

Name \_\_\_\_\_

Chemistry

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**Solutions Test**

For each of the following, circle and write the letter of the best answer on the line.

- \_\_\_\_\_ Which of the following solutions has the lowest boiling point?  
(A) 0.20 *m* C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, glucose (B) 0.20 *m* NH<sub>4</sub>Br (C) 0.20 *m* ZnSO<sub>4</sub>  
(D) 0.20 *m* KMnO<sub>4</sub> (E) 0.20 *m* MgCl<sub>2</sub>
- \_\_\_\_\_ How many mL of water should be added to 200. mL of stock solution with a molarity of 5.00 to make a 1.50 M solution?  
(A) 667 mL (B) 867 mL (C) 60. mL (D) 140. mL (E) 467 mL
- \_\_\_\_\_ Calculate the molality of a solution that contains 6.5 moles of sodium chloride dissolved in 725 grams of water.  
(A) 0.0090 *m* (B) 0.16 *m* (C) 9.0 *m* (D) 110 *m* (E) 4.7 *m*
- \_\_\_\_\_ How many mL of acetic acid, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, is needed to make 1.0 L of a 15.0% acetic acid solution?  
(A) 150 mL (B) 15 mL (C) 870 mL (D) 6.7 mL (E) 1500 mL
- \_\_\_\_\_ Calculate the molality of a 20.0 percent by weight aqueous solution of NaNO<sub>3</sub>.  
(A) 0.250 *m* (B) 0.235 *m* (C) 5.88 *m* (D) 2.94 *m* (E) 0.0502 *m*
- \_\_\_\_\_ How many grams of sucrose, C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>, would you need to make 0.50 kilogram of a 7.0% solution?  
(A) 12 g (B) 0.35 g (C) 0.070 g (D) 7.2 g (E) 35 g
- \_\_\_\_\_ A solution of 2.250 grams of an unknown molecular compound in 18.12 grams of camphor freezes at a temperature 12.2 Celsius degrees below the normal freezing point of pure camphor. Determine the molar mass of the unknown substance. *K<sub>f</sub>* for camphor is 40.0 kg-K·mol<sup>-1</sup>  
(A) 407 g/mol (B) 204 g/mol (C) 102 g/mol (D) 305 g/mol (E) 30.5 g/mol
- \_\_\_\_\_ What is the percent mass of a solution that has 73.0 grams of NaCl dissolved in 275 grams of solution?  
(A) 0.265 % (B) 26.5% (C) 0.476% (D) 7.55% (E) 4.57%
- \_\_\_\_\_ How many kilograms of water are needed to make a 1.5 molal solution using 70.0 grams of CaCl<sub>2</sub>?  
(A) 0.95 kg (B) 0.42 kg (C) 2.4 kg (D) 47 kg (E) 0.047 kg
- \_\_\_\_\_ A solution of toluene(C<sub>7</sub>H<sub>8</sub>) and benzene(C<sub>6</sub>H<sub>6</sub>) is prepared. If the mole fraction of toluene is 0.25, what is the mole fraction of benzene?  
(A) 25 (B) 0.25 (C) 0.75 (D) 0.29 (E) 0.71
- \_\_\_\_\_ A 5.00 M solution with a volume of 400. mL is left uncovered and 75.0 mL evaporates. What is the new molarity of the solution?  
(A) 6.15 M (B) 26.7 M (C) 4.21 M (D) 5.00 M (E) 5.33
- \_\_\_\_\_ Given that a solution is 20 percent sucrose by mass, what additional information is necessary to calculate the molarity of the solution?  
I. The density of water  
II. The density of the solution  
III. The molar mass of sucrose  
(A) I only (B) II only (C) III only (D) I and III (E) II and III
- \_\_\_\_\_ If the temperature of an aqueous solution of NaCl is increased from 20 °C to 90 °C, which of the following statements is true?  
(A) The density of the solution remains unchanged.  
(B) The molality of the solution remains unchanged.  
(C) The molarity of the solution remains unchanged.  
(D) The mole fraction of solute decreases.  
(E) The mole fraction of solute increases.

