

## Иррациональные уравнения и неравенства

1. Укажите номера уравнений, являющихся равносильными:

1)  $\sqrt{x^2 - 1} = 0$ ;                      2)  $(x-1)\sqrt{x+1} = 0$ ;                      3)  $\frac{\sqrt{x^3}}{\sqrt{x}} = 1$ ;  
4)  $|x| = 1$ ;                      5)  $x^2 + 3\sqrt{-x} = 1 + 3\sqrt{-x}$ .

2. Найдите сумму корней (или корень):

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

3. Найдите произведение корней:

$$\sqrt{x^2 - 32} = \sqrt{-4x}$$

4. Найдите сумму корней уравнения:

$$\sqrt{x^2 - 8x + 16} - \sqrt{2} = \sqrt{6 - 4\sqrt{2}}$$

5. Если  $x_0$  - корень уравнения

$$\sqrt{3x+4} + \sqrt{x-4} = 2\sqrt{x}, \text{ то } x_0(x_0 - 1) = ?$$

6. Увеличенная в 7 раз сумма всех корней

$$\sqrt{9x-46} - \sqrt{2x-8} = \sqrt{x+6}$$

7. Решите уравнение:

$$\sqrt{18-2x} + \sqrt{x+4} = \sqrt{2-6x} - \sqrt{-x-4}$$

8. Решите уравнения:

а)  $\sqrt{(x-5)^2(x-7)} = |x-5|\sqrt{49-x^2}$

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

в)  $\sqrt{x+3-4\sqrt{x-1}} + 2\sqrt{x-1} = 7$

г)  $\sqrt{x-1} + 3\sqrt[3]{1-x} + 4 = 0$

д)  $\sqrt{2x^2 - 14x + 24} - 4x = 4\sqrt{8-2x} - x\sqrt{3-x}$

е)  $\sqrt{3x^2 + 6x - 2} - \sqrt{3x^2 + 8x + 4} = \sqrt{x^2 - 1} - \sqrt{x^2 - 3x - 10}$

ж)  $\frac{x}{2 + \sqrt{x+4}} = \sqrt{x+4} + x^2 + x - 4$

з)  $\sqrt{2}\sqrt{1 + \sqrt{1-16x^2}} + 1 = -x + 2\sqrt{1+4x} + \sqrt{1-4x}$

и)  $\sqrt{x^2 - 8x + 12} = 2x = 2\sqrt{6-x} - x\sqrt{2-x}$

к)  $\frac{\sqrt{21+x} + \sqrt{21-x}}{\sqrt{21+x} - \sqrt{21-x}} = \frac{21}{x}$

л)  $(x+3)(4-x)(\sqrt{x-6} + 2) = 3$

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

н)  $\sin(\pi x) + \sqrt{2 - \sin^2(\pi x)} + \sin(\pi x)\sqrt{2 - \sin^2(\pi x)} = 3$

о)  $\sqrt{25 + 4x^2 - 12x} + \cos^2 \frac{5x\pi}{3} = 4$

9. Найдите значение выражения  $\frac{x_0 + 10}{2x_0}$ ; где  $x_0$  - корень уравнения

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

10. Найдите сумму корней

$$a) \sqrt{3x+1} + \sqrt[3]{5x+2} = 7;$$

$$б) x^2 - \frac{6}{7\sqrt{x^2+2x}} = 1\frac{36}{49} - 2x$$

**11. Решите систему уравнений:**

$$a) \begin{cases} x^2 + 2 = \sqrt{2yz}, \\ y^2 - 4 = 3xz\sqrt{4-2yz}; \end{cases}$$

$$б) \begin{cases} \sqrt[4]{x+y} - \sqrt[4]{x-y} = 2, \\ \sqrt{x+y} - \sqrt{x-y} = 8; \end{cases}$$

$$в) \begin{cases} \sqrt[3]{x}\sqrt{y} + \sqrt[3]{y}\sqrt{x} = 12, \\ xy = 64; \end{cases}$$

$$г) \begin{cases} \sqrt{\frac{2x-y}{x+y}} - 3\sqrt{\frac{x+y}{2x-y}} = -2, \\ (x+1)^2 - 3y^2 + 2 = 0; \end{cases}$$

