

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 nnp semiconductors.
 - C) either pnp or nnp 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 $7.73 \times 10^{-45} \text{ kg} \cdot \text{m}^2$. What is the rotational energy when it is in the quantum state characterized by $L = 2$? (1 eV = $1.60 \times 10^{-19} \text{ J}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

- A) $2.27 \times 10^{-5} \text{ eV}$
- B) $2.70 \times 10^{-5} \text{ eV}$
- C) $7.22 \times 10^{-5} \text{ eV}$
- D) $8.71 \times 10^{-5} \text{ eV}$

Answer: B

Var: 1

2) A diatomic molecule has $2.6 \times 10^{-5} \text{ eV}$ of rotational energy in the $L = 2$ quantum state. What is its rotational energy in the $L = 1$ quantum state? (1 eV = $1.60 \times 10^{-19} \text{ J}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

- A) $3.4 \times 10^{-6} \text{ eV}$
- B) $5.3 \times 10^{-6} \text{ eV}$
- C) $7.8 \times 10^{-6} \text{ eV}$
- D) $8.7 \times 10^{-6} \text{ eV}$

Answer: D

Var: 1

3) A diatomic molecule has $18 \times 10^{-5} \text{ eV}$ of rotational energy in the $L = 2$ quantum state. What is its rotational energy in the $L = 0$ quantum state? (1 eV = $1.60 \times 10^{-19} \text{ J}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

- A) $9.0 \times 10^{-5} \text{ eV}$
- B) $6.0 \times 10^{-5} \text{ eV}$
- C) $3.0 \times 10^{-5} \text{ eV}$
- 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 = $1.60 \times 10^{-19} \text{ J}$, $m_{\text{proton}} = 1.67 \times 10^{-27} \text{ kg}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

- 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 2.0×10^{13} Hz. What is its vibrational energy? ($1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

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? ($c = 3.00 \times 10^8 \text{ m/s}$, $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$)

A) 599 nm

B) 959 nm

C) 873 nm

D) 994 nm

Answer: D

Var: 1