

Chapter 6. Quadratic Equations

Ex 6.1

Answer 1.

$$(x-8)(x+6) = 0$$

$$(x-8)=0 \text{ or } (x+6)=0$$

$$x=8 \text{ or } x=-6$$

Answer 2.

$$(2x+3)(3x-7) = 0$$

$$\Rightarrow (2x+3) = 0, (3x-7) = 0$$

$$\Rightarrow 2x = -3, 3x = 7$$

$$\Rightarrow x = -\frac{3}{2}, x = \frac{7}{3}$$

Answer 3.

$$4x^2 + 16x = 0$$

$$4x(x+4) = 0$$

$$4x = 0, (x+4) = 0$$

$$x = 0, x = -4$$

Answer 4.

$$2x^2 - 3x - 9 = 0$$

$$x^2 - \frac{3}{2}x - \frac{9}{2} = 0$$

$$x^2 - 3x + \frac{3}{2}x - \frac{9}{2} = 0$$

$$x(x-3) + \frac{3}{2}(x-3) = 0$$

$$(x-3)(x + \frac{3}{2}) = 0$$

$$(x-3) = 0, (x + \frac{3}{2}) = 0$$

$$x = 3, x = -\frac{3}{2}$$

Answer 5.

$$2x^2 - x - 6 = 0$$

$$x^2 - \frac{1}{2}x - 3 = 0$$

$$x^2 - 2x + \frac{3}{2}x - 3 = 0$$

$$x(x - 2) + \frac{3}{2}(x - 2) = 0$$

$$(x - 2)(x + \frac{3}{2}) = 0$$

$$(x - 2) = 0, (x + \frac{3}{2}) = 0$$

$$x = 2, x = -\frac{3}{2}$$

Answer 6.

$$5x^2 - 11x + 2 = 0$$

$$5x^2 - 10x - x + 2 = 0$$

$$5x(x - 2) - 1(x - 2) = 0$$

$$(x - 2)(5x - 1) = 0$$

$$(x - 2) = 0, (5x - 1) = 0$$

$$x = 2, x = \frac{1}{5}$$

Answer 7.

$$4x^2 - 13x - 12 = 0$$

$$x^2 - \frac{13}{4}x - 3 = 0$$

$$x^2 - 4x + \frac{3}{4}x - 3 = 0$$

$$x(x - 4) + \frac{3}{4}(x - 4) = 0$$

$$(x - 4)(x + \frac{3}{4}) = 0$$

$$(x - 4) = 0, (x + \frac{3}{4}) = 0$$

$$x = 4, x = -\frac{3}{4}$$

Answer 9.

$$25x(x+1) = -4$$

$$x^2 + x = -\frac{4}{25}$$

$$x^2 + x + \frac{4}{25} = 0$$

$$x^2 + \frac{1}{5}x + \frac{4}{5}x + \frac{4}{25} = 0$$

$$x(x + \frac{1}{5}) + \frac{4}{5}(x + \frac{1}{5}) = 0$$

$$(x + \frac{1}{5})(x + \frac{4}{5}) = 0$$

$$(x + \frac{1}{5}) = 0, (x + \frac{4}{5}) = 0$$

$$x = -\frac{1}{5}, x = -\frac{4}{5}$$

Answer 10.

$$10x - \frac{1}{x} = 3$$

$$10x^2 - 1 = 3x$$

$$10x^2 - 3x - 1 = 0$$

$$x^2 - \frac{3}{10}x - \frac{1}{10} = 0$$

$$x^2 + \frac{1}{5}x - \frac{1}{2}x - \frac{1}{10} = 0$$

$$x(x + \frac{1}{5}) - \frac{1}{2}(x + \frac{1}{5}) = 0$$

$$(x + \frac{1}{5})(x - \frac{1}{2}) = 0$$

$$(x + \frac{1}{5}) = 0, (x - \frac{1}{2}) = 0$$

$$x = -\frac{1}{5}, x = \frac{1}{2}$$

Answer 11.

$$\frac{2}{x^2} - \frac{5}{x} + 2 = 0$$

$$2 - 5x + 2x^2 = 0$$

$$2x^2 - 5x + 2 = 0$$

$$x^2 - \frac{5}{2}x + 1 = 0$$

$$x^2 - 2x - \frac{1}{2}x + 1 = 0$$

$$x(x - 2) - \frac{1}{2}(x - 2) = 0$$

$$(x - 2)(x - \frac{1}{2}) = 0$$

$$(x - 2) = 0, (x - \frac{1}{2}) = 0$$

$$x = 2, x = \frac{1}{2}$$

Answer 12.

$$\sqrt{2}x^2 - 3x - 2\sqrt{2} = 0$$

$$x^2 - \frac{3}{\sqrt{2}}x - 2 = 0$$

$$x^2 + \frac{1}{\sqrt{2}}x - 2\sqrt{2}x - 2 = 0$$

$$x(x + \frac{1}{\sqrt{2}}) - 2\sqrt{2}(x + \frac{1}{\sqrt{2}}) = 0$$

$$(x + \frac{1}{\sqrt{2}})(x - 2\sqrt{2}) = 0$$

$$(x + \frac{1}{\sqrt{2}}) = 0, (x - 2\sqrt{2}) = 0$$

$$x = -\frac{1}{\sqrt{2}}, x = 2\sqrt{2}$$

Answer 13.