$$д) \begin{cases} \sqrt{5x+2y+5} - \sqrt{x+y} = 3, \\ 6x+3y-12; \end{cases}$$

**12. Найдите наименьшее натуральное решение неравенства:**  $\frac{(x-1)\sqrt{x^2-x-2}}{6+x-x^2} \geq 0$

**13. Найдите наименьшее целое решение неравенства:**  $\frac{|x+2|-|x|}{\sqrt{x^3-4}} \geq 0$

**14. Найдите число целых решений неравенства:**

$$\sqrt[3]{2x^2-11x-21} \cdot \sqrt{4-x} \leq 0$$

**15. Найдите число целых решений неравенства**

$$\sqrt[4]{\left(\frac{x^2-x-6}{x^2+4}\right)} + \sqrt{\left(\frac{x^2+3x+2}{x^2+1}\right)^2} > 0, \text{ принадлежащих интервалу } (-3;3).$$

**16. Найдите количество целых решений, удовлетворяющих неравенству**

$$\frac{2x}{\sqrt{2x+9}} \leq \sqrt{1+2x} - 1$$

## Иррациональные уравнения и неравенства (ответы и решения)

**1.**

1.  $x = \pm 1$

2.  $x = \pm 1$

3.  $x = \pm 1$

4.  $x = \pm 1$

**2.**

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

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

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

$$x = 4$$

**3.**

$$\sqrt{x^2 - 32} = \sqrt{-4x}$$

$$x^2 - 32 = -4x$$

$$x^2 + 4x - 32 = 0$$

$$x \leq 0$$

$$x = -8$$

**4.**

$$\sqrt{x^2 - 8x + 16} - \sqrt{2} = \sqrt{6 - 4\sqrt{2}}$$

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

$$x_1 = 4 + \sqrt{2} + \sqrt{6 - 4\sqrt{2}}$$

$$x_2 = 4 - \sqrt{2} - \sqrt{6 - 4\sqrt{2}}$$

$$\Sigma = 8$$

**5.**

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

$$[ \sqrt{A} \pm \sqrt{B} = \pm \sqrt{C} \Rightarrow (A - B)^2 - 2C(A + B) + C^2 = 0 ]$$

$$A = 3x + 4, B = x - 4, C = 4x$$

$$(3x + 4 - x + 4)^2 - 2 \cdot 4x(3x + 4 + x - 4) + 16x^2 = 0$$

$$(2x + 8)^2 - 8x \cdot 4x + 16x^2 = 0$$

$$4x^2 + 32x + 64 - 32x^2 + 16x^2 = 0$$

$$-12x^2 + 32x + 64 = 0$$

$$3x^2 - 8x - 16 = 0$$

$$\frac{D}{4} = 16 + 48 = 64$$

$$x_1 = \frac{4 - 8}{3} < 0$$

$$x_2 = 4$$

$$4(4 - 1) = 12$$

6.

$$\sqrt{9x-46} - \sqrt{2x-8} = \sqrt{x+6}$$

$$x \geq \frac{46}{9}$$

$$\sqrt{9x-46} = \sqrt{2x-8} + \sqrt{x+6}$$

$$9x-46 = 2x-8 + 2\sqrt{(2x-8)(x+6)} + x+6$$

$$6x-44 = 2\sqrt{2x^2+4x-48}$$

$$3x-22 = \sqrt{2x^2+4x-48}$$

$$9x^2 - 132x + 484 - 2x^2 - 4x + 48 = 0$$

$$7x^2 - 136x + 532 = 0$$

$$\frac{D}{4} = 4624 - 3724 = 900$$

$$x_1 = \frac{68-30}{7} = \frac{38}{7}; x_2 = \frac{68+30}{7} = \frac{98}{7} = 14$$

7.

$$\sqrt{18-2x} + \sqrt{x+4} = \sqrt{2-6x} - \sqrt{-x-4}$$

$$18-2x \geq 0 \quad 2-6x \geq 0 \quad -x-4 \geq 0$$

$$x \leq 9; \quad x \geq -4 \quad 6x \leq 2 \quad -x \geq 4$$

$$x \leq \frac{1}{3} \quad x \leq -4$$

Следовательно,  $x = -4$ .

