

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 x10 ⁸ m s ⁻¹
Avogadro's number, (N _A)	= 6.022 x10 ²³ mol ⁻¹
Planck's constant, (h)	= 6.626 x10 ⁻³⁴ J s
Electron charge, (e)	= 1.602x10 ⁻¹⁹ C
Proton mass, (m _p)	= 1.673 x10 ⁻²⁷ kg
Electron mass, (m _e)	= 9.10 x10 ⁻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 (%)		

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° .
 - (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. Valence 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 $n = 3$.

	<i>Possible values</i>		
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 $1.09737 \times 10^7 \text{ m}^{-1}$. [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:

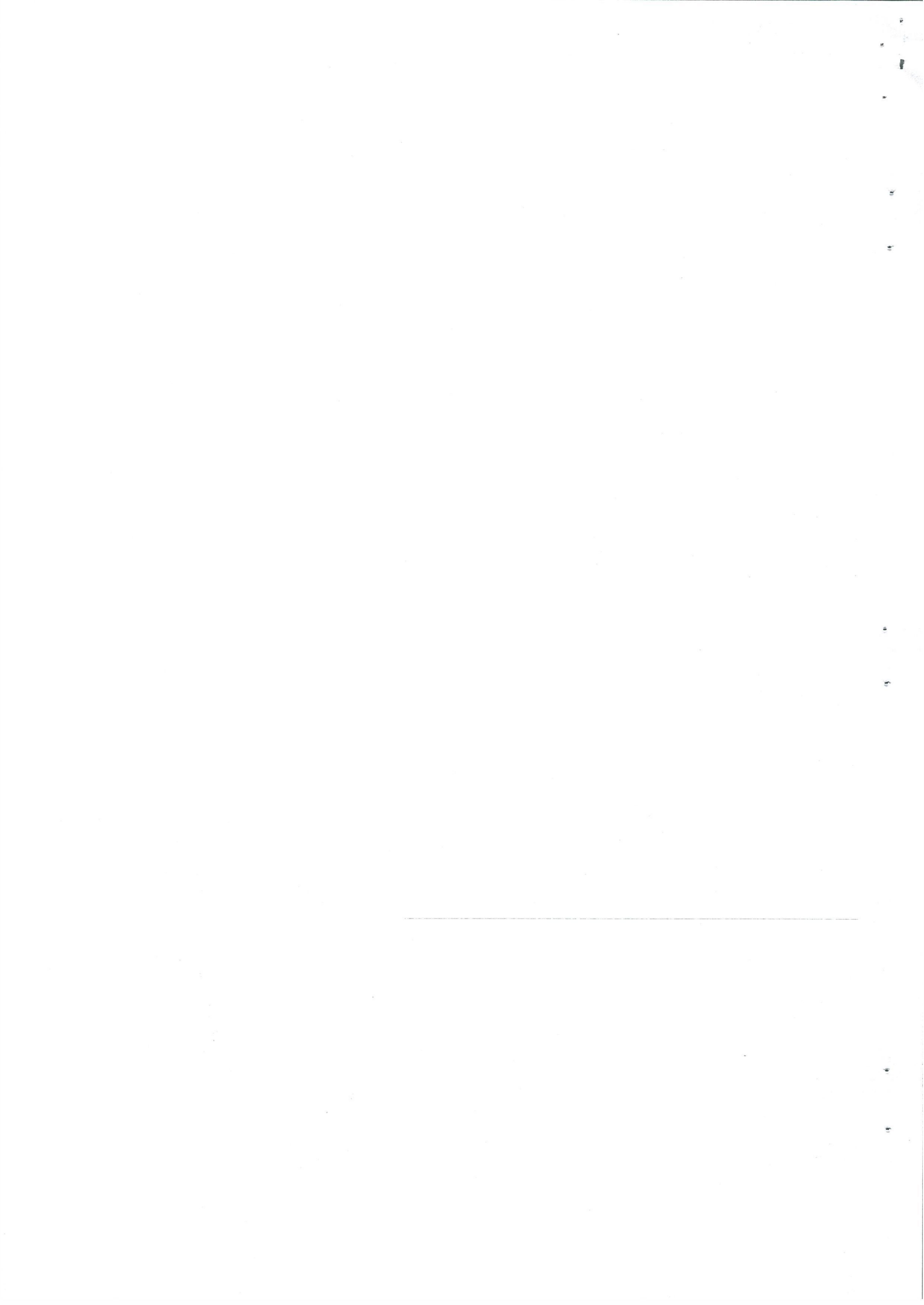
(i) He₂ molecule does not exist.

[05marks]

(ii) O₂ molecule is attracted by an external magnetic field.