$$a^2x^2b - 3abx + 2b^2 = 0$$

$$x^2 - 3\frac{b}{a}x + 2\left(\frac{b}{a}\right)^2 = 0$$

$$x^2 - \frac{b}{a}x - 2\frac{b}{a}x + 2\left(\frac{b}{a}\right)^2 = 0$$

$$x\left(x - \frac{b}{a}\right) - 2\frac{b}{a}\left(x - \frac{b}{a}\right) = 0$$

$$\left(x - \frac{b}{a}\right)\left(x - 2\frac{b}{a}\right) = 0$$

$$\left(x - \frac{b}{a}\right) = 0, \left(x - 2\frac{b}{a}\right) = 0$$

$$x = \frac{b}{a}, x = 2\frac{b}{a}$$

Answer 14.

$$x^2 - (\sqrt{2} + 1)x + \sqrt{2} = 0$$

$$x^2 - x - \sqrt{2}x + \sqrt{2} = 0$$

$$x(x - 1) - \sqrt{2}(x - 1) = 0$$

$$(x - 1)(x - \sqrt{2}) = 0$$

$$(x - 1) = 0, (x - \sqrt{2}) = 0$$

$$x = 1, x = \sqrt{2}$$

Answer 15.

$$x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$$

$$x^2 - x - \sqrt{3}x + \sqrt{3} = 0$$

$$x(x - 1) - \sqrt{3}(x - 1) = 0$$

$$(x - 1)(x - \sqrt{3}) = 0$$

$$(x - 1) = 0, (x - \sqrt{3}) = 0$$

$$x = 1, x = \sqrt{3}$$

Answer 16.

$$4x^2 + 4bx - (a^2 - b^2) = 0$$

$$x^2 + bx - \frac{(a^2 - b^2)}{4} = 0$$

$$x^2 + \frac{(a+b)}{2}x - \frac{(a-b)}{2}x - \frac{(a^2 - b^2)}{4} = 0$$

$$x\left\{x + \frac{(a+b)}{2}\right\} - \frac{(a-b)}{2}\left\{x + \frac{(a+b)}{2}\right\} = 0$$

$$\left\{x + \frac{(a+b)}{2}\right\}\left\{x - \frac{(a-b)}{2}\right\} = 0$$

$$\left\{x + \frac{(a+b)}{2}\right\} = 0, \left\{x - \frac{(a-b)}{2}\right\} = 0$$

$$x = -\frac{(a+b)}{2}, x = \frac{(a-b)}{2}$$

Answer 17.

$$ax^2 + (4a^2 - 3b)x - 12ab = 0$$

$$x^2 + 4ax - 3\frac{b}{a}x - 12b = 0$$

$$x(x + 4a) - 3\frac{b}{a}(x + 4a) = 0$$

$$(x + 4a)\left(x - 3\frac{b}{a}\right) = 0$$

$$x = -4a, x = 3\frac{b}{a}$$

Answer 18.

$$\left(x - \frac{1}{2}\right)^2 = 4$$

$$x^2 - x + \frac{1}{4} = 4$$

$$x^2 - x - \frac{15}{4} = 0$$

$$x^2 + \frac{3}{2}x - \frac{5}{2}x - \frac{15}{4} = 0$$

$$x\left(x + \frac{3}{2}\right) - \frac{5}{2}\left(x + \frac{3}{2}\right) = 0$$

$$\left(x + \frac{3}{2}\right)\left(x - \frac{5}{2}\right) = 0$$

$$x = -\frac{3}{2}, x = \frac{5}{2}$$

Answer 19.

$$x^2 - 4\sqrt{2}x + 6 = 0$$

$$x^2 - \sqrt{2}x - 3\sqrt{2}x + 6 = 0$$

$$x(x - \sqrt{2}) - 3\sqrt{2}(x - \sqrt{2}) = 0$$

$$(x - \sqrt{2})(x - 3\sqrt{2}) = 0$$

$$(x - \sqrt{2}) = 0, (x - 3\sqrt{2}) = 0$$

$$x = \sqrt{2}, x = 3\sqrt{2}$$

Answer 20.

$$\frac{x+3}{x+2} = \frac{3x-7}{2x-3}$$

$$(x+3)(2x-3) = (3x-7)(x+2)$$

$$2x^2 + 6x - 3x - 9 = 3x^2 - 7x + 6x - 14$$

$$2x^2 + 3x - 9 = 3x^2 - x - 14$$

$$(3-2)x^2 + (-1-3)x + (-14+9) = 0$$

$$x^2 - 4x - 5 = 0$$

$$x^2 + x - 5x - 5 = 0$$

$$x(x+1) - 5(x+1) = 0$$

$$(x+1)(x-5) = 0$$

$$(x+1) = 0, (x-5) = 0$$

$$x = -1, x = 5$$

Answer 21.

$$\frac{2x}{x-4} + \frac{2x-5}{x-3} = \frac{25}{3}$$

$$\frac{6x}{x-4} + \frac{6x-15}{x-3} = 25$$

$$6x(x-3) + (6x-15)(x-4) = 25(x-4)(x-3)$$

$$6x^2 - 18x + 6x^2 - 15x - 24x + 60 = 25(x^2 - 4x - 3x + 12)$$

$$12x^2 - 57x + 60 = 25x^2 - 175x + 300$$

$$13x^2 - 118x + 240 = 0$$

$$x^2 - \frac{118}{13}x + \frac{240}{13} = 0$$

$$x^2 - 6x - \frac{40}{13}x + \frac{240}{13} = 0$$

$$x(x-6) - \frac{40}{13}(x-6) = 0$$

$$(x-6)(x - \frac{40}{13}) = 0$$

$$x = 6, x = \frac{40}{13}$$

Answer 22.

