Explore Physics By Himanshu
Centre of Excellence | Physical Science
(CSIR-NET, GATE, JEST, BARC, TIFR, IIT-JAM)

PHYSICAL SCIENCE

ASSIGNMENT

ATOMIC & MOLECULAR PHY.

GATE

Previous Year Questions

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1. An excited state of Ca atom is $[Mg]3p^5 4s^2 3d^1$. The spectroscopic terms corresponding to the total orbital angular momentum are **[GATE-2022]**

(a) S, P, and D

(b) P, D, and F

(c) P and D

(d) S and P

2. For normal Zeeman lines observed ∥ and ⊥ to the magnetic field applied to an atom, which of the following statements are true? **[GATE-2022]**

(a) Only π-lines are observed ∥ to the field

(b) σ-lines ⊥ to the field are plane polarized

(c) π-lines ⊥ to the field are plane polarized

(d) Only σ-lines are observed ∥ to the field

3. In a solid, a Raman line observed at 300 cm^{-1} has intensity of Stokes line four times that of the anti-Stokes line. The temperature of the sample is _____K. **[GATE-2022]**

(Round off to the nearest integer) ($1\,cm^{-1} \equiv 1.44\,K$)

4. Consider a non-interacting gas of spin 1 particles, each with magnetic moment μ, placed in a weak magnetic field B, such that $\frac{\mu B}{k_B T} \ll 1$. The average magnetic moment of a particle is **[GATE-2022]**

(a) $\frac{2\mu}{3}\left(\frac{\mu B}{k_B T}\right)$

(b) $\frac{\mu}{2}\left(\frac{\mu B}{k_B T}\right)$

(c) $\frac{\mu}{3}\left(\frac{\mu B}{k_B T}\right)$

(d) $\frac{3\mu}{4}\left(\frac{\mu B}{k_B T}\right)$

5. In a nucleus, the interaction $V_{so}\,\vec{l}.\vec{s}$ is responsible for creating spin-orbit doublets. The energy difference between $p_{1/2}$ and $p_{3/2}$ states in units of $V_{so}\frac{\hbar^2}{2}$ is _____
(Round off to the nearest integer) **[GATE-2022]**

6. Among the term symbols

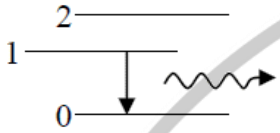
$^4S_1, ^2D_{7/2}, ^3S_1$ and $^2D_{5/2}$

Choose the option(s) possible in the LS coupling notation **[GATE-2021]**

(a) $^4S_1$ (b) $^2D_{7/2}$

(c) $^3S_1$ (d) $^2D_{5/2}$

7. To sustain lasing action in a three-level laser as shown in the figure, necessary condition (s) is (are) **[GATE-2021]**



(a) Lifetime of the energy level 1 should be greater than that of energy level 2

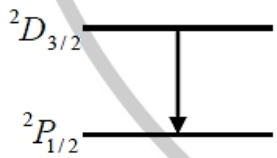
(b) Population of the particles in level 1 should be greater than that of level 0

(c) Lifetime of the energy level 2 should be greater than that of energy level 0

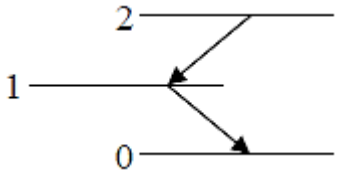
(d) Population of the particles in level 2 should be greater than that of level 1

8. The spacing between two consecutive S -branch lines of the rotational Raman spectra of hydrogen gas is 243.2 cm^{-1}. After excitation with a laser of wavelength 514.5 nm, the Stoke's line appeared at 17611.4 cm^{-1} for a particular energy level. The wavenumber (rounded off to the nearest integer), in cm^{-1}, at which Stoke's line will appear for the next higher energy level is _____. **[GATE-2021]**

9. The transition line, as shown in the figure, arises between $^2D_{3/2}$ and $^2P_{1/2}$ states without any external magnetic field. The number of lines that will appear in the presence of a weak magnetic field (in integer) is_____. **[GATE-2021]**



10. Consider the atomic system as shown in the figure, where the Einstein A coefficients for spontaneous emission for the levels are $A_{2\to1} = 2\times10^7 s^{-1}$ and $A_{1\to0} = 10^8 s^{-1}$. If 10^{14} atoms/cm^3 are excited from level 0 to level 2 and a steady state population in level 2 is achieved, then the steady state population at level 1 will be $x\times10^{13} cm^{-3}$. The value of x (in integer) is _____ **[GATE-2021]**



11. Consider an atomic gas with number density $n = 10^{20} m^{-3}$, in the ground state at $300K$. The valence electronic configuration of atoms is f^7. The paramagnetic susceptibility of the gas $\chi = m \times 10^{-11}$. The value of m (rounded off to two decimal places) is_____. (Given : Magnetic permeability of free space $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$ **[GATE-2021]**

Bohr magneton $\mu_B = 9.274 \times 10^{-24} Am^2$

Boltzmann constant $k_B = 1.3807 \times 10^{-23} JK^{-1}$)

12. The spin-orbit effect splits the ${}^2P \rightarrow {}^2S$ transition (wavelength, $\lambda = 6521\text{Å}$) in Lithium into two lines with separation of $\Delta\lambda = 0.14\text{Å}$. The corresponding positive value of energy difference between the above two lines, in eV, is $m \times 10^{-5}$. The value of m (rounded off to the nearest integer) is _____ **[GATE-2021]**

(Given: Planck's constant, $h = 4.125 \times 10^{-15}$ eVs, Speed of light, $c = 3 \times 10^8 ms^{-1}$)

13. A hydrogenic atom is subjected to a strong magnetic field. In the absence of spin-orbit coupling, the number of doubly degenerate states created out of the d -level is _____

[GATE-2020]

14. Consider a gas of hydrogen atoms in the atmosphere of the Sun where the temperature is $5800K$. If a sample from this atmosphere contains 6.023×10^{23} of hydrogen atoms in the ground state, the number of hydrogen atoms in the first excited state is approximately 8×10^n, where n is an integer. The value of n is _____. **[GATE-2020]**

(Boltzmann constant: 8.617×10^{-5} eV/K)

