

## Part A

### Answer all questions in this part.

*Directions (1–30):* For *each* statement or question, record on your separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

- Compared to an electron, which particle has a charge that is equal in magnitude but opposite in sign?  
(1) an alpha particle      (3) a neutron  
(2) a beta particle      (4) a proton
- The mass of a proton is approximately equal to  
(1) 1 atomic mass unit  
(2) 12 atomic mass units  
(3) the mass of 1 mole of carbon atoms  
(4) the mass of 12 moles of electrons
- Which property *decreases* when the elements in Group 17 are considered in order of increasing atomic number?  
(1) atomic mass      (3) melting point  
(2) atomic radius      (4) electronegativity
- Any substance composed of two or more elements that are chemically combined in a fixed proportion is  
(1) an isomer      (3) a solution  
(2) an isotope      (4) a compound
- Which term refers to how strongly an atom of an element attracts electrons in a chemical bond with an atom of a different element?  
(1) entropy  
(2) electronegativity  
(3) activation energy  
(4) first ionization energy
- At STP, which substance has metallic bonding?  
(1) ammonium chloride      (3) iodine  
(2) barium oxide      (4) silver
- What is the number of electrons shared between the carbon atoms in a molecule of ethyne?  
(1) 6      (3) 8  
(2) 2      (4) 4
- Which atom in the ground state has a stable valence electron configuration?  
(1) Ar      (3) Si  
(2) Al      (4) Na
- What occurs when two fluorine atoms react to produce a fluorine molecule?  
(1) Energy is absorbed as a bond is broken.  
(2) Energy is absorbed as a bond is formed.  
(3) Energy is released as a bond is broken.  
(4) Energy is released as a bond is formed.
- Which gas sample at STP has the same number of molecules as a 2.0-liter sample of  $\text{Cl}_2(\text{g})$  at STP?  
(1) 1.0 L of  $\text{NH}_3(\text{g})$       (3) 3.0 L of  $\text{CO}_2(\text{g})$   
(2) 2.0 L of  $\text{CH}_4(\text{g})$       (4) 4.0 L of  $\text{NO}(\text{g})$
- All atoms of uranium have the same  
(1) mass number  
(2) atomic number  
(3) number of neutrons plus protons  
(4) number of neutrons plus electrons
- The concentration of a solution can be expressed in  
(1) kelvins  
(2) milliliters  
(3) joules per kilogram  
(4) moles per liter

- 13 Compared to the boiling point and the freezing point of water at 1 atmosphere, a 1.0 M  $\text{CaCl}_2(\text{aq})$  solution at 1 atmosphere has a
- (1) lower boiling point and a lower freezing point
  - (2) lower boiling point and a higher freezing point
  - (3) higher boiling point and a lower freezing point
  - (4) higher boiling point and higher freezing point
- 14 According to the kinetic molecular theory, which statement describes an ideal gas?
- (1) The gas particles are diatomic.
  - (2) Energy is created when the gas particles collide.
  - (3) There are no attractive forces between the gas particles.
  - (4) The distance between the gas particles is small, compared to their size.
- 15 Which physical change is endothermic?
- (1)  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$
  - (2)  $\text{CO}_2(\ell) \rightarrow \text{CO}_2(\text{s})$
  - (3)  $\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\ell)$
  - (4)  $\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\text{s})$
- 16 Which Group 16 element combines with hydrogen to form a compound that has the strongest hydrogen bonding between its molecules?
- (1) oxygen
  - (2) selenium
  - (3) sulfur
  - (4) tellurium
- 17 Hydrocarbons are composed of the elements
- (1) carbon and hydrogen, only
  - (2) carbon and oxygen, only
  - (3) carbon, hydrogen, and oxygen
  - (4) carbon, nitrogen, and oxygen
- 18 Which atom is bonded to the carbon atom in the functional group of a ketone?
- (1) fluorine
  - (2) hydrogen
  - (3) nitrogen
  - (4) oxygen
- 19 Two types of organic reactions are
- (1) addition and sublimation
  - (2) deposition and saponification
  - (3) decomposition and evaporation
  - (4) esterification and polymerization
- 20 The isomers butane and methylpropane have
- (1) the same molecular formula and the same properties
  - (2) the same molecular formula and different properties
  - (3) different molecular formulas and the same properties
  - (4) different molecular formulas and different properties
- 21 In a redox reaction, which particles are lost and gained in equal numbers?
- (1) electrons
  - (2) neutrons
  - (3) hydroxide ions
  - (4) hydronium ions
- 22 What is the oxidation state for a Mn atom?
- (1) 0
  - (2) +7
  - (3) +3
  - (4) +4
- 23 Which compounds are classified as electrolytes?
- (1)  $\text{KNO}_3$  and  $\text{H}_2\text{SO}_4$
  - (2)  $\text{KNO}_3$  and  $\text{CH}_3\text{OH}$
  - (3)  $\text{CH}_3\text{OCH}_3$  and  $\text{H}_2\text{SO}_4$
  - (4)  $\text{CH}_3\text{OCH}_3$  and  $\text{CH}_3\text{OH}$
- 24 Which compound is an Arrhenius base?
- (1)  $\text{CO}_2$
  - (2)  $\text{CaSO}_4$
  - (3)  $\text{Ca}(\text{OH})_2$
  - (4)  $\text{C}_2\text{H}_5\text{OH}$
- 25 According to one acid-base theory, a water molecule acts as a base when it accepts
- (1) an  $\text{H}^+$  ion
  - (2) an  $\text{OH}^-$  ion
  - (3) a neutron
  - (4) an electron