

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 1) The F-B-F bond angle in the  $\text{BF}_3$  molecule is \_\_\_\_\_.
- A)  $109.5^\circ$                       B)  $120^\circ$                       C)  $180^\circ$                       D)  $90^\circ$                       E)  $60^\circ$
- 2) The molecular geometry of the  $\text{BCl}_3$  molecule is \_\_\_\_\_, and this molecule is \_\_\_\_\_.
- A) trigonal pyramidal, polar  
B) trigonal planar, nonpolar  
C) trigonal pyramidal, nonpolar  
D) trigonal bipyramidal, polar  
E) trigonal planar, polar
- 3) Viscosity is \_\_\_\_\_.
- A) the "skin" on a liquid surface caused by intermolecular attraction  
B) the resistance to flow  
C) unaffected by temperature  
D) the same as density  
E) inversely proportional to molar mass
- 4) The London dispersion force is the attractive force between \_\_\_\_\_.
- A) two permanent dipoles  
B) an ion and a permanent dipole  
C) two molecules with hydrogen bonded to an oxygen atom  
D) any of the above  
E) an instantaneous dipole and an induced dipole
- 5) \_\_\_\_\_ hybrid orbitals are used for bonding by Xe in the  $\text{XeF}_4$  molecule.
- A) sp                      B)  $\text{sp}^2$                       C)  $\text{sp}^3\text{d}$                       D)  $\text{sp}^3\text{d}^2$                       E)  $\text{sp}^3$
- 6) Elemental iodine ( $\text{I}_2$ ) is a solid at room temperature. What is the major attractive force that exists among different  $\text{I}_2$  molecules in the solid?
- A) dipole-dipole attractions  
B) covalent-ionic interactions  
C) dipole-dipole rejections  
D) ionic-dipole interactions  
E) London dispersion forces
- 7) Of the molecules below, only \_\_\_\_\_ is polar.
- A)  $\text{AsH}_3$                       B)  $\text{SbF}_5$                       C)  $\text{CH}_4$                       D)  $\text{SF}_6$                       E)  $\text{I}_2$

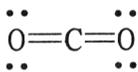
- 8) Of the following, \_\_\_\_\_ is an exothermic process.
- A) melting
  - B) subliming
  - C) boiling
  - D) freezing
  - E) All of the above are exothermic.
- 9) A volatile liquid is one that \_\_\_\_\_.
- A) is highly viscous
  - B) is highly cohesive
  - C) is highly hydrogen-bonded
  - D) is highly flammable
  - E) readily evaporates
- 10) The direct conversion of a solid to a gas is called \_\_\_\_\_.
- A) fusion
  - B) sublimation
  - C) condensation
  - D) boiling
  - E) vaporization
- 11) There are \_\_\_\_\_ unpaired electrons in the Lewis symbol for an oxygen atom.
- A) 1
  - B) 0
  - C) 4
  - D) 3
  - E) 2
- 12) Of the following substances, \_\_\_\_\_ has the highest boiling point.
- A) Kr
  - B) H<sub>2</sub>O
  - C) NH<sub>3</sub>
  - D) CO<sub>2</sub>
  - E) CH<sub>4</sub>
- 13) A nonpolar bond will form between two \_\_\_\_\_ atoms of \_\_\_\_\_ electronegativity.
- A) different, different
  - B) identical, equal
  - C) identical, different
  - D) different, opposite
  - E) similar, different
- 14) A double bond consists of \_\_\_\_\_ pairs of electrons shared between two atoms.
- A) 1
  - B) 2
  - C) 3
  - D) 4
  - E) 6
- 15) In the overall process of hybrid orbital formation, the purpose of promoting one or more electrons is to \_\_\_\_\_.
- A) increase the number of unpaired electrons
  - B) increase the number of atomic orbitals
  - C) increase the number of hybrid orbitals
  - D) make sure that every atomic orbital is occupied prior to hybridization
  - E) make sure that all of the electrons in atomic orbitals are unpaired prior to hybridization