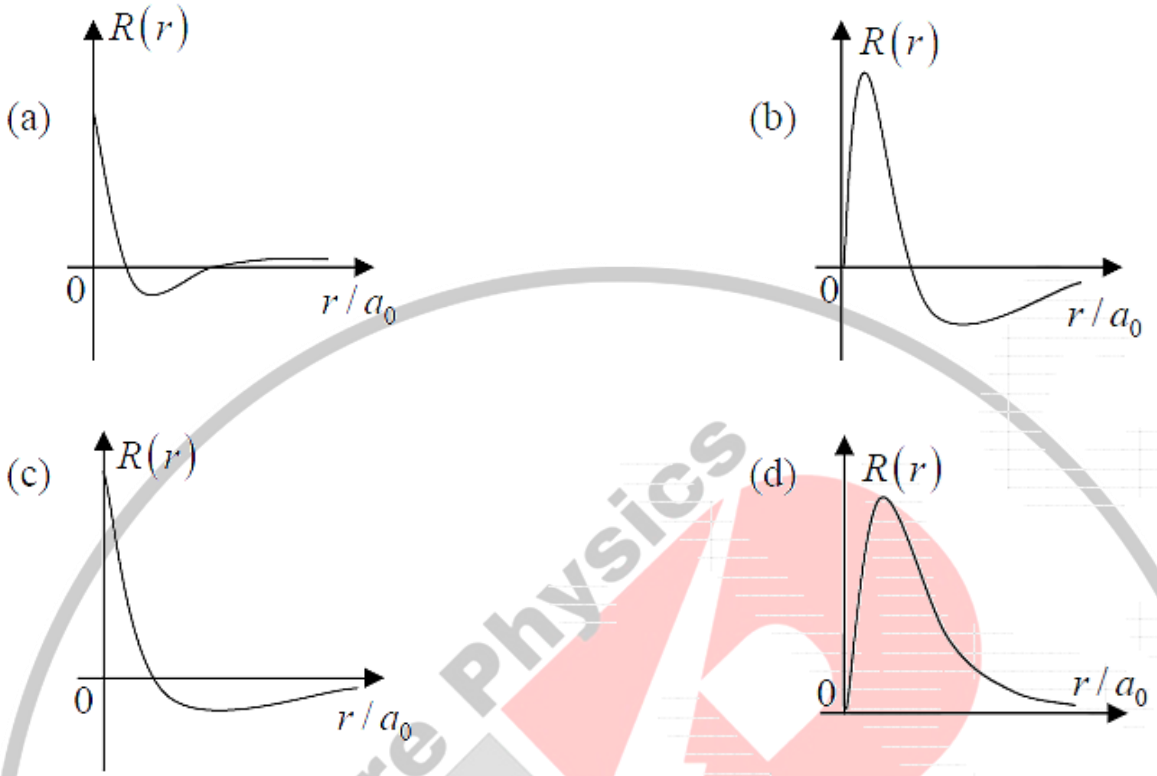
15. The spin-orbit interaction term of an electron moving in a central field is written as $f(r)\vec{l}.\vec{s}$, where r is the radial distance of the electron from the origin. If an electron moves inside a uniformly charged sphere, then **[GATE-2019]**

(a) $f(r) =$ constant (b) $f(r) \propto r^{-1}$

(c) $f(r) \propto r^{-2}$ (d) $f(r) \propto r^{-3}$

16. The ground state electronic configuration of the rare-earth ion $\left(Nd^{3+}\right)$ is $[Pd]4f^3 5s^2 5p^6$. Assuming LS coupling, the Lande g - factor of this ion is $\frac{8}{11}$. The effective magnetic moment in units of Bohr magneton μ_B (rounded off to two decimal places) is _____ **[GATE-2019]**

17. Which one of the following represents the 3*p* radial wave function of hydrogen atom? (a_0 is the Bohr radius) **[GATE-2018]**



18. Given the following table,

Group I	Group II
P: Stern-Gerlach experiment	1: Wave nature of particles
Q: Zeeman effect	2: Quantization of energy of electrons in the atoms
R: Frank-Hertz experiment	3: Existence of electron spin
S: Davisson-Germer experiment	4: Space quantization of angular momentum

Which one of the following correctly matches the experiments from Group I to their inferences in Group II? **[GATE-2018]**

(a) P-2, Q-3, R-4, S-1

(b) P-1, Q-3, R-2, S-4

(c) P-3, Q-4, R-2, S-1

(d) P-2, Q-1, R-4, S-3

19. The expression for the second overtone frequency in the vibrational absorption spectra of a diatomic molecule in terms of the harmonic frequency ω_e and anharmonicity constant x_e is **[GATE-2018]**

(a) $2\omega_e(1-x_e)$

(b) $2\omega_e(1-3x_e)$

(c) $3\omega_e(1-2x_e)$

(d) $3\omega_e(1-4x_e)$

20. Match the physical effects and order of magnitude of their energy scales given below, where $\alpha = \dfrac{e^2}{4\pi \in_0 \hbar c}$ is fine structure constant; m_e and m_p are electron and proton mass, respectively. **[GATE-2018]**

Group I	Group II
P: Lamb shift	1: $\sim O\left(\alpha^2 m_e c^2\right)$
Q: Fine structure	2: $\sim O\left(\alpha^4 m_e c^2\right)$
R: Bohr energy	3: $\sim O\left(\alpha^4 m_e^2 c^2 / m_p\right)$
S: Hyperfine structure	4: $\sim O\left(\alpha^5 m_e c^2\right)$

