

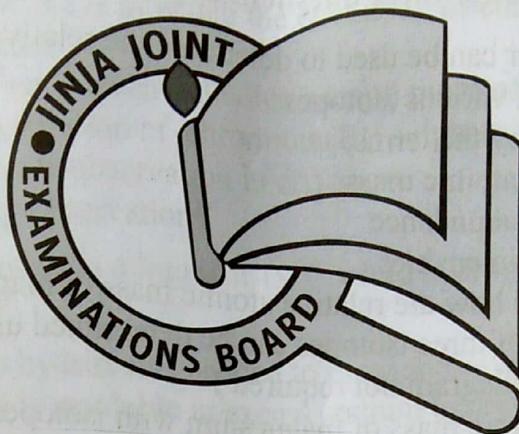
P525/2

**CHEMISTRY**

**Paper 2**

**December 2020**

**2½ hours.**



**JINJA JOINT EXAMINATIONS BOARD**

*Uganda Advanced Certificate of Education*

**MOCK EXAMINATIONS DECEMBER, 2020**

**CHEMISTRY**

**(Principal Subject)**

**Paper 2**

**2 hours 30 minutes.**

**INSTRUCTION TO CANDIDATES:**

Answer **FIVE** questions including three questions from section A and any **two** from section B.

Write answers in the answer booklet provided

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers

Where necessary use ( $\text{Cu} = 64$ ,  $\text{S} = 32$ ,  $\text{O} = 16$ ,  $\text{Br} = 79.9$ ,  $\text{H} = 1$ )

Faraday's constant is  $96500\text{c}$

## SECTION A

**(Answer three questions from this section)**

1

The mass spectrometer can be used to determine the relative atomic mass of elements consisting of various isotopes

- (a) What is meant by the terms;
  - (i) Relative atomic mass (01 mark)
  - (ii) Relative abundance (01 mark)
  - (iii) Relative intensities (01 mark)
- (b) Briefly describe how the relative atomic mass of magnesium metal which consists of three isotopes can be determined using a mass spectrometer (Diagram not required) (06 marks)
- (c) The relative atomic mass of magnesium with isotopes  $^{24}_{12}Mg$ ,  $^{25}_{12}Mg$ , and  $^{26}_{12}Mg$  is 24.3, if the percentage abundance of  $^{25}_{12}Mg$  and  $^{26}_{12}Mg$  is equal,
  - (i) Calculate the percentage abundance of each isotope of magnesium ( $1\frac{1}{2}$  marks)
  - (ii) Sketch the mass spectrum of magnesium. (02 marks)
- (d) The table below shows the results of radioactive decay of a radioactive isotope of magnesium  $^{26}_{12}Mg$ . Use the data to plot a graph of log (mass) against time (04 marks)
 

Mass of $^{26}_{12}Mg$ (g)	18.7	14.6	11.3	8.8	6.9	5.4
Time (S)	300	600	900	1200	1500	1800
- (e) Using the graph plotted in (d) above determine the,
  - (i) Order of radioactive decay of  $^{26}_{12}Mg$  (01 mark)
  - (i) Rate constant and hence half life of  $^{26}_{12}Mg$  ( $1\frac{1}{2}$  marks)
  - (iii) Original mass of  $^{26}_{12}Mg$  (01 mark)

2

- A saturated bromo compound, X,  $C_nH_{2n-1}Br$  contains 49.08% by mass of bromine.
- (a) (i) Determine the molecular formula of X (02marks)
  - (ii) Write the structural formula and name of X (01mark)
  - (b) Phenol was reacted with X;
    - (i) State the condition(s) for the reaction (01mark)
    - (ii) Write the equation and mechanism for the reaction that took place (04 marks)
  - (c) X can be distinguished from Bromobenzene;
    - (i) Name the reagent(s) that can be used to distinguish the two compounds and State what is observed (03mark)
    - (ii) Using relevant illustrations and equations explain the difference in observations (05marks)

3

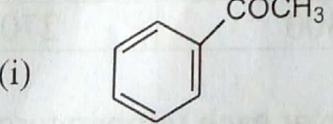
- (a) Describe, using equations where applicable, the reactions of chromium with;
  - (i) Air (04marks)

- (ii) Sulphuric acid (08marks)  
 (iii) Sodium hydroxide  
 (b) (i) Explain why chromium is considered a typical transition metal (02marks)
- (ii) State five ways in which the chemistry of chromium is similar to that of aluminium (05 marks)
- (c) (i) State what is observed when a small piece of magnesium ribbon is dropped into a solution of chromium(III) sulphate (02marks)  
 (ii) Explain the observation in c(i) above (03marks)

4 Explain the following observations

- (a) Hydrogen fluoride is a liquid at  $19^{\circ}\text{C}$  while hydrogen chloride is a gas. (3½ marks)
- (b) When sodium hydroxide is added to manganese(II)chloride, a white precipitate is formed that is insoluble in excess sodium hydroxide but turns brown on standing (4½ marks)
- (c) Carbon tetrachloride molecule is non-polar yet the bonds in it are polar (4½ marks)
- (d) Phenol is a stronger acid than Cyclohexanol (3½ marks)
- (e) A Mixture of 50cc of 0.1M ammonium hydroxide solution and 50cc of 0.1M solution of hydrochloric acid gives a solution which is less than seven. (04marks)

