Realne funkcije realne varijable – 1. dio

MATEMATIKA 2

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Sadržaj

prvi zadatak

drugi zadatak

Trigonometrijske i ciklometrijske funkcije

treći zadatak

prvi zadatak

Zadatak 1

Odredite domene i nultočke sljedećih funkcija:

a) $f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$

b) $g(x) = (2 + x - x^2)^{\frac{1}{5}}$

c) $h(x) = \log\left(10^{x-1} - 5\right)$

d) $k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2}-2} - 1$$

Rješenje

a) domena

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

Rješenje

a) domena

$$\frac{x-3}{x+2} - 2 \geqslant 0$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$x + 2 \neq 0$$

Rješenje

a) domena

$$\frac{x-3}{x+2} - 2 \geqslant 0$$

uključeno u ovom uvjetu

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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Rješenje

uključeno u ovom uvjetu

a) domena

$$\frac{x-3}{x+2} - 2 \geqslant 0$$

$$\overline{\qquad\qquad\qquad}$$
$$x+2$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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a) domena

uključeno u ovom uvjetu

$$\frac{x-3}{x+2} - 2 \geqslant 0$$

$$\frac{x-3-2(x+2)}{x+2}$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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$$\frac{x - 3 - 2(x+2)}{x+2} \geqslant 0$$

$$\frac{}{x+2}$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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Rješenje

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$$\frac{x-3}{x+2} - 2 \geqslant 0$$

$$\frac{x-3-2(x+2)}{x+2} \geqslant 0$$

$$\frac{-x-7}{x+2}$$

$$x+2\neq 0$$

Rješenje

a) domena

uključeno u ovom uvjetu

$$\frac{x-3}{x+2}-2\geqslant 0$$

$$\frac{x-3-2(x+2)}{x+2}\geqslant 0$$

$$\frac{-x-7}{x+2}\geqslant 0$$

$$f(x)=\sqrt[4]{\frac{x-3}{x+2}-2}-1$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$x + 2 \neq 0$$

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$$\frac{x-3}{x+2} - 2 \geqslant 0$$

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$$\frac{-x-7}{x+2} \geqslant 0$$

$$-x - 7 = 0$$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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$-x-7$		

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	$-\infty$	
$-x-7$		
$x+2$		
$\frac{-x-7}{x+2}$		

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	$-\infty$	$+\infty$
$-x-7$		
$x+2$		
$\frac{-x-7}{x+2}$		

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	$-\infty$ … -7	-7 … -2	-2 … $+\infty$
$-x-7$	$+$		
$x+2$			
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	$-\infty$ -7	-7 -2	-2 $+\infty$
$-x-7$	$+$	$-$	$-$
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$-x-7$	$+$	$-$	$-$
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$\frac{-x-7}{x+2}$	$-$	$+$	

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$\frac{-x-7}{x+2}$	$-$	$+$	$-$

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	$-\infty$ ... -7	-7 ... -2	-2 ... $+\infty$
$-x-7$	$+$	$-$	$-$
$x+2$	$-$	$-$	$+$
$\frac{-x-7}{x+2}$	$-$	$+$	$-$

RJEŠENJE:

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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	$-\infty$ do -7	-7 do -2	-2 do $+\infty$
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$x+2$	$-$	$-$	$+$
$\frac{-x-7}{x+2}$	$-$	$+$	$-$

RJEŠENJE:

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$-x-7$	$+$	$-$	$-$	
$x+2$	$-$	$-$	$+$	
$\frac{-x-7}{x+2}$	$-$	$+$	$-$	

RJEŠENJE: $x \in [-7, -2\rangle$

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$x + 2 \neq 0$$

uključeno u ovom uvjetu

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	$-\infty$ do -7	-7 do -2	-2 do $+\infty$
$-x-7$	$+$	$-$	$-$
$x+2$	$-$	$-$	$+$
$\frac{-x-7}{x+2}$	$-$	$+$	$-$

RJEŠENJE: $x \in [-7, -2\rangle$

$$D_f = [-7, -2\rangle$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

nultočke

$$\sqrt[4]{\frac{x-3}{x+2}-2}-1=0$$

$$f(x)=\sqrt[4]{\frac{x-3}{x+2}-2}-1$$

$$D_f=[-7,-2\rangle$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^{4}$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

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$$\frac{x-3}{x+2} - 2$$

nultočke

$$\sqrt[4]{\frac{x-3}{x+2}-2}-1=0$$

$$\sqrt[4]{\frac{x-3}{x+2}-2}=1 \quad \Big/^{4}$$

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

$$f(x)=\sqrt[4]{\frac{x-3}{x+2}-2}-1$$

$$D_f=[-7,-2\rangle$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

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$$\frac{x-3}{x+2} - 2 = 1$$

nultočke

$$\sqrt[4]{\frac{x-3}{x+2}-2}-1=0$$

$$\sqrt[4]{\frac{x-3}{x+2}-2}=1 \quad \Big/^{4}$$

$$\frac{x-3}{x+2}-2=1$$

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

$$f(x)=\sqrt[4]{\frac{x-3}{x+2}-2}-1$$

$$D_f=[-7,-2\rangle$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2}-2}-1$$

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$$\sqrt[4]{\frac{x-3}{x+2}-2}-1=0$$

$$\sqrt[4]{\frac{x-3}{x+2}-2}=1 \quad \Big/^4$$

$$\frac{x-3}{x+2}-2=1$$

$$\frac{x-3}{x+2}=3 \quad \Big/ \cdot (x+2)$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \Big/ ^4$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \Big/ \cdot (x+2)$$

$$x - 3$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^{4}$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \quad \Big/ \cdot (x+2)$$

$$x - 3 =$$

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$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

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$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^{4}$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \quad \Big/ \cdot (x+2)$$

$$x - 3 = 3x + 6$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^{4}$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \quad \Big/ \cdot (x+2)$$

$$x - 3 = 3x + 6$$

$$-2x = 9$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^4$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \quad \Big/ \cdot (x+2)$$

$$x - 3 = 3x + 6$$

$$-2x = 9$$

$$x = -\frac{9}{2}$$

nultočke

$$f(x) = \sqrt[4]{\frac{x-3}{x+2} - 2} - 1$$

$$D_f = [-7, -2\rangle$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} - 1 = 0$$

$$\sqrt[4]{\frac{x-3}{x+2} - 2} = 1 \quad \Big/^4$$

$$\frac{x-3}{x+2} - 2 = 1$$

$$\frac{x-3}{x+2} = 3 \quad \Big/ \cdot (x+2)$$

$$x - 3 = 3x + 6$$

$$-2x = 9$$

$$\boxed{x = -\frac{9}{2}}$$

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jest nultočka
jer pripada domeni

b) domena

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

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nultočke

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

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nultočke

$$ax^2 + bx + c = 0$$
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$$\sqrt[5]{2 + x - x^2} = 0 \,/\, ^5$$
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c) domena

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jest nultočka jer pripada domeni

$\log_a x = b \rightsquigarrow x = a^b$

$a^x = b \rightsquigarrow x = \log_a b$

$$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$$

d) domena

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d) domena

- $x + 2 > 0$

$$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$$

d) domena

- $x + 2 > 0 \leftsquigarrow$ zbog $\log_{\frac{1}{2}}$

$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$

d) domena

- $x + 2 > 0$ ⇜ zbog $\log_{\frac{1}{2}}$
- $\log_{\frac{1}{2}}(x+2) \geqslant 0$

$$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$$

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- $x + 2 > 0$ ⇜ zbog $\log_{\frac{1}{2}}$
- $\log_{\frac{1}{2}}(x+2) \geqslant 0$ ⇜ zbog $\sqrt{}$

$$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$$

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$$x + 2 > 0$$
$$x > -2$$

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$$\log_{\frac{1}{2}}(x+2) \geqslant 0$$

$$\log_{\frac{1}{2}}(x+2) \geqslant \log_{\frac{1}{2}}\left(\frac{1}{2}\right)^0$$

Ako je $a > 1$

$\log_a x > \log_a y \;\Leftrightarrow\; x > y$

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$k(x) = \sqrt{\log_{\frac{1}{2}}(x+2)}$

d) domena

- $x + 2 > 0$ ⟵ zbog $\log_{\frac{1}{2}}$
- $\log_{\frac{1}{2}}(x+2) \geqslant 0$ ⟵ zbog $\sqrt{}$

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presjek rješenja

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presjek rješenja

$$x \in \langle -2, -1]$$

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$$x \in \langle -2, -1]$$

$$D_k = \langle -2, -1]$$

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nultočke

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nultočke

$$D_k = \langle -2, -1]$$

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jest nultočka
jer pripada domeni

$$\log_a x = b \rightsquigarrow x = a^b$$

drugi zadatak

Zadatak 2

Odredite nultočke funkcija

$f(x) = 2^{5-x} + 50 \;\; i \;\; g(x) = 2^{5-x} - 50.$

Zadatak 2

Odredite nultočke funkcija

$f(x) = 2^{5-x} + 50$ *i* $g(x) = 2^{5-x} - 50.$

Rješenje

nultočke od f

Zadatak 2

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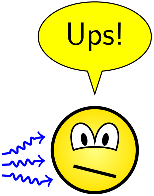

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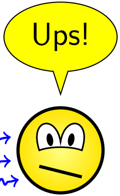

funkcija f nema nultočki

$$a^x = b \rightsquigarrow x = \log_a b$$

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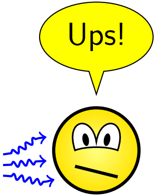

funkcija f nema nultočki

nultočke od g

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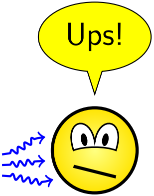

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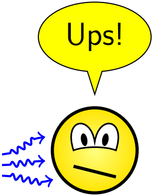

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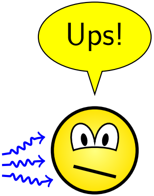

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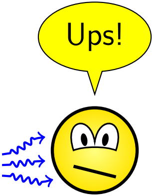

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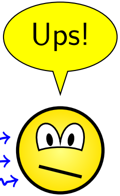

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Zadatak 2

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Rješenje

nultočke od f

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funkcija f nema nultočki

nultočke od g

$$2^{5-x} - 50 = 0$$

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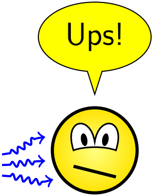

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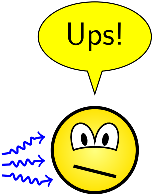

funkcija f nema nultočki

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$$x = 5 - \log_2 50$$

$a^x = b \rightsquigarrow x = \log_a b$

Zadatak 2

$$\log_a x = \frac{\log x}{\log a} = \frac{\ln x}{\ln a}$$

Odredite nultočke funkcija

$f(x) = 2^{5-x} + 50$ *i* $g(x) = 2^{5-x} - 50.$

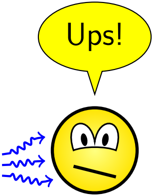
Rješenje

nultočke od f

$$2^{5-x} + 50 = 0$$

$$2^{5-x} = -50$$

$$5 - x = \log_2(-50)$$



funkcija f nema nultočki

nultočke od g

$$2^{5-x} - 50 = 0$$

$$2^{5-x} = 50$$

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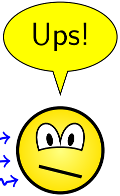

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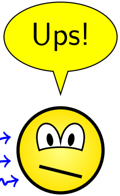

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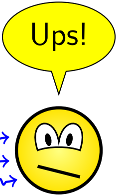

funkcija f nema nultočki

$$a^x = b \rightsquigarrow x = \log_a b$$

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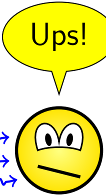

funkcija f nema nultočki

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egzaktna vrijednost nultočke

$$x = 5 - \frac{\log 50}{\log 2}$$

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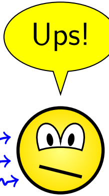

funkcija f nema nultočki

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egzaktna vrijednost nultočke

$$x = 5 - \frac{\log 50}{\log 2}$$

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Zadatak 2

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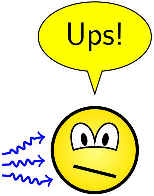

funkcija f nema nultočki

nultočke od g

$$2^{5-x} - 50 = 0$$

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egzaktna vrijednost nultočke

$$\boxed{x = 5 - \log_2 50}$$

$$x = 5 - \frac{\log 50}{\log 2}$$

aproksimacija nultočke na 5 decimala

$$\boxed{x \approx -0.64386}$$

$$a^x = b \rightsquigarrow x = \log_a b$$

Nultočke funkcije g

1. način

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2. način

$$a^x = b \rightsquigarrow x = \log_a b$$

Nultočke funkcije g

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Nultočke funkcije g

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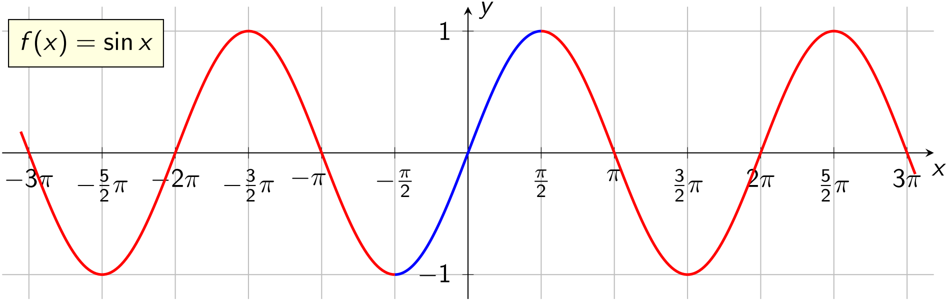
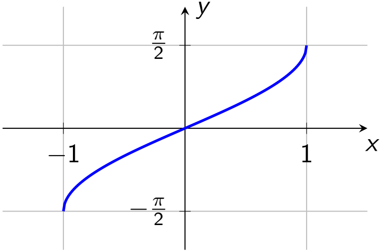
Trigonometrijske i ciklometrijske funkcije

