

Answer three questions only from this section.

2. (a) Complete the table below.

Reaction	Colour of gas produced	Smell of gas produced	Effect of gas on damp red litmus paper
$\text{HCl} + \text{KMnO}_4$			
$\text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2$			
$\text{Cu} + \text{HNO}_3$			

[9 marks]

- (b) (i) Write the chemical formula of an oxide of an element in period three of the periodic table that is:
- (α) neutral ;
 - (β) acidic ;
 - (γ) basic ;
 - (δ) amphoteric.
- (ii) Mention **one** property of diamond that makes it **suitable** for:
- (α) making jewellery ;
 - (β) cutting and drilling.

[6 marks]

- (c) (i) Name **two** salts that would decompose on heating to produce oxygen gas.
- (ii) Write balanced equations for the decomposition reaction for **each** of the salts mentioned in 2(c)(i).

[6 marks]

- (d) Explain **briefly** why CCl_4 has a lower boiling point than CBr_4 .

[4 marks]

- (a) (i) (α) Draw the structures of all possible isomers of the compound with molecular formula $\text{C}_4\text{H}_9\text{OH}$.
- (β) Name **each** of the isomers drawn in 3(a)(i) (α).
- (ii) Name the type of isomerism shown by the isomers drawn in 3(a)(i) (α).
- (iii) State what will be observed when propan-1-ol is oxidized by acidified $\text{K}_2\text{Cr}_2\text{O}_7$.
- (iv) Name the product formed when propan-1-ol is dehydrated with concentrated H_2SO_4 .

[12 marks]

Turn over

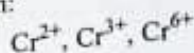
- (b) In an experiment, a piece of magnesium ribbon was added to dilute hydrochloric acid according to the reaction equation:



- (i) state what would be observed as the reaction progresses;
- (ii) if the magnesium ribbon was 0.503 g and the concentration of the acid was 1.60 mol dm^{-3} , calculate the volume of acid that would be required for a complete reaction;
- (iii) calculate the volume of gas produced at stp. in the reaction.
[H = 1.0, Mg = 24.0; molar volume of gas at stp = 22.4 dm^3]

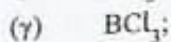
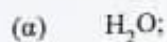
[8 marks]

- (c) Chromium has atomic number 24. Arrange giving reasons, the following ions in order of increasing paramagnetic strength:



[5 marks]

4. (a) (i) Define the term *hybridization*.
- (ii) State the hybridization of the central atom of **each** of the following molecules:



[6 marks]

- (b) (i) Define *rate of chemical reaction*.
- (ii) There was a reaction between two compounds X and Y. The reaction was studied and the following data was obtained:

Experiment	[X] / mol dm^{-3}	[Y] / mol dm^{-3}	Rate of reaction / $\text{mol dm}^{-3} \text{ s}^{-1}$
1	0.04	0.04	6.5×10^{-5}
2	0.04	0.08	12.8×10^{-5}
3	0.08	0.04	25.1×10^{-5}
4	0.08	0.08	51.2×10^{-5}

- (α) Determine the rate law;
- (β) Find the value of K.

- (c) (i) Define an acid according to Bronsted-Lowry concept.

[13 Marks]

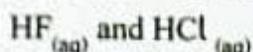
- (ii) Hydrogen chloride and hydrogen fluoride react with water to form acidic solutions as follows:



Explain **briefly** why water behaves as a Bronsted-Lowry base in **both** reactions.

[3 marks]

- (d) Consider the following acid solutions:



- (i) State which of the solutions would have a higher pH;
 (ii) Give a reason for the answer stated in (d)(i).

[3 marks]

5.

- (a) (i) Define the term *enthalpy* of neutralization.
 (ii) Describe **briefly** how the enthalpy of neutralization of $\text{HCl}_{(aq)}$ and $\text{KOH}_{(aq)}$ can be determined.
 (iii) Explain **briefly** why the enthalpy of neutralisation determined for HCl and KOH is greater than that for $\text{CH}_3\text{COOH}_{(aq)}$ and $\text{KOH}_{(aq)}$.

[11 marks]

- (b) (i) Describe **briefly** the bonding in benzene molecule.
 (ii) What is responsible for the stability of the benzene molecule.

[6 marks]

- (c) Write chemical equations **only** to show how a mixture of RCOOH and RCOONa behaves as a buffer.

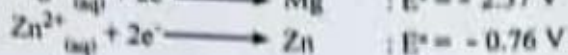
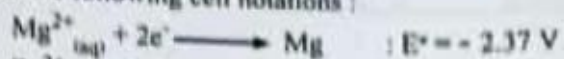
[4 marks]

- (d) (i) What is a *nucleon*?
 (ii) Give **two** uses of the mass spectrometer.

[4 marks]

END OF ESSAY TEST

15. Consider the following cell notations :



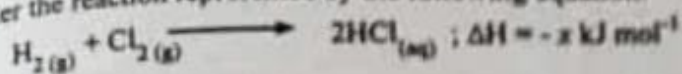
Determine the voltage of the cell.

