

Begin your response to **QUESTION 6** on this page.

6. A student is studying the properties of  $\text{CaSO}_4$  and  $\text{PbSO}_4$ . The student has samples of both compounds, which are white powders.

- (a) The student tests the electrical conductivity of each solid and observes that neither solid conducts electricity. Describe the structures of the solids that account for their inability to conduct electricity.

The student places excess  $\text{CaSO}_4(s)$  in a beaker containing 100 mL of water and places excess  $\text{PbSO}_4(s)$  in another beaker containing 100 mL of water. The student stirs the contents of the beakers and then measures the electrical conductivity of the solution in each beaker. The student observes that the conductivity of the solution in the beaker containing the  $\text{CaSO}_4(s)$  is higher than the conductivity of the solution in the beaker containing the  $\text{PbSO}_4(s)$ .

- (b) Which compound is more soluble in water,  $\text{CaSO}_4(s)$  or  $\text{PbSO}_4(s)$ ? Justify your answer based on the results of the conductivity test.

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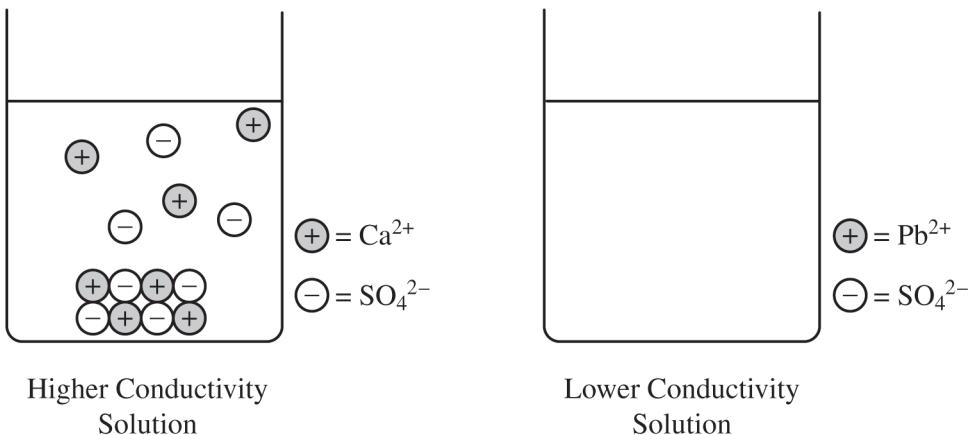
Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

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The left side of the diagram below shows a particulate representation of the contents of the beaker containing the  $\text{CaSO}_4(s)$  from the solution conductivity experiment.



(c) Draw a particulate representation of  $\text{PbSO}_4(s)$  and the ions dissolved in the solution in the beaker on the right in the diagram. Draw the particles to look like those shown to the right of the beaker. Draw an appropriate number of dissolved ions relative to the number of dissolved ions in the beaker on the left.

(d) The student attempts to increase the solubility of  $\text{CaSO}_4(s)$  by adding 10.0 mL of 2 M  $\text{H}_2\text{SO}_4(aq)$  to the beaker, and observes that additional precipitate forms in the beaker. Explain this observation.

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**Question 6: Short Answer****4 points**

- (a)** For a correct description: **1 point**

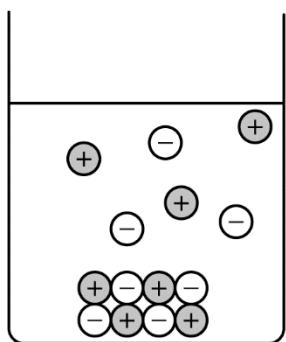
*Ionic solids do not have free-moving ions that are required to carry an electric current. Therefore, there is no conduction of electricity.*

- (b)** For the correct answer and a valid justification: **1 point**

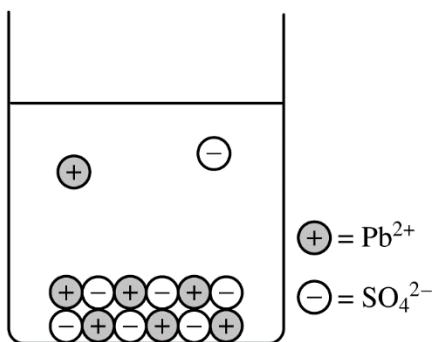
*CaSO<sub>4</sub>. The greater electrical conductivity of the CaSO<sub>4</sub> solution relative to the PbSO<sub>4</sub> solution implies a higher concentration of ions, which comes from the dissolution (dissociation) of CaSO<sub>4</sub> to a greater extent.*

- (c)** For a correct drawing that shows an equal number of cations and anions: **1 point**

*The drawing shows solid PbSO<sub>4</sub> at the bottom of the beaker (similar to the solid shown for CaSO<sub>4</sub>) and fewer dissociated Pb<sup>2+</sup> and SO<sub>4</sub><sup>2-</sup> ions in the solution.*



Higher Conductivity  
Solution



Lower Conductivity  
Solution

- (d)** For a correct explanation: **1 point**

*The additional precipitate is CaSO<sub>4</sub> that forms in response to the increased [SO<sub>4</sub><sup>2-</sup>] in solution. According to Le Chatelier's principle ( $Q > K_{sp}$ ), the introduction of SO<sub>4</sub><sup>2-</sup> as a common ion shifts the equilibrium towards the formation of more CaSO<sub>4</sub>(s).*

**Total for question 6 4 points**