P525/1
CHEMISTRY
Paper 1
July / Aug.2023
2 ¾ hours

UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **ALL** questions in Section A and **six** questions in Section **B.**

All questions must be answered in the spaces provided.

Mathematical tables (3- figure) and non-programmeable electronic calculators may be used.

Illustrate your answers with equations where applicable.

Molar gas constant, $R = 8.31 JK^{-1}mol^{-1}$

Molar volume of a gas at s.t.p. is 22.4 litres.

Standard temperature = 273 K

Standard pressure = $101325 Nm^{-2}$

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

Turn Over

SECTION A

I. (a) Define the following terms;

        (i) Radio activity.   (01 mark)

....

....

....

        (ii) Relative atomic mass.   (01 marks)

....

....

....

(b) Complete the following equations for radioactive reactions.

        (i) $^{27}_{13}Al + ^{1}_{0}n \longrightarrow \beta + $ ....

                                            (½ mark)

        (ii) $4^{1}_{1}H \longrightarrow ^{4}_{2}He + $ .... (½ mark)
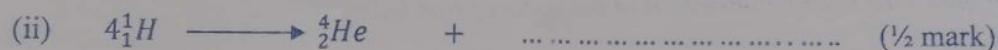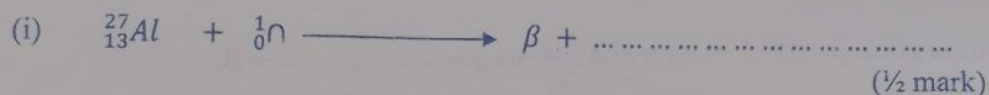
(c) An element X has two naturally occurring isotopes with relative isotopic masses and proportions shown below.

Isotopic mass	Relative abundance
81	49.5
79	50.5

Calculate the average atomic mass of **X**.   (1 ½ marks)

....

....

....

....

....

....

2

2. (a) Define the following terms:
   (i) Catalyst. (01 mark)

   ....

   ....

   ....

   ....

   (ii) Activation energy. (01 mark)

   ....

   ....

   ....

   ....

   (b) Potassium iodide was added to potassium peroxodisulphate solution.
   (i) State what was observed. (½ mark)

   ....

   (ii) Write equation for the reaction that takes place. (½ mark)

   ....

   ....

   (c) (i) Name the catalyst used in the above reaction. (½ mark)

   ....

   (ii) Give a reason for your answer in (c) (i). (1 ½ marks)

   ....

   ....

   ....

3. Complete each of the following equations and name the main organic product(s).

   (a) ⬡ $+ \ C_6H_5COCl \ \xrightarrow{\ AlCl_3\ }$ (01 mark)

   ....

   ....

3

(b) $CH_3CH = CH_2$ $\dfrac{(i)\quad O_3/CCl_4/ < 20^0C}{(ii)\quad Zn/H_2O/\ CH_3COOH}$ ....

(c)

$\dfrac{CH_3I}{Na\ Dryether}$ ....

....
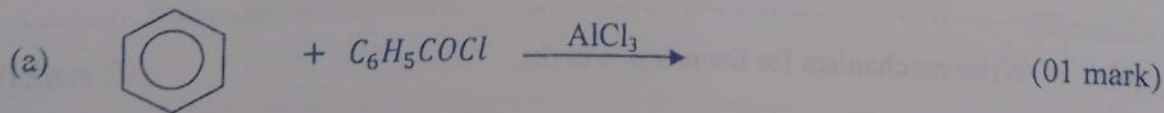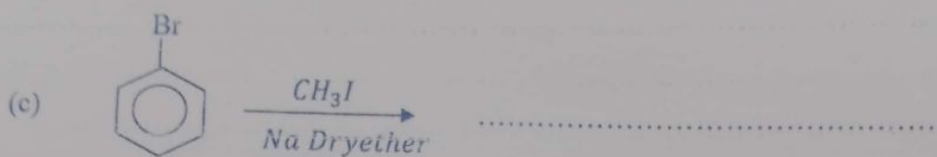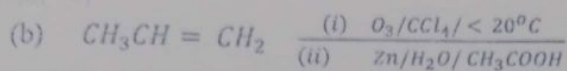
(01 mark)

4.   (a)   Define the term **bond energy**.

(01 mark)

....

....

....

(b)   Some bond energies are given in the table below:

Bond	Energy (KJmol^{-1})
$Cl - Cl$	242
$C - H$	435
$C - Cl$	339
$H - Cl$	431

Determine the enthalphy change for the formation of chloromethyl benzene from methylbenzene and chlorine in presence of ultra violet light.

