NTI Day 9 Assignment
Content: ACT Prep 2 – Research Summaries
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When a chemical reaction takes place, the heat content of the reaction changes depending on whether the heat is absorbed or released by the reaction. The heat of the reaction is the change in its heat content, which takes place at a constant pressure. If the heat of the reaction is positive, the reaction is endothermic. If the heat of the reaction is negative, the reaction is exothermic.

A student performed an experiment to study the heat of a reaction. In a beaker, he added solid NaOH to a solution of HCl, without stirring the solution. The pressure was kept constant throughout the experiment. The temperature was recorded after every minute for 13 minutes. Figure 1 represents the change in the temperature of the solution over time. The graph does not begin when the NaOH is added to the solution.

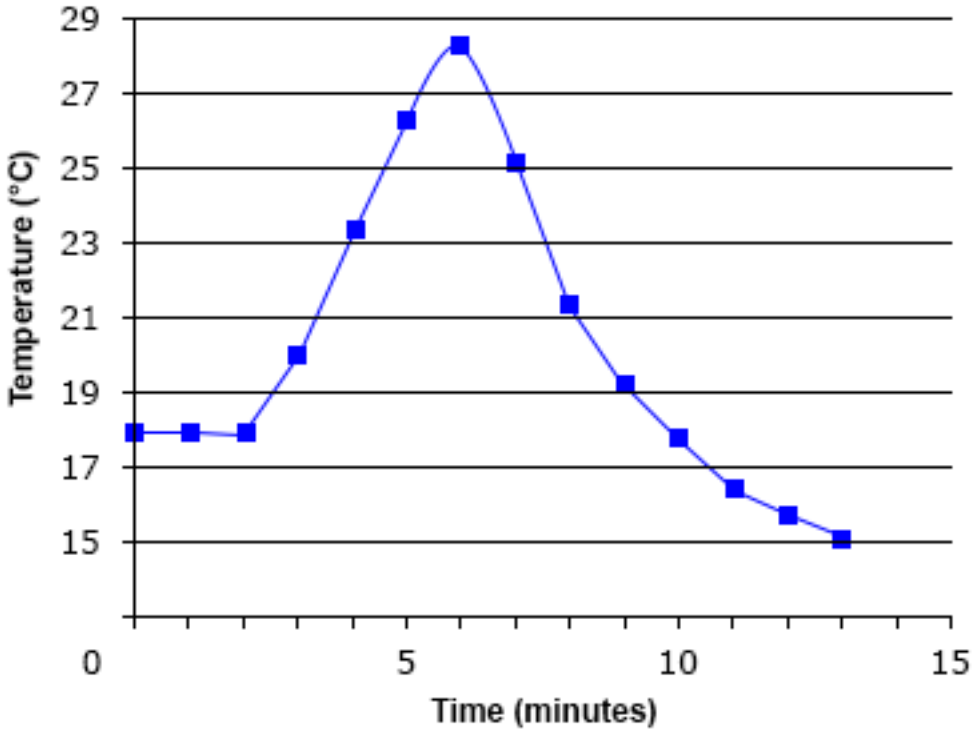

Figure 1

Question 1. At what time on the graph was the solid reactant most likely added to the solution?

- **A.** 10 minutes
- **B.** At the beginning of the graph
- **C.** 6 minutes
- **D.** 2 minutes

An ideal gas is a theoretical or perfect gas that exists based on certain assumptions. The number of molecules in an ideal gas is very large. These molecules spread out in the container where they are stored, and they move in random motion. The collective volume of these molecules is very small compared to the total volume of the gas. In an ideal gas, the molecules do not experience intermolecular attraction. The collisions between the molecules are perfectly elastic, so there is no loss of kinetic energy. The ideal gas can be described using the following variables: absolute pressure (*P*), volume *(V)*, number of moles (n), and absolute temperature (*T*). The relationship between them is represented using the ideal gas law shown below, where R is the universal gas constant.

$$PV = n\mathrm{R}T$$

A real gas does not behave exactly like an ideal gas. However, under certain conditions, the behavior of real gases can be similar to that of an ideal gas.