(a) P-3, Q-1, R-2, S-4 (b) P-2, Q-3, R-1, S-4

(c) P-4, Q-2, R-1, S-3 (d) P-2, Q-4, R-1, S-3

21. The intrinsic/permanent electric dipole moment in the ground state of hydrogen atom is (a_0 is the Bohr radius) **[GATE-2018]**

(a) $-3ea_0$ (b) zero

(c) ea_0 (d) $3ea_0$

22. Which one of the following is an allowed electric dipole transition? **[GATE-2018]**

(a) ${}^1S_0 \rightarrow {}^3S_1$ (b) ${}^2P_{3/2} \rightarrow {}^2D_{5/2}$

(c) ${}^2D_{5/2} \rightarrow {}^2P_{1/2}$ (d) ${}^3P_0 \rightarrow {}^5D_0$

23. The term symbol for the electronic ground state of oxygen atom is **[GATE-2018]**

(a) ${}^1S_0$ (b) ${}^1D_2$

(c) ${}^3P_0$ (d) ${}^3P_2$

24. 4 *MeV* γ - rays emitted by the de-excitation of ${}^{19}F$ are attributed, assuming spherical symmetry, to the transition of protons from $1d_{3/2}$ state to $1d_{5/2}$ state. If the contribution of spin-orbit term to the total energy is written as $C\left\langle \vec{l}.\vec{s} \right\rangle$, the magnitude of C is _____ *MeV* (up to one decimal place). **[GATE-2018]**

25. An atom in its singlet state is subjected to a magnetic field. The Zeeman splitting of its 650 *nm* spectral line is 0.03 *nm*. The magnitude of the field is _____ Tesla (up to two decimal places). **[GATE-2018]**

$\left(e = 1.60 \times 10^{-19} C, m_e = 9.11 \times 10^{-31} kg, c = 3.0 \times 10^8 ms^{-1}\right)$

26. The wavefunction of which orbital is spherically symmetric: **[GATE-2017]**

(a) p_x (b) p_y

(c) s (d) d_{xy}

27. The total energy of an inert-gas crystal is given by $E(R)=\frac{0.5}{R^{12}}-\frac{1}{R^6}(\text{in } eV)$, where R is the inter-atomic spacing in Angstroms. The equilibrium separation between the atoms is Angstroms. (up to two decimal places) **[GATE-2017]**

28. Which one of the following gases of diatomic molecules is Raman, infrared, and NMR active? **[GATE-2017]**

(a) ${}^{1}H-{}^{1}H$ (b) ${}^{12}C-{}^{16}O$

(c) ${}^{1}H-{}^{35}Cl$ (d) ${}^{16}O-{}^{16}O$

29. Using Hund's rule the total angular momentum quantum number J for the electronic ground state of the nitrogen atom is **[GATE-2017]**

(a) $\frac{1}{2}$ (b) $\frac{3}{2}$

(c) 0 (d) 1

30. Positronium is an atom made of an electron and a positron. Given the Bohr radius for the ground state of the Hydrogen atom to be 0.53 Angstroms, the Bohr radius for the ground state of positronium is……Angstroms. (up to two decimal places).

[GATE-2017]

31. The molecule ${}^{17}O_2$ **[GATE-2016]**

(a) Raman active but not NMR (nuclear magnetic resonance) active.

(b) Infrared active and Raman active but not NMR active.

(c) Raman active and NMR active. (d) Only NMR active.

