SECTION B (15 Marks)

Attempt any **two** questions from this section.

1. (a) (i)Draw a well labeled diagram of the set up that can be used to prepare a dry sample of ammonia gas in the laboratory. (3 marks)

   (ii)Write an equation for the reaction. (1½ marks)

   (b)(i) Name a reagent that can be used to test for ammonia gas. (½ mark)

   (ii)Write an equation for the reaction that takes place. (1½ marks)

   (a) Ammonia gas was reacted with lead(II) oxide.
   - (i) State the conditions for the reaction (01 mark)
   - (ii) State what was observed under the above conditions. (01 mark)
   - (iii) Write an equation for the reaction that took place. (1½ marks)

   (b) 3.31 g of Lead(II) nitrate was heated strongly until no further change.
   - (i) State what was observed. (1½ marks)
   - (ii) Write an equation for the reaction that took place. (1½ marks)
   - (iii) Calculate the volume of the coloured gaseous product formed at room temperature. (1 mole of gas occupies 24000cm^3 at room temperature, Pb=207, N=14, O=16). (02 Marks)

2. (a) (i) With the aid of a well labeled diagram describe how a pure dry sample of chlorine gas can be prepared in the laboratory at room temperature. (7½ marks)

   (ii)Write an equation for the reaction. (1½ marks)

   (b) State what was observed and write an equation for the reaction that took place when dry chlorine was;

   (i) passed over heated iron. (2½marks)

   (ii) bubbled in a solution of potassium iodide. (2½ marks)

   (c)State any two uses of chlorine. (01 mark)

3. (a) (i)Explain how a dry sample of sulphur dioxide gas can be prepared in the laboratory.(Diagram not required) (4½ marks)
   - (i) Write an equation for the reaction. (1½ marks)
   - (ii) Name a reagent that can be used to test for sulphur dioxide and state what would be observed if sulphur dioxide was treated with the reagent.(1½ marks)

   (b) Sulphur dioxide is an acid anhydride.

   (i) Define an acid anhydride. (01 mark)

(ii) Write an equation for the reaction showing that sulphur dioxide is an acid anhydride.
(1½ marks)

(a) State what would be observed and write an equation for the reaction which would take place if ;
(i) Burning magnesium was lowered in a gas jar of sulphur dioxide.(03 marks)
(ii) Sulphur dioxide was bubbled in concentrated nitric acid in a testtube.
(02 marks)

4. (a) 2.5g of an oxide of a metal M, was reduced by hydrogen to 1.98g of metal. Calculate the molecular formula of the oxide of M
(b) When 50.0cm^3 of a 1M sulphuric acid was added to 50cm^3 of 2M sodium hydroxide, the temperature rose by 13℃
(i) Write an ionic equation for the reaction that took place
(ii) Calculate the enthalpy of neutration of sodium hydroxide
(c)

5 (a) A mixture of zinc carbonate and magnesium sulphate was shaken with

excess water and filtered

(i) State what was observed
(ii) To the filtrate was added lead (II) nitrate solution . State what was observed and write equation for the reaction.

(b) When the residue in (a) was dried and heated, gas Q was given off. Gas Q was reacted with heated carbon. State what was observed and write the equations for the reactions.

(c) When 10g of the mixture of zinc carbonate and magnesium sulphate was added 250cm^3 of 2M nitric acid , 140cm^3 of carbon dioxide was evolved at st.p.(Zn = 65 , C = 12 , O = 16 , 1mole of a gas occupies 22.4dm^3 at s.t.p)

Calculate

(i) percentage of zinc carbonate in the mixture.
(ii) the excess moles of the acid.

(d) State the method and principle employed in the separation of the following mixtures

(i) sodium chloride and ammonium chloride

(ii) potassium chloride and sodium chloride

(iii) petrol and diesel
(iv) water and carbon disulphide.
(v) Nitrogen and oxygen

6 Nitric acid is a strong monobasic acid

(a) Explain what is meant by the terms
   (i) strong acid
   (ii) Monobasic acid

(b) Dilute nitric acid was added to copper (II) oxide in a beaker.
   (i) State what was observed
   (ii) Write equation of reaction

(c) To the resultant solution in (b) was added ammonia solution drop-wise until in excess. State what was observed and write equation(s) for the reaction(s) that tae place.

