Chapter 6. Quadratic Equations

Ex 6.1

Answer 1.

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

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

$x=8$ 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.

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

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

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

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

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

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

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

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.

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

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

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

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

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

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

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

Answer 17.

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

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

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

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

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

Answer 18.

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

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

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

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

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

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

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

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.

$$(a+b)^2x^2 - 4abx - (a-b)^2 = 0$$
$$(a+b)^2x^2 - [(a+b)^2 - (a-b)^2]x - (a-b)^2 = 0$$
$$(a+b)^2x^2 - (a+b)^2x + (a-b)^2x - (a-b)^2 = 0$$
$$\{(a+b)^2x\}(x-1) + \{(a-b)^2\}(x-1) = 0$$
$$(x-1)[(a+b)^2x + (a-b)^2] = 0$$
$$x = 1, x = -\frac{(a-b)^2}{(a+b)^2} = -\frac{(a-b)}{(a+b)}$$

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.

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

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

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

Discriminant $= b^2 - 4ac$

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

$= 25 - 24$

$= 1$

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

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

Discriminant $= b^2 - 4ac$

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

$= 4 - 16$

$= -12$

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

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

Discriminant $= b^2 - 4ac$

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

$= 9 - 8$

$= 1$

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

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

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

Discriminant $= b^2 - 4ac$

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

$= 9 + 40$

$= 49$

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

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

Discriminant $= b^2 - 4ac$

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

$= 4 + 8$

$= 12$

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

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

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

$16x^2 = 24x + 1$

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

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

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

$D = b^2 - 4ac$

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

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

$= \frac{10}{4}$

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 20 + 60$

$= 80$

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

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

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

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

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

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

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

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

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

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

$D = b^2 - 4ac$

$= (-8\sqrt{5})^2 - 4(5)(15)$

$= 40 - 300$

$= -260$

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

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

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

$$x = \frac{4\sqrt{5}}{5}$$ (Since $\sqrt{-260}$ is not possible)

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

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

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

$D = b^2 - 4ac$

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

$= 25 - 25$

$= 0$

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 144 - 144$

$= 0$

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 49 + 20$

$= 69$

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 16 + 4$

$= 20$

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

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 49 + 240$

$= 289$

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 36 - 16$

$= 20$

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

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

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

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

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

$4 - 11x = 3x^2$

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

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

$D = b^2 - 4ac$

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

$= 121 + 48$

$= 169$

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

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

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 12 - 24$

$= -12$

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

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

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

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

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

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

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

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

$D = b^2 - 4ac$

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

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

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

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

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

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

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

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

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

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

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

$D = b^2 - 4ac$

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

$= 240 + 16$

$= 256$

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

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

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

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