

# 14 • Solutions

## PRACTICE TEST

- What is the molality of 7.80% by weight glucose ( $C_6H_{12}O_6$  molar mass = 180.16 g/mol) solution?  
a) 0.470 m                      d) 0.0454 m  
b) 0.845 m                      e) 0.0844 m  
c) 0.0432 m
- The mol fraction of  $NH_4Cl$  in a solution is 0.0311. What is its molality?  
(The molar mass of water is 18.016 g/mol.)  
a) 1.78 *m*                      d) 0.562 *m*  
b) 1.66 *m*                      e) 0.0983 *m*  
c) 0.969 *m*
- What is the mol fraction  $Na_2SO_4$  in a solution which is 11.5% by weight  $Na_2SO_4$  (molar mass  $Na_2SO_4 = 142.06$  g/mol and  $H_2O = 18.016$  g/mol)?  
a) 0.0810                      d) 0.0173  
b) 0.0914                      e) 0.0162  
c) 0.0745
- What is the mol fraction  $NaNO_3$  in a solution which is 2.15 *m*?  
a) 0.0180                      d) 0.09387  
b) 0.0268                      e) 0.0785  
c) 0.0373
- A 1.34 *M*  $NiCl_2$  (molar mass = 129.6 g/mol) solution has a density of 1.12 g/cm<sup>3</sup>. What is the weight percent  $NiCl_2$  of the solution?  
a) 1.73%                      d) 25.4%  
b) 8.64%                      e) 29.8%  
c) 15.5%
- A 1.25 *M*  $Cu(NO_3)_2$  (molar mass = 187.56 g/mol) solution has a density of 1.19 g/cm<sup>3</sup>. What is the weight percent  $Cu(NO_3)_2$  of the solution?  
a) 1.88%                      d) 14.3%  
b) 2.36%                      e) 19.9%  
c) 10.5%
- Hydrobromic acid (molar mass = 80.9 g/mol) is commercially available in a 34.0 mass percent solution which has a density of 1.31 g/cm<sup>3</sup>. What is the molarity of the commercially available hydrobromic acid?  
a) 2.75 *M*                      d) 9.35 *M*  
b) 4.45 *M*                      e) 10.2 *M*  
c) 5.50 *M*
- The maximum contamination level of arsenic ion in a water system is 0.050 parts per million. If the arsenic is present as  $AsCl_3$ , how many grams of arsenic chloride could be present in a system that contains  $8.2 \times 10^5$  Liters?  
a) 0.55 g                      d) 62 g  
b) 7.3 g                      e) 98 g  
c) 41 g
- A student prepared a solution containing 0.30 mol solute and 1.00 mole solvent. The mole fraction of *solvent* is  
a) 1.30                      d) 0.30  
b) 1.00                      e) 0.23  
c) 0.77

