Index No.:_____ AM06/I.23m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2023 FIRST SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	I
DATE:	17th May 2023
TIME:	4:00 p.m. to 7:05 p.m.

Required Data: Relative atomic masses (RAM): H = 1, C = 12, O =16

Answer ALL questions

1. a) Define electronegativity.

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_____

_____ (1)

b) With the aid of diagrams, describe how the bond angle of the H_3O^+ ion is different from the bond angle in H_2O.

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_____

_____ (2)

c) Explain why carbon dioxide is a non-polar molecule.

_____

_____

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_____

_____ (2)

Please turn the page.

d) The table below shows the structural formula and relative molecular masses (RMM) of four compounds.

i) Complete the table by stating the dominant intermolecular force for each compound. (2)

Structural formula	$CH_2(OH)CH_2(OH)$	$CH_3CH_2CH_2CH_3$	$CH_3CH_2CH_2NH_2$	$CH_3CH_2CH_2F$
RMM	62	58	59	62
Intermolecular force				

ii) Indicate the compound that has the highest boiling point and explain your answer.

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_____

_____

_____

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_____

_____ (3)

(Total: 10 marks)

2. This question is on s-block chemistry.

a) Give an equation to describe why group 1 metals initially appear shiny when cut but tarnish quickly to a dull grey colour.

_____

_____ (1)

b) Explain why the polarising power of group 2 elements is higher than group 1 elements.

_____

_____

_____

_____

_____ (2)

c) Describe **TWO** chemical properties that show how beryllium compounds differ from the compounds of other group 2 elements.

_____

_____

_____

_____ (2)

d) Describe why scaling occurs on heating hard water. In your answer, refer to the solubility and thermal stability of hydrogencarbonates and carbonates of group 2 elements.

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_____ (2)

e) The solubility of sulfates(VI) decreases on going down group 2. Explain this statement.

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_____ (3)

(Total: 10 marks)

Please turn the page.

3. This question is about periodicity.

a) Consider the elements of period 3.

i) Explain why there is a general increase in the first ionisation energy across period 3.

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_____

_____ (2)

ii) Explain why the first ionisation energy of phosphorus is higher than that of sulfur.

_____

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_____ (3)

b) Consider the oxides formed by the elements of period 3.

i) Give the formula of an ionic and a covalent oxide.

_____ (1)

ii) Give equations to show how certain oxides give rise to acidic or basic solutions on reaction with water.

_____

_____ (2)

c) Both potassium chloride and aluminium chloride are white solids at room temperature. Explain how these solids can be distinguished using a simple chemical test.

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_____ (2)

(Total: 10 marks)

4. Consider the following half equations and the corresponding standard electrode potential values.

Half-equation	**$E^{\ominus}$ (V)**
$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$	–2.36
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	–0.76
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	–0.44
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00

a) A zinc rod is immersed in a hydrochloric acid solution.

i) Deduce the ionic equation for the reaction and its standard $E^{\ominus}$ value. Show your reasoning.

_____

_____

_____

_____ (2)

ii) Indicate the oxidising agent and the reducing agent in this zinc-acid reaction.

_____

_____ (1)

b) Give the cell diagram for an electrochemical cell made up of the zinc half-cell and the standard hydrogen electrode. In your answer, indicate the anode and the cathode.

_____

_____

_____ (2)

Please turn the page.

c) Consider a cell made up of two Fe^{2+}/Fe half cells. Use the Nernst equation, shown below, to calculate the ($Fe^{2+}_{anode}/Fe^{2+}_{cathode}$) ratio when E_{cell} is equal to 0.12 V.

$$E_{cell} = E^{\theta}_{cell} - \frac{0.06}{n} log\left(\frac{[Fe^{2+}_{anode}]}{[Fe^{2+}_{cathode}]}\right)$$

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_____ (3)

d) Explain why an iron container exposed to the elements can be protected from corrosion if a magnesium rod is attached to it.

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_____ (3)

(Total: 11 marks)

5. This question is about energetics.

a) Consider the following data:

Enthalpy change	Value (kJ mol^{-1})
Lattice enthalpy of strontium chloride	–2150
First ionisation enthalpy for strontium	+549
Second ionisation enthalpy for strontium	+1064
The first electron affinity of chlorine	–349
The enthalpy of atomisation of chlorine	+122
The enthalpy of sublimation of strontium	+164

i) Construct a Born-Haber cycle for strontium chloride in the space provided.

