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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ). 2023 අගෝස්තු

General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I	**Time - 2.5 Hours**

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34}\ J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

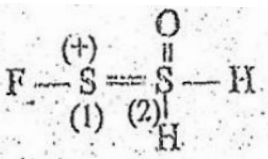
Monthly Evaluation Test – 2021 August

Part I- MCQ

- **Answer all the Questions.**
- **Do not use Calculators or any other Notes.**
- **Submit your Answer script (including Rough works) in PDF Form.**

1. Which of the following has the longest wave length.
   1) Radio waves 2) X - rays
   3) Infra red radiation 4) Ultra violet radiation
   5) Gamma rays

2. Which of the following has the highest second ionization energy?
   1) Mg 2) Al 3) Be 4) B 5) Ar

3. 

   Oxidation numbers of the S atoms labelled as (1) and (2) in above structure are,
   1) +2 and 0 2) +1 and 0 3) +3 and +4 4) +2 and +4 5) +4 and +6

4. Which of the following is true regarding the $^{208}_{82}Pb^{2+}$ ion?

a) It contains equal number of electrons and neutrons.
b) It contains an equal number of electrons and protons.
c) the no of neutrons if it is, 126
d) the no of electrons in it is, 80

5. Which statement of the following statements is / are correct?

(a) e/m ratio of beta particles is higher than that of an electron.
(b) An electron has particle properties as well as wave properties.
(c) A beam of electrons can travel through a vacuum.
(d) Cathode rays are not generated from cathode and these are formed by ionization of the gas in discharge tube.

6. Which of the following statements is / are false?

(a) Van Der Waal radius of an atom is larger than its covalent radius.
(b) Ionic radius of S^{2-} is higher than the ionic radius of Cl^- ion.
(c) Second ionization energy of Mg is higher than the second ionization energy of Na.
(d) Always two atoms should be participated to form a molecule.

7. The element A reacts with the element X to form the molecule AX_3. AX_3 is a T shaped molecule. What the number of lone pairs around the atom A in AX_3?

1) 0 2) 1 3) 2 4) 3 5) 4

8. The correct variation of the first ionsation energy of the elements Li, K, N, O, Ne and Ar is

(1) K < Li < O < N < Ar < Ne.
(2) Ne < Ar < N < O < Li < K.
(3) K < Li < O < N < Ne < Ar.
(4) K < O < Li < N < Ar < Ne.
(5) Li < N < O < K < Ar < Ne.

9. Which molecule from the molecules given below consists the highest number of pi (π) bonds?

(1) H_2SO_4 (2) H_2SO_3 (3) HNO_3 (4) H_3PO_4 (5) $HClO_4$

10. Which one of the following statements is false with regards to the most stable lewis structures following species?

(a). CO_2 (b). IF_2^- (c). H_2O (d). SO_2

(1) All the species show two different types of geometric shapes.
(2) All the species have different electron – pair geometries.
(3) Only in three species, central atom has lone pairs.
(4) Only two species contain pi bonds.
(5) The ascending order of bond angles is d < c < a < b.

11. How many resonance structures are there for N_2O molecule?

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

12. Which of the following statements is /are **True**?

(a) Electron shows particle properties as well as wave properties.
(b) Cathode rays are not electromagnetic radiations.
(c) Energy of an electromagnetic radiation emits continuously.
(d) Positive rays are generated when electrons are removed from atoms or molecules in the discharge tube.

Response	First statement	Second statement
(1)	True	True and correctly explains the first statement.
(2)	True	True but does not explain the first statement correctly.
(3)	True	False
(4)	False	True
(5)	False	False

13.

First statement	Second statement
Nuclides are atomic species with definite number of protons and definite number of electrons.	Though, ${}_1^1H$, ${}_1^2H$ and ${}_1^3H$ are isotopes of the same elements, those are not nuclides.

14.

One bond in H_3O^+ ion is different while other two bonds are similar.	One bond in H_3O^+ ion is a dative bond.

15.

Two electrons in a certain atom do not possess identical sets of quantum numbers.	Electrons spinning in same direction, do not exist in an atom.

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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ), 2023 අගෝස්තු

General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34}\ J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

Part II- A- Structured Essay

❖ **Answer all the Questions**

1.. a) Arrange the following in the increasing order or the property indicated in parenthesis. (Reasoning is not necessary.

i) H^-, Li^+, Na^+, Cl^- (Ionic radius)

.....

ii) e, p, Li^+, He^+ (e/m ratio of particles)

.....

iii) Mn^{4+}, Cr^{2+}, Ni^{2+}, Zn^{2+} (Number of unpaired electrons)

.....

iv) N, O, F, Mg (1^{st} ionization energy)

.....

v) NH_2^-, NH_3, SO_2, IF_2^- (Bond angle)

.....

b) Consider the following chemical species given in the list and answer the following questions.

SF_6 , NH_4Cl, SiO_2, $HClO_4$, H_3O^+, CO_3^{2-}

i. Identify the species which has a shape similar to the shape of NCl_3 (.....)

ii. Identify the species which has the heighest number of lone pair (.....)

iii. Identify the species which exhibits both ionic and covalent character (.....)

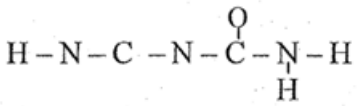
iv. Identify the species which has the highest melting point (.....)

v. Identify the species which has the bond angle 120^0 (.....)

vi. Identify the species which has the highest oxidation number +7 in the central atom

(.....)

c) The skeleton of the organic molecule whose molecular formula is $C_2H_3N_3O$ is given below.



Answer the parts (I – VI) which are based on this compound.

i) Draw the most acceptable Lewis structure of this molecule.