A scientist measured the volume occupied by one mole of carbon dioxide at various temperatures and pressures. He compared this to the theoretical volume of an ideal gas under the same conditions. The results are shown below.

Table 1

Temperature (°C)	Pressure (kPa)	Molar Volume CO_2 (L/mol)	Molar Volume (ideal, L/mol)	Difference (%)
10	1,000	2.21	2.35	6
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Question 2. What conclusion can be made from this experiment regarding the effects of temperature and pressure on gases other than carbon dioxide?

- **A.** Only the effect of temperature on different gases is related to the results of this experiment.
- **B.** No conclusion can be made because the study does not include high temperatures and low pressures.
- **C.** No conclusion can be made because the study did not compare the effect of temperature and pressure on different gases.
- **D.** Only the effect of pressure on different gases is related to the results of this experiment.

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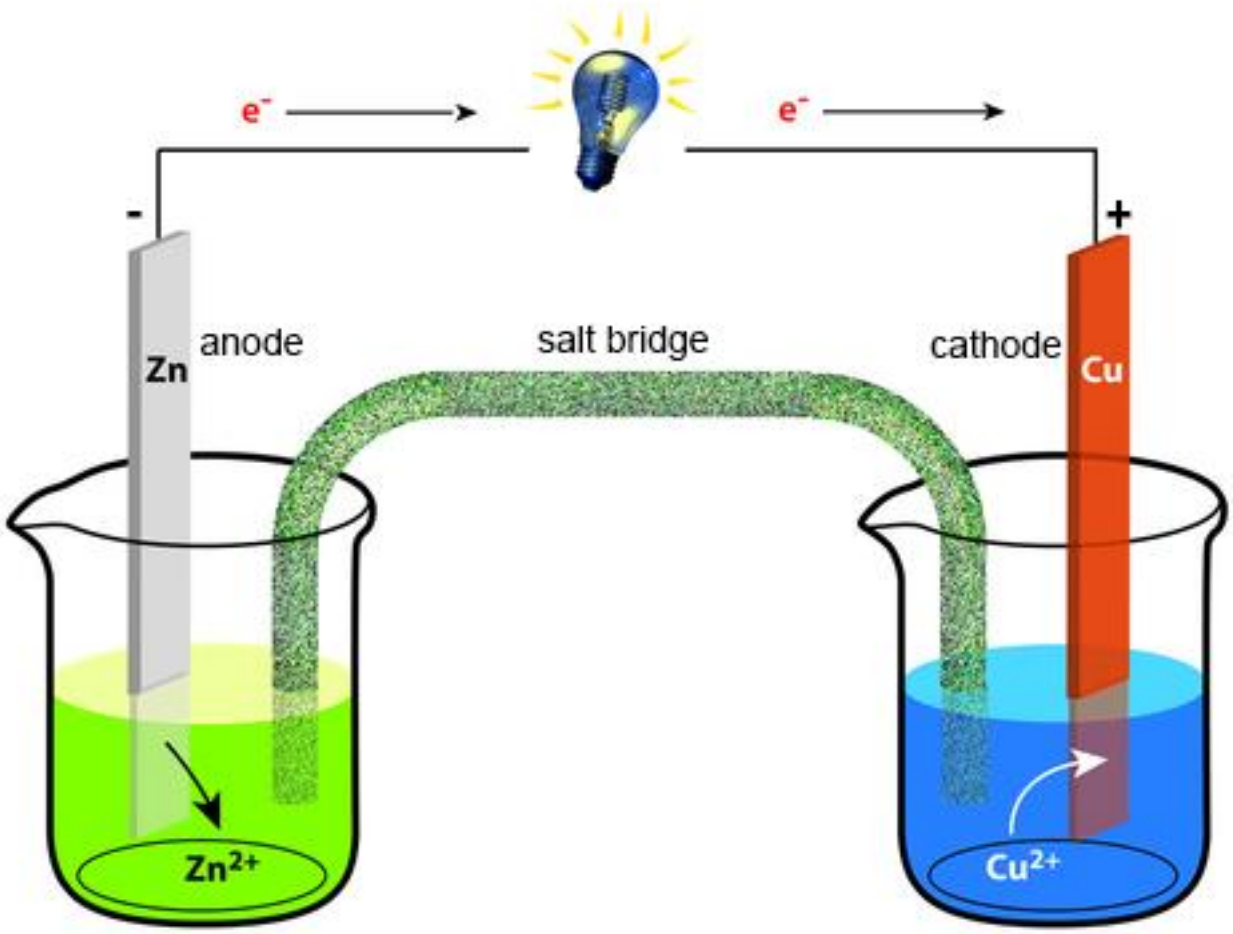
The electric potential produced by a voltaic cell depends on the substances used for the anode and cathode. It also has a slight dependence on the concentrations of the solutions in which the anode and cathode are immersed. The standard cell potential is defined as the electric potential of the cell at 25°C when the concentration of each of the solutes is 1 M. An example of voltaic cell is shown in Figure 1. A strip of zinc is used as an anode, and a copper strip is used as a cathode.