$$\sqrt{18+8+0} = \sqrt{26}$$

8. а)  $\sqrt{(x-5)^2(x-7)} = |x-5|\sqrt{49-x^2}$

$$\begin{cases} x \geq 7 \\ 49-x^2 \geq 0 \end{cases} \quad |x| \leq 7 \quad x = 7$$

б)  $5-4x-5\sqrt{x^2+4x-5}-x^2=0$

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

$$5t-t^2=0$$

$$t=0 \quad \text{ИЛИ} \quad t=5$$

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

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

$$x^2+4x-5-25=0$$

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

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

$$x_1 = -5$$

$$\frac{D}{4} = 4+30 = 34$$

$$x_2 = 1$$

$$x_3 = -2 - \sqrt{34}$$

$$x_4 = -2 + \sqrt{34}$$

в)  $\sqrt{x+3-4\sqrt{x-1}} + 2\sqrt{x-1} = 7$

$$|\sqrt{x-1}-2|+2\sqrt{x-1}=7$$

$$\begin{array}{lll} x-1 \geq 0 & \sqrt{x-1}-2 \geq 0 & 3\sqrt{x-1}=9 \\ x \geq 1 & x-1 \geq 4 & \sqrt{x-1}=3 \\ & x \geq 5 & x-1=9 \\ & & x=10 \end{array}$$

$$1 \leq x < 5$$

$$2-\sqrt{x-1}+2\sqrt{x-1}=7$$

$$\sqrt{x-1}=5$$

$$x-1=25$$

$$x=26$$

не является корнем

г)

$$\sqrt{x-1}+3\sqrt[3]{1-x}+4=0$$

$$\sqrt{x-1}-3\sqrt[3]{x-1}+4=0$$

$$\sqrt[6]{(x-1)^3}-3\sqrt[6]{(x-1)^2}+4=0$$

$$a^3-3a^2+4=0+a=-1$$

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

$$a=2$$

$$\sqrt[6]{x-1}=2$$

$$x-1=64$$

$$x=65$$

д)

$$\sqrt{2x^2-14x+24}-4x=4\sqrt{8-2x}-x\sqrt{3-x}$$

$$2x^2-14x+24 \geq 0 \quad 8-2x \geq 0 \quad 3-x \geq 0$$

$$x^2-7x+12 \geq 0 \quad 2x \leq 8 \quad x \leq 3$$

$$(-\infty; 3] \cup [4; +\infty) \quad x \leq 4$$

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

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

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

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

$$3-x=16 \quad 8-2x=x^2$$

$$x=-13 \quad x^2+2x-8=0$$

$$-4u2$$

е)

$$\begin{aligned} \sqrt{3x^2+6x-2} - \sqrt{3x^2+8x+4} &= \sqrt{x^2-1} - \sqrt{x^2-3x-10} \\ \frac{3x^2+6x-2-3x^2-8x-4}{\sqrt{3x^2+16-2} + \sqrt{3x^2+8x+4}} &= \frac{x^2-1-x^2+3x+10}{\sqrt{x^2-1} + \sqrt{x^2-3x-10}} \\ \frac{-2x+6}{\sqrt{3x^2+6x-2} + \sqrt{3x^2+8x+4}} &= \frac{3x+9}{\sqrt{x^2-14} + \sqrt{x^2-3x-10}} \\ x+3 &= 0 \\ x &= -3 \end{aligned}$$

ж)

$$\begin{aligned} \frac{x}{2+\sqrt{x+4}} &= \sqrt{x+4} + x^2 + x - 4 \\ \frac{x-2\sqrt{x+4}-x-4}{2+\sqrt{x+4}} &= x^2 + x - 4 \\ -2 &= x^2 + x - 4 \\ x^2 + x - 2 &= 0 \\ x_1 = 1 \quad x_2 = -2 \end{aligned}$$