### SECTION B: Attempt two (2) questions

- 5 (a) Write equations to show how each of the following compounds can be synthesized. In each case, indicate a mechanism for the reaction.
- (i)  from Benzene (03 marks)
- (ii)  $(\text{CH}_3)_2\text{C}=\text{N}-\text{OH}$  from Propanone (05 marks)
- (b) Name the reagent(s) that can be used to differentiate between the compounds in each of the following pairs. In each case, state what would be observed and write the equation(s) for the reaction if any when each member of the pairs is treated with the reagent(s) stated.
- (i) Phenol and cyclohexanol (04 marks)  
 (ii) Ethanal and Phenylmethanal (04 marks)
- (c) Using equations while stating conditions for each step clearly show how 2-bromopropane can be converted to phenol (04marks)
- 6 (a) The melting points of Magnesium, Silicon and sulphur are  $650^{\circ}\text{C}$ ,  $1423^{\circ}\text{C}$ , and  $120^{\circ}\text{C}$  respectively. Explain the difference in the melting point of the elements (06 marks)

- (b) (i) Name the type of bond that exists in the hydride of Magnesium , Silicon and Sulphur.  
 $(1\frac{1}{2} \text{marks})$
- (ii) Write the equation to show the reaction of any of the hydrides in  
 (i) with water  $(4\frac{1}{2} \text{marks})$   
 (c) Describe the reactions of the oxide of silicon with;  
 (i) hydrofluoric acid  
 (ii) Sodium hydroxide  
 (iii) water

- 7 (a) (i) Write balanced equations to illustrate the main stages of the contact process (03marks)  
 (ii) Explain the conditions used in the contact process to ensure maximum yield. (05marks)

- (b) Sulphuric acid vapour dissociates when heated according to the equation:



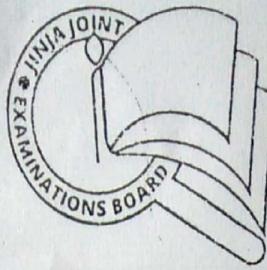
Write an expression for the equilibrium constant  $K_p$ , for the reaction and state its units  $(1\frac{1}{2} \text{ marks})$

- (c) The following data shows the equilibrium partial pressure of sulphuric acid vapour, steam and sulphurtrioxide at two different temperatures and a pressure of 1atm;

Temperature (K)	Partial pressures (Pa)		
	$\text{H}_2\text{SO}_4$	$\text{H}_2\text{O}$	$\text{SO}_3$
400	4.5	3.2	2.9
493	470	300	270

- (i) Calculate the equilibrium constant,  $K_p$  at each temperature. Hence deduce with an explanation whether the dissociation sulphuric acid vapour is exothermic or endothermic (04marks)
- (ii) Explain the effect of increasing pressure on the equilibrium position and equilibrium constant  $K_p$  at 400K  $(2\frac{1}{2} \text{ marks})$
- (d) (i) Sketch the structure and name the shape of the sulphuric acid molecule (02marks)  
 (ii) Explain why sulphuric acid molecule adopts the shape named. (02marks)
- 8 (a) (i) What is meant by the term **ore**? (01mark)  
 (ii) Write the formula and name of **one** ore from which copper is extracted. (01marks)
- (b) Describe how pure copper can be extracted from the ore in (a)(ii) above. (1 1/2marks)
- (c) Discuss the reactions of copper with  
 (i) Concentrated hydrochloric acid

- (ii) Nitric acid (04marks)
- (d) Few drops of potassium hexacyanoferrate(II) solution were added to copper(II) sulphate solution ; (01mark)
- (i) State what would be observed. (1½marks)
- (ii) Write equation for the reaction.

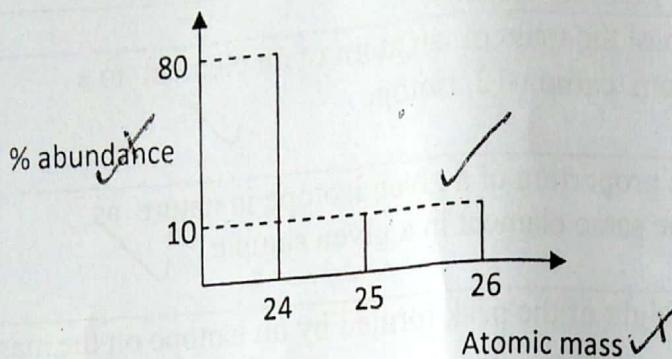


JJEB UACE MOCK 2020 CHEMISTRY P525/2 MARKING GUIDE

Number	Possible response	SCORE
1(a) (i)	Relative atomic mass is the ratio of the mass of an atom of an element to a twelfth ( $\frac{1}{12}$ th) the mass of one atom carbon-12 isotope ✓	01
(ii)	Relative abundance refers to the proportion of a given isotope in nature as compared to other isotopes of the same element in a given sample ✓	01
(iii)	Relative intensity refers to the height of the peak formed by an isotope on the mass spectrum ✓	01
(b)	<ul style="list-style-type: none"> <li>The mass spectrometer is evacuated through the evacuation pump to prevent interference to movement of the positive ions by air molecules</li> <li>A vaporized magnesium sample is then introduced into the ionization chamber where it's subjected to a beam of first moving electrons from the electron gun that collide with the Magnesium gaseous atoms to cause ionization and form positive gaseous ions; <math>Mg_{(g)} \longrightarrow Mg_{(g)}^{2+} + 2e^-</math></li> <li>The positive ions formed are accelerated at the same velocity and kinetic energy by the electric field so that they enter the magnetic field.</li> <li>In the magnetic field the positive ions are deflected according to their mass to charge ratio, such that ions of higher mass to charge ratio are deflected least while those of low mass to charge ratio are deflected most.</li> <li>The strength of the magnetic field is therefore varied such that different ions hit or enter the collector. The positive ions with same mass to charge ratio enter the collector and produce an electric current which is amplified and detected as a line peak on the mass spectrum.</li> <li>Each line peak on the mass spectrum corresponds to an isotope with a specific mass. The height of the line peak is directly proportional to the relative abundance of the isotope that produced it.</li> </ul>	06
	Relative atomic mass = $\sum \left( \frac{\text{Isotopic mass} \times \text{Relative abundance}}{\text{Total abundance}} \right)$ ✓	
(c) (i)	<p>Let each of the percentage abundance of <math>^{26}_{12}Mg</math> and <math>^{25}_{12}Mg</math> be n      The percentage abundance of <math>^{24}_{12}Mg</math> will be <math>(100 - 2n)</math></p> <p>Relative atomic mass</p> $= \frac{(25n) + (26n) + (24 \times (100 - 2n))}{100}$ $= \frac{(25n) + (26n) + (2400 - 48n)}{100}$ $24.3 = 51n - 48$ $2430 - 2400 = 51n - 48$ $30 = 10n$ <p>Each line peak in the mass spectrum corresponds to an isotope with</p> <p>The percentage abundance of <math>^{25}_{12}Mg</math> = 10</p> <p>The percentage abundance of <math>^{26}_{12}Mg</math> = 10</p> <p>The percentage abundance of <math>^{24}_{12}Mg</math> = 80 ✓</p>	12