(4)

ii) Calculate the enthalpy of formation of strontium chloride.

_____

_____

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_____

_____ (3)

Please turn the page.

b) Construct a Hess' cycle to calculate the enthalpy of combustion of benzene using the following data:

Enthalpy change	Value (kJ)
$6C\ (s) + 3H_2\ (g) \rightarrow C_6H_6\ (l)$	+45.9
$H_2(g) + ½O_2(g) \rightarrow H_2O\ (l)$	−285.9
$C(s) + O_2(g) \rightarrow CO_2(g)$	−393.5

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_____ (4)

(Total: 11 marks)

6. This question is about kinetics.

a) Consider the following chemical reaction and the corresponding kinetic data in the table below.

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

Experiment	Initial concentration of NO (mol dm^{-3})	Initial concentration of H_2 (mol dm^{-3})	Initial rate (mol dm^{-3} min^{-1})
1	5.0×10^{-3}	2.0×10^{-3}	1.25×10^{-5}
2	1.0×10^{-2}	2.0×10^{-3}	5.00×10^{-5}
3	1.0×10^{-2}	4.0×10^{-3}	1.00×10^{-4}

i) Find the order of reaction with respect to NO.

_____

_____

_____ (1)

ii) Find the order with respect to H_2.

_____

_____

_____ (1)

iii) Derive the rate equation for the reaction.

_____ (1)

iv) Calculate the rate constant for this reaction, including the units.

_____

_____

_____

_____ (2)

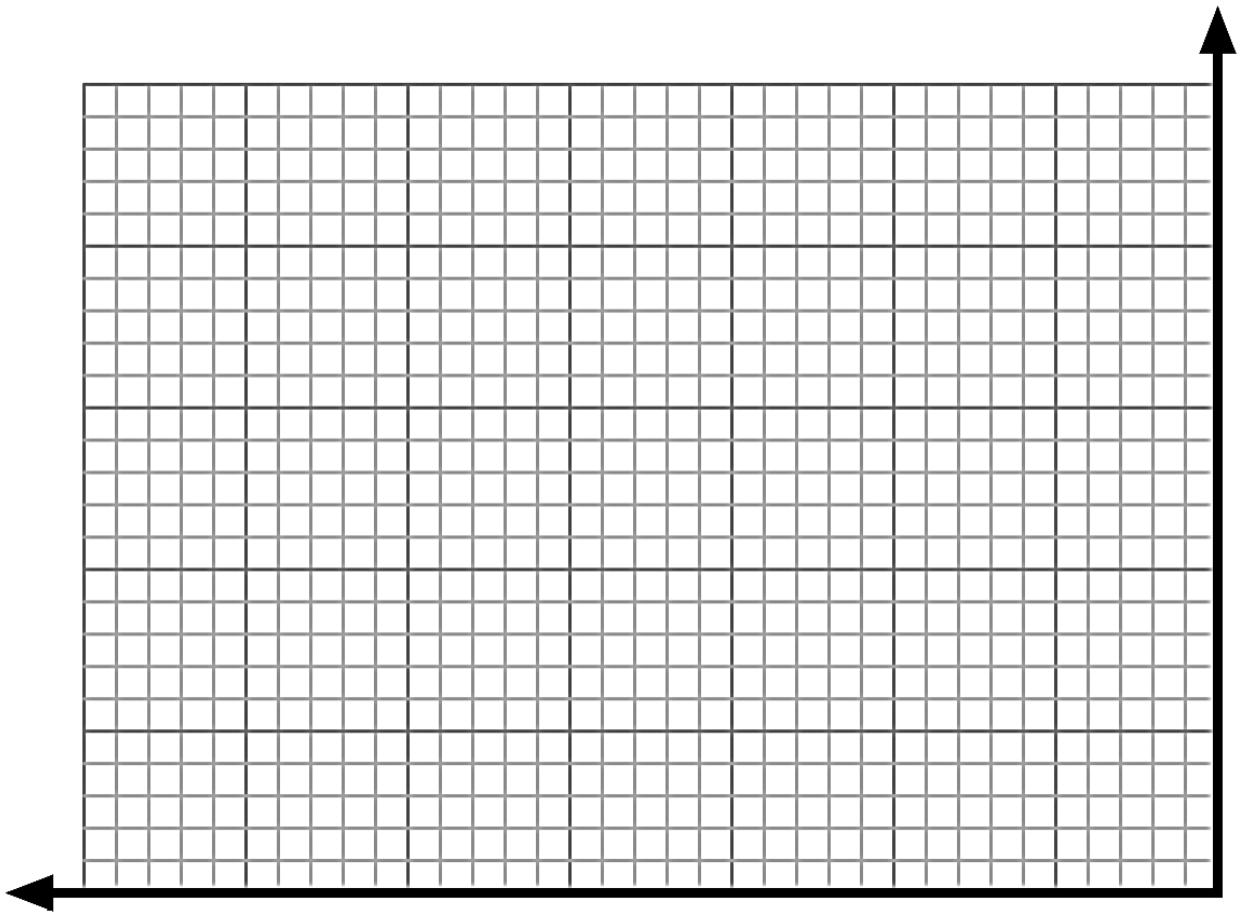
b) The following data was recorded in an experiment to determine how the rate of reaction changes with the concentration of nitrogen dioxide during its decomposition. The rate expression for the decomposition is:

