Index No.:_____ AM06/I.21s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2021 SECOND SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	I
DATE:	4th October 2021
TIME:	4:00 p.m. to 7:05 p.m.

Required Data: Relative atomic masses: H = 1; C = 12; N = 14; O = 16
Universal Gas constant (R) = 8.3145 J mol^{-1} K^{-1}.
0 °C = 273 K

Answer ALL questions

1. (a) Define the following terms:

(i) atomic number;

_____

_____ (1)

(ii) nucleon number;

_____

_____ (1)

(iii) isotope.

_____

_____ (1)

(b) Some elements in the periodic table are shown to have a fractional value of the relative atomic mass. Explain how these fractional values arise.

_____

_____

_____

_____ (3)

(c) The mass spectrum of molecular chlorine exhibits a number of different peaks. Account for these peaks.

(3)

(Total: 9 marks)

2. (a) Explain, giving an example in each case, what is meant by:

(i) a dative covalent bond;

(2)

(ii) a hydrogen bond.

(2)

(b) Both the C=O bond and the S=O bond are considered to be polar bonds. Explain what is meant by this statement.

(2)

(c) Given that both the bonds in part (b) are polar, explain why CO_2 has **no** net dipole moment whilst SO_2 does.

(4)

(Total: 10 marks)

3. Consider the following reactions:

(i) $S\ (s) + O_2\ (g) \rightarrow SO_2\ (g)$ $\quad \Delta H^{\ominus} = -297\ kJ\ mol^{-1}$

(ii) $SO_2\ (g) + ½\ O_2\ (g) \rightleftharpoons SO_3\ (g)$ $\quad \Delta H^{\ominus} = -92\ kJ\ mol^{-1}$

(a) Construct an enthalpy cycle and calculate the value of the standard enthalpy of formation of sulfur trioxide ($SO_3\ (g)$).

(4)

Question continues on next page.

(b) Explain, with reasons, how the equilibrium in reaction (ii) responds to:

(i) an increase in pressure at constant temperature;

(2)

(ii) an increase in temperature at constant pressure.

(2)

(c) Using the concepts of free energy change and entropy change of a reaction, discuss how temperature influences the feasibility of reaction (ii).

(4)

(Total: 12 marks)

4. This question is about periodicity.

(a) Give the full electronic configuration of the following species in s, p, d, f notation.

Na (1)

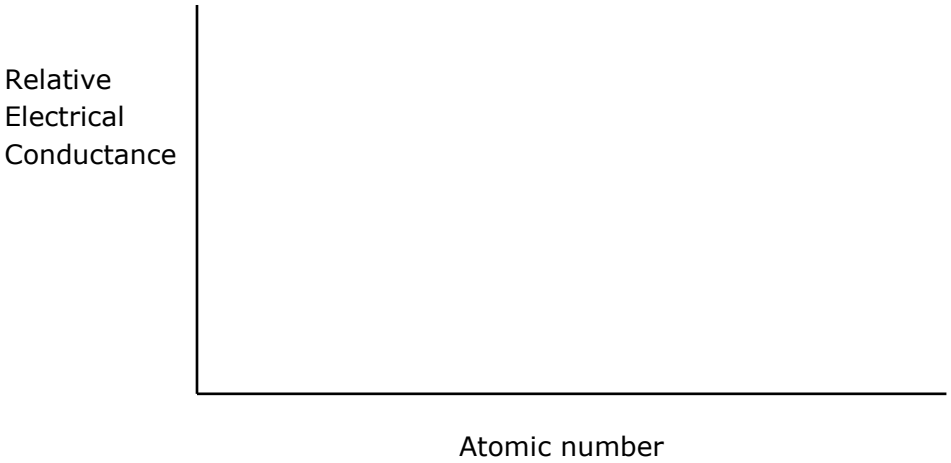
Cl^- (1)

Al^{3+} (1)

(b) Explain, in terms of bonding, why sodium chloride is a high melting point solid whilst aluminium chloride sublimes at 180 °C and 1 atm pressure.

(4)

(c) Illustrate by sketching a graph on the axes below, the variation of electrical conductivity of the elements across the period for the elements of Period 3 in their standard state.



(2)

(d) Complete the following table giving the missing formulae or acid-base character of the oxides of elements in Period 3.

