

# Bhutan Certificate Secondary Examination

## CHEMISTRY

Paper 1 Multiple Choice

1 hour

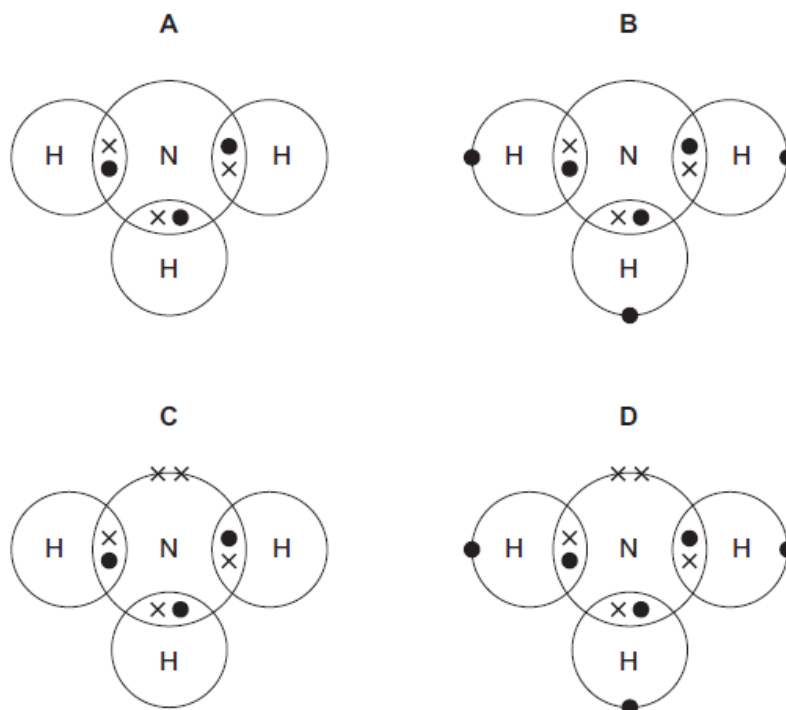
SPECIMEN PAPER

For each question, there are FOUR responses: A, B, C and D. Choose the corresponding letter of your response and CIRCLE it. If you change your answer, cross out the previous response clearly and circle your new answer. NO score will be awarded if you circle more than ONE letter.

- 1 An element X has an atomic number of 8 and nucleon number of 16. Which of the following is an isotope of the element X?

| Isotope | Proton number | Neutron number |
|---------|---------------|----------------|
| A       | 8             | 8              |
| B       | 8             | 9              |
| C       | 9             | 8              |
| D       | 9             | 9              |

- 2 Ammonia,  $\text{NH}_3$ , is a covalent molecule. Which diagram shows the outer shell electron arrangement in a molecule of ammonia?



- 3 A student is given two colourless liquid samples, X and Y, suspected to be hydrocarbons. When aqueous bromine is added and shaken with the samples, sample X rapidly decolourises the bromine solution, while sample Y shows no visible change. Which conclusion is most appropriate?
- A X is saturated hydrocarbon; Y is unsaturated hydrocarbon  
B X is unsaturated hydrocarbon; Y is saturated hydrocarbon  
C Both are unsaturated hydrocarbons  
D Both are saturated hydrocarbons
- 4 Why are plastics considered an environmental problem even though they are useful materials?
- A They accumulate in landfill and rivers, and may release toxic gases when burned  
B They are produced from renewable resources and are harmless when burned  
C They break down rapidly in the environment without causing harm  
D They dissolve easily in water and improve soil quality
- 5 The figure shows elements W, X, Y and Z in a section of the Periodic Table.

[illegible]

Which statement about the metallic character of the elements is correct?