$$\text{rate} = k[NO_2]^n$$

Rate of reaction (mol dm^{-3} s^{-1})	1.00	1.78	4.50	9.90
Concentration of NO_2 (mol dm^{-3})	0.031	0.045	0.063	0.100

Transform the data to a suitable format and plot a graph in the space provided to determine the order of reaction, n.

Please turn the page.



(7)

(Total: 12 marks)

7) a) Fill in the following table giving the structural formula or systematic name, as required. Where necessary, classify the compounds as primary, secondary, or tertiary.

Compound	Structural formula	Systematic name	Class
A	$(CH_3)_2CHCH_2Cl$		1^o
B		2-bromomethylpropane	
C	$CH_3CH_2CH(OH)CH_3$		
D	$(CH_3)_2CHCH(NH_2)CH_2OH$		

(4)

b) Give the structural formula for the organic product formed when compound **B** reacts with warm dilute aqueous NaOH.

_____ (1)

c) Compound **A** undergoes a similar reaction to that described in part (b) but does so at a different rate. State **TWO** reasons why the reaction of compound **A** is slower.

_____

_____ (2)

d) Distilling compound **C** in acidified dichromate produces compound **E**. Give an equation for this reaction.

_____ (1)

e) Both compounds, **C** and **E**, react with PCl_5, yet only one forms white fumes during the reaction with PCl_5. Explain this statement.

_____

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_____ (3)

(Total: 11 marks)

Please turn the page.

8) This question is about aromatic chemistry.

a) In the space provided, describe the mechanism for the methylation of benzene. In your answer, clearly identify the reagents required.

_____

_____ (4)

b) The dimethylation of benzene yields 1,4-dimethylbenzene and another isomer. Give the structure of the isomer.

_____ (1)

c) Give an equation for the reaction of 1,4-dimethylbenzene with acidified manganate(VII) ions.

_____ (1)

d) The organic product of the reaction in part (c) forms a polymer when it reacts with ethane-1,2-diol. Give the repeating unit of this polymer.

_____ (1)

e) A student had to select a plastic container to store concentrated hydrochloric acid. Two plastic bottles were available; one made of the polymer produced in part (d) and the other made from poly(propene). Which of these two plastics would be best suited for such use? Explain your answer.

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_____

_____

_____

_____

_____ (3)

(Total: 10 marks)

9) This question is about spectroscopy.

a) The IR spectrum of compound **F** is given in Figure 1. The absorption data is also given below.