(1 ½ marks)

....

....

....

....

....

....

(c)   Write mechanism for the reaction in (b).

(02 marks)

....

....

....

4

. . . .

. . . .

. . . .

5. (a) Define the following terms;
      (i) **Electrolytic conductivity.** (01 mark)

. . . .

. . . .

. . . .

. . . .

      (ii) **Molar conductivity.** (01 mark)

. . . .

. . . .

. . . .

. . . .

(b) The electrolytic conductivity of 0.016M solution of ethanoic acid is $1.96 \times 10^{-2} \Omega^{-1} cm^{-1}$ at 20°C and its molar conductivity at infinite dilution is $3.5 \times 10^{-2} \Omega^{-1} cm^2 mol^{-1}$ at the same temperature. Calculate;

      (i) Molar conductivity of ethanoic acid at 20°C. (01 mark)

. . . .

. . . .

. . . .

. . . .

      (ii) Degree of ionization of ethanoic acid at 20°C. (01 mark)

. . . .

. . . .

. . . .

. . . .

      (iii) pH of the acid. (02 marks)

. . . .

. . . .

. . . .

(iv)   Hence deduce the acid dissociation constant of ethanoic acid. (1 mark)

....

....

....

....

6.   Carbon, silicon, germanium, tin and lead are group IV elements of the periodic table.

(a)   Explain why carbondioxide is gas at room temperature while silicon (IV) oxide is solid at room temperature.   (03 marks)

....

....

....

....

....

(b)   (i)   Apart from the physical state of the oxides, state two other properties in which carbon differs from other members of the group.   (01 mark)

....

....

....

....

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

....

....

....

....

....

9. (a) Write general outer configuration of group II elements. (½ mark)

....

(b) Describe the reaction of any of the following elements; beryllium, magnesium and calcium with:

(i) Dilute sulphuric acid. (2 ½ marks)

....

....

....

....

....

(ii) Sodium hydroxide solution. (1 ½ marks)

....

....

....

....

(c) The table below shows the trend in melting point of Group II elements.

Element	Be	Mg	Ca	Sr	Ba
Melting point (^{o}C)	1287	649	839	768	727

Explain the trend in melting point. (3 ½ marks)

....

....

....

....

....

....

....

....

....

8

Answer any six(6) questions from this section

10. (a) Define the term **cryoscopic constant.** (01 mark)

....

....

(b) The data below shows freezing point of solutions of various concentration of a non – volatile solute D in water at 1 atmosphere.

Concentration of D (g/dm³)	0	30	60	90	120	150
Freezing point (°C)	0	-0.16	-0.32	-0.49	-0.65	-0.81

Draw a graph of freezing point depression against concentration of D. (04 marks)