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Concentration (M)		Cell Potential (V)
$ZnSO_4$	$CuSO_4$	
1	1	1.10
0.1	1	1.13
1	0.1	1.07
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0.1	0.01	1.07
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Question 3. According to the data given in the table, the student observed minor changes to the cell potential. Which of the following actions would most likely change the cell potential by a greater amount?

- **A.** Changing the distance between the anode and the cathode
- **B.** Changing the metals used for the anode and cathode
- **C.** Reducing the concentration of each half-cell by 10%
- **D.** Changing the size of the beaker that holds the solution

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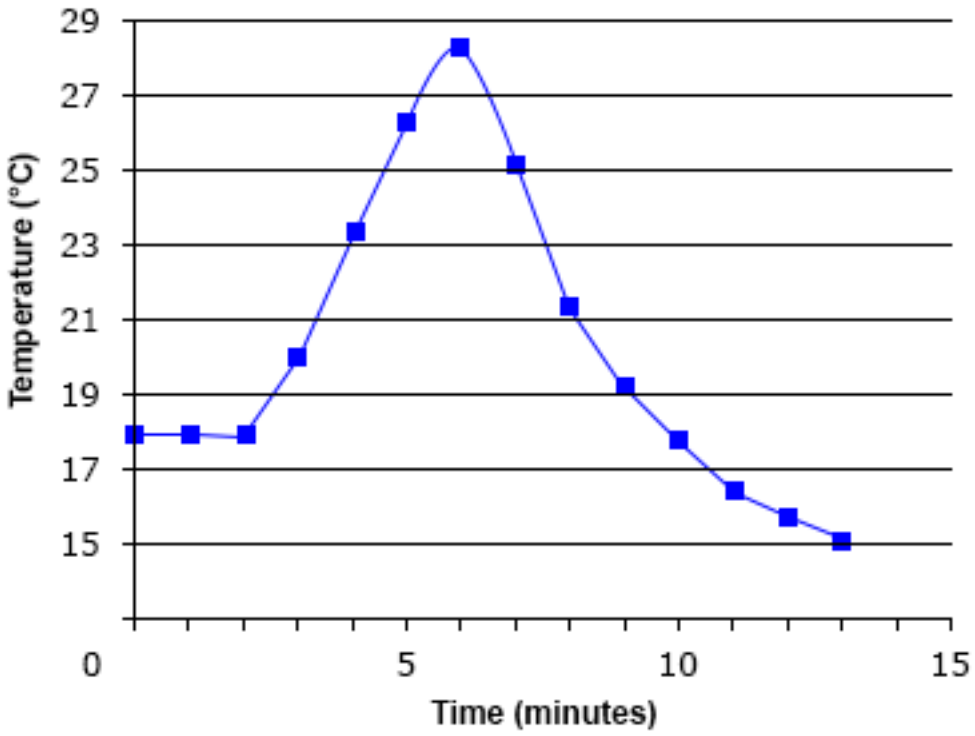

Figure 1

Question 4. Which statement best predicts how the graph would be different if NaOH were added gradually over a period of several minutes?

