Realne funkcije realne varijable – 2. dio

Matematika 2

Damir Horvat

FOI, Varaždin

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definicija funkcije

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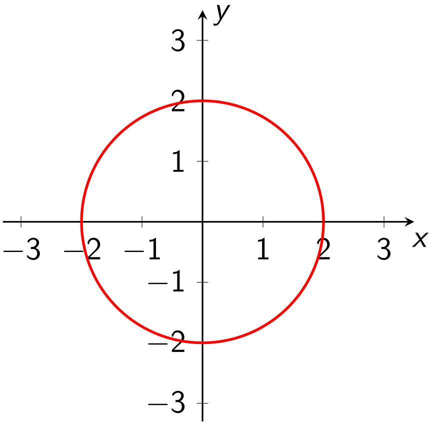
šesti zadatak

definicija funkcije

Definicija funkcije

$\boxed{x^2 + y^2 = 4}$



Kružnica $x^2 + y^2 = 4$ nije graf niti jedne funkcije $y = f(x)$ jer

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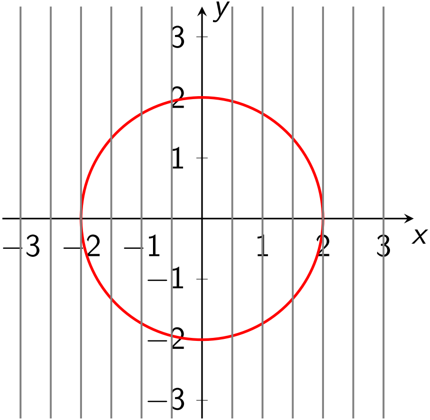
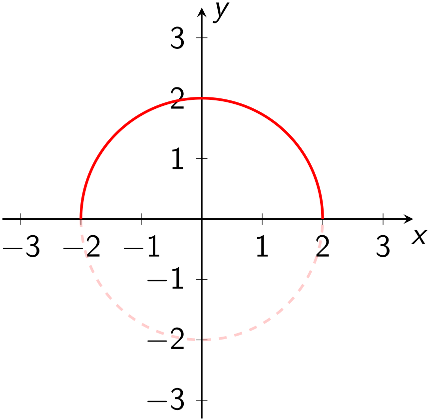


Kružnica $x^2 + y^2 = 4$ nije graf niti jedne funkcije $y = f(x)$ jer postoje paralele s y-osi koje sijeku tu krivulju u više od jedne točke.

Definicija funkcije

$$\boxed{x^2 + y^2 = 4}$$

$$\boxed{y = \sqrt{4 - x^2}}$$



Gornja polukružnica jest graf funkcije $y = f(x)$ jer

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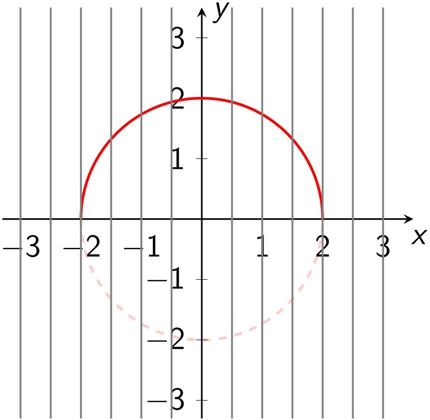

Gornja polukružnica jest graf funkcije $y = f(x)$ jer svaka paralela s y-osi siječe tu krivulju u najviše jednoj točki.

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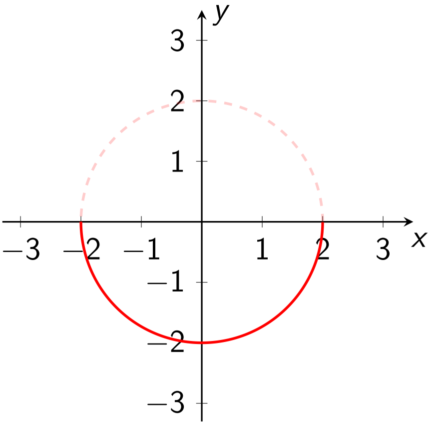

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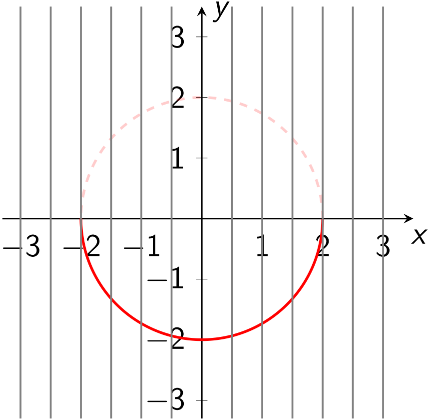