(d) With the aid of a labelled diagram describe how concentrated nitric acid can prepared in the laboratory.

(e) State what would be observed and write equation for the reaction when
   (i) Dilute nitric acid is added to copper turnings

   (ii) concentrated nitric acid is warmed with charcoal

   (iii) concentrated nitric acid is mixed with concentrated ammonia solution
   (iv) concentrated nitric acid is warmed with sulphur

7. A compound **Y** contains 62.5% lead , 8.5% nitrogen and the rest being oxygen. If the RFM of **Y** is 331;

(a) Determine the molecular formula of **Y**
(b) Compound **Y** was heated strongly
   (i) State what was observed

   (ii) write equation for the reaction

(b) Compound **Y** was dissolved in water and the solution divided into three portions

   (i) To the first portion was added sodium hydroxide solution drop-wise until in excess. State what was observed and write equation(s) for the reaction(s) that took place..
   (ii) To the second portion was added potassium iodide solution. State what was observed and write equation for the reaction.
   (iii) To the third portion copper turnings were added followed by concentrated sulphuric acid. State what was observed and explain your answer.

(c) Describe briefly how pure crystals of compound **Y** can prepared from a carbonate.

8. The cell convention for an electro- chemical cell is shown below

$Mg(s)/Mg^{2+}(aq)$ // $Cu^{2+}(aq)$ / Cu(s)

(a) Name two substances that could be used as electrolytes

(b) State which one of the electrodes is the cathode?

(c) Write equation for the reaction at the

(i) cathode

(ii) anode

(d) Write equation for the overall cell reaction.

(e) Distinguish between electrochemical cell and electrolysis cell

(e) Describe how impure copper can purified by electrolysis.

9. Part of the periodic table indicating the position of the elements P,Q,R,S,T,V,W and X is shown below

	Groups							
	I	II	III	IV	V	VI	VII	VIII
Period 2	S						P	
Period 3			W	X			Q	V
Period 4	T						R	

(a) State the

(i) most reactive non-metal

(ii) most reactive metal

(b) (i) Write the formula of the compound formed between X and R

(ii) State whether the compound is ionic or covalent

(c) The oxide of T was dissolved in water. Write the equation for the reaction.

(d) Which of the elements is inert?

(e) Which of the elements W, X, Q and V has smallest atomic radius? Give a reason for your answer.

(f) How does the reactivity of group(VII) elements with sodium vary from P to R.

10. (a) The number of protons of the elements P,Q,R and S are 6, 11, 17 and 8.

(i) Which term can be used to mean "**number of protons"**

(ii) Write the electronic configurations of P,Q, and R

b) P combines with S and Q combines with R to form compounds

(i) use valency electrons to explain briefly how the atoms P and S, Q and R form compounds.

(ii) Write the structural formula of the compound formed when P combines with S.

(c) State two properties of the compounds formed between

(i) P and S

(ii) Q and R

11 An element X forms an ion with the formula X^{2+}. The electronic configuration of the ion is 2:8:8.

(a) State the

(i) valency of X

(ii) period to which X belongs

(iii) family of elements to which X belongs.

(b) Write the equation for the reaction between X and water.

(c) The atomic number of Y is 11 and that of Z is 8.

(i) Using electronic structures represent how Y and Z combine to form a compound.

(ii) State three physical properties of the compound formed in (c)(i) above.

12. (a) Explain giving equations, how boiling can only remove temporary hardness whereas addition of sodium carbonate can remove both temporary and permanent hardness of water

(b) State

(i) two advantages of hard water

(ii) one disadvantage of using hard water for laundry work

(d) Give **two** properties of carbon dioxide gas that make it suitable for use as a fire extinguisher.