10. Which measure of concentration is most appropriate for the calculation of the vapor pressure of a solution?
- a) mol fraction      d) weight %  
b) molarity      e) ppm  
c) molality
11. A chemist knows the empirical formula of a new compound but not the molecular formula. What must be determined experimentally so that the molecular formula can be determined?
- a) density      d) melting point  
b) viscosity      e) molar mass  
c) % composition
12. A volumetric flask is necessary for the preparation of which one of the following concentration measurements?
- a) molality      d) molarity  
b)  $X$       e) ppm  
c) mass %
13. If the pressure of a gas over a liquid increases, the amount of gas dissolved in the liquid will
- a) increase  
b) decrease  
c) remain the same  
d) have a higher vapor pressure  
e) depends on the polarity of the gas
14. Which of the following solutions would have the lowest vapor pressure?
- a) 1  $m$  glucose ( $C_6H_{12}O_6$ )  
b) 1  $m$   $MgCl_2$       d) 1  $m$   $NaBr$   
c) 1  $m$   $NaNO_3$       e) pure  $H_2O$
15. What is the primary energetic factor in the lack of miscibility between  $CCl_4(l)$  and water?
- a) the strength of intermolecular forces between  $CCl_4$  molecules  
b) the strength of intermolecular forces between  $H_2O$  molecules  
c) the charge on the C atom in  $CCl_4$   
d) the difference between the molecular weights of the molecules  
e) the electronegativity difference between carbon and chlorine
16. Which of the following would have a boiling point closest to that of 1  $m$   $NaCl$ ?
- a) 1  $m$  sucrose ( $C_{12}H_{22}O_{11}$ )  
b) pure  $H_2O$       d) 0.5  $m$   $CH_3OH$   
c) 1  $m$   $MgCl_2$       e) 1  $m$   $NH_4NO_3$
17. Which of the following would have the highest freezing point?
- a) 1  $m$  glucose ( $C_6H_{12}O_6$ )  
b) 1  $m$   $MgCl_2$       d) 1  $m$   $(NH_4)_2SO_4$   
c) 1  $m$   $NaNO_3$       e) pure  $H_2O$
18. You need a solution that is 0.15  $m$  in ions. How many grams of  $MgCl_2$  (molar mass = 95.2 g/mol) must you dissolve in 400. g of water? (Assume total dissociation of the ionic salt.)
- a) 0.060 g      d) 7.6 g  
b) 1.9 g      e) 17 g  
c) 5.7 g

19. A solution is prepared by dissolving 0.500 g of non-dissociating solute in 12.0 g of cyclohexane. The freezing point depression of the solution is  $8.94^{\circ}\text{C}$ . The  $K_{\text{fp}}$  for cyclohexane is  $-20.0^{\circ}\text{C}/m$ . Calculate the molar mass of the solute.
- a) 93.2 g/mol            d) 182 g/mol  
 b) 112 g/mol            e) 205 g/mol  
 c) 128 g/mol
20. What is the freezing point of a solution containing 4.134 grams naphthalene (molar mass = 128.2) dissolved in 30.0 grams paradichlorobenzene? The freezing point of pure paradichlorobenzene is  $53.0^{\circ}\text{C}$  and the freezing point depressing constant  $K_{\text{fp}}$  is  $-7.10^{\circ}\text{C}/m$ .
- a)  $52.0^{\circ}\text{C}$             d)  $17.6^{\circ}\text{C}$   
 b)  $48.7^{\circ}\text{C}$             e)  $7.63^{\circ}\text{C}$   
 c)  $45.4^{\circ}\text{C}$
21. What is the molar mass of a compound if 4.28 grams is dissolved in 25.0 grams of chloroform solvent to form a solution which has a boiling point elevation of  $2.30^{\circ}\text{C}$ . The boiling point constant of chloroform  $K_{\text{bp}}$  is  $+3.63^{\circ}\text{C}/m$ .
- a) 34.5 g/mol            d) 168 g/mol  
 b) 67.5 g/mol            e) 270 g/mol  
 c) 135 g/mol
22. Concentrated salt solutions have boiling points lower than those calculated using the equation,  $T_{\text{b}} = K_{\text{b}} \cdot m \cdot i$ . Which of the following is a reasonable explanation of this observation?
- a) Positive ions repel each other more at high concentration.  
 b) Ions of opposite charge will tend to stay paired instead of breaking up.  
 c) The water molecules will have a greater attraction for each other.  
 d) Concentrated solutions really have small particles of non-dissolved salt, thus lowering the molality.  
 e) The difference between the crystal lattice energy and the heat of hydration must be taken into consideration.

Answers:

- |     |   |     |   |
|-----|---|-----|---|
| 1.  | A | 11. | E |
| 2.  | A | 12. | D |
| 3.  | E | 13. | A |
| 4.  | C | 14. | B |
| 5.  | C | 15. | B |
| 6.  | E | 16. | E |
| 7.  | C | 17. | E |
| 8.  | E | 18. | B |
| 9.  | C | 19. | A |
| 10. | A | 20. | C |
|     |   | 21. | E |
|     |   | 22. | B |