Group	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
Oxide	Na_2O	MgO		SiO_2	P_4O_{10}	SO_2	
Acid-base character	basic					acidic	acidic

(3)

(Total: 12 marks)

Please turn the page.

5. This question is about Group IV elements and their compounds.

(a) Define the term allotropy.

_____

_____ (1)

(b) (i) In the space below, draw the structure of the **TWO** carbon allotropes graphite and diamond.

(2)

(ii) Using the structures for the two allotropes, describe why the two forms exhibit different electrical conductivities and hardness.

_____

_____

_____

_____

_____ (4)

(c) The melting point of silicon dioxide is 1700 °C while that of carbon dioxide is −78.5 °C (sublimation point at 1 atm). Account for this difference.

_____

_____

_____ (2)

(d) Describe the acid-base behaviour of tin(II) oxide and lead(II) oxide.

_____

_____

_____ (3)

(e) Lead forms two chlorides, namely $PbCl_2$ and $PbCl_4$. Explain how the existence of these compounds illustrates the inert pair effect in lead.

_____

_____

_____ (2)

(Total: 14 marks)

6. Barium is the last member of Group 2. Use trends observed in properties of Group 2 elements to predict properties of barium and its compounds.

(a) Explain, giving a reason for your answer, whether barium would be expected to be harder or softer than magnesium.

_____

_____

_____ (2)

(b) Explain, why the solubility of barium sulfate(VI) is far lower than that of magnesium sulfate.

_____

_____

_____ (2)

Question continues on next page.

(c) Explain, giving reasons, whether barium carbonate would be expected to be more or less thermally stable than calcium carbonate.

(3)

(d) A solution containing Mg^{2+} ions only and one containing Ba^{2+} ions only can be distinguished by the addition of sodium hydroxide. Explain this statement.

(3)

(Total: 10 marks)

7. (a) Give the reagents (organic or inorganic reagents) and conditions that are required to carry out the following conversions.

(i) CH_3CH_2OH to CH_3CHO;

(2)

(ii) CH_3CHO to CH_3COOH;

(1)

(iii) CH_3CH_2OH to $CH_3CH_2COOCH_2CH_3$;

(2)

(iv) CH_3CH_2OH to a compound which has a molecular formula $C_4H_{10}O$;

(2)

(v) CH_3CH_2OH to compound which has an empirical formula CH_2.

_____

_____ (2)

(b) Write the molecular formula of the product that forms when CH_3CHO reacts with HCN.

_____ (1)

(c) $CH_3CH(OH)COOH$ is considered to be a chiral compound and forms a useful polymeric material.

(i) Explain what makes this compound chiral.

_____

_____

_____ (2)

(ii) In the space below, draw the repeat unit that forms from $CH_3CH(OH)COOH$.

(1)

(Total: 13 marks)

Please turn the page.

8. (a) Give the name and structure of a compound that fits the descriptions given below.

	Description	Name and structure
(i)	A four-carbon hydrocarbon which exhibits delocalisation along the whole molecule.	
(ii)	A compound containing carbon, hydrogen and oxygen that undergoes a disproportionation reaction when treated with concentrated sodium hydroxide.	
(iii)	A hydrocarbon that undergoes an addition reaction with water in the presence of mercury(II) sulfate and dilute sulfuric acid at 60 °C to form ethanal.	
(iv)	A compound which gives ethylamine on treatment with bromine and concentrated alkali.	

(8)

(b) Ethylamine has a boiling temperature of 17 °C. What volume would be the maximum volume of ethylamine evolved at 25 °C and 101,000 Pa produced from 5.9 g of the compound described in part (a) (iv)?

_____

_____

_____

_____

_____ (4)

(Total: 12 marks)

9. (a) Would you expect benzene to be very reactive? Explain, indicating the type of reactions that benzene undergoes.

_____

_____

_____ (2)

(b) Explain the following observations in detail, giving relevant chemical equations or structural formulae as appropriate.

(i) On addition of a few drops of aqueous silver nitrate to liquid (bromomethyl) benzene in a test tube, a cream coloured precipitate forms; no precipitate forms if silver nitrate solution is added to liquid 1-bromo-2-methylbenzene.

_____

_____

_____

_____

_____ (3)

(ii) When a solution of phenylamine in dilute hydrochloric acid is added to an ice-cold solution of sodium nitrite, a colourless product is obtained; on addition of liquid phenylamine a yellow precipitate forms.

