Our country, our future

525/1

S6 CHEMISTRY

Exam 15

PAPER 1

DURATION: 2 HOUR 45 MINUTES

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

Answer all question in part I and six questions in part II
All questions are to be answered in the spaces provided
Periodic table, with relative atomic masses, is supplied at the end of the paper.
Simple calculator may be used

For Examiners use only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

1. Complete the following equation of radioactive decay

(a) $^{233}_{91}Pa \longrightarrow$ -β + ……. $\longrightarrow$ $^{4}_{2}He$ + ……. (2marks)

(b) $^{223}_{88}Ra \longrightarrow$ …… + $^{219}_{86}Rn \longrightarrow$ …… + $^{215}_{84}Po$ (2marks)

(c) $^{207}_{81}Ti \longrightarrow$ …….. + $^{207}_{82}Pb$ (1 mark)

2. Draw the shapes and name the structure of each of the following species

Species	Shape	structure
i. H_2O		
ii. CO_2		

iii. H_3O^+

iv. PCl_5

3. Write an equation for dissolution of each of the following salt in water. State whether the resulting solution would be neutral, basic or acidic

(a) chromium (III) chloride (2marks)

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(b) Magnesium chloride (1mark)

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(c) ammonium methanoate (2marks)

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4. (a) Complete the following equations

i. $CH_3CH_2COCH_3 + H_2NNH\text{-}C_6H_5 \longrightarrow$ …… (1mark)

ii. $C_6H_5COOH + CH_3OH \xrightarrow{H^+}$ …… (1½ mark)

iii. $nCH_2= \underset{\displaystyle Cl}{\underset{|}{C}}H\text{-}C = CH_2 \longrightarrow$ …… (1mark)

iv. $(CH_3)_3C\text{-}Br + OH^-(aq) \longrightarrow$ ……. (1mark)

(b) State the name of the mechanism of the reaction in (a)(iv) (2marks)

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5. 20.0cm^3 of 0.02M sodium hydroxide was added to 30 cm^3 of 0.025M sulphuric acid. Calculate

a. Molar concentration of the hydrogen ions in the initial sulphuric acid (1 mark)

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b. Concentration of hydrogen ions in the resultant solution (3marks)

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c. The pH of the resultant solution (1mark)

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6. (a) Write the electron configuration of an atom of titanium (1mark)

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(b) State the possible oxidation number of Titanium (1mark)

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(c) For each of the oxidation state states in (b), write the formula of a species in which titanium show the oxidation state

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7. Name one regent that can be used to distinguish between each of the following pairs of compound and state what would be observed in each case if the reagents reacted with the compounds.

(a) $C_6H_5COCH_2CH_3$ and $C_6H_5COCH_3$ (3marks)

Reagent

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……..……

Observations

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(b) $CH_2CH_2CH_2OH$ and $(CH_3)_3COH$ (3marks)

Reagent

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Observations
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8. The convention of a cell is given below

$Pt/Fe^{2+}(aq), Fe^{3+}(aq) \parallel MnO_4^-(aq)\ Mn^{2+}(aq), H^+(aq)/Pt.$

(a) Write equation for the half cell reaction at

(i) anode (1marks)

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(ii) cathode (1marks)

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(b) Write the overall equation for the cell reaction (1½ marks)

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(c) The electrode potential of system $Fe^{3+}(aq)/Fe^{2+}(aq)$ and $.MnO_4^-(aq)/Mn^{2+}(aq)$ are +0.76 and 1.51 volts respectively. Deduce whether the reaction in (b) is feasible or not and give a reaction for your answer.

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9. Write an

(i) equation for the reaction between hydrogen and nitrogen.

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(ii) expression for equilibrium constant of the reaction in (a)(i) above.

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(b) When hydrogen was reacted with nitrogen at 895K, the total pressure for the system at equilibrium was 30 atmospheres, and the partial pressure of nitrogen and hydrogen were 2 and 6 atmospheres respectively.

(i) Determine the partial pressure of ammonia in equilibrium mixture

(ii) Calculate equilibrium constant

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Section B

Answer six questions from this section

10. (a) State the oxidation state of chromium in

(i) Potassium chromate (1mark)

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(i) Potassium dichromate (1mark)

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(b) Acidified potassium dichromate was reacted with potassium iodide

(i) state what was observed (1mark)

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(ii) Write half equations and overall equations for the reactions. (4marks)

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(c) Potassium chromate solution was added to aqueous Lead (II) nitrate

(i) State what was observed (1½ marks)

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(ii) Write the ionic equation for the reaction

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11. Complete the following reactions and suggest mechanisms for the reaction

(a) $2(CH_3)_2CO \xrightarrow[\text{Room temp.}]{\text{dil NOH}}$ (3 ½ marks)

