

Logarifmik tengsizliklarni yechishning yana bir usuli haqida.

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Kalit so'zlar: Ifoida, tengsizlik, ishora, fuksiya, aniqlanish sohasi, yechim, interval, funksiya nollari.

Logarifmik tengsizliklarni yechishning bir qancha usullari mavjud. Biz quyida tengsizliklarni yechishning yana bir usuli haqida to'xtalib o'tmoqchimiz. $\log_a b$ va $(a-1)(b-1)$ ifoda bir hil ishoraga ega bo'lishini isbotlaymiz.

Isbot: Agar $a > 1$ va $\log_a b > 0$ bo'lsa, u holda $b > 1$ va $(a-1)(b-1) > 0$ bo'ladi. Agar $a > 1$ va $\log_a b < 0$ bo'lsa, u holda $0 < b < 1$ va $(a-1)(b-1) < 0$ bo'ladi. Agar $0 < a < 1$ va $\log b > 0$ bo'lsa, u holda $0 < b < 1$ va $(a-1)(b-1) > 0$ bo'ladi.

Agar $0 < a < 1$ va $\log b < 0$ bo'lsa, u holda $b > 1$ va $(a-1)(b-1) < 0$ bo'ladi. Isbotlandi.

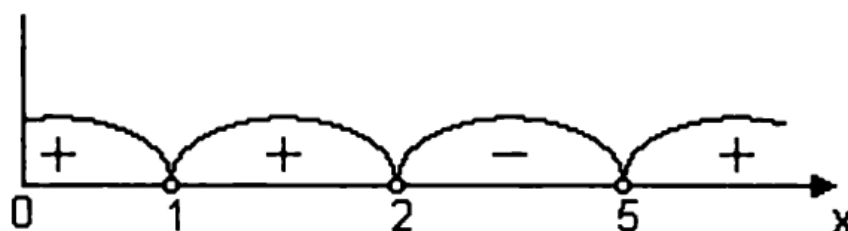
1-misol. Ushbu

$$\log_{\frac{1}{2}} \frac{2(x-2)}{(x+1)(x-5)} \geq 1$$

tengsizlikni yeching.

Yechish. Tengsizlikning chap tarafida turgan funksiyaning aniqlanish sohasini topamiz (1-rasm)

$$\begin{cases} x > 0, \\ x \neq 1, \\ \frac{2(x-2)}{(x+1)(x-5)} > 0 \end{cases} \Leftrightarrow \begin{cases} x > 0, \\ x \neq 1 \\ \frac{x-2}{x-5} > 0 \end{cases}$$



1-rasm

$$D(f): x \in (0;1) \cup (1;2) \cup (5;\infty).$$

Tengsizlikni

$$\log_{\frac{1}{2}} \frac{2(x-2)x}{(x+1)(x-5)} \geq \log_{\frac{1}{2}} \frac{1}{x}$$

ko‘rinishda yozamiz. Bundan $\log_{\frac{1}{x}} \frac{2(x-2)x}{(x+1)(x-5)} \geq 0$.

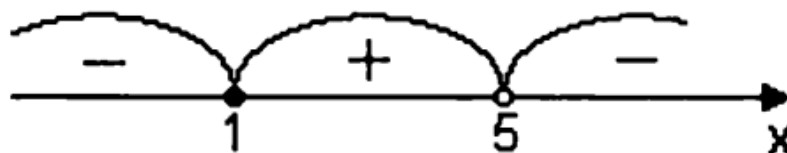
Endi yuqorida isbotlangan tasdiqdan foydalanamiz.

$$\left(\frac{1}{x} - 1\right) \frac{2(x-2)x}{(x+1)(x-5)} - 1 \geq 0 \Leftrightarrow \frac{1-x}{x} \cdot \frac{2x^2 - 4x - x^2 + 5x - x + 5}{(x+1)(x-5)} \geq 0 \Leftrightarrow$$

$$\Leftrightarrow \frac{(1-x)(x^2+5)}{x(x+1)(x-5)} \geq 0$$

Aniqlanish sohasiga ko‘ra $x > 0$ bo‘lgani uchun $x+1 > 0$, $x^2+5 > 0$ bo‘ladi. Shuning uchun

oxirgii tengsizlikni $\frac{1-x}{x-5} \geq 0$ ko‘rinishda yozish mumkin (2-rasm)



2-rasm

$x \in [1;5]$, $x \neq 1$ bo‘lgani uchun $x \in (1;5)$ bo‘ladi. Funksiyaning aniqlanish sohasini e‘tiborga olib $(1;2)$ ni hosil qilamiz.

Javob: $(1;2)$

2- misol. $\log_{x-3} (x^2 - 4x)^2 \leq 4$ tengsizlikni yeching.

Yechish. Funksiyaning aniqlanish sohasini topamiz.

$$f(x) = \log_{x-3} (x^2 - 4x)^2; \begin{cases} x-3 > 0, \\ x-3 \neq 1, \\ (x^2 - 4x)^2 > 0 \end{cases} \Leftrightarrow \begin{cases} x > 3, \\ x \neq 4, \\ x \neq 0. \end{cases} D(f): (3;4) \cup (4;\infty)$$

Berilgan tengsizlikni $\log_{x-3} (x^2 - 4x)^2 \leq \log_{x-3} (x-3)^4$

yoki $\log_{x-3} \frac{(x^2 - 4x)^2}{(x-3)^4} \leq 0$ tengsizlik bilan almashtiramiz. Yuqorida keltirilgan tasdiqdan

foydalanamiz.

$$(x-4) \left(\frac{(x^2 - 4x)^2}{(x-3)^4} - 1 \right) \leq 0 \Leftrightarrow (x-4) \frac{(x^2 - 4x - (x-3)^2)(x^2 - 4x + (x+3)^2)}{(x-3)^4} \leq 0 \Leftrightarrow$$

$$\Leftrightarrow (x-4) \frac{(2x-9)(2x^2-10x+9)}{(x-3)^4} \leq 0$$

$$q(x) = (x-4) \frac{(2x-9)(2x^2-10x+9)}{(x-3)^4}$$

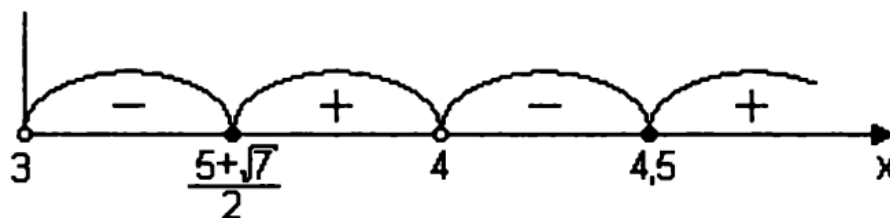
funksiyani qaraymiz.

Uning aniqlanish sohasi $D(q): x \neq 3$. Funksiyaning nollarini topamiz.

$$(x-4) = 0 \Leftrightarrow x = 4, \quad (2x-9) = 0 \Leftrightarrow x = 4,5;$$

$$2x^2 - 10x + 9 = 0 \Leftrightarrow x = \frac{5 \pm \sqrt{7}}{2}$$

$f(x)$ funksiyaning aniqlanish sohasini e'tiborga olib, 3-rasmni hosil qilamiz.



3-rasm

$$\text{Javob: } \left[3; \frac{5+\sqrt{7}}{2} \right] \cup (4; 4,5)$$

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