

## Biquadratic Equation.

If  $\alpha, \beta, \gamma, \delta$  are roots of the biquadratic equation  $ax^4 + bx^3 + cx^2 + dx + e = 0$ , then

$$S_1 = \alpha + \beta + \gamma + \delta = -b/a, \quad S_2 = \alpha.\beta + \alpha.\gamma + \alpha.\delta + \beta.\gamma + \beta.\delta + \gamma.\delta = (-1)^2 \frac{c}{a} = \frac{c}{a}$$

$$\text{or } S_2 = (\alpha + \beta)(\gamma + \delta) + \alpha\beta + \gamma\delta = c/a, \quad S_3 = \alpha\beta\gamma + \beta\gamma\delta + \gamma\delta\alpha + \alpha\beta\delta = (-1)^3 \frac{d}{a} = -d/a$$

$$\text{or } S_3 = \alpha\beta(\gamma + \delta) + \gamma\delta(\alpha + \beta) = -d/a \quad \text{and} \quad S_4 = \alpha.\beta.\gamma.\delta = (-1)^4 \frac{e}{a} = \frac{e}{a}$$