(ii)

Mass spectrum of Magnesium



02

(d)

Values plotted

$\log(\text{Mass})$	1.27	1.16	1.05	0.94	0.84	0.73 ✓
Time (s)	300	600	900	1200	1500	1800

04

See the graph attached ;

~~Axes = 01 plotting = 01 shape = 01~~

e (i)

The decay is first order or one because a graph of  $\log(\text{Mass})$  against time plotted is a straight line with a negative slope.

(ii)

From the equation for first order reactions ;  $\log Nt = \frac{-\Lambda t}{2.303} + \log N_0$ 

$$\text{Slope} = \frac{-\Lambda}{2.303}$$

$$\text{From graph slope} = \frac{\text{Change in } \log(\text{Mass})}{\text{time}}$$

$$= \frac{1.215 - 0.75}{450 - 1740} = -3.6 \times 10^{-4} \checkmark$$

$$\frac{-\Lambda}{2.303} = -3.6 \times 10^{-4} \checkmark$$

$$\Lambda = 3.6 \times 10^{-4} \times 2.303$$

$$\Lambda = 8.29 \times 10^{-4} \text{ per second}$$

12

(iii)

Original mass No;

$$\log N_0 = \text{intercept}$$

$$\text{From graph intercept} = 1.375 \checkmark$$

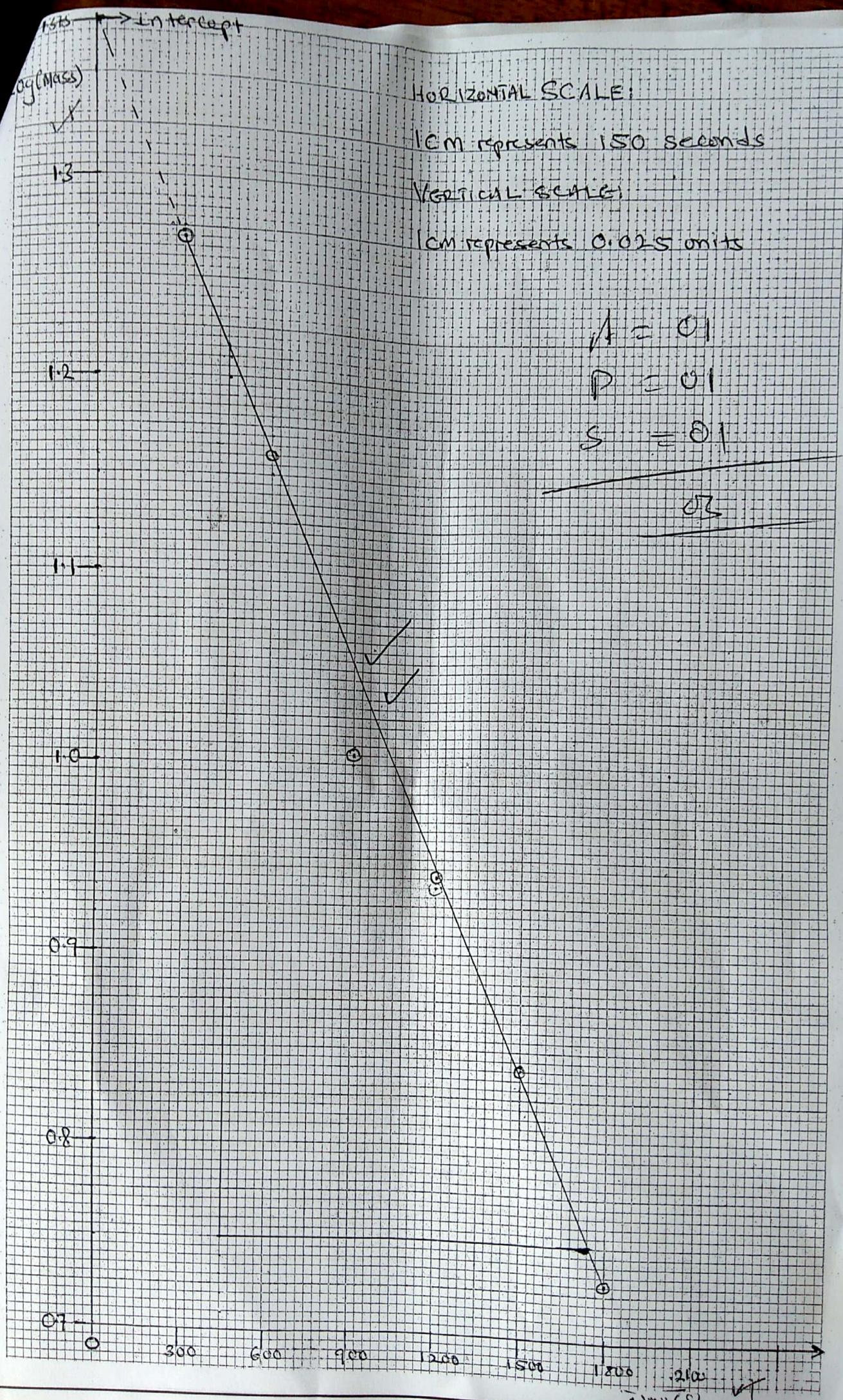
$$\log N_0 = 1.375 \checkmark$$

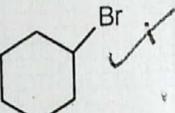
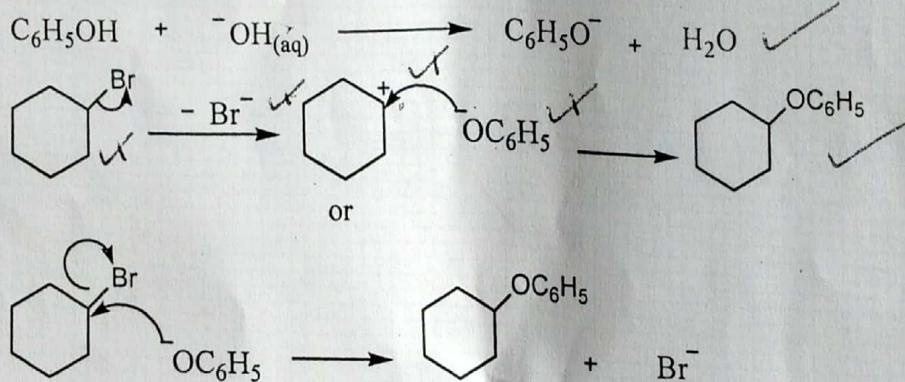
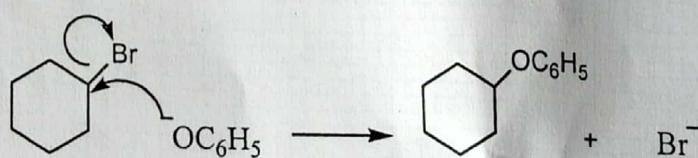
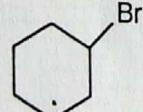
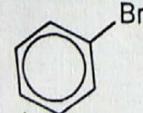
