Malaviya National Institute of Technology Jaipur

Department of Physics

Model Question Paper

1. Two identical Bosons are placed in an infinite square well. They interact weakly with one another via the potential

   $V(x_1-x_2) = -aV_0\ \delta(x_1-x_2)$

   (Where V_0 is a constant with the dimensions of energy and a is the width of the well)
   Use first order perturbation theory to estimate the effect of the particle-particle interaction on the energy of the first excited state.

   (a) $3V_0$ (b) $-2V_0$ (c) $-3V_0$ (d) $-20V_0$

2. $f(x)$ is a periodic function of x with a period of 2π. In the interval $-\pi<x<\pi$, $f(x)$ is given by

   $f(x) = \begin{cases} 0 & -\pi < x < 0 \\ \sin x & 0 < x < \pi \end{cases}$

   In the expansion of $f(x)$ as a Fourier series of sine and cosine functions, the coefficient of $\cos(2x)$ is

   (a) $\dfrac{2}{3\pi}$ (b) $\dfrac{1}{\pi}$ (c) 0   (d) $-\dfrac{2}{3\pi}$

3. The interplanar spacing of (220) planes of a Face-centered cubic(FCC) structure is 1.7458 Å. Calculate the lattice constant.
   a) 4.983 Å
   b) 2.458 Å
   c) 0
   d) 5.125 Å

4. Consider the transition of liquid water to steam as water boils at a temperature of 0 100 C under a pressure of 1 atmosphere.
   Which one of the following quantities does not change discontinuously at the transition?

   (a) The Gibbs free energy (b) The internal energy (c) The entropy (d) The specific volume

5. The Born's approximation is applicable for :

a) High energy, low atomic number for scatterer   b) Low energy, low atomic number for scatterer   c) High energy, high atomic number for scatterer   d) Low energy, high atomic number for scatterer

Answers

1. b   2. a   3.a   4.a 5.a