



FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

BACHELOR OF OPTOMETRY

MODULE CEM1CA1
CHEMISTRY 1C

CAMPUS DFC

JUNE EXAMINATION

DATE: 31/05/2018

SESSION: 08:30 – 11:30

ASSESSOR

DR N MABUBA

INTERNAL MODERATOR

DR LN DLAMINI

DURATION: 3 HOURS

MARKS: 130

NUMBER OF PAGES: 6 AND A PERIODIC TABLE.

INSTRUCTIONS: ANSWER ALL QUESTIONS.

REQUIREMENT: ANSWER SCRIPT.

SECTION 1

ANSWER THIS SECTION IN YOUR ANSWER SCRIPT BY WRITING THE QUESTION NUMBER AND THE LETTER OF YOUR CHOICE. FOR EXAMPLE: 2. B

1. Which of the following is a chemical property of water?
 - A. A blue solution is formed when copper(II) sulphate dissolves in water.
 - B. It forms hydrogen gas when it comes into contact with potassium metal.
 - C. It is colourless, odourless and tasteless.
 - D. It freezes at 0°C.
2. Isotopes of the same element have
 - A. the same atomic numbers, but different mass numbers
 - B. the same atomic numbers and the same mass numbers
 - C. different atomic numbers, but the same mass numbers
 - D. different atomic numbers and different mass numbers
3. Which quantum number describes the orientation in space of an orbital?
 - A. n
 - B. l
 - C. m_l
 - D. m_s
4. A major effect of the Pauli Exclusion Principle is to allow
 - A. only one subshell in the first energy level
 - B. three orbitals in the 3p subshell
 - C. three orbitals in any p subshell
 - D. no more than two electrons per orbital
5. The silicon atom would be expected to have ____ unpaired electrons.
 - A. 4
 - B. 3
 - C. 2
 - D. 1
6. Which of the following species has the largest radius?
 - A. Xe
 - B. I^-
 - C. Rb^+
 - D. Sr^{2+}
7. Consider atoms of sodium, potassium, fluorine and chlorine. The following list shows them in order of **increasing** first ionization energy.
 - A. Na; K; F; Cl
 - B. Na; K; Cl; F
 - C. K; Na; Cl; F
 - D. K; Na; F; Cl
8. Two elements are likely to form an ionic bond if
 - A. one has a high ionization energy and the other a low electron affinity
 - B. one is has a low ionization energy and the other a high electron affinity
 - C. their electronegativities are the same
 - D. they have the same number of valence electrons

9. The SO_3 molecule has
- A. three single bonds
 - B. one double bond and one dative covalent bonds
 - C. one double bond, two dative covalent bonds and one lone pair of electrons
 - D. none of the above
10. The molecular shape and polarity of NF_3 can be described as
- A. trigonal planar, nonpolar
 - B. trigonal planar, polar
 - C. trigonal pyramidal, polar
 - D. tetrahedral, nonpolar
11. Which of the following is **not** a characteristic property of the Group VII elements?
- A. They form -1 ions.
 - B. They can form acids.
 - C. They are known as halogens.
 - D. The atomic radius decreases with increasing atomic number.
12. The oxidation number of manganese in MnO_4^- is
- A. +3
 - B. -9
 - C. +7
 - D. +12
13. How many carbon atoms are there in 0.40 mol of procaine, $\text{C}_{13}\text{H}_{20}\text{N}_2\text{O}_2$, a pain killer used by dentists?
- A. 2.4×10^{23}
 - B. 4.8×10^{24}
 - C. 4.8×10^{23}
 - D. 3.1×10^{24}
14. How many moles of ammonium ions are there in 150 mL of a 0.030 M $(\text{NH}_4)_3\text{PO}_4$ solution?
- A. 0.0002
 - B. 4.50
 - C. 0.0135
 - D. 18

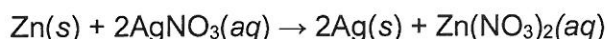
[14 x 2 = 28]

SECTION 2**QUESTION 1**

- 1.1 Define the terms, homogeneous and heterogeneous mixtures. Also give one example in each case. (4)
- 1.2 Draw the Lewis structures for the following compounds and identify the type of bonding in each case.
- 1.2.1 N_2 (3)
- 1.2.2 CaCl_2 (3)
- 1.3 Write a balanced chemical equation representing each of the following reactions. **Also identify the type of reaction equation that has occurred in each case.**
- 1.3.1 Aqueous solution of silica tetrachloride and magnesium metal are mixed. (3)
- 1.3.2 Solid sodium nitrate reacts with an aqueous solution of sulphuric acid. (3)
- 1.3.3 Nickel(II) hydroxide when heated. (3)
- 1.4 Consider the following redox equation occurring in an acidic medium and answer the questions below:
- $$\text{MnO}_4^-(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + \text{Fe}^{3+}(\text{aq})$$
- 1.4.1 Identify the oxidizing reagent in the above reaction equation. (1)
- 1.4.2 Balance each half-reaction **AND** classify each as reduction or oxidation. (4)
- 1.4.3 Write the overall balanced redox equation. (3)

[27]**QUESTION 2**

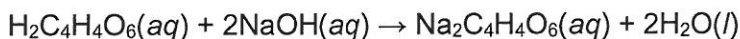
- 2.1 A strip of zinc metal with a mass of 2.00 g is placed in an aqueous solution containing 2.50 g of silver nitrate.