$$N_0 = 10^{1.375}$$

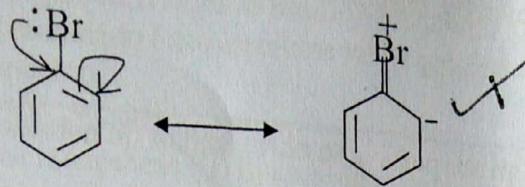
$$N_0 = 23.71 \text{ g} \checkmark$$

01

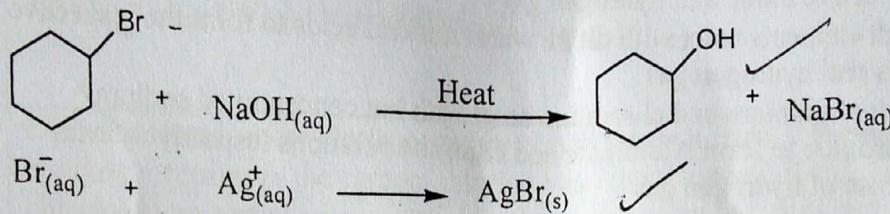
20



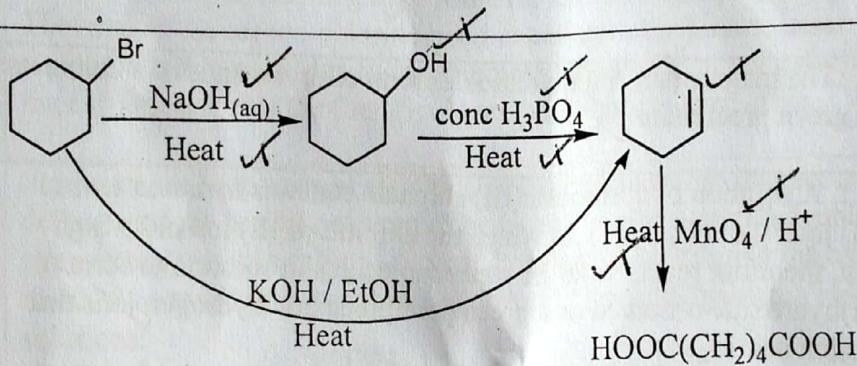
2(a) (i)	<p>RMM of <math>C_nH_{2n-1}Br</math> = <math>12n + 2n - 1 + 80</math>  <math>= 14n + 79</math></p> <p>Percentage of Bromine in RMM is 49.08</p> <p>Therefore <math>\frac{80}{14n + 79} \times 100 = 49.08</math></p> <p><math>n = 5.999 \approx 6</math></p> <p>Molecular mass <math>= C_6H_{11}Br</math></p>	02
(ii)	<p>Structure :</p>  <p>Name : Bromocyclohexane</p>	01
(b) (i)	Aqueous sodium hydroxide solution and Heat	01
(ii)	<p><math>C_6H_5OH + -OH_{(aq)} \rightarrow C_6H_5O^- + H_2O</math></p> <p></p> <p>or</p> <p></p>	04
(c) (i)	<p>Reagent : Hot sodium hydroxide solution, dilute nitric acid and silver nitrate solution</p> <p>Observation :</p> <p></p> <p>Pale yellow precipitate</p> <p></p> <p>No observable change</p>	03
(ii)	<p>The lone pairs of electrons on the Bromine atom in Bromobenzene interact with the pie bonding system to form a partial double bond which strengthens the carbon-Bromine bond making it harder to break for substitution of the bromine atom by the hydroxide ion from sodium hydroxide.</p>	