[12 marks]

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Periodic Table of the Elements

Atomic Number	Symbol	Name	Atomic Weight
1	H	Hydrogen	1.008
2	He	Helium	4.00262
3	Li	Lithium	6.94
4	Be	Beryllium	9.012182
5	B	Boron	10.81
6	C	Carbon	12.011
7	N	Nitrogen	14.007
8	O	Oxygen	15.999
9	F	Fluorine	18.99847363
10	Ne	Neon	20.1797
11	Na	Sodium	22.98976928
12	Mg	Magnesium	24.305
13	Al	Aluminum	26.9815385
14	Si	Silicon	28.085
15	P	Phosphorus	30.973761998
16	S	Sulfur	32.06
17	Cl	Chlorine	35.45
18	Ar	Argon	39.948
19	K	Potassium	39.0983
20	Ca	Calcium	40.078
21	Sc	Scandium	44.955912
22	Ti	Titanium	47.88
23	V	Vanadium	50.9415
24	Cr	Chromium	51.9961
25	Mn	Manganese	54.938044
26	Fe	Iron	55.845
27	Co	Cobalt	58.933194
28	Ni	Nickel	58.6934
29	Cu	Copper	63.546
30	Zn	Zinc	65.38
31	Ga	Gallium	69.723
32	Ge	Germanium	72.630
33	As	Arsenic	74.921595
34	Se	Selenium	78.9718
35	Br	Bromine	79.904
36	Kr	Krypton	83.798
37	Rb	Rubidium	85.4678
38	Sr	Strontium	87.62
39	Y	Yttrium	88.90584
40	Zr	Zirconium	91.224
41	Nb	Niobium	92.90637
42	Mo	Molybdenum	95.94
43	Tc	Technetium	(98)
44	Ru	Ruthenium	101.07
45	Rh	Rhodium	102.90550
46	Pd	Palladium	106.42
47	Ag	Silver	107.8682
48	Cd	Cadmium	112.411
49	In	Indium	114.818
50	Sn	Tin	118.710
51	Sb	Antimony	121.750
52	Te	Tellurium	127.60
53	I	Iodine	126.90447
54	Xe	Xenon	131.29
55	Ba	Barium	137.327
56	La	Lanthanum	138.9048
57	Fr	Francium	(223)
58	Ra	Radium	(226)
59	Ce	Cerium	140.12
60	Nd	Neodymium	144.242
61	Pm	Promethium	(145)
62	Sm	Samarium	150.36
63	Eu	Europium	151.964
64	Gd	Gadolinium	157.25
65	Tb	Terbium	158.92535
66	Dy	Dysprosium	162.50
67	Ho	Holmium	164.93032
68	Er	Erbium	167.258
69	Tm	Thulium	168.9342
70	Yb	Ytterbium	173.045
71	Lu	Lutetium	174.967
72	Hf	Hafnium	178.49
73	Ta	Tantalum	180.94788
74	W	Tungsten	183.84
75	Re	Rhenium	186.207
76	Os	Osmium	190.23
77	Ir	Iridium	192.222
78	Pt	Platinum	195.084
79	Au	Gold	196.966569
80	Hg	Mercury	200.59
81	Tl	Thallium	204.38
82	Pb	Lead	207.2
83	Bi	Bismuth	208.9804
84	Po	Polonium	(209)
85	At	Astatine	(210)
86	Rn	Radon	(222)
87	Fr	Francium	(223)
88	Ra	Radium	(226)
89	Ac	Actinium	(227)
90	Th	Thorium	232.0377
91	Pa	Protactinium	231.036
92	U	Uranium	238.02891
93	Np	Neptunium	(237)
94	Pu	Plutonium	(244)
95	Am	Americium	(243)
96	Cm	Curium	(247)
97	Bk	Berkelium	(247)
98	Cf	Californium	(251)
99	Es	Einsteinium	(252)
100	Fm	Fermium	(257)
101	Md	Mendelevium	(288)
102	No	Nobelium	(289)
103	Lr	Lawrencium	(260)
104	Rf	Rutherfordium	(261)
105	Db	Dubnium	(262)
106	Sg	Seaborgium	(266)
107	Bh	Borhrium	(264)
108	Hs	Hassium	(277)
109	Mt	Meitnerium	(276)
110	Ds	Darmstadtium	(285)
111	Rg	Roentgenium	(281)
112	Cn	Copernicium	(285)
113	Nh	Nihonium	(286)
114	Fl	Flerovium	(289)
115	Mc	Moscovium	(288)
116	Lv	Livermorium	(293)
117	Ts	Tennesse	(294)
118	Og	Oganesson	(294)

