

P525/1
Chemistry
Paper 1
July - August 2024
2¾ hours



UGANDA MUSLIM TEACHERS' ASSOCIATION
UMTA JOINT MOCK EXAMINATIONS - 2024

NAME.....
INDEX NO..... SIGNATURE.....

UGANDA ADVANCED CERTIFICATE OF EDUCATION
Chemistry
Paper 1
2 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

- 1 atmosphere = 101325 Nm^{-2}
- All questions must be answered in the spaces provided.
- Answer all questions in Section A and six questions in Section B.
- Illustrate your answers with equations where applicable.
- Molar gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$.
- Molar volume of a gas at s.t.p is 22400 cm^3
- Standard temperature = 273 K
- Standard pressure = 101325 Nm^{-2}
- The periodic table with relative atomic masses will be provided.

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 from this section

1. (a) Polonium, $^{216}_{84}\text{Po}$ undergoes nuclear decay to give element M according to the following equation

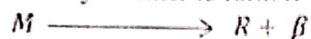


State

(i) The atomic number of M (½ mark)

(ii) The mass number of M (½ mark)

- (b) M decays further to form R as shown below



State

(i) The atomic number of R (½ mark)

(ii) The mass number of R (½ mark)

- (c) A sample of M had an initial activity of 104 counts per second. After 12 minutes the activity had reduced to 100 counts per second. Calculate the half-life of M . (2½ marks)

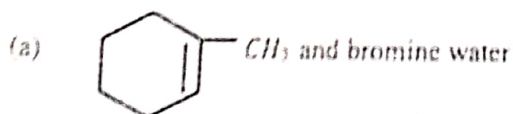
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2. State what would be observed and write equation(s) for the reaction(s) that would take place when the following pairs of substances are mixed.



Observation


(01 mark)

Equation

(01 mark)

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(b)  CH_2OH and phosphorus pentachloride.

Observation

(½ mark)

Equation

(01 mark)

(c) $\text{CH}_3\text{CH}(\text{CH}_3)\text{NH}_2$ and sodium nitrite in concentrated hydrochloric acid

Observation

(½ mark)

Equation

(01 mark)

3. The table below shows the trend in the melting points of group IV dioxides.

Formula of oxide	CO_2	SiO_2	GeO_2	SnO_2	PbO_2
Melting points ($^\circ\text{C}$)	-18	1700	1120	1830	752

(a) Explain the trend in melting points of the dioxides.

(4½ marks)

(b) Write equation for the reaction between lead (IV) oxide and aqueous sodiumhydroxide. (1½ marks)

1.38g of a compound Q made up of carbon, oxygen and hydrogen atoms only was burnt, 672cm³ of carbondioxide measured at s.t.p and 0.54g of water were formed.

(a) (i) Calculate the empirical formula of Q. (03 marks)

(ii) Determine the molecular formula of Q, given that its relative molecular mass is 46. (01 mark)

(b) Compound Q reacts with a saturated solution of sodium hydrogen carbonate liberating carbondioxide gas. Identify Q. (½ mark)

(c) A hot solution of Q was added to acidified potassium manganate (VII) solution.

(i) State what was observed. (½ mark)

(ii) Write equation for the reaction that took place.

(1½ marks)

5. The standard electrode potentials for some half cells are shown below;



E^θ/V

+ 1.23



+2.20

(a) Write

(i) The cell notation for the cell formed when the half cells are combined.

(1½ mark)

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(ii) The equation for overall cell reaction.

(01 mark)

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(b) (i) Calculate Gibb's free energy for the cell in (a).

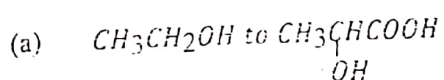
(01 mark)

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(ii) State whether the cell reaction is feasible or not. Give a reason for your answer. (01 mark)

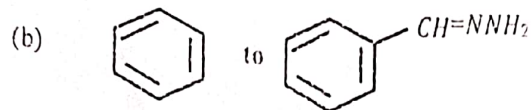
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6. Using equations show how the following conversion can be brought about.



(2½ marks)

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(2½ marks)

7. Write equation for the reaction that takes place when the following are mixed.

(a) Trileadtetraoxide and concentrated nitric acid.

(1½ marks)

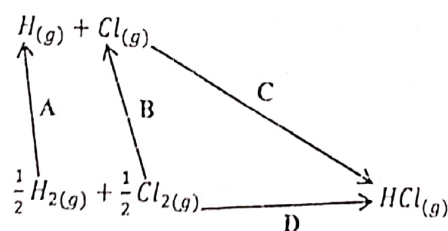
(b) Aqueous sodium hydroxide solution and
(i) Zinc

(1½ marks)

(ii) Silicon tetrahydride

(1½ marks)

8. The energy diagram for the reaction between hydrogen and chlorine is given below;



(a) Identify the energy changes

A.....($\frac{1}{2}$ mark)

B.....($\frac{1}{2}$ mark)

C.....($\frac{1}{2}$ mark)

D.....($\frac{1}{2}$ mark)

(b) Calculate the enthalpy change for the reaction (2½ marks)

(The $H-H$, $Cl-Cl$ and $H-Cl$ bond energies are 435.9 , 241.8 and $431.0 \text{ kJ mol}^{-1}$)

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9. (a) 9.8g of an organic compound *W* containing carbon and hydrogen only was burnt in excess oxygen, 31.55g of Carbondioxide and 10.76g of water were formed. Determine the empirical formula of *W*. (03 marks)

- (b) *W* was steam distilled at 70°C and 760 mmHg and the distillate was found to contain 8.9% by mass of water. Calculate the formula mass of *W*. (Vapour pressure of water at 70°C is 234 mmHg)

