

Chemistry - Dulan Maduranga පුස්තකාලය - ජනපත විද්‍යා විභාග මධ්‍යස්ථානය
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 Special Online Speed Test
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 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 $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Plank's constant $h = 6.626 \times 10^{-34} \text{ J s}$

Avogadro constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Velocity of light $c = 3 \times 10^8 \text{ m s}^{-1}$

Second Semester Test(Unit 01-03) – 2022 March

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.

- Which of the following gives the electron pair geometry and hybridisation around an oxygen atom in H_2O respectively?
 (1) angular, sp^3 (2) tetrahedral, sp^3 (3) tetrahedral, sp^2
 (4) angular, sp (5) linear, sp
- The correct variation of the first ionisation energy of the elements Li, K, N, O, Ne and Ar is
 (1) $\text{K} < \text{Li} < \text{O} < \text{N} < \text{Ar} < \text{Ne}$. (2) $\text{Ne} < \text{Ar} < \text{N} < \text{O} < \text{Li} < \text{K}$.
 (3) $\text{K} < \text{Li} < \text{O} < \text{N} < \text{Ne} < \text{Ar}$. (4) $\text{K} < \text{O} < \text{Li} < \text{N} < \text{Ar} < \text{Ne}$.
 (5) $\text{Li} < \text{N} < \text{O} < \text{K} < \text{Ar} < \text{Ne}$.
- In which of the following elements does a gaseous atom in ground state contain **only** four unpaired electrons?
 (1) Ti (2) Cr (3) Fe (4) Co (5) Sn
- In an atom, what is the number of atomic orbitals in which an electron with principal quantum number, $n = 3$ and magnetic quantum number, $m_l = 0$ can exist?
 (1) 1 (2) 2 (3) 3 (4) 4 (5) 5
- The volume of 0.01 mol dm^{-3} $\text{K}_2\text{Cr}_2\text{O}_7$ (cm^3) required to react completely with 25.00 cm^3 of 0.02 mol dm^{-3} of FeI_2 aqueous solution in acidic medium is,
 (1) 8.33 (2) 10.00 (3) 16.67 (4) 20.00 (5) 25.00

6. The relative atomic mass of Pb is approximately four times greater than that of Cr. The mass percentage of Pb in a mixture containing only Pb and Cr is 80%. What is the mole fraction of Pb in the mixture?
 (1) 0.20 (2) 0.25 (3) 0.50 (4) 0.65 (5) 0.80
7. Which gives the correct variation of O - O bond length in the species, O_2 , O_2^{2-} and O_3 ?
 (1) $O_2 < O_3 < O_2^{2-}$ (2) $O_3 < O_2 < O_2^{2-}$ (3) $O_2 < O_2^{2-} < O_3$
 (4) $O_3 < O_2^{2-} < O_2$ (5) $O_2^{2-} < O_3 < O_2$
8. Which of the following molecular shapes have the octahedral electron pair geometry around the central atom?
 (1) Square pyramidal, Linear (2) Linear, Square planar
 (3) Trigonal planar, T-shape (4) See-saw shape, Trigonal bipyramidal
 (5) Square pyramidal, Square planar
9. The skeletal structure of NH_2COOH is given. What is the maximum number of Lewis dot-dash structures that can be drawn for this molecule?
 (1) 3 (2) 4 (3) 5
 (4) 6 (5) 7
- $$\begin{array}{c} \text{O} \\ | \\ \text{H}-\text{N}-\text{O}-\text{C}-\text{O}-\text{H} \\ | \\ \text{H} \end{array}$$
10. Which one of the following statements is **not true** about hybridisation?
 (1) Hybrid orbitals formed from a given hybridisation have the same shape.
 (2) Hybrid orbitals may form π bonds.
 (3) The angle between sp^2 hybrid orbitals is 120° .
 (4) All carbon atoms in hydrocarbons are hybridised.
 (5) Hybrid orbitals formed from a given hybridisation have the same energy.
11. Which molecule consists of only London forces as secondary interactions?
 (1) O_3 (2) OF_2 (3) BCl_2F (4) SF_4 (5) XeF_4
12. 500cm^3 of 0.02mol dm^{-3} aqueous solution of $BaCl_2$ is mixed with 100cm^3 of 0.5mol dm^{-3} $(NH_4)_2SO_4$ solution. What is the maximum theoretical amount of precipitate of $BaSO_4$ that can be formed?
 (1) 0.01mol (2) 0.02mol (3) 0.05mol (4) 0.1mol (5) 1.0mol

