Structural questions.

1.a.Define

i. a transition element. ii. d-block element.

b. Explain the following.

i. Zinc is not a transition element. ii. Fe^{2+} is less stable than Fe^{3+}.

iii. Compounds of Cu^{+} are not coloured while those of Cu^{2+} are colored?

c. Briefly state and explain the properties of transition metals.

2. a. Define a complex.

b. Briefly explain why transition metals form complexes.

c. Determine the oxidation states and coordination number of the central metal ion.

Complex	Oxidation state	Coordination number
$Cu(NH_3)_4(OH)_2$		
$[Cr(NH_3)_5Cl]Cl_2$		
$[Co(CN)_6]^{3-}$		
$[Ag(CN)_2]^{-}$		

3.a. Complete the following table.

Complex	Structure of complex	Name of the structure of the complex	Name of the complex
$[Cu(NH_3)_2]^{+}$			
$[Cu(NH_2CH_2CH_2NH_2)_2]^{2+}$			
$[Co(NH_3)_4Cl_2]^{+}$			

b.i. Which type of isomers are found in $[Co(NH_3)_4Cl_2]^{+}$

ii. show the different structures of the above isomers.

4. Explain the following trends in across the 1st transitional series from Sc to Zn.

a. atomic radius. b. Ionisation energy.

5. a. Define a ligand.

b. Explain why ligand is supposed to a lewis base?

c. An hydrous cobolt (ii) chloride is a lewis acid.

i. Explain the meaning of lewis acid?

ii. Give the formula, shape and color of the complex formed when anhydrous cobolt ii chloride is treated separately with water and concentrated hydrochloric acid.

iii. Give the reason for the difference in the shape.

iv. Give the reason for the difference in the color.

6. One of the applications of complexes is cis-platin $[Pt(NH_3)_2Cl_2]$ used in the treatment of some types of cancer.

a. Give the structure and the full name of Cis-platin.

b. What name is given to the structure above.

c. Give the coordination number of the complex.

d. Identify any other two biological applications of complexes

Structural questions.

1.a. State three properties of chromium as a transition metal.

b. A solution of potassium dichromate (VI) was added to acidified of iron (II) sulphate.

i. State what was observed.
ii. Write the ionic equation for the reaction that took place.
c .i. Write the structural formulae of the isomers of chromium iii chloride,
$CrCl_3.6H_2O$.
ii. identify the structure that forms geometrical isomers and show the optical isomers.
ii.i State one of way distinguishing the isomers.
2.a .i. Write down the electron configuration of Cr.
ii. Give all the oxidation states of Cr giving examples of compounds in which chromium has those states.
iii. Explain why the solutions of Cr^{3+} are acidic.
3 .a. State the oxidation states of chromium in
i. Potassium chromate.
ii. Potassium dichromate.
b. Acidified potassium dichromate was reacted with potassium iodide.
i. State what was observed
ii. Write the half equations for reaction.
c. Potassium chromate was added to aqueous lead ii nitrate
i. State what was observed.
ii. Write the equation for reaction.
4. Sodium hydroxide was added drop wise to solution containing Cr^{3+} followed by hydrogen peroxide.
a. State what was first observed before adding hydrogen peroxide and write the equation for reaction.
b. What was finally observed?
c. What will be observed if a few drops of dilute sulphuric acid was added to the above solution.
5.a. Chromium (iii) sulphate solution was dissolved in water and then a few drops of sodium carbonate was added.
i. State what was observed.
ii. Give a reason for your and write the equations for reaction.
b. Potassium chromate was dissolved in water.
i. Draw and name the shape of chromate ion.
ii. To the solution a few drops of sulphuric acid was added followed by sodium hydroxide
State what was observed and write the equations for reaction.
6. A solution of chromate (CrO_4^{2-}) was prepared as follows. Sodium hydroxide solution was added to aqueous Cr^{3+} to give a grey green precipitate. Excess sodium hydroxide was added to dissolve the green precipitate to give a green solution. Aqueous hydrogen peroxide was added and the mixture was warmed to give a yellow solution containing CrO_4^{2-}.
a. Calculate the oxidation number of Cr in CrO_4^{2-}.
b. Write balanced ionic equation to show:
i. the reaction Cr^{3+} to give a grey green precipitate.
ii. the reaction of the grey green precipitate to form a green solution.
c. What is the role the hydrogen peroxide in the above preparation?
d. When an acid is added to CrO_4^{2-}it changes to $Cr_2O_7^{2-}$.
i. State the color of aqueous $Cr_2O_7^{2-}$.
ii. Write an equation for reaction of CrO_4^{2-} with H^+ to form $Cr_2O_7^{2-}$. Is this a redox reaction ?
Give a reason for your answer.
e. Acidified $Cr_2O_7^{2-}$ is commonly used as an oxidizing agent.
The relevant half-equation is
$Cr_2O_7^{2-} + 14H^+_{(aq)} + 6e \rightarrow 2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$
Write a balanced equation for the reaction between acidified $Cr_2O_7^{2-}$and Fe^{2+}.
f) Chromium is used in the manufacture of steel alloys one such as stainless steel.
i. What is an alloy?
ii. Give one major property of stainless steel.

