Candidate's Name:…………………………………………………………………………

	Random No.				Personal No.	

Signature:………………………………

(Do not write your school/ Centre Name or Number anywhere on this booklet.)

P525/1
CHEMISTRY
   Paper 1
Nov./Dec. 2020
   2 ¾ hours

THE CHEMISTRY SYNDICATE–UGANDA
Uganda Advanced Certificate of Education
MOCK EXAMS
CHEMISTRY
Paper 1
2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **all** questions in this Section **A** and **six** questions in Section **B**.*

***All** questions must be written in the spaces provided.*

The Periodic Table, with relative atomic masses, is attached at the end of the paper.

Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used.

Illustrate your answers, with equations where applicable.

Where necessary, use the following;

   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 = 273K.
   Standard pressure = $101325Nm^{-2}$

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

*Answer **all** questions in this section*

1. (a) What is meant by the term **bond energy**? *(01 mark)*

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(b) The bond energies of $C = O$, $C - H$, $C - O$, $C - C$, $C \equiv N$ and $O - H$ bonds respectively are 743, 412, 360, 348, 887 and 463 $kJmol^{-1}$. Calculate the enthalpy change for the reaction below. *(1 ½ mark)*

$$(CH_3)_2C = O \quad + \quad HCN \longrightarrow (CH_3)_2\underset{OH}{C}CN$$

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(c) For each of the following compounds state the type of bonding and structure adopted. *(03 marks)*

Compound	Bonding type	Structure
Iodine		
Calcium fluoride		
Silicon(IV) oxide		

2. 2.09 g of phosphorus(V) chloride were allowed to reach equilibrium at 200°C in a 1 dm^3 capacity vessel. If the equilibrium constant of the above reaction is 4×10^{-6} $moldm^{-3}$ at this temperature and in the conditions stated. Calculate the percentage dissociation of phosphorus(V) chloride at equilibrium.

(04 marks)

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3. (a) State three properties in which carbon differs from the rest of group IV elements. *(1½ marks)*

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(b) Write equations for the reaction between concentrated sulphuric acid and:

(i) carbon *(1 ½ marks)*

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   (ii) Tin *(1 ½ marks)*

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4. A green solid **J** decomposes when heated to form a gas which has a sweet smell and forms a yellow precipitate with 2,4-dinitrophenylhydrazine in acidic medium and dissolves in water to form a pale green solution. The green solution forms a green precipitate, **K** which is soluble in excess ammonia to form a purplish-blue solution, **L**.

(a) Identify **J** *(01 mark)*

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(b) Write equation for the reaction that would take place if **J** is heated with concentrated sulphuric acid. *(1 ½ marks)*

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(c) Write equation(s) for the reaction(s) that lead to formation of:

   (i)   **K** *(01 mark)*

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(ii)   **L**   *(1 ½ marks)*

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(d) Name a reagent that can be used to confirm presence of the cation in J in qualitative analysis   *(1 mark)*

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5. (a) What is meant by the term **steam distillation**?   *(1 ½ marks)*

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(b) A compound **T** is immiscible with water and forms a mixture which boils at 92°C. If the total vapour pressure of the mixture is 101.3kPa and the vapour pressure of water at the same temperature is 88.2 kPa, determine the percentage composition by mass of the mixture.(*The formula mass of T is 125*)   *(3 ½ marks)*

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6. To an aqueous solution of cobalt(II) chloride hexahydrate was added concentrated hydrochloric acid dropwise until in excess.
    (a) Name:
    (i)   the cobalt species present in the solution before hydrochloric acid was added.   *(01 mark)*

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    (ii)   the cobalt species present in the solution containing excess hydrochloric acid.   *(01 mark)*

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    (b) The solution containing excess hydrochloric acid was diluted with water.
    (i)   State the colour change that took place.   *(01 mark)*

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

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7. Complete the following reactions and outline the reaction mechanism.

(a) CH_3COCH_3 $\xrightarrow{NH_2COCH_2NH_2/H^+}$ .... *(03 marks)*

Mechanism:

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(b) [benzene ring]$CHClCH_2Cl$ $\xrightarrow[\text{Heat}]{CH_3CH_2OH/\bar{O}H}$ ....*(03 marks)*
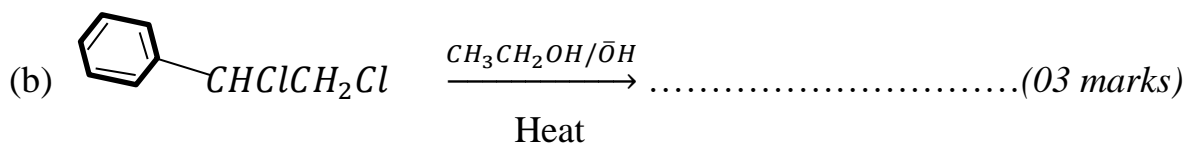
Mechanism:

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8. (a) Write an expression for the acid dissociation constant, K_a of ethanoic acid in water. *(01 mark)*

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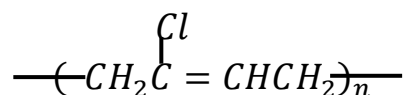
(b) The table below shows acid dissociation constants, K_a for some acids at a particular temperature.

