Mahindra University Hyderabad
École Centrale School of Engineering
Minor I Regular Examination
(Batch 2023)

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Program: B. Tech	Branch: All (except, CB & BT)	Year: I Semester: I
	Subject: Chemistry - I (CH 1101)	
Date: 16/09/2023		Start Time: 10.00 AM
Time Duration: 1.5 Hours		Max. Marks: 30

Instructions

1. Answer all questions.

2. No clarifications will be entertained during the examination.

3. If any information is missing, make appropriate assumptions and proceed.

Q1. (Marks: [7+2+4+1+1=15])

(i) Derive the expression for radius of Bohr orbit of electron revolving around the nucleus using Bohr's model.

(ii) The radius of a Bohr orbit of the hydrogen atom is 16 a_0 (bohr). What is the principle quantum number of the orbit?

(iii) Using Bohr's model find the ionization energy (in atomic unit, E_h, known as hartree) of helium (He) ion, that is, the minimum energy required for the following process:

$$He^+ \longrightarrow He^{2+} + e^-$$
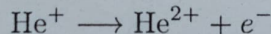
(iv) Energies absorbed or radiated by a blackbody are _____.

(v) At _____ frequencies classical theory fails to explain blackbody radiation.

Q2. (Marks: [4+7+4=15])

(i) Write down the expression for time-independent Schrödinger equation; explain its each term.

(ii) Show that $\Psi(x) = e^{ikx} + e^{-ikx}$ is an eigenfunction of the Hamiltonian operator $\hat{H}$ for a free-particle in one-dimension. What eigenvalue did you obtain? What is the observable here?

(iii) Which of the following expressions are acceptable wavefunctions, and which are not? State why.

a.
$$\psi(x) = \frac{1}{5-x}, \quad \text{where} \quad 0 \leq x \leq 4$$

b.
$$\psi(x) = e^{x^2}, \quad \text{where} \quad 0 \leq x \leq \infty$$