CHE-01

ASSIGNMENT BOOKLET

Bachelor's Degree Programme (B.Sc.)

ATOMS AND MOLECULES

(Valid from January 1, 2021 to December 31, 2021)

Please Note

- **You can take electives (56 to 64 credits) from a minimum of TWO and a maximum of FOUR science disciplines, viz. Physics, Chemistry, Life Sciences and Mathematics.**
- **You can opt for elective courses worth a MINIMUM OF 8 CREDITS and a MAXIMUM OF 48 CREDITS from any of these four disciplines.**
- **At least 25% of the total credits that you register for in the elective courses from Life Sciences, Chemistry and Physics disciplines must be from the laboratory courses. For example, if you opt for a total of 64 credits of electives in these 3 disciplines, at least 16 credits should be from lab courses.**
- **You cannot appear in the Term-End Examination of any course without registering for the course. Otherwise, your result will not be declared and the onus will be on you.**

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2021)

Dear Student,

We hope, you are familiar with the system of evaluation to be followed for the Bachelor's Degree Programme. At this stage you may probably like to re-read the section on assignments in the Programme Guide that we sent you after your enrolment. A weightage of 30 percent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment. The assignment is based on Blocks 1 and 2.

Instructions for Formatting Your Assignments

Before attempting the assignments, please read the following instructions carefully.

1 On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO:…..…….……

NAME:……..……

ADDRESS:…….....……

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COURSE CODE : ….....……

COURSE TITLE : ….....……

ASSIGNMENT NO.: ….....……

STUDY CENTRE : ….....…… DATE:..…….
(NAME AND CODE)

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2 Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3 Leave 4 cm margin on the left, top and bottom of your answer sheet.

4 Your answers should be precise.

5 While writing answers, clearly indicate the Question No. and part of the question being solved.

6 Please note that:

i) The Assignment is valid from 1st January, 2021 to 31st December, 2021.

ii) The response to this assignment is to be submitted to the Study Centre Coordinator within eight weeks of the receipt of this booklet in order to get the feedback and comments on the evaluated assignment.

iii) In any case, you have to submit the assignment response before appearing in the term end examination.

7 We strongly suggest that you should retain a copy of your assignment responses.

Wishing you all good luck.

Tutor Marked Assignment

Course Code: CHE-01
Assignment Code; CHE-01/TMA/2021
Maximum Marks: 100

Each question carries 10 marks

Use the following data

Permittivity in vacuum = 8.854×10^{-12} $C^2N^{-1}m^{-2}$

Planck's constant = 6.626×10^{-34} J s

Mass of electron = 9.109×10^{-31} kg

Magnitude of the charge on the electron = 1.602×10^{-19} C

Avogadro constant = 6.022×10^{23} mol^{-1}

Velocity of light = 2.998×10^{8} m s^{-1}

Relative atomic masses: Hydrogen = 1; Deuterium = 2; Iodine = 127

Q.1 a) Calculate the radius of the second and third orbits in He^+ ion. Also calculate the energy of the electron in the second and third orbits of He^+ ion. (5)

Hint: Use Bohr atom model. Z value for He^+ ion = 2.

b) Calculate he wave number (m^{-1}) and energy (kJ mol)$^{-1}$ of the light of wavelength 800 nm. (5)

Q.2 a) Write the values of four quantum numbers for 4*s* and 4*p* electrons. (5)

b) Calculate the de Broglie wavelength associated with a body of mass 1.5 kg moving with a velocity of 100 m s^{-1}. (5)

Q.3 a) Arrive at the Lewis structures of ICl_2^+ and ICl_2^- ions. Using VSEPR theory, predict the shapes of these compounds. (5)

b) Calculate the bond lengths in bromoethane and bromoethylene using covalent radii values given in Table 3.10 of Unit 3. For hydrogen, assume that the covalent radius in 28 pm in these compounds. (5)

Q.4 a) Explain the structure of BF_3 molecule based on hybridization concept. What is its shape? (5)

b) Starting from Lewis structures, determine the hybridisation type of the central atoms in IF_4^+ and ICl_4^-. (5)

Q.5 a) State the definitions of bonding, antibonding and nonbonding orbitals. Draw the molecular orbitals obtained by the linear combination of two 1*s* orbitals. (5)

b) Using the molecular orbital theory, explain why the oxygen-to-oxygen bond is stronger in oxygen molecule than in peroxide (O_2^{2-}) ion. (5)

Hint: Start from molecular orbital configuration for oxygen molecule and peroxide Ion; then calculate bond order for each.

Q.6 a) An element X forms a compound, $XOCl_3$, in which X and O form a double bond while X and Cl form single bonds. Identify X from the following elements:

i) Al ii) Si iii) P (iv) S.

Give reason for your answer. Predict the shape of the molecule. (5)

b) You are given a gaseous substance. Suggest an experimental method to find out whether it is polar or nonpolar. Discuss the steps to be used in this method. (5)

Q.7 a) $(Fe(CN)_6)^{3-}$ is a low-spin complex ion while $(Fe(H_2O)_6)^{3+}$ is a high-spin complex ion. Both the complex ions are derived from ferric (Fe(III)) ion. Following the example worked out for d^4 configuration in Sec. 6.8 of Unit 6, answer the following:

i) What is the number of electron in 3*d* level of Fe^{3+} ion?

ii) Indicate the number of unpaired electrons in 3*d* level of Fe (III) species in each of the complex ions. Predict the magnetic moments of both the complex ions in Bohr magnetion units. (5)

b) Explain the terms, racemic mixture and meso form, with an example in each case. Mention a difference between the two. (5)

Q.8 a) The bond length of HI molecule is 163 pm. Calculate its (i) moment of inertia and (ii) rotational constant. (5)

b) What is the essential condition for a molecule to be microwave active? Give three examples each for the diatomic molecules. (5)

i) having microwave activity and

ii) not having microwave activity.

Q.9 a) Calculate the ratio for the fundamental frequencies of HI and DI. (5)

b) Based on Beer-Lambert law, explain the method of finding out the concentration of a given solution of potassium dichromate. You are also provided with a standard solution of potassium dichromate. (5)

Q.10 a) The rate constant for the radioactive disintegration of $^{60}_{27}Co$ is 0.1317 $year^{-1}$.

Calculate the mass of $^{60}_{27}Co$ that will remain after 21.04 years out of 1 gram sample. (5)

b) Explain the principle of determining the age of organic materials using radioactive dating method. (5)