However the carbon-Bromine bond in Bromocyclohexane is weak and it is easily Breaks to substitute the Bromine atom forming cyclohexane and Bromide ions that react with silver nitrate solution to form silver Bromide that is observed as a yellow precipitate



(d)



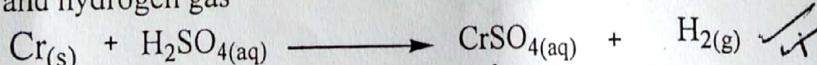
05

04

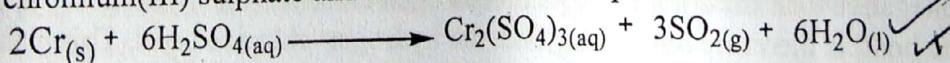
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3 (a) (i) Chromium reacts with oxygen in air when heated to form chromium(III) oxide  
 $4\text{Cr}_{(\text{s})} + 3\text{O}_{2(\text{g})} \longrightarrow 2\text{Cr}_2\text{O}_{3(\text{s})}$

(ii) Chromium reacts with warm dilute sulphuric acid to form chromium(II) sulphate and hydrogen gas

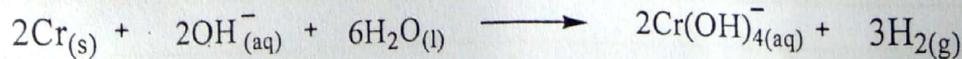
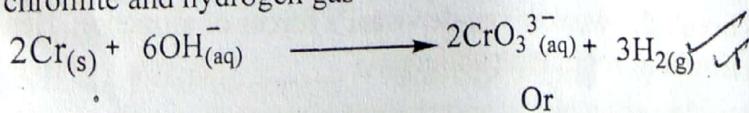


Chromium reacts with hot concentrated sulphuric acid which oxidizes it to form chromium(III) sulphate and itself reduced to sulphur dioxide and water



04

(iii) Chromium reacts with hot sodium hydroxide solution to form a solution of a chromite and hydrogen gas



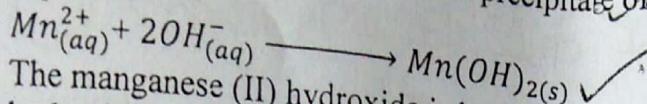
02

5

(b) (i)	<p>The chromium atom (24) with electron configuration <math>(1S^2 2S^2 2P^6 3S^2 3P^6 4S^1 3d^5)</math> has partially filled 3d orbital and forms several stable ions with partially filled 3d orbital e.g chromium (III) ion with electron configuration <math>1S^2 2S^2 2P^6 3S^2 3P^6 3d^3</math></p>	62
(ii)	<ul style="list-style-type: none"> <li>• Both Aluminium and chromium are passive to nitric acid or do not react with nitric acid</li> <li>• Both aluminium and chromium react with air when strongly heated to form the respective oxides. The reaction slows down in both elements due to formation of a film of the oxide that is passive</li> <li>• Both aluminium and chromium react with steam when heated to form respective oxide and hydrogen gas</li> <li>• Both elements react with dilute warm mineral acids to form the respective salts and hydrogen gas</li> <li>• Both aluminium and chromium react with hot concentrated sodium hydroxide to form Aluminate and chromite solutions respectively with release of hydrogen gas</li> </ul>	65
C (i)	<p><b>Observation :</b> The magnesium ribbon dissolves with effervescence of a colourless gas to form a green precipitate ✗</p>	12
(ii)	<p><b>Explanation :</b> A solution of chromium(III) sulphate contains hydrated ions of chromium(III) ions <math>(Cr(H_2O)_6^{3+})</math>, in which the chromium(III) ion has a high charge density, therefore reacts with the water molecules in solution to form chromium(III)hydroxide observed as a green precipitate and hydrogen ions that make the solution acidic</p> $Cr(H_2O)_{6(aq)}^{3+} + 3H_2O_{(l)} \longrightarrow Cr(H_2O)_3(OH)_{3(s)} + 3H_3O_{(aq)}^+$ <p>Or</p> $Cr_{(aq)}^{3+} + 3H_2O_{(l)} \longrightarrow Cr(OH)_{3(s)} + 3H_{(aq)}^+$ <p>The hydrogen ions released in solution then react with the magnesium ribbon to dissolve it and form magnesium ions and hydrogen gas</p> $Mg_{(s)} + 2H_{(aq)}^+ \longrightarrow Mg_{(aq)}^{2+} + H_{2(g)}$	52
4 (a)	<p>Fluorine atom in hydrogen fluoride has a smaller atomic radius and is more electronegative than the chlorine atom in hydrogen chloride. The hydrogen fluorine bond is therefore more polar than the hydrogen-chlorine bond. This makes the hydrogen fluoride molecules to associate through hydrogen bonding while the hydrogen chloride molecules form Van-der-waals forces of attraction. Thus a lot of energy is required to break the stronger hydrogen bond for boiling to occur than the energy required to break the weaker van-der-waal's forces of attraction. Hence hydrogen fluoride is a liquid at room temperature.</p>	32

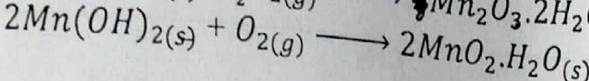
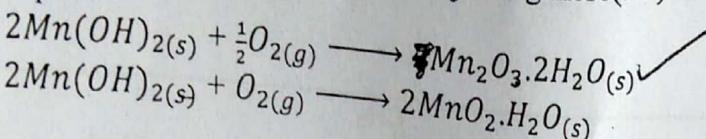
b

Manganese(II) ions in solution react with the hydroxide ions from sodium hydroxide to form insoluble white precipitate of Manganese(II) hydroxide



The manganese (II) hydroxide is basic and doesn't react with excess sodium hydroxide.