_____

_____

_____

_____

_____ (3)

(Total: 8 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2021 SECOND SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	II
DATE:	5th October 2021
TIME:	4:00 p.m. to 7:05 p.m.

A Periodic Table is provided.

Universal Gas constant (R) = 8.3145 J mol^{-1} K^{-1}
Ionisation constant for water (K_w) = 10^{-14} mol^2 dm^{-6} at 298 K

Answer TWO questions from each section and ANY other question.

SECTION A

1. (a) Ethanoic acid has an acid dissociation constant, K_a, of 1.8×10^{-5} mol dm^{-3} at 25 °C. Calculate the pH and pOH of 0.1 mol dm^{-3} aqueous solution of ethanoic acid at 25 °C. (10)

   (b) Calculate the pH of a solution prepared by adding 100 cm^3 of 0.1 mol dm^{-3} aqueous sodium hydroxide to 500 cm^3 of 0.1 mol dm^{-3} ethanoic acid. (6)

   (c) The K_a of trichloroethanoic acid is 2.2×10^{-1} mol dm^{-3} at 25 °C. Discuss this value in contrast to the value given for ethanoic acid reported in part (a) of this question. (4)

   (Total: 20 marks)

2. (a) Describe the phenomenon of osmosis and explain how reverse osmosis is applied to obtaining relatively pure water from sea water. (4)

   (b) Calculate the molar concentration of an aqueous solution of sucrose which has an osmotic pressure of pressure of 2.27×10^4 N m^{-2} at 298 K. (4)

   (c) An equimolar mixture of two solvents exhibits a total saturated vapour pressure of 40.9×10^3 N m^{-2} at 25 °C. The individual saturated vapour pressures of the liquids are 21.6×10^3 N m^{-2} and 60.2×10^3 N m^{-2} at 25 °C. Show how, on the basis of these data, the mixture can be said to be an ideal solution. (5)

   (d) With the help of a boiling point-composition diagram, explain what happens when separation of the ideal solution is attempted. (7)

   (Total: 20 marks)

3. Experiments show that the aqueous iodination of propanone in the presence of an acid catalyst follows a rate law (rate equation) that is first order with respect to propanone and the concentration of H^+. The reaction is zero order with respect to iodine.

(a) Give the equation for the rate law of the iodination reaction and use it to explain the term order of reaction with respect to a reactant and deduce the overall order of the reaction. Explain why iodine is not present in the rate law. (6)

(b) Iodine is insoluble in water. Explain how the introduction of iodine in the aqueous reaction mixture can be achieved. (2)

(c) The progress of the reaction can be followed through a series of titrations. Suggest how this can be carried out giving the titrant and the species whose concentration is being measured. (4)

(d) At 298 K, the initial concentration of propanone is 0.1 mol dm^{-3} and the pH is 1, the rate of the reaction is 1.25×10^{-5} mol dm^{-3} s^{-1}.

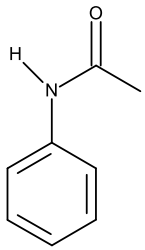
(i) Calculate the rate of reaction when initial pH of the reaction is changed to 2.5. (4)

(ii) Estimate the rate constant of the reaction at 308 K. (4)

(Total: 20 marks)

4. (a) Organic reactions often involve nucleophiles and electrophiles. Explain what these species are and give **TWO** examples of inorganic species in each case. (6)

(b) Describe how the methylation of the ring of N-phenylacetamide (I, below) can be achieved. Indicate the electrophile and the inorganic reagent required for this process, the different products and explain why it is **not** possible to methylate the ring in the case of phenylamine.



I

(6)

(c) Explain why whilst alcohols react with carboxylic acids to form esters, phenols require treatment with carboxylic acid derivatives. (4)

(d) Explain how an impure crystalline sample of benzoic acid can be purified from aqueous media by adjustment of the pH and explain how one can ascertain the purity of the recrystallised material. (4)

(Total: 20 marks)

SECTION B

5. Explain each of these statements about the elements fluorine, chlorine, bromine and iodine in detail. Your answers need to include balanced chemical reactions when relevant.