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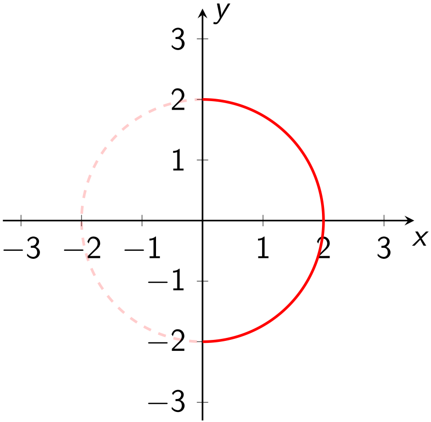

Desna polukružnica nije graf niti jedne funkcije $y = f(x)$ jer

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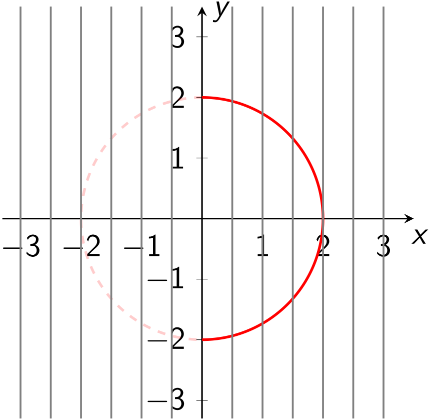

Desna polukružnica nije graf niti jedne funkcije $y = f(x)$ jer postoje paralele s y-osi koje sijeku tu krivulju u više od jedne točke.

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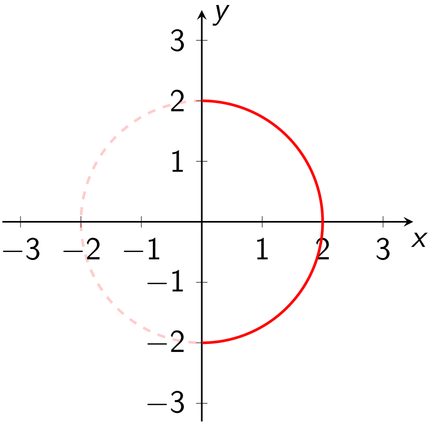

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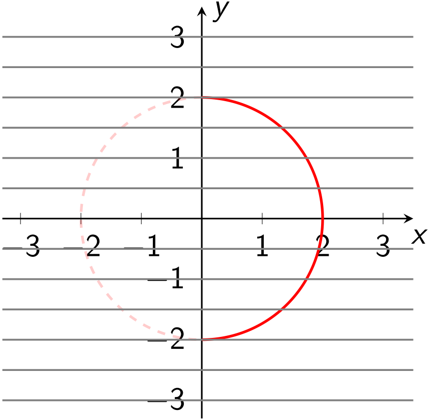

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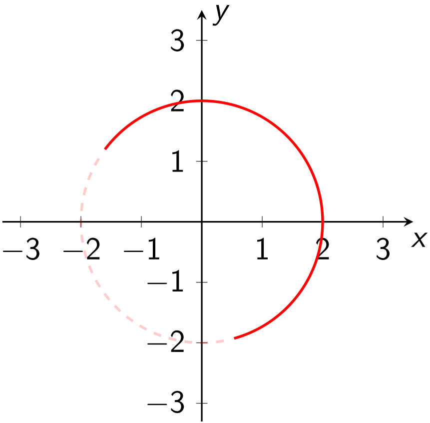

Dio kružnice prikazan na slici

Definicija funkcije

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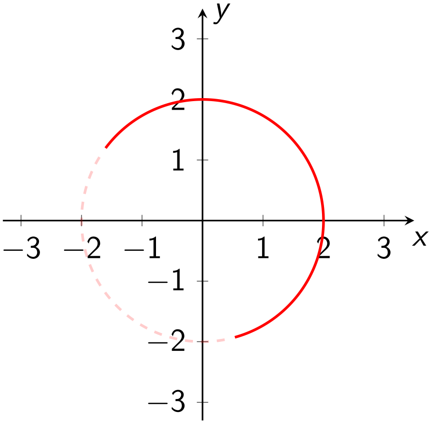

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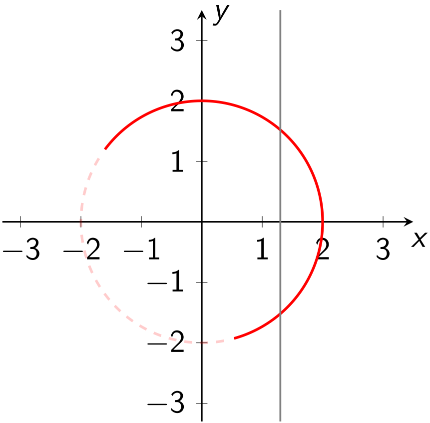

Dio kružnice prikazan na slici nije graf niti jedne funkcije $y = f(x)$ jer postoji paralela s y-osi koja siječe tu krivulju u više od jedne točke.

