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Class: X
Subject: Mathematics
Topic: Quadratic equations
No. of Questions: 25

Q1 If x=2 and x=3 are roots of the equation $3x^2 - 2kx + 2m=0$, find the value of k and m.

Sol. Since x=2 and x=3 are the roots of the equation $3x^2 - 3kx + 2m=0$
$3 \times 2^2 - 2k \times 2 + 2m=0$ and $3 \times 3^2 - 2k \times 3 + 2m=0$
$12 - 4k + 2m=0$ and $27 - 6k + 2m=0$
$12= 4k - 2m$ and $27= 6k - 2m$
On solving, we get k=15/2 and m=9

Q2. If one root of the quadratic equation $2x^2 + kx - 6=0$ is 2, find the value of k. Also, find the other root.

(CBSE-2002)

Sol. Since x=2 is a root of the equation
$2x^2 + kx - 6=0$
$2 \times 2^2 + 2k - 6=0$
$8 + 2k - 6=0$
$2k + 2=0$, $k=-1$
Putting k=-1 in the equation $2x^2 + kx - 6=0$
$2x^2 + (-1)x - 6=0$
$2x^2 - x - 6=0$
$2x^2 - 4x + 3x - 6=0$
$2x(x-2) + 3(x-2)=0$
$(x-2)(x+3)=0$
x=2, -3/2
Hence, the other root is -3/2

Q3. Sum of the areas of two squares is 468 m^2. If the difference of their perimeters is 24m, formulate the quadratic equation to find the sides of the two squares.

Sol. Let the length of the square be x meters. Then, perimeter is 4x.
If the given difference= 24 m
Perimeter of the second square= 24 + 4x m
Length of each side of second square= (24 + x)/4 m= (6+x)m
According to question,

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$x^2 + (6+x)^2 = 468$
$x^2 + (36 + 12x + x^2) = 468$
$2x^2 + 12x - 432 = 0$
$x^2 + 6x - 216 = 0$

Q4. Factorize and solve the quadratic equation: $x^2 + 2\sqrt{2}x - 6 = 0$

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

Q5. Solve the quadratic equation by factorization method: $x^2 - 8x + 16 = 0$

Sol. $x^2 - 8x + 16 = 0$
$(x-4)^2 = 0$
$x = 4, 4$

Q6. Solve for x: $\frac{1}{x-2} + \frac{2}{x-1} = \frac{6}{x}$

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

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

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

$3x^2 - 5x = 6x^2 - 18x + 12$
$3x^2 - 13x + 12 = 0$
$3x^2 - 9x - 4x + 12 = 0$
$3x(x-3) - 4(x-3) = 0$
$(x-3)(3x-4) = 0$
$x = 3$ or $-4/3$

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Q7. Solve the equation for x: $\frac{4}{x}-3=\frac{5}{2x+4}$, x≠0, -3/2 (CBSE-2006)

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

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

(4 – 3x)(2x+3)= 5x

12 – x – 6x^2= 5x

6x^2 + 6x – 12=0

x^2 + x – 2=0

x^2 + 2x - x – 2=0

x(x+2) – 1(x+2)=0

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

x=1, -2

Q8. Solve: $x=\cfrac{1}{2-\cfrac{1}{2-\cfrac{1}{2-x}}}$, x≠2

Sol. $x=\cfrac{1}{2-\cfrac{1}{2-\cfrac{1}{2-x}}}$

$x=\cfrac{1}{2-\cfrac{1}{\cfrac{2(2-x)-1}{2-x}}}=\cfrac{1}{2-\cfrac{2-x}{4-2x-1}}$

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

x(4-3x)= (3-2x)

4x- 3x^2 = 3-2x

3x^2-6x+3 = 0

x^2 – 2x +1 = 0

(x-1)^2=0

x=1, 1

Q9. Solve: $4x^2 - 4ax + (a^2 - b^2) = 0$

(CBSE-2012)

Sol. $x^2 - 2ax + a^2 - b^2 = 0$

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

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

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

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

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

$x = a - b$ or $a + b$

Q10. Solve the given equation: $x^2 + 3x - (a^2 + a - 2) = 0$

Sol. $x^2 + 3x - (a^2 + a - 2) = 0$

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

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

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

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

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

$x = -(a + 2)$ or $a - 1$

Q11. Solve: $4x^2 - 2(a^2 + b^2)x + a^2b^2 = 0$ (CBSE-2004)