(a) Hydrogen halides are soluble in water, forming acidic solutions with acid strength that varies down the group. (4)

(b) Chlorine is highly reactive and toxic. Describe how chlorine can be safely prepared in the laboratory. In your description include a diagram. (4)

(c) Soluble metal halides can be distinguished by their reactions with silver ions, and conc. sulfuric acid. (4)

(d) Potassium chlorate is a strong oxidising agent that has several uses e.g. in fireworks. On heating potassium chlorate releases a colourless gas and a solid residue. (4)

(e) Iodine is used in volumetric analysis, typically with thiosulfate, $S_2O_3^{2-}$. This type of titration is termed as redox titration. (4)

(Total: 20 marks)

6. (a) Describe **TWO** laboratory preparations of oxygen, one using a peroxide, and the other using an oxide. How would you test for the presence of oxygen? (4)

(b) Ozone plays an important role in the stratosphere. Explain how it forms in the stratosphere and its role. (4)

(c) Given these four oxides: Li_2O, CO, Al_2O_3, NO_2. Describe how each can be formed. (4)

(d) Hydrogen peroxide is the simplest peroxide, with many known uses such as, an oxidising agent and as a bleaching agent. Account for its oxidising and reducing properties. Describe the structure and bonding of the peroxide ion. (4)

(e) Account for the inertness of N_2 in terms of its bonding and name the types of covalent bonds present in N_2. (Hint: Draw your answer from multiple bonds formed by carbon to carbon.) (4)

(Total: 20 marks)

Please turn the page.

7. Explain in detail each of the following observations. Give relevant chemical equations for any reactions mentioned.

   (a) The reaction of methanal with hot aqueous potassium hydroxide produces a mixture of products which, on treatment with excess sulfuric acid and heating, transforms into an organic product having the same empirical formula as methanal but double the molecular mass. (5)

   (b) The two structural isomers of butene can be distinguished through ozonolysis. (5)

   (c) Esterification of benzene-1,2-dicarboxylic acid (phthalic acid) with ethanol forms two compounds having the following molecular formulae $C_{10}H_{10}O_4$ and $C_{12}H_{14}O_4$. One of the esters is insoluble in cold aqueous alkali while the other dissolves readily. Gentle heating of benzene-1,2-dicarboxylic acid readily releases a vapour which condenses into a colourless, odourless liquid. (5)

   (d) The major product of the reaction of bromine water with ethene is 2-bromoethan-1-ol whilst 1,2-dibromoethane is the minor product. (5)

(Total: 20 marks)

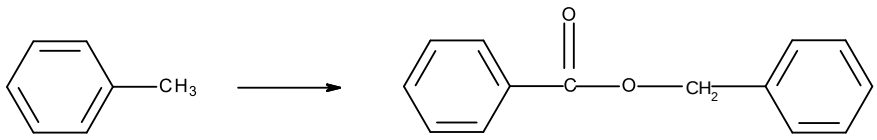
8. Give the reagents and reaction conditions needed for the conversions (a) to (d). More than one step may be required for each conversion. No other organic compound, other than the starting compound is available for each conversion. In your answers try to use the least steps possible.

   (a) $CH_3OH \longrightarrow (CH_3)_3N$ (5)

   (b) $CH_3CH_2Br \longrightarrow CH_3CH_2CH_2OH$ (5)

   (c) $CH_3CH{=}CH_2 \longrightarrow CH_3CH(OH)CH_3$ (5)

   (d) (5)



(Total: 20 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2021 SECOND SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	III
DATE:	6th October 2021
TIME:	4:00 p.m. to 5:35 p.m.

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer all questions. Write all your answers in this booklet. Drawings and graphical representations of data are to be made on the appropriate pages within this booklet.
- The marks allotted to parts of question are indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.
- The use of a copy of a periodic table is permitted.

For examiners' use only:

Questions	1	2	3	
Maximum	20	15	15	50
Score				

1. A company holds a stock of phosphoric acid. According to the label on the drum, the acid is of a concentration of 14.5 mol dm^{-3}. The quality control protocol requires that this value is confirmed in the laboratory.

   A sample of the stock acid, labelled S is delivered to the lab for titrimetric analysis.

   (a) Give **TWO** safety precautions that need to be followed during this procedure.

_____

_____

_____

_____ (2)

   (b) The analyst carries out a serial dilution.

   A 25.0 cm^3 aliquot of the stock solution S is transferred to a 250.0 cm^3 volumetric flask and the solution is made up to the mark with distilled water. This is labelled P.

