MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2017

SUBJECT:	CHEMISTRY
PAPER NUMBER:	I
DATE:	26th May 2017
TIME:	4.00 p.m. to 7.05 p.m.

Required Data: Molar Mass / g mol^{-1} : H = 1 C = 12 N = 14 O = 16 As = 75
                             Avogadro's Number = 6.02×10^{23} mol^{-1}
                             R = 8.314 J K^{-1} mol^{-1}

Answer **ALL** questions

1. (a) (i)   Arsenic ($_{33}$As) is the element beneath phosphorus in group V of the periodic table. Complete the electronic configuration of Arsenic.

   [Ar] _____

   (1)

   (ii) To which block does arsenic belong? Give an explanation for your answer.

   _____

   _____

   _____

   (2)

(b) (i)   Define the relative atomic mass of an atom.

   _____

   _____

   (1)

   (ii)   Deduce the mass number and atomic number of an atom that has four fewer protons and four fewer neutrons than the isotope $_{33}^{68}$As.

   _____

   _____

   (2)

Question continues on next page

_____

(iii) To which block does the element deduced in part (ii) belong to? Give **THREE** features which are common to most elements in this block.

_____

_____

_____

_____

(4)

(iv) Arsenic has a number of oxides. Deduce the empirical formula of the oxide which contains 65.2 % arsenic by mass.

_____

_____

_____

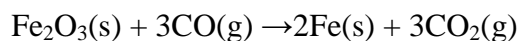_____

(2)
(**Total: 12 marks**)

2. Consider the following data:

Substance	Fe_2O_3 (s)	Fe (s)	CO (g)	CO_2 (g)
$\Delta H_f^{\ominus}$ / kJ mol^{-1}	−824.2	0	−110.5	−393.5

(a) The following equation shows one of the reactions that can occur in the extraction of iron.
$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$$

Calculate the standard enthalpy change for this reaction (show your working):

_____

_____

_____

(3)

_____

(b) The standard entropy change of the reaction is $+17$ J K^{-1} mol^{-1}. Explain what is meant by the term entropy change of a reaction and explain what the value implies?

_____

_____
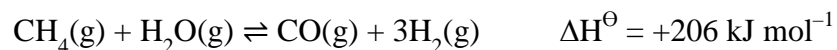
_____

_____

_____

(3)

(c) Explain why this reaction is feasible at all temperatures.

_____

_____

(3)
(Total: 9 marks)

3. Hydrogen is produced industrially by the reaction between steam and methane when the following dynamic equilibrium is established.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H^\Theta = +206 \text{ kJ mol}^{-1}$$

(a) State Le Chatelier's Principle.

_____

_____

_____

_____

_____

(2)

Question continues on next page

_____

(b) Use Le Chatelier's principle to predict the separate effects of (i) an increase in temperature and of (ii) an increase in pressure on the yield of hydrogen obtained in the above reaction. In each case, explain your answer.

    (i)   increase in temperature at constant pressure:

_____

_____

_____

_____

(2)

    (ii)   increase in pressure at constant temperature:

_____

_____

_____

_____

(2)

(c) State what can be used to increase the amount of hydrogen produced in a given time, without changing the equilibrium yield of hydrogen.

_____

(1)

(d) Predict the changes in the yield and K_p expected when an inert gas is added at constant temperature and constant volume.

_____

_____

_____

_____

_____

(4)

(Total: 11 marks)

_____

4. This question is about redox potentials. Where appropriate, use the standard electrode potential data in the table below to answer the questions which follow.

				$E^{\ominus}/V$
$Zn^{2+}(aq) + 2e^-$	$\rightarrow$	$Zn(s)$		-0.76
$V^{3+}(aq) + e^-$	$\rightarrow$	$V^{2+}(aq)$		-0.26
$SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$	$\rightarrow$	$SO_3^{2-}(aq) + H_2O(l)$		$+0.17$
$VO^{2+}(aq) + 2H^+(aq) + e^-$	$\rightarrow$	$V^{3+}(aq) + H_2O(l)$		$+0.34$
$Fe^{3+}(aq) + e^-$	$\rightarrow$	$Fe^{2+}(aq)$		$+0.77$
$VO_2^+(aq) + 2H^+(aq) + e^-$	$\rightarrow$	$VO^{2+}(aq) + H_2O(l)$		$+1.00$
$Cl_2(g) + 2e^-$	$\rightarrow$	$2Cl^-(aq)$		$+1.36$

(a) From the table above, select the species which is the most powerful reducing agent.
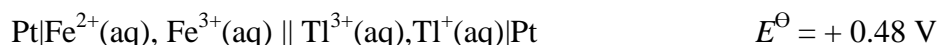
_____

(1)

(b) From the table above select:

(i) a species which, in acidic solution, will reduce VO_2^+ (aq) to VO^{2+}(aq) but will **not** reduce VO^{2+}(aq) to V^{3+}(aq);

_____

(1)

(ii) a species which, in acidic solution, will oxidise VO^{2+}(aq) to VO_2^+ (aq).