First statement	Second statement
Carbon shows the highest oxidation state when Li to F are considered.	The oxidation state of carbon in $C_2O_4^{2-}$ is +3.
The second ionization enthalpy of Al is less than that of Mg.	Nuclear charge of Al is higher than that of Mg.
Spectral lines having highest frequency are in Lymana series of the emission spectrum of Hydrogen	Energy difference between the energy levels $n=1$ and $n=2$ is higher than that of between $n=2$ and $n=\infty$ (infinite)

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Chemistry I

02

S/E

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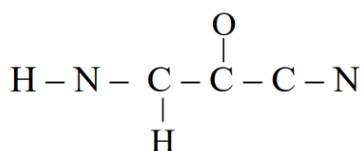
Plank's constant $h = 6.626 \times 10^{-34} \text{ J s}$

Velocity of light $c = 3 \times 10^8 \text{ m s}^{-1}$

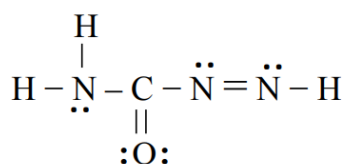
❖ **Answer all the Questions**

- 1) (a) If the following statements are true mark "✓" and if the statement is false put "×" marks in the given space.
- (1) Hybridization of the central atom of SO_3^{2-} is sp^3
- (2) If the dipole moment of AX_4 molecule is zero, the shape of the molecule is exactly tetrahedral.
- (3) The releasing energy of gaining an electron is higher in Cl than that of F.
- (4) The releasing energy of hydration of a stable cation in second period is increasing down the group.

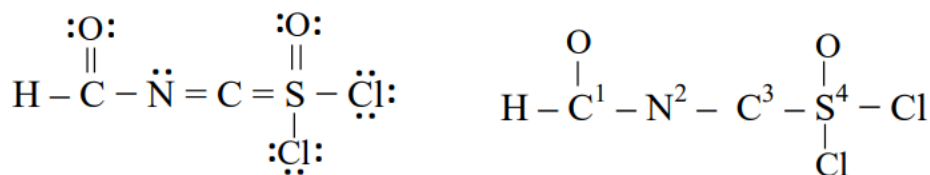
- (b)
- (i) Draw the most acceptable Lewis dot-dash structure for the molecule $\text{C}_3\text{N}_2\text{H}_2\text{O}$. Its skeleton is given below.



- (ii) Most stable Lewis dot-dash structure of molecule $\text{H}_3\text{N}_3\text{CO}$ is given below. Draw two more Lewis dot-dash structures (resonance structures) for this molecule.



(iii) Complete the given table considering the Lewis dot-dash structure and its labelled skeletal structure given below.



	C ¹	N ²	C ³	S ⁴
VSEPR pairs around the atom.				
Electron pair geometry around the atom.				
Shape around the atom.				
Hybridization of the atom.				

Questions (iv) to (v) are based on the Lewis dot-dash structure given in above question (iii). Labelling of atoms is as in part (iii).

(iv) Identify the atomic/hybrid orbitals involved in the formation of σ – bonds between the two atoms given below.

I.	H - C ¹	H :	C ¹ :
II.	C ¹ - O	C ¹ :	O :
III.	C ¹ - N ²	C ¹ :	N ² :
IV.	N ² - C ³	N ² :	C ³ :
V.	C ³ - S ⁴	C ³ :	S ⁴ :
VI.	S ⁴ - Cl	S ⁴ :	Cl :

(v) Identify the atomic orbitals involved in the formation of π – bonds between the two atoms given below.

I.	C ¹ - O	C ¹ :	O :
II.	N ² - C ³	N ² :	C ³ :

- 2 (a) Products of reaction between hydroxyl amine (NH_2OH) and Fe^{3+} are given below.



- (i) Write oxidation half ionic equation.

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- (ii) Write the reduction half ionic equation.