- ○ **A.** The temperature would increase more slowly, and the peak temperature would remain the same.
- ○ **B.** The temperature would increase more slowly, and the peak temperature would be slightly lower.
- ○ **C.** The temperature would increase faster, and the peak temperature would remain same.
- ○ **D.** The temperature would increase faster, and the peak temperature would be slightly higher.

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Question 5. Which of the following situations would have compromised the significance of the experimental results?

- **A.** During one of the tests, liquid carbon dioxide condensed on the walls of the container.
- **B.** When the temperature was decreased, water condensed on the outside of the container.
- **C.** When the pressure was increased, the molar volume decreased more than the scientist expected.
- **D.** During one of the tests, carbon dioxide behaved less like an ideal gas.

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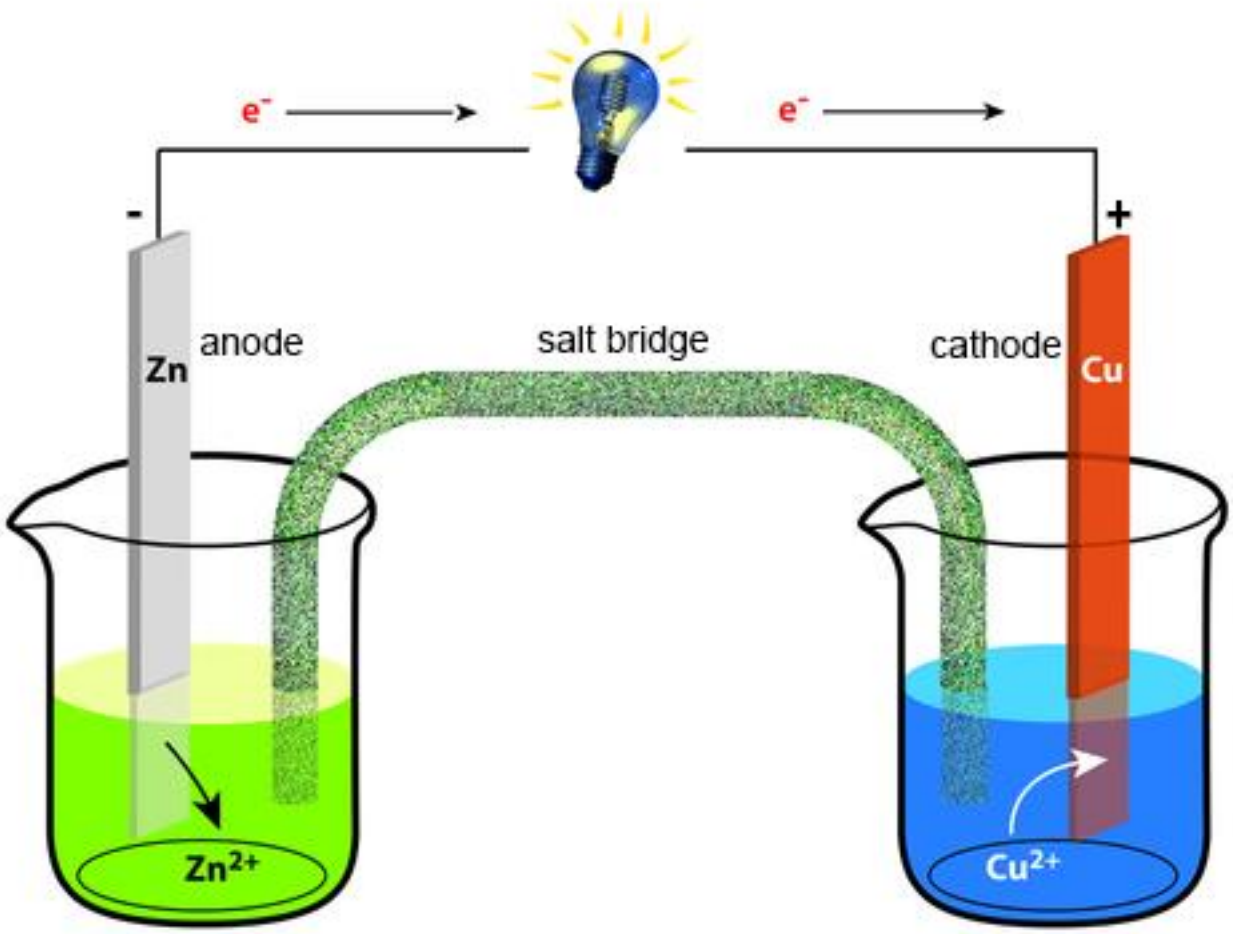

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Question 6. If the concentrations of $ZnSO_4$ and $CuSO_4$ were each changed to 0.2 M, what would the cell potential be?