_____

(1)

(c) The cell represented below was set up under standard conditions.

$$Pt|Fe^{2+}(aq), Fe^{3+}(aq) \; || \; Tl^{3+}(aq),Tl^+(aq)|Pt \qquad E^{\ominus} = +0.48 \text{ V}$$

(i) Deduce the standard electrode potential for the following half-reaction.

$$Tl^{3+}(aq) + 2e^- \rightarrow Tl^+(aq)$$

_____
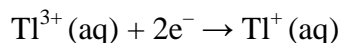
(1)

(ii) Write an equation for the spontaneous cell reaction.

_____

(2)

_____

(d) After acidification, 25.0 cm^3 of a solution of hydrogen peroxide reacted exactly with 16.2 cm^3 of a 0.0200 mol dm^{-3} solution of potassium manganate(VII). The overall equation for the reaction is given below.

$$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$$
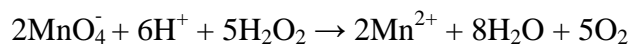
(i) Use the equation for this reaction to determine the concentration, in g dm^{-3}, of the hydrogen peroxide solution.

(4)

(ii) Calculate the maximum volume of oxygen, measured at a pressure of 98.0 kPa and a temperature of 298 K, which would be evolved in this reaction.

(3)

(Total: 13 marks)

_____

5. This question concerns the elements sodium, magnesium, aluminium.

   (a) (i)   Place the elements in order of increasing strength as reducing agents.

_____
                                                                                                          (1)

        (ii)   Explain the factors which determine the strength of these elements as reducing agent.

_____

_____

_____

_____

_____
                                                                                                     (2)

   (b) For the Na^+, Mg^{2+} and Al^{3+} ions:

        (i)   write the electronic configuration in terms of orbitals;

_____
                                                                                                   (1)

        (ii)   list the ions in order of increasing size;

_____
                                                                                                   (1)

        (iii)   explain why there is a difference in the size of the ions.

_____

_____

_____

_____
                                                                                                   (2)

Question continues on next page

_____

(c)   A solution of sodium sulfate is neutral, whereas a solution of aluminium sulfate is acidic. Give a reason for this.

(3)

(d)   Sodium chloride crystals may be obtained by evaporating an aqueous solution of the salt to dryness. Magnesium chloride crystals cannot be prepared in this way. Explain this observation, giving balanced equations where required.

(2)

(Total: 12 marks)

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_____

6. Period 3 elements of the Periodic Table show variations in their physical properties across the period.

(a) The graph below shows the variation of melting and boiling points of the elements across Period 3.
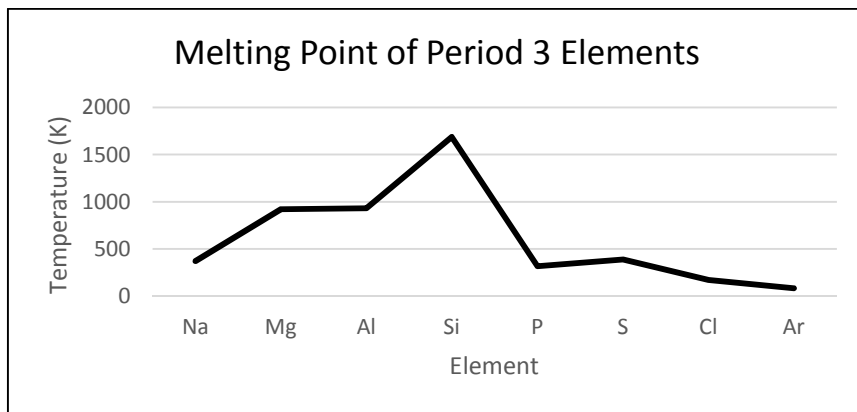
In each of the following parts of this question, identify clearly the interactions involved.

(i) Explain the general increase in melting point from Na to Al.

