

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) $\text{CO}_2(\text{l}) \rightarrow \text{CO}_2(\text{s})$
 - (3) $\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\text{l})$
 - (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) KNO_3 and H_2SO_4
 - (2) KNO_3 and CH_3OH
 - (3) CH_3OCH_3 and H_2SO_4
 - (4) CH_3OCH_3 and CH_3OH
- 24 Which compound is an Arrhenius base?
- (1) CO_2
 - (2) 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 H^+ ion
 - (2) an OH^- ion
 - (3) a neutron
 - (4) an electron