The Quartic Formula

$$x=\frac{-3b\pm\left(\sqrt{3\left(3b^2-8ac+2a\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace+\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}+2a\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace-\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}\right)}\pm\sqrt{3\left(3b^2-8ac+2a\left(\frac{-1+\sqrt{-3}}{2}\right)\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace+\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}+2a\left(\frac{-1-\sqrt{-3}}{2}\right)\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace-\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}\right)}\right)\pm\operatorname{sgn}\left(\left(\operatorname{sgn}\left(-b^3+4abc-8a^2d\right)-\frac{1}{2}\right)\left(\operatorname{sgn}\left(\max((2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3,\min(3b^2-8ac,3b^4+16a^2c^2+16a^2bd-16ab^2c-64a^3e))\right)-\frac{1}{2}\right)\right)\sqrt{3\left(3b^2-8ac+2a\left(\frac{-1-\sqrt{-3}}{2}\right)\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace+\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}+2a\left(\frac{-1+\sqrt{-3}}{2}\right)\sqrt[3]{4\left(2c^3-9bcd+27ad^2+27b^2e-72ace-\sqrt{(2c^3-9bcd+27ad^2+27b^2e-72ace)^2-4(c^2-3bd+12ae)^3}\right)}\right)}}{12a}$$

The quartic formula gives the solutions of $ax^4+bx^3+cx^2+dx+e=0$ for real numbers a, b, c, d, e with $a\neq 0$.

Directions: Choose all possibilities for the three $\pm$ signs with the last two equivalent. Use real cube roots if possible, and principal roots otherwise.