- 16) When NaCl dissolves in water, aqueous  $\text{Na}^+$  and  $\text{Cl}^-$  ions result. The force of attraction that exists between  $\text{Na}^+$  and  $\text{H}_2\text{O}$  is called a(n) \_\_\_\_\_ interaction.
- A) London dispersion force
  - B) dipole-dipole
  - C) ion-dipole
  - D) ion-ion
  - E) hydrogen bonding
- 17) Hydrogen bonding is a special case of \_\_\_\_\_.
- A) ion-dipole attraction
  - B) London-dispersion forces
  - C) dipole-dipole attractions
  - D) none of the above
  - E) ion-ion interactions
- 18) The intermolecular force(s) responsible for the fact that  $\text{CH}_4$  has the lowest boiling point in the set  $\text{CH}_4$ ,  $\text{SiH}_4$ ,  $\text{GeH}_4$ ,  $\text{SnH}_4$  is/are \_\_\_\_\_.
- A) mainly London-dispersion forces but also dipole-dipole interactions
  - B) mainly hydrogen bonding but also dipole-dipole interactions
  - C) London dispersion forces
  - D) dipole-dipole interactions
  - E) hydrogen bonding
- 19) Of the molecules below, only \_\_\_\_\_ is nonpolar.
- A)  $\text{CO}_2$                       B)  $\text{NH}_3$                       C)  $\text{H}_2\text{O}$                       D)  $\text{TeCl}_2$                       E)  $\text{HCl}$
- 20) A \_\_\_\_\_ covalent bond is the longest.
- A) triple
  - B) single
  - C) double
  - D) They are all the same length.
  - E) strong
- 21) A gas is \_\_\_\_\_ and assumes \_\_\_\_\_ of its container whereas a liquid is \_\_\_\_\_ and assumes \_\_\_\_\_ of its container.
- A) compressible, the volume and shape, compressible, the volume
  - B) compressible, the shape, not compressible, the volume and shape
  - C) condensed, the volume and shape, condensed, the volume and shape
  - D) condensed, the shape, compressible, the volume and shape
  - E) compressible, the volume and shape, not compressible, the shape of a portion

- 22) The Lewis structure of  $\text{AsH}_3$  shows \_\_\_\_\_ nonbonding electron pair(s) on As.
- A) 0
  - B) 1
  - C) 2
  - D) 3
  - E) This cannot be determined from the data given.
- 23) Crystalline solids \_\_\_\_\_.
- A) exist only at high temperatures
  - B) have their particles arranged randomly
  - C) have highly ordered structures
  - D) are usually very soft
  - E) exist only at very low temperatures
- 24) Bond enthalpy is \_\_\_\_\_.
- A) sometimes positive, sometimes negative
  - B) always negative
  - C) always zero
  - D) always positive
  - E) unpredictable
- 25) A typical triple bond \_\_\_\_\_.
- A) consists of two  $\sigma$  bonds and one  $\pi$  bond
  - B) consists of three shared electrons
  - C) consists of one  $\sigma$  bond and two  $\pi$  bonds
  - D) is longer than a single bond
  - E) consists of six shared electron pairs
- 26) The ability of an atom in a molecule to attract electrons is best quantified by the \_\_\_\_\_.
- A) electron change-to-mass ratio
  - B) diamagnetism
  - C) first ionization potential
  - D) paramagnetism
  - E) electronegativity
- 27) The blending of one s atomic orbital and two p atomic orbitals produces \_\_\_\_\_.
- A) three  $\text{sp}^2$  hybrid orbitals
  - B) two  $\text{sp}^2$  hybrid orbitals
  - C) three  $\text{sp}^3$  hybrid orbitals
  - D) two  $\text{sp}^3$  hybrid orbitals
  - E) three sp hybrid orbitals

