

**Marks**  
**5**

- Nickel metal can be extracted and recycled from mobile phone batteries. This process leads to solutions containing both  $\text{Cu}^{2+}(\text{aq})$  and  $\text{Ni}^{2+}(\text{aq})$  ions. Separation of these ions is achieved by adding tiny amounts of sulfide ions as the metal sulfides have low and very different solubilities:  $K_{\text{sp}}(\text{CuS}) = 8 \times 10^{-34}$  and  $K_{\text{sp}}(\text{NiS}) = 3 \times 10^{-19}$ .

An aqueous solution has  $[\text{Ni}^{2+}(\text{aq})] = 0.0100 \text{ M}$  and an unknown concentration of  $\text{Cu}^{2+}(\text{aq})$  ions.  $\text{S}^{2-}(\text{aq})$  ions are added in small increments.  $\text{CuS}$  begins to precipitate when  $[\text{S}^{2-}(\text{aq})] = 8 \times 10^{-32} \text{ M}$ . What was the original value of  $[\text{Cu}^{2+}(\text{aq})]$ ?

Answer:

At what  $[\text{S}^{2-}(\text{aq})]$  will  $\text{NiS}$  precipitate?

Answer:

If the  $\text{CuS}$  formed is filtered off before any  $\text{NiS}$  precipitates, how pure will the  $\text{NiS}$  precipitate be?

Answer: