

$$\textcircled{1} (\sqrt{6}-6)(\sqrt{5}+3)$$

$$\boxed{\sqrt{30} - 6\sqrt{5} + 3\sqrt{6} - 18}$$

$$\textcircled{2} (6 + \sqrt[3]{2})(6 - \sqrt[3]{2})$$

$$(6)^2 - (\sqrt[3]{2})^2$$

$$\boxed{36 - \sqrt[3]{4}}$$

$$\begin{aligned} \textcircled{3} (7 + \sqrt{3})^2 &= a^2 + 2ab + b^2 = 7^2 + 2(7)(\sqrt{3}) + (\sqrt{3})^2 \\ &= 49 + 14\sqrt{3} + 3 \\ &= \boxed{52 + 14\sqrt{3}} \end{aligned}$$

$$\begin{aligned} \textcircled{4} (\sqrt{13} + 5)(\sqrt{13} - 5) &= (\sqrt{13})^2 - (5)^2 \\ &= 13 - 25 = \boxed{-12} \end{aligned}$$

$$\begin{aligned} \textcircled{5} \sqrt{3} \sqrt[3]{4} &= (3^{1/2})(4^{1/3}) = 3^{3/6} 4^{2/6} \\ &= \sqrt[6]{3^3} \sqrt[6]{4^2} \\ &= \sqrt[6]{27 \cdot 16} = \sqrt[6]{432} \end{aligned}$$