FINAL	%	

UNISA

CHE1501
SECOND PAPER

MAY/JUNE 2018

GENERAL CHEMISTRY 1A

STUDENT NUMBER									

IDENTITY NUMBER												

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Question No	Marks					
	Examiners					
	1		2		3	
1						
2						
3						
4						
5						
6						
7						
Total						

Subject

Number of paper

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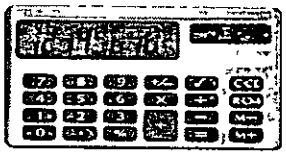
UNIVERSITY EXAMINATIONS



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UNISA university of south afric

CHE1501
SECOND PAPER

May/June 2018

General Chemistry IA

Duration 2 Hours

100 Marks

EXAMINERS

FIRST MR MG SMITH
SECOND DR B VAN DER WESTHUIZEN

Use of a non-programmable pocket calculator is permissible

Closed book examination

The above-mentioned calculator may be a SCIENTIFIC calculator.

This paper consists of 21 pages (including this page)

Four pages are attached for rough work (pg 16-19)
A table of physical constants and conversion factors is included (pg 20)
A periodic table is attached (pg 21)

Answer all the Questions

Fill in the answers on the question paper

Show all your calculations

Write the correct units at each step in your calculations and answers

NB Marks may be lost for incorrect or missing units

Section A: Multiple choice questions

Section Total: 35 Marks

WRITE THE LETTER OF THE CORRECT OPTION *NEATLY* IN THE SQUARE BOX PROVIDED IN EACH QUESTION.

You are provided with empty rough work pages on page 16 – 19 in this exam book.

Only one answer per question is allowed.

Answers are not marked negatively.

Section A has a total of 35 marks. You should pace yourself so as not to spend more than approximately 30 – 40 minutes on this section.

QUESTION 1 [20]

Questions 1.1 – 1.10 are worth 2 marks each.

Question 1.1 (2)

Which of the following correctly describes copper sulphate ($CuSO_4$)?

A An element

B A compound

C A homogeneous mixture

D A heterogeneous mixture

E None of the above

Question 1.2 (2)

Which of the following is a noble gas configuration?

A $1s^2\ 2s^2$

B $1s^2\ 2s^2\ 2p^6$

C $1s^2\ 2s^2\ 2p^6\ 3s^2$

D $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$

E [Ne] $3d^{10}$

Question 1.3 (2)

Which of the following sets of atoms/ions is isoelectronic?

A H^+, H and H^-

B Li^+, Na^+ and K^+

C Cl^-, Br^- and I^-

D F^-, Ne and Na^+

E Cu, Fe and Mn

Question 1.4 (2)

Which quantum number(s) do 2s and 2p orbitals have in common?

A l

B l and m_l

C n

D n and l

E n, m_l and m_s

Question 1.5 (2)

Which of the following orbital diagrams is impossible according to the Pauli Exclusion Principle?

	1s	2s	2p		
A	↑↓	↑	_	_	_
B	↑↓	↑↓	↑↓	↑↑	↓↓
C	↑↓	↑↓	_	_	_
D	↑↓	↑↓	↑	↑	↑
E	↑↓	↑↓	↑↓	↓	↓

Question 1.6 (2)

Which of the following is insoluble in water?

A LiCl
B potassium sulphate
C sodium acetate
D ammonium phosphate
E AgCl

Question 1.7 (2)

What is the main source or sources of acid rain?

A Antarctic ice
B Sewers
C Methane gas from animals
D Magnesium oxide
E Nitrogen oxide and sulphur dioxide

Question 1.8 (2)

Bonds formed by elements of widely different electronegativities are

A covalent double bonds
B non-polar covalent bonds
C hydrogen bonds
D weak bonds
E ionic bonds

Question 1.9 (2)

Which of the following statements is **incorrect**?

A The oxidation number of hydrogen in the hydrogen molecule (H_2) is 0
B Ions cannot have an oxidation number of 0
C The oxidation number of sodium metal (Na) is 0
D The oxidation number of bromine in Br_2 is 0
E The oxidation number of calcium in Ca^{2+} is 0

Question 1.10 (2)

What are the products of the acid-base reaction between hydrochloric acid and magnesium hydroxide?

A magnesium chloride and carbon dioxide and water

B magnesium chloride and water

C magnesium chlorate and hydrogen

D magnesium chlorate and water

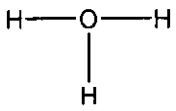
E magnesium hydrochloride and water

QUESTION 2 [15]

Questions 2.1 – 2.5 are worth 3 marks each.

Question 2.1 (3)

What is the formal charge of the oxygen atom in the following molecule?



A -2

B -1

C 0

D +1

E +2

Question 2.2 (3)

How many moles of HCl are there in 10 mL of a solution with a concentration of 0 5 mol L^{-1}?

A 0 05 mol

B 0 5 mol

C 1 mol

D 5 mol

E 20 mol

Question 2.3 (3)

An aqueous solution containing a concentration of 2 5 x 10^{-8} mol L^{-1} of OH^- ions has a pH of

A 2 50

B 6 40

C 7 40

D 7 60

E None of the above

Question 2.4 (3)

If 5 0 mol of hydrochloric acid and 5 0 mol of sodium sulphide are mixed and reacted according to the equation below, how many moles of hydrogen sulphide (H_2S) are produced?

(Note that the equation is unbalanced)

$$HCl + Na_2S \rightarrow H_2S + NaCl$$

A 1 mol

B 1 25 mol

C 2 5 mol

D 3 mol

E 5 mol

Question 2.5 (3)

Identify the **type** of reaction for the following reaction

$C_2H_6 + 5O_2 \rightarrow 3H_2O + 2CO_2$

A Synthesis

B Decomposition

C Precipitation

D Double replacement

E Combustion

Section B: Long questions

Section Total: 65 Marks

WRITE YOUR ANSWERS IN THE BOX PROVIDED.

Show all your calculations!!!

Marks are awarded for the steps as well as the answers.

Marks may be lost for missing or incorrect units.

Section B has a total of 65 marks. You should pace yourself so as not to spend more than approximately 70 – 80 minutes on this section.

QUESTION 3 [14]

Question 3.1

Draw the energy orbital diagram of the sulfur atom Is the atom paramagnetic or diamagnetic? (4)

3 2 1) Give the condensed (noble core) electron configuration for the carbon atom (2)

3 2 2) How many *valence* electrons in C have $\ell=1$ quantum number? (2)

3 2 3) Write a valid set of four quantum numbers for the valence electron of C with $\ell=1$ (2)

3 2 4) What is the name of the CO_3^{2-} ion? (2)

3 2 5) What is the oxidation number of sodium in Na_2CO_3 (2)

QUESTION 4 [14]

Question 4.1 (7)

Consider the phosphoric acid molecule, H_3PO_4

Calculate the total number of valence electrons in the molecule (Show your answer)

Draw the *Lewis* structure of H_3PO_4 What is the formal charge of the P atom in H_3PO_4? Show the equation that you used to calculate this

Question 4.2

A solution of silver nitrate is mixed with calcium chloride and a precipitate is formed Write a balanced chemical equation for the reaction and write the **name** of the precipitate (3)

Question 4.3

For each of the following pairs of atoms below, predict the type of bonding that will occur between the atoms (4)

LiBr: _____

NO: _____

FeO: _____

CH: _____

QUESTION 5

[17]

Question 5.1 (7)

A white powder is analyzed and found to contain 43 64 % phosphorus and 56 36 % oxygen by mass The compound has a molar mass of 283 88 g/mol What is the compound's empirical and molecular formulas?

Question 5.2

What is the molarity of a solution prepared by dissolving 11 5 g of solid NaOH in enough water to make 1 50 L of solution? (3)

Question 5.3 (7)

Methanol (CH_3OH) is the simplest alcohol It is used as a fuel in race cars and is a potential replacement for petrol. Methanol can be manufactured by combining gaseous carbon monoxide and hydrogen Suppose 68.5 kg CO (g) is reacted with 8 60 kg H_2 (g) Calculate the theoretical yield of methanol If $3\ 57 \times 10^4$ g CH_3OH is actually produced, what is the percentage yield of methanol?

QUESTION 6 [8]

Question 6.1

a) Consider the following balanced redox reaction

$$2\ PbS\ (s) + 3O_2\ (g) \rightarrow 2PbO\ (s) + 2SO_2\ (g)$$

(i) What is the reducing agent? (2)

(ii) Which *element* is reduced? (2)

(iii) What species contains the element with the highest oxidation number? (2)

(iv) How many electrons are lost by the sulphur atom? (2)

QUESTION 7

[12]

Question 7.1

Arsenic (As) can be extracted from its ores by first reacting the ore with oxygen (called *roasting*) to form solid As_4O_6, which is then reduced using carbon

$$As_4O_6\ (s) + 6\ C\ (s) \leftrightarrows As_4\ (g) + 6\ CO\ (g)$$

How will the equilibrium shift in each of the following changes in conditions

a) Carbon monoxide gas is added (2)

b) More solid carbon is added (2)

c) The pressure is increased (2)

Question 7.2

a) Which of the following samples of gas will have the greatest pressure if they all have the same volume?

