

Question 6: Short Answer

4 points

(a) For the correct answer: 1 point
525 nm

(b)(i) For the correct answer: 1 point
92.0 mL

(ii) For the correct calculated value: 1 point

$$V_1 = \frac{M_2 V_2}{M_1} = \frac{(1.68 \times 10^{-3} M)(100.0 \text{ mL})}{(2.40 \times 10^{-3} M)} = 70.0 \text{ mL}$$

Total for part (b) 2 points

(c) For the correct answer and a valid justification: 1 point

The student could have improperly executed step 3. If the cuvette was not rinsed with the standard solution prior to being filled for the measurement of absorbance, the standard solution would be diluted by the remaining distilled water, and the absorbance would be lower than what it should be.

Total for question 6 4 points

Question 3: Long Answer

10 points

(a) For the correct balanced equation (state symbols not required): 1 point
 $\text{Ba}^{2+}(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{BaSO}_4(s)$

(b) For the correct calculated value of the mass of precipitate (may be implicit): 1 point
 $1.136 \text{ g} - 0.764 \text{ g} = 0.372 \text{ g BaSO}_4$

For the correct calculated value of the number of moles, consistent with mass of precipitate: 1 point

$$0.372 \text{ g} \times \frac{1 \text{ mol}}{233.39 \text{ g}} = 0.00159 \text{ mol}$$

Total for part (b) 2 points

(c) For the correct calculated value, consistent with part (b): 1 point
 $0.00159 \text{ mol BaSO}_4 \times \frac{1 \text{ mol CuSO}_4}{1 \text{ mol BaSO}_4} = 0.00159 \text{ mol CuSO}_4$

$$\frac{0.00159 \text{ mol CuSO}_4}{0.0500 \text{ L}} = 0.0318 \text{ M CuSO}_4 \quad (0.0319 \text{ M if decimals are carried})$$

(d) For the correct calculated value: 1 point

$$M_1 V_1 = M_2 V_2$$

$$V_1 = \frac{(0.0500 \text{ M})(50.00 \text{ mL})}{(0.1000 \text{ M})} = 25.0 \text{ mL}$$

(e) For a correct technique to measure the volume of solution: 1 point

First, measure out the correct volume of 0.1000 M CuSO₄ solution with a 25.0 mL volumetric pipet (graduated cylinder or buret is acceptable).

For a correct technique to dilute the solution to the final volume: 1 point

Transfer the 25.0 mL of solution to a 50.00 mL volumetric flask and dilute the solution with water up to the 50.00 mL mark.

Total for part (e) 2 points

(f) For the correct value (between 0.032 M and 0.038 M): 1 point

Accept one of the following:

- $y = mx = \frac{0.63}{0.1000} x = 6.3x$
- $x = \frac{y}{6.3} = \frac{0.219 \text{ M}}{6.3} = 0.035 \text{ M}$
- Estimated value from the graph within the specified range.*

(g)	For the correct answer: <i>The concentration will be <u>less than</u> that determined in part (f).</i>	1 point
	For a valid justification: <i>The additional water will decrease the concentration of CuSO_4 in the cuvette. Therefore, there will be a decrease in absorbance (according to the Beer-Lambert law). This dilution results in a lower estimated concentration of CuSO_4.</i>	1 point
Total for part (g)		2 points
Total for question 3		10 points