

UNIVERSITY OF SWAZILAND  
FINAL EXAMINATION – 2018, DECEMBER

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**TITLE OF PAPER** : Chemistry

**COURSE NUMBER** : CPR 103

**TIME** : **Three Hours**

**INSTRUCTIONS** : Answer any four questions (each question is 25 marks)

**NB:** Non-programmable electronic calculators may be used  
A periodic table is attached

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This Examination Paper Contains **FIVE** Printed Pages Including This Page

*You are not supposed to open the paper until permission to do so has been granted by the  
Chief Invigilator.*

**Question 1**

- a) The width, length and height of a small box are 11.5 cm, 24.2 cm and 8.3 cm, respectively. Calculate the volume of the box, using the correct number of significant figures in your answer. [3]
- b) Name the following compounds:
- $\text{ICl}_5$
  - $\text{OF}_2$
  - $\text{Ca}(\text{ClO})_2$
  - $\text{Cu}(\text{ClO}_4)_2$
  - $\text{Fe}_2\text{O}_3$
- [10]
- c) How many of the indicated atoms are contained in one mole of each chemical formula: [9]
- Carbon atoms in  $\text{C}_2\text{H}_5\text{COOCH}_3$
  - Oxygen atoms in  $\text{Ca}(\text{ClO}_4)_2$
  - Hydrogen atoms in  $(\text{NH}_4)_2\text{HPO}_4$
- d) What is the formula mass of  $\text{Fe}_2\text{O}_3$ ? [2]

**Question 2**

- a) For the reaction between aqueous solutions of sodium sulphate,  $\text{Na}_2\text{SO}_4$ , and barium chloride,  $\text{BaCl}_2$ , write
- The balanced molecular equation,
  - The complete ionic equation,
  - The net ionic equation.
- [5]
- b) Calculate the molarity of a solution made by dissolving 23.4 g of sodium sulphate ( $\text{Na}_2\text{SO}_4$ ) in enough water to form 125 mL of solution. [5]
- c) What mass (g) of  $\text{AgBr}$  is formed when 35.5 mL of 0.184 M  $\text{AgNO}_3$  is treated with an excess of aqueous hydrobromic acid? [5]
- [15]

**Question 3**

- a) Write the electron configuration of the following elements: [10]
- Cr
  - Ga,
  - Cu
  - $\text{Cu}^+$
  - $\text{As}^{3-}$
- b) Predict the ion generally formed by [3]

- i. Sr
  - ii. S
  - iii. Al.
- c) In the isoelectronic series  $\text{Rb}^+$ ,  $\text{Sr}^{2+}$ ,  $\text{Y}^{3+}$ , which ion is largest? [2]
- d) In a titration experiment, 34.4 mL of 0.450 M HCl is required to neutralize 25.0 mL of NaOH solution. Determine the concentration of the NaOH solution. [10]

#### Question 4

- a) What is the empirical formula of a compound that contains 29% Na, 41 % S, and 30% O by mass? [10]
- b) Antimony reacts with oxygen as follows
- $$4 \text{ Sb(s)} + 3 \text{ O}_2\text{(g)} \longrightarrow 2 \text{ Sb}_2\text{O}_3\text{(s)}$$
- i) What type of reaction is this? [1]
  - ii) What is the limiting reactant when 5.0 mol Sb(s) and 5.0 mol  $\text{O}_2\text{(g)}$  react? [4]
  - iii) How many moles of the excess reactant remain when the reaction is complete? [2]
  - iv) How many moles of product can be formed? [3]
  - v) If 2.0 mol  $\text{Sb}_2\text{O}_3$  forms, what is the percentage yield? [5]

#### Question 5

- a) State whether the following are soluble or not soluble in water: [10]
- i. Cobalt(II) hydroxide
  - ii. Barium nitrate
  - iii. Ammonium phosphate
  - iv. Sodium carbonate
  - v. Lead sulphate
- b) Determine the oxidation numbers of sulfur in: [10]
- i.  $\text{H}_2\text{S}$
  - ii.  $\text{S}_8$
  - iii.  $\text{SCl}_2$
  - iv.  $\text{Na}_2\text{SO}_3$
  - v.  $\text{SO}_4^{2-}$
- c) Name the following compounds [5]
- i.  $\text{Ca(OH)}_2$
  - ii.  $\text{CrPO}_4$