$$\frac{x+3}{x-2} - \frac{1-x}{x} = \frac{17}{4}$$

$$\frac{4x+12}{x-2} - \frac{4-4x}{x} = 17$$

$$x(4x+12) - (4-4x)(x-2) = 17x(x-2)$$

$$4x^2 + 12x - (4x - 4x^2 - 8 + 8x) = 17x^2 - 34x$$

$$4x^2 + 12x - 4x + 4x^2 + 8 - 8x = 17x^2 - 34x$$

$$8x^2 + 8 = 17x^2 - 34x$$

$$9x^2 - 34x - 8 = 0$$

$$x^2 - \frac{34}{9}x - \frac{8}{9} = 0$$

$$x^2 - 4x + \frac{2}{9}x - \frac{8}{9} = 0$$

$$x(x-4) + \frac{2}{9}(x-4) = 0$$

$$(x-4)(x + \frac{2}{9}) = 0$$

$$x = 4, x = -\frac{2}{9}$$

Answer 23.

$$\frac{1}{x-2} + \frac{2}{x-1} = \frac{6}{x}$$

$$\frac{(x-1)+2(x-2)}{(x-2)(x-1)} = \frac{6}{x}$$

$$x(x-1) + 2x(x-2) = 6(x-2)(x-1)$$

$$x^2 - x + 2x^2 - 4x = 6(x^2 - 2x - x + 2)$$

$$3x^2 - 5x = 6x^2 - 18x + 12$$

$$3x^2 - 13x + 12 = 0$$

$$x^2 - \frac{13}{3}x + 4 = 0$$

$$x^2 - 3x - \frac{4}{3}x + 4 = 0$$

$$x(x-3) - \frac{4}{3}(x-3) = 0$$

$$(x-3)(x - \frac{4}{3}) = 0$$

$$x = 3, x = \frac{4}{3}$$

Answer 24.

$$\frac{x+1}{x-1} - \frac{x-1}{x+1} = \frac{5}{6}$$

$$\frac{(x+1)^2 - (x-1)^2}{(x-1)(x+1)} = \frac{5}{6}$$

$$\frac{x^2 + 2x + 1 - (x^2 - 2x + 1)}{x^2 - x + x - 1} = \frac{5}{6}$$

$$\frac{x^2 + 2x + 1 - x^2 + 2x - 1}{x^2 - 1} = \frac{5}{6}$$

$$6(4x) = 5(x^2 - 1)$$

$$24x = 5x^2 - 5$$

$$5x^2 - 24x - 5 = 0$$

$$x^2 - \frac{24}{5}x - 1 = 0$$

$$x^2 + \frac{1}{5}x - 5x - 1 = 0$$

$$x(x + \frac{1}{5}) - 5(x + \frac{1}{5}) = 0$$

$$(x + \frac{1}{5})(x - 5) = 0$$

$$x = 5, x = -\frac{1}{5}$$

Answer 25.

$$\frac{x-1}{2x+1} + \frac{2x+1}{x-1} = \frac{5}{2}$$

$$\frac{(x-1)^2 + (2x+1)^2}{(2x+1)(x-1)} = \frac{5}{2}$$

$$\frac{(x^2 - 2x + 1) + (4x^2 + 4x + 1)}{2x^2 + x - 2x - 1} = \frac{5}{2}$$

$$\frac{5x^2 + 2x + 2}{2x^2 - x - 1} = \frac{5}{2}$$

$$10x^2 + 4x + 4 = 10x^2 - 5x - 5$$

$$-9x - 9 = 0$$

$$x + 1 = 0$$

$$x = -1$$

Answer 26.

$$\frac{m}{n}x^2 + \frac{n}{m} = 1 - 2x$$

Multiply by mn

$$m^2x^2 + n^2 = mn - 2mnx$$

$$m^2x^2 + 2mnx + n^2 = mn$$

$$(mx + n)^2 = mn$$

$$mx + n = \pm\sqrt{mn}$$

$$mx = -n \pm \sqrt{mn}$$

$$x = \frac{-n \pm \sqrt{mn}}{m}$$

Answer 27.

$$\frac{1}{(x-1)(x-2)} + \frac{1}{(x-2)(x-3)} + \frac{1}{(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{(x-3)(x-4) + (x-1)(x-4) + (x-1)(x-2)}{(x-1)(x-2)(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{x^2 - 3x - 4x + 12 + x^2 - x - 4x + 4 + x^2 - x - 2x + 2}{(x-1)(x-2)(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{3x^2 - 15x + 18}{(x-1)(x-2)(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{3(x^2 - 5x + 6)}{(x-1)(x-2)(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{3(x-3)(x-2)}{(x-1)(x-2)(x-3)(x-4)} = \frac{1}{6}$$

$$\frac{3}{(x-1)(x-4)} = \frac{1}{6}$$

$$x^2 - 5x + 4 = 18$$

$$x^2 - 5x - 14 = 0$$

$$x^2 + 2x - 7x - 14 = 0$$

$$x(x+2) - 7(x+2) = 0$$

$$(x+2)(x-7) = 0$$

$$x = -2, x = 7$$

Answer 28.