- 2.1.1 Which reagent is limiting? (2)
- 2.1.2 What mass of silver that could be produced in a complete reaction? (4)
- 2.1.3 What mass of the excess reagent remains after the reaction? (5)
- 2.1.4 Calculate the percentage yield if 1.20 g of zinc nitrate were produced. (4)

QUESTION 2 (CONTINUED)

- 2.2 Tartaric acid, $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$, is often present in wine and precipitates from solution as the wine ages. A 50.0 mL sample of wine was titrated against NaOH requiring 12.62 mL of a 0.2025 M NaOH solution to completely neutralize the tartaric acid according to the following equation:



- Calculate the % m/v of tartaric acid contained per 50.0 mL of wine. (5)
- 2.3 Calculate the mass of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) that is needed to prepare 100.0 mL of a 0.150 M glucose solution. (3)
- 2.4 A 200 mL solution contains 2 mL of NaOH, express the concentration in ppm. (2)
- [25]

QUESTION 3

- 3.1 Differentiate between a strong acid and a concentrated acid and illustrate your answer with appropriate examples. (4)
- 3.2 Calculate the following:
- 3.2.1 The pH of a 0.2 M sodium hydroxide solution. (3)
- 3.2.2 The $[\text{H}^+]$ of lemon juice which has a pH = 2.2. (2)
- [9]

QUESTION 4

Complete the following sentences by writing only the number and your answer.

The concept of hybridization can be used to explain why carbon is able to form sigma and pi bonds. When a compound contains only sigma bonds all its carbon atoms must be (1)___ hybridized. Pi bonds are formed between (2)___ orbitals.

The octane rating of petrol is determined by its (3)___ and (4)___ content.

Methane gas burns easily in the presence of oxygen and is often responsible for gas explosions in underground mines. This reaction is represented by the following equation: (5)___.

Alkyl halides are very reactive towards nucleophiles and bases due to (6)___ . An example of a nucleophile is (7)___ . Zaitsev's Rule can be used to predict the major product of an elimination reaction in alkyl halides. It states that (8)___ . The following equation illustrates the application of Zaitsev's rule: (9)___ .

Geometric isomers have the same (10)___ , but different (11)___ . This can be illustrated by the following examples (12)___ and (13)___ .

QUESTION 4 (continued)

Amines are compounds are classified as primary, secondary or tertiary. Examples of structural formulae of primary, secondary and tertiary amines are (14)____(15)____and (16)_____.

[23]**QUESTION 5**

Write a chemical equation representing each of the following reactions. **GIVE THE IUPAC NAMES OF THE PRODUCTS.**

- 5.1 2-chloro-2,3-dimethylhexane + NaI → (3)
- 5.2 2-Methylbutene + HBr → (3)
- 5.3 Pentyne + Excess H₂/Pt → (3)
- 5.4 Benzene + HNO₃/H₂SO₄ → (3)
- 5.5 Heptanone + HCN → (3)
- 5.6 ethanoic acid + CH₃OH/H⁺ → (3)

[18]**TOTAL MARKS = 130**

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Department of Applied Chemistry

1	H	1.0079
3	Li	6.941
11	Na	22.990
19	K	39.098
37	Rb	85.47
55	Cs	132.91
87	Fr	(223)
4	Be	9.0122
12	Mg	24.305
20	Ca	40.078
38	Sr	87.62
56	Ba	137.33
88	Ra	226.03

Atomic Number	2	He	4.0026
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Atomic Weight

5	B	10.811	6	C	12.011	7	N	14.007	8	O	15.999	9	F	18.998	10	Ne	20.179
13	Al	26.982	14	Si	28.086	15	P	30.974	16	S	32.064	17	Cl	35.453	18	Ar	39.948
31	Ga	69.723	32	Ge	72.61	33	As	74.922	34	Se	78.96	35	Br	79.904	36	Kr	83.80
49	In	114.82	50	Sn	118.71	51	Sb	121.75	52	Te	127.60	53	I	126.90	54	Xe	131.29
81	Tl	204.38	82	Pb	207.2	83	Bi	208.98	84	Po	(209)	85	At	(210)	86	Rn	(222)

21	Sc	44.956	22	Ti	47.88	23	V	50.942	24	Cr	51.996	25	Mn	54.938	26	Fe	55.847	27	Co	58.933	28	Ni	58.69	29	Cu	63.546	30	Zn	65.39
39	Y	88.906	40	Zr	91.224	41	Nb	92.906	42	Mo	95.94	43	Tc	(98)	44	Ru	101.07	45	Rh	102.91	46	Pd	106.42	47	Ag	107.87	48	Cd	112.41
57	La	138.91	72	Hf	178.49	73	Ta	180.95	74	W	183.85	75	Re	186.2	76	Os	190.2	77	Ir	192.22	78	Pt	195.08	79	Au	196.97	80	Hg	200.59
89	Ac	227.03																											

58	Ce	140.12	59	Pr	140.91	60	Nd	144.24	61	Pm	146.92	62	Sm	150.36	63	Eu	151.97	64	Gd	157.25	65	Tb	158.93	66	Dy	162.50	67	Ho	164.93	68	Er	167.26	69	Tm	168.93	70	Yb	173.04	71	Lu	174.97
90	Th	232.04	91	Pa	231.04	92	U	238.03	93	Np	237.05	94	Pu	(244)	95	Am	(244)	96	Cm	(247)	97	Bk	247	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(260)