

**Exercise 4A**

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**Question 1: Which of the following are quadratic equations in x?**

- (i)  $x^2 - x + 3 = 0$
- (ii)  $2x^2 + \frac{5}{2}x - \sqrt{3} = 0$
- (iii)  $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$
- (iv)  $\frac{1}{3}x^2 + \frac{1}{5}x - 2 = 0$
- (v)  $x^2 - 3x - \sqrt{x} + 4 = 0$
- (vi)  $x - \frac{6}{x} = 3$
- (vii)  $x + \frac{2}{x} = x^2$
- (viii)  $x^2 - \frac{1}{x^2} = 5$
- (ix)  $(x + 2)^3 = x^3 - 8$
- (x)  $(2x + 3)(3x + 2) = 6(x - 1)(x - 2)$
- (xi)  $(x + \frac{1}{x})^2 = 2x + \frac{1}{x} + 3$

**Solution:**

A quadratic equation is an equation of the second degree.

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

Highest Degree: 2

Quadratic equation.

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

Highest Degree: 2

Quadratic equation.

(iii)  $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$

Highest Degree: 2

Quadratic equation.

(iv)  $\frac{1}{3}x^2 + \frac{1}{5}x - 2 = 0$

Above equation can be simplify as:  $5x^2 + 3x - 2 = 0$

Highest Degree: 2

Quadratic equation.

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

Equation has a fractional power.

Not a quadratic equation.

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

Simply as  $x^2 - 3x - 6 = 0$

Degree : 2

Quadratic equation.

(vii)  $x + \frac{2}{x} = x^2$

Simplify above equation:

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

Degree: 3

Not a quadratic equation.

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

Simplify above equation

$$x^4 - 1 = 5x^2$$

$$\text{or } x^4 - 5x^2 - 1 = 0$$

Degree: 4

Not a quadratic equation.

$$\text{(ix) } (x + 2)^3 = x^3 - 8$$

$$x^3 + 8 + 6x^2 + 12x = x^3 - 8$$

$$-6x^2 + 12x + 16 = 0$$

Degree = 2

A quadratic equation.

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

Simplify above equation:

$$6x^2 + 4x + 9x + 6 = 6x^2 - 12x - 6x + 12$$

$$31x - 6 = 0$$

Degree : 1

Not a quadratic equation

$$\text{(xi) } (x + 1/x)^2 = 2x + 1/x + 3$$

Simplify above equation:

$$(x^4 + 2x^2 + 1) / x^2 = (2x^2 + 2) / x + 3$$

$$(x^4 + 2x^2 + 1)x = x^2(2x^2 + 2) + 3$$

Not a quadratic equation.

Answer: (i), (ii), (iii), (iv), (vi) and (ix) are only quadratic equations.

### Question 2:

Which of the following are the roots of  $3x^2 + 2x - 1 = 0$ ?

(i) -1

(ii)  $1/3$

(iii)  $-1/2$

### Solution:

Simplify given equation:

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

$$= 3x(x + 1) - 1(x + 1)$$

$$= (x + 1)(3x - 1)$$

To find roots, put  $3x^2 + 2x - 1 = 0$

Either,  $x + 1 = 0$  or  $3x - 1 = 0$

$$x = -1 \text{ or } x = 1/3$$

Therefore, (-1) and  $1/3$  are the required roots.

### Question 3:

(i) Find the value of  $k$  for which  $x = 1$  is a root of the equation  $x^2 + kx + 3 = 0$ . Also, find the other root.

(ii) Find the values of  $a$  and  $b$  for which  $x = 3/4$  and  $x = -2$  are the roots of the equation  $ax^2 + bx - 6 = 0$ .

### Solution:

(i)  $x = 1$  is a solution of  $x^2 + kx + 3 = 0$ , which means it must satisfy the equation.

$$(1)^2 + k(1) + 3 = 0$$

$$k = -4$$

Hence the required value of  $k = -4$

**Find other root:**

We have equation,  $x^2 - 4x + 3 = 0$

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

$$x(x - 1) - 3(x - 1) = 0$$

$$(x - 1)(x - 3) = 0$$

either  $x - 1 = 0$  or  $x - 3 = 0$

$$x = 1 \text{ or } x = 3$$

Other root is 3.