$$7x + \frac{3}{x} = 35\frac{3}{5}$$

$$7x^2 + 3 = \frac{178}{5}x$$

$$7x^2 - \frac{178}{5}x + 3 = 0$$

$$x^2 - \frac{178}{35}x + \frac{3}{7} = 0$$

$$x^2 - 5x - \frac{3}{35}x + \frac{3}{7} = 0$$

$$x(x - 5) - \frac{3}{35}(x - 5) = 0$$

$$(x - 5)(x - \frac{3}{35}) = 0$$

$$x = 5, x = \frac{3}{35}$$

Answer 29.

$$\frac{a}{x-a} + \frac{b}{x-b} = \frac{2c}{x-c}$$

$$\frac{a(x-b) + b(x-a)}{(x-a)(x-b)} = \frac{2c}{x-c}$$

$$\frac{ax - ab + bx - ab}{x^2 - ax - bx + ab} = \frac{2c}{x-c}$$

$$\frac{(a+b)x - 2ab}{x^2 - (a+b)x + ab} = \frac{2c}{x-c}$$

$$\{(a+b)x - 2ab\}(x-c) = 2c\{x^2 - (a+b)x + ab\}$$

$$(a+b)x^2 - 2abx - c(a+b)x + 2abc = 2cx^2 - 2c(a+b)x + 2abc$$

$$(a+b)x^2 - [2ab + c(a+b)]x + 2abc = 2cx^2 - 2c(a+b)x + 2abc$$

$$(a+b-2c)x^2 = (2ab + ac + bc - 2ca - 2bc)x$$

$$(a+b-2c)x^2 = (2ab - ac - bc)x$$

$$x = 0, x = \frac{(2ab - ac - bc)}{(a+b-2c)}$$

Answer 30.

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

$$x^2 + 2ab = 2ax + bx$$

$$x^2 - 2ax - bx + 2ab = 0$$

$$x(x - 2a) - b(x - 2a) = 0$$

$$(x - 2a)(x - b) = 0$$

$$x = 2a, x = b$$

Answer 31.

$$(a + b)^2 x^2 - 4abx - (a - b)^2 = 0$$

$$(a + b)^2 x^2 - [(a + b)^2 - (a - b)^2]x - (a - b)^2 = 0$$

$$(a + b)^2 x^2 - (a + b)^2 x + (a - b)^2 x - (a - b)^2 = 0$$

$$\{(a + b)^2 x\}(x - 1) + \{(a - b)^2\}(x - 1) = 0$$

$$(x - 1)[(a + b)^2 x + (a - b)^2] = 0$$

$$x = 1, x = -\frac{(a - b)^2}{(a + b)^2} = -\frac{(a - b)}{(a + b)}$$

Answer 32.

$$a(x^2 + 1) - x(a^2 + 1) = 0$$

$$ax^2 + a - a^2x - x = 0$$

$$x^2 + 1 - ax - \frac{1}{a}x = 0$$

$$x^2 - ax - \frac{1}{a}x + 1 = 0$$

$$x(x - a) - \frac{1}{a}(x - a) = 0$$

$$(x - a)(x - \frac{1}{a}) = 0$$

$$x = a, x = \frac{1}{a}$$

Answer 33.

$$x^2 - x - a(a+1) = 0$$

$$x^2 + ax - (a+1)x - a(a+1) = 0$$

$$x(x+a) - (a+1)\{(x+a)\} = 0$$

$$(x+a)\{x - (a+1)\} = 0$$

$$x = -a, x = (a+1)$$

Answer 34.

$$x^2 + \left(a + \frac{1}{a}\right)x + 1 = 0$$

$$x^2 + ax + \frac{1}{a}x + 1 = 0$$

$$x(x+a) + \frac{1}{a}(x+a) = 0$$

$$(x+a)\left(x + \frac{1}{a}\right) = 0$$

$$x = -a, x = -\frac{1}{a}$$

Answer 35.

$$abx^2 + (b^2 - ac)x - bc = 0$$

$$abx^2 + b^2x - acx - bc = 0$$

$$bx(ax+b) - c(ax+b) = 0$$

$$(ax+b)(bx-c) = 0$$

$$x = -\frac{b}{a}, x = \frac{c}{b}$$

Answer 36.

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

$$b^2x(a^2x+1) - 1(a^2x+1) = 0$$

$$(a^2x+1)(b^2x-1) = 0$$

$$x = -\frac{1}{a^2}, x = \frac{1}{b^2}$$

Answer 37.

$$\frac{x-1}{x-2} + \frac{x-3}{x-4} = 3\frac{1}{3}$$

$$\frac{(x-1)(x-4) + (x-3)(x-2)}{(x-2)(x-4)} = \frac{10}{3}$$

$$\frac{x^2 - 5x + 4 + x^2 - 5x + 6}{x^2 - 6x + 8} = \frac{10}{3}$$

$$\frac{2x^2 - 10x + 10}{x^2 - 6x + 8} = \frac{10}{3}$$

$$6x^2 - 30x + 30 = 10x^2 - 60x + 80$$

$$4x^2 - 30x + 50 = 0$$

$$2x^2 - 15x + 25 = 0$$

$$x^2 - \frac{15}{2}x + \frac{25}{2} = 0$$

$$x^2 - 5x - \frac{5}{2}x + \frac{25}{2} = 0$$

$$x(x-5) - \frac{5}{2}(x-5) = 0$$

$$(x-5)(x - \frac{5}{2}) = 0$$

$$x = 5, x = \frac{5}{2}$$

Ex 6.2

Answer 1.

