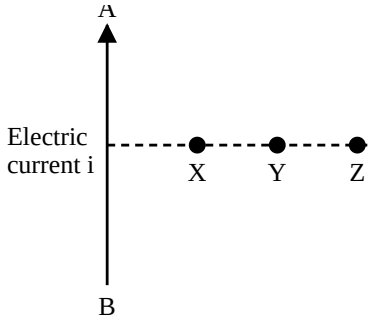
35. A person is unable to read a book placed closer than 1 meter from his eyes. Identify the defect of vision in his eyes. Draw the ray diagrams to show the defect of vision and its correction. 3

36. (a) Describe an activity to show that a current carrying conductor, placed in an external magnetic field experiences a force. 3

(b) Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally towards the front wall from the back wall, is deflected by a strong magnetic field to your right side. Find the direction of the magnetic field.

37. (a) The pattern of magnetic field due to a current carrying wire depends upon the shape made by that wire. Justify. 3

(b) A current carrying straight wire AB is shown in the given diagram. Out of X, Y and Z on which point will the strength of magnetic field be maximum and why ?



38. Read the following passage and answer the questions given :

Lenses can form different types of images depending upon their focal length and position of object. A convex lens can create real, inverted or virtual, erect images, while a concave lens forms only virtual and diminished images. The focal length determines the power of lens. Convex lenses have positive focal length while concave lenses have negative focal length by convention. When lenses are placed together, their combined power is determined by the sum of their individual powers. Ray diagrams help to visualize how light converges or diverges through lens to form an image.

(a) A convex lens of focal length 20 cm is used to form an image. If an object is placed at 40 cm from the lens, what will be the position and nature of image ? [1]

(b) Illustrate the formation of image with the help of ray diagram, when the object is placed between the optical centre and principal focus of concave lens. [1]

(c) (i) A lens combination consists of a convex lens of focal length 30 cm and a concave lens of focal length 15 cm placed together. Find the equivalent focal length and power of this lens combination. [2]

OR

(c) (ii) Two lenses are placed in contact. One is a concave lens with focal length 2 m and the other is a convex lens with focal length 1.5 m. What type of lens will the combination behave as (convex or concave) ? Give reason. [2]

39. (a) (i) Due to change in length and area of cross-section of a conductor, resistance of conductor changes while resistivity does not change. Why ? 5

(ii) Conductors of electric toasters and electric iron are made of an alloy rather than a pure metal. Why ?

(iii) Define the S.I. unit of electric current.

OR

(b) (i) How many bulbs of resistance 8 Ω each should be connected in parallel combination to draw a current of 2 A from a battery of 4 V ?

(ii) Name the device used for measuring electric current. How is it connected in a circuit ?

(iii) State Joule's law of heating.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q7	Q8	Q9	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q30	Q31	Q32
(B)	(D)	(D)	(B)	(B)	(C)	(A)	(C)	(C)	(B)	(D)	(B)	(A)	(A)	(B)	(A)	(C)	(A)	(C)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (B). Stomata, the tiny pores on the leaf surface, let O_2 and CO_2 in and out. Xylem and phloem conduct water and food; the cuticle is a waxy layer that reduces water loss.

Q2. Answer (D). One cell (Amoeba): the nucleus divides, then the cytoplasm divides, giving two similar daughter cells. That is binary fission.

Q3. Answer (D). Spirogyra reproduces by fragmentation, Leishmania by binary fission and Hydra by budding (and regeneration): all asexual. Leishmania is unicellular while Spirogyra and Hydra are multicellular, so (B) and (C) fail.

Q4. Answer (B). The cerebellum (in the hind-brain) is responsible for precision of voluntary actions and for posture and balance.

Q5. Answer (B). Pancreatic juice contains trypsin, which digests proteins, and lipase, which breaks down emulsified fats.

Q6. (1 marks) Answer: all three statements are true; see the note on the options.
All three statements are true for human beings: the mother's egg always carries an X chromosome, and the father's sperm carries either an X or a Y chromosome. [½]
No option lists all three. The father's gametes, which decide the sex of the child, are (ii) and (iii), option (A); a boy (XY) comes from (i) and (iii), option (C). Write the reasoning and check CBSE's marking scheme for the option it accepted. [½]

Q7. Answer (C). Polythene, synthetic rubber bands and plastic ball pens are not broken down by decomposers. The other groups are made of natural, biodegradable materials.

Q8. Answer (A). A reflex is a sudden, automatic response without thinking: A is true. The reflex arc is formed in the spinal cord, so the response is made there before the signal reaches the brain for thinking: R is true and explains A. Answer (A).

Q9. Answer (C). Haemoglobin in the red blood cells is the respiratory pigment: A is true. Haemoglobin has a very high affinity for oxygen; carbon dioxide is carried mostly dissolved in the blood: R is false. Answer (C).

Q10. (2 marks) Answer: helps breathing by changing the volume of the chest cavity; between the thoracic and abdominal cavities.
Function: when we breathe in, the diaphragm contracts and flattens (with the ribs lifted), so the chest cavity becomes larger and air is sucked into the lungs; when it relaxes, the cavity becomes smaller and air is pushed out. [1]
Position: it is a muscular sheet at the floor of the chest (thoracic) cavity, separating it from the abdominal cavity. [1]

Q11. (2 marks) Answer: see the model answer.
(a) Chewing is a voluntary action controlled by the brain (cerebrum); salivation on seeing food is an involuntary (reflex) action. [1]
Chewing is done by the jaws and teeth with muscles we control at will; salivation is secretion by the salivary glands, which we cannot stop or start at will. [1]
OR (b) Pollination is the transfer of pollen grains from the anther to the stigma; fertilisation is the fusion of the male and female germ cells (gametes). [1]
Pollination takes place before and outside the ovary, by wind, water or animals; fertilisation takes place later, inside the ovule in the ovary, and forms the zygote. [1]

Q12. (2 marks) Answer: (a) stigma; (b) pollen tube.
Diagram: a pistil (stigma, style, ovary with ovule) with a pollen grain on the stigma and a pollen tube growing down through the style into the ovule. [1]
(a) Stigma. [½] (b) Pollen tube. [½]

Q13. (3 marks) Answer: (a) grass (i); deer, rabbit (ii); snake (iii); lion (iv).
(a) (i) Producers: grass; (ii) primary consumers: deer, rabbit; (iii) secondary consumer: snake; (iv) tertiary consumer: lion. [1]
(b) Only about 10% of the energy of one level passes to the next (ten percent law); the rest is used in life processes and lost as heat, so the primary consumers have more energy than the secondary consumers that eat them. [1]
(c) Producers trap the most energy and are the most numerous; the energy available falls at every level, so the base is broad and the pyramid narrows upwards. [1]

Q14. (3 marks) Answer: see the model answer.
(a) A nephron is the structural and functional unit of the kidney that filters blood and forms urine; a neuron is the structural and functional unit of the nervous system that carries messages (nerve impulses). [1]
(b) A sensory nerve carries impulses from the receptors (sense organs) to the brain or spinal cord; a motor nerve carries impulses from the brain or spinal cord to the effectors (muscles, glands). [1]
(c) Consumers eat other organisms (plants or animals) for food; decomposers (bacteria, fungi) break down dead remains and wastes into simple substances that return to the soil. [1]

Q15. (4 marks) Answer: see the model answer.
(a) Tallness is dominant over shortness; every F_1 plant (Tt) has one factor for tallness, so all are tall. [1]
(b) By self-pollination (selfing) of the F_1 plants. [1]
(c)(i) A dominant trait shows up even when only one copy of its factor is present (Tt); a recessive trait shows up only when both copies are recessive (tt). [2]
OR (c)(ii) All F_1 plants were tall; no plant was of medium height (the traits did not blend). [1 + 1]

Q16. (5 marks) Answer: see the model answer.
(a) (i) Only the bacteria with variations that let them survive higher temperature will survive and multiply; the others die, and the population changes. [1]
(ii) Fertilisation takes place in the oviduct and a zygote is formed. [1]
(iii) A unisexual (pistillate) flower has no anthers, so it depends on cross-pollination by pollen from another flower. [1]
(iv) The uterine lining, prepared to receive the embryo, breaks down and comes out through the vagina as blood and mucus: menstruation. [1]
(v) The seed germinates: the embryo grows into a seedling, with the plumule forming the shoot and the radicle the root. [1]
OR (b) (i) Each spore germinates on a moist surface into a new Rhizopus (bread mould) plant. [1]
(ii) Buds in the notches of the leaf margin grow into new plants (vegetative propagation). [1]
(iii) The pollen does not germinate or form a pollen tube, so there is no fertilisation. [1]
(iv) It prevents the implantation of the embryo (it is a contraceptive device); it may cause side effects such as irritation of the uterus. [1]
(v) Each fragment grows into a new Spirogyra filament (fragmentation). [1]

Q17. Answer (C). In both, the two compounds exchange ions (double displacement), and an insoluble solid forms: AgCl (white) in (i) and $BaSO_4$ (white) in (ii), so both are precipitation reactions.