$f(x) = \sin x$

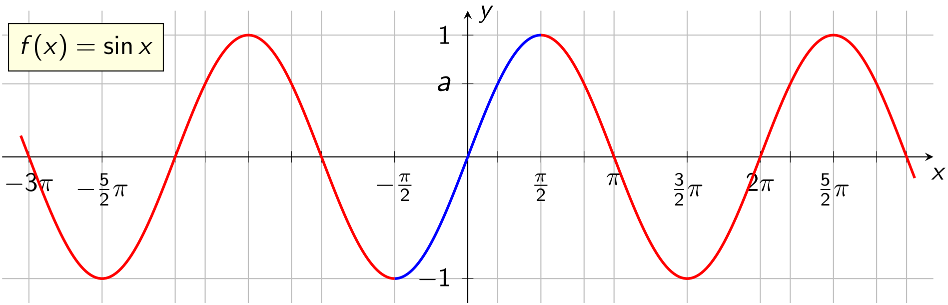


$f^{-1}(x) = \arcsin x$

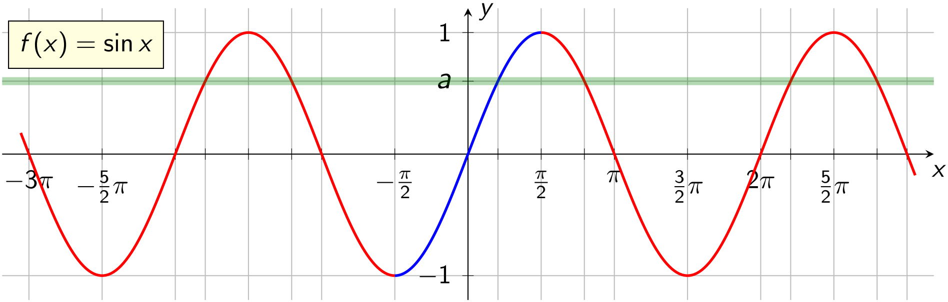


$$\sin x = 0 \;\Leftrightarrow\; x = k\pi,\ k \in \mathbb{Z}$$

$$\arcsin x = 0 \;\Leftrightarrow\; x = 0$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$



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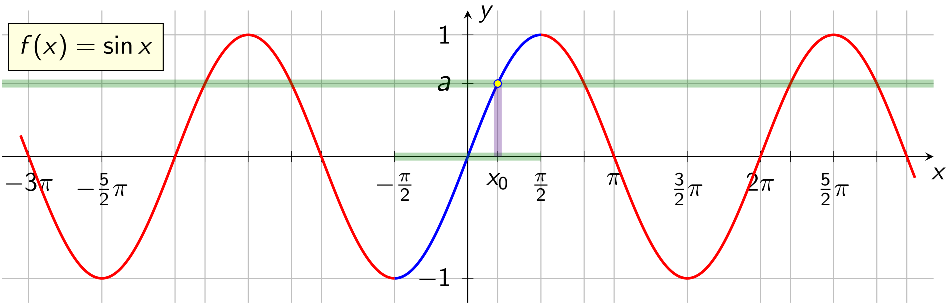
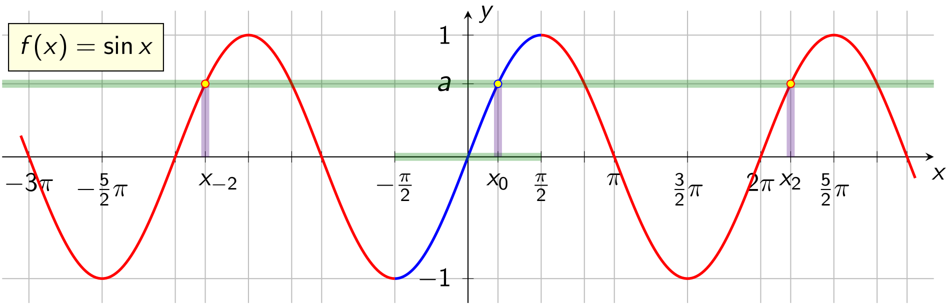


Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

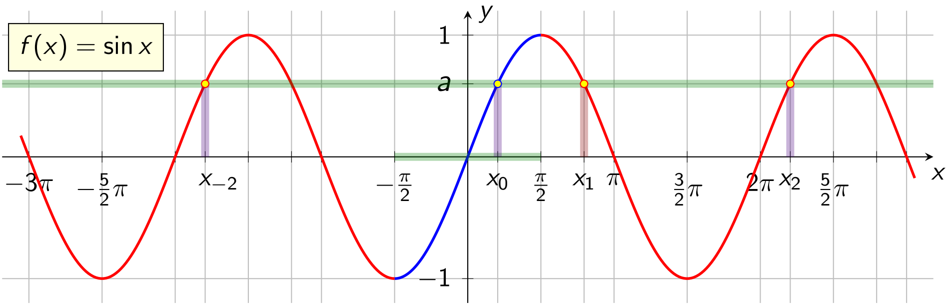
$$x_0 = \arcsin a$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

$$x_0 = \arcsin a$$

$$x_{2k} = x_0 + 2k\pi$$

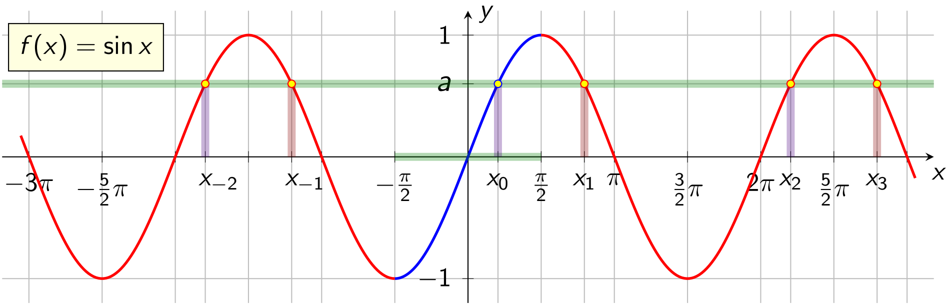


Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

$$x_0 = \arcsin a$$

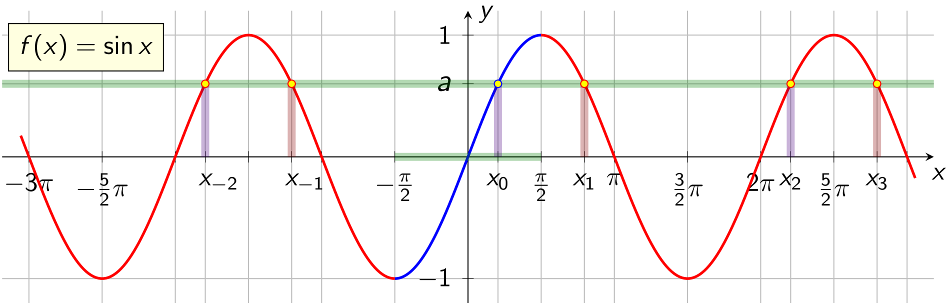
$$x_1 = \pi - \arcsin a$$

$$x_{2k} = x_0 + 2k\pi$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

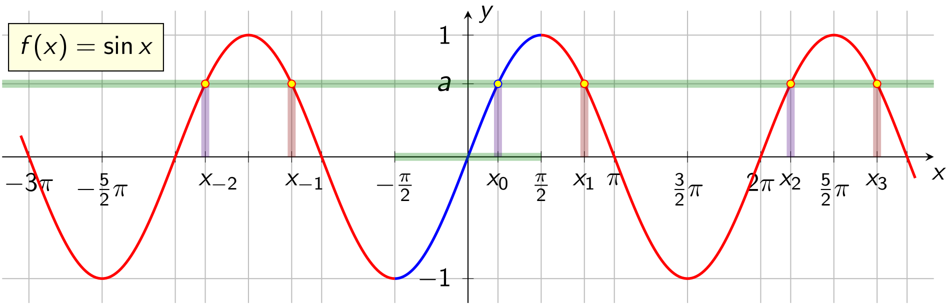
$$x_0 = \arcsin a$$
$$x_1 = \pi - \arcsin a$$
$$x_{2k} = x_0 + 2k\pi$$
$$x_{2k+1} = x_1 + 2k\pi$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

- $x_k^{(1)} = \arcsin a + 2k\pi, \;\; k \in \mathbb{Z}$

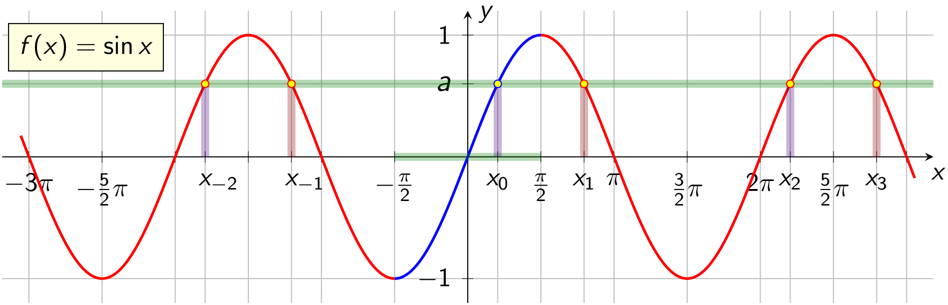
$$x_0 = \arcsin a$$
$$x_1 = \pi - \arcsin a$$
$$x_k^{(1)} = x_{2k} = x_0 + 2k\pi$$
$$x_{2k+1} = x_1 + 2k\pi$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

- $x_k^{(1)} = \arcsin a + 2k\pi, \ \ k \in \mathbb{Z}$
- $x_k^{(2)} = \pi - \arcsin a + 2k\pi, \ \ k \in \mathbb{Z}$

$$x_0 = \arcsin a$$
$$x_1 = \pi - \arcsin a$$
$$x_k^{(1)} = x_{2k} = x_0 + 2k\pi$$
$$x_k^{(2)} = x_{2k+1} = x_1 + 2k\pi$$



Rješenja jednadžbe $\sin x = a$ za $|a| \leqslant 1$

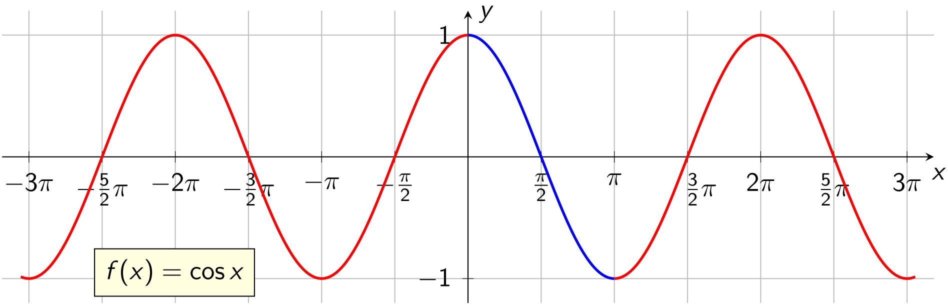
$$x_0 = \arcsin a$$
$$x_1 = \pi - \arcsin a$$

- $x_k^{(1)} = \arcsin a + 2k\pi,\ \ k \in \mathbb{Z}$
- $x_k^{(2)} = \pi - \arcsin a + 2k\pi,\ \ k \in \mathbb{Z}$

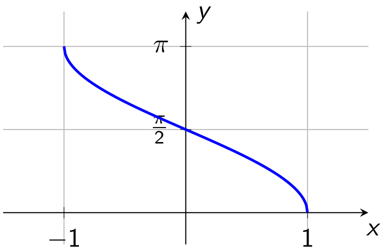
$$x_k^{(1)} = x_{2k} = x_0 + 2k\pi$$
$$x_k^{(2)} = x_{2k+1} = x_1 + 2k\pi$$

Možemo sva rješenja zapisati pomoću jedne formule

$$x_k = (-1)^k \arcsin a + k\pi,\ \ k \in \mathbb{Z}$$

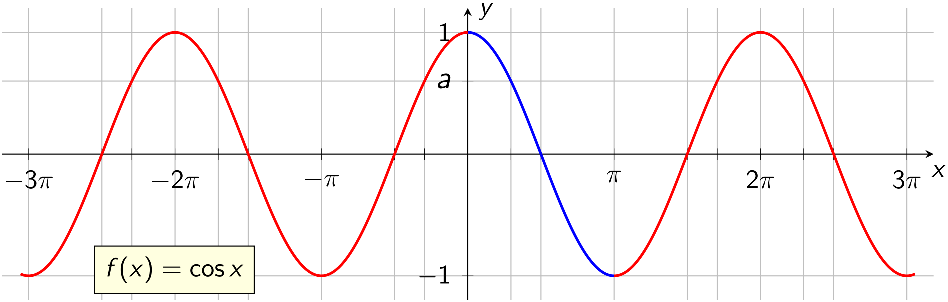


$f^{-1}(x) = \arccos x$

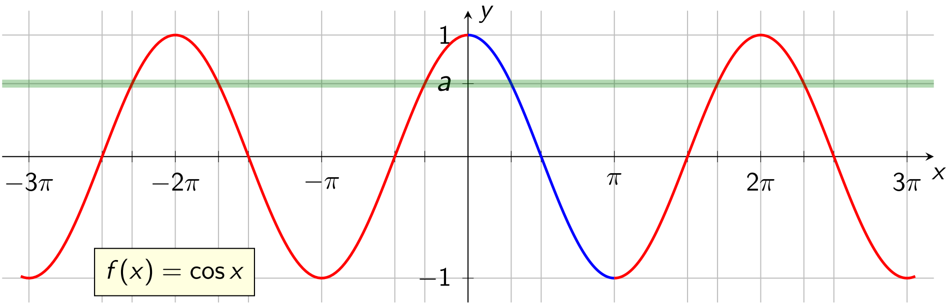


$$\cos x = 0 \;\Leftrightarrow\; x = \frac{2k+1}{2}\pi,\; k \in \mathbb{Z}$$

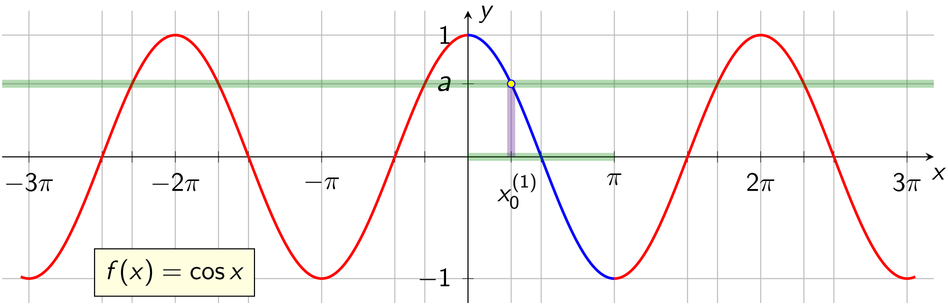
$$\arccos x = 0 \;\Leftrightarrow\; x = 1$$



Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

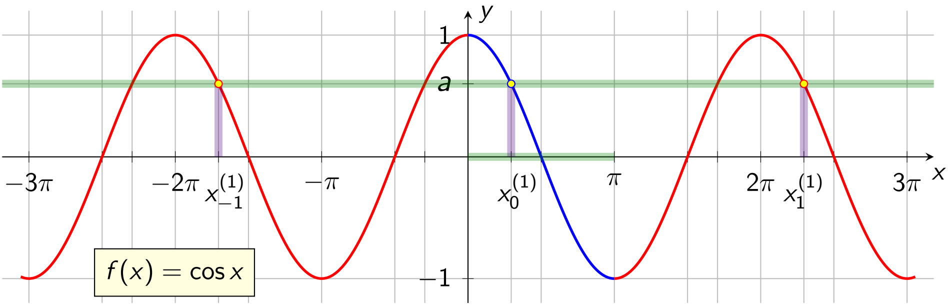


Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$



$x_0^{(1)} = \arccos a$

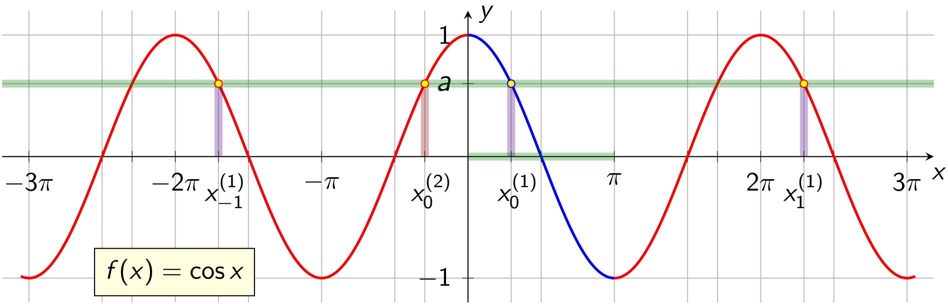
Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$



Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

$$x_0^{(1)} = \arccos a$$

$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$

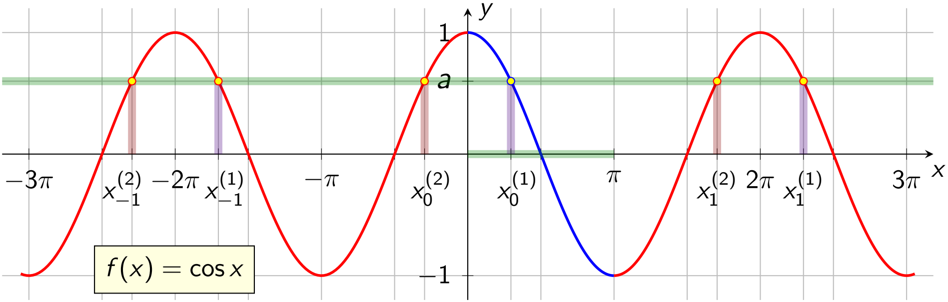


Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

$$x_0^{(1)} = \arccos a$$

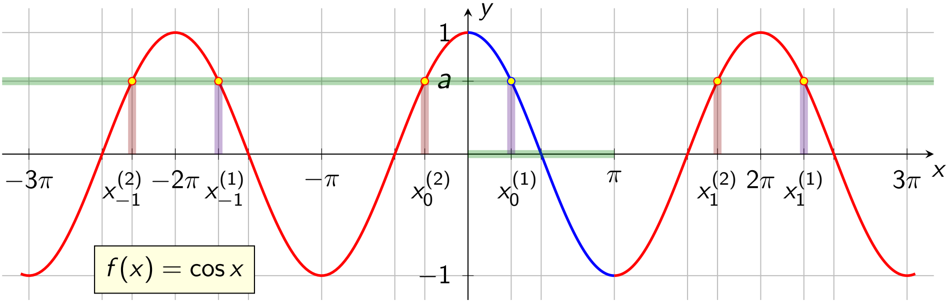
$$x_0^{(2)} = -\arccos a$$

$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$



Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

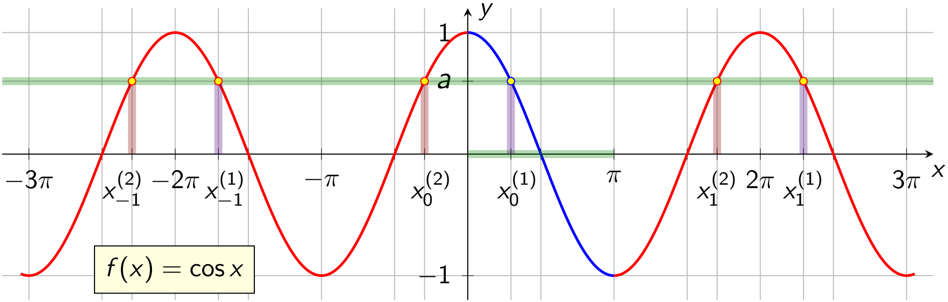
$$x_0^{(1)} = \arccos a$$
$$x_0^{(2)} = -\arccos a$$
$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$
$$x_k^{(2)} = x_0^{(2)} + 2k\pi$$



Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

- $x_k^{(1)} = \arccos a + 2k\pi,\ \ k \in \mathbb{Z}$

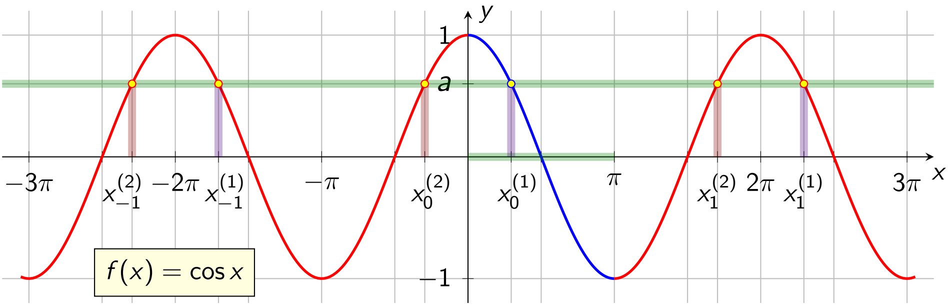
$$x_0^{(1)} = \arccos a$$
$$x_0^{(2)} = -\arccos a$$
$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$
$$x_k^{(2)} = x_0^{(2)} + 2k\pi$$



Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

- $x_k^{(1)} = \arccos a + 2k\pi, \ \ k \in \mathbb{Z}$
- $x_k^{(2)} = -\arccos a + 2k\pi, \ \ k \in \mathbb{Z}$

$$x_0^{(1)} = \arccos a$$
$$x_0^{(2)} = -\arccos a$$
$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$
$$x_k^{(2)} = x_0^{(2)} + 2k\pi$$



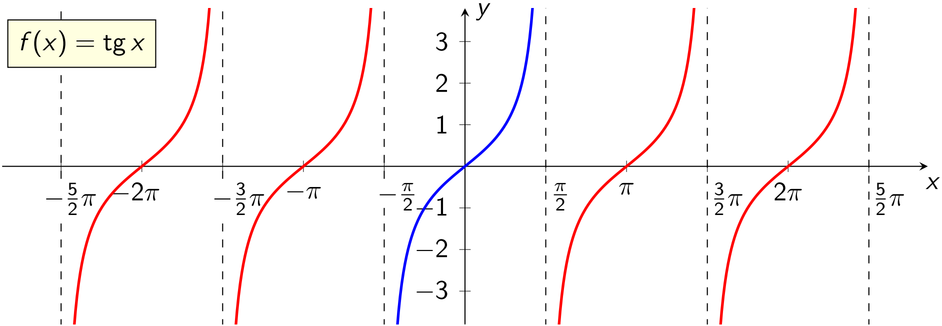
Rješenja jednadžbe $\cos x = a$ za $|a| \leqslant 1$

$$x_0^{(1)} = \arccos a$$
$$x_0^{(2)} = -\arccos a$$
$$x_k^{(1)} = x_0^{(1)} + 2k\pi$$
$$x_k^{(2)} = x_0^{(2)} + 2k\pi$$

- $x_k^{(1)} = \arccos a + 2k\pi, \; k \in \mathbb{Z}$
- $x_k^{(2)} = -\arccos a + 2k\pi, \; k \in \mathbb{Z}$

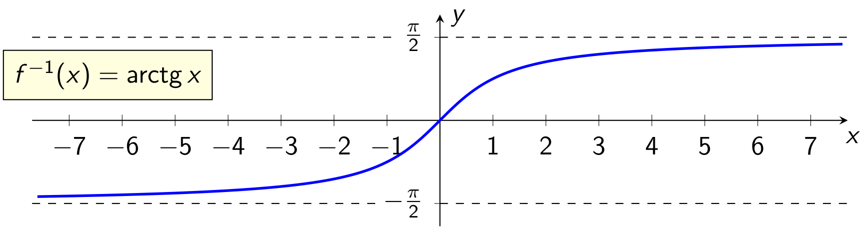
Bez indeksiranja možemo sva rješenja kratko zapisati

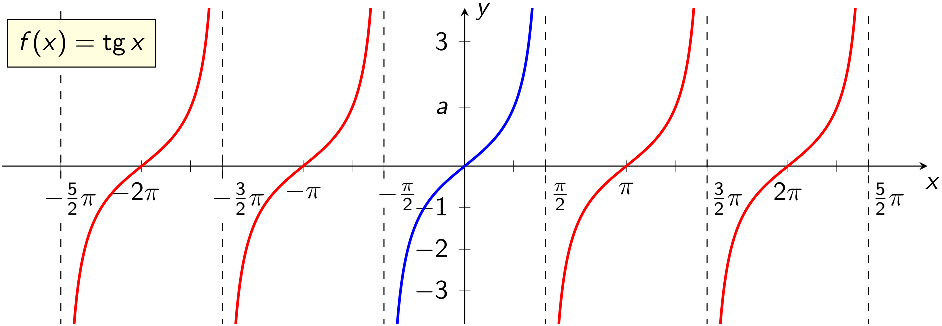
$$x = \pm \arccos a + 2k\pi, \; k \in \mathbb{Z}$$



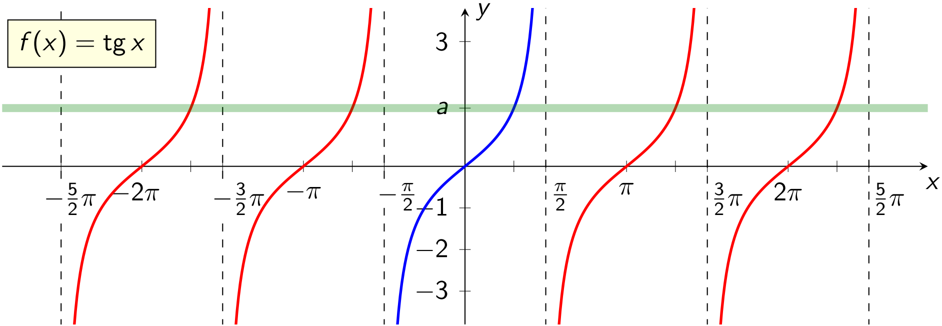
$$\operatorname{tg} x = 0 \iff x = k\pi,\ k \in \mathbb{Z}$$

$$\operatorname{arctg} x = 0 \iff x = 0$$

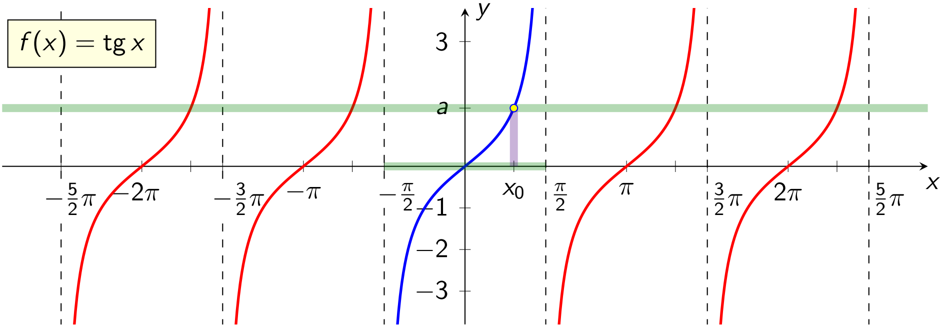




Rješenja jednadžbe $\operatorname{tg} x = a$

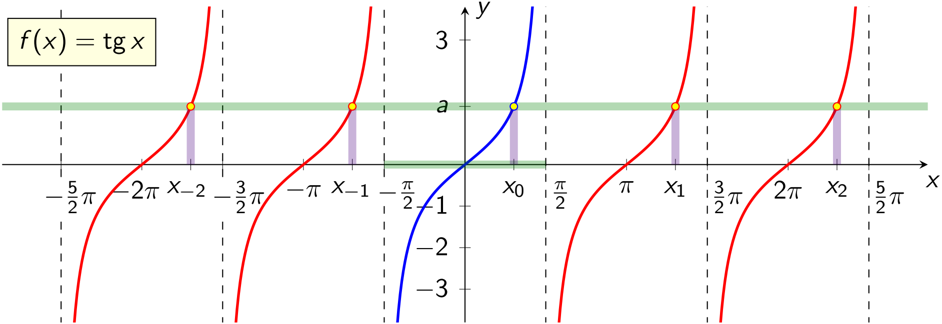


Rješenja jednadžbe $\operatorname{tg} x = a$



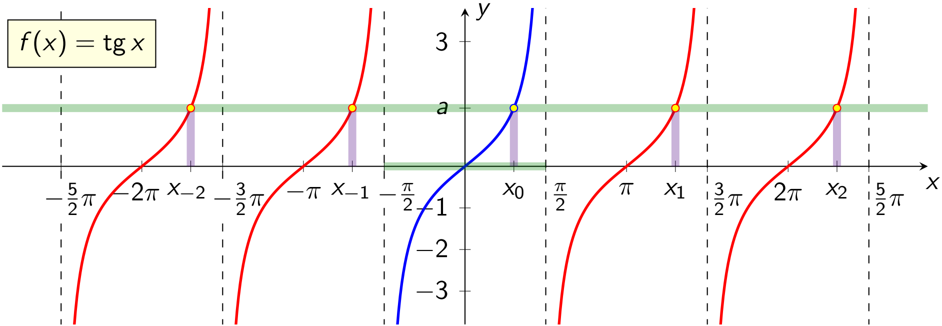
Rješenja jednadžbe $\operatorname{tg} x = a$