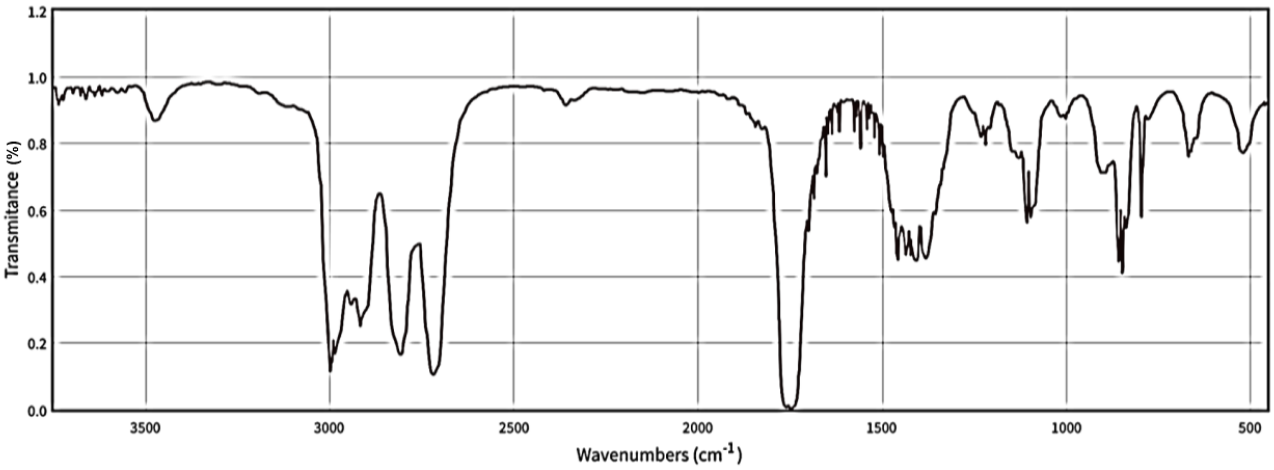

Figure 1**:** IR spectrum of compound **F**

Wavenumber (cm^{-1})	**Bond**	**Compound**
3200 – 3500 (broad)	O–H	alcohols/phenol
2500 – 3500 (very broad)	O–H	carboxylic acid
3300	C–H	aromatic
2845 – 2975	C–H	alkane (aliphatic)
2650 – 2880	C–H	aldehyde
1650 – 1750	C=O	aldehyde/ketone/carboxylic acid
1500 – 1650	C=C	alkene

Question continues on next page.

i) Use this information to identify the homologous series to which compound **F** belongs. Explain your answer.

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_____ (4)

ii) A simple mass spectrum of compound **F** shows peaks at m/z 15, 29 and 58. Deduce the structure of compound **F**. In your answer, assign possible ions to each m/z ratio.

_____

_____

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_____

_____ (3)

b) The high-resolution ^{1}H NMR spectrum of compound **G** is given in Figure 2, together with the peak integration data shown in brackets. The chemical shift data is given in the table below.

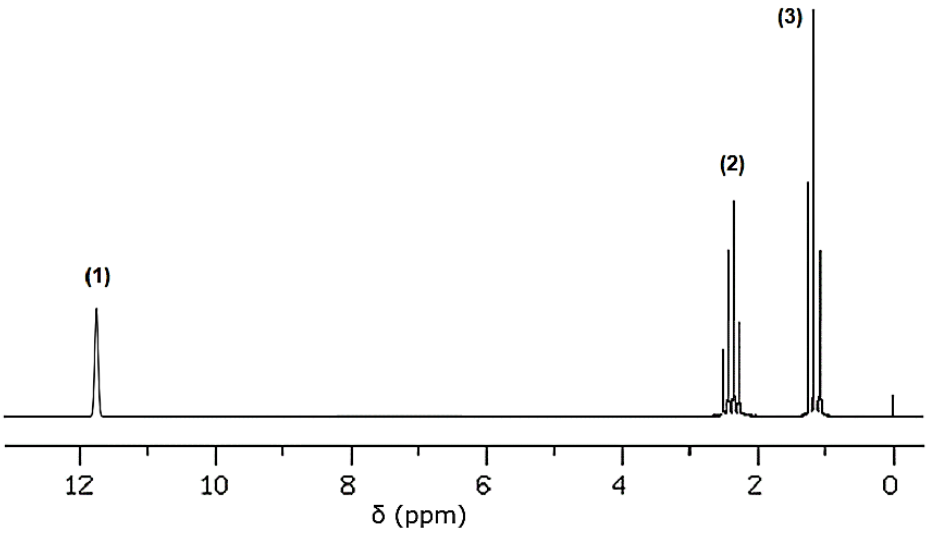

Figure 2**:** High-resolution ^{1}H NMR spectrum of compound **G**

Type of Proton	**Chemical shift, δ (ppm)**
R-O**H**	0.5 – 5.0
R-C**H₃,** R-C**H₂**-R	0.7 – 1.4
R-C**H₂**-O	3.3 – 4.3
R-C**H**O	9.0 – 10.0
R-COO**H**	10.0 – 12.0

i) Interpret the high-resolution ^{1}H NMR spectrum and identify the structure of compound **G**. Explain your answer.

