

137. The vibrational frequency of a homo-nuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be half that of the ground state is given by
 (a) $h\nu \cdot \ln 2 / k_B$ (b) $h\nu / (\ln 2 \cdot k_B)$ (c) $\ln 2 / (h\nu \cdot k_B)$ (d) $h\nu \cdot \log 2 / k_B$
138. The irreducible representations of C_{2h} are A_g, B_g, A_u and B_u . The Raman active modes of trans-1, 3-butadiene belong to the irreducible representations
 (a) A_g and B_g (b) A_g and A_u (c) A_u and B_g (d) B_g and B_u
139. The symmetry-allowed atomic transition among the following is
 (a) ${}^3F \rightarrow {}^1D$ (b) ${}^3F \rightarrow {}^3D$ (c) ${}^3F \rightarrow {}^1P$ (d) ${}^3F \rightarrow {}^3P$
140. The average end-to-end distance of a random coil polymer 10^6 monomers (in units of segment length) is
 (a) 10^6 (b) 10^5 (c) 10^4 (d) 10^3
141. A reversible expansion of 1.0 mol of an ideal gas is carried out from 1.0 L to 4.0 L under isothermal condition at 300K. ΔG for this process is
 (a) $300R \cdot \ln 2$ (b) $600R \cdot \ln 2$ (c) $-600R \cdot \ln 2$ (d) $-300R \cdot \ln 2$
142. The temperature-dependence of the vapour pressure of solid A can be represented by $\log p = 10.0 - \frac{1800}{T}$, and that of liquid A by $\log p = 8.0 - \frac{1400}{T}$. The temperature of the triple point of A is
 (a) 200 K (b) 300 K (c) 400 K (d) 500 K
143. The non-spontaneous process among the following is
 (a) vapourisation of superheated water at 105°C and 1 atm pressure
 (b) expansion of a gas into vacuum freezing
 (c) freezing of supercooled water at -10°C and 1 atm pressure
 (d) freezing of water at 0°C and 1 atm pressure.
144. The radial part of a hydrogenic wave function is given as $r(\alpha - r)e^{-\beta r}$ (α, β are constants). This function is then identifiable as
 (a) 2s (b) 3p (c) 4d (d) 5f
145. A normalised state ϕ is constructed as a linear combination of the ground state (ψ_0) and the first excited state (ψ_1) of some harmonic oscillator with energies $1/2$ and $3/2$ units, respectively. If the average energy of the state ϕ is $7/6$, the probability of finding ψ_0 in ϕ will be
 (a) $1/2$ (b) $1/3$ (c) $1/4$ (d) $1/5$