Q) **Write the second degree polynomials given below as the product of two first degree polynomials. Find also the solutions of the equation p(x) = 0 in each.**

1. $p(x) = x^2 + 7x + 12$
2. $p(x) = x^2 - 8x + 12$
3. $p(x) = x^2 + 13x + 12$
4. $p(x) = x^2 + 12x - 13$

1. $p(x) = x^2 + 7x + 12$

If $x^2 + 7x + 12 = (x + a)(x + b)$

$x^2 + 7x + 12 = x^2 + (a + b)x + ab$

Then $a + b = 7$ .... (1)

$ab = 12$

$(a - b)^2 = (a + b)^2 - 4ab = 49 - 48 = 1$

$a - b = \sqrt{1} = 1$ .... (2)

(1) + (2), $2a = 8$, $a = 4$

From (1) $4 + b = 7$

$b = 7 - 4 = 3$

$\therefore x^2 + 7x + 12 = (x + 4)(x + 3)$

Solutions of $x^2 + 7x + 12 = 0$ are -4 and -3.

2. $p(x) = x^2 - 8x + 12$

If $x^2 - 8x + 12 = (x + a)(x + b)$

$x^2 - 8x + 12 = x^2 + (a + b)x + ab$

Then $a + b = -8$ .... (1)

$ab = 12$

$(a - b)^2 = (a + b)^2 - 4ab$

$= 64 - 48 = 16$

$a - b = \sqrt{16} = 4$ ..... (2)

(1) + (2), $2a = -4$, $a = -2$

From (1), $-2 + b = -8$

$b = -8 + 2 = -6$

$\therefore x^2 - 8x + 12 = (x - 2)(x - 6)$

Solutions of $x^2 - 8x + 12 = 0$ are 2 and 6.

3. $p(x) = x^2 + 13x + 12$

If $x^2 + 13x + 12 = (x + a)(x + b)$

$x^2 + 13x + 12 = x^2 + (a + b)x + ab$

Then $a + b = 13$ ..... (1)

$ab = 12$

$(a - b)^2 = (a + b)^2 - 4ab = 169 - 48 = 121$

$a - b = \sqrt{121} = 11$ ..... (2)

(1) + (2), $2a = 24$, $a = 12$

From (1), $12 + b = 13$

$b = 13 - 12 = 1$

$\therefore x^2 + 13x + 12 = (x + 12)(x + 1)$

Solutions of $x^2 + 13x + 12 = 0$ are -12 and -1.

4. $p(x) = x^2 + 12x - 13$

If $x^2 + 12x - 13 = (x + a)(x + b)$

$x^2 + 12x - 13 = x^2 + (a + b)x + ab$

Then $a + b = 12$ ..... (1)

$ab = -13$ ...... (2)

$(a - b)^2 = (a + b)^2 - 4ab = 12^2 - 4 \times (-13)$

$= 144 + 52 = 196$

$a - b = \sqrt{196} = 14$ ..... (3)

(1) + (3), $2a = 26$, $a = 26 \div 2 = 13$

From (1) $13 + b = 12$, $b = 12 - 13 = -1$

$\therefore x^2 + 12x - 13 = (x + 13)(x - 1)$

Solutions of $x^2 + 12x - 13 = 0$ are -13 and 1.