Acid	CH_3COOH	$ClCH_2COOH$	$Cl_2CHCOOH$	Cl_3CCOOH
K_a $(moldm^{-3})$	1.7×10^{-5}	1.4×10^{-3}	5.1×10^{-3}	2.2×10^{-1}

State and explain the trend in acid strength of the acids. *(03 marks)*

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9. (a) Neoprene rubber is a polymer with the structure;

$$-\left(CH_2 \underset{\underset{\displaystyle Cl}{\big|}}{C} = CHCH_2\right)_n-$$

   (i)   Name the monomer used in making the polymer   (½ mark)

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   (ii)   State the type of polymerization involved during the formation of the polymer.   (½ mark)

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   (iii) Write the equation leading to formation of neoprene rubber.   (01 mark)

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   (iv)   State **one** use of the polymer.   (½ mark)

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(b) A solution containing $28.76 g dm^{-3}$ of neoprene rubber had an osmotic pressure of 0.23 atmospheres at 27 °C.
Determine;

   (i)   the molecular mass of the polymer.   (02 marks)

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   (ii)   the number of monomers in the formula of the polymer.   (02 marks)

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SECTION B: (54 MARKS)

Answer any **six** *questions from this section.*

10.(a) A compound **Q** contains carbon, hydrogen and oxygen. 0.0291g of **Q** on combustion gave 0.0581g of carbon dioxide and 0.0239g of water.

(i) Calculate the empirical formula of **Q**. *(2 ½ marks)*

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(ii) When 0.14g of **Q** was vapourised at 20℃ and 740mmHg pressure, it occupied a volume of $39.5cm^3$. Determine the molecular formula of **Q**. *(03 marks)*

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(b) When **Q** was treated with sodium bicarbonate, effervescence of a colourless gas occurred. Identify **Q**. *(01 mark)*

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(c) **Q** was heated with iron(III) chloride solution. State what was observed and write equation for the reaction that takes place. *(2 ½ marks)*

Observation

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Equation

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11. Benzoic acid is a weak acid.
    (a) Write equation for the ionisation of benzoic acid in water.   *(01 mark)*

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    (b) The pH of an aqueous solution of 0.2M benzoic acid is 5.25. Determine the acid dissociation constant, K_a for benzoic acid.   *(2 ½ marks)*

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    (c) Using your results from (b) above, calculate the hydrolysis constant, K_h for sodium benzoate.   *(02 marks)*
    $(Ionic\ product\ , K_w\ for\ water\ is\ 1.0 \times 10^{-14}\ mol^2 dm^{-6})$

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    (d) Determine the pH of an aqueous solution of sodium benzoate made by dissolving 7.2g of sodium benzoate in $500cm^3$ of water.   *(3 ½ marks)*

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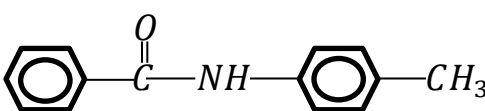
12. Write equations to show how the following compounds can be synthesized.
    (a) 1-phenylpropanone from chlorobenzene   *(03 marks)*

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(b) 2-methylpropan-2-ol from propan-2-ol   *(2 ½ marks)*

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(c) [benzene ring]—$\overset{O}{\overset{\|}{C}}$—NH—[benzene ring]—$CH_3$ from benzene and iodomethane

(3 ½ marks)

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13. (a) Beryllium, Magnesium, Calcium and Barium are elements in group II of the Periodic Table. Briefly describe how the hydroxides of the elements above react with ;

(i)   sodium hydroxide solution   *(02 marks)*

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(ii)   hydrochloric acid   *(02 marks)*

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(b) The table below shows the solubility of group II hydroxides in water at 20°C.