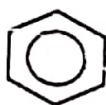
(03 marks)

SECTION B

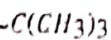
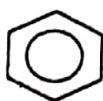
Answer six questions from this section

10. Write a mechanism to show how each of the following conversions can be effected.

(a)



to



(03 marks)

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(b) CH_3COCH_3 to $(\text{CH}_3)_2\text{C}=\text{NOH}$

(4½ marks)

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(c) $(\text{CH}_3)_2\text{C}=\text{CH}_2$ to $(\text{CH}_3)_2\overset{\text{Br}}{\underset{|}{\text{C}}}\text{CH}_3$

(1½ marks)

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11. (a) (i) Sketch a graph to show the pH changes that take place when Benzoic acid is titrated into Sodium Hydroxide Solution. (1½ marks)

(ii) Explain the shape of your sketch graph in (a) (i).

(3½ marks)

(b) Calculate the pH of the resultant solution formed when 20cm³ of 0.1M potassium hydroxide solution was added to 40cm³ of 0.05M benzoic acid at 25°C, ($k_a = 6.3 \times 10^{-5} \text{ mol dm}^{-3}$)

(04 marks)

12. Briefly explain what would be observed when the following are mixed.

(a) Chlorine and Sulphurous acid.

(03 marks)

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(b) Hydrogen sulphide gas and acidified potassium dichromate (VI) solution.

(03 marks)

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(c) Acidified solution of hydrogen peroxide and iodine solution.

(03 marks)

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13. (a) State why transition elements form complexes.

(1½ marks)

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- (b) Iron (III) sulphate was dissolved in water and the resultant solution tested with litmus paper. State what was observed and explain your answer. (3½ marks)

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- (c) State what would be observed and write equation for the reaction that would take place when the following solutions are added to the solution in (b).

(i) Ammonium thiocyanate solution.

(02 marks)

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(ii) Potassium hexacyanoferrate (II) solution.

(02 marks)

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14. (a) A mixture of 86cm^3 of a gaseous hydro carbon Y was exploded with 1015cm^3 of oxygen which was in excess. The volume after explosion and cooling to room temperature was 800cm^3 . After addition of concentrated potassium hydroxide solution there was a contraction in volume of 774cm^3 .

(i) Determine the molecular formula of Y.

(03 marks)

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- (ii) Y burns with a sooty flame. Write the structural formulae and IUPAC names of all possible isomers of Y. (03 marks)

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- (b) When treated with concentrated sulphuric acid at 25°C compound Y formed another compound Z. When warmed with water compound Z gave compound X that gave no observable change when treated with hot acidified potassium dichromate solution.

Identify (01 mark)

(i) Y..... (01 mark)

(ii) Z..... (01 mark)

- (c) Name a reagent that can be used to identify the functional group in compound X and state what is observed when this reagent is reacted with X. (03 marks)
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15. (a) Define the term solubility product. (01 mark)
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(b) Manganese (II) sulphide is a sparingly soluble salt. Write the expression for;

(i) the solubility of manganese (II) sulphide in water.

(01 mark)

(ii) the solubility product of manganese (II) sulphide.

(01 mark)

(c) The solubility product of manganese (II) sulphide is $2.5 \times 10^{-13} \text{ mol}^2 \text{ dm}^{-6}$ at 25°C . Calculate its solubility in water.

(02 marks)

(d) 10 cm^3 of 0.01 M silver nitrate solution was mixed with 20 cm^3 of 0.0005 M of potassium chloride solution.

(i) Determine whether precipitation of silver chloride will take place or not.
(K_{sp} of AgCl at that temp is $1.7 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$)

(2½ marks)

(ii) State any two applications of solubility product.

(01 mark)

16. Polyphenylethene and nylon - 6,6 are both synthetic polymers.
 (a) In each case write the structural formula(e) of the monomer(s); indicate whether the polymer is formed by addition or condensation polymerization and write the structural formula of the polymer. (03 marks)

Polymer	Structural formula of monomer	Method of formation of polymer	Structural formula of polymer
Polyphenylethene			
Nylon - 6, 6			

(b) State one use of

(i) polyphenylethene

(½ mark)

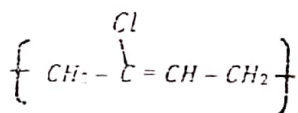
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(ii) Nylon - 6,6

(½ mark)

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(c) Neoprene is an addition polymer of structure



(i) Define the term addition polymer.

(01 mark)

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- (ii) A solution containing 1.4% of neoprene was found to exert an osmotic pressure of 3.5×10^{-4} atmospheres at 25°C .

Calculate the relative molecular mass of neoprene.

$$(R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1})$$

(2½ marks)

- (iii) Determine the number of monomers(n) that formed neoprene.

(1½ marks)

17. Nitrogen monoxide combines with oxygen to form nitrogen dioxide according to the equation



- (a) Write the expression for the equilibrium constant, K_c .

(01 mark)

- (b) (i) 3 moles of nitrogen monoxide and 1.5 moles oxygen were put into a vessel which was heated to 40°C . When equilibrium was established the vessel found to contain 0.5 moles of oxygen. Calculate the value of K_c at this temperature.

(02 marks)

- (ii) When the temperature was raised to 500°C the mixture in (i) was found to contain 25% of the initial nitrogen monoxide. Calculate the equilibrium constant at this temperature. (03 marks)

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- (c) From your answer to (b) (i) and (ii) deduce whether the process is endothermic or exothermic and explain how you arrive at this deduction. (02 marks)

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- (d) What would be the effect on K_c when a catalyst is added to the reaction mixture? (01 mark)

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THE 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	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															
			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

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