**CBSE Class–10 Mathematics**

**NCERT solution**

**Chapter - 4**

**Quadratic Equations - Exercise 4.4**

**1. Find the nature of the roots of the following quadratic equations. If the real roots exist, find them.**

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

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

**(iii)** $2x^2 - 6x + 3 = 0$

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

Comparing this equation with general equation $ax^2 + bx + c = 0$,

We get $a = 2$, $b = -3$ and $c = 5$

Discriminant = $b^2 - 4ac = (-3)^2 - 4$ (2) (5)

= 9 – 40 = −31

Discriminant is less than 0 which means equation has no real roots.

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

Comparing this equation with general equation $ax^2 + bx + c = 0$,

We get $a = 3$, $b = -4\sqrt{3}$ and c = 4

Discriminant = $b^2 - 4ac$ = $\left(-4\sqrt{3}\right)^2$ – 4 (3) (4)

= 48 – 48 = 0

Discriminant is equal to zero which means equations has equal real roots.

Applying quadratic formula $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ to find roots,

$$x=\frac{4\sqrt{3}\pm\sqrt{0}}{6}=\frac{2\sqrt{3}}{3}$$

Because, equation has two equal roots, it means $x=\frac{2\sqrt{3}}{3},\frac{2\sqrt{3}}{3}$

**(iii)** $2x^2-6x+3=0$

Comparing equation with general equation $ax^2+bx+c=0$,

We get $a$ = 2, $b$ = −6, and $c$ = 3

Discriminant = $b^2-4ac=(-6)^2-4$ (2) (3)

= 36 – 24 = 12

Value of discriminant is greater than zero.

Therefore, equation has distinct and real roots.

Applying quadratic formula $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ to find roots,

$$x=\frac{6\pm\sqrt{12}}{4}=\frac{6\pm2\sqrt{3}}{4}$$

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

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

**2. Find the value of k for each of the following quadratic equations, so that they have two equal roots.**

**(i)** $2x^2 + kx + 3 = 0$

**(ii) *kx* (*x* − 2) + 6 = 0**

**Ans. (i)** $2x^2 + kx + 3 = 0$

We know that quadratic equation has two equal roots only when the value of discriminant is equal to zero.

Comparing equation $2x^2 + kx + 3 = 0$ with general quadratic equation $ax^2 + bx + c = 0$, we get $a = 2$, $b = k$ and $c = 3$

Discriminant = $b^2 - 4ac = k^2 - 4$ (2) (3) = $k^2 - 24$

Putting discriminant equal to zero

$k^2 - 24 = 0 \Rightarrow k^2 = 24$

$\Rightarrow k = \pm\sqrt{24} = \pm 2\sqrt{6}$

$\Rightarrow k = 2\sqrt{6}, -2\sqrt{6}$

**(ii)** $kx(x - 2) + 6 = 0$

$\Rightarrow kx^2 - 2kx + 6 = 0$

Comparing quadratic equation $kx^2 - 2kx + 6 = 0$ with general form $ax^2 + bx + c = 0$, we get $a = k$, $b = -2k$ and $c = 6$

Discriminant = $b^2 - 4ac = (-2k)^2 - 4$ ($k$) (6)

= $4k^2 - 24k$

We know that two roots of quadratic equation are equal only if discriminant is equal to zero.

Putting discriminant equal to zero

$4k^2 - 24k = 0$

$\Rightarrow 4k(k-6)=0 \Rightarrow k=0, 6$

The basic definition of quadratic equation says that quadratic equation is the equation of the form $ax^2+bx+c=0$, where $a \neq 0$.

Therefore, in equation $kx^2-2kx+6=0$, we cannot have k = 0.

Therefore, we discard k = 0.

Hence the answer is k = 6.

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**3. Is it possible to design a rectangular mango grove whose length is twice its breadth, and the area is $800\,m^2$ ? If so, find its length and breadth.**

**Ans.** Let breadth of rectangular mango grove = $x$ metres

Let length of rectangular mango grove = $2x$ metres

Area of rectangle = $length \times breadth = x \times 2x = 2x^2\,m^2$

According to given condition:

=> $2x^2=800$

$\Rightarrow 2x^2-800=0$

$\Rightarrow x^2-400=0$

Comparing equation $x^2-400=0$ with general form of quadratic equation $ax^2+bx+c=0$, we get $a=1$, $b=0$ and $c=-400$

Discriminant $=b^2-4ac=(0)^2-4(1)(-400)=1600$

Discriminant is greater than 0 means that equation has two disctinct real roots.

Therefore, it is possible to design a rectangular grove.

Applying quadratic formula, $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ to solve equation,

$$x=\frac{0\pm\sqrt{1600}}{2\times1}=\frac{\pm 40}{2}=\pm20$$

$\Rightarrow x = 20, -20$

We discard negative value of $x$ because breadth of rectangle cannot be in negative.

Therefore, $x$ = breadth of rectangle = 20 metres

Length of rectangle = $2x$ = $2 \times 20$ = 40 metres

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**4. Is the following situation possible? If so, determine their present ages.**

**The sum of the ages of two friends is 20 years. Four years ago, the product of their ages in years was 48.**

**Ans.** Let age of first friend = $x$ years

then age of second friend = $(20 - x)$ years

Four years ago, age of first friend = $(x - 4)$ years

Four years ago, age of second friend = $(20 - x) - 4 = (16 - x)$ years

According to given condition,

=> $(x - 4)(16 - x) = 48$

$\Rightarrow 16x - x^2 - 64 + 4x = 48$

$\Rightarrow 20x - x^2 - 112 = 0$

$\Rightarrow x^2 - 20x + 112 = 0$

Comparing equation, $x^2 - 20x + 112 = 0$ with general quadratic equation $ax^2+bx+c=0$, we get $a = 1$, $b = -20$ and $c = 112$

Discriminant = $b^2 - 4ac = (-20)^2 - 4$ (1) (112) = 400 – 448 = −48 < 0

Discriminant is less than zero which means we have no real roots for this equation.

Therefore, the give situation is not possible.

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**5. Is it possible to design a rectangular park of perimeter 80 metres and area 400 $m^2$. If so, find its length and breadth.**

**Ans.** Let length of park = $x$ metres

We are given area of rectangular park = $400m^2$

Therefore, breadth of park = $\frac{400}{x}$ metres{Area of rectangle = length × *breadth*}

Perimeter of rectangular park = 2 (*length* + *breath*) = $2\left(x+\frac{400}{x}\right)$ metres

We are given perimeter of rectangle = 80 metres

According to condition:

=> $2\left(x+\frac{400}{x}\right)=80$

⇒ $2\left(\frac{x^2+400}{x}\right)=80$

⇒ $2x^2 + 800 = 80x$

⇒ $2x^2 - 80x + 800 = 0$

⇒ $x^2 - 40x + 400 = 0$

Comparing equation, $x^2 - 40x + 400 = 0$ with general quadratic equation $ax^2+bx+c = 0$, we get $a$ = 1, $b$ = −40 and $c$ = 400

Discriminant = $b^2 - 4ac = (-40)^2 - 4$ (1) (400) = 1600 – 1600 = 0

Discriminant is equal to 0.

Therefore, two roots of equation are real and equal which means that it is possible to design a rectangular park of perimeter 80 metres and area $400m^2$ .

Using quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to solve equation,

$$x = \frac{40 \pm \sqrt{0}}{2} = \frac{40}{2} = 20$$

Here, both the roots are equal to 20.

Therefore, length of rectangular park = 20 metres

Breadth of rectangular park = $\frac{400}{x} = \frac{400}{20} = 20\ m$