Hydroxide	$Be(OH)_2$	$Mg(OH)_2$	$Ca(OH)_2$	$Sr(OH)_2$	$Ba(OH)_2$
Solubility(g/100g at 20^OC)	Insoluble	0.002	0.15	0.9	4.0

(i)   State and explain the trend in solubility of the hydroxides.   *(3 ½ marks)*

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(ii)   Different masses of solid calcium hydroxide and barium hydroxide containing the same number of moles were separately shaken with the same volume of water at 25°C. Identify the solution with higher pH value. Give a reason for your answer.   *(1 ½ marks)*

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14.(a) In the extraction of zinc from one of its ores, the ore is first concentrated and then roasted in air. The roasted material is mixed with coke and limestone and heated by hot air in a blast furnace producing zinc.

(i)   Write the name of the ore from which zinc can be extracted by the above treatment.   *(½ mark)*

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(ii)   Describe how the ore you have named in (a) above can be concentrated.   *(02 marks)*

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(b) Write equation for the reaction:

(i) that takes place when the ore above is roasted in air. *(01 mark)*

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(ii)   that leads to formation of zinc in the blast furnace. *(01 mark)*

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(c) State what would be observed and write equation for the reaction when zinc metal is added to:

(i)   copper(II) sulphate solution *(2 ½ marks)*

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(ii)   aqueous sodium hydroxide solution. *(02 marks)*

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15. Benzene is used on a large scale to manufacture phenol via by the cumene process.

(a) Name:

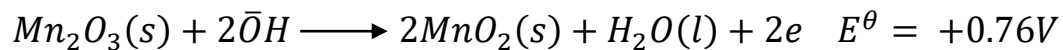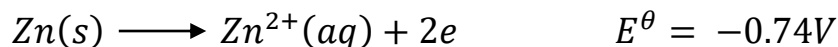(i)   **one** other reagent used as a starting material in the cumene process. *(½ mark)*

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(ii)   the bi-product of the reaction leading to the formation of phenol from benzene and the named reagent in a(i) *(01 mark)*

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(b) Write equations to show how the named bi-product in (a) (ii) can be obtained from ethanol. *(03 marks)*

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16. Half-cell equations for some reactions are given below and the corresponding electrode potentials.

$$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e \qquad E^\theta = -0.74V$$
$$Mn_2O_3(s) + 2\bar{O}H \longrightarrow 2MnO_2(s) + H_2O(l) + 2e \quad E^\theta = +0.76V$$

(a) Write cell notation of the cell made by combining the two half cells.

(01 mark)

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(b) Write the equation for the overall cell reaction. *(1 ½ marks)*

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(c) (i) Calculate the work done by the cell. *(2 ½ marks)*

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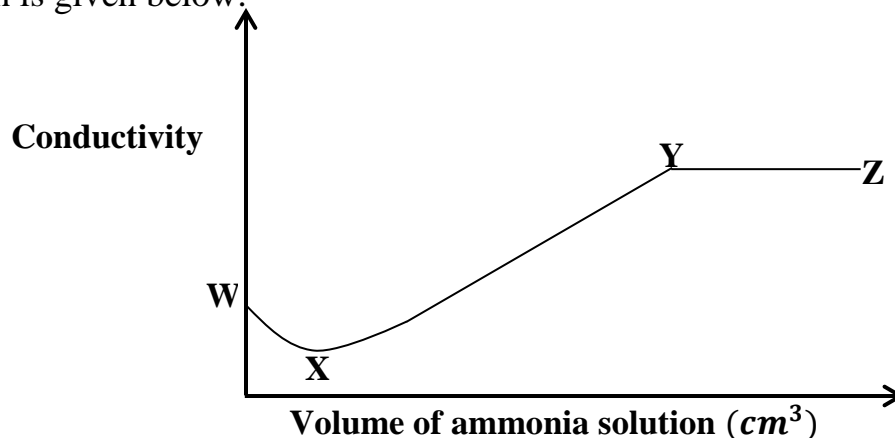
(ii)   State whether the reaction in (b) above is feasible or not. Give a reason for your answer. *(01 mark)*

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(d) The conductimetric curve for titration of ethanoic acid and ammonia solution is given below:

Conductivity

W

X

Y

Z

Volume of ammonia solution (cm^3)

Explain the shape of the graph. *(03 marks)*

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17. Explain the following observations. Your answer should include relevant equations if any.

(a) An aqueous solution of sodium sulphite is alkaline whereas that of sodium hydrogen sulphite is acidic. *(03 marks)*

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(b) Lead(II) chloride is insoluble in ethanol whereas lead(IV) chloride readily dissolves in ethanol. *(03 marks)*

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(c) When hydrogen iodide is treated with concentrated sulphuric acid, iodine is liberated. However, when hydrogen chloride is similarly treated, chlorine is not evolved. *(03 marks)*

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
																1.0 H 1	4.0 He 2
1.0 H 1																	
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

END.