- **A.** 1.10 V
- **B.** 0.706 V
- **C.** 1.023 V
- **D.** 0.089 V

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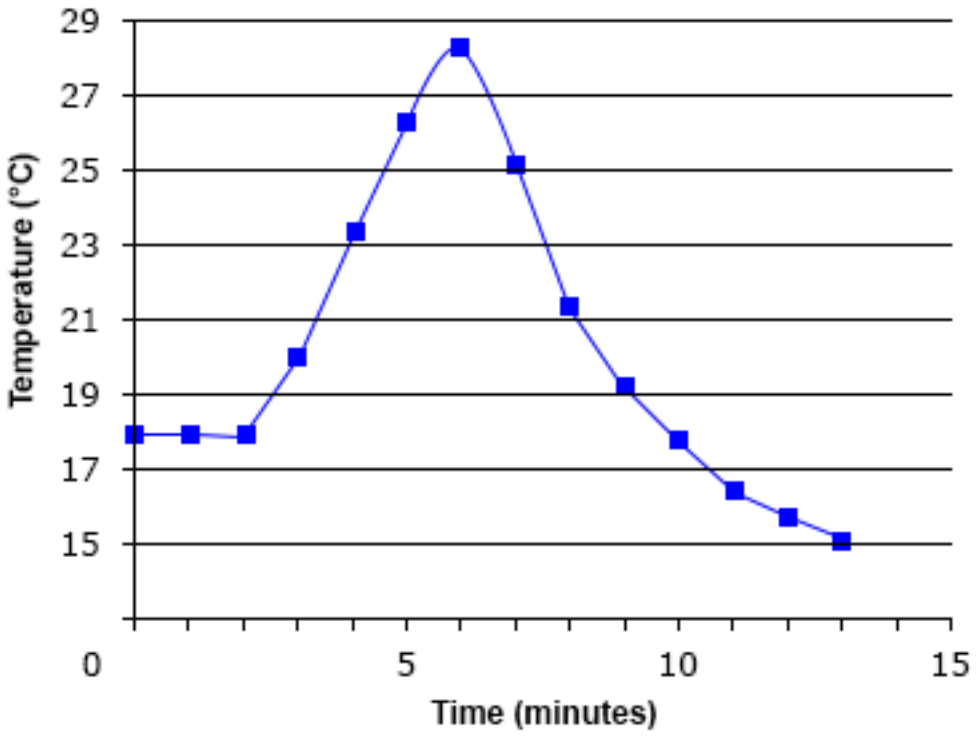

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Question 7. What change to the experimental setup would likely result in less of a decrease in temperature after 6 minutes?

- **A.** Using a more insulated reaction vessel
- **B.** Performing the experiment at room temperature
- **C.** Stirring the solution after it reaches the peak temperature
- **D.** Cooling the solution after it reaches the peak temperature

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Question 8. Based on the data given, which factor had the greatest effect on the behavior of the gas?

- **A.** The type of gas molecules used
- **B.** The increase in temperature
- **C.** The increase in the number of gas molecules
- **D.** The increase in pressure

Question 9. In order for the results to be valid, which of the following must be held constant in all trials?