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- (iii) Balance the above equation.

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- (iv) A 10 cm^3 sample of hydroxyl amine was diluted to 1 dm^3 . 50.00 cm^3 of this solution was boiled with excess Fe^{3+} solution. The resulting solution required 12.0 cm^3 of 0.02 mol dm^{-3} KMnO_4 solution for complete oxidation of Fe^{2+} ($\text{N} = 14, \text{O} = 16, \text{H} = 1$)

- I. Write balanced ionic equation for the reaction between Fe^{2+} and MnO_4^-

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- II. Calculate the amount of KMnO_4 used for the complete oxidation of Fe^{2+} .

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- III. What is the amount of Fe^{2+} present in the solution.

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- IV. What is the amount of NH_2OH present in 1 dm^3

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- c) i) The compound IPO_4 reacts in aqueous medium to form IO_3^- and H_2PO_4^- in acidic medium.

- i) Write the oxidation half reaction.

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- ii) Write the reduction half reaction.

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- iii) Write balanced ionic equation.

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Chemistry I

02

S/E

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Plank's constant $h = 6.626 \times 10^{-34} \text{ J s}$

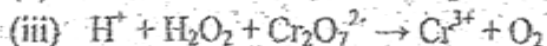
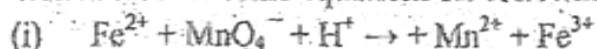
Velocity of light $c = 3 \times 10^8 \text{ m s}^{-1}$

Answer all the Questions.

Element	1 st ionization energy / kJ mol ⁻¹	2 nd ionization energy / kJ mol ⁻¹	3 rd ionization energy / kJ mol ⁻¹	4 th ionization energy / kJ mol ⁻¹
A	900	1800	15000	20000
B	800	2500	3600	25000
C	580	1800	2800	11000

- i) Identify the groups above A, B, and C elements. Briefly explain the reason for your identification.
- ii) If these elements are in second and third periods, identify these elements.
- iii) Write the chlorides formed by above A and E elements and state their geometric shapes. State the hybridization of each element.
- b) i) NH_3 , CCl_4 , $\text{CH}_3\text{CH}_2\text{OH}$, CHCl_3 , Ar, H_2S , NH_4Cl , H_3O^+ , MgCl_2 .
Which of the above substances contain following secondary interactions?
- Dipole – Dipole forces
 - Hydrogen bonds
 - London dispersion forces
 - Dative bonds
 - Ionic bonds
- ii) Arrange $\text{Mg}(\text{NO}_3)_2$, $\text{Ca}(\text{NO}_3)_2$, $\text{Sr}(\text{NO}_3)_2$, and $\text{Ba}(\text{NO}_3)_2$ in the increasing order of decomposition temperature. Explain your answer in associated with Polarizability.
- iii) Deduce the geometric shapes of following ions using VSEPR theory.
- PO_4^{3-}
 - NO_2^-
 - ICl_5

c). Write balanced ionic equations for following reactions.



4). a) 10 g of a sample containing MgCl_2 and CaCO_3 was dissolved in 200 cm^3 of 2 mol dm^{-3} HCl solution. Then this solution was diluted up to 250 cm^3 by adding distilled water. 25.0 cm^3 portion of this solution was reacted with 1 mol dm^{-3} NaOH solution. Volume of NaOH spent was 35.5 cm^3 . Calculate the mass percentage of CaCO_3 in the sample. ($\text{Ca} = 40, \text{C} = 12, \text{O} = 16$)

b) Organic compound named A contains 48.65% of C, 8.11% of H according to mass. The rest is oxygen. ($\text{C} = 12, \text{H} = 1, \text{O} = 16$)

i) Find the empirical formula of compound of A.

ii) Find the molecular formula of A.

iii) If A contains a $-\text{COOH}$ group, draw the structure of A.

c) Solar radiation with 325 nm wavelength is bad for human skin. Calculate the following regarding this radiation.

i) Frequency of the radiation.

ii) Energy of a photon of the radiation.

iii) Energy of one mole of photons.

iv) Identify the region of the electromagnetic spectrum to which this radiation belongs.

v) State two uses of this radiation.

***** 2nd Semester Evaluation Test – 2022 March *****