   A 25.0 cm^3 aliquot of P is then transferred to a second volumetric flask, which is again made up to the 250.0 cm^3 mark. This is labelled as P(dilute).

   (i) State which other item(s) of glassware you would use to carry out the dilutions quantitatively. Describe also what precautions you would take to ascertain accuracy.

_____

_____

_____

_____

_____

_____ (4)

   (ii) Calculate the dilution factor of P(dilute) relative to the stock solution S.

_____

_____

_____

_____

_____

_____ (3)

(c) The analyst fills a 50.0 cm^3 burette with 0.20M sodium hydroxide solution and transfers 25.0 cm^3 of P(dilute) into each of three conical flasks. Describe and explain any precautions that need to be taken to ensure accuracy.

_____

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_____

_____

_____

_____ (3)

Methyl orange is used as an indicator. The colour change from yellow to red detects the first endpoint as follows:

$$NaOH_{(aq)} + H_3PO_{4(aq)} \rightarrow NaH_2PO_{4(aq)} + H_2O_{(l)}$$

Please turn the page.

(d) The results of the titrations are shown in the table below.

Final burette reading (cm^3)	19.20	18.50	18.50
Initial burette reading (cm^3)	0.00	0.00	0.00
Titre (cm^3)			

Complete the table and indicate in the space below, which value the analyst should discard. Explain your choice and calculate the average titre value.

_____

_____

_____

_____ (2)

(e) Use the titre value to calculate the molarity of P(dilute).

_____

_____

_____

_____

_____

_____ (3)

(f) Calculate the molarity of the stock acid S.

_____

_____

_____ (3)

(Total: 20 marks)

2. A student is asked to determine the partition coefficient of iodine between tetrachloromethane (CCl_4) and water. A 0.30 mol dm^{-3} solution of iodine in tetrachloromethane labelled T is provided.

   10 cm^3 of the iodine solution in tetrachloromethane is pipetted into a separatory funnel. 100 cm^3 of water are added. The funnel is stoppered and shaken vigorously. The organic and the aqueous layers are allowed to separate.

   (a) Tetrachloromethane is toxic by inhalation. Describe how this substance may be handled safely in the laboratory.

_____

_____

_____ (1)

   (b) Calculate the number of moles of iodine present in the 10 cm^3 aliquot of T.

_____

_____

_____ (1)

   (c) 25 cm^3 aliquots of the aqueous layer are transferred in turn to a conical flask and titrated with a 0.005 M solution of sodium thiosulfate. Starch indicator is used as the end-point is approached.

   The following data is obtained:

Final burette reading (cm^3)	33.00	32.1	32.2
Initial burette reading (cm^3)	0.00	0.00	0.00
Titre (cm^3)			

   Complete the table and calculate the average titre value.

_____

_____

_____

_____ (2)

Please turn the page.

(d) Thiosulfate and iodine react as follows:

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

Calculate the concentration of iodine in the aqueous solution and hence, the number of moles in 100 cm^3 .

_____

_____

_____

_____

_____

_____ (3)

(e) Calculate the number of moles of iodine in the organic layer (Hint: subtract the moles in the aqueous layer). Given that the volume of the organic layer is 10 cm^3, calculate the concentration of iodine in tetrachloromethane after partitioning.