(ii) given equation is  $ax^2 + bx - 6 = 0$

As  $\frac{3}{4}$  is its root, then must satisfy the equation

$$a\left(\frac{3}{4}\right)^2 + b\left(\frac{3}{4}\right) - 6 = 0$$

$$9a + 12b - 96 = 0 \dots(1)$$

Again,  $x = -2$  is its root

$$a(-2)^2 + b(-2) - 6 = 0$$

$$4a - 2b - 6 = 0 \dots(2)$$

Solving (1) and (2), we get

$$a = 4 \text{ and } b = 5$$

**Question 4: Show that  $x = -bc/ad$  is a solution of the quadratic equation**

$$ad^2\left(\frac{ax}{b} + \frac{2c}{d}\right)x + bc^2 = 0$$

**Solution:**

$$ad^2\left(\frac{ax}{b} + \frac{2c}{d}\right)x + bc^2 = 0 \dots\dots\dots(1)$$

$x = -bc/ad$  is solution of equation (1), if it satisfy the equation.

$$ad^2 \left( \frac{-bc}{bd} + \frac{2c}{d} \right) \frac{b^2c^2}{a^2d^2} + bc^2 = 0$$

$$\left( \frac{-bcd + 2bcd}{bd^2} \right) \times \frac{b^2c^2}{a} + bc^2 = 0$$

$$\frac{bcd}{bd^2} \times \frac{b^2c^2}{a} + bc^2 = 0$$

$$\frac{b^2c^3}{a} + bc^2 = 0$$

Which is not true.

So  $x = -bc/ad$  is not a solution of given quadratic equation.