32. There are four electrons in the 3d shell of an isolated atom. The total magnetic moment of the atom in units of Bohr magneton is _____. **[GATE-2016]**

33. Which of the following transitions is NOT allowed in the case of an atom, according to the electric dipole radiation selection rule? **[GATE-2016]**

(a) $2s-1s$ (b) $2p-1s$

(c) $2p-2s$ (d) $3d-2p$

34. The number of spectroscopic terms resulting from the $L.S$ coupling of a 3p electron and a 3d electron is _____. **[GATE-2016]**

35. In a rigid rotator of mass M, if the energy of the first excited state is (1 meV), then the fourth excited state energy (in meV) is _____. **[GATE-2015]**

36. The binding energy per molecule of *NaCl* (lattice parameter is 0.563*nm*) is 7.956 *eV*. The repulsive term of the potential is of the form $\frac{K}{r^9}$, where *K* is a constant. The value of the Modelung constant is _____ (upto three decimal places) **[GATE-2015]**
$\left(\text{Electron charge } e = -1.6\times10^{-19}C;\ \ \varepsilon_0 = 8.854\times10^{-12}C^2N^{-1}m^{-2}\right)$

37. Match the phrases in Group I and Group II and identify the correct option.

Group I	**Group II**
(P) Electron spin resonance (ESR)	(i) radio frequency
(Q) Nuclear magnetic resonance (NMR)	(ii) visible range frequency
(R) Transition between vibrational states of a molecule	(iii) microwave frequency
(S) Electronic transition	(iv) far-infrared range

[GATE-2015]

(a) (P-i), (Q-ii), (R-iii), (S-iv) (b) (P-ii), (Q-i), (R-iv), (S-iii)

(c) (P-iii), (Q-iv), (R-i), (S-ii) (d) (P-iii), (Q-i), (R-iv), (S-ii)

38. The excitation wavelength of laser in a Raman effect experiment is 546*nm*. If the Stokes' line is observed at 552*nm*, then the wavenumber of the anti-Stokes' line (in cm^{-1}) is _____ **[GATE-2015]**

39. The number of permitted transitions from $^2P_{3/2} \rightarrow ^2S_{1/2}$ in the presence of a weak magnetic field is _____ **[GATE-2015]**

40. The number of normal Zeeman splitting components of $^1P \rightarrow ^1D$ transition is **[GATE-2014]**

(a) 3 (b) 4 (c) 8 (d) 9

41. The moment of inertia of a rigid diatomic molecule *A* is 6 times that of another rigid diatomic molecule *B*. If the rotational energies of the two molecules are equal, then the corresponding values of the rotational quantum numbers J_A and J_B are **[GATE-2014]**

(a) $J_A = 2, J_B = 1$ (b) $J_A = 3, J_B = 1$

(c) $J_A = 5, J_B = 0$ (d) $J_A = 6, J_B = 1$

42. The value of the magnetic field required to maintain non-relativistic protons of energy 1*MeV* in a circular orbit of radius 100*mm* is _____ Tesla **[GATE-2014]**

(Given: $m_p = 1.67\times10^{-27}kg,\ e = 1.6\times10^{-19}C$)

43. Neutrons moving with speed $10^3 m/s$ are used for the determination of crystal structure. If the Bragg angle for the first order diffraction is 30° the interplannar spacing of the crystal is _____ Å. **[GATE-2014]**

(Given: $m_n = 1.675\times10^{-27}kg \qquad h = 6.626\times10^{-34}J.s$)

44. The emission wavelength for the transition $D_2 \rightarrow F_3$ is 3122 Å. The ratio of population of the final to the initial states at a temperature $5000K$ is **[GATE-2014]**

$\left(h = 6.626 \times 10^{-34} J - s, c = 3 \times 10^8 m/s,\ k_B = 1.380 \times 10^{-23} J/K\right)$

(a) 2.03×10^{-5} (b) 4.02×10^{-5} (c) 7.02×10^{-5} (d) 9.83×10^{-5}

45. The number of spectral lines allowed in the spectrum for the $3^2D \rightarrow 3^2P$ transition in sodium is _____. **[GATE-2013]**

46. In a normal Zeeman Effect experiment, spectral splitting of the line at the wavelength 643.8 *nm* corresponding to the transition $5\ ^1D_2 \rightarrow 5\ ^1P_1$ of cadmium atoms is to be observed. The spectrometer has a resolution of 0.01 *nm*. Minimum magnetic field needed to observe this is **[GATE-2013]**

