

(Please print legibly!)

Recitation instructor: _____

Recitation time (circle): B hour E hour

Ordinarily, our traditional Hogwarts PS60 quiz occurs, appropriately, closer to Halloween. Hopefully Prof. Dumbledore will not be upset that we are a bit early this year! Please show your work in the following problems.

I. All members of the Order of the Phoenix know about the Heir of Slytherin. Most witches and wizards (and certainly most muggles) do not know that the Air of Slytherin is a really stinky mixture of 2.9 g CH₄, 11.3 g H₂S, and 62.5985 g NH₃! What is the mole fraction of NH₃ in the gas mixture?

$$\begin{array}{l}
 \frac{2.9 \text{ g CH}_4}{16 \text{ g}} \left| \frac{1 \text{ mol CH}_4}{16 \text{ g}} \right. = 0.18 \text{ mol CH}_4 \\
 \frac{11.3 \text{ g H}_2\text{S}}{34 \text{ g}} \left| \frac{1 \text{ mol H}_2\text{S}}{34 \text{ g}} \right. = 0.332 \text{ mol H}_2\text{S} \\
 \frac{62.5985 \text{ g NH}_3}{17 \text{ g}} \left| \frac{1 \text{ mol NH}_3}{17 \text{ g}} \right. = 3.67362 \text{ mol NH}_3
 \end{array}
 \left. \vphantom{\begin{array}{l} \\ \\ \\ \end{array}} \right\} 4.19 \text{ moles total}$$

$$\frac{62.5985 \text{ g}}{17 \text{ g}} \left| \frac{1 \text{ mol NH}_3}{17 \text{ g}} \right. = 4.19 \text{ moles}$$

$$\boxed{= 0.877}$$

II. If pure butterbeer is 0.192 M in sucrose, how much pure butterbeer in mL would Harry Potter need to dilute with water in order to have 73.5 mL of butterbeer solution that is 0.0218 M in sucrose?

73.5 mL	1 L	0.0218 M sucrose	1000 mL
	1000 mL	0.192 M sucrose	1 L

$$\boxed{= 8.35 \text{ mL pure butterbeer}}$$

III. The Pensieve requires the proper potassium ion concentration for its liquid crystal display of peoples' memories to function properly. If Ron Weasley mixes 1.2 L of 1.05 M KCl solution (MW of KCl = 74.55) and 528 mL of 0.70 M K₃PO₄ solution (MW of K₃PO₄ = 212.27) together, what value for molarity of potassium ions will Ron have in the final solution?

$$\frac{1.2 \text{ L}}{1 \text{ L KCl}} \left| \frac{1.05 \text{ mol KCl}}{1 \text{ mol KCl}} \right. = 1.3 \text{ mol K}^+ \text{ (from KCl)}$$

$$\frac{528 \text{ mL}}{1000 \text{ mL}} \left| \frac{0.70 \text{ mol K}_3\text{PO}_4}{1 \text{ mol K}_3\text{PO}_4} \right. = 1.1 \text{ mol K}^+ \text{ ions (from K}_3\text{PO}_4)$$

} 2.4 total moles K⁺

$$\text{Molarity K}^+ = \frac{2.4 \text{ mol K}^+}{(1.2 \text{ L} + 0.528 \text{ L})} = \boxed{1.4 \text{ M K}^+}$$

PLEDGE: _____

Dr. U's favorite Halloween joke: Since you'll recall that the picometer is 1 x 10⁻¹² m, is scaring somebody by 1 x 10⁻¹² of the fundamental scare unit a picoboo?!?! :)