(3)

(ii) Account for the variation in the melting points from P to Ar.

(3)

(iii) Si has a much higher melting point than any of the other elements in the period. Why is this?

(1)

Question continues on next page

_____

(b)   Period 3 elements also show different behaviour in their chemical properties.

   (i)   Describe what you would observe when separate samples of magnesium and sulfur are reacted with oxygen. Write an equation for each reaction.

   •   magnesium

_____

_____

(1)

   •   sulfur

_____

_____

(1)

   (ii) Write equations for the reactions of aluminium oxide, Al_2O_3, with

   •   sodium hydroxide;

_____

(1)

   •   hydrochloric acid.

_____

(1)

(Total: 11 marks)

7. This question concerns the following sequence of reactions:

	CH_3		COOH		COCl

(a)   Give the systematic name of **A**.

_____

(2)
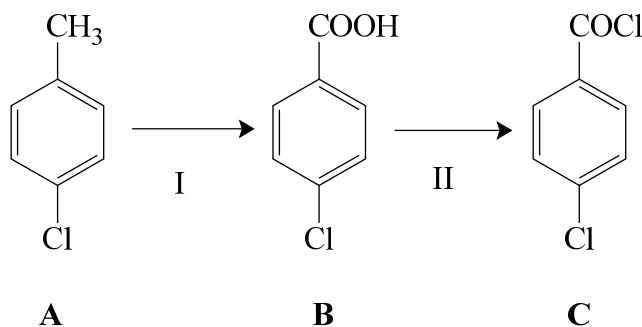
(b)   **B** is only slightly soluble in water. However, its solubility increases on increasing pH. Explain these observations.

(3)

(c)   Give reagents and conditions that can be used for reaction:

I

(2)

II

(2)

(d)   Reaction of 1 mole of **C** with excess aqueous silver nitrate(V) produces 1 mole of silver chloride. Explain this observation.

(2)
(**Total: 11 marks**)

_____

8. Tartaric acid, (**D**), is a naturally occurring compound found in gapes. The molecule has two *chiral carbons*.

$$HOOC–CH(OH)–CH(OH)–COOH$$
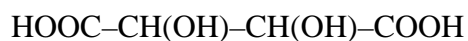
(a) Give the systematic name of **D**.

(2)

(b) Explain what is meant by a *chiral carbon* and indicate, by an (*) the *chiral carbons* in tartaric acid.

(2)

(c) Name the type of isomerism which may be exhibited by tartaric acid.

(1)

(d) Explain the following two terms:
 (i) enantiomer;

(1)

 (ii) (-)–tartaric acid.

(1)

_____

(e)   Distinguish between internal and external compensation, using tartaric acid to exemplify the differences between the two terms.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total: 12 marks)

9. Treatment of benzene with a mixture of concentrated nitric(V) and sulfuric(VI) acids at 60^0C, produces substance **E**, which is a yellow liquid with a characteristic smell.

(a)   Write an equation for the formation of a nitrogen-containing electrophile from the interaction of nitric(V) and sulfuric(VI) acids and identify the electrophile.

_____

_____

_____

(2)

Question continues on next page

(b)   The electrophile in part (a) reacts with benzene and forms an intermediate, **F** which has a positive delocalized charge. Draw the structure of **F** and indicate with an (*) the carbon atom which is **NOT** involved in delocalization.

F is

(2)

(c)   **F** reacts to form **E**. Write an equation for this reaction.

(2)

(d)   When methylbenzene is used instead of benzene in the reaction in part (a), two major products and one minor product are formed. Draw the structures of the two major products and the minor product.

(3)
(Total: 9 marks)

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SUBJECT:	CHEMISTRY
PAPER NUMBER:	II
DATE:	30th May 2017
TIME:	4.00 p.m. to 7.05 p.m.

Required Data: Relative atomic masses: H = 1; C = 12; N = 14; O = 16; S = 32; Fe = 56.
Self-ionization product for water, K_w = 1 x 10^{-14} mol^2 dm^{-6}.
A Periodic Table is provided.

Answer TWO questions from each section and ANY other question.