$\left(m_e = 9.1 \times 10^{-31} kg, e = 1.6 \times 10^{-19} C, c = 3 \times 10^8 m/s\right)$

(a) $0.26T$ (b) $0.52T$ (c) $2.6T$ (d) $5.2T$

47. The spacing between vibrational energy levels in CO molecule is found to be $8.44 \times 10^{-2} eV$. Given that the reduced mass of CO is $1.14 \times 10^{-26} kg$, Planck's constant is $6.626 \times 10^{-34} Js$ and $1eV = 1.6 \times 10^{-19} J$. The force constant of the bond in CO molecule is **[GATE-2013]**

(a) 1.87 N/m (b) 18.7 N/m

(c) 187 N/m (d) 1870 N/m

48. The ground state of sodium atom $\left(^{11}Na\right)$ is a $^2S_{1/2}$ state. The difference in energy levels arising in the presence of a weak external magnetic field *B*, given in terms of Bohr magnet on, μ_B, is **[GATE-2012]**

(a) $\mu_B B$ (b) $2\mu_B B$ (c) $4\mu_B B$ (d) $6\mu_B B$

49. The first Stokes line of a rotational Raman spectrum is observed at 12.96 cm^{-1}. Considering the rigid rotor approximation, the rotational constant is given by **[GATE-2012]**

(a) 6.48 cm^{-1} (b) 3.24 cm^{-1} (c) 2.16 cm^{-1} (d) 1.62 cm^{-1}

50. Match the typical spectroscopic regions specified in Group I with the corresponding type of transitions in Group II. **[GATE-2012]**

Group I	**Group II**
(P) Infra-red region	(i) electronic transitions involving valence electrons
(Q) Ultraviolet-visible region	(ii) nuclear transitions
(R) X-ray region	(iii) vibrational transitions of molecules
(S) γ-ray region	(iv) transitions involving inner shell electrons

(a) (P, i); (Q, iii); (R, ii); (S, iv) (b) (P, ii); (Q, iv); (R, i); (S, iii)

(c) (P, iii); (Q, i); (R, iv); (S, ii) (d) (P, iv); (Q, i); (R, ii); (S, iii)

51. The term $\{j_1, j_2\}_J$, arising from $2s^1 3d^1$ electronic in *j-j* coupling scheme are

[GATE-2012]

(a) $\left\{\frac{1}{2},\frac{3}{2}\right\}_{2,1}$ and $\left\{\frac{1}{2},\frac{5}{2}\right\}_{3,2}$

(b) $\left\{\frac{1}{2},\frac{1}{2}\right\}_{1,0}$ and $\left\{\frac{1}{2},\frac{3}{2}\right\}_{2,1}$

(c) $\left\{\frac{1}{2},\frac{1}{2}\right\}_{1,0}$ and $\left\{\frac{1}{2},\frac{5}{2}\right\}_{3,2}$

(d) $\left\{\frac{3}{2},\frac{1}{2}\right\}_{2,1}$ and $\left\{\frac{1}{2},\frac{5}{2}\right\}_{3,2}$

52. The equilibrium vibration frequency for an oscillator is observed at 2990 cm^{-1}. The ratio of the frequencies corresponding to the first and the fundamental spectral lines is 1.96. Considering the oscillator to be anharmonic, the anharmonicity constant is

[GATE-2012]

(a) 0.005

(b) 0.02

(c) 0.05

(d) 0.1

53. The population inversion in a two layer material CANNOT be achieved by optical pumping because **[GATE-2011]**

(a) the rate of upward transitions is equal to the rate of downward transitions

(b) the upward transitions are forbidden but downward transitions are allowed

(c) the upward transitions are allowed but downward transitions are forbidden

(d) the spontaneous decay rate of the higher level is very low

54. A heavy symmetrical top is rotating about its own axis of symmetry (the *z*-axis). If I_1, I_2 and I_3 are the principal moments of inertia along *x*, *y* and *z* axes respectively, then