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_____ (5)

ii) The ^{1}H NMR spectrum was re-run after compound **G** was mixed with a drop of D_2O. What changes to the spectrum, if any, do you expect? Explain your answer.

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_____ (3)

(Total: 15 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2023 FIRST SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	II
DATE:	18th May 2023
TIME:	4:00 p.m. to 7:05 p.m.

A Periodic Table is provided.
Ionic product of water, K_w = 1.00 x 10^{-14} mol^2 dm^{-6}
Molar Gas Constant, R = 8.31 J mol^{-1} K^{-1}

Answer TWO questions from each section and ANY other question.

SECTION A

1. This question deals with ionic equilibria.
   a) 20 cm^3 of 0.10 mol dm^{-3} ethanoic acid solution is titrated with 0.10 mol dm^{-3} aqueous sodium hydroxide. The K_a of ethanoic acid is 1.8 x 10^{-5} mol dm^{-3}.
      i) Calculate the initial pH of ethanoic acid. (4)
      ii) Calculate the pH at half the equivalence point of the reaction. (3)
      iii) Calculate the pH at the equivalence point of the reaction. (7)
      iv) On the graph paper provided, sketch a graph to show the pH change for this titration. The graph should include the pH values calculated in parts (i), (ii) and (iii). (4)

   b) Suggest a suitable indicator that can be used for this reaction, and on the graph sketched in part (a), mark the pH range where the expected colour change will occur. (2)

(Total: 20 marks)

2. This question is about organic chemistry.
   a) The reductive ozonolysis of compound **A** yields a single organic compound, **B**. Compound **B** is a symmetrical molecule with the molecular formula $C_8H_{14}O_2$ that reacts with I_2 in the presence of aqueous NaOH to give a yellow precipitate with an antiseptic smell. Give the structures of compounds **A** and **B** and give balanced chemical equations where relevant. (6)

   b) Describe the mechanism for the reaction of 2-bromo-2-phenylpropane with an equimolar amount of ammonia in ethanol. (5)

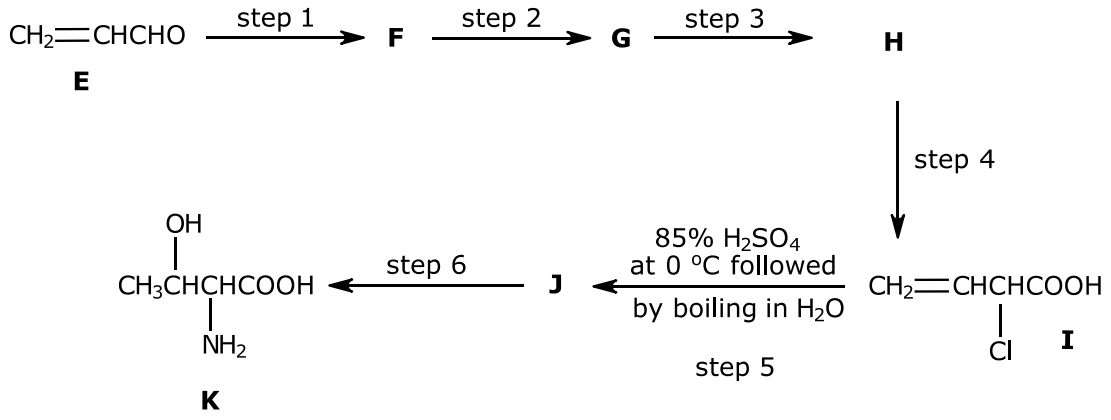
   c) Alcohols **C** and **D** were obtained by the reaction of ethylmagnesium bromide with methanal and pentan-2-one, respectively, followed by hydrolysis. Give chemical equations for the formation of **C** and **D** and describe a simple chemical test that can be used to distinguish the two alcohols. (6)

   d) Although the molecule of alcohol **D** exhibits stereoisomerism, alcohol **D,** as prepared by the reaction described in part (c), does **not** rotate the plane of plane-polarised light. Explain this statement. (3)

(Total: 20 marks)

Please turn the page.

3. This question deals with organic chemistry. Consider the following reaction scheme to produce compound **K.**



a) Give the systematic name of compound **K.** (1)
b) Complete the reaction scheme by giving the structures of compounds **F**, **G**, **H** and **J**. (5)
c) Give the reagents and conditions for steps 1 to 4 and 6. (6)
d) Explain why compound **K** is a solid at room temperature. (3)
e) The reaction in step 5 also gives an isomer of compound **J**. Give the structure of this isomer and describe why compound **J** forms in greater quantities than its isomer. (5)

(Total: 20 marks)

4. This question is about chemical equilibria.
a) Ammonium hydrogensulfide dissociates to form hydrogen sulfide and ammonia. This endothermic reaction reaches dynamic equilibrium in a closed system.

$$NH_4HS(s) \rightleftharpoons H_2S(g) + NH_3(g)$$

i) Define the terms dynamic equilibrium and closed system. (3)
ii) Write an expression for the equilibrium constant, K_p, for this reaction. Give the units of the expression in atmospheres. (2)
iii) Describe and explain the effect on the equilibrium constant, K_p, if the amount of $NH_4HS(s)$ is increased at a constant temperature. (2)
iv) Describe and explain the effect on the equilibrium constant, K_p, if the temperature is increased at constant pressure. (2)
v) Calculate the total pressure, in atmospheres, at equilibrium if solid NH_4HS is placed in an evacuated container and allowed to reach equilibrium at 25 °C. The numerical value for K_P for this reaction at this temperature is 0.11. (4)

b) Consider the equilibrium reaction $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$. The endothermic reaction is allowed to reach equilibrium in a clear gas syringe kept at 185 °C. The numerical value for the equilibrium constant, K_c, for this reaction at this temperature is 2.0×10^{-6}.
i) Explain what would be observed if the temperature is lowered to 100 °C at constant pressure. (4)
ii) Calculate the equilibrium constant, K_c, at 185 °C for the reaction $4NO(g) + 2O_2(g) \rightleftharpoons 4NO_2(g)$. (3)

(Total: 20 marks)

SECTION B

5. This question deals with the chemistry of transition metals.
   a) Define the term transition metal. (1)

   b) Complex ion formation is a property of transition metals. Complex ions are formed when they combine with a suitable ligand.
      i) Explain the terms complex ion and ligand. (2)
      ii) Describe why aminoethanoate is a bidentate ligand. (2)
      iii) Give an ionic equation for the formation of a blood red-coloured complex on the addition of aqueous potassium thiocyanate to $Fe^{3+}(aq)$ ions. (2)

   c) Give the electronic configuration of Cr^{3+} ions and draw the complex ion that forms between Cr^{3+} and water molecules. (2)

   d) Adding aqueous ammonia to an aqueous solution of Cu^{2+} ions changes the colour of the solution, while the addition of concentrated ammonia solution to solid CuCl dissolves the solid to give a colourless solution. Explain this statement. (5)

   e) Some complex ions can exist as optical isomers:
      i) Explain the term optical isomerism. (1)
      ii) Name the complex ion, $[Ni(NH_2CH_2CH_2NH_2)_3]^{2+}$. (1)
      iii) Give the structures of the two optical isomers of the complex ion $[Ni(NH_2CH_2CH_2NH_2)_3]^{2+}$. (4)

(Total: 20 marks)

6. This question is about the chemistry of the elements of groups 5 and 7.
   a) The boiling points of the group 7 elements increase on going down the group. Explain this statement. (2)

   b) Chlorine can undergo disproportionation reactions. Explain this statement and give ionic equations for the reaction of chlorine with respectively cold and hot aqueous sodium hydroxide. (3)

   c) Potassium chlorate(V) is often used as an oxidising agent in pyrotechnics.
      i) Give a balanced equation for the thermal decomposition of potassium chlorate(V). (1)
      ii) Explain why potassium chlorate(VII) is considered to be a safer oxidising agent than potassium chlorate(V) in pyrotechnics. (3)

   d) Explain why iodine is soluble in aqueous potassium iodide. (2)

   e) With the aid of chemical equations, describe how nitric(III) acid can be prepared in the lab. In your answer, describe why nitric(III) acid needs to be prepared in situ. (5)

   f) Nitric acid can behave as a strong oxidising agent or as an acid. Explain this statement, and give balanced chemical equations where necessary. (4)

(Total: 20 marks)

Please turn the page.