- A. - 3.13 V
 B. - 1.61 V
 C. + 3.13 V
 D. + 1.61 V
16. Which of the following factors does **not** affect an equilibrium reaction?
 A. Catalyst
 B. Pressure
 C. Temperature
 D. Concentration
17. If the atomic number of an element, J is 11 and that of nitrogen is 7, the most likely formula of the nitride of J is
 A. J_3N
 B. JN_3
 C. J_3N
 D. N_2J
18. Which of the following organic acids is present in vinegar?
 A. Methanoic acid
 B. Propanoic acid
 C. Butanoic acid
 D. Ethanoic acid
19. Which of the following compounds would react with dilute HNO_3 at equivalence point to give an acidic solution?
 A. NaOH
 B. $\text{Ca}(\text{OH})_2$
 C. KOH
 D. NH_4OH
20. The percentage by mass of Cr in Cr_2O_3 is
 [Cr = 52, O = 16]
 A. 68.4 %
 B. 75.5 %
 C. 34.2 %
 D. 76.5 %
21. All pure samples of a chemical substance contains the same elements combined together in the same proportion by mass. This is a statement of the
 A. law of reciprocal proportions.
 B. law of multiple proportions.
 C. law of definite proportions.
 D. law of conservation of mass.

Which of the following compounds is **not** required for the extraction of iron in the blast furnace?

- A. Carbon (II) oxide
 B. Calcium oxide
 C. Silicon (IV) oxide
 D. Haematite

Consider the reaction represented by the following equation:



The negative sign in the value of ΔH is because

- A. H_2 lattice energy is greater than hydration energy.
 B. more bonds are formed than are broken.
 C. the speed of the reaction increases with increasing temperature.
 D. the total energy of bond breaking is less than that of bond forming.

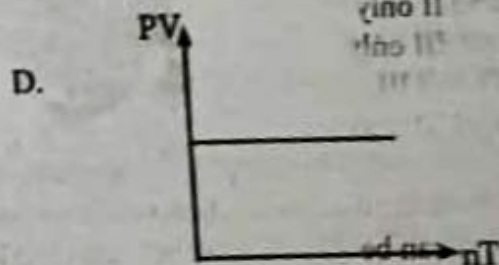
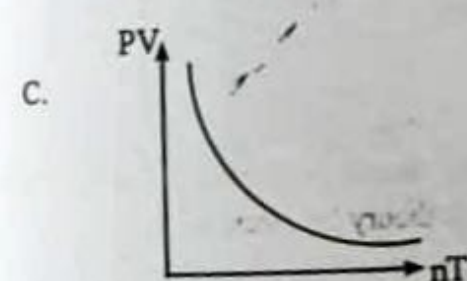
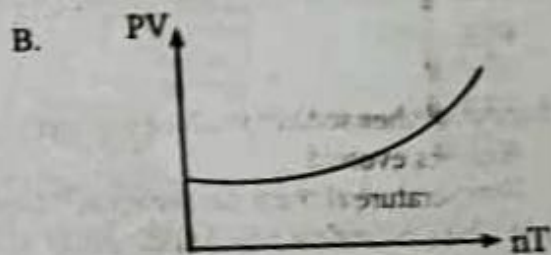
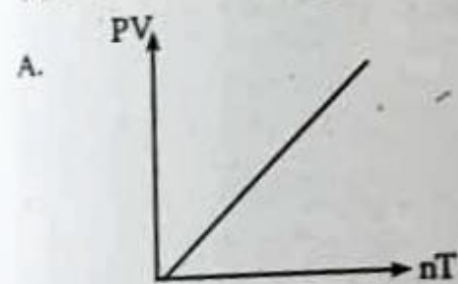
Which of the following metals will **not** displace Cu from $\text{CuSO}_4(\text{aq})$?

- A. Calcium
 B. Lead
 C. Zinc
 D. Silver

Which of the following compounds produces a precipitate with aqueous NH_3 , but would **not** dissolve when excess NH_3 is added?

- A. FeCl_3
 B. KOH
 C. CuSO_4
 D. ZnCO_3

Which of the following graphs correctly illustrates the ideal gas equation?



Which of the following phase transitions is **most** exothermic?

- A. Liquid \longrightarrow solid
 B. Gas \longrightarrow solid
 C. Solid \longrightarrow gas
 D. Gas \longrightarrow liquid

43. The substance with the **least** change in solubility with change in temperature is
- Na_2SO_4
 - NaCl
 - KClO_3
 - KCl
44. Deviations from the ideal gas law are **less** at
- high temperatures and high pressures.
 - low temperatures and high pressures.
 - high temperatures and low pressures.
 - low temperatures and low pressures.
45. Which of the following reactions is **best** considered to be a decomposition process?
- Double decomposition
 - Polymerization
 - Hydrolysis
 - Cracking
46. The chemical formula of ammonium trioxocarbonate (IV) is
- NH_4CO_3
 - $(\text{NH}_4)_2\text{CO}_3$
 - $\text{NH}_4(\text{CO}_3)_2$
 - NH_3CO_3
47. An element in group 1 of the periodic table would
- form an acidic oxide.
 - produce hydrogen from cold water.
 - form an insoluble chloride.
 - produce effervescence with a base.
48. A solution of potassium chloride is
- unionized.
 - neutral.
 - alkaline.
 - acidic.
49. Which of the following processes is exothermic ?
- Melting of ice
 - Cracking of lubricating oil
 - Burning of petrol in a car engine
 - Fractional distillation of petroleum
50. Ammonium chloride was heated with an aqueous solution of a substance **X** to produce an ammonia gas **X** is likely to be
- sodium chloride.
 - sodium tetraoxosulphate (VI).
 - sodium trioxocarbonate (IV).
 - sodium hydroxide.

END OF PAPER