[GATE-2011]

(a) $I_2 = I_3; I_1 \neq I_2$

(b) $I_1 = I_3; I_1 \neq I_2$

(c) $I_1 = I_2; I_1 \neq I_3$

(d) $I_1 \neq I_2 \neq I_3$

55. A neutron passing through a detector is detected because of **[GATE-2011]**

(a) the ionization it produces

(b) the scintillation light it produces

(c) the electron-hole pairs it produces

(d) the secondary particles produced in a nuclear reaction in the detector medium

56. An atom with one outer electron having orbital angular momentum *l* is placed in a weak magnetic field. The number of energy levels into which the higher total angular momentum state splits, is **[GATE-2011]**

(a) $2l + 2$

(b) $2l + 1$

(c) $2l$

(d) $2l - 1$

57. For a multi-electron atom l, L and S specify the one-electron orbital angular momentum, total orbital angular momentum and total spin angular momentum, respectively. The selection rules for electric dipole transition between the two electronic energy levels, specified by l, L and S are **[GATE-2011]**

(a) $\Delta L = 0, \pm 1$; $\Delta S = 0$; $\Delta l = 0, \pm 1$ (b) $\Delta L = 0, \pm 1$; $\Delta S = 0$; $\Delta l = \pm 1$

(c) $\Delta L = 0, \pm 1$; $\Delta S = \pm 1$; $\Delta l = 0, \pm 1$ (d) $\Delta L = 0, \pm 1$; $\Delta S = \pm 1$; $\Delta l = \pm 1$

58. The lifetime of an atomic state is 1 nanosecond. The natural line width of the spectral line in the emission spectrum of this state is of the order of **[GATE-2011]**

(a) $10^{-10} eV$ (b) $10^{-9} eV$ (c) $10^{-6} eV$ (d) $10^{-4} eV$

59. The degeneracy of an excited state of nitrogen atom having electronic configuration $1s^2 2s^2 2p^2 3d^1$ is **[GATE-2011]**

(a) 6 (b) 10 (c) 15 (d) 150

60. The far infrared rotational absorption spectrum of a diatomic molecule shows equilibrium lines with spacing 20 cm^{-1}. The position of the first Stokes line in the rotational Raman spectrum of this molecule is **[GATE-2011]**

(a) 20 cm^{-1} (b) 40 cm^{-1} (c) 60 cm^{-1} (d) 120 cm^{-1}

61. To detect trace amounts of gaseous species in a mixture of gases, the preferred probing tool is **[GATE-2010]**

(a) Ionization spectroscopy with X-rays (b) NMR spectroscopy

(c) ESR spectroscopy (d) Laser spectroscopy

62. A collection of N atoms is exposed to a strong resonant electromagnetic radiation with N_g atoms in the ground state and N_e atoms in the excited state, such that $N_g + N_e = N$. This collection of two-level atoms will have the following population distribution:

[GATE-2010]

(a) $N_g << N_e$ (b) $N_g >> N_e$ (c) $N_g \approx N_e \approx N/2$ (d) $N_g - N_e \approx N/2$

63. Two states of an atom have definite parities. An electric dipole transition between these states is **[GATE-2010]**

(a) Allowed if both the sates have even parity

(b) Allowed if both the states have odd parity

(c) Allowed if the two states have opposite parities

(d) Not allowed unless a static electric field is applied

64. The spectrum of radiation emitted by a black body at a temperature 1000 K peaks in the

[GATE-2010]

(a) Visible range of frequencies (b) Infrared range of frequencies

(c) Ultraviolet range of frequencies (d) Microwave range of frequencies

65. The three principal moments of inertia of a methanol (CH_3OH) molecule have the property $I_x = I_y = I$ and $I_z \neq I$. The rotation energy eigenvalues are **[GATE-2010]**