SECTION A

1. (a) Use hydrochloric acid and ethanoic acid to explain in detail what is meant by the use of the terms a strong acid and a weak acid. (4)

   (b) A 0.21 mol dm^{-3} solution of sodium hydroxide was added from a burette to 25.0 cm^3 of a 0.16 mol dm^{-3} solution of ethanoic acid in a conical flask. Given that the value of the acid dissociation constant, K_a, for ethanoic acid is 1.74 x 10^{-5} mol dm^{-3}, calculate the pH at 25 °C of the solution in the conical flask at the following three points:
   (i) before any sodium hydroxide had been added;
   (ii) after 8.0 cm^3 of sodium hydroxide solution had been added;
   (iii) after 40.0 cm^3 of sodium hydroxide solution had been added. (12)

   (c) Explain how an acid-base indicator works and why such an indicator is not useful for a titration between a weak acid and a weak base. (4)
   (Total: 20 marks)

2. (a) State and explain the effect of a catalyst: (i) on the rate, and (ii) on the equilibrium yield in a reversible reaction. (5)

   (b) "The strength of adsorption onto the active sites on the surface of a heterogeneous catalyst helps to determine the activity of the catalyst."
   (i) Define heterogenous catalyst.
   (ii) Explain how heterogeneous catalysts work, and discuss why different catalysts have different activities.
   (iii) Suggest **ONE** reason why a ceramic support is used for the catalyst in catalytic converters in cars.
   (iv) Explain briefly how lead poisons this catalyst in cars. (10)

   (c) In aqueous solution, Fe^{2+} ions act as a homogeneous catalyst in the reaction between I$^-$ and S$_2$O$_8^{2-}$ ions where S$_2$O$_8^{2-}$ are reduced to SO$_4^{2-}$ ions. Give **ONE** reason why the reaction is slow in the absence of a catalyst. Write equations to suggest how Fe^{2+} ions can act as a catalyst for this reaction. (5)
   (Total: 20 marks)

3.   (a)   The ion $C_2O_4^{2-}$ can act as a *bidentate ligand* by reacting with transition metal ions to form *coordinate bonds*. Explain the terms in italics.   (3)

(b)   Sketch the structure of the complex ion formed by Fe^{3+} ions which contains $C_2O_4^{2-}$ as the only ligand.   (3)

(c)   Explain the meaning of the chelate effect by giving relevant examples.   (4)

(d)   Describe how MnO_2 can be converted into manganate(VI) and how this species can disproportionate. What is the species that results from this disproportionation and deduce an equation for the redox reaction between the oxidized product of the disproportionation reaction and oxalic acid.   (10)

(Total: 20 marks)

4.   (a)   A sample of a hydrated double salt, $Fe(NH_4)_x(SO_4)_2.6H_2O$, which contains 0.363 g of iron. The sample was boiled with an excess of sodium hydroxide and the ammonia given off was absorbed in 20 cm^3 of 0.800 mol dm^{-3} hydrochloric acid. The resulting solution required 50 cm^3 of 0.060 mol dm^{-3} sodium hydroxide to neutralise the excess acid. Determine the value of x in the molecular formula and hence the molecular mass of the hydrated double salt.   (8)

(b)   State the observations for the colour changes expected when an excess of aqueous reagent is added to separate aqueous solutions of the following pairs of ions. Write an equation for the reaction of each ion with the sodium carbonate.
   (i)   Excess sodium carbonate to $[Fe(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{3+}$.   (4)
   (ii)   Excess of dilute aqueous sodium hydroxide is added to separate aqueous solutions containing $[Fe(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{3+}$.   (4)

(c)   Account for the fact that iron(III) iodide is unstable whilst iron(III) chloride is stable.   (4)

(Total: 20 marks)

SECTION B

5.   Explain fully the following statements. Some of the statements carry additional instructions to direct you better in your answer. Where necessary prove your point with appropriate equations.

   (a)   Upon addition of either a small amount of dilute hydrochloric acid or a small amount of sodium hydroxide to a mixture of sodium ethanoate and ethanoic acid, one notices that the pH does not vary that much.   (4)

   (b)   Manganese(IV) oxide doesn't react with dilute (1 mol dm^{-3}) hydrochloric acid, but oxidises concentrated (10 mol dm^{-3}) hydrochloric acid to chlorine. Explain these observations using the following standard redox potential values: reduction of manganese(IV) oxide to Mn^{2+} ions = +1.23 V and reduction of chlorine gas to Cl^- ions = +1.36 V.   (5)

   (c)   The bond dissociation enthalpy of the H—H bond is +436.0 kJ mol^{-1} whereas the mean bond dissociation enthalpy of the C—H bond in methane is +415.5 kJ mol^{-1}. Account fully for all differences in the two statements.   (5)

   (d)   During a seminar about human impact on the environment a participant stated the following: "Human activities are responsible for ozonolysis in the stratosphere". Using your knowledge of chemical processes, explain in depth why this statement is incorrect.   (6)

                                                                                                      (Total: 20 marks)

6.   Describe how the following conversions may be carried out. In your answer give the reagents, essential reaction conditions and equations to represent the reactions taking place.