**Solve each of the following quadratic equations.**

**Question 5:**

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

**Solution:**

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

Either  $2x - 3 = 0$  or  $3x + 1 = 0$

$$x = 3/2 \text{ or } x = -1/3$$

**Question 6:**

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

**Solution:**

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

$$\text{Or } x(4x + 5) = 0$$

Either  $x = 0$  or  $4x + 5 = 0$ , then

$$x = -5/4 \text{ or } 0$$

**Question 7:  $3x^2 - 243 = 0$**

**Solution:**

$$3x^2 - 243 = 0$$

$$\text{or } x^2 - 81 = 0$$

$$(x)^2 - (9)^2 = 0$$

$$(x + 9)(x - 9) = 0$$

$$\text{Either, } x + 9 = 0 \text{ or } x - 9 = 0$$

$$x = -9 \text{ or } 9$$

**Question 8:**

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

**Solution:**

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

$$2x^2 + 4x - 3x - 6 = 0$$

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

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

$$\text{Either } x + 2 = 0 \text{ or } 2x - 3 = 0$$

$$x = -2 \text{ or } 3/2$$

**Question 9:**

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

**Solution:**

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

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

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

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

either  $x + 5 = 0$  or  $x + 1 = 0$

$$x = -5 \text{ or } -1$$

**Question 10:**

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

**Solution:**

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

$$9x^2 - 6x + 3x - 2 = 0$$

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

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

either  $(3x + 1) = 0$  or  $(3x - 2) = 0$

$$x = -1/3 \text{ or } 2/3$$

**Question 11:**

$$x^2 + 12x + 35 = 0$$

**Solution:**

$$x^2 + 12x + 35 = 0$$

$$x^2 + 7x + 5x + 35 = 0$$

$$x(x + 7) + 5(x + 7) = 0$$

$$(x + 5)(x + 7) = 0$$

either  $(x + 5) = 0$  or  $(x + 7) = 0$

$$x = -5 \text{ or } -7$$

**Question 12:**

$$x^2 = 18x - 77$$

**Solution:**

$$x^2 - 18x + 77 = 0$$

$$x^2 - 7x - 11x + 77 = 0$$



$$x(x - 7) - 11(x - 7) = 0$$

$$(x - 11)(x - 7) = 0$$

either  $(x - 11) = 0$  or  $(x - 7) = 0$

$$x = 11 \text{ or } 7$$

**Question 13:**

$$6x^2 + 11x + 3 = 0$$

**Solution:**

$$6x^2 + 11x + 3 = 0$$

$$6x^2 + 2x + 9x + 3 = 0$$

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

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

either  $(2x + 3) = 0$  or  $(3x + 1) = 0$

$$x = -1/3 \text{ or } -3/2$$

**Question 14:**

$$6x^2 + x - 12 = 0$$

**Solution:**

$$6x^2 + x - 12 = 0$$

$$6x^2 + 9x - 8x - 12 = 0$$

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

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

Either,  $2x + 3 = 0$ , then  $2x = -3 \Rightarrow x = \frac{-3}{2}$

or  $3x - 4 = 0$ , then  $3x = 4 \Rightarrow x = \frac{4}{3}$

$$x = \frac{-3}{2} \text{ or } \frac{4}{3}$$

**Question 15:**

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

**Solution:**

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

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

$$3x(x - 1) + 1(x - 1) = 0$$

$$(x - 1)(3x + 1) = 0$$

Either,  $x - 1 = 0$ , then  $x = 1$

or  $3x + 1 = 0$ , then  $x = \frac{-1}{3}$

$$x = 1 \text{ or } \frac{-1}{3}$$

**Question 16:**

$$4x^2 - 9x = 100$$

**Solution:**

$$4x^2 - 9x = 100$$

$$4x^2 - 9x - 100 = 0$$

$$4x^2 - 25x + 16x - 100 = 0$$

$$x(4x - 25) + 4(4x - 25) = 0$$

$$(4x - 25)(x + 4) = 0$$

Either,  $4x - 25 = 0$ , then  $x = \frac{25}{4}$

or  $x + 4 = 0$ , then  $x = -4$

$$x = -4 \text{ or } \frac{25}{4}$$

**Question 17:**

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

**Solution:**

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

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

$$15x^2 - (21x - 20x) - 28 = 0$$

$$15x^2 - 21x + 20x - 28 = 0$$

$$3x(5x - 7) + 4(5x - 7) = 0$$

$$(3x + 4)(5x - 7) = 0$$

$$3x + 4 = 0 \text{ or } 5x - 7 = 0$$

$$x = -4/3 \text{ or } 7/5$$

**Question 18:**

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

**Solution:**

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

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

$$3x^2 + 12x - x - 4 = 0$$

$$3x(x + 4) - 1(x + 4) = 0$$

$$(x + 4)(3x - 1) = 0$$

$$\text{Either } x + 4 = 0 \text{ or } 3x - 1 = 0$$

$$x = -4 \text{ or } 1/3$$

**Question 19:**

$$48x^2 - 13x - 1 = 0$$

**Solution:**

$$48x^2 - 13x - 1 = 0$$

$$48x^2 - (16x - 3x) - 1 = 0$$

$$48x^2 - 16x + 3x - 1 = 0$$

$$16x(3x - 1) + 1(3x - 1) = 0$$

$$(16x + 1)(3x - 1) = 0$$

$$\text{Either } 16x + 1 = 0 \text{ or } 3x - 1 = 0$$

$$x = -1/16 \text{ or } 1/3$$

**Question 20:**

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