- 5
- A X has more metallic character than Y
  - B Z has more metallic character than X
  - C W has more metallic character than Z
  - D Y has more metallic character than Z
- 6 During a flame test, a student observes a bright red flame when a salt is heated in a clean wire loop. Which alkali metal ion is present in the salt?
- A Potassium ion
  - B Hydrogen ion
  - C Lithium ion
  - D Sodium ion

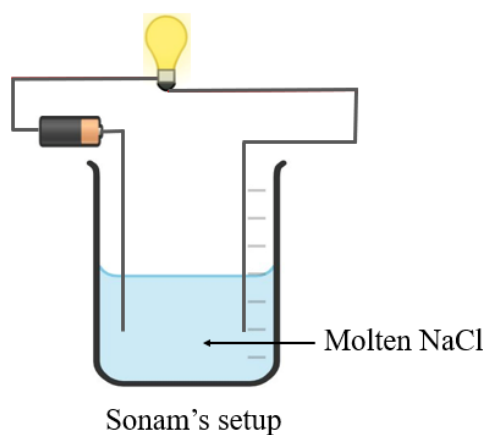
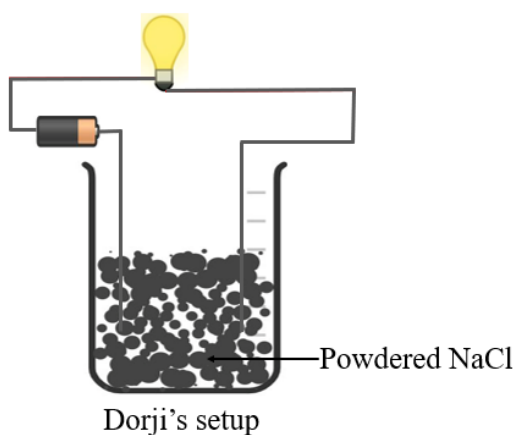
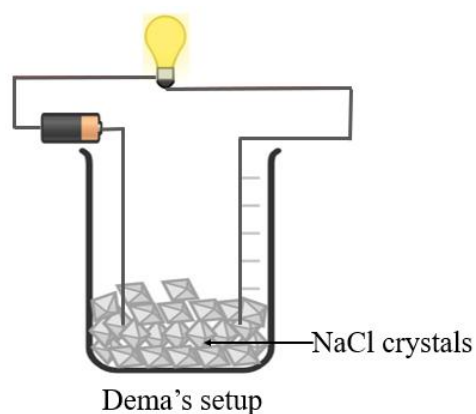
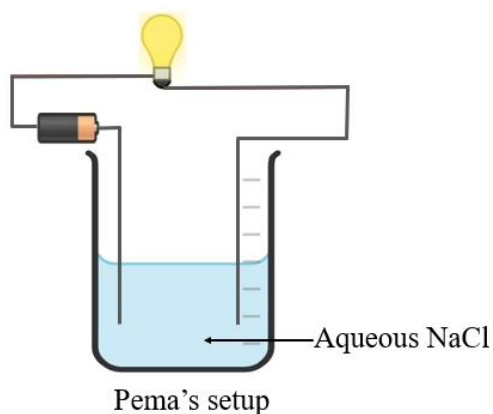
- 7 A manufacturer selects halogens for different products. Which pair correctly matches each halogen with its use based on its properties?
- A Fluorine in toothpaste to strengthen enamel
  - B Chlorine in making Teflon
  - C Chlorine in flame retardants
  - D Bromine in food supplements
- 8 Which statement best describes the law of conservation of mass?
- A Mass is created during a chemical reaction
  - B Mass is destroyed during a chemical reaction
  - C Mass remains constant in a closed system during a chemical reaction
  - D Mass changes depending on the temperature of the reaction
- 9 The melting point and boiling point of three elements, at 1 atmosphere, are shown.

| Element  | Melting point ( °C) | Boiling point (°C) |
|----------|---------------------|--------------------|
| Argon    | – 189               | – 186              |
| Nitrogen | – 210               | – 196              |
| Oxygen   | – 218               | – 183              |

Separate samples of argon, nitrogen and oxygen are stored at –200°C and at 1 atmosphere pressure. How many samples are liquids?

