

Name Key

5. Which of the following systems has the lowest degeneracy?

- a) particle in a 3-D box with $n_x + n_y + n_z = 2$
- b) harmonic oscillator with $v = 2$
(no degeneracy) (1)
- c) rigid rotor with $J = 2$ $2J + 1 = 5$
 m_J values
- d) particle on a circle with $|l| = 2$ (2)
 ± 2
(or ± 2)

6. Which of the following is *false*?

- a) Quantum mechanics is based on the combination of the classical equations that describe waves and the de Broglie postulate that gives the wavelength of a particle as a function of its momentum.
- b) Quantum mechanics must reduce to classical mechanics if the masses are large and the distances long.
- c) In a quantum-mechanical system it is never possible to determine exact values for both position and momentum.
- d) A molecule that has no permanent dipole moment has no absorption spectrum.
A transient (i.e., changing) dipole moment is sufficient. (consider asymmetric stretch in $O=C=O$)

II. All three of the following questions must be answered. Each question is worth 25 points. Please be careful to use a reasonable number of significant digits. Work must be shown.

If n could be zero would be 6: $\begin{matrix} 110 & 200 \\ 101 & 020 \\ 011 & 002 \end{matrix}$

but since $n > 0$ there are no possible sets of quantum numbers

(all students given 4 pts)