   (a)   **CH_3CH_2Br** to **$CH_3CH_2CH_2OH$**   (4)

   (b)   **C_2H_5COOH** to **$C_2H_5NH_2$**   (6)

   (c)   **CH_3CH_2Br** to **$CH_3CH_2CH_2NH_2$**

                                                                                                      (4)

   (d)

                                                                                                      (6)

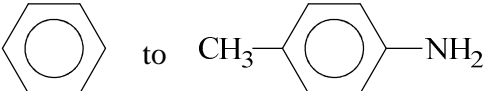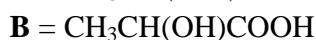   **(Total: 20 marks)**

Questions continue on next page

7. This question is about the following molecules:

 A = CH₃CH(NH₂)COOH
 B = CH₃CH(OH)COOH

 (a) Describe the synthesis of molecules **A** and **B**, starting from ethanol, including reagents and intermediate structural formulas. (7)

 (b) Describe test tube reactions that would indicate the presence of the two functional groups in compound **B**. (3)

 (c) The melting point of molecule **A** is 297 °C, while that of molecule **B** is 18 °C. Explain the difference in the melting points of these two molecules. (4)

 (d) Both **A** and **B** can polymerise. Name the type of polymers formed by both **A** and **B**, indicate how each polymer forms and draw the structure of the repeat unit. (6)

 (Total: 20 marks)

8. (a) Draw and label the apparatus that would be used to prepare ethanal, CH₃CHO from ethanol, CH₃CH₂OH in the laboratory, describing how the product can be purified using a technique that involves a reaction with sodium hydrogensulfate(IV). (9)

 (b) Precautions need to be taken during the laboratory preparation of ethanal from ethanol, to prevent the loss of the main product as a result of side reactions. Name the most important products of these side reactions. State **TWO** precautions that may be taken to prevent the loss of the main product, ethanal. (4)

 (c) The saturated vapour pressure of ethanol at 25 °C is 7.9 kPa.
  (i) Use Raoult's law to calculate the vapour pressure of the alcohol over a solution in water with a mole fraction of 0.1 of the alcohol.
  (ii) The value obtained from Raoult's law is significantly lower than that obtained experimentally. Explain this observation.
  (iii) Sketch and label an appropriate T-X diagram for the water-ethanol system. (7)

 (Total: 20 marks)

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2017

SUBJECT:	CHEMISTRY
PAPER NUMBER:	III – *Practical*
DATE:	15th June 2017
TIME:	3 hours 5 minutes

There are three questions in this paper. Answer ALL questions.

1. In this experiment, you are required to:

    i)   standardise solution S with an iodometric technique;
    ii) determine the concentration of solution C with a back titration method.

    You are provided with the following solutions:

    i)   a solution of sodium thiosulfate, labelled **S**;
    ii) potassium iodate of concentration 0.0130 mol dm^{-3}, labelled **K**;
    iii) a solution of ascorbic acid (vitamin C), labelled **C$_n$**;
    iv) 10% potassium iodide;
    v)   2 M sulfuric acid;
    vi) starch indicator.

    (a) **Enter the value of your laboratory number, n, in the following box.**

    # CANDIDATE LABORATORY NUMBER, n: _____

    (b) **Standardisation of solution S**

    Using a suitably rinsed pipette, transfer 25.0 cm^3 of solution **K** into each of three conical flasks. Add approximately 10 cm^3 of 10% potassium iodide, followed by approximately 10 cm^3 of 2 M sulfuric acid.

    Titrate the iodine discharged with solution **S**, adding 2 cm^3 of starch indicator towards the end-point. Record the results of **TWO** concordant titrations in the table below.