- A 0
- B 1
- C 2
- D 3

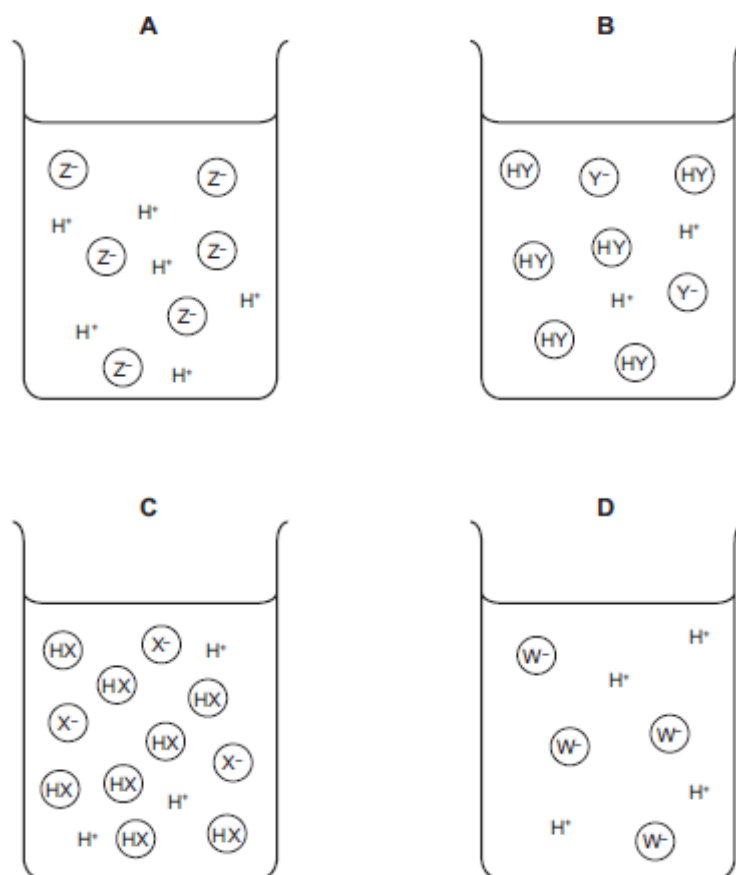
- 10 The figures below are the four experimental setups prepared by four chemistry students to investigate the electrical conductivity of sodium chloride in four different forms.



In which case does the bulb glow?

- A Pema's setup only
  - B Dema and Dorji's setups
  - C Dema and Sonam's setups
  - D Pema and Sonam's setups
- 11 The boiling points of ethanol and butanol are  $78^{\circ}\text{C}$  and  $118^{\circ}\text{C}$  respectively. What is the boiling point of propanol?
- A  $57^{\circ}\text{C}$
  - B  $77^{\circ}\text{C}$
  - C  $97^{\circ}\text{C}$
  - D  $137^{\circ}\text{C}$

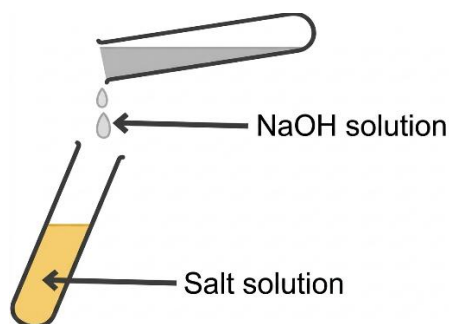
- 12 Four different acids are dissolved in equal volumes of water to form four solutions, as shown in the diagrams. The diagrams represent the relative numbers of acid molecules and hydrogen ions present in each solution. Which beaker contains the strongest acid solution?



- 13 A controlled variable is a factor that is kept constant in an experiment to ensure a fair test and obtain reliable results. In Gay-Lussac's law, which variable is kept constant?
- A Temperature
  - B Pressure
  - C Volume
  - D Mole

- 14 Sonam added a few drops of sodium hydroxide solution to 5 cm<sup>3</sup> of a salt solution, as shown in the figure. A reddish-brown precipitate was formed.