.....

.....

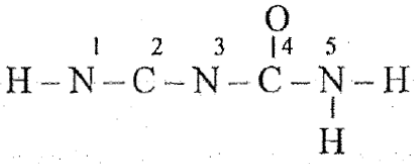
ii) Draw four resonance structures of this molecule, excluding the structure drawn in part (i) above.

.....

iii) State the following regarding C and N atoms in the table.

I. No of VSEPR pairs around the atom.
II. Electron pair geometry (arrangement of electron pairs) around the atom.
III. Shape around the atom.
IV. Hybridization of the atom.

The C and N atoms of the above molecule are labelled as follows.



		N^1	C^2	C^4	N^5
I	No. of VSEPR pairs				
II	Electron pair geometry				
III	Shape				
IV	Hybridization				

iv) Sketch the shape of the Lewis structure drawn in part (i) above indicating approximate values of the bond angles. (Show all bond angles)

v) Identify the atomic / hybrid orbitals involved in the formation of the following σ bonds in the Lewis structure drawn in part (i) above (numbering of the atoms as in part (iii))

I. $N^1 - C^2$ N^1 ..... C^2 .....

II. $C^2 - N^3$ C^2 ..... N^3 .....

III. $C^4 - O$ C^4 ..... O .....

IV. $N^5 - H$ N^5 ..... H .....

vi) In the Lewis structure drawn in part (i) above, indicate whether N^3 and N^5 has the higher electronegativity. Give the main reason for your choice. (Numbering of atoms is as in part iii).

.....

.....

.....

.....

2. a) Arrange the following in ascending order of the property stated within parenthesis.

i) Cl^- , S^{2-} , Ca^{2+}, K^+ (ionic radii)

.....

.....

ii) P, S, Cl (second ionization energy)

.....

.....

iii) Mn_2O_7 , MnO , MnO_2 (electronegativity of Mn))

.....

.....

b) Atomic skeletal of methylthiocyanate (CH_3SCN) is given bellow.

C – S – C – N

i) Draw the most acceptable Lewis structure of this molecule.

ii) Draw three possible resonance structures for mthylthiocyanate.

iii) Considering the structure drawn in (b) (i) above, fill the table given bellow.

$C^4 – S^3 – C^2 – N^1$

		C^4	S^3	C^2
i)	No. of VSEPR pairs			
ii)	Electron pair geometry			
iii)	Shape			
iv)	Hybridization			

(C) By using *VSEPR*theory derive the shape of following ions / molecules and draw the respective structure of them.

1. CrO_4^{2-}

.....

.....

.....

2. ICl_4^-

.....

.....

.....

3. $Tecl_4$

.....

.....

.....

4. PCl_3

.....

.....

.....

The Periodic Table

1	1 H																2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

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Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

Part II- B Essay

Answer all the Questions.

3.. a) Write the electronic configuration of given species.

1. Cu →
2. Zn^{2+} →
3. Na^{+} →
4. N^{3-} →
5. Cl^{-} →

b) w, x, y, z are four non transition successive elements in the periodic table. All are gases at room temperature. The first ionization energy of x, y, z are in the following orders x< y< z.

I. Identify w, x, y and z.

w - ..... x - ..... y - ..... z - .....

II. Indicate the first ionization energy of w, x, y, z in the ascending order.

III. Which element is highest electro-negativity?

IV. Write the element of w, x, y and z in the ascending order of atomic size.

V. W forms a compound with y, write the molecular formula of that compound.

(c) The 3rd transition element M for the stable M^{3+} ion with five unpaired electron in aqous solution. An atom of element M has has four unpaired electron in its ground state.

(i) Identify M.

(ii) Write the complete electronic configuration of M.

(iii) Write the sets of four quantum numbers for the outer most electrons of M.

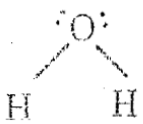
(d) State the main type of bond/bonds present in the following chemical species using the words given below. (Polar covalent, Non – polar covalent, Dative bond, Ionic bond, Metallic bond)

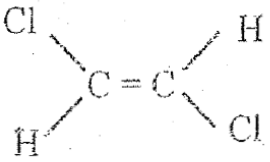
1. $HCl \rightarrow$
2. $NH_4Cl \rightarrow$
3. $Ag_{(s)} \rightarrow$
4. $Cl_{2\,(g)} \rightarrow$
5. $LiCl_{(s)} \rightarrow$

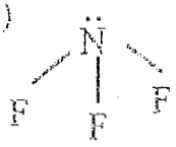
4. (a) (i) Indicate the following on the given diagrams of the molecules.

I. Polarizibility of the bonds

II. Polarizibility of the whole molecule and the direction that of it acting.

(A) 

(B) 

(C) 

(ii) Write down two factors that effect for polarization.

(iii) The variation of heat decomposition temperatures of group two elements' carbonates is $BeCO_3 < MgCO_3 < CaCO_3 < SrCO_3$. Explain this on the basis of polarizibility of the bond.

(iv) Covalent character of $CuSO_4$ is higher than that of Na_2SO_4.

(b) (i) Draw the Lewis structures of the following molecules / ions.

(A) N_2O_3 (B) $S_2O_3^{2-}$ (C) N_3^- (D) HPO_4^{2-} (E) IBr_5

(ii) Draw the geometrical shape of following molecules / ion.

(A) XeF_4 (B) ICl_3 (C) CH_3^- (D) NOCl

(c) Draw the Lewis structures for following species and deduce the shape around central atom.

i) XeO_2F_2

ii) XeF_3^+

iii) S_2CO^{2-}

********** **Monthly Evaluation Test – August, 2021** **********