14. \_\_\_\_\_ Determine the boiling point if 600. grams of toluene ( $C_7H_8$ ) is dissolved in 800. grams of benzene ( $C_6H_6$ ).  
Boiling Point of benzene:  $80.10^\circ C$ ,  $K_b = 2.53 \text{ kg}\cdot K\cdot \text{mol}^{-1}$   
(A)  $100.7^\circ C$  (B)  $59.5^\circ C$  (C)  $20.6^\circ C$  (D)  $82.00^\circ C$  (E)  $1.90^\circ C$
15. \_\_\_\_\_ An aqueous 1.0 m  $CaCl_2$  solution has a density of 1.05. Determine the molarity of the solution.  
(A) 2.84 M (B) 8.57 M (C) 0.857 M (D) 10.0 M (E) 0.945 M
16. \_\_\_\_\_ How many mL of stock sodium chloride solution would you need to prepare 700. mL of a 0.60 M solution from a 7.0 M stock solution?  
(A) 60. mL (B) 8200 mL (C) 640 mL (D) 120 mL (E) 30. mL
17. \_\_\_\_\_ A solution is prepared by mixing 23.0 g ethanol ( $C_2H_5OH$ ) with 100.0 g water to give a final volume of 119 mL. Calculate the molarity of ethanol in this solution.  
(A) 2.03 M (B) 8.90 M (C) 4.06 M (D) 1.93 M (E) 4.20 M
18. \_\_\_\_\_ If 345 grams of  $AlCl_3$  is dissolved in 890. grams of water, what is the mole fraction of aluminum chloride in water?  
(A) 0.388 (B) 38.8 (C) 0.0522 (D) 2.90 (E) 0.0496
19. \_\_\_\_\_ A 580. mL solution contains 120. mL of ethanol ( $C_2H_5OH$ ). Calculate the volume percent of this solution.  
(A) 20.7% (B) 4.83% (C) 7.47% (D) 4.50% (E) 0.207%
20. \_\_\_\_\_ An aqueous solution is prepared to be 48.0% ethanol ( $C_2H_5OH$ ) by volume. The density of ethanol is 0.789 g/mL. The density of the solution is 0.976 g/mL. Determine the mole fraction of ethanol in solution.  
(A) 0.636 (B) 0.389 (C) 0.611 (D) 0.480 (E) 0.201
21. \_\_\_\_\_ How many liters of solution is produced in making a 4.1 M solution and using 190 grams of  $C_{12}H_{22}O_{11}$ .  
(A) 0.14 L (B) 46 L (C) 2.3 L (D) 7.4 L (E) 0.046 L
22. \_\_\_\_\_ A student wishes to prepare 2.00 liters of 0.100-molar  $KIO_3$ . The proper procedure is to weigh out  
(A) 42.8 grams of  $KIO_3$  and add 2.00 kilograms of  $H_2O$   
(B) 42.8 grams of  $KIO_3$  and add  $H_2O$  until the final homogeneous solution has a volume of 2.00 liters  
(C) 21.4 grams of  $KIO_3$  and add  $H_2O$  until the final homogeneous solution has a volume of 2.00 liters  
(D) 42.8 grams of  $KIO_3$  and add 2.00 liters of  $H_2O$   
(E) 21.4 grams of  $KIO_3$  and add 2.00 liters of  $H_2O$
23. \_\_\_\_\_ Calculate the mass of  $CaBr_2$  needed to make 870 mL of a 0.75 M solution.  
(A) 170 g (B) 11.6 g (C) 0.86 g (D) 0.65 g (E) 130 g
24. \_\_\_\_\_ Determine the freezing point if 4.0 moles of  $Na_2SO_4$  is dissolved in 6.0 kilograms of water.  
Freezing point:  $0.0^\circ C$ ,  $K_f = 1.86 \text{ kg}\cdot K\cdot \text{mol}^{-1}$   
(A)  $3.72^\circ C$  (B)  $1.24^\circ C$  (C)  $-1.24^\circ C$  (D)  $-2.48^\circ C$  (E)  $-3.72^\circ C$
25. \_\_\_\_\_  
I. Difference in temperature between freezing point of solvent and freezing point of solution  
II. Molal freezing point depression constant,  $K_f$ , for solvent
- In addition to the information above, which of the following gives the minimum data required to determine the molecular mass of a nonionic substance by the freezing point depression technique?
- (A) No further information is necessary. (B) Mass of solute  
(C) Mass of solute and mass of solvent (D) Mass of solute and volume of solvent  
(E) Mass of solute, mass of solvent, and vapor pressure of solvent