SOLUTIONS: Practice problems 2012

1. How would you prepare 400 ml of a 0.24 M NaCl solution (MW = 58.44 g/mole)?

\[ V \times C \times MW = \frac{0.4 \text{ L} \times 0.24 \text{ moles/L} \times 58.44 \text{ g/mole}}{0.24 \text{ moles/L}} = 5.61 \text{ g NaCl dissolved in/brought up to 400 ml water} \]

2. How would you prepare 750 ml of a 0.35 M Na₂PO₄ solution (MW = 141.96 g/mole)?

\[ 0.75 \text{ L} \times 0.35 \text{ moles/L} \times 141.96 \text{ g/mole} = 37.265 \text{ g Na₂PO₄ dissolved in/brought up to 750 ml water} \]

3. How would you prepare 225 ml of a 0.15 M citric acid solution (453.6 g/mole)?

\[ 0.225 \text{ L} \times 0.15 \text{ moles/L} \times 453.6 \text{ g/mole} = 15.309 \text{ g citric acid dissolved in/brought up to 225 ml water} \]

4. What volume of stock 0.24 M NaCl is needed to prepare 75 ml of 0.1 M NaCl?

\[ (cv=CV) \text{solve for } V_1: \quad V_1 = \frac{(0.1 \text{ M})(75 \text{ ml})}{(0.24 \text{ M})} = 31.25 \text{ ml of stock NaCl} \]

5. What volume of stock 0.35 M Na₂PO₄ is needed to prepare 150 ml of 0.2 M Na₂PO₄?

\[ V_3 = \frac{(0.2 \text{ M})(150 \text{ ml})}{(0.35 \text{ M})} = 85.714 \text{ ml of stock Na₂PO₄} \]

6. What volume of stock 0.15 M citric acid is needed to prepare 230 ml of 2.5 \times 10^{-3} M citric acid?

\[ V_3 = \frac{(0.0025 \text{ M})(230 \text{ ml})}{(0.15 \text{ M})} = 3.833 \text{ ml of stock citric acid} \]

7. How much (ml) 3 \times 10^{-3} M Na₂PO₄ can be prepared from 20 ml of 0.2 M Na₂PO₄?

\[ [cv=CV] \text{solve for } V_2: \quad V_2 = \frac{(0.2 \text{ M})(20 \text{ ml})}{0.003 \text{ M}} = 1333.33 \text{ ml} \]

8. If you have 35 ml of 0.1 M NaCl, is it enough to prepare 200 ml of 0.06 M NaCl?

\[ [cv=CV] \text{solve for } V_2: \quad V_2 = \frac{(0.06 \text{ M})(200 \text{ ml})}{(0.1 \text{ M})} = 120 \text{ ml, so no, you do not have enough stock}, \text{ OR, using a different approach,} \]

\[ \text{Solve for } V_2: \quad V_2 = \frac{(0.1 \text{ M})(35 \text{ ml})}{(0.06 \text{ m})} = 58.333 \text{ ml stock needed to make this amount}. \]

9. For each of the following, indicate the mass (g) of reagent needed to prepare 125 ml of the indicated percent solution:
<table>
<thead>
<tr>
<th>Reagent</th>
<th>Molecular weight</th>
<th>Percent solution needed (125 ml)</th>
<th>Mass of reagent (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>58.44</td>
<td>10 %</td>
<td>(0.1 g/ml)(125 ml)=12.5 g</td>
</tr>
<tr>
<td>Na₂PO₄</td>
<td>141.96</td>
<td>4.5 %</td>
<td>(0.045 g/ml)(125 ml)=5.625 g</td>
</tr>
<tr>
<td>Citric acid</td>
<td>453.6</td>
<td>2.5 %</td>
<td>(0.025 g/ml)(125 ml)=3.125 g</td>
</tr>
</tbody>
</table>

Percent concentration is a straight mass/volume (g/ml) calculation and doesn’t need the MW. 1 g/ml = 100% solution.

10. You have 200 ml of 50X TAE. What volume of the 50X TAE is needed to prepare 25 ml of 10X TAE?

\[ C_v = C_i \cdot V_i / V_f = (\text{ml of } 10X) / (\text{ml of } 50X) = \text{5 ml of 50X TAE stock} \]

11. A protocol calls for using a working concentration of 1.5 \( \times 10^{-4} \) M boric acid. To save shelf space, you decide to make up a 20X stock solution. What will be the molarity of that stock solution?

\[ 20 \times 1.5 \times 10^{-4} \text{ M} = 3.0 \times 10^{-3} \text{ M} \]

12. You make up 1000 ml of a buffer containing 300 ml citric acid and 700 ml disodium phosphate (Na₂PO₄). If the citric acid stock solution is 0.15 M and the Na₂PO₄ stock solution is 0.35 M, what are the working concentrations of these two components in the buffer?

\[ \text{Citric acid} = (300 \text{ ml}/1000 \text{ ml}) \times 0.15 \text{ M} = 0.045 \text{ M} \text{ or } 4.5 \times 10^{-2} \text{ M} \]

\[ \text{Na₂PO₄} = (700 \text{ ml}/1000 \text{ ml}) \times 0.35 \text{ M} = 0.245 \text{ M} \text{ or } 2.45 \times 10^{-1} \text{ M} \]

13. You prepare a crude extract of alpha amylase from 2.7 g of germinated barley seed in 10 ml of buffer solution. What is the extract concentration in terms of milligrams of tissue extracted per milliliter of buffer?

\[ 2.7 \text{ g} / 10 \text{ ml} = 0.27 \text{ g/ml or 270 mg/ml} \]

14. You use 0.5 ml of the extract prepared in # 13 in a total reaction volume of 6 ml. What is the working concentration of the extract in the reaction?

\[ (0.5 \text{ ml})(270 \text{ mg/ml})/6 \text{ ml} = 22.5 \text{ mg/ml} \]

15. In a plate count analysis of \( E. \text{ coli} \) cell density in a water sample you find 57 colonies on an LB agar plate inoculated with 100 ul of \( 10^{-4} \) diluted water sample. What is the cell density (#cells/ml) of \( E. \text{ coli} \) in the water sample?

\[ \text{Given: 1 colony arises from 1 cell} \]

\[ (57 \text{ cells/100 ul}) \times 10 = 570 \text{ cells/ml in the } 10^{-4} \text{ dilution} \quad \text{(this normalizes to cells/ml)} \]

\[ 570 \text{ cells/ml} \times 10^4 = 5.7 \times 10^6 \text{ cells/ml} = \text{the original cell density in the water sample}. \]