3)

$$\begin{aligned} \sqrt{2}\sqrt{1+\sqrt{1-16x^2}} + 1 &= -x + 2\sqrt{1+4x} + \sqrt{1-4x} \\ \sqrt{2+2\sqrt{1-4x}\cdot\sqrt{1+4x}} &= \sqrt{1-4x} + \sqrt{1+4x} \\ \sqrt{1-4x} + \sqrt{1+4x} + 1 &= -x + 2\sqrt{1+4x} + \sqrt{1-4x} \\ \sqrt{1+4x} &= x+1 \\ 1+4x &= x^2 + 2x + 1 \\ x^2 - 2x &= 0 \\ x=0 \quad x=2 \end{aligned}$$

$$\kappa) \frac{\sqrt{21+x} + \sqrt{21-x}}{\sqrt{21+x} - \sqrt{21-x}} = \frac{21}{x} \quad -21 \leq x \leq 21$$

$$\frac{(\sqrt{21+x} - \sqrt{21-x})^2}{21+x-21-x} = \frac{21}{x}$$

$$21+x+21-x+2\sqrt{44-x^2} = 21 \cdot 2$$

$$21 \cdot 2 + 2\sqrt{441-x^2} = 21 \cdot 2$$

$$x^2 = 21^2$$

$$x = \pm 21$$

$$\text{л) } (x+3)(4-x)(\sqrt{x-6}+2) = 3$$

$$x-6 \geq 0 \quad x+3 \geq 9 \quad \sqrt{x-6}+2 \geq 2$$

$$x \geq 6 \quad 4-x < 0$$

нет корней

$$\text{м) } (x+4)\sqrt{x^2-5x-5} = x+4$$

$$x = -4 \quad \sqrt{x^2 + 5x - 5} = 1$$

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

$$-6 \text{ и } -1$$

н)

$$\sin(\pi x) + \sqrt{2 - \sin^2(\pi x)} + \sin(\pi x)\sqrt{2 - \sin^2(\pi x)} = 3$$

$$a = \sin(\pi x) + \sqrt{2 - \sin^2(\pi x)}$$

$$a^2 = \sin(\pi x) + 2 - \sin^2(\pi x)\sqrt{2 - \sin^2(\pi x)} + 2 - 2 - \sin^2$$

$$\frac{a^2 - 2}{2} = \sin(\pi x)\sqrt{2 - \sin^2(\pi x)}$$

$$\frac{a^2 - 2}{2} + a = 3$$

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

$$a^2 + 2a - 8 = 0$$

$$-4 \text{ и } -2$$

$$\sin(\pi x) + \sqrt{2 - \sin^2(\pi x)} = 2$$

$$\sin(\pi x) = 1$$

$$\pi x = \frac{\pi}{2} + 2\pi n$$

$$x = \frac{1}{2}2n, n \in \mathbb{Z}$$

о)

$$\sqrt{25 + 4x^2 - 12x} + \cos^2 \frac{5x\pi}{3} = 4$$

$$\sqrt{4x^2 - 12x + 25} = 4 - \cos^2 \frac{5x\pi}{3}$$

$$\sqrt{(2x-3)^2 + 16} \geq 4$$

$$4 - \cos^2 \frac{5x\pi}{3} \leq 4$$

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

9.

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

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

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

$$x^2 - x = 2x^2$$

$$x^2 + x = 0$$

$$x = 0$$

$$4x^2 - -4x = 2x^2$$

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

$$x = 0$$

10.

a)  $\sqrt{3x+1} + \sqrt[3]{5x+2} = 7;$

$x=5 \quad 4+3$

$$x^2 - \frac{6}{7\sqrt{x^2+2x}} = 1 - \frac{36}{49} - 2x$$

$$x^2 + 2x - \frac{36}{49} = 1 + \frac{6}{7\sqrt{x^2+2x}}$$

$$\left(\sqrt{x^2+2x} - \frac{6}{7}\right)\left(\sqrt{x^2+2x} + \frac{6}{7}\right) = \frac{7\sqrt{x^2+2x} + 6}{7\sqrt{x^2+2x}}$$