17  
iii.  $V_2O_5$

**Question 6**

- a) Name any six classes of organic compounds and give an example for each (6)
- b) Draw all the structural and geometric isomers of pentene,  $C_5H_{10}$ , that have an unbranched hydrocarbon chain. (4)
- c) Draw structures of the following compounds (15)
- i. 1,1-dichloro-1-butene
  - ii. 2,4-dichloro-2-pentyne
  - iii. 1-chloro-1-pentene
  - iv. 4,5-dimethyl-2-heptanol
  - v. Propanone
  - vi. Ethanoic acid
  - vii. 4-ethyl,4-methyloctane
  - viii. Methanal

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Department of Chemistry

1	H	1.0079	2	He	4.0026
3	Li	6.941	4	Be	9.0122
11	Na	22.990	12	Mg	24.305
19	K	39.098	20	Ca	40.078
37	Rb	85.47	38	Sr	87.62
55	Cs	132.91	56	Ba	137.33
87	Fr	(223)	88	Ra	226.03
21	Sc	44.956	22	Ti	47.88
39	Y	88.906	40	Zr	91.224
57	La	138.91	58	Ce	140.12
89	Ac	227.03	90	Th	232.04
23	V	50.942	24	Cr	51.996
41	Nb	92.906	42	Mo	95.94
73	Ta	180.95	74	W	183.85
72	Hf	178.49	73	Ta	180.95
71	Ir	192.22	72	Pt	195.08
70	Pd	106.42	71	Ag	107.87
68	Ho	164.93	69	Er	167.26
67	Dy	162.50	68	Ho	164.93
66	Tb	158.93	67	Dy	162.50
65	Gd	157.25	66	Tb	158.93
64	Eu	151.97	65	Gd	157.25
63	Sm	150.36	64	Eu	151.97
62	Pm	146.92	63	Sm	150.36
61	Nd	144.24	62	Pm	146.92
60	Pr	140.91	61	Nd	144.24
59	Ce	140.12	60	Pr	140.91
58	Th	232.04	59	Ce	140.12
91	Pa	231.04	92	U	238.03
90	Th	232.04	91	Pa	231.04
94	Pu	(244)	95	Am	(243)
96	Cm	(247)	97	Bk	247
98	Cf	(251)	99	Es	(252)
100	Fm	(257)	101	Md	(258)
102	No	(259)	103	Lr	(260)
104	Lu	174.97	105	Yb	173.04
106	Tm	168.93	107	Yb	173.04
108	Ho	164.93	109	Er	167.26
110	Dy	162.50	111	Tm	168.93
112	Lu	174.97	113	Yb	173.04
114	Hf	178.49	115	Ta	180.95
116	W	183.85	117	Re	186.2
118	Os	190.2	119	Ir	192.22
120	Pt	195.08	121	Ag	107.87
122	Cd	112.41	123	In	114.82
124	Sn	118.71	125	Sb	121.75
126	Te	127.60	127	I	126.90
128	Xe	131.29	129	Ba	137.33
130	Rn	(222)	131	Pb	207.2
132	Bi	208.98	133	Po	(209)
134	At	(210)	135	Fr	(223)
136	Ra	226.03	137	Ac	227.03
138	Th	232.04	139	Pa	231.04
140	U	238.03	141	Np	237.05
142	Pu	(244)	143	Am	(243)
144	Cm	(247)	145	Bk	247
146	Cf	(251)	147	Es	(252)
148	Fm	(257)	149	Md	(258)
150	No	(259)	151	Lr	(260)
152	Lu	174.97	153	Yb	173.04
154	Tm	168.93	155	Yb	173.04
156	Ho	164.93	157	Er	167.26
158	Dy	162.50	159	Tm	168.93
160	Lu	174.97	161	Yb	173.04
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164	W	183.85	165	Re	186.2
166	Os	190.2	167	Ir	192.22
168	Pt	195.08	169	Ag	107.87
170	Cd	112.41	171	In	114.82
172	Sn	118.71	173	Sb	121.75
174	Te	127.60	175	I	126.90
176	Xe	131.29	177	Ba	137.33
178	Rn	(222)	179	Pb	207.2
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246	No	(259)	247	Lr	(260)
248	Lu	174.97	249	Yb	173.04
250	Tm	168.93	251	Yb	173.04
252	Ho	164.93	253	Er	167.26
254	Dy	162.50	255	Tm	168.93
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260	W	183.85	261	Re	186.2
262	Os	190.2	263	Ir	192.22
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