***Physics: Principle and Applications*, 7e (Giancoli)**
**Chapter 29 Molecules and Solids**

29.1 Conceptual Questions

1) Covalent bonding is due to
A) the sharing of electrons between atoms.
B) the transfer of electrons between atoms.
C) unequal charge distributions around neutral molecules.
D) atoms bonding to hydrogen molecules.
Answer: A
Var: 1

2) Ionic bonding is due to
A) the sharing of electrons between atoms.
B) the transfer of electrons between atoms.
C) unequal charge distributions around neutral molecules.
D) atoms bonding to hydrogen molecules.
Answer: B
Var: 1

3) Van der Waals bonding is due to
A) the sharing of electrons between atoms.
B) the transfer of electrons between atoms.
C) unequal charge distribution around neutral molecules.
D) atoms bonding to hydrogen molecules.
Answer: C
Var: 1

4) In general, which of the following is usually the strongest bond?
A) hydrogen bond
B) van der Waals bond
C) ionic bond
Answer: C
Var: 1

5) In general, which of the following is usually the weakest bond?
A) hydrogen bond
B) van der Waals bond
C) ionic bond
D) covalent bond
Answer: B
Var: 1

6) For a diatomic quantum mechanical rotator, the energy difference between adjacent energy levels
A) increases as $L$ increases.
B) decreases as $L$ increases.
C) is constant for all $L$.
D) varies randomly as $L$ increases.
Answer: A
Var: 1

7) A diatomic quantum mechanical rotator in the $L = 1$ quantum state has energy $E$. The same rotator in the $L = 2$ quantum state will have energy equal to
A) $2E$.
B) $3E$.
C) $6E$.
D) none of the given answers.
Answer: B
Var: 1

8) In its lowest quantum state, the energy of a diatomic harmonic oscillator having frequency $f$ is
A) $hf/4$.
B) $hf/2$.
C) $hf$.
D) $3hf/2$.
Answer: B
Var: 1

9) For a diatomic quantum mechanical vibrator, the energy difference between adjacent quantum states
A) increases as the integer $v$ increases.
B) decreases as the integer $v$ increases.
C) is constant for all values of the integer $v$.
D) varies randomly as the integer $v$ increases.
Answer: C
Var: 1

10) In its lowest quantum state, a diatomic quantum mechanical rotator has a rotational energy of
A) zero.
B) $\frac{\hbar^2}{2I}$.
C) $\frac{\hbar^2}{I}$.
D) none of the given answers.
Answer: A
Var: 1

11) If a diatomic quantum mechanical vibrator in its ground state has energy $E$, what is its energy in its second state above the ground state?
A) $E$.
B) $3E$.
C) $5E$.
D) $7E$.
E) $9E$.
Answer: C
Var: 1

12) Metallic bonding is due to
A) the sharing of electrons by all atoms.
B) the transfer of electrons between atoms.
C) unequal charge distributions around neutral molecules.
D) atoms bonding to hydrogen molecules.
Answer: A
Var: 1

13) In a good conductor, the highest energy band containing electrons is
A) only partially filled.
B) completely filled.
C) completely empty.
Answer: A
Var: 1

14) In a good insulator, the highest energy band containing electrons, called the valence band, is
A) only partially filled.
B) completely filled.
C) completely empty.
Answer: B
Var: 1

15) An *n*-type semiconductor is produced by
A) doping the host crystal with donor impurities.
B) doping the host crystal with acceptor impurities.
C) pure crystals of germanium.
Answer: A
Var: 1

16) A *p*-type semiconductor is produced by
A) doping the host crystal with donor impurities.
B) doping the host crystal with acceptor impurities.
C) pure crystals of germanium.
Answer: B
Var: 1

17) In a *p*-type semiconductor, a hole is
A) a donor atom.
B) an extra electron supplied by a donor atom.
C) a missing atom in the crystalline structure.
D) a region where an electron is missing.
Answer: D
Var: 1

18) When a voltage is applied across a *p*-type semiconductor, the holes
A) are destroyed.
B) move toward the positive electrode.
C) move toward the negative electrode.
D) do not move.
Answer: C
Var: 1

19) If a battery is connected to a diode with the positive terminal to the *p* side and the negative terminal to the *n* side, then diode is said to be
A) forward biased.
B) reversed biased.
C) Neither choice is correct.
Answer: A
Var: 1

20) A simple junction transistor consists of three semiconductor sections consisting of
A) only *pnp* semiconductors.
B) only *npn* semiconductors.
C) either *pnp* or *npn* semiconductors.
D) none of the given combinations.
Answer: C
Var: 1

29.2 Problems

1) A diatomic quantum mechanical oscillator has a moment of inertia of $7.73 \times 10^{-45}$ kg · m$^2$. What is the rotational energy when it is in the quantum state characterized by $L = 2$? (1 eV = $1.60 \times 10^{-19}$ J, $h = 6.626 \times 10^{-34}$ J · s)
A) $2.27 \times 10^{-5}$ eV
B) $2.70 \times 10^{-5}$ eV
C) $7.22 \times 10^{-5}$ eV
D) $8.71 \times 10^{-5}$ eV
Answer: B
Var: 1

2) A diatomic molecule has $2.6 \times 10^{-5}$ eV of rotational energy in the $L = 2$ quantum state. What is its rotational energy in the $L = 1$ quantum state? (1 eV = $1.60 \times 10^{-19}$ J, $h = 6.626 \times 10^{-34}$ J · s)
A) $3.4 \times 10^{-6}$ eV
B) $5.3 \times 10^{-6}$ eV
C) $7.8 \times 10^{-6}$ eV
D) $8.7 \times 10^{-6}$ eV
Answer: D
Var: 1

3) A diatomic molecule has $18 \times 10^{-5}$ eV of rotational energy in the $L = 2$ quantum state. What is its rotational energy in the $L = 0$ quantum state? (1 eV = $1.60 \times 10^{-19}$ J, $h = 6.626 \times 10^{-34}$ J · s)
A) $9.0 \times 10^{-5}$ eV
B) $6.0 \times 10^{-5}$ eV
C) $3.0 \times 10^{-5}$ eV
D) 0 eV
Answer: D
Var: 1

4) Estimate the maximum rotational energy (in electron-volts) for a free and freely-spinning diatomic hydrogen molecule in the $L = 2$ quantum state. The equilibrium separation for the atoms in the $H_2$ molecule is 0.075 nm. (1 eV = $1.60 \times 10^{-19}$ J, $m_{\text{proton}} = 1.67 \times 10^{-27}$ kg, $h = 6.626 \times 10^{-34}$ J · s)
A) 0.011 eV
B) 0.022 eV
C) 0.033 eV
D) 0.044 eV
Answer: D
Var: 1

5) A diatomic molecule is vibrating in the $v = 1$ quantum state with a frequency of $2.0 \times 10^{13}$ Hz. What is its vibrational energy? (1 eV = $1.60 \times 10^{-19}$ J, $h = 6.626 \times 10^{-34}$ J · s)
A) 0.041 eV
B) 0.083 eV
C) 0.12 eV
D) 0.17 eV
Answer: C
Var: 1

6) The energy gap between the valence and conduction bands in a certain semiconductor is 1.25 eV. What is the threshold wavelength for optical absorption in this substance? ($c = 3.00 \times 10^{8}$ m/s, $h = 6.626 \times 10^{-34}$ J · s)
A) 599 nm
B) 959 nm
C) 873 nm
D) 994 nm
Answer: D
Var: 1