(i) $2x^2 - 5x + 3 = 0$

$$2x^2 - 5x + 3 = 0$$

$$\text{Discriminant} = b^2 - 4ac$$

$$(-5)^2 - 4(2)(3)$$

$$= 25 - 24$$

$$= 1$$

(ii) $x^2 + 2x + 4 = 0$

$$x^2 + 2x + 4 = 0$$

$$\text{Discriminant} = b^2 - 4ac$$

$$= (2)^2 - 4(1)(4)$$

$$= 4 - 16$$

$$= -12$$

(iii) $2x^2 - 3x + 1 = 0$

$$2x^2 - 3x + 1 = 0$$

$$\text{Discriminant} = b^2 - 4ac$$

$$= (-3)^2 - 4(2)(1)$$

$$= 9 - 8$$

$$= 1$$

(iv) $10x - \frac{1}{x} = 3$

$$10x - \frac{1}{x} = 3$$

$$10x^2 - 3x - 1 = 0$$

$$\text{Discriminant} = b^2 - 4ac$$

$$= (-3)^2 - 4(10)(-1)$$

$$= 9 + 40$$

$$= 49$$

(v) $x^2 + 2x - 2 = 0$

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

$$\text{Discriminant} = b^2 - 4ac$$

$$= (2)^2 - 4(1)(-2)$$

$$= 4 + 8$$

$$= 12$$

(vi) $4\sqrt{3}x^2 + 5x - 2\sqrt{3} = 0$

$$4\sqrt{3}x^2 + 5x - 2\sqrt{3} = 0$$

$$\text{Discriminant} = b^2 - 4ac$$

$$= (5)^2 - 4(4\sqrt{3})(-2\sqrt{3})$$

$$= 25 + 96$$

$$= 121$$

Answer 2.

(i) $2x^2 + x - 1 = 0$

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

$$b^2 - 4ac$$

$$= (1)^2 - 4(2)(-1)$$

$$= 1 + 8$$

$$= 9$$

Since 9 is a perfect square and greater than 0, hence the roots are real and rational.

(ii) $x^2 - 4x + 4 = 0$

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

$$b^2 - 4ac$$

$$= (-4)^2 - 4(1)(4)$$

$$= 16 - 16$$

$$= 0$$

Since discriminant is 0, hence the roots are real and equal.

(iii) $x^2 + 3x + 1 = 0$

$$x^2 + 3x + 1 = 0$$

$$b^2 - 4ac$$

$$= (3)^2 - 4(1)(1)$$

$$= 9 - 4$$

$$= 5$$

Since discriminant is positive, hence the roots are real and irrational.

(iv) $4x^2 - 8x + 5 = 0$

$$4x^2 - 8x + 5 = 0$$

$$b^2 - 4ac$$

$$= (-8)^2 - 4(4)(5)$$

$$= 64 - 100$$

$$= -36$$

Since discriminant is negative, hence the roots are imaginary.

(v) $2x^2 + 5x - 6 = 0$

$$2x^2 + 5x - 6 = 0$$

$$b^2 - 4ac$$

$$= (5)^2 - 4(2)(-6)$$

$$= 25 + 48$$

$$= 73$$

Since discriminant is positive, hence the roots are real and irrational.

(vi) $2x^2 - 3x + 4 = 0$

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

$$b^2 - 4ac$$

$$= (-3)^2 - 4(2)(4)$$

$$= 9 - 32$$

$$= -23$$

Since discriminant is negative, hence the roots are imaginary.

$$(vii) (x - 1)(2x - 7) = 0$$

$$(x - 1)(2x - 7) = 0$$

$$2x^2 - 2x - 7x + 7 = 0$$

$$2x^2 - 9x + 7 = 0$$

$$b^2 - 4ac$$

$$= (-9)^2 - 4(2)(7)$$

$$= 81 - 56$$

$$= 25$$

Since discriminant is a perfect square, hence the roots are real and rational.

$$(viii) x^2 - 5x + 7 = 0$$

$$x^2 - 5x + 7 = 0$$

$$b^2 - 4ac$$

$$= (-5)^2 - 4(1)(7)$$

$$= 25 - 28$$

$$= -3$$

Since discriminant is negative, hence the roots are imaginary.