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

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

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

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

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

$x = a^2/2$ or $b^2/2$

Q12. Solve: $9x^2 - 9(a+b)x + (2a^2 + 5ab + 2b^2) = 0$

Sol. $9x^2 - 9(a+b)x + (2a^2 + 5ab + 2b^2) = 0$

$9x^2 - 3\{(2a+b) + (a + 2b)\}x + (2a + b)(a + 2b) = 0$

$9x^2 - 3(2a+b)x - 3(a + 2b)x + (2a + b)(a + 2b) = 0$

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

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

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

Q13. Solve: $a^2b^2x^2 + b^2x – a^2x – 1=0$

Sol. $a^2b^2x^2 + b^2x – a^2x – 1=0$
$(a^2b^2x^2 + b^2x) – (a^2x + 1)=0$
$(a^2x + 1)b^2x – (a^2x + 1)=0$
$(a^2x + 1)(b^2x - 1)=0$
$x= -1/a^2$ or $1/b^2$

Q14. Solve: $\frac{1}{a+b+x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x}$, $a+b\neq 0$ (CBSE-2005)

Sol. $\frac{1}{a+b+x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x}$
$\frac{1}{a+b+x} - \frac{1}{x} = \frac{1}{a} + \frac{1}{b}$

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

Q15. Solve the equation $2x^2 – 5x + 3=0$ by the method of completing the square.

Sol. $2x^2 – 5x + 3=0$
$x^2 – 5x/2 + 3/2=0$
$x^2 – 5x/2 = -3/2$
$x^2 – 2(5/4)x + (5/4)^2 = (5/4)^2 -3/2$
$(x – 5/4)^2 = 25/16 -3/2$
$(x – 5/4)^2 = 1/16$
$(x – 5/4) = 1/4^2$
$x – 5/4 = \pm 1/4$
$x = 5/4 \pm 1/4$
$x= 3/2$ or 1

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Q16. Using quadratic formula, solve $p^2x^2 + (p^2 – q^2)x – q^2=0, p\neq0$ (CBSE-2004)

Sol. Comparing it with the equation $ax^2 + bx + c=0$
$a= p^2, b=p^2 – q^2, c= - q^2$
$D= b^2 – 4ac= (p^2 – q^2) – 4 * p^2 * - q^2= (p^2 – q^2)^2 + 4p^2q^2= (p^2 + q^2)^2 >0$
So, this equation has real roots given by

$\alpha= \frac{-b+\sqrt{D}}{2a} = - [(p^2-q^2)+ (p^2 + q^2)]/ 2p^2 = q^2/p^2$

$\beta=\frac{-b-\sqrt{D}}{2a} = - [(p^2-q^2) - (p^2 + q^2)]/ 2p^2 = -1$

Q17 Solve for x: $9x^2 – 9(a+b)x + (2a^2 + 5ab + 2b^2)=0$, using quadratic formula. (CBSE- 2009)

Sol. $A= 9, B= - 9(a+b), C= 2a^2 + 5ab + 2b^2$
$D= B^2 – 4AC$
$D= 81(a+b)^2 – 36(2a^2 + 5ab + 2b^2)$
$D= 9a^2 + 9b^2 – 18ab$
$D= 9(a – b)^2 \geq 0$
So, the roots of the given equation are real and are given by

$\alpha= \frac{-B+\sqrt{D}}{2A} = \frac{9(a+b)+3(a-b)}{18} = \frac{2a+b}{3}$

$\beta=\frac{-B-\sqrt{D}}{2A} = \frac{9(a+b)-3(a-b)}{18} = \frac{a+2b}{3}$

Q18. Using quadratic formula, solve the following equation for x:
$bx^2 + (b^2 – ac)x – bc=0$ (CBSE- 2005)

Sol. $abx^2 + (b^2 – ac)x – bc=0$
$x= [- (b^2 – ac) \pm \sqrt{\{(b^2 – ac)^2 – 4(ab)(-bc)\}}]/ 2ab$
$x= [- (b^2 – ac) \pm \sqrt{\{(b^2 – ac)^2+ 4ab^2c\}}]/ 2ab$
$x= [- (b^2 – ac) \pm \sqrt{(b^4 – 2ab^2c + a^2c^2 + 4ab^2c)}]/ 2ab$
$x= [- (b^2 – ac) \pm \sqrt{(b^2 + ac)^2}]/ 2ab$
$x= [- (b^2 – ac) + \sqrt{(b^2 + ac)^2}]/ 2ab$; $x= x= [- (b^2 – ac) - \sqrt{(b^2 + ac)^2}]/ 2ab$
$x= 2ac/ 2ab; x= -2b^2/2ab$
$x= c/b; x= -b/a$