_____

_____

_____

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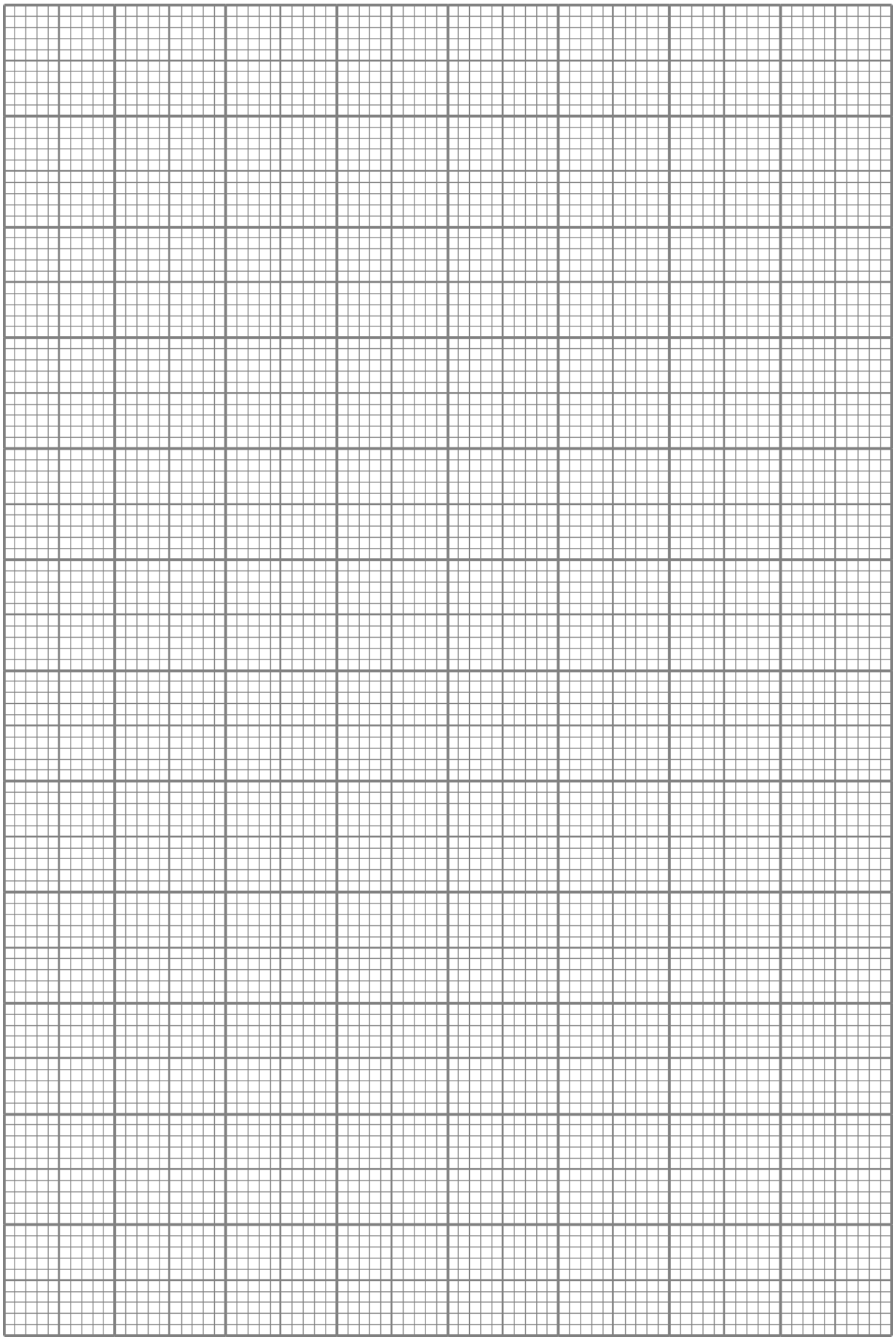
_____ (2)

(f) The experiment was repeated using 150 cm^3, 200 cm^3 and 250 cm^3 .

The table below summarises the data obtained. Complete the table with the result of your calculation. Plot values of the iodine concentration in the organic layer against the iodine concentration in the aqueous layer on the graph paper provided. (5)

Volume of organic layer (cm^3)	10	10	10	10
Volume of aqueous layer (cm^3)	100	150	200	250
Titre (0.005M thiosulfate, cm^3)	31.15	30.00	29.00	27.00
$[I_2]$ in organic layer		0.2546	0.2420	0.2310
$[I_2]$ in aqueous layer		0.003	0.0029	0.0027



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(g) The partition coefficient (K_D)for this system is given by the expression:

$$K_D=[I_2]_{organic} / [I_2]_{aqueous}$$

Hence, determine a value for K_D from your plot.

_____

_____

_____(1)

(Total: 15 marks)

3. During a stock-taking exercise of the chemical inventory, a rather old container of ammonium iron(II) sulfate hexahydrate $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ was found. The lid was not tightly closed and it was suspected that prolonged exposure to the atmosphere may have caused an oxidation of iron(II) to iron(III).

A titrimetric analysis of the sample was carried out to determine the iron(II) content of the sample.

12.0000 g of the sample was weighed out and dissolved in 100 cm^3 of water in a beaker. This was acidified with 20 cm^3 of 2M sulfuric acid, and transferred quantitatively to a 250 cm^3 volumetric flask and made up to the mark. This is labelled F.