**Solution:**

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

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

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

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

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

or  $x - \sqrt{2} = 0$ , then  $x = \sqrt{2}$

$$x = \sqrt{2} \text{ or } -3\sqrt{2}$$

**Question 21;**

$$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$$

**Solution:**

$$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$$

$$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$$

$$\sqrt{3}x^2 + 3x + 7x + 7\sqrt{3} = 0$$

$$\sqrt{3}x(x + \sqrt{3}) + 7(x + \sqrt{3}) = 0$$

$$(x + \sqrt{3})(\sqrt{3}x + 7) = 0$$

either  $\sqrt{3}x + 7 = 0$  or  $x + \sqrt{3} = 0$

$$x = -\sqrt{3} \text{ or } -7/\sqrt{3}$$

**Question 22:**

$$\sqrt{3}x^2 + 11x + 6\sqrt{3} = 0$$

**Solution:**

$$\sqrt{3}x^2 + 11x + 6\sqrt{3} = 0$$

$$\sqrt{3}x^2 + 9x + 2x + 6\sqrt{3} = 0$$

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

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

either  $(\sqrt{3}x + 2) = 0$  or  $(x + 3\sqrt{3}) = 0$

$$x = -3\sqrt{3} \text{ or } -2\sqrt{3}/3$$

### Question 23:

$$3\sqrt{7}x^2 + 4x + \sqrt{7} = 0$$

### Solution:

$$3\sqrt{7}x^2 + 4x - \sqrt{7} = 0$$

$$3\sqrt{7}x^2 + 4x - \sqrt{7} = 0$$

$$3\sqrt{7}x^2 - 3x + 7x - \sqrt{7} = 0$$

$$3x(\sqrt{7}x - 1) + \sqrt{7}(\sqrt{7}x - 1) = 0$$

$$(3x + \sqrt{7})(\sqrt{7}x - 1) = 0$$

either  $(3x + \sqrt{7}) = 0$  or  $(\sqrt{7}x - 1) = 0$

$$x = -\sqrt{7}/3 \text{ or } 1/\sqrt{7}$$

### Question 24:

$$\sqrt{7}x^2 - 6x - 13\sqrt{7} = 0$$

### Solution:

$$\sqrt{7}x^2 - 6x - 13\sqrt{7} = 0$$

$$\sqrt{7}x^2 + 7x - 13x - 13\sqrt{7} = 0$$

$$\sqrt{7}x(x + \sqrt{7}) - 13(x + \sqrt{7}) = 0$$

$$(x + \sqrt{7})(\sqrt{7}x - 13) = 0$$

Either,  $x + \sqrt{7} = 0$ , then  $x = -\sqrt{7}$

or  $\sqrt{7}x - 13 = 0$ , then  $\sqrt{7}x = 13$

$$x = -\sqrt{7} \text{ or } \frac{13\sqrt{7}}{7}$$

**Question 25:**

$$4\sqrt{6}x^2 - 13x - 2\sqrt{6} = 0$$

**Solution:**

$$4\sqrt{6}x^2 - 13x - 2\sqrt{6} = 0$$

$$4\sqrt{6}x^2 - 16x + 3x - 2\sqrt{6} = 0$$

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

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

Either,  $\sqrt{3}x - 2\sqrt{2} = 0$ , then  $\sqrt{3}x = 2\sqrt{2}$

$$x = \frac{2\sqrt{6}}{3}$$

and

$4\sqrt{2}x + \sqrt{3} = 0$ , then  $4\sqrt{2}x = -\sqrt{3}$

$$x = \frac{-\sqrt{6}}{8}$$

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

$$x = \frac{2\sqrt{6}}{3}, \frac{-\sqrt{6}}{8}$$

**Question 26.**

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

**Solution:**

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

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

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

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

Either,  $\sqrt{3}x - \sqrt{2} = 0$ , then  $x = \frac{\sqrt{2}}{\sqrt{3}}$

or  $\sqrt{3}x - \sqrt{2} = 0$ , then  $x = \frac{\sqrt{2}}{\sqrt{3}}$

$$x = \frac{\sqrt{2}}{\sqrt{3}} \text{ or } \frac{\sqrt{2}}{\sqrt{3}}$$

**Question 27:**

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

**Solution:**

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

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

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

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

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

$$x = \sqrt{6} \text{ or } -\sqrt{2}/\sqrt{3}$$

**Question 28.**

$$x^2 - 3\sqrt{5}x + 10 = 0$$

**Solution:**

$$x^2 - 3\sqrt{5}x + 10 = 0$$

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

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

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

$$\text{Either, } x - 2\sqrt{5} = 0, \text{ then } x = 2\sqrt{5}$$

$$\text{or } x - \sqrt{5} = 0, \text{ then } x = \sqrt{5}$$

$$\text{Hence, } x = 2\sqrt{5} \text{ or } \sqrt{5}$$

**Question 29:**

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

**Solution:**

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

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

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

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

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

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

$$x = 1 \text{ or } \sqrt{3}$$

**Question 30:**

$$x^2 + 3\sqrt{3}x - 30 = 0$$



**Solution:**

$$x^2 + 3\sqrt{3}x - 30 = 0$$

$$x^2 + 5\sqrt{3}x - 2\sqrt{3} - 30 = 0$$

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

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

$$\text{either } (x - 2\sqrt{3}) = 0 \text{ or } (x + 5\sqrt{3}) = 0$$

$$x = -5\sqrt{3} \text{ or } 2\sqrt{3}$$

