Basic Identities:

$$(a+b)^2 = a^2 + b^2 + 2ab$$
$$(a+b)^3 = a^3 + b^3 + 3a^2b + 3ab^2$$
$$(a+b)(a-b) = a^2 - b^2$$

Relation between roots and coefficients of a quadratic equation.

In general we can write a quadratic equation as follows:

$$ax^2 + bx + c = 0 \quad \text{or}$$
$$a\left[x^2 + \frac{b}{a}x + \frac{c}{a}\right] = 0 \quad \ldots\ldots\ldots\ldots \quad (1)$$

If r_1 and r_2 are roots of the above equation, then

$$a(x-r_1)(x-r_2) = 0 \quad \text{Expanding we get}$$

$$a\left[x^2 - r_1x - r_2x + r_1r_2\right] = 0$$

$$a\left[x^2 - (r_1+r_2)x + r_1r_2\right] = 0 \quad \ldots\ldots \quad (2)$$

Comparing (1) & (2) we get

$$\frac{b}{a} = -(r_1+r_2) \quad \text{or} \quad \boxed{r_1 + r_2 = \frac{-b}{a}} \leftarrow \text{SUM OF ROOTS}$$

$$\text{and} \quad \frac{c}{a} = r_1r_2 \qquad \boxed{r_1r_2 = \frac{c}{a}} \leftarrow \text{PRODUCT OF ROOTS}$$

Examples:

$3x^2 - 2x - 4 = 0$

SUM OF ROOTS $= \frac{-(-2)}{3} = \frac{2}{3}$

PRODUCT $= \frac{-4}{3}$

ROOTS ARE $\frac{1}{3} \pm \frac{\sqrt{13}}{3}$

$-2x^2 + x - 1 = 0$

SUM OF ROOTS $= \frac{-1}{-2} = 1/2$

PRODUCT $= \frac{-1}{-2} = 1/2$

COMPLEX ROOTS

$x^2 - 3x + 2 = 0$

SUM $= \frac{-(-3)}{1} = 3$

PRODUCT $= 2$

Roots are: $r_1 = 1$, $r_2 = 2$