- 28) Which of the following is not a type of solid?
- A) metallic
  - B) ionic
  - C) supercritical
  - D) covalent-network
  - E) molecular
- 29) Of the following substances, only \_\_\_\_\_ has London dispersion forces as its only intermolecular force.
- A) CH<sub>4</sub>                      B) CH<sub>3</sub>OH                      C) NH<sub>3</sub>                      D) H<sub>2</sub>S                      E) HCl
- 30) Together, liquids and solids constitute \_\_\_\_\_ phases of matter.
- A) all of the
  - B) the fluid
  - C) the compressible
  - D) the condensed
  - E) the disordered
- 31) Of the atoms below, \_\_\_\_\_ is the most electronegative.
- A) F                      B) Br                      C) N                      D) O                      E) Cl
- 32) According to VSEPR theory, if there are four electron domains in the valence shell of an atom, they will be arranged in a(n) \_\_\_\_\_ geometry.
- A) octahedral
  - B) trigonal bipyramidal
  - C) tetrahedral
  - D) trigonal planar
  - E) linear
- 33) According to VSEPR theory, if there are five electron domains in the valence shell of an atom, they will be arranged in a(n) \_\_\_\_\_ geometry.
- A) linear
  - B) trigonal planar
  - C) octahedral
  - D) trigonal bipyramidal
  - E) tetrahedral
- 34) For resonance forms of a molecule or ion, \_\_\_\_\_.
- A) one always corresponds to the observed structure
  - B) all the resonance structures are observed in various proportions
  - C) the same atoms need not be bonded to each other in all resonance forms
  - D) there cannot be more than two resonance structures for a given species
  - E) the observed structure is an average of the resonance forms

- 35) Some things take longer to cook at high altitudes than at low altitudes because \_\_\_\_\_.
- natural gas flames don't burn as hot at high altitudes
  - heat isn't conducted as well in low density air
  - water boils at a higher temperature at high altitude than at low altitude
  - water boils at a lower temperature at high altitude than at low altitude
  - there is a higher moisture content in the air at high altitude
- 36) What intermolecular force is responsible for the fact that ice is less dense than liquid water?
- dipole-dipole forces
  - ionic bonding
  - ion-dipole forces
  - hydrogen bonding
  - London dispersion forces
- 37) The vapor pressure of any substance at its normal boiling point is
- 1 atm
  - equal to atmospheric pressure
  - 1 torr
  - equal to the vapor pressure of water
  - 1 Pa
- 38) Heat of sublimation can be approximated by adding together \_\_\_\_\_ and \_\_\_\_\_.
- heat of freezing (solidification), heat of vaporization
  - heat of fusion, heat of vaporization
  - heat of fusion, heat of condensation
  - heat of deposition, heat of vaporization
  - heat of freezing (solidification), heat of condensation
- 39) In general, the vapor pressure of a substance increases as \_\_\_\_\_ increases.
- molecular weight
  - temperature
  - viscosity
  - surface tension
  - hydrogen bonding
- 40) The formal charge on carbon in the molecule below is \_\_\_\_\_.



- A) +1                      B) +3                      C) -1                      D) 0                      E) +2
- 41) In order to produce  $sp^3$  hybrid orbitals, \_\_\_\_\_ s atomic orbital(s) and \_\_\_\_\_ p atomic orbital(s) must be mixed.
- two, three
  - one, two
  - two, two
  - one, one
  - one, three

## Answer Key

Testname: 1411-4F.TST

**MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question.

- 1) B
- 2) B
- 3) B
- 4) E
- 5) D
- 6) E
- 7) A
- 8) D
- 9) E
- 10) B
- 11) E
- 12) B
- 13) B
- 14) B
- 15) A
- 16) C
- 17) C
- 18) C
- 19) A
- 20) B
- 21) E
- 22) B
- 23) C
- 24) D
- 25) C
- 26) E
- 27) A
- 28) C
- 29) A
- 30) D
- 31) A
- 32) C
- 33) D
- 34) E
- 35) D
- 36) D
- 37) A
- 38) B
- 39) B
- 40) D
- 41) E