Answer 3.

$$(i) 16x^2 = 24x + 1$$

$$16x^2 = 24x + 1$$

$$16x^2 - 24x - 1 = 0$$

$$x^2 - \frac{3}{2}x - \frac{1}{16} = 0$$

$$a = 1; b = -\frac{3}{2}; c = -\frac{1}{16}$$

$$D = b^2 - 4ac$$

$$= \left(-\frac{3}{2}\right)^2 - 4(1)\left(-\frac{1}{16}\right)$$

$$= \frac{9}{4} + \frac{1}{4}$$

$$= \frac{10}{4}$$

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

$$x = \frac{-(-\frac{3}{2}) \pm \sqrt{\frac{10}{4}}}{2 \times 1}$$

$$x = \frac{3 + \sqrt{10}}{4}, x = \frac{3 - \sqrt{10}}{4}$$

$$(ii) x^2 + 10x - 8 = 0$$

$$x^2 + 10x - 8 = 0$$

$$a = 1; b = 10, c = -8$$

$$D = b^2 - 4ac$$

$$= (10)^2 - 4(1)(-8)$$

$$= 100 + 32$$

$$= 132$$

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

$$x = \frac{-10 \pm \sqrt{132}}{2}$$

$$x = -\frac{10}{2} \pm \sqrt{\frac{132}{4}}$$

$$x = -5 + \sqrt{33}, x = -5 - \sqrt{33}$$

$$(iii) 2x^2 - 2\sqrt{6}x + 3 = 0$$

$$2x^2 - 2\sqrt{6}x + 3 = 0$$

$$a = 2; b = -2\sqrt{6}; c = 3$$

$$D = b^2 - 4ac$$

$$= (-2\sqrt{6})^2 - 4(2)(3)$$

$$= 24 - 24$$

$$= 0$$

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

$$x = \frac{-(-2\sqrt{6}) \pm 0}{2 \times 2}$$

$$x = \frac{\sqrt{6}}{2}$$

$$(iv) 3x^2 + 2\sqrt{5}x - 5 = 0$$

$$3x^2 + 2\sqrt{5}x - 5 = 0$$

$$a = 3; b = 2\sqrt{5}; c = -5$$

$$D = b^2 - 4ac$$

$$= (2\sqrt{5})^2 - 4(3)(-5)$$

$$= 20 + 60$$

$$= 80$$

$$-b \pm \sqrt{b^2 - 4ac}$$

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

$$x = \frac{-(2\sqrt{5}) \pm \sqrt{80}}{6}$$

$$x = \frac{-(2\sqrt{5}) \pm 4\sqrt{5}}{6}$$

$$x = \frac{-2\sqrt{5} + 4\sqrt{5}}{6}, x = \frac{-2\sqrt{5} - 4\sqrt{5}}{6}$$

$$x = \frac{\sqrt{5}}{3}, x = -\sqrt{5}$$

$$(v) 2x^2 + 5\sqrt{3}x + 6 = 0$$

$$2x^2 + 5\sqrt{3}x + 6 = 0$$

$$a = 2; b = 5\sqrt{3}; c = 6$$

$$D = b^2 - 4ac$$

$$D = (5\sqrt{3})^2 - 4(2)(6)$$

$$= 75 - 48$$

$$= 27$$

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

$$x = \frac{-(5\sqrt{3}) \pm 3\sqrt{3}}{4}$$

$$x = \frac{-5\sqrt{3} + 3\sqrt{3}}{4}, x = \frac{-5\sqrt{3} - 3\sqrt{3}}{4}$$

$$x = \frac{-2\sqrt{3}}{4}, x = \frac{-8\sqrt{3}}{4}$$

$$x = -\frac{\sqrt{3}}{2}, x = -2\sqrt{3}$$

$$(vi) \frac{5}{4}x^2 - 2\sqrt{5}x + 4 = 0$$

$$\frac{5}{4}x^2 - 2\sqrt{5}x + 4 = 0$$

$$5x^2 - 8\sqrt{5}x + 16 = 0$$

$$a = 5; b = -8\sqrt{5}; c = 16$$

$$D = b^2 - 4ac$$

$$= (-8\sqrt{5})^2 - 4(5)(16)$$

$$= 40 - 300$$

$$= -260$$

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

$$x = \frac{-(-8\sqrt{5}) \pm \sqrt{-260}}{2 \times 5}$$

$$x = \frac{8\sqrt{5} \pm \sqrt{-260}}{2 \times 5}$$

$$x = \frac{4\sqrt{5}}{5}$$

(Since $\sqrt{-260}$ is not possible)