(a) Describe the weighing process using an analytical balance and the quantitative transfer of the sample to the volumetric flask, giving **all** relevant practical details.

_____

_____

_____

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_____

_____ (3)

(b) A burette is filled with a 0.020M solution of potassium manganate(VII). 25.0 cm^3 aliquots of solution F are transferred into suitably rinsed conical flasks and acidified with 20 cm^3 2M sulfuric acid. Describe and explain what you would observe at the end-point of the titration.

_____

_____

_____

_____

_____

_____ (2)

(c) Complete the following table, showing the results of three consecutive titrations and calculate the mean titre value.

Final burette reading (cm^3)	26.40	25.30	25.35
Initial burette reading (cm^3)	0.00	0.00	0.00
Titre (cm^3)			

_____

_____

_____

_____

_____

_____ (2)

(d) Given that iron(II) and manganate(VIII) react as follows, calculate the moles of iron(II) in a 25 cm^3 aliquot of F. Hence calculate the mass of iron(II) in 250 cm^3 of the solution.

$$MnO_4^-{}_{(aq)} + 5Fe^{2+}{}_{(aq)} + 8H^+{}_{(aq)} \rightarrow Mn^{2+}{}_{(aq)} + Fe^{3+}{}_{(aq)} + 4H_2O_{(l)}$$

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_____

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_____ (3)

(e) Assuming the sample of ammonium iron(II) sulfate hexahydrate underwent no oxidation, what would be the percentage of iron(II) by mass of a pure sample?

_____

_____

_____

_____

_____

_____ (2)

(f) From your calculations, what is the percentage of iron(II) by mass of the sample analysed? What can you conclude about the degree of purity of your sample?

_____

_____

_____

_____

_____

_____(3)

(Total: 15 marks)

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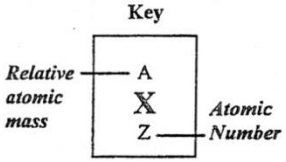
PERIODIC TABLE

Key



I	II										III	IV	V	VI	VII	VIII
1 **H** 1																4 **He** 2
7 **Li** 3	9 **Be** 4										11 **B** 5	12 **C** 6	14 **N** 7	16 **O** 8	19 **F** 9	20 **Ne** 10
23 **Na** 11	24 **Mg** 12										27 **Al** 13	28 **Si** 14	31 **P** 15	32 **S** 16	35.5 **Cl** 17	40 **Ar** 18
39 **K** 19	40 **Ca** 20	45 **Sc** 21	48 **Ti** 22	51 **V** 23	52 **Cr** 24	55 **Mn** 25	56 **Fe** 26	59 **Co** 27	59 **Ni** 28	63.5 **Cu** 29	65 **Zn** 30	70 **Ga** 31	73 **Ge** 32	75 **As** 33	79 **Se** 34	80 **Br** 35	84 **Kr** 36
85 **Rb** 37	88 **Sr** 38	89 **Y** 39	91 **Zr** 40	93 **Nb** 41	96 **Mo** 42	99 **Tc** 43	101 **Ru** 44	103 **Rh** 45	106 **Pd** 46	108 **Ag** 47	112 **Cd** 48	115 **In** 49	119 **Sn** 50	122 **Sb** 51	128 **Te** 52	127 **I** 53	131 **Xe** 54
133 **Cs** 55	137 **Ba** 56	139 **La** 57	178.5 **Hf** 72	181 **Ta** 73	184 **W** 74	186 **Re** 75	190 **Os** 76	192 **Ir** 77	195 **Pt** 78	197 **Au** 79	201 **Hg** 80	204 **Tl** 81	207 **Pb** 82	209 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
223 **Fr** 87	226 **Ra** 88	227 **Ac** 89															

140 **Ce** 58	141 **Pr** 59	144 **Nd** 60	147 **Pm** 61	150 **Sm** 62	152 **Eu** 63	157 **Gd** 64	159 **Tb** 65	162 **Dy** 66	165 **Ho** 67	167 **Er** 68	169 **Tm** 69	173 **Yb** 70	175 **Lu** 71
232 **Th** 90	231 **Pa** 91	238 **U** 92	237 **Np** 93	244 **Pu** 94	243 **Am** 95	247 **Cm** 96	247 **Bk** 97	251 **Cf** 98	252 **Es** 99	257 **Fm** 100	258 **Md** 101	259 **No** 102	260 **Lr** 103