Atmospheric oxygen then oxidizes the manganese hydroxide on standing to form hydrated manganese(III) oxide or Manganese(IV) oxide



Hz

c

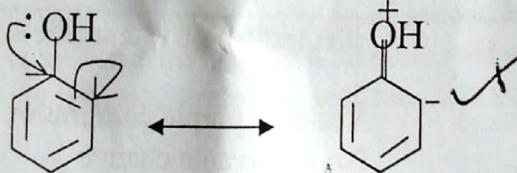
Chlorine atom is more electronegative than the carbon atom, it therefore attracts bonding electrons in the carbon-chlorine bond more towards itself. This makes the chlorine atom partially negative while the carbon atom becomes partially positive. This makes the carbon-chlorine bond in carbon tetrachloride polar but the molecule is non polar due to the symmetrical distribution of chlorine atoms around the carbon such that the four dipole moments cancel each other

Hz

d

In phenol the lone pairs of electrons on the oxygen atom interact with the delocalized pie bonding system of benzene forming a partial double bond, this strengthens the carbon - oxygen bond while weakening the oxygen - hydrogen bond. As a result the phenol molecule easily releases hydrogen ions in aqueous solutions.

**Illustration**



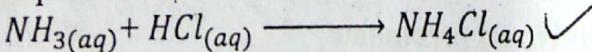
In Cyclohexanol there is no delocalized pie bonding system therefore the oxygen - hydrogen bond is not weakened

Hz

e

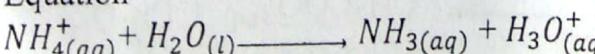
Ammonium hydroxide is a weak base that reacts with hydrochloric acid a strong acid to form ammonium chloride according to the equation below;

**Equation**



Ammonium chloride formed undergoes hydrolysis to form ammonia solution which poorly ionizes and hydrogen ions

**Equation**

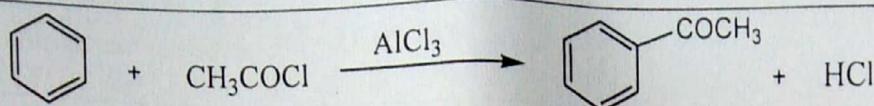


The hydrogen ions make the solution acidic with a pH less than seven

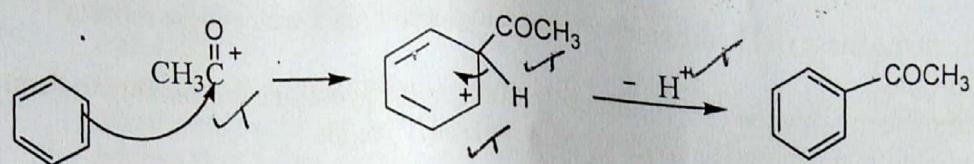
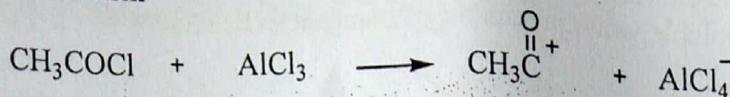
Hz

Hz

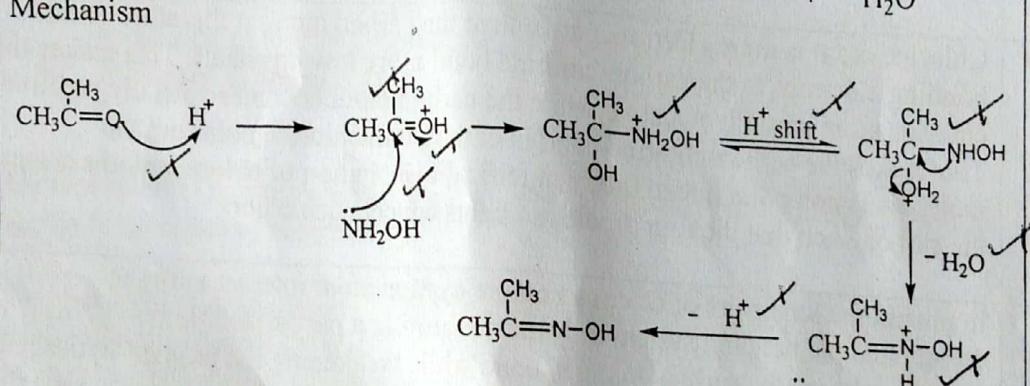
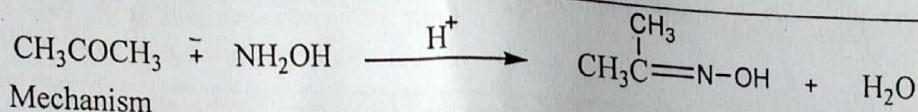
5 a (i)



Mechanism



(ii)



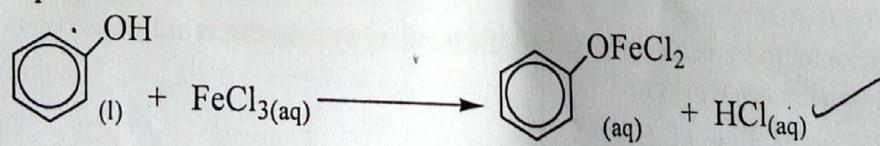
B (i)