- $x_0 = \operatorname{arctg} a$



Rješenja jednadžbe tg $x = a$

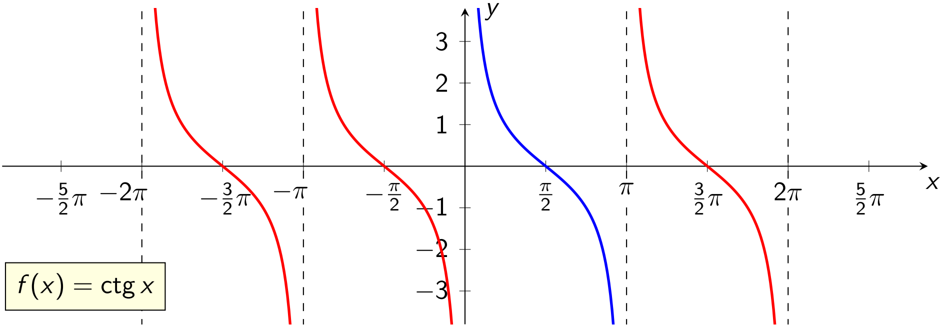
- $x_0 = \operatorname{arctg} a$
- $x_k = x_0 + k\pi, \; k \in \mathbb{Z}$



Rješenja jednadžbe $\operatorname{tg} x = a$

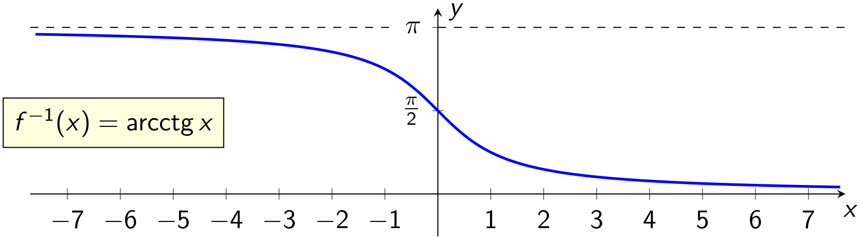
- $x_0 = \operatorname{arctg} a$
- $x_k = x_0 + k\pi, \;\; k \in \mathbb{Z}$

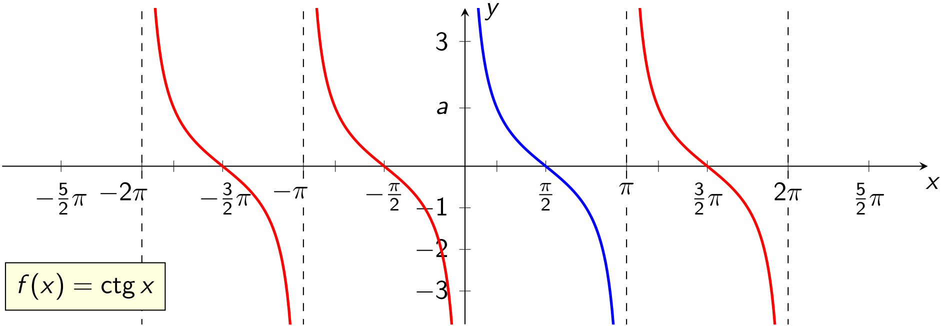
$$x_k = \operatorname{arctg} a + k\pi, \;\; k \in \mathbb{Z}$$



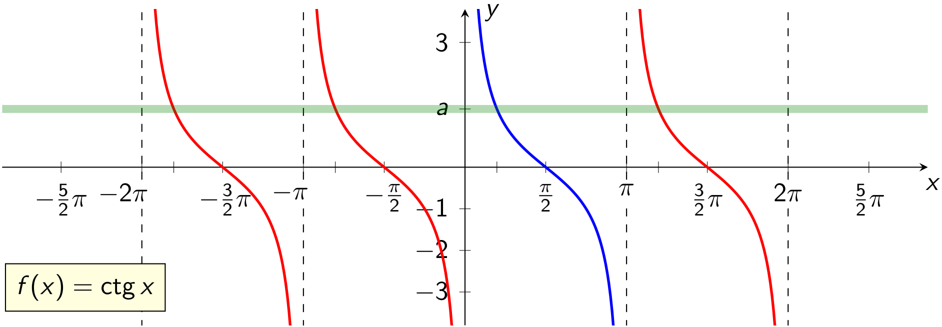
$$\operatorname{ctg} x = 0 \iff x = \frac{2k+1}{2}\pi,\ k \in \mathbb{Z}$$

$$(\forall x \in \mathbb{R})\big(\operatorname{arcctg} x \neq 0\big)$$

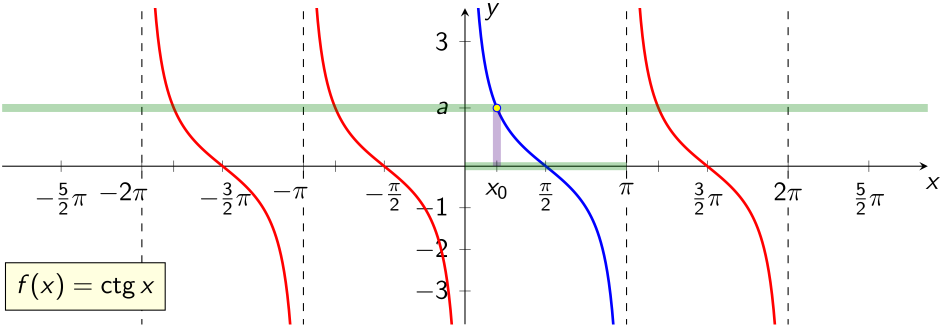




Rješenja jednadžbe $\operatorname{ctg} x = a$

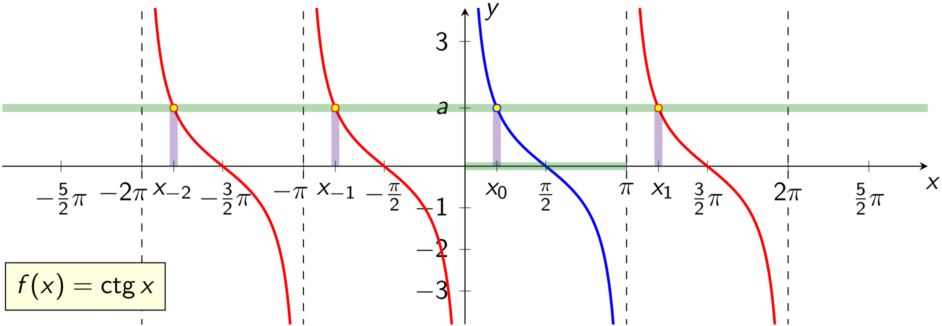


Rješenja jednadžbe $\operatorname{ctg} x = a$



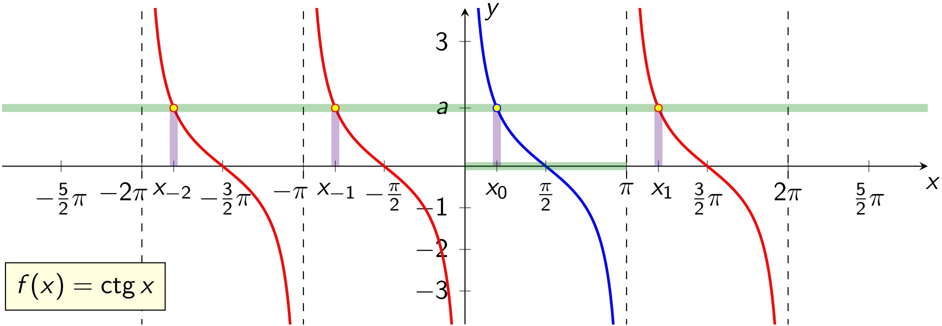
Rješenja jednadžbe $\text{ctg}\, x = a$

- $x_0 = \text{arcctg}\, a$



Rješenja jednadžbe $\operatorname{ctg} x = a$

- $x_0 = \operatorname{arcctg} a$
- $x_k = x_0 + k\pi, \ k \in \mathbb{Z}$



Rješenja jednadžbe $\operatorname{ctg} x = a$

- $x_0 = \operatorname{arcctg} a$
- $x_k = x_0 + k\pi, \;\; k \in \mathbb{Z}$

$$x_k = \operatorname{arcctg} a + k\pi, \;\; k \in \mathbb{Z}$$

treći zadatak

Zadatak 3

Odredite domenu i nultočke sljedećih funkcija:

a) $h(x) = \operatorname{ctg}(\pi x + 2)$

b) $f(x) = \sqrt{\sin 3x + \frac{1}{2}}$

c) $g(x) = \dfrac{\arccos(x^2 - 3)}{x - 2}$

Rješenje

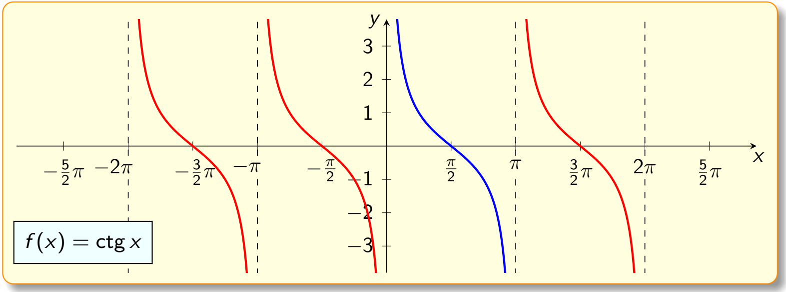
$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

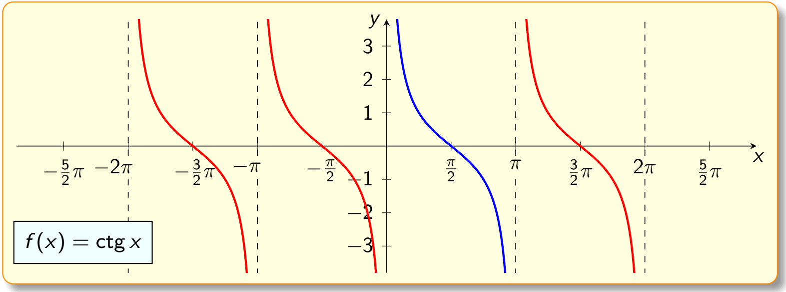


Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$



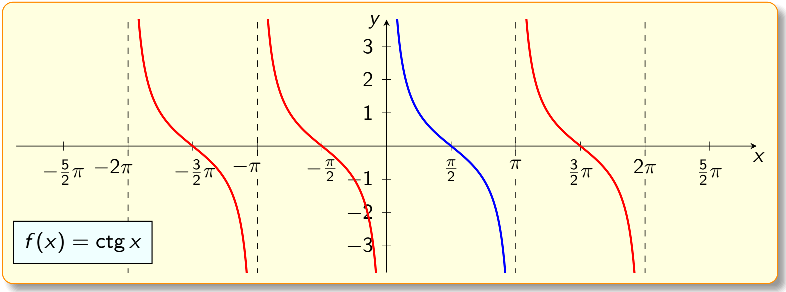
Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2$$



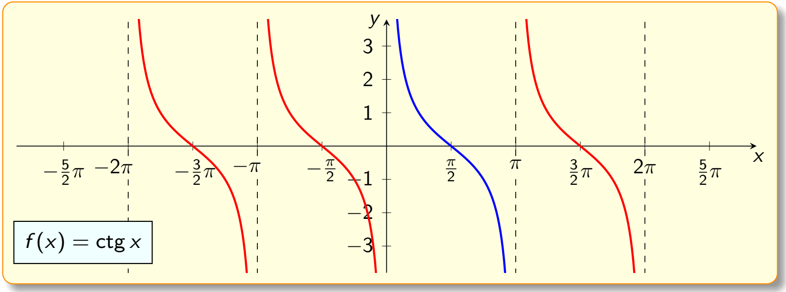
Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,\Big/ : \pi$$



Rješenje

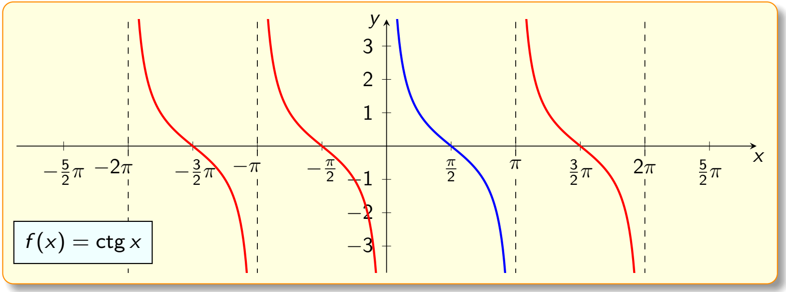
$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \;/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$



Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

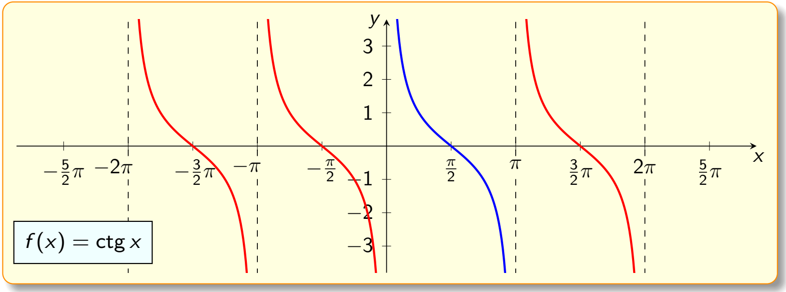
a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}$$



Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

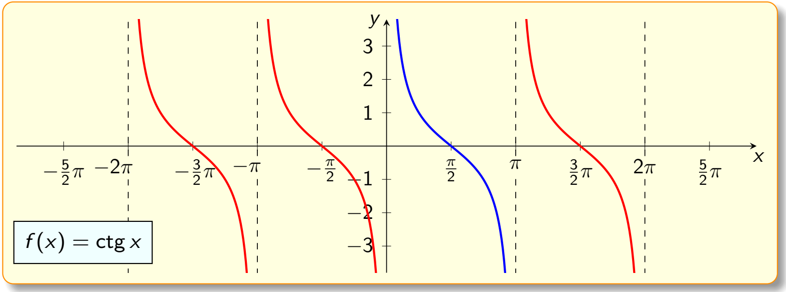
a) domena

$$\pi x + 2 \neq k\pi,\ \ k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi},\ \ k \in \mathbb{Z}$$



Rješenje

$h(x) = \text{ctg}\left(\pi x + 2\right)$

a) domena

$$\pi x + 2 \neq k\pi, \ \ k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,\Big/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \ \ k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{k - \frac{2}{\pi} : k \in \mathbb{Z}\right\}$$

Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi,\;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,\Big/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi},\;\; k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{k - \frac{2}{\pi} : k \in \mathbb{Z}\right\}$$

Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \, \big/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \;\; k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{ k - \frac{2}{\pi} : k \in \mathbb{Z} \right\}$$

ekvivalentni zapis

$$D_h = \bigcup_{k \in \mathbb{Z}} \left\langle k - \frac{2}{\pi}, \, k + 1 - \frac{2}{\pi} \right\rangle$$

Rješenje

$h(x) = \text{ctg}\,(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \;\; k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{k - \frac{2}{\pi} : k \in \mathbb{Z}\right\}$$

ekvivalentni zapis

$$D_h = \bigcup_{k\in\mathbb{Z}} \left\langle k - \frac{2}{\pi}, \, k + 1 - \frac{2}{\pi} \right\rangle$$

nultočke

Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \;/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \;\; k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{k - \frac{2}{\pi} : k \in \mathbb{Z}\right\}$$

ekvivalentni zapis

$$D_h = \bigcup_{k \in \mathbb{Z}} \left\langle k - \frac{2}{\pi}, \, k + 1 - \frac{2}{\pi} \right\rangle$$

nultočke

$$\operatorname{ctg}(\pi x + 2) = 0$$

Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

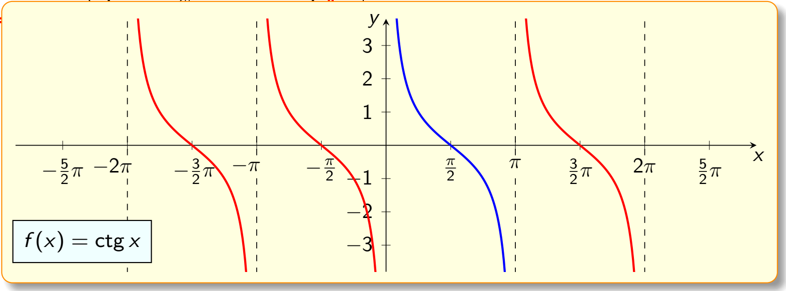
$$x \neq k - \frac{2}{\pi}, \;\; k \in \mathbb{Z}$$

$$D_h = \mathbb{R} \setminus \left\{k - \frac{2}{\pi} : k \in \mathbb{Z}\right\}$$

nultočke

$$\operatorname{ctg}(\pi x + 2) = 0$$

D_h



Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \ \ k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \ \ k \in \mathbb{Z}$$

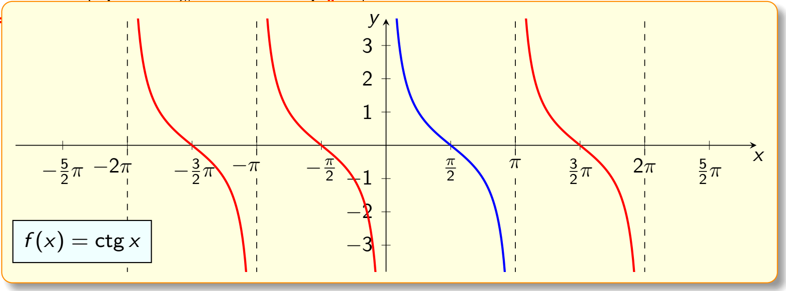
$$D_h = \mathbb{R} \setminus \left\{ k - \frac{2}{\pi} : k \in \mathbb{Z} \right\}$$

nultočke

$$\operatorname{ctg}(\pi x + 2) = 0$$

$$\pi x + 2 =$$

D_h



Rješenje

$h(x) = \operatorname{ctg}(\pi x + 2)$

a) domena

$$\pi x + 2 \neq k\pi, \;\; k \in \mathbb{Z}$$

$$\pi x \neq k\pi - 2 \,/ : \pi$$

$$x \neq \frac{k\pi - 2}{\pi}$$

$$x \neq k - \frac{2}{\pi}, \;\; k \in \mathbb{Z}$$

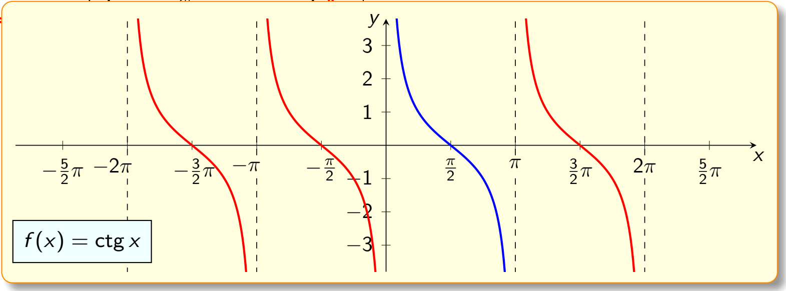
$$D_h = \mathbb{R} \setminus \left\{ k - \frac{2}{\pi} : k \in \mathbb{Z} \right\}$$

D_h

nultočke

$$\operatorname{ctg}(\pi x + 2) = 0$$

$$\pi x + 2 = \frac{2k+1}{2}\pi$$



Rješenje

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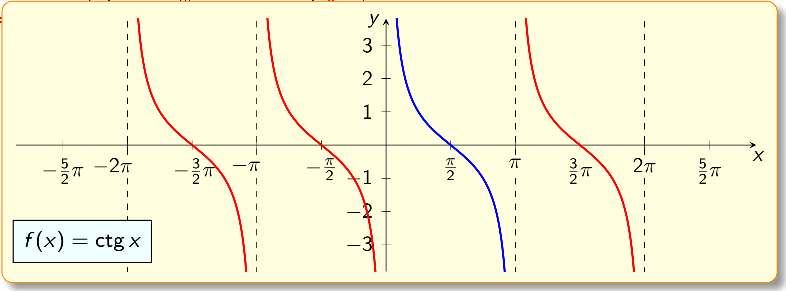

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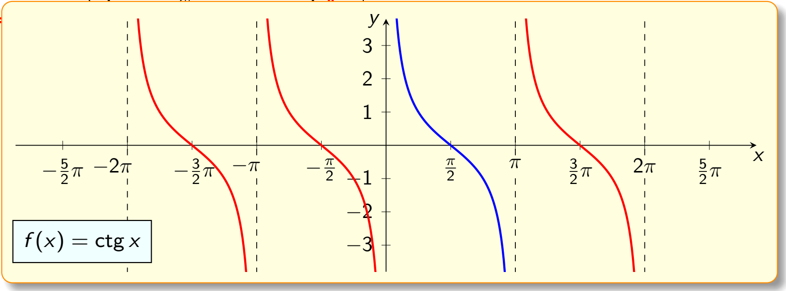

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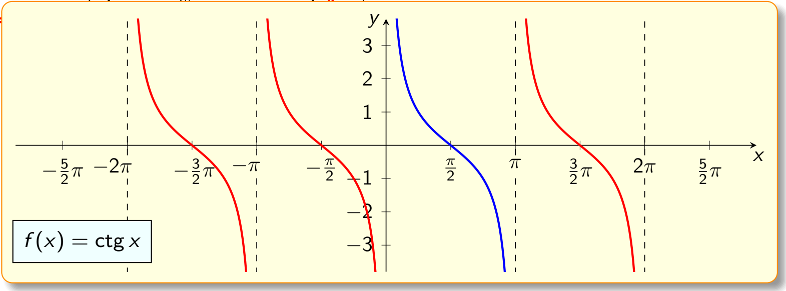

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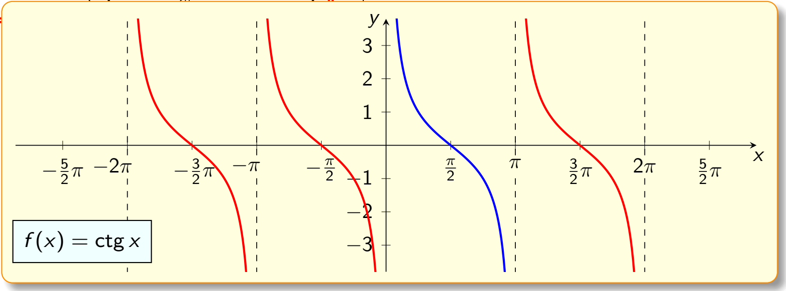

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jesu nultočke
jer pripadaju domeni

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Domena

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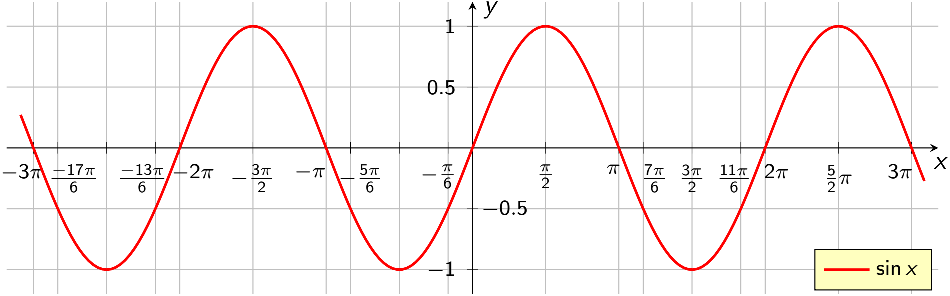

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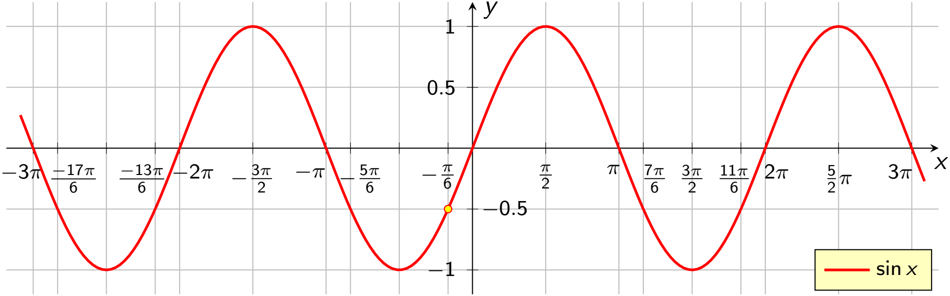

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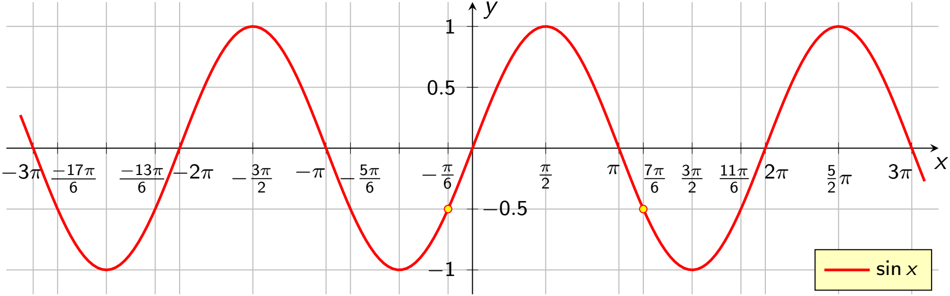

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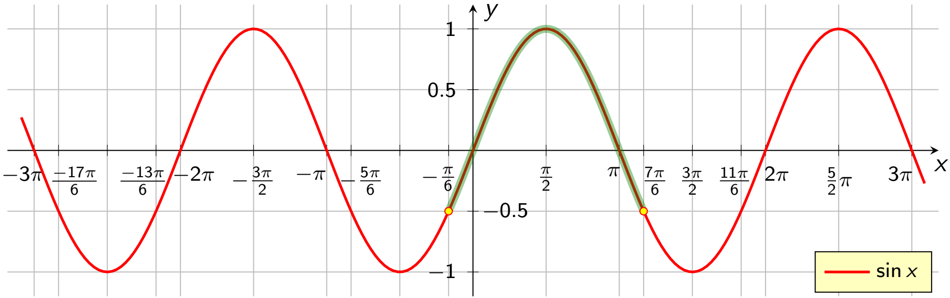

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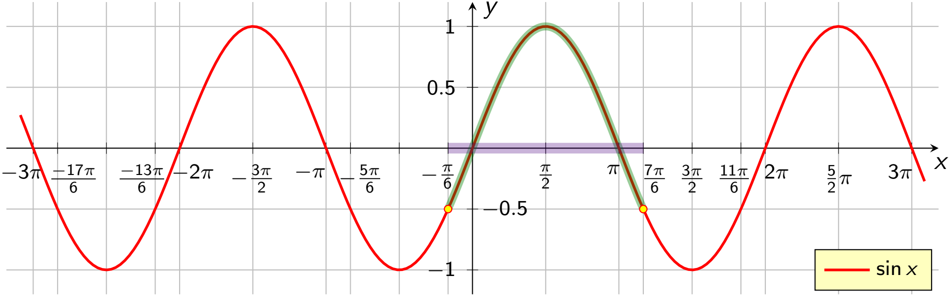