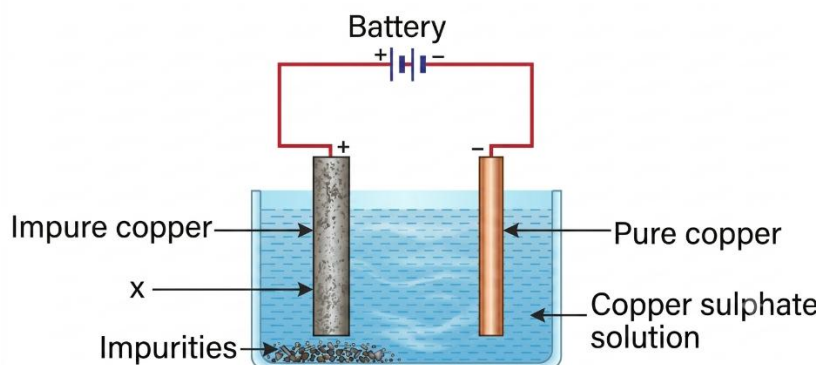
Which salt solution was present in the test tube?



- A FeCl<sub>2</sub> solution  
B FeCl<sub>3</sub> solution  
C CuSO<sub>4</sub> solution  
D ZnSO<sub>4</sub> solution
- 15 In Bhutan, alcohol has been a part of the culture, where it is used for various purposes in almost all occasions and celebrations. However, the sale of alcohol to children under 18 years is restricted by law.

What could be the primary reasons for this regulation?

- A To ensure that individuals are financially independent  
B To prevent underage drinking and related health issues  
C To increase alcohol sales by targeting older demographics  
D To encourage responsible drinking habits from a young age
- 16 The setup depicted in the figure illustrates the electro-refining of impure copper.



Which of the following statements accurately describes about an electrode X?

- A Electrode X is the anode, and its mass decreases  
B Electrode X is the anode, and its mass increases  
C Electrode X is the cathode, and its mass decreases  
D Electrode X is the cathode, and its mass increases

17 Which of the following correctly defines a system in thermodynamics?

- A Everything present in the universe
- B The part of the universe under study
- C Only the container holding the substance
- D The surroundings that interact with the system

18 Which one of the following is an empirical formula?

- A  $\text{C}_2\text{H}_5$
- B  $\text{C}_2\text{H}_6$
- C  $\text{H}_2\text{O}_2$
- D  $\text{C}_6\text{H}_{12}\text{O}_6$

19 A student calculates the number of moles in 11 g of carbon dioxide ( $\text{CO}_2$ ).  
(Molar mass of  $\text{CO}_2$  = 44 g/mol)

The student writes:

$$\text{Number of moles} = 11/44 = 0.5 \text{ mol.}$$

Which statement correctly evaluates the student's calculation?

- A The answer is correct because  $\text{CO}_2$  always forms 0.5 mol in such cases
- B The answer is correct because mass is always equal to moles  $\times$  2
- C The answer is incorrect because molar mass of  $\text{CO}_2$  is 11 g/mol
- D The answer is incorrect because  $11 \div 44 = 0.25$ , not 0.5 mol

20 A museum is preparing a bronze statue to be placed in an outdoor garden for long-term display.

Which choice gives the best justification for using bronze instead of pure copper?

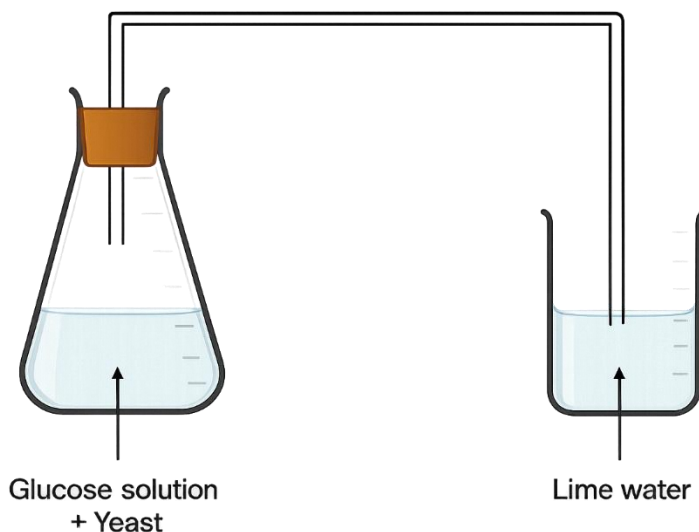
- A Bronze is softer than copper and easier to shape
- B Copper resists corrosion better than bronze
- C Bronze is stronger and more corrosion-resistant than copper
- D Copper is harder and does not react with the environment

