BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: IMSC **SEMESTER: III**
BRANCH: CHEMISTRY **SESSION: MO/2022**

SUBJECT: CH215 PHYSICAL CHEMISTRY-III

TIME: 2 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. **The total marks of the questions are 25.**
2. **Candidates attempt for all 25 marks.**
3. **Before attempting the question paper, be sure that you have got the correct question paper.**
4. **The missing data, if any, may be assumed suitably.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

				CO	BL
Q1	(a)	What is the significance of Heisenberg uncertainty principle in quantum mechanics?	[2]	CO1	1
Q1	(b)	What is the de Broglie wavelength associated with (a) an electron moving with speed of 5.4×10^6 m/s, and (b) a ball of mass 150 g travelling at 30.0 m/s? [Given: mass of an electron= 9.1×10^{-31} kg]	[3]	CO1	2
Q2	(a)	Verify that the wave function $\Psi(x) = x\, e^{-ax^2}$ is an eigenfunction of the operator $d^2/dx^2 - 4a^2x^2$. What is the corresponding eigenvalue?	[2]	CO1	2
Q2	(b)	Write down the time-independent Schrodinger equation for three dimensions. What is Hamiltonian operator?	[3]	CO1	3
Q3	(a)	Indicate which of the following functions are acceptable as wave functions: $\Psi=\sin x$ and $\Psi=e^{-x}$	[2]	CO1	2
Q3	(b)	Show that spacing between two lines in rotational spectrum is 2B.	[3]	CO4	1
Q4	(a)	Why does microwave spectrum appear as line whereas infra-red spectrum appears as band?	[2]	CO4	2
Q4	(b)	The lowest energy transitions in the rotational spectrum of HF are 41.105 and 82.211 cm^{-1}. Calculate the equilibrium bond length of HF.	[3]	CO4	2
Q5	(a)	Which of the following molecules give pure-rotational absorption spectra? N_2, O_2, NO, CO, CO_2, N_2O, SO_2, C_2H_4, CH_4, and $H_2C=O$	[2]	CO4	2
Q5	(b)	Explain the origin of P, Q and R branch in vibration-rotational spectrum of diatomic molecules.	[3]	CO4	1

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