Practice Problems for Solutions ANSWERS

Solution Molarity	Number of grams solute	Solute formula	Volume in mL
(1)	1345 g	$CaCl_2$	3260 mL
1.05 M	(2)	$AgNO_3$	25.0 mL
5.92 M	424.0 g	NH_4Cl	(3)

$$\text{Molarity} = \frac{\text{\# Moles Solute}}{\text{Liters of Solution}}$$

1. Molarity = $\frac{1345 \text{ g } CaCl_2}{1} \times \frac{1 \text{ mole } CaCl_2}{110 \text{ grams } CaCl_2} = 12.23 \text{ moles}$

$\frac{12.23 \text{ moles}}{3.260 \text{ Liters}} = 3.752 \text{ Molarity}$ 4 SF

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2. 1.05 M = $\frac{\text{X moles } AgNO_3}{0.025 \text{ Liters}} = (1.05 \text{ M})(0.025 \text{ L}) = \text{X moles } AgNO_3$

$= 0.0263 \text{ moles } AgNO_3$ (3 SF)

$\frac{0.0263 \text{ moles } AgNO_3}{1} \times \frac{170 \text{ grams } AgNO_3}{1 \text{ mole } AgNO_3} = 4.46 \text{ grams } AgNO_3$ (3 SF)

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3. $\frac{424.0 \text{ g } NH_4Cl}{1} \times \frac{1 \text{ mole } NH_4Cl}{53 \text{ grams } CaCl_2} = 8.000 \text{ moles}$ (4 SF)

$$5.92 \text{ M} = \frac{8.000 \text{ moles } NH_4Cl}{\text{X Liters}}$$

$(5.92 \text{ M})(\text{X Liters}) = 8.000 \text{ moles}$ $\quad \text{X Liters} = \frac{8.000 \text{ moles}}{5.92 \text{ M}} = 1.35 \text{ liters}$ (3 SF)

$1.35 \text{ L} = 1350 \text{ mL}$

4. How do you prepare 125.0 mL of 0.625 M $NaCl_{(AQ)}$ from a stock solution of 3.00 molarity?

$M_1V_1 = M_2V_2$ $\quad (3.00\ M)(V_1) = (0.625\ M)(125.0\ mL)$ $\quad V_1 = 26.0$ mL stock (3 SF)

125.0 mL total - 26.0 stock solution = 99.0 mL water

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5. How do you prepare 6.75 mL of 1.14 M $KCl_{(AQ)}$ from a stock solution of 4.70 molarity?

$M_1V_1 = M_2V_2$ $\quad (4.70\ M)(V_1) = (1.14\ M)(6.75\ mL)$ $\quad V_1 = 1.64$ mL stock (3 SF)

6.75 mL total - 1.64 mL stock = 5.11 mL water

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6. What is the concentration in parts per million when 164 grams of mercury is mixed into a pond of 120,150 liters?

$$\text{PPM} = \frac{\text{grams of mercury}}{\text{grams of solution}} \times 1{,}000{,}000 = \frac{164\text{ g Hg}}{120{,}150{,}000\text{ g solution}} \times 1{,}000{,}000 =$$

$= 1.36$ PPM (3 SF)

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7. Benzene (C_6H_6) is a carcinogenic molecule when it reaches 10 PPM. In drinking water in a city in China, scientists measured 1.43 grams in 98.75 liters of water. What is the concentration of benzene in this water? Is it safe to drink?

$$\text{PPM} = \frac{\text{grams of benzene}}{\text{grams of solution}} \times 1{,}000{,}000 = \frac{1.43\text{ g } C_6H_6}{98750\text{ g solution}} \times 1{,}000{,}000 = 14.5 \text{ PPM}$$

3 SF

No, this water is NOT SAFE to drink, it exceeds the safe limit

8. You have 1.0 liter of four different solutions: $CaCl_2$, $(NH_3)_3PO_4$, KCl, and $C_6H_{12}O_6$. Put them in order of lowest to highest boiling point.

Calcium chloride has 3 moles of ions
Ammonium phosphate has 4 moles of ions,
Potassium chloride has 2 moles of ions
Glucose is not ionic (but it is polar) and has just 1 mole of particles.
Less particles means a smaller Boiling Point elevation

Lowest BP to highest = $C_6H_{12}O_6$ KCl $CaCl_2$ $(NH_3)_3PO_4$

9. You have 5 beakers containing 400. mL each, of PURE H_2O, and 1.0 M K_3PO_4, NaCl, $CHCl_3$, and $MgBr_2$ solutions. Put them in order of highest → lowest freezing points.

Water has no particles in solution.
K_3PO_4 has 4 moles of particles
NaCl has 2 moles of particles
$CHCl_3$ is not ionic, but it is polar so it dissolves, it has 1 mole of particles
$MgBr_2$ has 3 moles of particles

More particles means greater freezing point depression, so…
HIGHEST FP is H_2O
followed by $CHCl_3$, NaCl, $MgBr_2$, and K_3PO_4 has the LOWEST FP (it has the most particles).

10. What is the freezing point and the boiling point in centigrade temperature of 1.00 liters of a 2.00 Molar aluminum nitrate solution?

1 mole $Al(NO_3)_3$ form 4 moles of ions. This 2.00 molar solution has 2 moles of $Al(NO_3)_3$ which forms into 8 moles of ions in solution.

The BP elevation = 100°C + (8 x 0.50°C) = 104°C boiling point.
The FP depression = 0°C – (8 x 1.86°C) = – 14.9°C

11. BONUS THINKING QUESTION: when 1.0 moles of urea (CH_4N_2O) dissolved in a 250. mL aqueous solution, what is the freezing point and the boiling point? (hint: urea is molecular)

    Here you have 1 mole in 0.25 Liters of solution, so it has 4 moles per liter, therefore the BP elevation is X4. The BP is 102°C.

12. What is the vapor pressure of H_2O at 25°C?
    If you replaced that pure water with sugary water, what would the approximate vapor pressure be of this solution?
    Table H shows us it is approximately 4 kPa.
    With sugar it would be LESS than 4 kPa.