	1st Titration	2nd Titration	3rd Titration
Final reading			
Initial reading			
Titre			

    Mean titre: _____cm^3

                                                                                (18)

_____

(c)   Determine the molarity of solution **S**. The following equations will be useful.

$$6H^+ + IO_3^- + 5I^- \rightarrow 3I_2 + 3H_2O$$
$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$$

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d)   **Determination of the concentration of Vitamin C**

Iodine can be considered to react with vitamin C according to the following equation:

$$C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2I^- + 2H^+$$

Into each of the three conical flasks, pipette 25 cm^3 of solution **K** (excess). Using a suitably rinsed pipette, transfer 25 cm^3 of solution **C$_n$** into each conical flask. Add 10 cm^3 of 10% potassium iodide, followed by 10 cm^3 of 2 M sulfuric acid. Titrate the iodine discharged with solution **S**, adding 2 cm^3 of starch indicator towards the end-point.
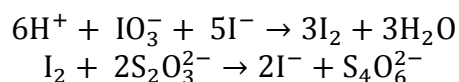
Repeat for concordant results, and enter your data in the table below.

	1st Titration	2nd Titration	3rd Titration
Final reading			
Initial reading			
Titre			

Mean: _____ cm^3

(18)

(e)   Hence calculate:

    (i)   the number of moles of unreacted iodine;

_____

_____

_____

_____

_____

_____

(3)

    (ii)   the number of moles of iodine which reacted with vitamin C;

_____

_____

_____

_____

(3)

    (iii)   the concentration of solution **C**.

_____

_____

_____

_____

(4)
(Total: 50 marks)

Please turn the page

2.　You are provided with a mixture of two inorganic salts labelled **M**, consisting of a water soluble substance and an insoluble component. Carry out the following tests and suggest a plausible identity of the two substances.

(a)　To your sample of **M**, add 10 cm^3 of distilled water and shake. Filter the mixture and wash the residue with **two** portions of 5 cm^3 distilled water. Retain both the filtrate and the residue for subsequent tests.

　　　　　　　Observation　　　　　　　　　　　　　　*Inference*

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

To 1 cm^3 portions of the filtrate, add:

(b)　aqueous sodium hydroxide, dropwise at first, and then in excess;

　　　　　　　Observation　　　　　　　　　　　　　　*Inference*

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

(c)　aqueous ammonia, dropwise at first, and then in excess. **Retain the mixture for the next test.**

　　　　　　　Observation　　　　　　　　　　　　　　*Inference*

　　　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿　　　　　＿＿＿＿＿＿＿＿＿＿＿＿＿

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(d)   To the mixture obtained in test in part (c), add 10 drops of dimethylglyoxime. Note: Wash the test tube immediately after use.

Observation   *Inference*

_____   _____

_____   _____

_____   _____

_____   _____

(e)   Acidify 1 cm^3 of the filtrate with 1 cm^3 of dilute nitric acid, followed by three drops of barium chloride solution.

Observation   *Inference*

_____   _____

_____   _____

_____   _____

_____   _____

(f)   To approximately half of your residue from part (a), add 5 cm^3 of dilute nitric acid. Using the reagents provided, test for any gases evolved. **Retain the reaction mixture for tests (g) to (i).**

Observation   *Inference*

_____   _____

_____   _____

_____   _____

_____   _____

In the following three tests, to 1 cm^3 portions of the solution obtained in test (f), add:

(g)   10 drops of dilute aqueous sodium hydroxide, followed by an excess;

Observation   *Inference*

_____   _____

_____   _____

_____   _____

_____   _____

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(h)   15 drops aqueous ammonia, dropwise at first and then in excess;

Observation   _Inference_

(i)   1 cm^3 drops of potassium hexacyanoferrate(II).

Observation   _Inference_

Conclusion: M is probably a mixture of _____

(Total: 30 marks)

3.   You are provided with an organic substance labelled **F**. Carry out the tests as described below and suggest a plausible structure for the compound.

(a)   Burn one drop of **F** on a crucible lid.

Observation   _Inference_

(b)   To 1 cm^3 of 2,4-DNPH solution add three drops of substance **F**.

Observation   _Inference_

(c)   To 1 cm^3 of silver nitrate, add two drops of aqueous sodium hydroxide. Add aqueous ammonia until the precipitate just dissolves. Add two drops of **F** and place in a warm water bath for a minute.

Observation   _Inference_

(d)   Mix 1 cm^3 of Fehling A solution with 1 cm^3 of Fehling B. Add three drops of **F** and place in a warm water bath for a minute.

Observation   _Inference_

(e)   To about 1 cm^3 of iodine solution, slowly add aqueous five drops sodium hydroxide dropwise until a pale yellow solution is obtained. Add two drops of **F**.

Observation   _Inference_

Conclusion: A possible structure for F is: _____

(Total: 20 marks)

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