10
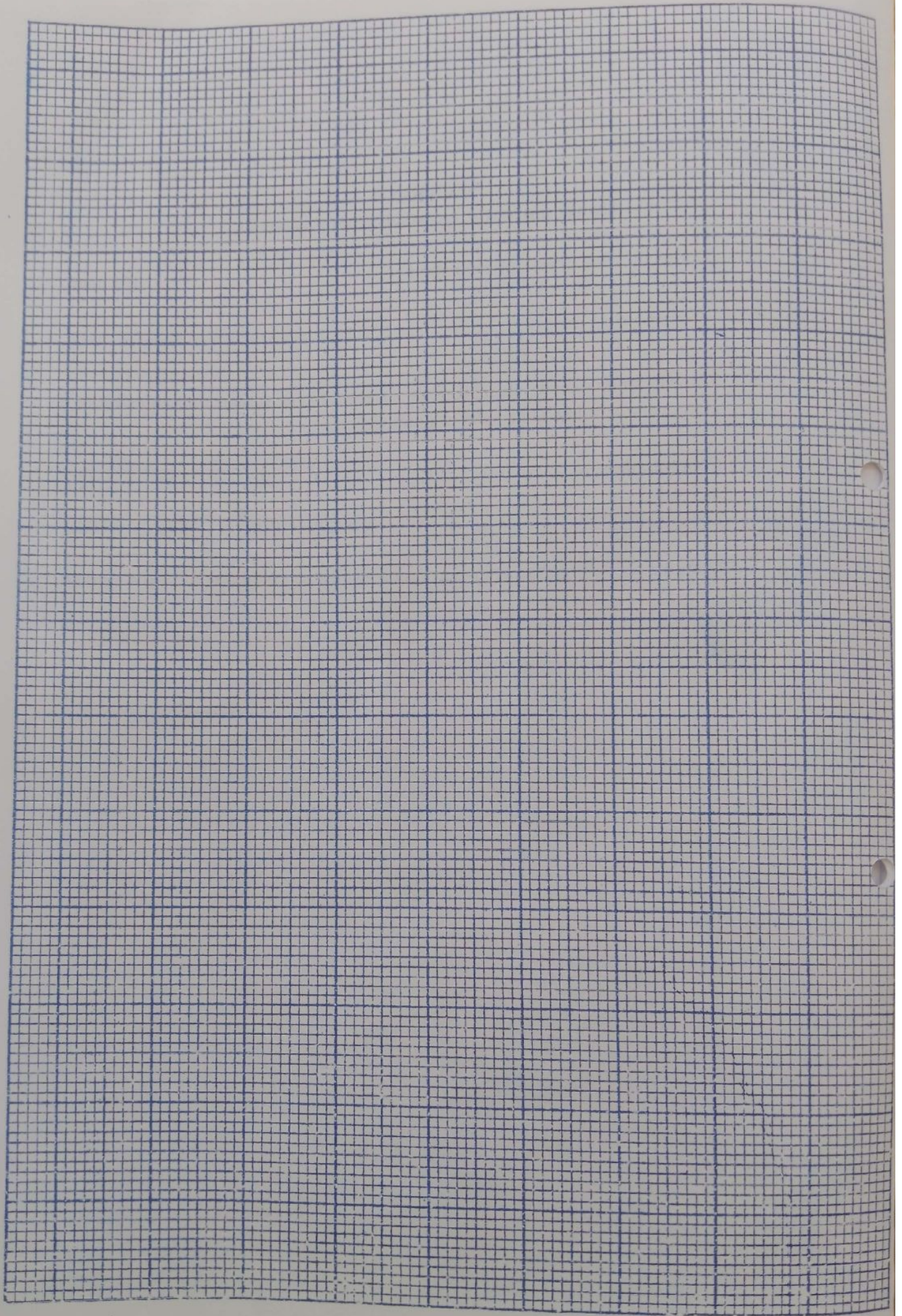
(c)   Determine the;

(i)   Slope of the graph you have drawn in (b).   (1 ½ marks)

....
....
....

(ii)   Relative molecular mass of D. (K_f of water = $1.86°C$ mol^{-1} 1000g of water).   (2 ½ marks)

....
....
....
....

11. (a)   Define the terms;

(i)   **Eutectic mixture.**   (01 mark)

....
....

(ii)   **Phase**   (01 mark)

....
....

(b)   The figure below shows a phase diagram of an aqueous solution of potassium nitrate.

Percentage of potassium nitrate

11
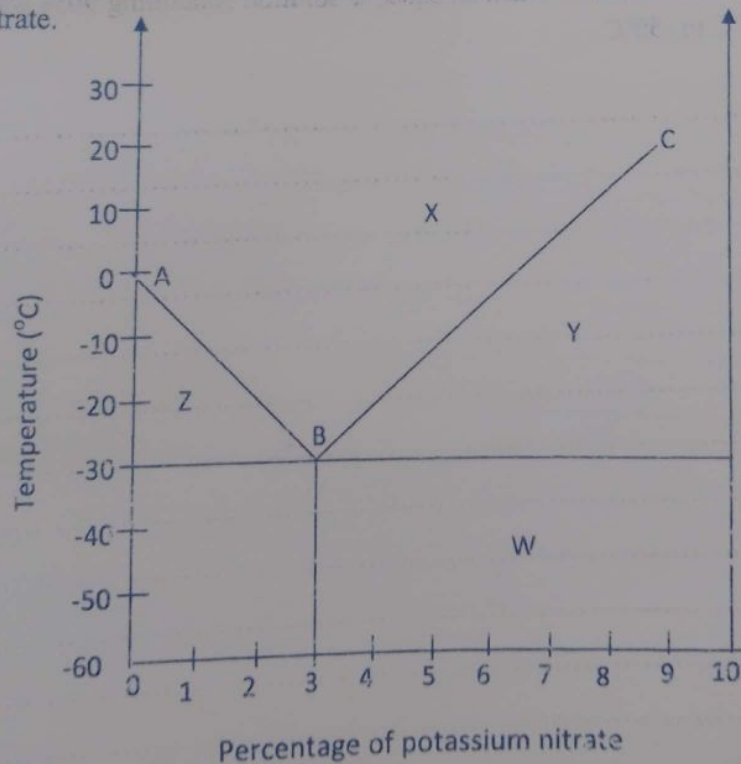
(i)   X   (½ mark)

....

