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525/1

S6 CHEMISTRY

Exam 14

PAPER 1

DURATION: 2 HOUR 45 MINUTES

For Marking guide contact and consultations: Dr. Bbosa Science 0776 802709,

This paper Instructions

- This paper consists of two sections A and B
- Section A is compulsory
- Attempt only six questions in section B
- Answers must be written in the spaces provided only.

Where necessary use the following:

Molar gas constant, R	= $8.31\text{JK}^{-1}\text{mol}^{-1}$
Molar volume of a gas at s.t.p	= 22.4litres
Standard temperarue	= 273K
Standard pressure	= 10125Nm^{-2}

For Examiner's Use Only																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

SECTION A

Answer questions from this section

1. (a)(i) The decay law is give in the expression below

$$-\frac{dN}{dt} = \lambda N$$

State what the symbols represent.

(1 ½ marks)

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- (ii) Using the above expression derive the expression for relating the half-life ($t_{1/2}$) and a decay constant. (2marks)

- (b)(i) Nickel (^{63}Ni) decays to copper (^{63}Cu).

Name the particle emitted and write the equation for the reaction:

Name of the particle

(1mark)

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Equation:

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- (ii) Calculate the time taken for $\frac{15}{16}$ of nickel to change to copper.

(the half-life of nickel is 120 years)

(2marks)

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2. (a) state conditions for the reaction between aluminium oxide and sulphuric acid and write the equations for the reaction

Conditions

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Equation

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- (b) The resultant solution in (a) was mixed with aqueous sodium carbonate solution. State what was observed and write equation for the reaction that took place.

Observation

(2 ½ mark)

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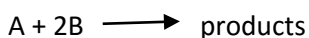
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Equation

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3. The following experimental results were obtained for the reaction



Experiment number	Initial concentration (mol ⁻¹)		Rate (mol ⁻¹ s ⁻¹)
	A	B	
1	3.0×10^{-2}	3.0×10^{-2}	2.7×10^{-5}
2	3.0×10^{-2}	6.0×10^{-2}	5.4×10^{-5}
3	6.0×10^{-2}	3.0×10^{-2}	10.8×10^{-5}

- (a) Deduce the order of reaction with respect to

- (i) A

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(ii) B
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(iii) Write the expression for the rate equation (½ mark)
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(b) The rate of the reaction under certain conditions for temperature is x. express the rate in terms of when the following changes are made. (½ mark each)

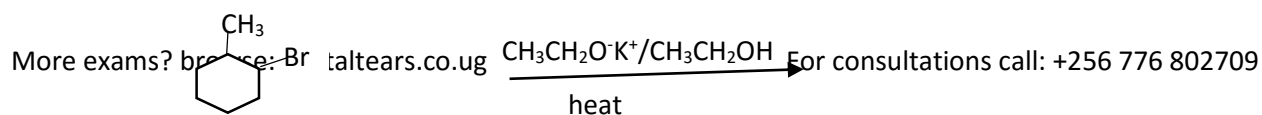
(i) The concentration of B is halved while the concentration of A remains unchanged.
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(ii) The rate constant is doubled, by increasing temperature, but keeping the concentrations of A and B unchanged.
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(iii) If 90% of B is removed by precipitation, without affecting the concentration of A
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(c) Calculate the value of the rate constant and state its units (2marks)
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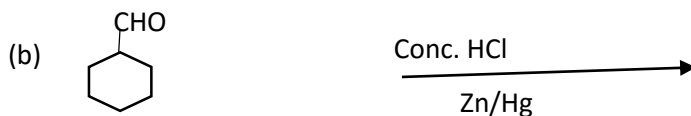
4. Complete the following reaction equations and write the IUPAC names of the main organic product in each case. (1 ½ mark each)



(a)

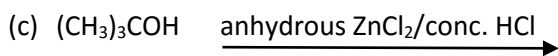
Name of the product

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Name of the product

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Name of the product

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5. (a) Write half equation (s) to show the action of hydrogen peroxide as

(i) Oxidizing agent

(1mark)

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(ii) Reducing agent.