g. Give the electronic configuration of Chromium(Cr) (Atomic number of Cr: 24)

7.When a conc. NH_3 is added dropwise to a solution of chromium (III) sulphate, a green precipitate **A** forms. **A** dissolves slowly in excess NH_3 to give a purple solution **B**. **A** also dissolves in NaOH to give a green solution, **C**, Addition of hydrogen peroxide to C gives a yellow solution, **D**. when is treated with dil. H_2SO_4, it gives an orange solution E. Identify **A, B ,C, D** and **E**

8. $(NH_4)_2SO_4Fe_2(SO_4)_3.24H_2O$, 5g is dissolved in 250cm^3 of distilled water. 100cm^3 of the solution was boiled with Zn powder until the solution is green. 25cm^3 of this solution was acidified 25cm^3 of 1M H_2SO_4 acid. This solution was titrated with 0.02M potassium dichromate required 24.5cm^3.

a. Write a balanced redox equation between Fe^{2+} and $Cr_2O_7^{2-}$

b. Calculate number

i. moles of potassium dichromate that reacted. ii. moles of Fe^{2+} ion in 25cm^3.

iii. moles of Fe^{2+} ion in 250cm^3. iv. mass Fe^{2+} in 250cm^3 (Fe =56) v. percentage purity of Fe.

c. What is the purpose of Zn.

Structural questions.

1.a.i. Write down the electron configuration of Mn

ii. Give all the oxidation states of manganese giving examples of compounds in which it shows these states.

b. Explain why Mn^{2+} compounds are more stable than those of Mn^{3+}.

2. Potassium permanganate is used as standardising agent in volumetric analysis.

a. Explain why

i. titrations of potassium permanganate do not need indictors.

ii. potassium permanganate is not acidified using hydrochloric acid.

b. Write a balanced equation between

i. acidified potassium permanganate and sodium oxalate.

ii. between acidified $Mn^{2+}$and sodium bismuthate. (state what is observed).

3. A solid X was dissolved in water to give a slightly pink solution. A few drops of sodium hydroxide was added to give a white precipitate which quicky turns to brown the black. when the same pink solution was treated with conc nitric acid followed by sodium bismuthate a purple solution is observed.

a. Identify the cation in X.

b. Write down an ionic equation between the cation and sodium hydroxide.

c. Give the chemical species responsible for then to brown, black and purple colours.

4. In an experiment to find the value of n in $(NH_4)_2SO_4.FeSO_4.nH_2O$, 16.98g of the salt were dissolved in a mixture of the water and dilute sulphuric acid. the solution was made up to 250cm^3 in a volumetric flask. 25.0cm^3 of this solution was titrated with potassium manganate (VII) of concentration 0.030 mol dm^{-3} . 22.5cm^3 of this solution was required. a.

Calculate the number of moles of potassium permanganate that reacted.

b. Calculate the number of moles of Fe^{2+} that reacted in 25cm^3.

c. Calculate the number of moles of Fe^{2+} that reacted in 250cm^3.

d. Calculate the molar mass of the salt.

e. Find the value of n

f. Explain why Fe^{2+} is less stable than Fe^{3+}

g. What is the color change during titration.

5. An iron iron (ii) salt 10g, was dissolved in water and was made up 200cm^3. 20 cm^{3}of the solution was acidified with dilH_2SO_4 required 25cm^3 of 0.03M $KMnO_4$.

a. Calculate the number of moles of potassium permanganate that reacted.

b. Calculate the number of moles of Fe^{2+} that reacted in 25cm^3.

c. Calculate the number of moles of Fe^{2+} that reacted in 200cm^3.

d. Calculate the percentage by mass of Fe in the impure salt.

Structural questions.

1.a.Using equations outline the process of extraction of iron from iron (iii)oxide (diagram) required.

b. Using equations, briefly explain how iron reacts with the following compounds.

i. Water. ii.chlorine iii.dilute sulphuric acid. iv. dilute nitric acid.

2. a. Which type of bonding is in $FeCl_3$

b. Explain why a solution of $FeCl_3$ has a PH of less than 7.

c. Write the equation and state what will be observed when iron iii chloride solution reacts

i. with sodium hydroxide.

ii with sodium carbonate.