(ii)   Y   (½ mark)

....

(iii)   Z   (½ mark)

....

(iv)   W   (½ mark)

....

(c)   Name the curves;
      (i)   AB   (½ marks)

....

      (ii)   BC   (½ mark)

....

(d)   Describe what happens when an aqueous solution containing 90% water is cooled
      from 30°C to -50°C.   (3 ½ marks)

....

....

....

....

....

....

....

....

....

....

....

....

....

(e) State one application f eutectic mixture. (½ mark)

....

12. Name a pair of classes of organic compounds which can be distinguished by each of the following reagents, in each case, state what is observed and write equation(s) for the reaction(s) which take place.

(a) Ammoniacal silver nitrate solution. (03 marks)

....

....

....

....

....

....

....

(b) Bromine water. (03 marks)

....

....

....

....

....

....

....

(c) Neutral iron (III) chloride solution. (03 marks)

....

....

....

....

....

....

....

....

13. State what is observed and in each case explain your observation when;
    (a) Limited amount of chlorine is bubbled through sodium thiosulphate solution.
        Observation (01 mark)

....

....

        Explanation (08 marks)

....

....

....

....

....

....

    (b) Dilute sulphuric acid is added to copper (I) oxide;
        Observation (01 mark)

....

....

        Explanation (02 marks)

....

....

....

....

....

    (c) Dilute hydrochloric acid is added to sodium thiosulpate solution.
        Observation (01 mark)

....

....

Explanation (02 marks)

....

....

....

....

....

....

14. (a) A hydrocarbon **T** is composed of 88.9% carbon. Calculate the empirical formula of **T**. (02 marks)

....

....

....

....

....

....

....

(b) Oxygen travels 1.3 times faster than **T**.
    (i)   Calculate molecular mass of **T**. (01 mark)

....

....

....

....

....

....

....

....

....

(ii)   Determine molecular formula of **T**

(1 ½ marks)

....

....

....

....

(iii)   Write structural formular and names of position isomers of **T**. (02 marks)

....

....

....

....

(c)   **T** reacts with dilute sulphuric acid in presence of mercury (II) sulphate catalyst at 60°C to form compound **Q**.

(i)   Identify **Q**

(½ mark)

....

(ii)   Write equation and suggest mechanism leading to formation of **Q**.

(03 marks)

....

....

....

....

....

....

....

....

....

15.   (a)   Dilute ammonia solution was added to a solution of chromium (III) sulphate drop wise till in excess.

(i)   State what was observed.

(01 mark)

....

....

(ii) Write equation for the reaction that took place. (01 mark)

....

....

(b) To the resultant mixture in (a) was added hydrogen peroxide and the mixture warmed.

(i) State what was observed. (01 mark)

....

....

(ii) Explain your observation. (3 ½ marks)

....

....

....

....

....

....

(c) To the resultant solution in (b) was added dilute sulphuric acid.

(i) State what was observed. (01 mark)

....

....

(ii) Write equation for the reaction that took place. (1 ½ marks)

....

....

16. (a) Silver carbonate is sparingly soluble in water. Write:

(i) Equation of solubility of silver carbonate in water. (1 ½ marks)

....

....

(ii) Expression of solubility product for silver carbonate. (01 mark)

....

....

(b) The solubility product for silver carbonate at 20°C is 8.0×10^{-12} mol^3 dm^{-9}. Calculate the;

(i) Solubility of silver carbonate in water in $moldm^{-3}$ at 20°C. (02 marks)

....
....
....
....
....
....

(ii) Mass of silver carbonate precipitated in 0.1M aqueous solution of potassium carbonate. (4 ½ marks)

....
....
....
....
....
....
....
....
....

17. Explain the following observations:
(a) Phenylamine is a stronger base than ethanamide. (04 marks)

....
....
....
....
....
....

....
....
....
....

(b)   An aqueous solution of iron (III) chloride turns blue litmus paper to red.

(02 marks)

....
....
....
....
....
....

(03 marks)

(c)   Silicon tetrachloride fumes in moist air.

....
....
....
....
....
....

END

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