$$\frac{7\sqrt{x^2+2x} - 6}{7} \cdot \frac{7\sqrt{x^2+2x} + 6}{7} = \frac{7\sqrt{x^2+2x} + 6}{7\sqrt{x^2+2x}}$$

$$\frac{7t - 6}{7} = \frac{1}{t};$$

$$7t^2 - 6t - 7 = 0$$

$$\frac{D}{4} = 9 + 49 = 58$$

$$t_1 = \frac{3 - \sqrt{58}}{7} < 0$$

$$t_2 = \frac{3 + \sqrt{58}}{7}$$

б)  $\sqrt{x^2+2x} = \frac{3 + \sqrt{58}}{7}$

$$x^2 + 2x - \left(\frac{3 + \sqrt{58}}{7}\right)^2 = 0$$

$$x_1 + x_2 = -2$$



$$11. a) \begin{cases} x^2 + 2 = \sqrt{2yz}, \\ y^2 - 4 = 3xz\sqrt{4 - 2yz}; \end{cases}$$

$$2yz \geq 0$$

$$4 - 2yz \geq 0$$

$$2yz \leq 4$$

$$x^2 + 2 \geq 2$$

$$\sqrt{2yz} \leq 2$$

$$x^2 + 2 = 0$$

$$x = 0$$

$$y = \pm 2$$

$$yz = 2$$

$$z_1 = 1$$

$$z_2 = -1$$

$$(0; 2; 1)$$

$$(0; -2; -1)$$

$$6) \begin{cases} \sqrt[4]{x+y} - \sqrt[4]{x-y} = 2, \\ \left( \sqrt[4]{x+y} - \sqrt[4]{x-y} \right) \left( \sqrt[4]{x+y} + \sqrt[4]{x-y} \right) = 8 \end{cases}$$

$$\begin{cases} \sqrt[4]{x+y} - \sqrt[4]{x-y} = 2, \\ \sqrt[4]{x+y} + \sqrt[4]{x-y} = 4 \end{cases}$$

$$\sqrt[4]{x+y} = 6$$

$$2 \sqrt[4]{x+y} = 3$$

$$\sqrt[4]{x+y} = 1$$

$$\begin{cases} x+y = 8 \\ x-y = 1 \end{cases}$$

$$\begin{cases} x+y = 8 \\ x-y = 1 \end{cases}$$

$$2x = 82$$

$$\begin{cases} x = 41 \\ y = 40 \end{cases}$$

B)

$$\begin{cases} \sqrt[3]{x}\sqrt{y} + \sqrt[3]{y}\sqrt{x} = 12, \\ xy = 64; \end{cases}$$

$$\begin{aligned} \sqrt[6]{x^2 y^3} + \sqrt[6]{x^2 y^3} &= 12 \\ \sqrt[6]{x^2 y^3} + (\sqrt[6]{y} + \sqrt[6]{x}) &= 12 \\ \sqrt[3]{xy} &= 4 \\ \begin{cases} \sqrt[6]{y} + \sqrt[6]{x} = 3 \\ \sqrt[6]{xy} = 2 \end{cases} \\ \begin{cases} a + b = 3 \\ a \cdot b = 2 \end{cases} \end{aligned}$$

$$\begin{aligned} b &= 3 - a \\ (3 - a)a &= 2 \\ -a^2 + 3a &= a \\ a^2 - 3a + 2 &= 0 \\ a_1 &= 1 \\ b_1 &= 2 \\ a_2 &= 2 \\ b_2 &= 1 \end{aligned}$$

$$\begin{cases} \sqrt[6]{x} = 1 \\ \sqrt[6]{y} = 2 \end{cases} \quad \text{ИЛИ} \quad \begin{cases} \sqrt[6]{x} = 2 \\ \sqrt[6]{y} = 1 \end{cases}$$

$$\begin{cases} x = 1 \\ y = 64 \end{cases} \quad \begin{cases} x = 64 \\ y = 61 \end{cases}$$

$$\Gamma) \begin{cases} \sqrt{\frac{2x-y}{x+y}} - 3\sqrt{\frac{x+y}{2x-y}} = -2, \\ (x+1)^2 - 3y^2 + 2 = 0; \end{cases}$$

