UNIVERSITY OF JOHANNESBURG

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 3*p* 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 $MnO4^-$ is

A. +3
B. -9
C. +7
D. +12

13. How many carbon atoms are there in 0.40 mol of procaine, $C_{13}H_{20}N_2O_2$, 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 $(NH_4)_3PO_4$ 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:

$$MnO_4^-(aq) + Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + Fe^{3+}(aq)$$

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.

$$Zn(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Zn(NO_3)_2(aq)$$

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, $H_2C_4H_4O_6$, 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:

$$H_2C_4H_4O_6(aq) + 2NaOH(aq) \rightarrow Na_2C_4H_4O_6(aq) + 2H_2O(l)$$

Calculate the % m/v of tartaric acid contained per 50.0 mL of wine. (5)

2.3 Calculate the mass of glucose ($C_6H_{12}O_6$) 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 $[H^+]$ 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 $\rightarrow$ (3)

5.2 2-Methylbutene + HBr $\rightarrow$ (3)

5.3 Pentyne + Excess H_2/Pt $\rightarrow$ (3)

5.4 Benzene + HNO_3/H_2SO_4 $\rightarrow$ (3)

5.5 Heptanone + HCN $\rightarrow$ (3)

5.6 ethanoic acid + CH_3OH/H^+ $\rightarrow$ (3)

[18]

TOTAL MARKS = 130

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Department of Applied Chemistry

Atomic Number

2
He
4.0026

Atomic Weight

1																		
H																		**He**
1.0079																		*4.0026*
3	4											5	6	7	8	9	10	
Li	**Be**											**B**	**C**	**N**	**O**	**F**	**Ne**	
6.941	*9.0122*											*10.811*	*12.011*	*14.007*	*15.999*	*18.998*	*20.179*	
11	12											13	14	15	16	17	18	
Na	**Mg**											**Al**	**Si**	**P**	**S**	**Cl**	**Ar**	
22.990	*24.305*											*26.982*	*28.086*	*30.974*	*32.064*	*35.453*	*39.948*	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
K	**Ca**	**Sc**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**Ge**	**As**	**Se**	**Br**	**Kr**	
39.098	*40.078*	*44.956*	*47.88*	*50.942*	*51.996*	*54.938*	*55.847*	*58.933*	*58.69*	*63.546*	*65.39*	*69.723*	*72.61*	*74.922*	*78.96*	*79.904*	*83.80*	
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Rb	**Sr**	**Y**	**Zr**	**Nb**	**Mo**	**Tc**	**Ru**	**Rh**	**Pd**	**Ag**	**Cd**	**In**	**Sn**	**Sb**	**Te**	**I**	**Xe**	
85.47	*87.62*	*88.906*	*91.224*	*92.906*	*95.94*	*(98)*	*101.07*	*102.91*	*106.42*	*107.87*	*112.41*	*114.82*	*118.71*	*121.75*	*127.60*	*126.90*	*131.29*	
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
Cs	**Ba**	**La**	**Hf**	**Ta**	**W**	**Re**	**Os**	**Ir**	**Pt**	**Au**	**Hg**	**Tl**	**Pb**	**Bi**	**Po**	**At**	**Rn**	
132.91	*137.33*	*138.91*	*178.49*	*180.95*	*183.85*	*186.2*	*190.2*	*192.22*	*195.08*	*196.97*	*200.59*	*204.38*	*207.2*	*208.98*	*(209)*	*(210)*	*(222)*	
87	88	89																
Fr	**Ra**	**Ac**																
(223)	*226.03*	*227.03*																

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	**Pr**	**Nd**	**Pm**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**
140.12	*140.91*	*144.24*	*146.92*	*150.36*	*151.97*	*157.25*	*158.93*	*162.50*	*164.93*	*167.26*	*168.93*	*173.04*	*174.97*
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	**Pa**	**U**	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**
232.04	*231.04*	*238.03*	*237.05*	*(244)*	*(234)*	*(247)*	*247*	*(251)*	*(252)*	*(257)*	*(258)*	*(259)*	*(260)*