$$(vii) \quad 3x^2 - 5x + \frac{25}{12} = 0$$

$$3x^2 - 5x + \frac{25}{12} = 0$$

$$a = 3; b = -5; c = \frac{25}{12}$$

$$D = b^2 - 4ac$$

$$= (-5)^2 - 4(3)\left(\frac{25}{12}\right)$$

$$= 25 - 25$$

$$= 0$$

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

$$x = \frac{-(-5) \pm 0}{6}$$

$$x = \frac{5}{6}$$

$$(viii) \quad 4x^2 + 12x + 9 = 0$$

$$4x^2 + 12x + 9 = 0$$

$$a = 4; b = 12; c = 9$$

$$D = b^2 - 4ac$$

$$= (12)^2 - 4(4)(9)$$

$$= 144 - 144$$

$$= 0$$

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

$$x = \frac{-12 \pm 0}{8}$$

$$x = -\frac{3}{2}$$

$$(ix) \quad x^2 - 7x - 5 = 0$$

$$x^2 - 7x - 5 = 0$$

$$a = 1; b = -7; c = -5$$

$$D = b^2 - 4ac$$

$$= (-7)^2 - 4(1)(-5)$$

$$= 49 + 20$$

$$= 69$$

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

$$x = \frac{7 \pm \sqrt{69}}{2}$$

$$x = \frac{7 + \sqrt{69}}{2}, x = \frac{7 - \sqrt{69}}{2}$$

$$(x) \quad x^2 - 4x - 1 = 0$$

$$x^2 - 4x - 1 = 0$$

$$a = 1; b = -4; c = -1$$

$$D = b^2 - 4ac$$

$$= (-4)^2 - 4(1)(-1)$$

$$= 16 + 4$$

$$= 20$$

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

$$x = \frac{4 \pm \sqrt{20}}{2}$$

$$x = \frac{4 \pm 2\sqrt{5}}{2}$$

$$x = 2 + \sqrt{5}, x = 2 - \sqrt{5}$$

$$(xi) \quad 6x^2 + 7x - 10 = 0$$

$$6x^2 + 7x - 10 = 0$$

$$a = 6; b = 7; c = -10$$

$$D = b^2 - 4ac$$

$$= (7)^2 - 4(6)(-10)$$

$$= 49 + 240$$

$$= 289$$

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

$$x = \frac{-7 \pm \sqrt{289}}{12}$$

$$(xii) \quad x^2 - 6x + 4 = 0$$

$$x^2 - 6x + 4 = 0$$

$$a = 1; b = -6; c = 4$$

$$D = b^2 - 4ac$$

$$= (-6)^2 - 4(1)(4)$$

$$= 36 - 16$$

$$= 20$$

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

$$x = \frac{6 \pm \sqrt{20}}{2}$$

$$x = \frac{6 + 2\sqrt{5}}{2}, x = \frac{6 - 2\sqrt{5}}{2}$$

$$x = 3 + \sqrt{5}, x = 3 - \sqrt{5}$$

$$(xiii) 5x^2 - 19x + 17 = 0$$

$$5x^2 - 19x + 17 = 0$$

$$a = 5; b = -19; c = 17$$

$$D = b^2 - 4ac$$

$$= (-19)^2 - 4(5)(17)$$

$$= 361 - 340$$

$$= 21$$

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

$$x = \frac{19 \pm \sqrt{21}}{10}$$

$$x = \frac{19 + \sqrt{21}}{10}, x = \frac{19 - \sqrt{21}}{10}$$

$$(xiv) 15x^2 - 28 = x$$

$$15x^2 - 28 = x$$

$$15x^2 - x - 28 = 0$$

$$a = 15; b = -1; c = -28$$

$$D = b^2 - 4ac$$

$$= (-1)^2 - 4(15)(-28)$$

$$= 1 + 1680$$

$$= 1681$$

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

$$x = \frac{1 \pm \sqrt{1681}}{30}$$

$$x = \frac{1 + 41}{30}, x = \frac{1 - 41}{30}$$

$$x = \frac{42}{30}, x = \frac{-40}{30}$$

$$x = \frac{7}{5}, x = -\frac{4}{3}$$

$$(xv) 4 - 11x = 3x^2$$

$$4 - 11x = 3x^2$$

$$3x^2 + 11x - 4 = 0$$

$$a = 3; b = 11; c = -4$$

$$a = 3; b = 11; c = -4$$

$$D = b^2 - 4ac$$

$$= (11)^2 - 4(3)(-4)$$

$$= 121 + 48$$

$$= 169$$

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

$$x = \frac{-11 \pm \sqrt{169}}{6}$$

$$x = \frac{-11 + 13}{6}, x = \frac{-11 - 13}{6}$$

$$x = \frac{2}{6}, x = -\frac{24}{6}$$

$$x = \frac{1}{3}, x = -4$$

$$(xvi) 25x^2 + 30x + 7 = 0$$

$$25x^2 + 30x + 7 = 0$$

$$a = 25; b = 30; c = 7$$

$$D = b^2 - 4ac$$

$$= (30)^2 - 4(25)(7)$$

$$= 900 - 700$$

$$= 200$$

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

$$x = \frac{-30 \pm \sqrt{200}}{50}$$

$$x = \frac{-30 + 10\sqrt{2}}{50}, x = \frac{-30 - 10\sqrt{2}}{50}$$

$$x = \frac{-3 + \sqrt{2}}{5}, x = \frac{-3 - \sqrt{2}}{5}$$

$$(xvii) 16x^2 - 24x = 1$$

$$16x^2 - 24x = 1$$

$$16x^2 - 24x - 1 = 0$$

$$a = 16; b = -24; c = -1$$

$$D = b^2 - 4ac$$

$$= (-24)^2 - 4(16)(-1)$$

$$= 576 + 64$$

$$= 640$$

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

$$x = \frac{24 \pm 8\sqrt{10}}{32}$$