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

$$t - \frac{3}{t} + 2 = 0$$

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

$$-3 \text{ и } -1$$

$$(-2; -1) \quad (-6; -3)$$

$$\Delta) \begin{cases} \sqrt{5x+2y+5} - \sqrt{x+y} = 3, \\ 6x+3y-12; \end{cases}$$

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

$$\left(\sqrt{5x+2y+5}\right)^2 + \left(\sqrt{x+y}\right)^2 = 17$$

$$\begin{cases} a - b = 3 \\ a^2 + b^2 = 17 \end{cases}$$

$$a = 3 + b$$

$$(3 + b)^2 + b^2 = 17$$

$$9 + 6b + 2b^2 - 17 = 0$$

$$2b^2 + 6b - 8 = 0$$

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

$$b_1 = -4 \quad b_2 = -4$$

$$a = 4$$

$$x - y = 2x - y$$

$$-x = -2y$$

$$x = 2y$$

$$(2y+1)^2 - 3y^2 + 2 = 0$$

$$4y^2 + 4y + 1 - 3y^2 + 2 = 0$$

$$y^2 + 4y + 3 = 0$$

$$-1; -3$$

$$x = -2, \quad -6$$

$$\begin{cases} \sqrt{5x+2y+5} = 4 \\ \sqrt{x+y} = 1 \end{cases}$$

$$\begin{cases} \sqrt{5x+2y+5} = 16 \\ x+y=1 \end{cases}$$

$$-3y=6$$

$$y=-2$$

$$(3;-2)$$

$$12. \frac{(x-1)\sqrt{x^2-x-2}}{6+x-x^2} \geq 0$$

$$\begin{cases} x^2-x-2 \geq 0 \\ x^2-x-6 \neq 0 \end{cases}$$

$$(-\infty;-2) \cup (-2;-1] \cup [2;3) \cup (3;+\infty)$$

$$x=1$$

13.

$$\frac{|x+2|-|x|}{\sqrt{x^3-4}} \geq 0$$

$$\sqrt{x^3-4} > 0$$

$$x^3-4 > 0$$

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

$$x^3-4 > 0$$

$$\left(\sqrt[3]{4};+\infty\right)$$

$$14. \sqrt[3]{2x^2-11x-21} \cdot \sqrt{4-x} \leq 0$$

$$4-x \geq 0$$

$$x \leq 4$$

$$2x^2-11x-21=0$$

$$D=121+168=289$$

$$x_1 = \frac{11-17}{4} = -\frac{6}{4} = -\frac{3}{2}$$

$$x_2=7$$

$$\left[-\frac{3}{2};4\right] \quad -1; 0; 1; 2; 3; 4.$$

$$15. \sqrt[4]{\left(\frac{x^2-x-6}{x^2+4}\right)} + \sqrt{\left(\frac{x^2+3x+2}{x^2+1}\right)^2} > 0$$

$$\begin{cases} x^2-x-6=0 \\ x^2+3x+2=0 \end{cases}$$

$$\begin{cases} x^2-x-6=0 \\ x^2+3x+2=0 \end{cases}$$

3 и -2

-1; -2

-2

$$16. \frac{2x}{\sqrt{2x+9}} \leq \sqrt{1+2x} - 1$$

$$\frac{2x}{\sqrt{2x+9}} \leq \frac{1+2x-1}{\sqrt{1+2x+1}}$$

$$\frac{2x}{\sqrt{2x+9}} - \frac{2x}{\sqrt{1+2x+1}} \leq 0$$

$$2x \frac{\sqrt{1+2x+1} - \sqrt{2x+9}}{\sqrt{2x+9}(\sqrt{1+2x+1})} \leq 0$$

$$x \geq -\frac{1}{2}$$

$$x = 0$$

$$\sqrt{1+2x+1} = \sqrt{2x+9}$$

$$1+2x+2\sqrt{1+2x+1} = 2x+9$$

$$2\sqrt{1+2x} = 7$$

$$4(1+2x) = 49$$

$$4+8x = 49$$

$$8x = 45$$

$$x = 5\frac{5}{8}$$