- **A.** The number of gas molecules
- **B.** The temperature of the gas
- **C.** The pressure of the gas
- **D.** The distance between the gas molecules

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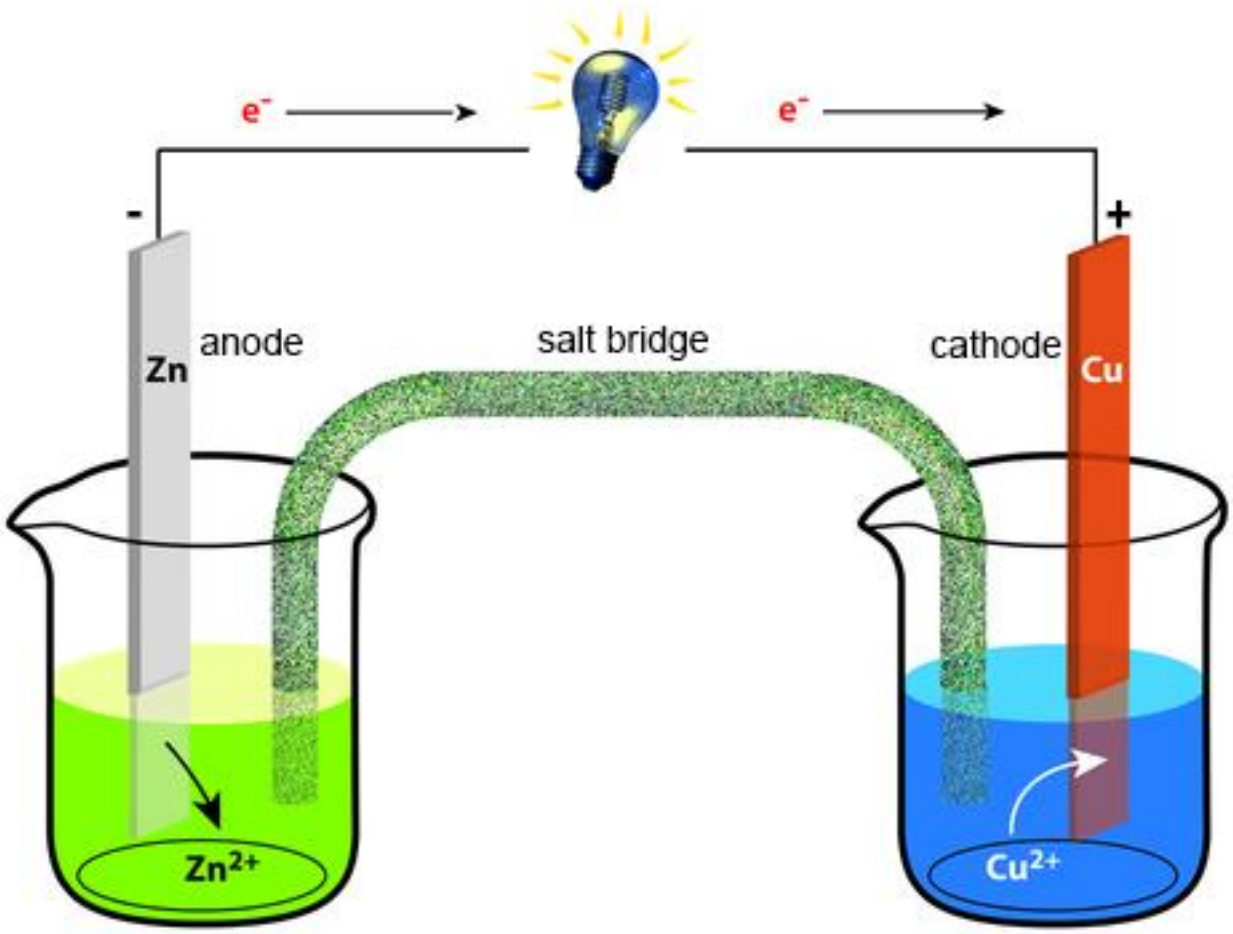

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Question 10. Which of the following statements can be concluded from the given data?

- **A.** The cell potential is the same as the standard cell potential if the concentrations of $ZnSO_4$ and $CuSO_4$ are the same.
- **B.** The cell potential does not change with a change in the concentration of only $ZnSO_4$.
- **C.** The cell potential varies even if the ratios of the concentrations of $ZnSO_4$ and $CuSO_4$ are the same.
- **D.** The cell potential does not change with a change in the concentration of only $CuSO_4$.