3. Name one reagent that can be used to distinguish between the following pairs of compounds and state what will be observed if each compound is treated with the reagent. Include observations.

a. Ni^{2+} and Cr^{3+}b. Fe^{2+} and Fe^{3+}c. $MnSO_4$ and $FeSO_4$

4. A compound A has 28% Fe, O 48% and S, 24%

a. Calculate its empirical formula.

b. If molecular mass of A is 400. Determine the molecular formula of A.

5.a. Define rust

b. Give the conditions necessary for rusting,

c. Write the equation that occurs during rusting.

i.anode ii. cathode iii. overall equation.

d. Give 4 ways that are used to prevent rusting of iron.

6.a. Write down the electron configuration of Fe^{2+}, Fe^{3+}, Fe^{6+} (26)

b. Explain why $Fe^{2+}$is oxidized to Fe^{3+}

c. With examples, give three properties in which iron acts as a transition metal.

d. Give two practical applications of iron.

7. The addition of iron fillings to the solution of copper (ii) sulphate to give a solution of ion Q and the solid is removed by filtration.

a. Write the ionic equation for reaction.

b. Give two possible observation(s)

c. In solution Q exists as a complex. Give the formula of the complex ion.

d. Addition of sodium hydroxide to Q gives Iron (II) hydroxide and on filtration, it gives a brown solid R on the filter paper.

i. state color of iron hydroxide.

ii. Give the formula of R.

iii. with what does iron (II) hydroxide react with to produce R.

iv. Give the type of reaction that lead to the formation of Q and R?

Structural questions.

1.a.Write the electron configuration of Copper.

b. State two properties of copper as a transition metal.

c. Hydrated copper (ii) sulphate was dissolved in water.

i. Write the name and the formula of the copper spiecie present.

ii. To the above solution was added concentrated hydrochloric acid.

State what was observed and write down the name of the copper spiece present.

2. a.i. Write down the formula and name of the ore copper.

ii. Outline the process of how pure copper is obtained from the ore above.

b. Write down the equation reactions between copper and

i. Sulphuric acid.

ii. Nitric acid. (include observations and conditions)

c. State what will be observed write the equation of reaction that takes place when the following reagents are added drop wise to the solution of copper ii chloride.

i. Sodium hydroxide solution.

ii. Concentrated hydrochloric acid.

3. A green powder was dissolved in dilute hydrochloric acid to give a green solution.

a. To the first portion a few drops of potassium hexacyanoferrate II.

A brown precipitate was formed. Name the cation in the powder.

b. To the second portion was added was added ammonia solution dropwise till excess.

i. State what was observed

ii. Write the equation for reaction.

c. To the third portion was added potassium iodide.

i. State what was observed ii. Write the equation for reaction.

4. A solution was prepared by dissolving 2.838g of $CuSO_4 .XH_2O$ to give 250cm^3 of aqueous solution. 25.0cm^3 of this solution was treated with an excess of aqueous Kl. The iodine produced was titrated with a solution of $Na_2S_2O_3$ and 23.70 cm^3 of $Na_2S_2O_3$ was required.

Given that 2.976g of $Na_2S_2O_3 .5H_2O$ had been dissolved in water to obtain 250cm^3 of aqueous solution using starch as a suitable indictor. (Cu=63.5, Na= 23, S=32, O=16)

Find the number of moles of water of crystallization x.

Use the following equations in your calculations.

$2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \rightarrow 2Cu_{(s)} + I_{2(aq)}$

$I_{2(aq)} + 2S_2O_3^{2-}{}_{(aq)} \rightarrow 2I^-_{(aq)} + S_4O_6^{2-}{}_{(aq)}$

Structured questions.

1. Cr (24) Mn(25) and Fe(26) are d block elements.

a. What is a d block element?

b. Explain why the atomic radii of three elements are similar.

c. Give three properties characteristic of transition elements, with examples from the three elements.

d. Write the electron configuration of Cr^{2+}, Mn^{3+} and Mn^{7+}.

2. Using equation briefly explain the following extraction (s)

a. Iron from haematite.

b. copper from copper pyrite.

c. Zn from Zinc blende.

Structural questions

1.a. By giving reagents and conditions, state two different methods of extracting metals starting from their oxides. In each case, write equation(s) to illustrate the extraction of an appropriate metal.

b.i. Why are metals more usually extracted from their oxides rather than from any other compound?

ii. State two environmental problems associated with the extraction of metals from their oxides or sulphides and give the chemical responsible for each problem.

2. a. Draw the diagram used in electrolysis during extraction of aluminium

b Write the equations that occur at the anode and carthode

C. Explain why the following are used during extraction

i. cryolite

ii. NaOH.

iii. CO_2.

iv. anode is replaced in intervals.

