UNIVERSITY OF RUHUNA

BACHELOR OF SCIENCE HONORS IN FISHERIES AND MARINE SCIENCES DEGREE / BACHELOR OF SCIENCE HONORS IN MARINE AND FRESHWATER SCIENCES DEGREE

Level I Semester I Examination - August/September 2018

CHM 1111 – Principles in Chemistry

Time: 01 ½ hrs.

Index Number: .....

Instructions:

- *Periodic Table is provided.*
- *Answer **all** questions on this paper itself.*
- *Use of calculators **is allowed**.*
- *Write your **Index Number** in the space provided above.*
- *In each of the questions **1-10** in **Part I**, pick one of the alternatives from* (1), (2), (3), (4), (5), *which is **correct** or **most appropriate,** and **underline** your response.*
- *Write your answers in the space provided for each question in **Part II**. Please note that the space provided is sufficient for the answer and the extensive answers are not expected.*

Velocity of light, (c)	$= 2.998 \times 10^{8}$ m s^{-1}
Avogadro's number, (N_A)	$= 6.022 \times 10^{23}$ mol^{-1}
Planck's constant, (h)	$= 6.626 \times 10^{-34}$ J s
Electron charge, (e)	$= 1.602 \times 10^{-19}$ C
Proton mass, (m_p)	$= 1.673 \times 10^{-27}$ kg
Electron mass, (m_e)	$= 9.10 \times 10^{-31}$ kg

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Part	Question No	Marks
I (MCQ) (***10 marks***)	1-10	
II (SEQ) (***90 marks***)	1	
	2	
Total (*100 marks*)		
Percentage (%)		

Part I -MCQ

Answer **all** questions.

1. Number of unpaired electrons present in chromium in its ground state.

   (1) 5 (2) 3 (3) 6 (4) 2 (5) 4

2. If the electronic configuration of oxygen atom is written as $1s^2 2s^2 2p^4$ which one of the following rule would be violated?

   (1) Hund's rule
   (2) Pauli exclusion principle
   (3) Aufbau principle
   (4) Both Hund's and Pauli's principles
   (5) None of the above

3. Which of the following statements about a ground state rubidium (Rb) atom is **incorrect**?

   (1) There are 18 electrons with $n = 3$.
   (2) There are at least 18 electrons with $m_s = -½$
   (3) There are no electrons with $\ell = 3$.
   (4) There are 6 electrons with $\ell = 0$.
   (5) There are 2 electrons with $m_l = -2$.

4. A possible set of quantum numbers for the last electron added to a gallium atom (Z= 31) in its ground state is,

	n	l	m_l	m_s
(1)	4	1	–1	+½
(2)	4	0	0	–½
(3)	3	2	+2	+½
(4)	3	0	0	–½
(5)	4	2	2	–½

5. Intermolecular forces between oxygen molecules are,

   (1) hydrogen bonding.
   (2) covalent bonding.
   (3) van der Waals forces.
   (4) ionic bonding.
   (5) σ-bonding.

6. Which of the following statements pertaining to $BeCl_2$ molecule is **incorrect**?

(1) The central atom in $BeCl_2$ molecule has two *sp* hybrid orbitals.
(2) The central atom in $BeCl_2$ molecule does not obey the octet rule.
(3) $BeCl_2$ molecule is linear with a bond angle of 180^0.
(4) $BeCl_2$ molecule is polar.
(5) Net dipole moment of $BeCl_2$ molecule is zero.

7. When there are lone pairs of electrons in the valence shell of the central atom in a molecule, those lone pairs stay as far apart as possible to minimize repulsions between them. Above concept is incorporated in the

(1) Pauli exclusion principle.
(2) Heisenberg uncertainty principle.
(3) Valence shell electron pair repulsion theory.
(4) Aufbau principle.
(5) Hund's rule.

8. According to the Molecular Orbital Theory, electrons in a molecule occupy,

(1) atomic orbitals.
(2) molecular orbitals.
(3) hybridized atomic orbitals.
(4) atomic orbitals and hybridized atomic orbitals.
(5) None of the above.

9. Valance Bond theory can be used to explain following information about a molecule.

(1) bond order.
(2) bond length.
(3) geometry.
(4) Colour.
(5) none of the above.

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

(1) London dispersion forces operate between all molecules.
(2) Melting point of Xe is greater than that of helium.
(3) Hydrogen bonding is a special type of intermolecular attraction between the hydrogen atom in a polar bond and an unshared electron pair on a nearby electronegative atom.
(4) London dispersion forces account for the fact that molecular iodine is a solid.
(5) The higher boiling point of water compared to that of H_2S is due to London dispersion forces.

[1x 10 marks]

Part II – STRUCTURED ESSAY

01. Answer **all** parts. (**40 marks**)

(a) (i) Define the following terms.

(I) Atomic orbital. [03 marks]

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(II) σ- and π- molecular orbitals. [03 marks]

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(III) Pauli exclusion principle. [03 marks]

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(ii) Sketch the shapes of the following orbitals.

(I) d_{xz} (II) d_z^2

[06 marks]

(b) (i) An electron in an atom can initially be assigned a set of four quantum numbers. Write the possible values for quantum numbers l, m_l, and m_s for the electrons when n = 3.

	Possible values		
l			
m_l			
m_s			

[10 marks]

(c) An electron transition occurs in a hydrogen atom from the energy level n=5 to n=1.

(i) To which series of the hydrogen spectrum does the above electronic transition belong? [03 marks]

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(ii) Give Rydberg equation which is used to calculate the wave number, $\bar{\nu}$, of the lines in the hydrogen spectrum. [02 marks]

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(iii) Calculate the energy released in the above electronic transition considering that the Rydberg constant is $1.09737 \times 10^7\ m^{-1}$. [10 marks]

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02. Answer **all** parts. **(50 marks)**

(a) (i) Define the term ionization energy.

[03 marks]

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(ii) List three factors that affect ionization energy of an element. Describe briefly the effect of them. [08 marks]

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(iii) Successive ionization energies (IE_1, IE_2, IE_3, IE_4) of four elements A, B, C, and D are given in the table below. Of these, three elements are found as Na, Mg, and Al. Giving reasons assign each of these three elements to A, B, C, D.

Element	Ionization energy (kJ/mol)			
	IE_1	**IE_2**	**IE_3**	**IE_4**
A	732	1451	7733	10540
B	496	4562	6912	9543
C	578	1817	2745	11575
D	1520	2665	3931	5770

[12 marks]

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(b) (i) What is meant by polarizing power and polarizability of ions?

[05marks]

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(ii) Describe briefly the polarizing power based on charge and the size of the cations separately.

[05marks]

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(c) Using suitable molecular orbital diagrams, show that:

(i) He_2 molecule does not exist.

[05marks]

(ii) O_2 molecule is attracted by an external magnetic field.

[12 marks]

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Periodic Table of the Elements