Water & Solutions Review Problems **ANSWERS**

1. How many grams of ammonium chloride saturate 375 mL of H_2O at 80°C?

80°C $\frac{NH_4Cl}{H_2O}$ $\frac{67\ g}{100\ mL}$ $\frac{x}{375\ mL}$

$100\ x = 25125$

$X = 251$ grams NH_4Cl

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2. Which of these three compounds, when mixed with pure water, creates an electrolytic solution? Ag_2SO_4 $Sr(OH)_2$, $MgCrO_4$

Of these the first one is NOT SOLUABLE on table F, so it cannot ionize and provide the ions in solution to make an electrolyte, which means it will conduct electricity. The second and third will be soluble. Both are ionic, so both will are electrolytes.

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3. What is the boiling point for pure water at 50 kPa?

Table H shows us 82°C.

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4. When these two compounds are dissolved into water, which is an endothermic process, which is exothermic?
sodium hydroxide ammonium nitrate

Table I shows us

NaOH exothermic $\Delta H = -44.51$ kJ

NH_4NO_3 endothermic $\Delta H = +25.69$ kJ

5. 156 grams of ammonium carbonate is dissolved into 3250 mL water. What is the molarity of this solution? What is the PPM solute in this solution?

Molarity = $\frac{\text{\# moles solute}}{\text{Liters of solution}}$

M = $\frac{1.63 \text{ moles } NH_4CO_3}{3.250 \text{ Liters}}$

M = 0.501 molar solution

PPM = $\frac{\text{gm solute}}{\text{gm solution}} \times 1{,}000{,}000$

PPM = $\frac{156 \text{ g}}{3250 \text{ g}} \times 1{,}000{,}000$

PPM = 48,000 parts per million

$$\frac{156 \text{ g } (NH_4)_2CO_3}{1} \times \frac{1 \text{ mole } (NH_4)_2CO_3}{96 \text{ g } (NH_4)_2CO_3} = 1.63 \text{ moles } (NH_4)_2CO_3$$

6. A 4.35 M $NaOH_{(AQ)}$ solution of 8.50 L contains how many g of NaOH?

$$\text{Molarity} = \frac{\text{\# moles solute}}{\text{Liters of solution}}$$

$$4.35\ M = \frac{X}{8.50\ \text{Liters}}$$

$$X = 36.975 = 37.0 \text{ moles NaOH}$$

$$\frac{37.0 \text{ moles NaOH}}{1} \times \frac{40 \text{ g NaOH}}{1 \text{ mole NaOH}} = 1480 \text{ grams NaOH}$$

7. Zippy seltzer contains 8.25 grams $CO_{2(G)}$ per 750. mL soda. What is the percent composition by mass of carbon dioxide in the soda, and then, what is the molarity of CO_2 in this soda?

$$\%\ \text{comp by mass} = \frac{\text{Part}}{\text{Whole}} \times 100\%$$

$$\%\ \text{comp by mass} = \frac{8.25\ \text{g}}{750.\ \text{g}} \times 100\% = 1.10\ \%$$

$$M = \frac{\#\ \text{moles solute}}{\text{Liters}} \qquad \frac{0.188\ \text{moles}}{0.750\ \text{L}} = 0.251\ M$$

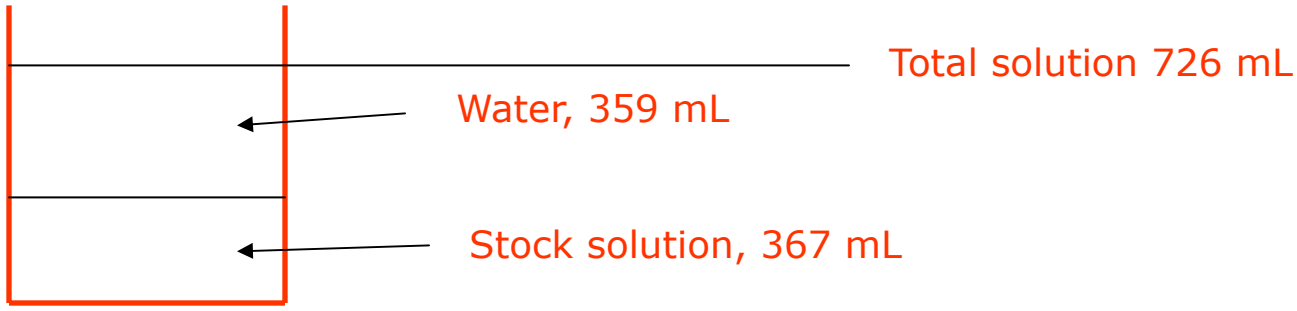
8. Choose the proper method for mixing up a 1.00 M $NaCl_{(AQ)}$ solution of 1.00 L.
   A. 58 g NaCl into 1.0 L water
   B. 1.0 L water into 58 g NaCl
   C. 58 g NaCl into a flask, fill to 1.0 L with water
   D. 58 g NaCl plus 1.0 L water into a flask larger than 1.00 L

9. Using a stock solution of 55 gallons that is 4.35 M nitric acid, how would you prepare 726 mL of a 2.20 nitric acid solution?

$$M_1V_1 = M_2V_2$$
$$(4.35\ M)\ (V_1) = (2.20\ M)(726\ mL)$$

$$V_1 = \frac{(2.20\ M)(726\ mL)}{(4.35\ M)}$$

V_1 = 367 mL of stock so



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10. When 3.0 moles sodium chloride is dissolved into one kilogram of pure water, what is the new boiling point of this aqueous solution? What is the new freezing point as well?

3.0 moles NaCl dissolves into water creating 3 moles of Na^{+1} cations and 3 moles Cl^{-1} anions. 3 moles of formula units here is six moles of ions (particles). So, the freezing point will be depressed by 6X, and the boiling point will be elevated by 6X.

Freezing point depression for water is –1.86°C per mole of particles in one liter of water. FP depression here = 6 x –1.86°C = -11.16°C

Boiling point elevation for water is +0.50°C per mole of particles in one liter of water.
BP elevation here = 6 X 0.50°C = 3°C higher than normal, or 103°C.