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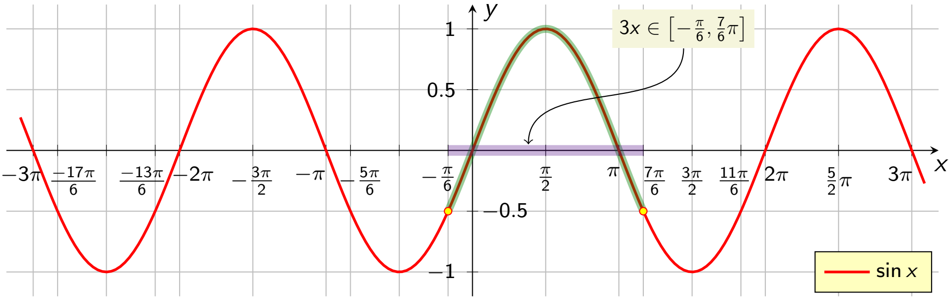

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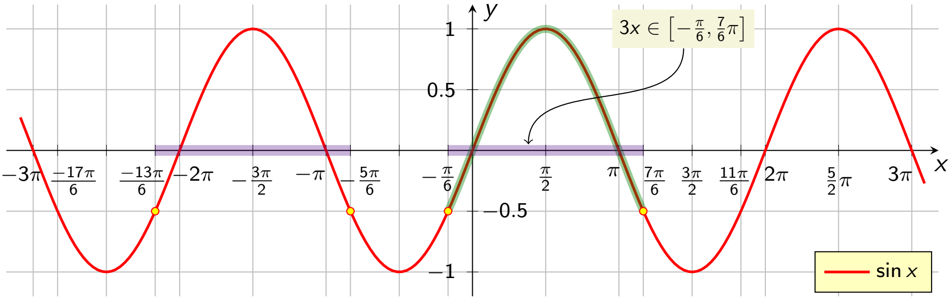

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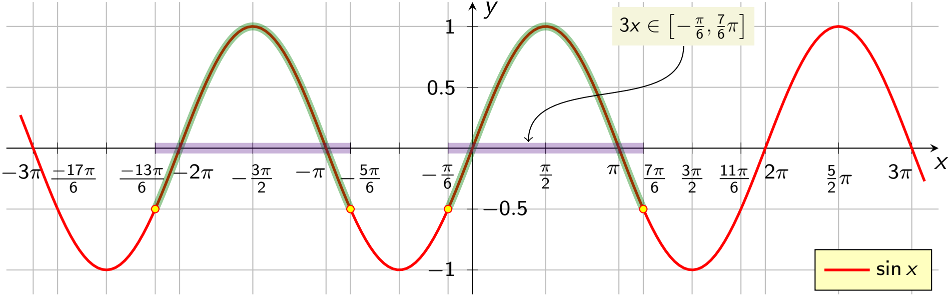

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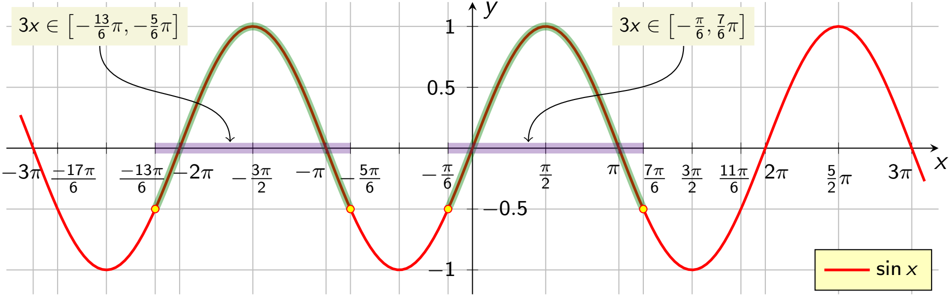

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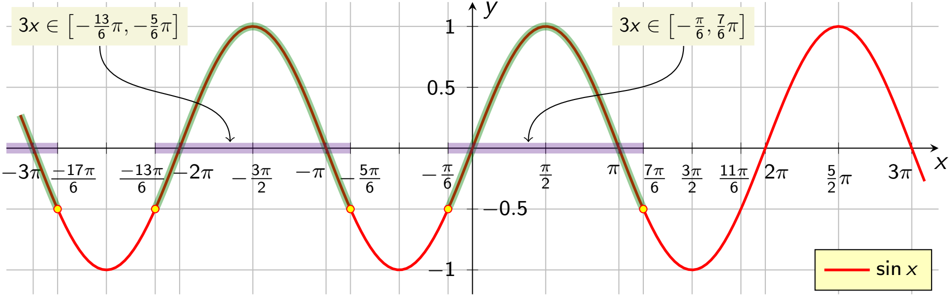

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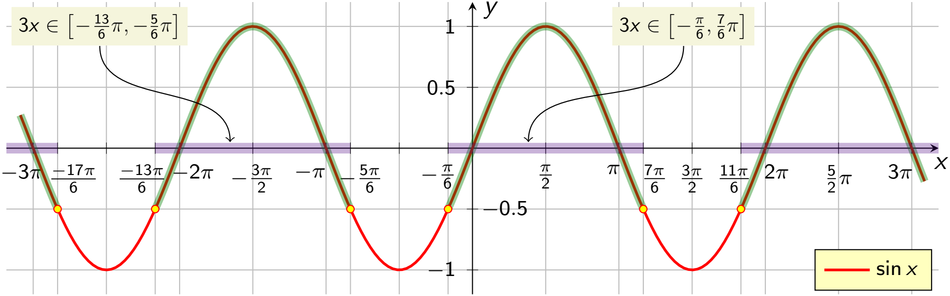

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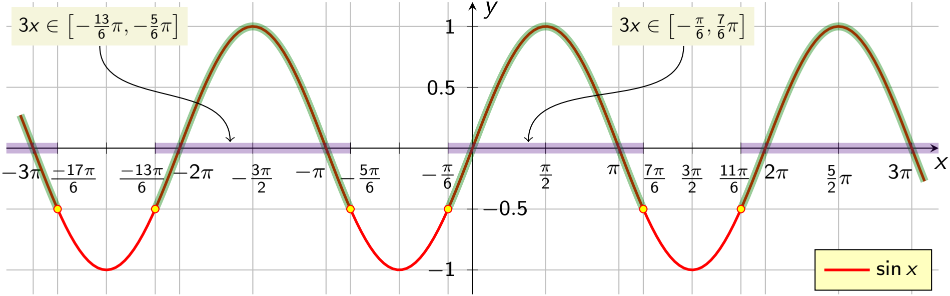

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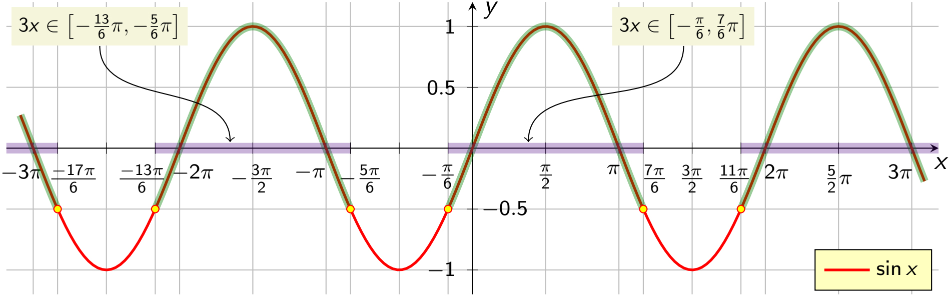

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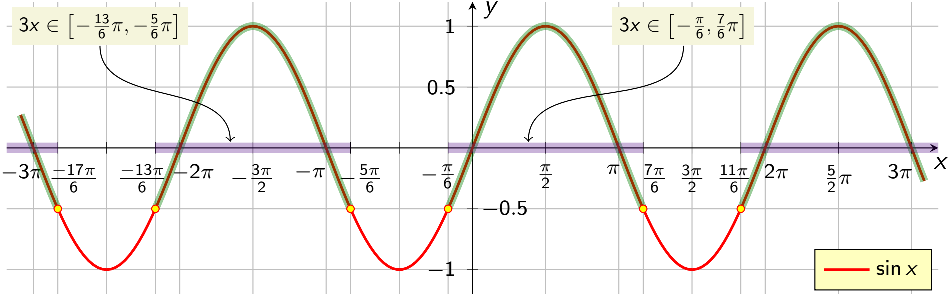

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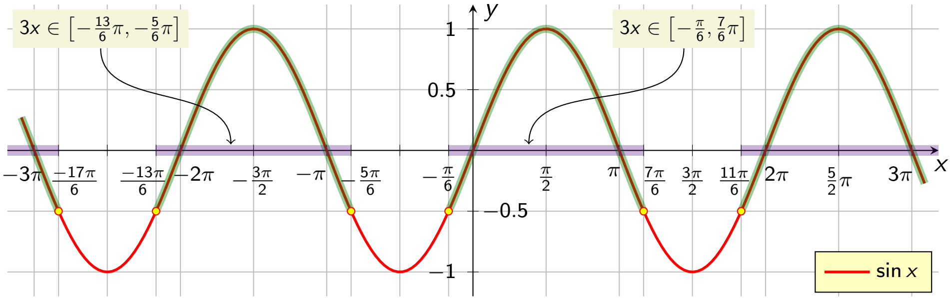

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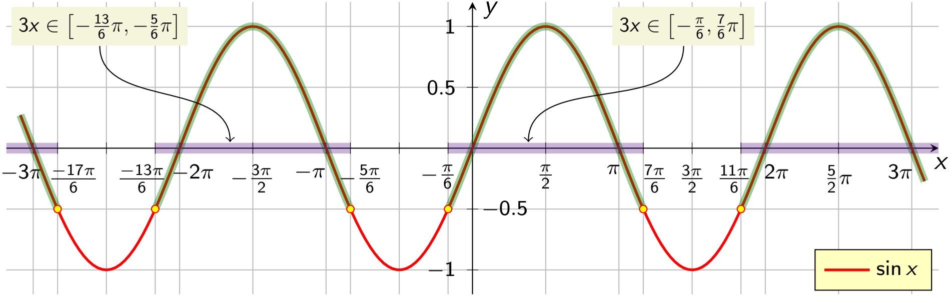

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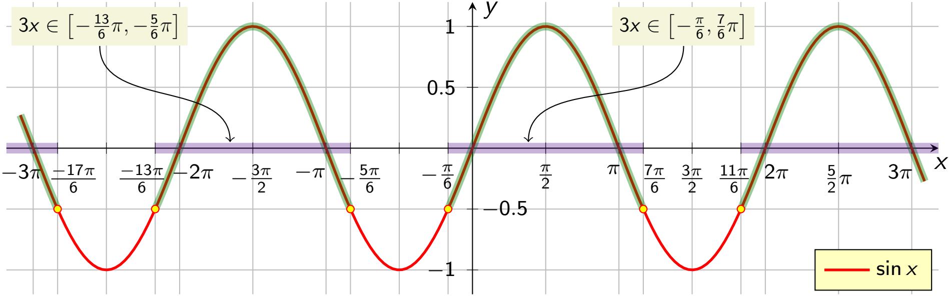

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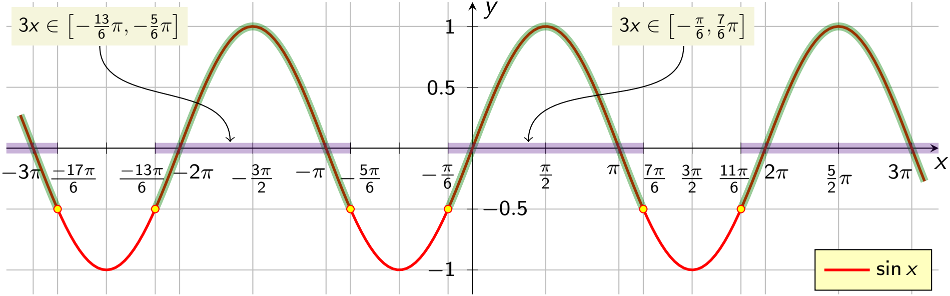

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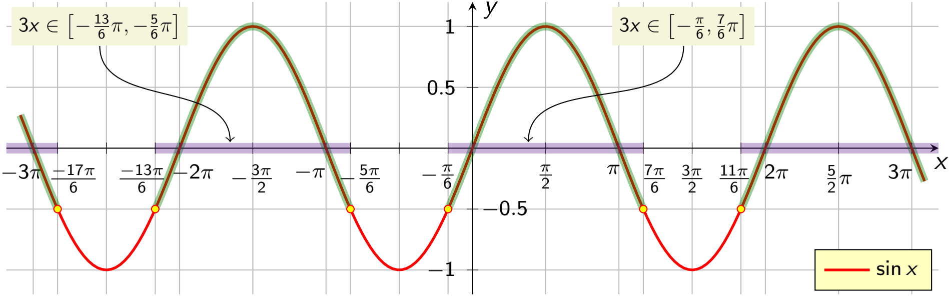

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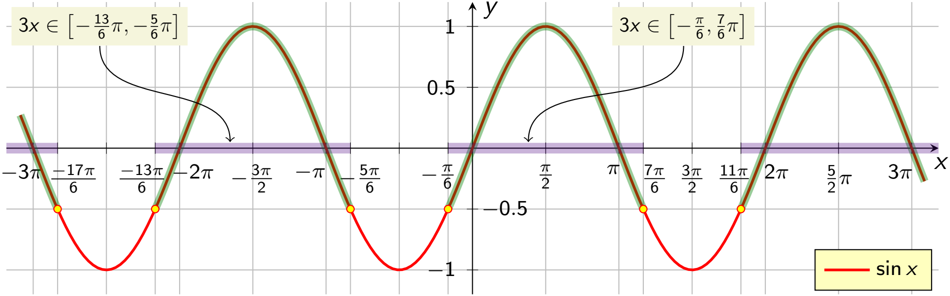

