4. Find an irreducible polynomial defining the field extension $K = \mathbb{Q}(\sqrt[3]{2}, \sqrt{-3})$ over $\mathbb{Q}$. Is K a normal extension of $\mathbb{Q}$? What is the Galois group for the splitting field of the polynomial defining K over $\mathbb{Q}$?

Please explain your reasoning and solution in as much detail as possible. Thank You.