21 A balloon filled with air is kept in a refrigerator. After a few hours, the balloon appears smaller.

Which explanation best describes this observation?

- A Cooling causes more gas particles to enter the balloon, provided pressure remains constant
- B The mass of gas inside the balloon decreases on cooling, provided pressure remains constant
- C Gas volume remains unchanged as temperature increases, provided pressure remains constant
- D Gas volume decreases as temperature decreases, provided pressure remains constant

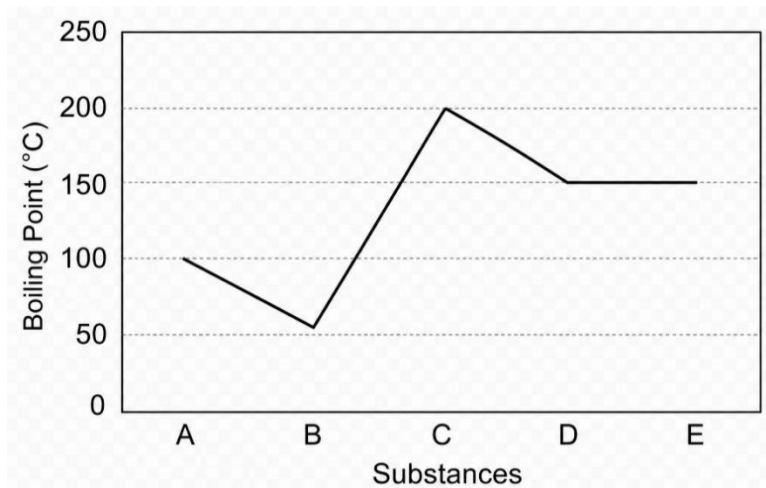
- 22 When a gas produced during the reaction was passed through lime water, the lime water turned milky, as shown below.



The gas produced in the reaction is

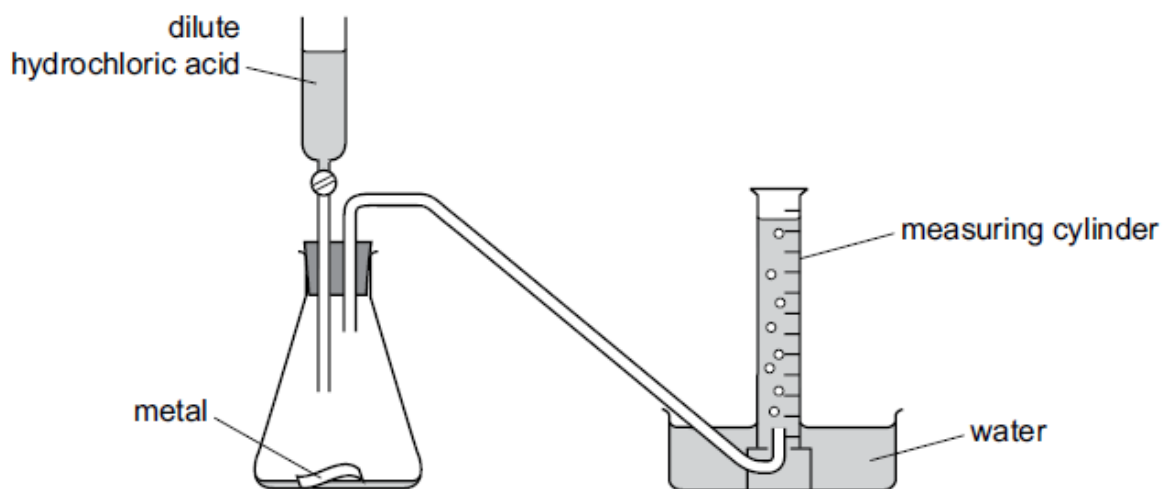
- A sulphur dioxide.
  - B carbon dioxide.
  - C hydrogen.
  - D oxygen.
- 23 The graph shows the variation in vapour pressure with temperature for four different substances, A, B, C, and D.