(a) $\frac{\hbar^2}{2I} l(l+1) + \frac{\hbar^2 m_1^2}{2I}\left(\frac{1}{I_z} - \frac{1}{I}\right)$ (b) $\frac{\hbar^2}{2I} l(l+1)$

(c) $\frac{\hbar^2 m_1^2}{2I}\left(\frac{1}{I_z} - \frac{1}{I}\right)$ (d) $\frac{\hbar^2}{2I} l(l+1) + \frac{\hbar^2 m_1^2}{2I}\left(\frac{1}{I_z} + \frac{1}{I}\right)$

66. Match the typical spectra of stable molecules with the corresponding wave-number range **[GATE-2010]**

1. Electronic spectra	(i) 10^6 cm^{-1} and above
2. Rotational spectra	(ii) $10^5 - 10^6$ cm^{-1}
3. Molecule dissociation	(iii) $10^8 - 10^2$ cm^{-1}

(a) 1 – ii, 2 – i, 3 – iii (b) 1 – ii, 2 – iii, 3 – i

(b) 1 – iii, 2 – ii, 3 – i (d) 1 – i, 2 – ii, 3 – iii

67. Consider the operations $P: \vec{r} \to -\vec{r}$ (parity) and T: $t \to -t$ (time reversal). For the electric and magnetic fields $\vec{E}$ and $\vec{B}$, which of the following set of transformations is correct? **[GATE-2010]**

(a) $P: \vec{E} \to -\vec{E}, \vec{B} \to \vec{B}$; $T: \vec{E} \to \vec{E}, \vec{B} \to -\vec{B}$

(b) $P: \vec{E} \to \vec{E}, \vec{B} \to \vec{B}$; $T: \vec{E} \to \vec{E}, \vec{B} \to \vec{B}$

(c) $P: \vec{E} \to -\vec{E}, \vec{B} \to \vec{B}$; $T: \vec{E} \to -\vec{E}, \vec{B} \to -\vec{B}$

(d) $P: \vec{E} \to \vec{E}, \vec{B} \to -\vec{B}$; $T: \vec{E} \to -\vec{E}, \vec{B} \to \vec{B}$

Common Data Questions 68 and 69:

In the presence of a weak magnetic field, atomic hydrogen undergoes the transition:

$^2P_{1/2} \to {}^2S_{1/2}$, by emission of radiation

68. The number of distinct spectral lines that are observed in the resultant Zeeman spectrum is **[GATE-2010]**

(a) 2 (b) 3 (c) 4 (d) 6

69. The spectral line corresponding to the transition

$$^2P_{1/2}\left(m_j = +\frac{1}{2}\right) \to {}^2S_{1/2}\left(m_j = -\frac{1}{2}\right)$$

is observed along the direction of the applied magnetic field. The emitted electromagnetic field is **[GATE-2010]**

(a) Circularly polarized (b) Linearly polarized

(c) Unpolarized

(d) Not emitted along the magnetic field direction

Assignment – Atomic and Molecular Physics

(GATE)

ANSWER KEY

Q.N.	ANS.	Q.N.	ANS.	Q.N.	ANS.	Q.N.	ANS.	Q.N.	ANS.
1	B	15	A	29	B	43	4	57	B
2	B, C, D	16	3.62	30	1.06	44	C	58	C
3	311 to 312	17	B	31	C	45	28	59	B
4	A	18	C	32	0	46	B	60	C
5	3 to 3	19	D	33	A	47	C	61	A
6	C, D	20	C	34	12	48	B	62	C
7	A, B	21	B	35	10	49	C	63	C
8	17368.2	22	B	36	2.80	50	C	64	A
9	6 to 6	23	D	37	D	51	A	65	A
10	2	24	1.6	38	18514	52	B	66	B
11	5.48	25	1.52	39	6	53	A	67	B
12	4.08	26	C	40	A	54	C	68	C
13	3	27	1	41	B	55	B	69	A
14	14	28	C	42	1.44	56	B		

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