

## Review Problems: Solutions

1. What is the concentration (in moles  $\text{L}^{-1}$ ) of a solution that contains 39.2 g of  $\text{H}_3\text{PO}_4$  in  $500.0 \text{ cm}^3$  of water? (**Answer**  $0.800 \text{ moles L}^{-1}$ )
2. Sodium phosphate,  $\text{Na}_3\text{PO}_4$  (known commercially as TSP), is used for cleaning grease and oil spills. Describe precisely how you would prepare  $250.0 \text{ mL}$  of a  $0.320 \text{ mol/L}$  solution of TSP. (*hint: you are writing a procedure here*). (**Answer** You would need to mass out  $13.1 \text{ g}$  of TSP)
3. What volume of  $0.95 \text{ mol/L}$  solution  $\text{Na}_2\text{SO}_4$  would be required to prepare  $200 \text{ mL}$  of a  $0.15 \text{ mol/L}$  solution of  $\text{Na}_2\text{SO}_4$ ? (**Answer**  $32 \text{ mL}$ )
4. What is the final concentration of a solution prepared by adding  $50.0 \text{ mL}$  of  $1.50 \text{ M HNO}_3$  to a flask and bringing the volume up to  $1.0 \text{ L}$ ? (**Answer**  $0.075 \text{ M}$ )
5. How many grams of  $\text{Ca}(\text{NO}_3)_2$  can be prepared by reacting  $125 \text{ mL}$  of  $5.00 \text{ M HNO}_3$  with an excess of  $\text{Ca}(\text{OH})_2$ ? (*Hint: recall the products of a neutralization reaction-reacting an acid with a base*) (**Answer**  $51.3 \text{ g}$ )
6. What is the molarity of a  $\text{NaOH}$  solution if  $50.0 \text{ mL}$  is required to react exactly with  $38.2 \text{ mL}$  of  $0.100 \text{ M HCl}$ ? Write a balanced molecular equation, the total ionic equation, and the net ionic equation for the neutralization of  $\text{NaOH}$  with  $\text{HCl}$ .
7. What mass of  $\text{AgCl}$  forms from reacting  $25.0 \text{ dm}^3$  of  $1.5 \text{ mol dm}^{-3} \text{ AgNO}_{3(\text{aq})}$  with  $50 \text{ dm}^3$  of a  $0.20 \text{ mol dm}^{-3}$  solution of  $\text{BaCl}_2$ ? Write a balanced molecular equation and the net ionic equation.
8. What is the mass of solid  $\text{KOH}$  required to prepare  $250.0 \text{ cm}^3$  of  $0.5322 \text{ mol dm}^{-3}$  solution? Describe how you would prepare such a solution.
9. Magnesium hydroxide,  $\text{Mg}(\text{OH})_{2(\text{aq})}$ , and phosphoric acid,  $\text{H}_3\text{PO}_{4(\text{aq})}$ , react to form magnesium phosphate,  $\text{Mg}_3(\text{PO}_4)_{2(\text{aq})}$ , and water,  $\text{H}_2\text{O}_{(\text{l})}$ . What mass of magnesium phosphate is produced when  $22.5 \text{ dm}^3$  of  $0.220 \text{ mol dm}^{-3}$  of magnesium hydroxide reacts with  $32.3 \text{ dm}^3$  of  $0.155 \text{ mol dm}^{-3}$  phosphoric acid?
10. (a) What mass of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ , must be dissolved in water to prepare  $0.250 \text{ dm}^3$  of a  $0.100 \text{ mol dm}^{-3}$  solution?  
(b) What volume of the resulting solution contains  $0.010 \text{ mol}$  of glucose?
11. Calculate the number  $\text{Cl}^-$  ions in each of the following aqueous solutions:  
a)  $0.10 \text{ M NaCl}$     b)  $0.05 \text{ M MnCl}_2$     c)  $0.03 \text{ M AlCl}_3$     d)  $0.02 \text{ M SnCl}_4$
12. A stock hydrochloric acid solution  $1.00 \text{ M HCl}$ . A student needed to prepare  $250.0 \text{ mL}$  of  $0.100 \text{ M HCl}$  (and had access to a wide range of pipettes and volumetric flasks). Describe how the more dilute solution can be prepared from the more concentrated one.

13. A student found that by diluting 10.00 mL of sulphuric acid solution to a final volume of 100.0 mL the concentration of the new solution was 0.00100 M. What was the concentration of the initial solution?

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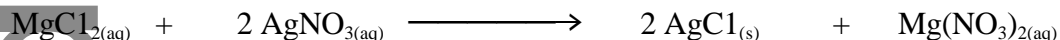
15. Calcium Phosphate  $\text{Ca}_3\text{PO}_4$ , forms as a precipitate when aqueous solutions of sodium phosphate,  $\text{Na}_3\text{PO}_4$ , and calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$  are mixed. The other product, sodium nitrate,  $\text{NaNO}_3$ , remains dissolved.

a) Write a balanced reaction for the reaction described (include state symbols)

b) What mass  $\text{Ca}_3(\text{PO}_4)$  will form when 48.4 mL of 0.212 M  $\text{Ca}(\text{NO}_3)_2$  is reacted with 25.2 mL of 0.485 M  $\text{Na}_3\text{PO}_4$

15. When 20g of the compound XY is dissolved in water to make 250 mL of a solution, a 0.500 M solution is obtained. What is the molar mass of XY?

16. In aqueous solution, magnesium chloride,  $\text{MgCl}_2$ , reacts completely without any side reactions with silver nitrate,  $\text{AgNO}_3$ , as follows:



In an experiment 19.50 mL of magnesium chloride solution reacted completely with 25.8 mL of silver nitrate solution, and 0.696 g of silver chloride was collected. Determine the concentration of the magnesium chloride solution.

17. 10.6 g of  $\text{Na}_2\text{CO}_{3(\text{s})}$  reacts with exactly 50.0 cm<sup>3</sup> of 4.00 mol dm<sup>-3</sup>  $\text{HCl}_{(\text{aq})}$  to produce 11.7 g  $\text{NaCl}_{(\text{aq})}$  and 4.40 g of  $\text{CO}_{2(\text{g})}$ . Calculate the equation for the reaction.

18. A student is asked to prepare some copper (II) nitrate by reacting nitric acid with copper (II) oxide.

a. Write a balanced equation for this reaction.

b. The student carries out this reaction by adding 0.0345 mol of copper (II) oxide to 36.0 cm<sup>3</sup> of 1.15 mol dm<sup>-3</sup> nitric acid solution. Calculate the amount (in mol) of nitric acid.

c. Use the information in (a) and (b) to identify the limiting reagent and determine the amount (in mol) of copper (II) nitrate formed.

d. The product of this reaction is isolated as copper (II) nitrate trihydrate. Calculate the molar mass of copper (II) nitrate trihydrate and the mass of the product obtained.