Which substance has the highest volatility as shown in the graph?



- A Substance D
- B Substance C
- C Substance B
- D Substance A

- 24 The figure shows an experiment to measure the rate of a chemical reaction.



- Which factors decreases the rate of reaction?
- A Adding water to the flask
  - B Heating the flask during the reaction
  - C Using more concentrated acid
  - D Using powdered metal
- 25 Farmers spread calcium hydroxide in the field to neutralise soils that are acidic for crops to grow well.
- Which ion neutralises the acid in the soil?
- A  $\text{Ca}^{2+}$
  - B  $\text{H}^+$
  - C  $\text{OH}^-$
  - D  $\text{O}^{2-}$
- 26 Four different solutions, J, K, L and M, are tested with universal indicator.

| solution                        | J     | K   | L      | M      |
|---------------------------------|-------|-----|--------|--------|
| colour with universal indicator | green | red | purple | orange |

Which of the solutions are acidic?

- A J and M
- B K and M
- C K only
- D L only

- 27 Which row describes the properties of a typical transition element?

|   | melting point | forms coloured compounds | acts as a catalyst |
|---|---------------|--------------------------|--------------------|
| A | high          | no                       | no                 |
| B | high          | yes                      | yes                |
| C | low           | no                       | yes                |
| D | low           | yes                      | no                 |

- 28 Which formula represents an unsaturated hydrocarbon?

- A  $C_5H_{12}$   
B  $C_4H_{10}$   
C  $C_3H_8$   
D  $C_3H_6$

- 29 A student heats two samples of water to test their purity. Sample X boils sharply at  $100^\circ\text{C}$ , while Sample Y boils over a temperature range from  $98^\circ\text{C}$  to  $104^\circ\text{C}$  at standard atmospheric pressure. Which conclusion is most appropriate?

- A Sample X is impure because its boiling point is exactly  $100^\circ\text{C}$   
B Both samples are equally pure because all water boils near  $100^\circ\text{C}$   
C Sample Y is purer because it boils over a wider temperature range  
D Sample X is pure water because pure substances have a fixed boiling point

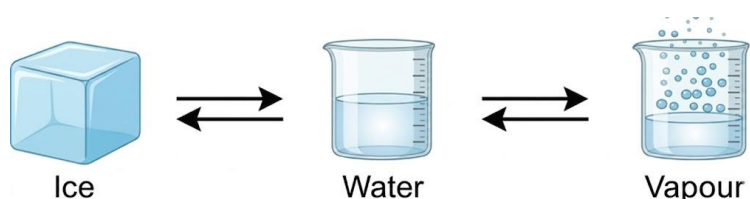
- 30 The figure shows two jars containing different amounts of oxygen gas.



The total number of oxygen molecules in Jar I and II are

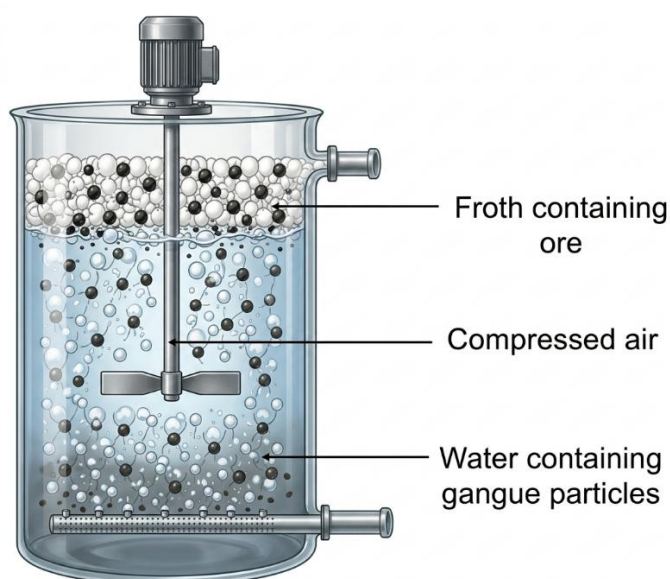
- A  $3.0115 \times 10^{23}$ .  
B  $6.023 \times 10^{23}$ .  
C  $9.0345 \times 10^{23}$ .  
D  $12.0046 \times 10^{23}$ .