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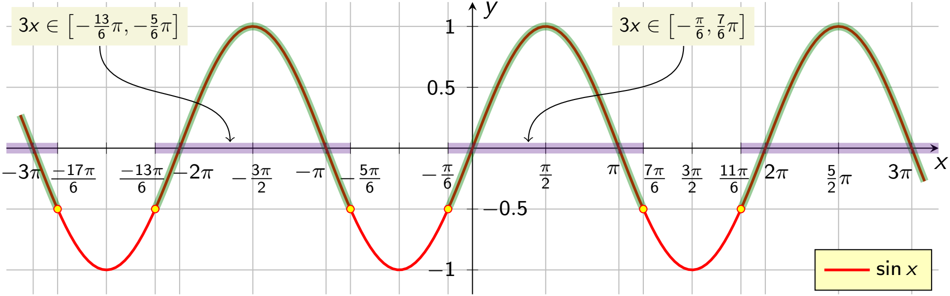

b) $\arcsin\left(-\frac{1}{2}\right) = -\frac{\pi}{6}$ $\qquad \pi - \left(-\frac{\pi}{6}\right) = \frac{7}{6}\pi$

$$f(x) = \sqrt{\sin 3x + \frac{1}{2}}$$

Domena

$$\sin 3x + \frac{1}{2} \geqslant 0$$

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$$3x \in \bigcup_{k\in\mathbb{Z}} \left[-\frac{\pi}{6} + 2k\pi,\ \frac{7}{6}\pi + 2k\pi\right] \Big/ : 3$$

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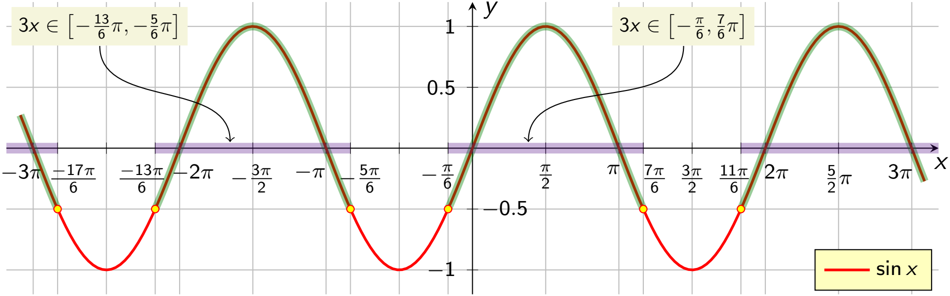
$$x \in \bigcup_{k\in\mathbb{Z}} \left[\frac{12k-1}{18}\pi,\right.$$



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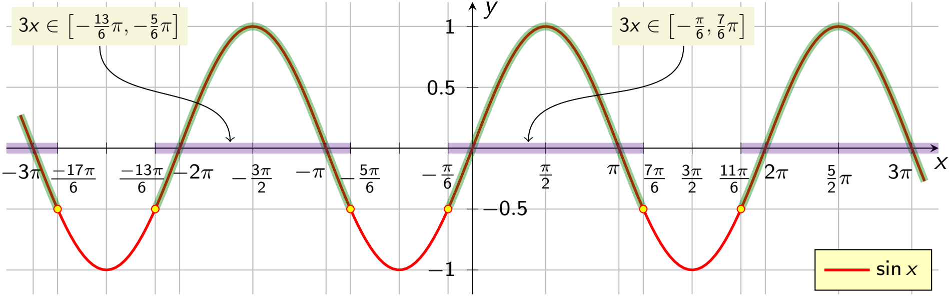

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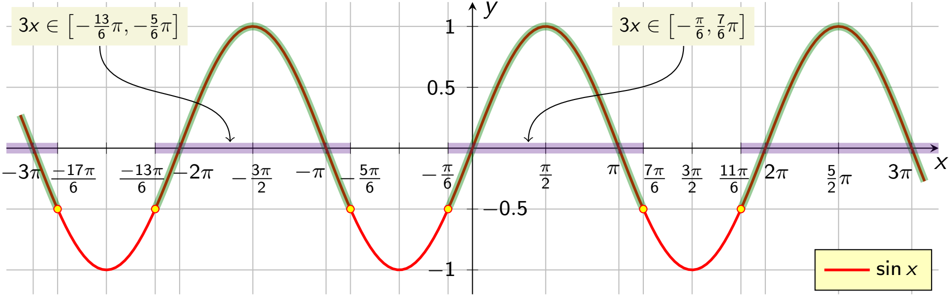

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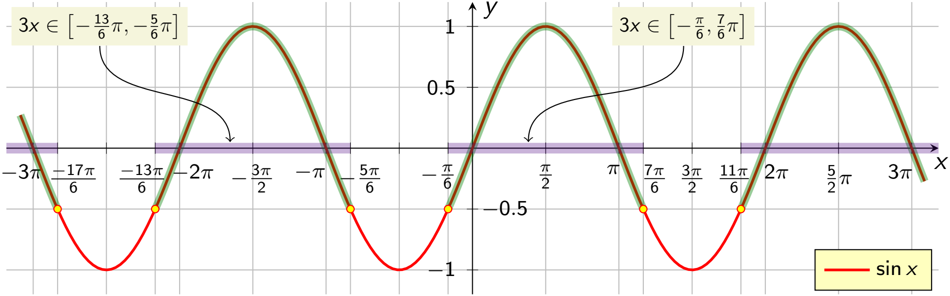
$$D_f = \bigcup_{k\in\mathbb{Z}} \left[\frac{12k-1}{18}\pi,\ \frac{12k+7}{18}\pi\right]$$



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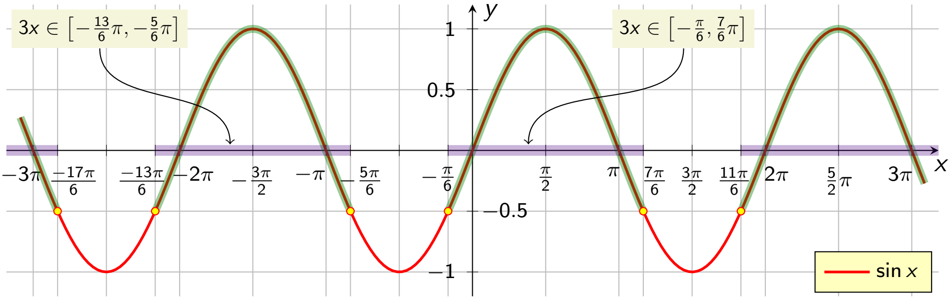

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Nultočke

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$$x = \frac{(-1)^{k+1}}{18}\pi + \frac{k\pi}{3}$$

$$x = \frac{6k + (-1)^{k+1}}{18}\pi, \;\; k \in \mathbb{Z}$$

$$\sin x = a \;\Leftrightarrow\; x = (-1)^k \arcsin a + k\pi, \;\; k \in \mathbb{Z}$$

b) $\arcsin\left(-\frac{1}{2}\right) = -\frac{\pi}{6}$ $\qquad \pi - \left(-\frac{\pi}{6}\right) = \frac{7}{6}\pi$

$$f(x) = \sqrt{\sin 3x + \frac{1}{2}}$$

Nultočke

$$\sqrt{\sin 3x + \frac{1}{2}} = 0 \,\Big/^2$$

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$$D_f = \bigcup_{k\in\mathbb{Z}} \left[\frac{12k-1}{18}\pi,\ \frac{12k+7}{18}\pi\right]$$

$$3x = (-1)^k \arcsin\left(-\frac{1}{2}\right) + k\pi \,\Big/ : 3$$

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jesu nultočke
jer pripadaju domeni

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$$x = \frac{(-1)^{k+1}}{18}\pi + \frac{k\pi}{3}$$

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$$x = \frac{\qquad\qquad}{18}\pi$$

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$$x = \frac{6\cdot 2s + (-1)^{2s+1}}{18}\pi$$

$$x = \frac{12s}{18}\pi$$

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$$x = \frac{12s + (-1)^{\text{neparan}}}{18}\pi$$

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✏ k neparan: $k = 2s + 1$ za neki $s \in \mathbb{Z}$

$$x = \frac{}{18}\pi$$

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✏ k neparan: $k = 2s + 1$ za neki $s \in \mathbb{Z}$

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$$f(x) = \sqrt{\sin 3x + \frac{1}{2}}$$

Nultočke

$$\sqrt{\sin 3x + \frac{1}{2}} = 0 \Big/^2$$

$$\sin 3x + \frac{1}{2} = 0$$

$$\sin 3x = -\frac{1}{2}$$

$$D_f = \bigcup_{k\in\mathbb{Z}} \left[\frac{12k-1}{18}\pi,\ \frac{12k+7}{18}\pi\right]$$

$$3x = (-1)^k \arcsin\left(-\frac{1}{2}\right) + k\pi \Big/ : 3$$

$$x = \frac{(-1)^k}{3} \cdot \frac{-\pi}{6} + \frac{k\pi}{3}$$

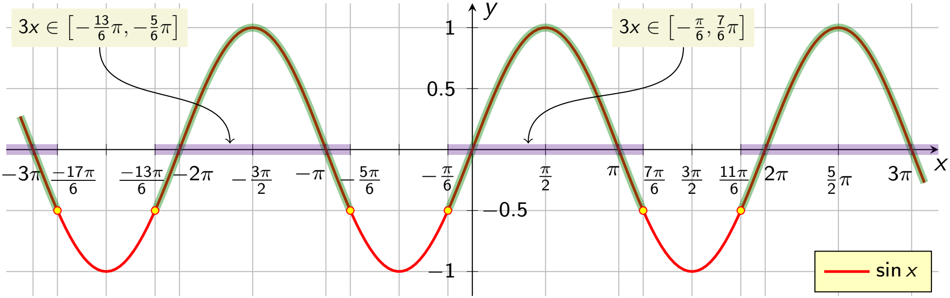
$$x = \frac{(-1)^k \cdot (-1) \cdot \pi}{18} + \frac{k\pi}{3}$$

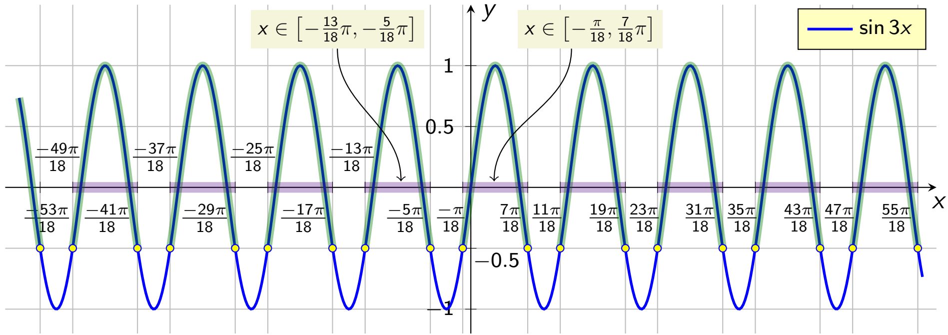
$$x = \frac{(-1)^{k+1}}{18}\pi + \frac{k\pi}{3}$$

$$x = \frac{6k + (-1)^{k+1}}{18}\pi, \ k \in \mathbb{Z}$$

jesu nultočke
jer pripadaju domeni

$$\sin x = a \ \Leftrightarrow \ x = (-1)^k \arcsin a + k\pi, \ k \in \mathbb{Z}$$


$3x \in \left[-\frac{13}{6}\pi, -\frac{5}{6}\pi\right]$
$3x \in \left[-\frac{\pi}{6}, \frac{7}{6}\pi\right]$
y
x
1
0.5
−0.5
−1
-3π $\frac{-17\pi}{6}$ $\frac{-13\pi}{6}$ -2π $-\frac{3\pi}{2}$ $-\pi$ $-\frac{5\pi}{6}$ $-\frac{\pi}{6}$ $\frac{\pi}{2}$ π $\frac{7\pi}{6}$ $\frac{3\pi}{2}$ $\frac{11\pi}{6}$ 2π $\frac{5}{2}\pi$ 3π
$\sin x$


$x \in \left[-\frac{13}{18}\pi, -\frac{5}{18}\pi\right]$
$x \in \left[-\frac{\pi}{18}, \frac{7}{18}\pi\right]$
$\sin 3x$
y
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1
0.5
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−1
$\frac{-49\pi}{18}$ $\frac{-37\pi}{18}$ $\frac{-25\pi}{18}$ $\frac{-13\pi}{18}$
$\frac{-53\pi}{18}$ $\frac{-41\pi}{18}$ $\frac{-29\pi}{18}$ $\frac{-17\pi}{18}$ $\frac{-5\pi}{18}$ $\frac{-\pi}{18}$ $\frac{7\pi}{18}$ $\frac{11\pi}{18}$ $\frac{19\pi}{18}$ $\frac{23\pi}{18}$ $\frac{31\pi}{18}$ $\frac{35\pi}{18}$ $\frac{43\pi}{18}$ $\frac{47\pi}{18}$ $\frac{55\pi}{18}$

c) Domena

$$g(x) = \frac{\arccos\left(x^2 - 3\right)}{x - 2}$$

c) Domena

✏ $x^2 - 3 \geqslant -1$

✏ $x^2 - 3 \leqslant 1$

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domena funkcije arccos
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zbog nazivnika

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$x \neq 2$

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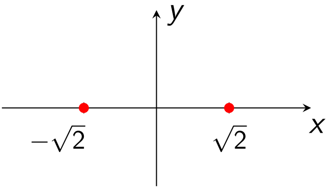

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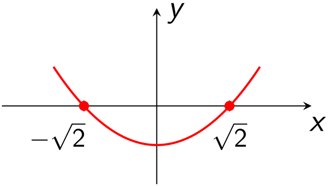

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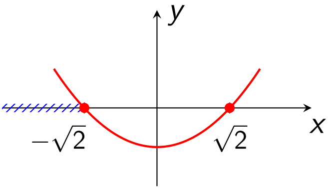

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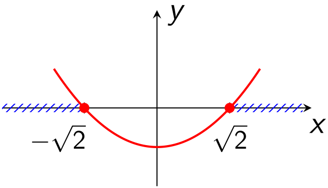

