

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

CLASS: IMSC
BRANCH: CHEMISTRY

SEMESTER: V
SESSION: MO/2022

SUBJECT: CH301 PHYSICAL CHEMISTRY-V

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.
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Q1 (a)	What factors affect width and intensity of spectral lines?	[2] CO1	1
Q1 (b)	Which of the following molecules show rotational spectra and why? HCl, H ₂ , CO, O ₂	[3] CO1	2
Q2 (a)	What do you mean by degrees of freedom of motion of molecules? Calculate the various degrees of freedom of the H ₂ O molecule.	[2] CO1	2
Q2 (b)	The rotational (microwave) spectrum of CO gas consists of a series of equally spaced lines with spacing equal to 32.4 cm ⁻¹ . Calculate the bond distance of the molecule. [Given masses are: ¹⁶ O=26.77 x 10 ⁻²⁷ kg, ¹² C=20.08 x 10 ⁻²⁷ kg]	[3] CO1	3
Q3 (a)	Explain the effect of isotopic substitution on the rotational spectra of diatomic molecule.	[2] CO1	2
Q3 (b)	Considering the Particle in a 2 and 3 Dimensional Box problem explain the concept of degeneracy.	[3] CO1	2
Q4 (a)	What are the properties of a well behaved wave function?	[2] CO1	2
Q4 (b)	Prove that the eigenvalues of hermitian operator are real numbers.	[3] CO1	2
Q5 (a)	Prove that the eigenfunctions corresponding to different eigenvalues of an hermitian operator are orthogonal.	[3] co1	2
Q5 (b)	What is the minimum possible energy in the case of a Particle in a 1 Dimensional Box ? Provide quantitative justification.	[2] co1	2

:::::: 26/09/2022 :::::M