

Begin your response to **QUESTION 3** on this page.

3. A student is given the task of determining the molar concentration of a CuSO_4 solution using two different procedures, precipitation and spectrophotometry.

For the precipitation experiment, the student adds 20.0 mL of 0.200 M $\text{Ba}(\text{NO}_3)_2$ to 50.0 mL of the $\text{CuSO}_4(aq)$. The reaction goes to completion, and a white precipitate forms. The student filters the precipitate and dries it overnight. The data are given in the following table.

Mass of dry filter paper	0.764 g
Volume of $\text{CuSO}_4(aq)$	50.0 mL
Volume of 0.200 M $\text{Ba}(\text{NO}_3)_2$	20.0 mL
Mass of filter paper and dried precipitate	1.136 g

(a) Write a balanced net ionic equation for the precipitation reaction.

(b) Calculate the number of moles of precipitate formed.

(c) Calculate the molarity of the original CuSO_4 solution.

GO ON TO THE NEXT PAGE.

Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

© 2021 College Board.

Visit College Board on the web: collegeboard.org.

Continue your response to **QUESTION 3** on this page.

For the spectrophotometry experiment, the student first makes a standard curve. The student uses a 0.1000 *M* solution of $\text{CuSO}_4(aq)$ to make three more solutions of known concentration (0.0500 *M*, 0.0300 *M*, and 0.0100 *M*) in 50.00 mL volumetric flasks.

(d) Calculate the volume of 0.1000 *M* $\text{CuSO}_4(aq)$ needed to make 50.00 mL of 0.0500 *M* $\text{CuSO}_4(aq)$.

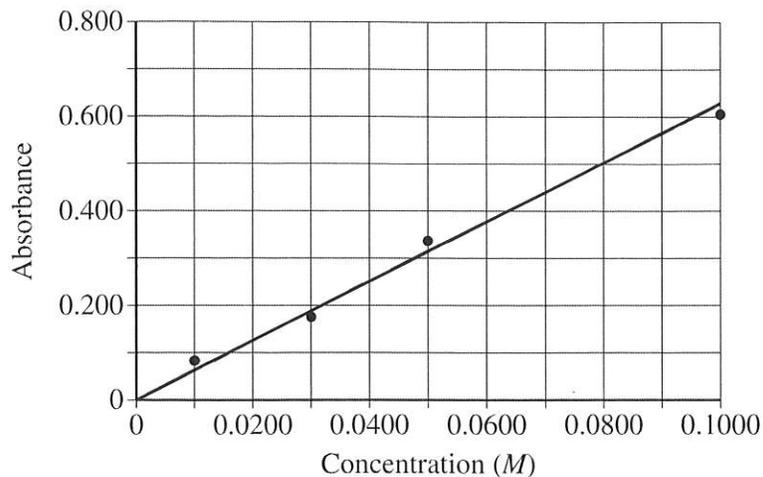
(e) Briefly describe the procedure the student should follow to make 50.00 mL of 0.0500 *M* $\text{CuSO}_4(aq)$ using 0.1000 *M* $\text{CuSO}_4(aq)$, a 50.00 mL volumetric flask, and other standard laboratory equipment. Assume that all appropriate safety precautions will be taken.

GO ON TO THE NEXT PAGE.

Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

Continue your response to **QUESTION 3** on this page.

The standard curve is given below.



(f) The absorbance of the CuSO_4 solution of unknown concentration is 0.219. Determine the molarity of the solution.

(g) A second student performs the same experiment. There are a few drops of water in the cuvette before the second student adds the $\text{CuSO}_4(aq)$ solution of unknown concentration. Will this result in a $\text{CuSO}_4(aq)$ concentration for the unknown that is greater than, less than, or equal to the concentration determined in part (f)? Justify your answer.

GO ON TO THE NEXT PAGE.

Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

© 2021 College Board.

Visit College Board on the web: collegeboard.org.