- 31 The figure shows the inter-conversion of ice to water vapour.



In which of the following interconversion is the value of  $\Delta H$  greater than zero?

- A Ice  $\rightarrow$  water
  - B Water  $\rightarrow$  ice
  - C Water vapour  $\rightarrow$  ice
  - D Water vapour  $\rightarrow$  water
- 32 Stainless steel is commonly used for cutlery, cooking utensils, and kitchen sinks instead of iron. Which of the following is the best reason for this choice?
- A Iron is more expensive than stainless steel
  - B Stainless steel does not rust easily due to formation of a protective layer
  - C Stainless steel has lower density than iron, making it lighter
  - D Stainless steel is softer and more malleable than iron
- 33 The figure shows a froth flotation setup used for the concentration of a sulphide ore.



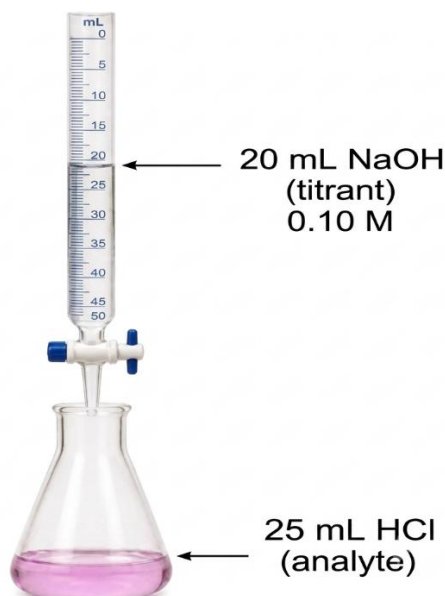
Which one of the statements best explains why sulphide ore particles rise with froth while impurities settle down?

- A Sulphide ore particles are soluble in oil and dissolve completely in froth
- B Sulphide ore particles become hydrophobic due to collector and attach to air bubbles
- C Impurities react with pine oil and become lighter than water
- D All particles become equally attracted to air bubbles but only ore particles float due to density

- 34 A driver blows into a breath analyser containing acidified potassium dichromate. The solution changes from orange to green. What causes this colour change?
- A Ethanol is reduced to ethanoic acid and dichromate is oxidised  
B Ethanol undergoes reduction while potassium dichromate acts as reducing agent  
C Ethanol is oxidised to ethanoic acid and potassium dichromate is reduced to chromium(III) ions  
D Carbon dioxide in breath causes the colour change by acid-base reaction
- 35 A laboratory assistant leaves three different salt samples uncovered on the laboratory bench overnight. In the morning, the following observations are made:

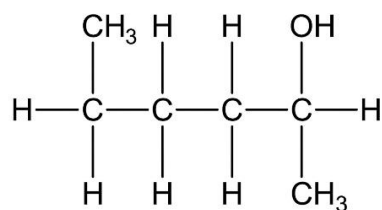
| Salt | Observation                                                         |
|------|---------------------------------------------------------------------|
| A    | crystals become powdery and lose their shape                        |
| B    | no visible change, but it feels slightly moist                      |
| C    | completely dissolves and forms a liquid solution on the watch glass |

- Which of the following correctly matches the salts with their classification?
- A Salt A → hygroscopic, Salt B → efflorescent, Salt C → deliquescent  
B Salt A → efflorescent, Salt B → hygroscopic, Salt C → deliquescent  
C Salt A → deliquescent, Salt B → efflorescent, Salt C → hygroscopic  
D Salt A → hygroscopic, Salt B → deliquescent, Salt C → efflorescent
- 36 The figure below shows an acid–base titration carried out by a student. Using the information provided in the figure, determine the concentration of the HCl solution.