Reagent : Neutral Iron(III) chloride solution

Observation :

phenol : Violet or purple colouration

Cyclohexanol : No observable change



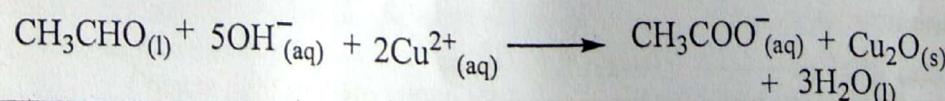
(ii)

Reagent : Fehling's solution and heat

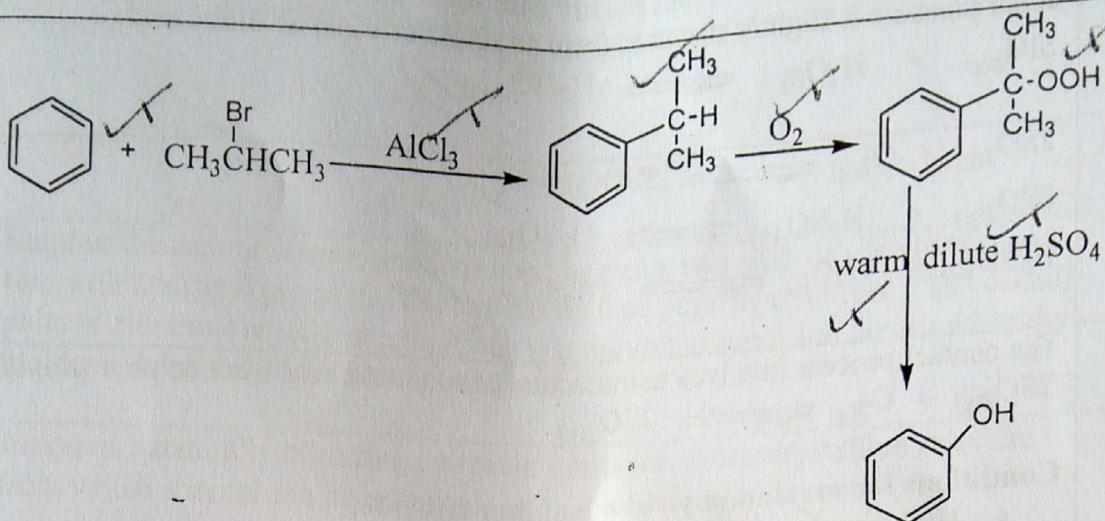
Observation :

Ethanal : Reddish-brown precipitate

Phenylmethanal : No observable change



c



- 6(a) Magnesium has a giant metallic structure in which each magnesium atom contributes two electrons to the electron cloud forming a strong metallic bond that requires a great amount of heat to melt the metal.  
 Silicon atoms are arranged through covalent bonding to form an infinite three dimensional giant covalent structure with many strong covalent bonds that require a lot of heat to be broken for melting to occur  
 Sulphur atoms are arranged to form  $S_8$  which is a simple molecular structure in which the molecules are held by weak van-der-waal's forces of attraction that require less amount of heat to be broken for melting to occur

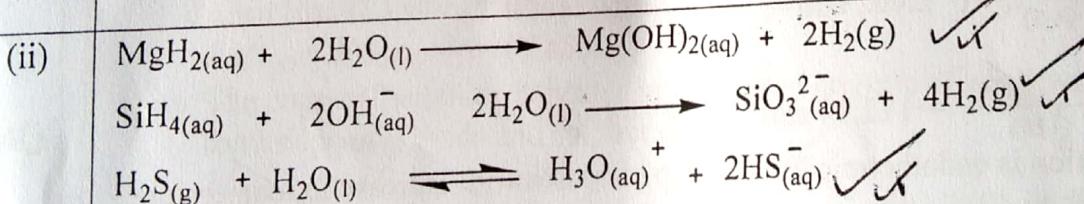
Q4

Q6

12

- (b) (i) The hydride of magnesium is magnesium hydride with ionic bonding  
 The hydride of silicon is silicon tetra hydride with covalent bonding  
 The hydride of Sulphur is Hydrogen sulphide with covalent bonding

H2

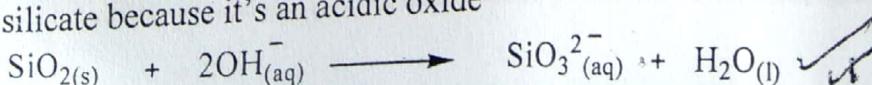


- c (i) Silicon (IV) oxide reacts with hydrofluoric acid to form silicon (IV) fluoride and water.
- $$\text{SiO}_2\text{(s)} + 4\text{HF(aq)} \longrightarrow \text{SiF}_4\text{(aq)} + 2\text{H}_2\text{O(l)}$$
- However in excess hydrofluoric acid, hexafluorosilicic acid is formed
- $$\text{SiO}_2\text{(s)} + 6\text{HF(aq)} \longrightarrow \text{H}_2\text{SiF}_6\text{(aq)} + 2\text{H}_2\text{O(l)}$$

Q4

Q2

- (ii) Silicon(IV)oxide reacts with hot concentrated sodium hydroxide to form sodium silicate because it's an acidic oxide