13. The table below indicates the pH value of solutions labeled A,B,C and E

pH	5	13	1	10	7
Solution	D	C	A	B	E

(a) Which solution has the highest number of free hydroxide ions

(b) Which solution has the highest number of hydrogen ions

(c) Which solution could be from lemon juice

(d) What colour would solution B turn after adding methyl orange indicator

14. Products formed by the action of heat on nitrates of A, B and C are listed below.

Nitrate of metal	Products
A	Metal oxide, nitrogen dioxide and oxygen
B	Metal, nitrogen dioxide and oxygen
C	Metal nitrite and oxygen

(a) Arrange the metals A, B and C in order of decreasing reactivity

(b) Give a metal that could be

(i) A

(ii) B

(iii) C

(c) Describe how the nitrate of C can be (i) prepared from potassium hydroxide (ii) converted into a carbon

15. Explain the following observations

(a) When magnesium carbonate was added to a solution of dry hydrogen chloride in methylbenzene, there was no observable change.

(b) When burning magnesium forms white solid with sulphur dioxide in a gas jar but there was no observable change with a burning splint.

(c) When oxygen gas was bubbled through concentrated ammonia solution of which hot platinum wire was held above white fumes were formed above solution.

(d) Water containing calcium hydrogen carbonate does not lather easily with soap

16. Given the empirical formula of a hydrocarbon is CH_2 and its RMM is 42.

(a) Determine the molecular formula of the hydrocarbon

(b) Draw the structural formula of the hydrocarbon

(c) To which homologous series does the hydrocarbon belong?

(d) Write equation for the complete combustion of the hydrocarbon

(e) Describe a chemical test for the hydrocarbon. Include an equation for the reaction.

17. (a)State how the following factors affect the reaction rate.

(i) Concentration

(ii) Temperature

(iii) Surface area

(b) The table below shows the volume of hydrogen gas produced with time when excess 0.5M hydrochloric acid is reacted with 0.24g of magnesium ribbon, at room temperature and pressure.

Time/sec	0	30	60	90	120	150	180	210	240
Vol. Of hydrogen/cm^3	0	80	140	190	220	240	250	250	250

(i) Draw a labeled diagram of apparatus which could be used to perform this experiment.

(ii) Plot a graph of volume of hydrogen against time

(iii) From the graph, determine how long it took to complete the reaction and the total volume of hydrogen produced

(iv) On the same axes sketch the curves that you would expect if the experiment the was carried out at the same conditions but using:

-0.4M HCl instead of 0.5M HCl. Label it P

-magnesium powder of the same mass instead of magnesium ribbon. Label the curve Q

18. (a) Starting with copper(II) carbonate, describe how crystals of copper(II) chloride may be prepared in the laboratory.

(b)State what would be observed and write equation for the reaction when

(i) copper(II) carbonate was heated strongly.

(ii) silver nitrate solution was added to copper(II) chloride solution.

(iii) concentrated sulphuric acid was added to solid copper(II) chloride.

(iv) iron filings were added to copper(II) chloride solution

19. (a) With the aid of a labelled diagram describe how anhydrous iron(III) chloride can be prepared from manganese(IV) oxide and concentrated hydrochloric acid.

(b)Dry chlorine gas was passed over 2.4g of heated iron

(i) State what was observed

(ii) Write equation for the reaction that took place

(iii) Determine the minimum volume of chlorine gas used at r.t.p (Fe=56, 1mole of gas at r.t.p=24dm^3)

(c) State what would be observed and write equation for the reaction when chlorine gas

(i) was bubbled through potassium bromide solution

(ii) was bubbled through cold dilute sodium hydroxide solution.

(iii) was passed into ammonia solution

(iv) bubbled through silver nitrate solution.

(v)

20. (a) Describe briefly how lead(II) chloride can be obtained from a mixture of lead(II) chloride and lead (II) sulphate.

(b) Describe how barium sulphate can be prepared using dilute sulphuric acid.

(c) (a) 15.0cm^3 of a 2 M sodium sulphate solution was diluted with distilled water to make 200cm^3 of a resultant solution. Calculate the concentration of the resultant solution in mol/dm^3 with respect to sodium ions

(b)When 5.95g of a hydrated salt, $YCl_2.nH_2O$, with formula mass of 238 was heated to constant mass, 3.25g of the anhydrous salt was formed.