Q18. Answer (B). Vanilla essence is an olfactory indicator: its smell is lost in a basic solution and stays in an acidic one, so it can be detected without seeing a colour change.

Q19. Answer (D). $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$: brown fumes of nitrogen dioxide and oxygen.

Q20. Answer (B). Aldehyde: –CHO. –COOH is a carboxylic acid, the C=O group between two carbons is a ketone and –OH an alcohol.

Q21. Answer (A). Lead (and mercury) are comparatively poor conductors of electricity among metals; silver, copper and aluminium are the best conductors.

Q22. Answer (A). Oxalic acid: tomato. Lactic acid: sour milk (curd). Methanoic acid: ant sting (and nettle sting). Orange contains citric acid.

Q23. Answer (B). Calcium reacts less violently with water; the bubbles of hydrogen formed stick to the surface of the metal, so it starts floating. Potassium and sodium react violently and catch fire; iron does not react with cold water.

Q24. Answer (A). Carbon (4 valence electrons) can neither gain nor lose 4 electrons easily, so it shares them, forming covalent bonds: A is true. The shared pairs count for both atoms, which attain the noble gas configuration; that is why carbon shares: R is true and explains A. Answer (A).

Q25. (2 marks) Answer: (b) ZnO amphoteric, Na_2O basic, CO_2 acidic.
(a) Metal oxides that react with both acids and bases to give salt and water. [1]
(b) ZnO: amphoteric; Na_2O: basic; CO_2: acidic. [1]

Q26. (3 marks) Answer: see the model answer.
(a) C is oxidised (to CO); ZnO is reduced (to Zn). [1]
(b) $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$. [1]
(c) Electrolytic: $2H_2O \rightarrow 2H_2 + O_2$ (electrolysis of water). By sunlight: $2AgCl \rightarrow 2Ag + Cl_2$ (or $2AgBr \rightarrow 2Ag + Br_2$). [½ + ½]

Q27. (3 marks) Answer: see the model answer.
(a) When electricity is passed through an aqueous solution of sodium chloride (brine), it decomposes to form sodium hydroxide; it is called chlor-alkali because of the products, chlorine and alkali. [1]
$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$. [1]
Chlorine gas at the anode, hydrogen gas at the cathode; sodium hydroxide solution forms near the cathode. [1]
OR (b) (i) $NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$. [1]
(ii) $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$ (chlorine on dry slaked lime). [1]
(iii) $CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot ½H_2O + 1½H_2O$, on heating gypsum at 373 K. [1]

Q28. (4 marks) Answer: see the model answer.
(a) It is easier to obtain a metal from its oxide than from its carbonate or sulphide (the oxide can be reduced by carbon). [1]
(b) $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ + heat (thermit reaction), or $3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$. [1]
(c)(i) Cu_2S is heated in air: $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$; [1] then the Cu_2O reacts with the rest of the Cu_2S: $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$. [1]
OR (c)(ii) (I) Highly reactive metals have more affinity for oxygen than carbon, so carbon cannot reduce their oxides. [1] (II) Solder has a low melting point, so it melts easily to join wires without damaging them. [1]

Q29. (5 marks) Answer: see the model answer.
(a) (i)(I) The bonding is by sharing electrons, so no ions are formed; without free ions or electrons they do not conduct electricity. [1]
(II) Hard water contains calcium and magnesium salts; soap reacts with them to form an insoluble precipitate (scum), so it is used up and no lather forms. [1]
(III) Carbon atoms are small and the C–C bond is very strong, so long chains are stable; Si–Si bonds are weaker, so silicon forms only short chains. [1]
(ii)(I) $CH_3CH_2OH + 2[O] \rightarrow CH_3COOH + H_2O$ (alkaline $KMnO_4$ or acidified $K_2Cr_2O_7$ supplies the oxygen). [1]
(II) $CH_2{=}CH_2 + H_2 \rightarrow CH_3{-}CH_3$, in the presence of a nickel (or palladium) catalyst. [1]
OR (b) (i) X: ethanoic acid, CH_3COOH; Y: ethyl ethanoate, $CH_3COOC_2H_5$ (an ester); Z: sodium ethanoate, CH_3COONa. [1½]
(ii) Conc. H_2SO_4 acts as a catalyst (and dehydrating agent). [½]
(iii) $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$ (conc. H_2SO_4): esterification. [1½]
$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$: saponification. [1½]

Q30. Answer (C). A real image of the same size is formed when the object is at 2F: $u = -2f = -30$ cm, and the image is at 2F on the other side, $v = +30$ cm. Check: $1/30 - 1/(-30) = 1/15$.

Q31. Answer (A). For a near object the ciliary muscles contract, the lens becomes thicker and its focal length decreases (accommodation).

Q32. Answer (C). A prism splits white light into seven colours: A is true. This is dispersion: different colours are refracted (bent) through different angles, red the least and violet the most. It is not due to scattering: R is false. Answer (C).

Q33. (2 marks) Answer: (a) convex lens; (b) 15 cm in front of the lens ($u = -15$ cm).
(a) Convex lens: it forms a virtual, erect and magnified image on the same side as the object (object between F and the lens). [1]
(b) Real image: inverted, $m = -2$, $v = +30$ cm. $m = v/u$ gives $u = v/m = 30/(-2) = -15$ cm: the object was 15 cm in front of the lens (its focal length is then 10 cm). [1]

Q34. (2 marks) Answer: (a) $2.2 \times 10^{-5}\ \Omega$ m; (b) 2000 W.
(a) $\rho = RA/l$ with $A = \pi r^2 = (22/7) \times (10^{-4}\ m)^2 = (22/7) \times 10^{-8}\ m^2$ and $l = 10^{-2}$ m. [1]
$\rho = 7 \times (22/7) \times 10^{-8} / 10^{-2} = 2.2 \times 10^{-5}\ \Omega$ m. [1]
OR (b) $R = V/I = 220/11 = 20\ \Omega$. [1]
At 200 V: $P = V^2/R = 200 \times 200/20 = 2000$ W = 2 kW. [1]

Q35. (3 marks) Answer: hypermetropia, corrected with a convex lens.
The defect is hypermetropia (far-sightedness): his near point has moved to 1 m. [1]
Diagram of the defect: rays from a near object N (at 25 cm) are focused behind the retina; the near point N′ is farther away. [1]
Correction: a convex (converging) lens of suitable power makes the rays from N appear to come from N′, so the image forms on the retina. [1]

Q36. (3 marks) Answer: (b) vertically downward.
(a) Suspend a small aluminium rod horizontally by two connecting wires between the poles of a horseshoe magnet, with the field vertical. Pass a current through the rod: it is displaced (to the left or right). Reverse the current, or the magnet, and it is displaced the other way. This shows a force on the conductor. [2]
(b) Electrons move from the back to the front, so the current is from the front to the back wall. The force is to the right. By Fleming's left-hand rule the magnetic field is vertically downward. [1]

Q37. (3 marks) Answer: (b) at X, nearest to the wire.

(a) A straight wire gives concentric circles around it; a circular loop gives circles near the wire that become nearly straight lines at the centre; a solenoid gives a uniform field of parallel lines inside, like a bar magnet. So the pattern depends on the shape of the wire. [2]

(b) At X: the field of a straight wire is inversely proportional to the distance from it, and X is nearest to the wire. [1]

Q38. (4 marks) Answer: (a) v = +40 cm, real, inverted, same size; (c)(i) −30 cm, −3.33 D; (c)(ii) convex, P ≈ +0.17 D.

(a) 1/v = 1/f + 1/u = 1/20 − 1/40 = 1/40, v = +40 cm: at 40 cm (2F) on the other side; real, inverted, same size. [1]

(b) Diagram: a ray parallel to the axis diverges as if from F; a ray through O goes undeviated; they appear to meet between F and O on the object's side: virtual, erect, diminished image. [1]

(c)(i) P = 1/0.30 − 1/0.15 = 3.33 − 6.67 = −3.33 D. [1] f = 1/P = −0.30 m = −30 cm (it acts as a concave lens). [1]

OR (c)(ii) P = −1/2 + 1/1.5 = −0.5 + 0.67 = +0.17 D. [1] The power is positive (f = +6 m), so the combination behaves as a convex (converging) lens. [1]

Q39. (5 marks) Answer: (b)(i) 4 bulbs.

(a) (i) R = ρl/A depends on the length and area of the wire, but resistivity ρ is a property of the material (at a given temperature), so it does not change with the dimensions. [2]

(ii) Alloys have higher resistivity than pure metals, so they produce more heat, and they do not oxidise (burn) readily at high temperatures. [2]

(iii) One ampere is the current when one coulomb of charge flows through a cross-section of a conductor in one second (1 A = 1 C/1 s). [1]

OR (b) (i) Required resistance R = V/I = 4/2 = 2 Ω. n bulbs of 8 Ω in parallel: 8/n = 2, so n = 4. [2]

(ii) An ammeter, connected in series in the circuit. [1]

(iii) The heat produced in a resistor is H = I^2Rt: proportional to the square of the current, to the resistance and to the time for which the current flows. [2]

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