Mechanism

(b) $C_6H_5\text{-}NHCH_3 + (CH_3CO)_2O \longrightarrow$

(3 marks)

Mechanism

(c) CH_3-(C_6H_4)-OH + CH_3CH_2Br $\xrightarrow{NaOH(aq),\ Heat}$ (2 ½ marks)

Mechanism

12 (a) What is meant by term electropositivity? (2marks)

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(b) Explain the variations in the electropositivity of the following elements

(i) C, Ge and Sn (3½ marks)

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(ii) Mg, Al, P and Cl (3½ marks)

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13 (a) State Kohlrausch's law of independent Conductivity of ions (1mark)

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(b) Some ionic conductivity at infinite dilution at 25^0C are shown below

Ion	Ionic conductivity ($\Omega^{-1}cm^2$)
OH^-	198.6
Cl^-	76.4
NH_4^+	73.6
Na^+	50.1

Calculate the molar conductivity of ammonium hydroxide at infinite dilution (2marks)

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(c) The ionic radii and ionic conductivities at infinite dilution of some ions are shown in the table below:

Ion	Ionic radius/nm	Ionic conductivity/$\Omega^{-1}cm^2$
Li+	0.060	38.7
Na+	0.095	50.1
K+	0.133	73.5

Explain the results in the table (3marks)

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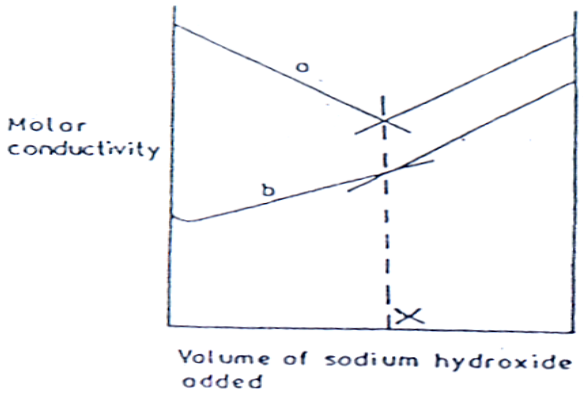
(d) The diagram below shows curves a and b obtained when aqueous sodium hydroxide was gradually added separately to equimolar
solution of hydrochloric and ethanoic acid separately



Explain the shape of the curves

(i) curve a (1½ marks)

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(ii) Curve b (1½ marks)

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14. Compound Y, C_3H_6O reacts with 2, 4-dinitrophenylhydrazine to give a yellow solid.

(a) Write the structural formulae and IUPAC names of all isomers of Y. (2 marks)

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(b) When Y is heated with Fehling's solution, a red precipitate is formed, Identify Y (1 mark)

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(c) Write a mechanism for the reaction that would take place between Y and hydroxylamine, NH_2OH. (3 marks)

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(d) Write equations to show how Y can be converted to an alkene (3marks)

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15. (a) An aqueous solution containing 7.2g of a non-cyclic substance Q in 250g of water freezes at -0.744^0C. the freezing point constant, K, for water is 1.86$mol^{-1}kg^{-1}$. (3marks)

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(b) If Q contains carbon, 66.7%, hydrogen, 11.1% and oxygen 22.2%

(i) Calculate the simplest formula of Q (2 mark)

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(ii) Determine the molecular formula of Q (1 mark)

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(iii) Write the structures of all possible isomers of Q 1½ mark)

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(d) Q forms a yellow precipitate with phenyl hydrazine and iodine solution in presence of sodium hydroxide. Identify Q.(½ mark)

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16. The solubility product, Ksp, of zinc hydroxide is 4.5 x 10^{-17} at 25^0C

(i) Write an expression for solubility product of zinc hydroxide (1½ marks)

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(b) Determine the concentration in moles per litre of zinc hydroxide ions in a saturated solution of zinc hydroxide at 25^0C (3marks)

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(c) State how solubility of zinc hydroxide would change if its saturated solution is treated separately with

(i) aqueous zinc sulphate (1 mark)

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(ii) ammonia (1mark)

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(d) Briefly explain your answer in (c). (3marks)

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17. Figure 2 is a phase diagram for a certain substance

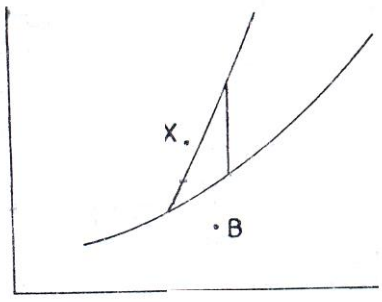

Fig.2

(a) Label the following on the diagram (4marks)

(i) the axes

(ii) the phases present

(iii) the critical temperature

(iv) the triple point

(b) Define the term

(i) Critical point (1 marks)

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(ii) triple point (1mark)

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(c) Explain what would happen when the substance at point X changes to point B

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End