(i) Calculate the number of moles of water of crystallization in the hydrated salt.

(ii) Determine the formula mass of Y(Cl=35.5)

(c) Determine the molar concentration of chloride ions when 250cm^3 of 2M iron(III) chloride solution .

21. (a) 2.2 g of a compound containing only phosphorous and sulphur contained 1.24g of phosphorous. Calculate the empirical formula of this compound.(P=31, S=32)

(b) Calcium chloride is prepared by reacting calcium hydroxide with hydrochloric acid.

(i) Write equation for the reaction that takes place

(ii) Calculate the volume of a solution containing 2 mol dm^{-3} of hydrochloric acid that reacted exactly with 5.6g of calcium hydroxide

(c) (a) 60 g of the metal M combine with 24 g of oxygen to form an oxide. Determine the formula of the oxide.(M=60, O=16)

(b) 100cm^3 of 0.5 M H_2SO_4 was added to 400cm^3 of 0.1 M KOH. Calculate the number of moles of hydrogen ions in the resultant mixture.

(c) Calculate the volume of 0.1 M hydrochloric acid which is just enough t0 react completely with 50.0 cm^3 of 0.2 M calcium hydroxide

(d) Calculate the mass of sodium thiosulphate-5-water($Na_2S_2O_3.5H_2O$) required to make up 250cm^3 of a 0.5 M solution (Na=23, S=32,O=16,H=1)

(e) A hydrocarbon consists of 86% carbon. At s.t.p, 3.2 dm^3 of the hydrocarbon has a mass of 6g. Calculate its

(i) empirical formula

(ii) relative molecular mass

(iii) molecular formula

(f) (a) 4.76 g of the hydrated chloride of a divalent metal N, of relative atomic mass 59, contain 2.6 g of the hydrous salt. Find the number of molecules of water of crystallization in each molecule of the hydrated salt.

(g) A hydrate of sodium carbonate, $Na_2CO_3.yH_2O$, weighing 2.48g loses 0.36 g of water on heating to a constant mass. What is the value of y?

22. (a)(i) Briefly explain a simple experiment that can be used to determine the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(ii)When 100cm^3 of 0.1 M NaOH is neutralized by excess hydrochloric acid, the final volume of the solution is 130cm^3 and the temperature of the mixture rises by 1.1°C . calculate the heat of neutralization(SHC=4.0$Jg^{-1}mol^{-1}$

(b) (i) Define the term **enthalpy of combustion**

(ii) Describe a simple experiment that can be used to determine the enthalpy of combustion of ethanol.

(iii) Given that the enthalpies of combustion of carbon and methane are – 394Kjmol $^{-1}$ and – 1560Kjmol $^{-1}$ respectively. Briefly explain which of the two a better fuel is.

(iv) Given that the enthalpy of combustion of ethanol is –1367 Kjmol $^{-1}$. Determine the mass of ethanol that can be burnt in air to raise the temperature of 200g of water by 35°C. (SHC of water is 4.2JK $^{-1}$ g $^{-1}$)

(c) 1.3g of zinc metal was added to 150cm^3 of 0.2M copper sulphate solution at 22°C. The solution mixture was thoroughly stirred and the final temperature measured was 26°C. Determine the enthalpy of the reaction given the density of the solution is 1gcm^{-3} and S.H.C of solution is 4.2JK $^{-1}$g

23. (a) Describe how a dry sample of calcium nitrate can be prepared from calcium carbonate.

(b)3.24 g of calcium nitrate was strongly heated at s.t.p.

(i) State what was observed

(ii) Write the equation for decomposition of calcium nitrate.

(iii) Determine the volume of the gaseous product(s) formed

24. (a)Describe how oxygen can

(i) commercially be preparation of from air.

(ii) be prepared from sodium peroxide in the laboratory

(Diagrams **not** required)

(b) State what is observed and write equation for the reaction when the following are heated in oxygen

(i) Magnesium

(ii) Sulphur

(iii) Calcium