**General Expression:-**

$$ax^2 + bx + c = 0 \qquad [a \neq 0]$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

(1) $If\ the\ two\ roots\ of\ a\ quadratic\ equation\ be\ \alpha\ \&\ \beta, then$

(a) $\alpha + \beta = -\frac{b}{a}$

(b) $\alpha\beta = \frac{c}{a}$

(2) **General structure of a quadratic equation:-**

$$x^2 - (Sum\ of\ the\ roots)x + (Product\ of\ the\ roots) = 0$$

(3) $Discriminant,\ D = b^2 - 4ac$

**Case I:- (When D>0 & a square no.)**

$The\ roots\ will\ be\ real, rational\ \&\ unequal$

**Case II:- (When D>0 but not a square no.)**

$The\ roots\ will\ be\ real, irrational\ \&\ unequal$

**Case III:- (When D=0)**

$The\ roots\ will\ be\ real\ \&\ equal$

**Case IV:- (When D<0)**

$The\ roots\ will\ be\ imaginary$

(4) $If\ a, b, c\ are\ real\ \&\ a\ root\ of\ equation\ (i)\ be\ \alpha + i\beta, then\ the\ other\ root\ will\ be\ \alpha - i\beta\ and\ vice-versa\ (where\ \alpha, \beta\ real).$

(5) $If\ a, b, c\ are\ rational\ \&\ a\ root\ of\ equation\ (i)\ be\ p + \sqrt{q}, then\ the\ other\ root\ will\ be\ p - \sqrt{q}\ \&\ vice-versa\ (where\ p, q\ real).$

(6) $The\ two\ roots\ will\ be\ common\ of\ two\ quadratic\ equation\ ax^2 + bx + c = 0\ \&\ a_1x^2 + b_1x + c_1 = 0$

$iff\ \frac{a}{a_1} = \frac{b}{b_1} = \frac{c}{c_1}.$

(7) $The\ two\ quadratic\ equations\ ax^2 + bx + c = 0\ \&\ a_1x^2 + b_1x + c_1 = 0\ will\ have\ exactly\ one\ common$

$root\ iff$

$(a_1c - ac_1)^2 = (ab_1 - a_1b)(bc_1 - b_1c)\ \&\ \frac{b}{a} \neq \frac{b_1}{a_1}\ or\ \frac{c}{a} \neq \frac{c_1}{a_1}.$

# Permutation

(1) $n! = n(n-1)(n-2)(n-3) \ldots \ldots \ldots 3.2.1$

(2) $0! = 1$

(3) ${}^n_rP = \frac{n!}{(n-r)!} = No. of\ permutations\ of\ n\ dissimilar\ things\ taken\ r\ at\ a\ time$

(4) $\frac{n!}{p!q!r!} = The\ permutation\ of\ n\ things\ in\ which\ p\ of\ them\ to\ be\ a, q\ of\ them\ to\ be\ b, r\ of\ them$

$to\ be\ c, and\ the\ rest\ to\ be\ unlike.$

(5) $n^r = The\ no. of\ permutations\ of\ n\ different\ things\ taken\ r\ at\ a\ time, each\ thing\ may\ be\ repeated$

$once, twice, \ldots..upto\ r\ times\ in\ any\ arrangement.$