- A 0.080 M  
B 0.100 M  
C 0.120 M  
D 0.125 M

- 37 The tungsten is used in making the filaments of an electric bulb because of its
- low density.
  - high density.
  - low melting point.
  - high melting point.
- 38 Historically, alcohol has played a central role in Bhutanese rituals, religious offerings, and community hospitality. Which statement best reflects the current tension between traditional alcohol use and contemporary social challenges?
- Alcohol remains a symbol of hospitality, with no significant impact on modern public health or productivity
  - Traditional alcohol use has been replaced by Western-style recreational drinking
  - Alcohol remains culturally significant but contributes to major health and social issues
  - Bhutanese culture has avoided the negative effects of alcohol
- 39 What is the IUPAC name of the given compound?



- 2-hexanol
  - 4-hexanol
  - 5-hexanol
  - 1,4-dimethylbutanol
- 40 A student investigated Gay Lussac law by performing an experiment. The table given below shows the record of the experiment.

| Experiment | Temperature (K) | Pressure (mmHg) |
|------------|-----------------|-----------------|
| Round 1    | 297.2           | 606.2           |
| Round 2    | 307.2           | 626.4           |
| Round 3    | 317.2           | 646.6           |
| Round 4    | 327.2           | 646.5           |
| Round 5    | 337.2           | 707.1           |

In which round an error in the finding was observed?

- 4
- 3
- 2
- 1

|        |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------|--|--|--------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 1      |  |  | 2      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| H      |  |  | He     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.01   |  |  | 4.00   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3      |  |  | 9      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Li     |  |  | Ne     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6.94   |  |  | 20.18  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11     |  |  | 18     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Na     |  |  | Ar     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 22.99  |  |  | 39.95  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 19     |  |  | 36     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| K      |  |  | Kr     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 39.10  |  |  | 83.80  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 37     |  |  | 54     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rb     |  |  | Xe     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 85.47  |  |  | 131.29 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 55     |  |  | 86     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cs     |  |  | Rn     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 132.91 |  |  | 222.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 87     |  |  | 118    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fr     |  |  | Og     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 233.00 |  |  | 294.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 1      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 9      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 10     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Be     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | F      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9.01   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 19.00  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 17     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mg     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Cl     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 24.30  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 35.45  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 33     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ca     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Se     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 40.08  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 78.97  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 39     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 53     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sr     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | I      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 87.62  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 126.90 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 38     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 84     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ba     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Po     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 137.33 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 209.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 89-103 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 116    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ra     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Lv     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 226.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 299.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 88     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 117    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fr     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Ts     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 233.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 294.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|----|----|--------|-----|----|--------|-----|----|--------|-----|----|--------|-----|----|--------|
| 57 | La | 138.91 | 58 | Ce | 140.12 | 59 | Pr | 140.91 | 60 | Nd | 144.24 | 61 | Pm | 144.91 | 62 | Sm | 150.36 | 63 | Eu | 151.96 | 64 | Gd | 157.25 | 65 | Tb | 158.93 | 66 | Dy | 162.50 | 67 | Ho | 164.93 | 68  | Er | 167.26 | 69  | Tm | 168.93 | 70  | Yb | 173.04 | 71  | Lu | 174.97 |
| 89 | Ac | 227.00 | 90 | Th | 232.04 | 91 | Pa | 231.04 | 92 | U  | 238.03 | 93 | Np | 237.00 | 94 | Pu | 244.00 | 95 | Am | 243.00 | 96 | Cm | 247.00 | 97 | Bk | 247.00 | 98 | Cf | 251.00 | 99 | Es | 252.00 | 100 | Fm | 257.00 | 101 | Md | 258.00 | 102 | No | 259.00 | 103 | Lr | 262.00 |

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