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(b) State what is observed and in each case write equation of the reaction that takes place when hydrogen peroxide is added to the following mixtures: (1½ mark each)

(i) Acidified potassium chromate (VI) solution)

Observations

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Equation

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(ii) Iron (II) sulphite in dilute sulphuric acid

Observations

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Equation

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(c) Give one reason why hydrogen peroxide is not used to estimate the concentration of iron (II) ions in volumetric analysis. (1mark)

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6. (a) Explain what is meant by the term first electron affinity? (1mark)

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(b) State three factors that can affect electron affinity. (1 ½ mark)

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(d) The first electron affinities of some of period 3 elements in the periodic table are shown below

Element	Al	Si	P	S
First electron affinity (kJmol ⁻¹)	-44	-134	-71.7	-200

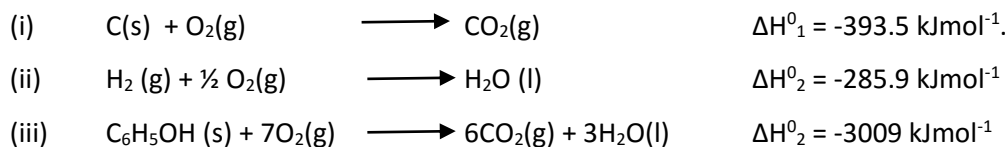
- (i) State the trend in the variation of electron affinities. (½ mark)

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- (ii) Explain your answer in c(i) above (2marks)

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7. (a) The enthalpies of some reactions are given below



Calculate the standard enthalpy of formation of phenol from its elements (3marks)

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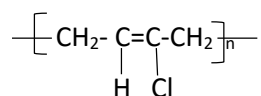
- (b) (i) From your answer in (a) state whether phenol is a stable compound or not (½ mark)

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- (ii) Give a reason for your answer in b(i) above. (01mark)

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(c) Write equation (s) to show how phenol can be synthesized from chlorobenzene. (1½ mark)

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8. (a) Neoprene is a synthetic polymer which has the following structure.



(i) Name the type of polymerization reaction which leads to formation of neoprene. (½ marks)

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(ii)

(i) Write the structure and name the neoprene. (1marks)

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(b) When 350g of the monomer was polymerized 9.89×10^{-2} moles of neoprene was formed. Calculate the relative molecular mass of neoprene. (2marks)

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(c) State one use neoprene (½ mark)

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9. Calculate the pH of 0.1 mol dm^{-3} solution of aluminium nitrate.

(Acid dissociation constant, K_a , at 25°C for $\text{Al}(\text{H}_2\text{O})_6^{3+}$ mol dm^{-3}) (3marks)

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SECTION A

(Attempt only questions in this section)

10 (a) Explain what is meant by the term common ion effect. (1mark)

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(b) Silver chromate is sparingly soluble in water

Write

(i) Equation for the solubility of silver chromate in water (1 ½ mark)

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(ii) The expression for the solubility product, K_{sp} , for silver chromate. (½ mark)

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(c) A saturated solution of silver chromate contains 2.4×10^{-2} g per liter at 20°C . Calculate the value for the solubility product, K_{sp} , for silver chromate at 20°C .

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(d) chloride ions is solution can be determine by titration with silver nitrate in the presence of chromate ions. The end point is indicated by a red precipitate of silver chromate.

(i) Explain why silver chromate does not precipitate until the end point is reacted (01marks)

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(ii) 25cm³ of a solution containing 0.1moles of potassium chloride and 0.001 moles of chromate ion is required on titration 50cm³ of 0.1M silver nitrate solution to reach the end point. Calculate the concentration of chloride ions at the end point.

[solubility product for silver chloride is $1.6 \times 10^{-10} \text{mol}^2 \text{l}^{-1}$]

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11. (a) A compound Y contains carbon, hydrogen and nitrogen. On combustion, 0.72g of Y produced 1.615g of carbon dioxide and 0.42g produced 84cm³ of nitrogen at 15°C and 760mmHg.