7. a) Give the equations, including reagents and conditions, for the conversion of benzene to benzenamine. (4)

   b) Explain, with the aid of canonical structures, why the bromination of benzenamine yields 2,4,6-tribromobenzenamine and requires less forceful conditions when compared to that of benzene. (7)

   c) Benzenamine can be purified by steam distillation. Calculate the percentage by mass of benzenamine that is obtained by steam distillation carried out at an atmospheric pressure of 1.0×10^5 Pa, given that the saturated vapour pressure of water at boiling is 9.4×10^4 Pa. (5)

   d) i) With the help of a simple diagram, explain the process of reverse osmosis. (2)
   ii) State why reverse osmosis is used in preference to distillation to produce fresh water from seawater. (2)

(Total: 20 marks)

8. a) A 150 g sample of ethyne was completely burned in oxygen forming carbon dioxide and water.
   i) Calculate the number of moles of ethyne that were burned. (1)
   ii) Calculate the total volume of gaseous product at 450 K and 100 kPa. (4)
   iii) Calculate the total volume of gaseous product at 727 ^{o}C at 100 kPa. (2)

   b) i) Oxygen gas can be prepared from the catalytic decomposition of hydrogen peroxide. Give a balanced chemical equation and state the catalyst. (1)
   ii) Explain how trioxygen forms in the stratosphere and its action as a screen of ultraviolet radiation. Give a reason why such a process is important. (4)

   c) i) Give the structure of the peroxide ion and explain why hydrogen peroxide is unstable and is best stored in brown bottles. (5)
   ii) Describe how aqueous hydrogen peroxide solution is prepared in the laboratory. (3)

(Total: 20 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2023 FIRST SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	III – *Practical*
DATE:	15th June 2023
TIME:	3 hours 5 minutes

1. You are provided with four solutions as follows:

   i) sodium hydroxide of concentration 0.0800 mol dm^{-3}, labelled **S**;
   ii) potassium manganate(VII), of concentration 0.0200 mol dm^{-3}, labelled **P**;
   iii) a solution of a compound whose formula is $K_xH_y(C_2O_4)_z$, labelled $\mathbf{Q_n}$;
   iv) 1M sulfuric acid solution.

   In this experiment, you are required to carry out titrations to determine the ratio y:z and hence the empirical formula of the anion in the compound dissolved in the solution labelled $\mathbf{Q_n}$:

a) Record the value of your laboratory number, n (found on solution **Q**), on your answer book in the following box.

CANDIDATE LABORATORY NUMBER, n:.....

Determination of the free protons in solution labelled Q_n

b) Fill your burette with solution **S**. Pipette a 25.0 cm^3 aliquot of solution $\mathbf{Q_n}$ into a conical flask, add three drops of phenolphthalein indicator, and titrate to a pink endpoint. Record the results in the table below.

	1st Titration	2nd Titration	3rd Titration
Final burette reading			
Initial burette reading			
Titre (cm^3)			

Mean titre: _____ cm^3 of solution **S**. (20)

c) Sodium hydroxide reacts with acid according to the following equation:

$$NaOH\ (aq) + H^+\ (aq) \rightarrow Na^+\ (aq) + H_2O\ (l)$$

Hence determine the molar concentration of free protons in solution $\mathbf{Q_n}$.

_____

_____

_____

_____

_____

_____

_____

_____

_____ (3)

Determination of the empirical formula of $K_xH_y(C_2O_4)_z$ in the solution, labelled Q_n.

d) Rinse your burette and fill it with solution **P**. Pipette a 25.0 cm^3 aliquot of solution $\mathbf{Q_n}$ into a conical flask and add approximately 20 cm^3 of 1M sulfuric acid solution. Heat the contents of the conical flask to around 60 ^oC. Titrate to a permanent pink endpoint and record the results in the table below.