(iii)	<p>Silicon(IV) oxide doesn't react readily with water but when heated with water under pressure it slightly reacts to form an acidic solution of silicic acid</p> $\text{SiO}_{2(g)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_2\text{SiO}_{3(aq)}$	02
7(a) (i)	$2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$ $2\text{SO}_{3(g)} + \text{H}_2\text{SO}_{4(l)} \rightleftharpoons \text{H}_2\text{SO}_{7(l)}$ $\text{H}_2\text{SO}_{7(l)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons 2\text{H}_2\text{SO}_{4(l)}$	03
(ii)	<p>The contact process involves manufacture of sulphuric acid from sulphur trioxide.</p> $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$ <p><b>Conditions for maximum yield of sulphur trioxide;</b></p> <ul style="list-style-type: none"> <li>High pressure ; This favours the forward reaction that proceeds with decrease in volume therefore maintains the equilibrium position to the right such that more sulphur trioxide is produced as sulphur dioxide reacts with oxygen</li> <li>Low temperature ; since the reaction is exothermic, the forward reaction is favoured by low temperature</li> <li>vanadium (v) oxide catalyst; Since the reaction is favoured by low temperature a catalyst is used in this reaction, which does not affect the amount of sulphur trioxide formed and position of equilibrium but increases the rate at which sulphur trioxide is obtained</li> <li>Excess oxygen to increase the rate of reaction with sulphur dioxide due to increased frequency of collision between the reactant molecules</li> </ul>	05
b	$K_p = \frac{P_{\text{H}_2\text{O}} \cdot P_{\text{SO}_3}}{P_{\text{H}_2\text{SO}_4}}$ <p>units = atmospheres (atm) or pa or <math>\text{NM}^{-2}</math></p>	4E
c (i)	<p>At 400k</p> $K_p = \frac{(3.2) \cdot (2.9)}{(4.5)} = 2.062 \text{ atm}$ <p>At 493k</p> $K_p = \frac{(300) \cdot (270)}{(470)} = 172.34 \text{ atm}$ <p>The reaction is endothermic because <math>K_p</math> increases with increase in temperature from 400k to 493K</p>	04
(ii)	<p>Increasing pressure favours the backward reaction that proceeds with decrease in volume; therefore steam reacts with sulphur trioxide to form more of sulphuric acid vapour. This increases the concentration of sulphuric acid at equilibrium while decreasing the concentration of steam and sulphur trioxide shifting the equilibrium position from right to left while keeping the value of <math>K_p</math> constant at 400k.</p>	22

d (i)	Structure 	Shape Tetrahedral ✓	02
(ii)	Sulphur the central atom forms four bonding pairs, two with oxygen ( $S=O$ ) and two with hydroxyl group ( $S-OH$ ) and has no lone pairs of electrons. The bonding pairs of electrons repel each other such that minimum repulsion occurs when the molecule adopts a tetrahedral shape.		02
8(a) (i)	An ore is a naturally occurring inorganic substance with a crystalline structure from which a metal can be extracted ✓		01
(ii)	<ul style="list-style-type: none"> <li>• Copper pyrites , <math>CuFeS_2</math> ✓</li> <li>• Malachite , <math>Cu(OH)_2 \cdot CuCO_3</math></li> </ul>		01
b	<p>The copper pyrites is crushed into powder and added to water containing a frothing agent in a floatation tank.. The oil wets the ore particles while the water wets the earthly impurities.</p> <p>Compressed air is blown through the mixture for agitation producing froth. The low density oiled particles rise and float to the surface with in the froth while the earthly impurities sink to the bottom of the tank.</p> <p>The froth containing the ore is skimmed off and dilute sulphuric acid added to break it down, filtered and the ore washed and dried</p> <p>The dried ore is then roasted in controlled amount of air to convert to copper(I) sulphide and sulphur dioxide</p> $2CuFeS_2(s) + 4O_{2(g)} \longrightarrow Cu_2S(s) + 2FeO(s) + 3SO_{2(g)}$ <p>The products are heated with silicon (IV) oxide in the absence of air to form Iron (II) silicate liquid which is tapped off.</p> $FeO(s) + SiO_{2(s)} \longrightarrow FeSiO_3(l)$ <p>The copper(I)sulphide is heated in controlled amount of heat and air to form copper(I) oxide and sulphur dioxide</p> $2Cu_2S(s) + 3O_{2(g)} \longrightarrow 2Cu_2O(s) + 2SO_{2(g)}$ <p>The copper(I)oxide is then heated with the unreacted copper(I)sulphide in absence of air to form impure copper and sulphur dioxide gas</p> $Cu_2S(s) + 2Cu_2O(s) \longrightarrow 6Cu(s) + SO_{2(g)}$ <p>The impure copper is made the anode and pure copper made the cathode in an electrolysis cell in which acidified copper (II) sulphate is the electrolyte. Current is passed through the solution and the copper anode dissolves to form copper (II) ions and pure copper is deposited at the cathode</p> <p>Anode : <math>Cu(s) \longrightarrow Cu^{2+}_{(aq)} + 2e^-</math> ✓</p> <p>Cathode : <math>Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu(s)</math> ✓</p>	112	

C(i)	Copper reacts with hot concentrated hydrochloric acid to form copper(I)chloride and hydrogen gas $2Cu_{(s)} + 2HCl_{(aq)} \longrightarrow Cu_2Cl_2 + H_2(g)$	1½
(ii)	Copper reacts with dilute nitric acid to form copper(II) nitrate , nitrogen monoxide and water $3Cu_{(s)} + 8HNO_3(aq) \longrightarrow 3Cu(NO_3)_2(aq) + 2NO_{(g)} + 4H_2O_{(l)}$ copper reacts with concentrated nitric acid to form copper(II) nitrate, nitrogen dioxide and water $Cu_{(s)} + 4HNO_3(aq) \longrightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O_{(l)}$	3½
d(i)	Brown precipitate	01
(ii)	$2Cu^{2+}_{(aq)} + Fe(CN)_6^{4-} \longrightarrow Cu_2Fe(CN)_6(s)$	1½

Copper reacts with concentrated nitric acid to form copper(II) nitrate, nitrogen dioxide and water

END

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