A 10 moles at 80 ^{0}C
B 10 moles at 70 ^{0}C
C 5 moles at 81 ^{0}C
D 2 moles at 82 ^{0}C (3)

b) If the behaviour of gas W is described by the ideal gas equation pV=nRT, which of the following statement(s) about gas W is correct?
(You can choose more than one statement to be correct) (3)

A The density of gas W at constant pressure is inversely proportional to its temperature

B One mole of gas W occupies the same volume under the same conditions of temperature and pressure as an ideal gas

C The volume of a given mass of gas W is doubled if its temperature is raised from 25 °C to 50 °C

ROUGH WORK

ROUGH WORK

PHYSICAL CONSTANTS:

Constant	Symbol	Value
Atomic mass unit	amu	1 66054 x10^{-27} kg
Avogadro's number	N	6 02214 x10^{23} mol^{-1}
Boltzmann constant	k	1 38066 x10^{-23} J K^{-1}
Charge of an electron	e	1 60218 x10^{-19} C
Gas constant	R	0 08206 L atm K^{-1} mol^{-1} 8 3145 L kPa K^{-1} mol^{-1} 8 31451 J K^{-1} mol^{-1}
Mass of an electron	m_e	5 48580 x10^{-4} amu
Mass of a neutron	m_n	1 00866 amu
Mass of a proton	m_p	1 00728 amu
Planck's constant	h	6 626 x10^{-34} Js
Speed of light	c	2 9979 x10^{8} m s^{-1}
Natural logarithm	e	2 71828

CONVERSION FACTORS:

Temperature K = °C + 273

Pressure 1 atm = 101 325 kPa

1 atm = 760 Torr

1 atm = 760 mmHg

1 L = 1000 mL

Periodic Table of Elements

1 1A																		18 VIIIA
1 H 1 008	2 IIA						1 H 1 008						13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4 003
3 Li 6 941	4 Be 9 012												5 B 10 81	6 C 12 01	7 N 14 01	8 O 16 00	9 F 19 00	10 Ne 20 18
11 Na 22 99	12 Mg 24 31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB			11 IB	12 IIB	13 Al 26 98	14 Si 28 09	15 P 30 97	16 S 32 07	17 Cl 35 45	18 Ar 39 95	
19 K 39 10	20 Ca 40 08	21 Sc 44 96	22 Ti 47 88	23 V 50 94	24 Cr 52 00	25 Mn 54 94	26 Fe 55 85	27 Co 58 93	28 Ni 58 69	29 Cu 63 55	30 Zn 65 39	31 Ga 69 72	32 Ge 72 59	33 As 74 92	34 Se 78 96	35 Br 79 90	36 Kr 83 80	
37 Rb 85 47	38 Sr 87 62	39 Y 88 91	40 Zr 91 22	41 Nb 92 91	42 Mo 95 94	43 Tc (98)	44 Ru 101 1	45 Rh 102 9	46 Pd 106 4	47 Ag 107 9	48 Cd 112 4	49 In 114 8	50 Sn 118 7	51 Sb 121 8	52 Te 127 6	53 I 126 9	54 Xe 131 3	
55 Cs 132 9	56 Ba 137 3	57 La* 138 9	72 Hf 178 5	73 Ta 180 9	74 W 183 8	75 Re 186 2	76 Os 190 2	77 Ir 192 2	78 Pt 195 1	79 Au 197 0	80 Hg 200 6	81 Tl 204 4	82 Pb 207 2	83 Bi 209 0	84 Po (210)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra (226)	89 Ac** (227)	104 Unq (257)	105 Unp (260)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)										

*Lanthanides	58 Ce 140 1	59 Pr 140 9	60 Nd 144 2	61 Pm (147)	62 Sm 150 4	63 Eu 152 0	64 Gd 157 3	65 Tb 158 9	66 Dy 162 5	67 Ho 164 9	68 Er 167 3	69 Tm 168 9	70 Yb 173 0	71 Lu 175 0
**Actinides	90 Th 232 0	91 Pa (231)	92 U 238 0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lw (257)