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

Mean titre: _____ cm^3 of solution **P**. (20)

e) Manganate(VII) and $C_2O_4^{2-}$ react as follows:

$$2MnO_4^- (aq) + 16H^+ (aq) + 5C_2O_4^{2-} (aq) \rightarrow 2Mn^{2+} (aq) + 8H_2O (l) + 10CO_2 (g)$$

Use your data and the stoichiometry above to calculate the molar concentration of $C_2O_4^{2-}$ in solution $\mathbf{Q_n}$.

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_____(3)

Please turn the page.

f) Determine the y:z ratio in $K_xH_y(C_2O_4)_z$, and hence the empirical formula of the compound.

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_____

_____(4)

(Total: 50 marks)

2. You are provided with two solid inorganic salts labelled **R** and **M**. You are to carry out the tests described below and identify the two substances.

a) Clean the nichrome wire provided with concentrated hydrochloric acid; carry out a flame test on substance **R**. *Leave half of your sample for subsequent tests*.

Observation	*Inference*
_____	_____
_____	_____
_____	_____

b) Dissolve about half of your sample of **R** in 10 cm^3 of water. ***Retain this solution for subsequent tests.***

Observation	*Inference*
_____	_____
_____	_____
_____	_____

c) To about 3 cm^3 of the solution obtained in test (b), add 5 cm^3 of dilute sulfuric acid. *Retain this solution for subsequent tests.*

Observation *Inference*

_____ _____

_____ _____

_____ _____

d) Filter the reaction mixture obtained in test (c). Allow around three minutes for the filtration, and to about 1 cm^3 of the filtrate, add 1 cm^3 of iron(II) sulfate solution. Hold the test tube at an angle and carefully add drops of concentrated sulfuric(VI) acid.

Observation *Inference*

_____ _____

_____ _____

_____ _____

_____ _____

e) Dissolve your sample of substance **M** in 10 cm^3 of water. *Retain this solution for subsequent tests.*

Observation *Inference*

_____ _____

_____ _____

_____ _____

_____ _____

f) To about 1 cm^3 of the solution obtained in test (e), add excess sodium hydroxide solution. Heat the contents of the test tube gently, and test for any gases.

Observation *Inference*

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_____ _____

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Please turn the page.

g) To about 1 cm^3 of the solution from test (e), add a few drops of potassium hexacyanoferrate(III) solution.

Observation *Inference*

_____ _____

_____ _____

_____ _____

h) Add 1 cm^3 of the solution obtained in test (b) to 1 cm^3 of the solution from test (e), followed by 1 cm^3 of dilute hydrochloric acid.

Observation *Inference*

_____ _____

_____ _____

_____ _____

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_____ _____

_____ _____

Conclusion

Suggest a possible identity for substance **R**: _____

Suggest a possible identity for substance **M**: _____

(Total: 30 marks)

3. Substance **H** is an organic compound. Carry out the chemical tests described below and suggest a plausible structure for the compound.

a) Burn a few drops of **H** on a crucible lid.

Observation *Inference*

_____ _____

_____ _____

_____ _____

_____ _____

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

Observation	*Inference*
_____	_____
_____	_____
_____	_____

c) Add three drops of dilute sodium hydroxide to about 1 cm^3 of aqueous silver nitrate in a clean test tube, followed by aqueous ammonia solution dropwise until the precipitate just dissolves. Add two drops of **H** and heat in a boiling water bath.
After completing this test, clean the test tube immediately and flush it with plenty of water.

Observation	*Inference*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

d) Place 4 drops of **H** in a clean test tube. Add 1 cm^3 of Fehling's A solution, followed by 1 cm^3 of Fehling's B solution, and heat in a boiling water bath.

Observation	*Inference*
_____	_____
_____	_____
_____	_____
_____	_____

Please turn the page.

e) Acidify 1 cm^3 of potassium dichromate solution with 1 cm^3 of dilute sulfuric acid. Add two drops of **H** and warm in a water bath.

Observation	*Inference*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

f) To about 1 cm^3 of aqueous iodine in potassium iodide, add just enough sodium hydroxide solution to give a clear solution. Add three drops of **H** and warm gently in a water bath.

Observation	*Inference*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Conclusion

A possible structure for **H** is: _____

(Total: 20 marks)