Q19. Find the value of k in $x^2 – 2x(1+3k) + 7(3+2k)=0$, for which the equation has real and equal roots. (CBSE-2002)

Sol. a= 1, b=-2(1 + 3k) and c= 7(3+2k)
$D= 4(1+3k)^2 – 4 * [7(3+2k)]$
$D= 4(9k^2 + 6k + 1 – 21 – 14k)$
$D= 4(9k^2 – 8k – 20)$
The equation will have equal roots, if D=0
$4(9k^2 – 8k – 20)=0$
$9k^2 – 8k – 20=0$
$9k^2 – 18k + 10k – 20=0$
(k – 2)(9k + 10)=0
k= 2 or k= -9/10

Q20. Find the values of k for which the following equation has equal roots:
$(k – 12)x^2 + 2(k – 12)x + 12=0$ (CBSE-2013)

Sol. $(k – 12)x^2 + 2(k – 12)x + 12=0$
a= k – 12; b= 2(k – 12) and c=2
$D= 4(k -12)^2 – 4(k – 12) * 2$
D= 4(k – 12){(k – 12) – 2}
D= 4(k – 12)(k – 14)
The equation will have equal roots if D=0
4(k – 12)(k – 14)=0
k=12 or 14

Q21. Find the values of k for which the equation $x^2 + 5kx + 16=0$ has no real roots.

Sol. $x^2 + 5kx + 16=0$
a=1, b=5k and c=16
$D= (5k)^2 – 64$
$D= 25k^2 – 64$
The equation will have no real roots, if
D<0
$25k^2 – 64 < 0$
$25(k^2 – 64/25)<0$
$k^2 – 64/25 <0$
$-8/5 < k < 8/5$

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Q22. Prove that the equation $x^2(a^2 + b^2) + 2x(ac + bd) + (c^2 + d^2)=0$ has no real root, if $ad \neq bc$.

Sol. The discriminant of the given equation is given by
$D= 4(ac + bd)^2 – 4(a^2 + b^2)(c^2 + d^2)$
$D= 4[(ac + bd)^2 – (a^2 + b^2)(c^2 + d^2)]$
$D= 4[a^2c^2 + b^2d^2 + 2ac . bd – a^2c^2 – a^2d^2 - b^2c^2 – b^2d^2]$
$D= 4[2ac.bd – a^2d^2 – b^2c^2]$
$D= -4[a^2d^2 + b^2c^2 – 2ad. bc]= -4(ad – bc)^2$
We have, $ad \neq bc$
$ad - bc \neq 0$; $(ad – bc)^2 >0$
$-4(ad – bc)^2 < 0$
$D<0$
Hence, the given equation has no real roots.

Q23. Find the value of k for which the quadratic equation $(k + 4)x^2 + (k + 1)x + 1=0$ has equal roots (CBSE- 2013)

Sol. $a= k + 4$, $b= k + 1$ and $c=1$
$D= b^2 – 4ac$
$D= (k+1) – 4(k + 4)$
$D= k^2 – 2k – 15$
$D= (k – 5)(k + 3)$
If the roots of the given equation are real, then
$D=0$
$k= 5, -3$

Q24. If -5 is a root of the quadratic equation $2x^2 + px – 15=0$ and the quadratic equation $p(x^2 + x) + k=0$ has equal roots, find the value of k. (CBSE- 2002)

Sol. Since -5 is a root of the equation $2x^2 + px – 15=0$. Therefore,
$2(-5)^2 – 5p – 15=0$
$50 – 5p – 15=0$
$p=7$
Putting $p=7$ in $p(x^2 + x) + k=0$, we get $7x^2 + 7x + k=0$
This equation will have equal roots, if
Discriminant=0
$49 – 4 * 7 * k=0$
$k= 7/4$

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Q25. The denominator of a fraction is one more than twice the numerator. If the sum of the fraction and its reciprocal is $2\frac{16}{21}$, find the fraction.

Sol. Let the numerator of the fraction be x. Then,
Denominator= 2x + 1
Fraction= x/(2x+1)
Reciprocal of the fraction= (2x+1)/x
According to the question,

$$\frac{x}{2x+1}+\frac{2x+1}{x}=2\frac{16}{21}$$

$[x^2 + (2x + 1)^2]/ x(2x+1)= 58/21$
$21(5x^2 + 4x – 1)= 58(2x^2 + x)$
$105 x^2 + 84x + 21= 116x^2 + 58x$
$11x^2 – 26x – 21=0$
$11x^2 – 33x + 7x – 21=0$
$(11x + 7)(x – 3)=0$
x=3, -7/11
We take x=3 as x is a natural number.
Hence, fraction= 3/7.