$$x = \frac{3 + \sqrt{10}}{4}, x = \frac{3 - \sqrt{10}}{4}$$

$$(xviii) 3x^2 + 2\sqrt{5}x - 5 = 0$$

$$3x^2 + 2\sqrt{5}x - 5 = 0$$

$$a = 3; b = 2\sqrt{5}; c = -5$$

$$D = b^2 - 4ac$$

$$= (2\sqrt{5})^2 - 4(3)(-5)$$

$$= 20 + 60$$

$$= 80$$

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

$$x = \frac{-(2\sqrt{5}) \pm \sqrt{80}}{6}$$

$$x = \frac{-(2\sqrt{5}) \pm 4\sqrt{5}}{6}$$

$$x = \frac{-2\sqrt{5} + 4\sqrt{5}}{6}, x = \frac{-2\sqrt{5} - 4\sqrt{5}}{6}$$

$$x = \frac{\sqrt{5}}{3}, x = -\sqrt{5}$$

$$(xix) 3x^2 + 12 = 32x$$

$$3x^2 + 12 = 32x$$

$$3x^2 - 32x + 12 = 0$$

$$a = 3; b = -32; c = 12$$

$$D = b^2 - 4ac$$

$$= (-32)^2 - 4(3)(12)$$

$$= 1024 - 144$$

$$= 880$$

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

$$x = \frac{32 \pm \sqrt{880}}{6}$$

$$x = \frac{32 + 4\sqrt{55}}{6}, x = \frac{32 - 4\sqrt{55}}{6}$$

$$x = \frac{16 + 2\sqrt{55}}{3}, x = \frac{16 - 2\sqrt{55}}{3}$$

$$(xx) x^2 + \frac{1}{2}x = 3$$

$$x^2 + \frac{1}{2}x = 3$$

$$2x^2 + x = 6$$

$$2x^2 + x - 6 = 0$$

$$a = 2; b = 1; c = -6$$

$$D = b^2 - 4ac$$

$$= (1)^2 - 4(2)(-6)$$

$$= 1 + 48$$

$$= 49$$

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

$$x = \frac{-1 \pm \sqrt{49}}{4}$$

$$x = \frac{-1+7}{4}, x = \frac{-1-7}{4}$$

$$x = \frac{6}{4}, x = \frac{-8}{4}$$

$$x = \frac{3}{2}, x = -2$$

$$(xxi) \sqrt{3}x^2 + 10x - 8\sqrt{3} = 0$$

$$\sqrt{3}x^2 + 10x - 8\sqrt{3} = 0$$

$$a = \sqrt{3}; b = 10; c = -8\sqrt{3}$$

$$D = b^2 - 4ac$$

$$= (10)^2 - 4(\sqrt{3})(-8\sqrt{3})$$

$$= 100 + 96$$

$$= 196$$

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

$$x = \frac{-10 \pm \sqrt{196}}{2\sqrt{3}}$$

$$x = \frac{-10+14}{2\sqrt{3}}, x = \frac{-10-14}{2\sqrt{3}}$$

$$x = \frac{4}{2\sqrt{3}}, x = -\frac{24}{2\sqrt{3}}$$

$$x = \frac{2}{\sqrt{3}}, x = -\frac{12}{\sqrt{3}}$$

$$(xxii) 2x^2 - 2\sqrt{6}x + 3 = 0$$

$$2x^2 - 2\sqrt{6}x + 3 = 0$$

$$a = 2; b = -2\sqrt{6}; c = 3$$

$$D = b^2 - 4ac$$

$$\begin{aligned}
 &= (-2\sqrt{6})^2 - 4(2)(3) \\
 &= 12 - 24 \\
 &= -12
 \end{aligned}$$

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

$$x = \frac{2\sqrt{6} \pm \sqrt{-12}}{4}$$

$$x = \frac{2\sqrt{6}}{4}$$

$$x = \frac{\sqrt{6}}{2}$$

(xxiii) $3a^2x^2 + 8abx + 4b^2 = 0, a \neq 0$

$$3a^2x^2 + 8abx + 4b^2 = 0$$

$$x^2 + \frac{8b}{3a}x + \frac{4b^2}{3a^2} = 0$$

$$a = 1; b = \frac{8b}{3a}; c = \frac{4b^2}{3a^2}$$

$$D = b^2 - 4ac$$

$$= \left(\frac{8b}{3a}\right)^2 - 4(1)\left(\frac{4b^2}{3a^2}\right)$$

$$= \frac{64b^2}{9a^2} - \frac{16b^2}{3a^2}$$

$$= \frac{64b^2 - 48b^2}{9a^2} = \frac{16b^2}{9a^2}$$

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

$$x = \frac{-\frac{8b}{3a} \pm \sqrt{\frac{16b^2}{9a^2}}}{2}$$

$$x = \frac{-\frac{8b}{3a} + \frac{4b}{3a}}{2}, x = \frac{-\frac{8b}{3a} - \frac{4b}{3a}}{2}$$

$$x = \frac{-4b}{6a}, x = \frac{-12b}{6a}$$

$$x = -\frac{2b}{3a}, x = -\frac{2b}{a}$$

(xxiv) $x^2 + \frac{1}{2}x - 1 = 0$

$$x^2 + \frac{1}{2}x - 1 = 0$$

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

$$a = 2; b = 1; c = -2$$

$$D = b^2 - 4ac$$

$$= (1)^2 - 4(2)(-2)$$

$$= 1 + 16$$

$$= 17$$

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

$$x = \frac{-1 \pm \sqrt{17}}{4}$$

$$x = \frac{-1 + \sqrt{17}}{4}, x = \frac{-1 - \sqrt{17}}{4}$$

$$(xxv) x^2 - 4\sqrt{15}x - 4 = 0$$

$$x^2 - 4\sqrt{15}x - 4 = 0$$

$$a = 1; b = -4\sqrt{15}; c = -4$$

$$D = b^2 - 4ac$$

$$= (-4\sqrt{15})^2 - 4(1)(-4)$$

$$= 240 + 16$$

$$= 256$$

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

$$x = \frac{4\sqrt{15} \pm \sqrt{256}}{2}$$

$$x = \frac{4\sqrt{15} + 16}{2}, x = \frac{4\sqrt{15} - 16}{2}$$

$$x = 2\sqrt{15} + 8, x = 2\sqrt{15} - 8$$