Calculate the empirical formula of Y

(4 ½ marks)

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(b) When Y was vaporized, it took 38seconds to diffuse through the same porous partition under similar conditions whereas oxygen takes 28s. calculate the molecular formula of Y (03minutes)

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(c) Y reacts with a mixture of concentrated hydrochloric acid and aqueous sodium nitrite to form a yellow oily liquid.

(i) Identify Y

(½ mark)

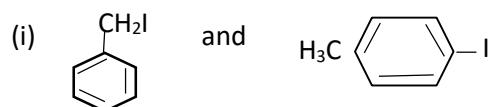
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(ii) Write equation for the reaction that takes place

(1mark)

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12. Name the reagents that can be used to distinguish between the following pairs of compounds. In each case state what would be observed if each member of the pair is separately treated with the reagent. (03marks)



Name of reagent(s)

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Observations

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(ii) 

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and $\text{CH}_3\text{CH}_2\text{N}\equiv\text{NCl}$

Name of reagent(s)

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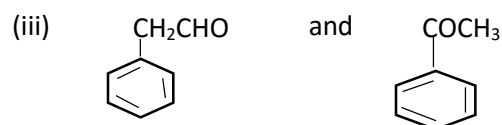
Observations

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Name of reagent(s)

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Observations

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13 (a)(i) Compare the reactivity of hydrides of group (VII) elements with concentrated sulphuric acid.

(write equation (s) for the reaction(s) which takes place if any)

(04marks)

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(i) Give a reason for the difference in reactivity shown by the hydrides in (a)(i) above. (1mark)

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(b) The bond length of hydrides of group (VII) elements are given in the table below

Hydride	HF	HCl	HBr	HI
Bond length (Å)	0.86	1.28	1.42	1.60

(i) State the trend in the variation of bond length of the hydrides. (1mark)

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(ii) Explain your answer in (b)(i) above (3marks)

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14. (a) Nitrogen reacts with hydrogen in a mole ratio of 1:3 to form ammonia.

Write

(i) equation for the reaction that takes place.

(1 ½ mark)

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(ii) the expression for the equilibrium constant (K_c)

(½ mark)

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(b) State the conditions used to obtain maximum yield of ammonia during its manufacture by the Haber process.

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(c) the percentage of ammonia in equilibrium mixture of gases was found to be 15% at 600°C.

Calculate the equilibrium constant (K_c) for the reaction at 600°C.

(4marks)

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(d) State what would happen to equilibrium position of the reaction in a(i) above when hydrogen chloride gas is added to the equilibrium mixture. Give a reason for your answer. (1 ½ mark)

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15. Write equation to show how the following conversions can be effected. (3marks each)

(a) Ethanol to benzene

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(b) 1,2-dibromoethane to ethanol

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(c) Phenylpropane to phenol

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16 (a)(i) State three characteristic properties exhibited by cobalt as a transition element. (½ mark)

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(ii) Explain why zinc is not considered to be a transition element.

(2marks)

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(b) Cobalt (II) nitrate decomposes on heating in the absence of air forming a green solid and dissolves in water forming a pink solution.

(i) Write equation for the decomposition of cobalt (II) nitrate.

(1 ½ marks)

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(ii) Name the species responsible for the pink color of the solution.

(1mark)

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(c) to the aqueous solution in (b) was added concentrated hydrochloric acid dropwise until in excess. State what was observed and write equation for the reaction that took place.

(i) observation

(ii) equation

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17. (a) Explain is meant by partition coefficient.

(2marks)

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(b) The table below shows the concentrations of iodine in the two layers shaken with a mixture of carbon tetrachloride and water at 25°C.

Concentration of I ₂ in CCl ₄ /moldm ⁻³	6.12	12.24	15.20	22.38
Concentration of I ₂ in water /moldm ⁻³	0.072	0.143	0.178	0.260

(i) Plot a graph of concentration of iodine in carbon tetrachloride against concentration of iodine in water.

(03marks)

(ii) from the graph determine the partition coefficient for iodine distributed between carbon tetrachloride and water.

(02 mark)

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(c) State two applications of partition coefficient

(2marks)

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END