3.a. Give the ores of iron.

b. Explain the extraction of iron from its ores.

4. Copper is a widely used metal. The main ore of copper contains copper sulphide.

Copper can be extracted from copper sulfide in a three-stage process.

a. In the first stage of extraction the copper sulfide is heated in air.

i. Write down a balanced equation for reaction.

ii. Explain the environmental problem caused by the above reaction.

b. In the second stage copper oxide, CuO, is reduced using carbon.

Describe and explain what happens during this reaction.

c. During the third stage the copper can be purified.

i. What is the name of the type of process used for this purification?
ii. Write down the equation(s) for reaction.
iii. Draw the diagram for the process.
iv. Give one use of purified copper.
d. Copper-rich ores are running out. New ways of extracting copper from low grade ores are being researched. Recycling of copper may be better than extracting copper from its ores. Explain why.
5.a. Give 2 or 3 uses of aluminium, copper, zinc, and iron.
b.Give two reasons why the extraction of aluminium is expensive.
c. Zinc and copper are also extracted in the same way as iron (in blast furnace) but exist as their sulphide ores.
i. How is the sulphide ore converted into an oxide and what is the problem with this process?
(give an equation)
ii. Why can aluminium not be extracted in this way?
iii. Why can tungsten not be extracted in this way? (give an equation
6.Tungsten is prepared in a pure form by high temperature reduction of tungsten (VI) oxide with hydrogen.
a. Construct an equation for this reaction.
b. Suggest why carbon is not used as the reducing agent.
c. Suggest one advantage (other than purity of the product) and one disadvantage of using hydrogen as the reducing agent on an industrial scale

Structural questions.

1. The chemical plant for manufacturing ammonia is often on the same site as plantsmanufacturing nitric acid and fertilisers.

a. What advantages will this have for the manufacturing company?

b. Using equation(s) show how ammonium nitrate is obtained from nitrogen gas.

c. i. Describe the environmental impact of such plants on the surrounding area.

   ii. Give two ways in which such impact can be reduced

2. Sulphuric acid reacts with ammonia to give ammonium sulphate

a.Write the balanced equation for that reaction

b. What property of ammonia is shown in this reaction?

c. Calculate the maximum mass of ammonium sulphate that can be obtained from 100 g of ammonia. [Ar: H, 1.0;N, 14.0; O, 16.0;S, 32.1)

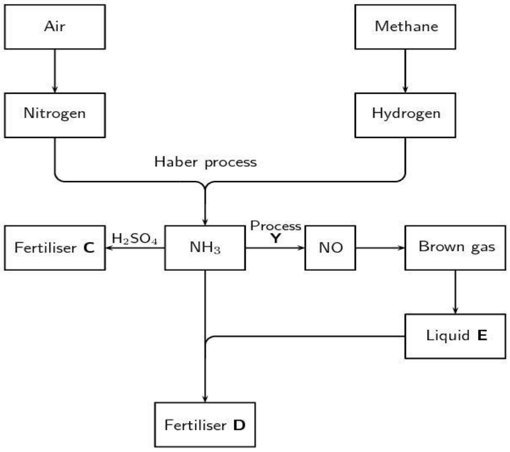
d. State the large scale use of ammonium sulphate.

3. A laboratory method of finding the percentage of ammonia in a fertiliser involves boiling the fertiliser with an excess of aqueous sodium hydroxide until no more ammonia is given off. The excess of sodium hydroxide is found by titration with standard hydrochloric acid.

a.Write an equation for the reaction between ammonium ions and hydroxide ions to give ammonia

b. Say how you could test for ammonia gas.

c. The flow diagram below shows the main steps in the industrial preparation of two importantsolid fertilisers.



4.a. Using advantages and disadvantages give the differences between the action of artificial and natural fetertilzers?

b. Explain the environment impact of excess use of fertilizers?

5. A fertilizer contains ammonium sulphate sample of 0.5g of fertilizer was warmed with sodium hydroxide solution. The ammonia evolved was absorbed in 100 cm^3 of 0.1mol dm^{-3} hydrochloric acid. The excess hydrochloric acid required 55.9$cm^3$of 0.1M sodium hydroxide for neutralization.

a. Write the equation for the reaction between

i. Sodium hydroxide and HCl acid

ii. Ammonium sulphate and sodium hydroxide

iii. Ammonia and HCl acid

b.Calculate

i.moles of base that reacted with excess HCl acid.

ii.total moles of the added HCl acid.

iii. moles of excess acid.

iv. moles of acid that reacted with ammonia.
v. mole of ammonia produced by the fertiliser
vi. moles of $(NH_4)_2SO_4$.
vii. mass of $(NH_4)_2SO_4$
viii. mass of N in the fertiliser
ix. percentage of N in the fertilizer