Our country, our future
525/1

S6 CHEMISTRY

Exam 9

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

SECTION A
(Answer all questions)

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 (2marks each)

	Species	Shape	name of the shape
i.	H_2O		
ii.	CO_2		
iii.	H_3O^+		

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 ½ 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 aluminium (1mark)

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(b) State the possible oxidation number of aluminium (½ mark)

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(c) Write an ionic equation for the reaction between aluminium and sodium hydroxide (1½ marks)

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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. (1mark)

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9. Write an

(i) equation for the reaction between hydrogen and nitrogen. (1 marks)

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(ii) expression for equilibrium constant (Kp) of the reaction in (a)(i) above. And state its units (2marks)

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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 (1mark)

(ii) Calculate equilibrium constant (1 ½ marks)

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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. (3marks)

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

(i) State what was observed (1½ mark)

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(ii) Write the ionic equation for the reaction (1½ mark)

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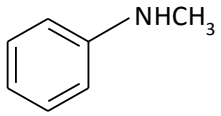
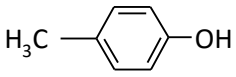
11. Complete the following reactions and suggest mechanisms for the reaction

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

Mechanism

(b)  + $(CH_3CO)O$ ⟶ (3 marks)

Mechanism

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

Mechanism

12 Explain the following:

(a) Aqueous solutions of chromium (II) and chromium (III) are colored while that of copper (I) is not (3marks)

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(b) Manganese, iron, cobalt and nickel form ions in the $^{+}2$ oxidation states. State which decrease in size from manganese to nickel. (2 marks)

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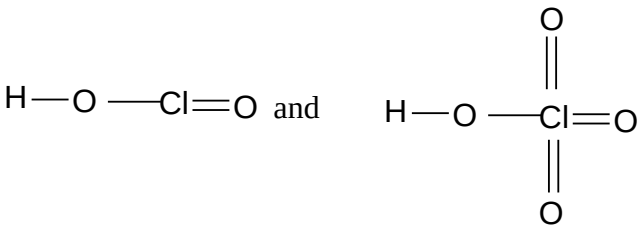
(c) The oxy-acids, $HClO_2$ and $HClO_4$ have the following respective structures.



Explain why $HClO_4$ is stronger acid than $HClO_2$
(Assume that oxygen is more electronegative than chlorine (2 marks)

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(d) Iron III sulphate solution changes litmus paper red (2 marks)

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

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(b) Some ionic conductivity at infinite dilution at 250C 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 values in the table (3 marks)

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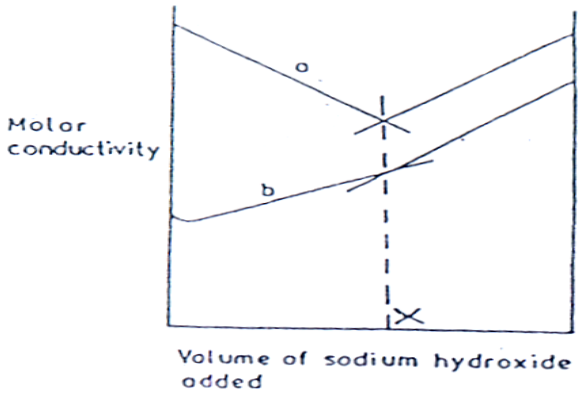
(d) The diagram below shows curves a and b obtained when aqueous sodium hydroxide was gradually added separately to equimolar solution of hydrochloric and ethanoic acid separately



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 $1.86mol^{-1}kg^{-1}$. (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. (1½ mark)

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16. The solubility product, Ksp, of zinc hydroxide is 4.5×10^{-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

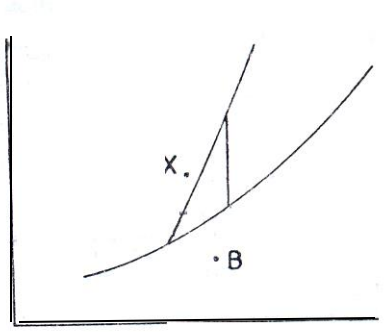

Fig.2

(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 (1½ marks)

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(ii) triple point (1½ mark)

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(c) Explain what would happen when the substance at point X changes to point B (2marks)

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Periodic Table

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 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 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	207 Ti 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															
			139 La 57	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
			227 AC 89	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	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

End