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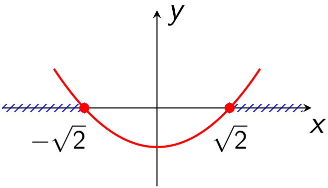

$$x \in \langle -\infty, -\sqrt{2}\,] \cup [\,\sqrt{2}, +\infty\rangle$$

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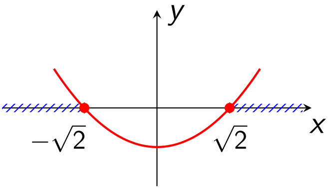

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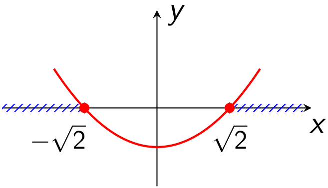

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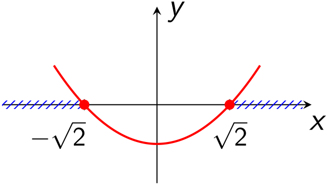

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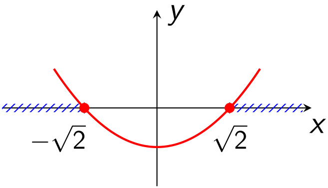

$$x \in \left\langle -\infty, -\sqrt{2}\,\right] \cup \left[\sqrt{2}, +\infty\right\rangle$$

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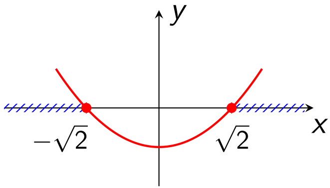

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$$x \neq 2$$

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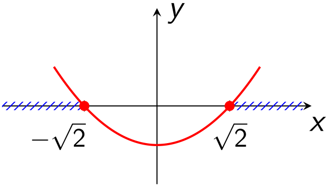

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domena funkcije arccos
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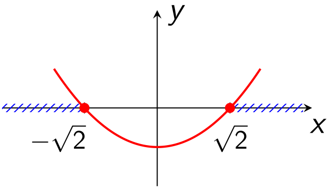

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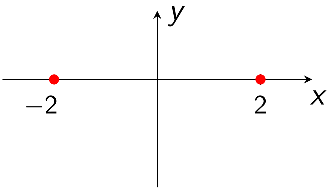

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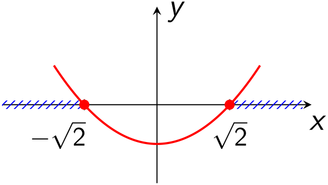

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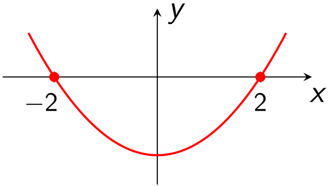

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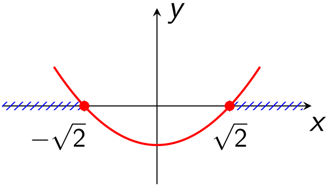

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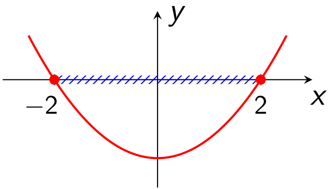

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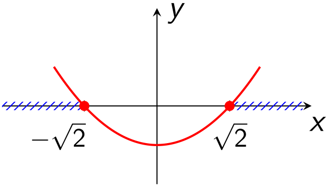

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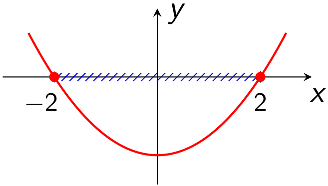

$$x \in [-2, 2]$$

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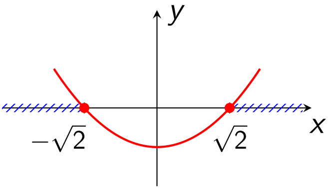
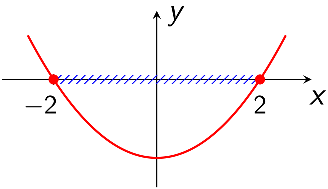


$$x \in \langle -\infty, -\sqrt{2}\,] \cup [\sqrt{2}, +\infty\rangle$$

$$x^2 - 3 \leqslant 1$$
$$x^2 - 3 - 1 \leqslant 0$$
$$x^2 - 4 \leqslant 0$$
$$x^2 - 4 = 0$$
$$x_1 = -2,\ x_2 = 2$$



$$x \in [-2, 2]$$

c) **Domena**

$$g(x) = \frac{\arccos(x^2-3)}{x-2}$$

✏ $x^2 - 3 \geqslant -1$

✏ $x^2 - 3 \leqslant 1$

✏ $x - 2 \neq 0$

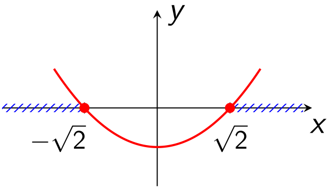
domena funkcije arccos je segment $[-1, 1]$

zbog nazivnika

$$x^2 - 3 \geqslant -1$$
$$x^2 - 3 + 1 \geqslant 0$$
$$x^2 - 2 \geqslant 0$$

$$x^2 - 2 = 0$$

$$x_1 = -\sqrt{2},\ x_2 = \sqrt{2}$$



$$x \in \langle -\infty, -\sqrt{2}\,] \cup [\,\sqrt{2}, +\infty\rangle$$

$$x \neq 2$$

presjek rješenja

$$x^2 - 3 \leqslant 1$$
$$x^2 - 3 - 1 \leqslant 0$$
$$x^2 - 4 \leqslant 0$$

$$x^2 - 4 = 0$$

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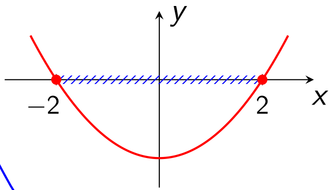

$$x \in [-2, 2]$$

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$$g(x) = \frac{\arccos\left(x^2 - 3\right)}{x - 2}$$

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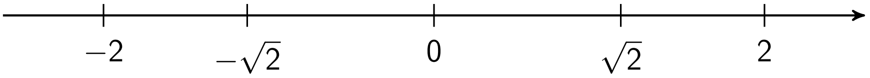

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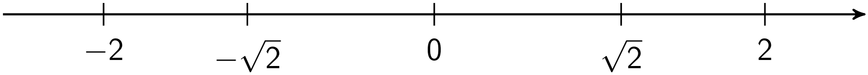

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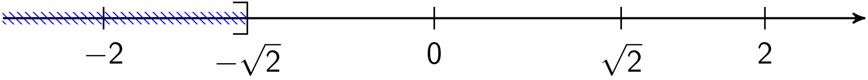

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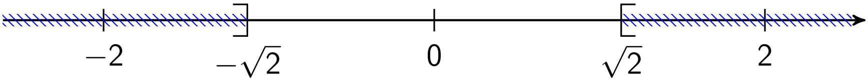

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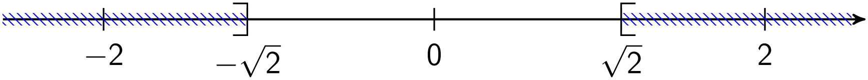
presjek rješenja



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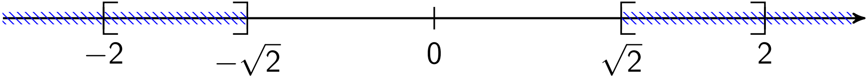

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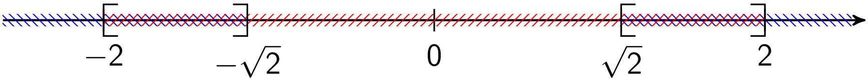

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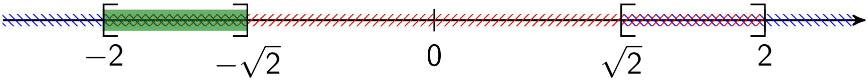

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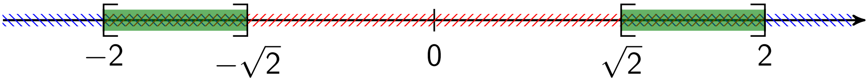

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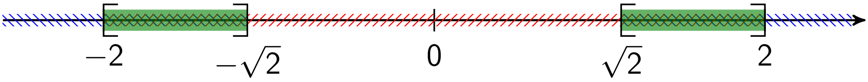

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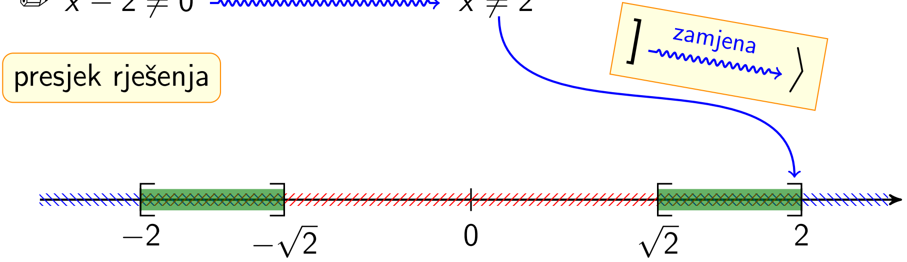

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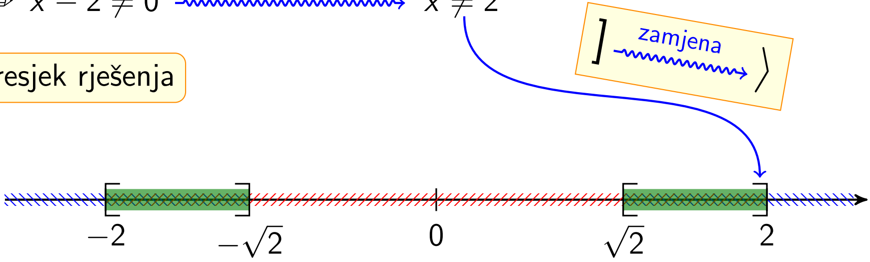

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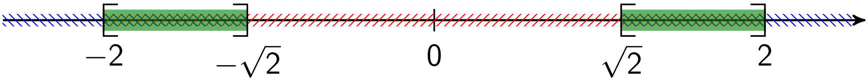
] zamjena ⟩

presjek rješenja



c) Nultočke

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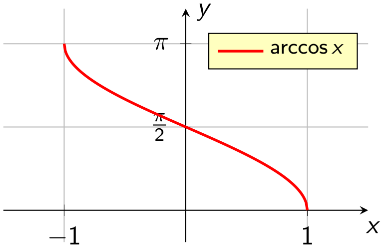

c) Nultočke

$$\arccos x = 0 \iff x = 1$$

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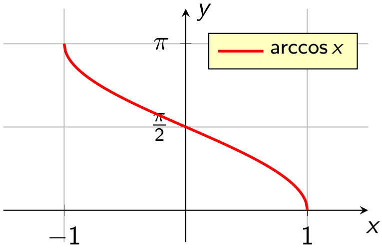

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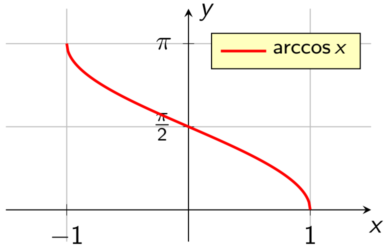

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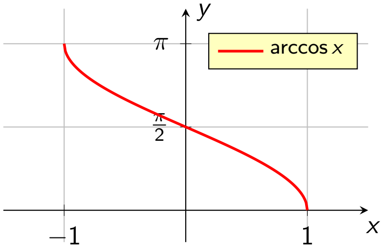

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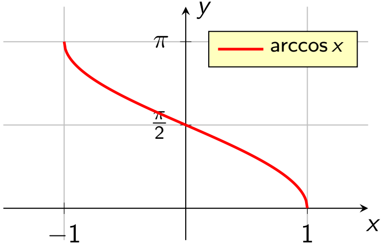
$$x_1 = -2$$



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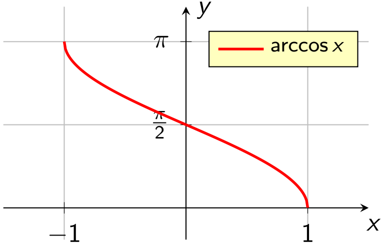

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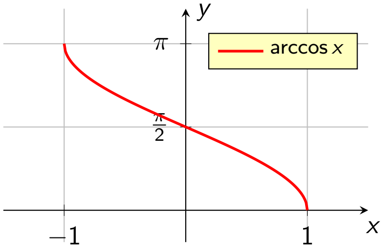

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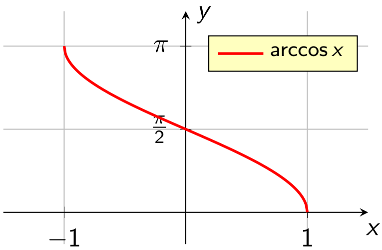

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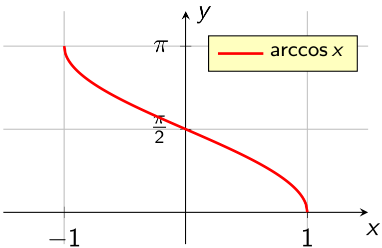

jest nultočka jer pripada domeni

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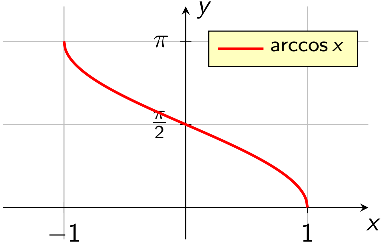

jest nultočka jer pripada domeni

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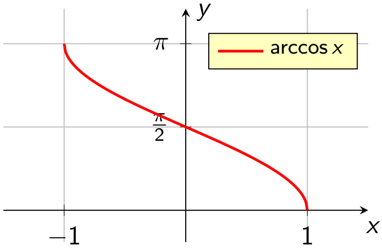

jest nultočka jer pripada domeni

nije nultočka jer ne pripada domeni

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