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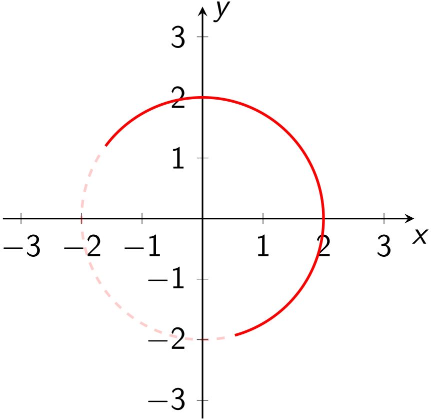

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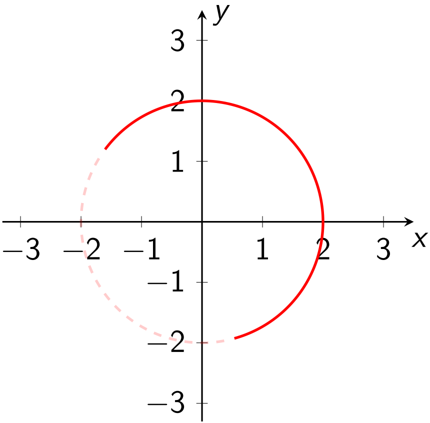

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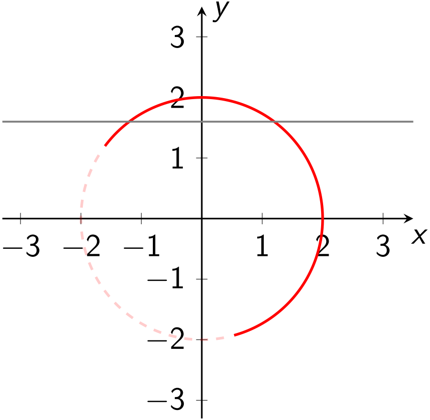

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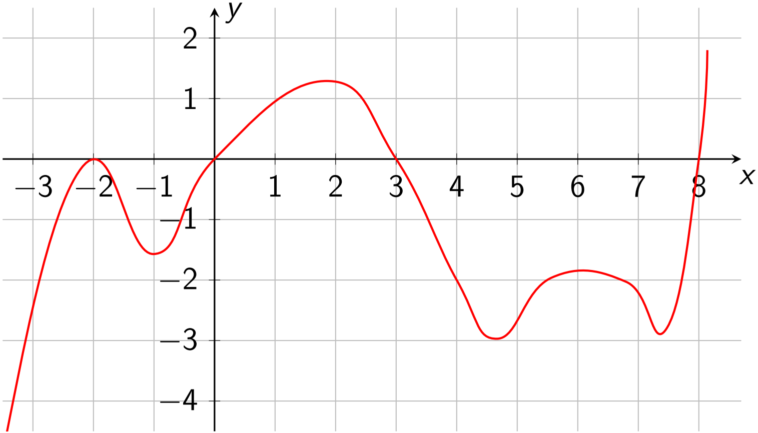
prvi zadatak

Zadatak 1

Zadan je graf funkcije f.



a) *Odredite nultočke funkcije f.*

b) *Navedite neki interval na kojemu je funkcija f pozitivna.*

c) *Navedite neki interval na kojemu je funkcija f negativna.*

d) *Napišite neki interval na kojemu funkcija f pada.*

e) *Napišite neki interval na kojemu funkcija f raste.*

f) *Napišite neki interval na kojemu funkcija f nije monotona.*

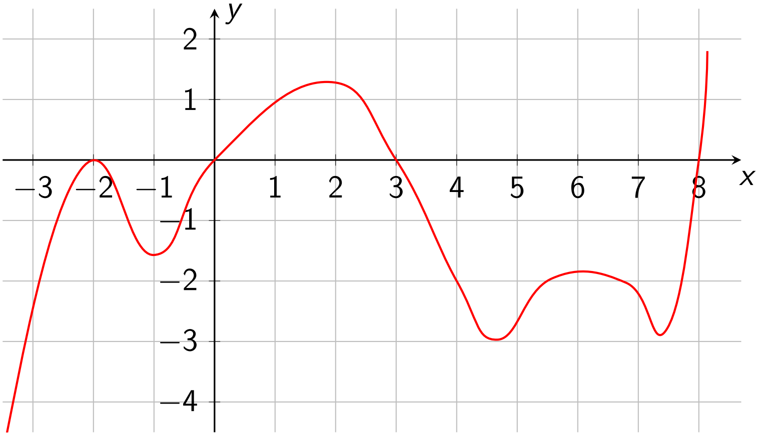
g) *Napišite neki interval na kojemu je $f(x) \leqslant -1$.*

h) *Koliko lokalnih ekstrema ima funkcija f?*

i) *Koliko rješenja ima jednadžba $f(x) = 1$ na segmentu $[-3, 9]$?*

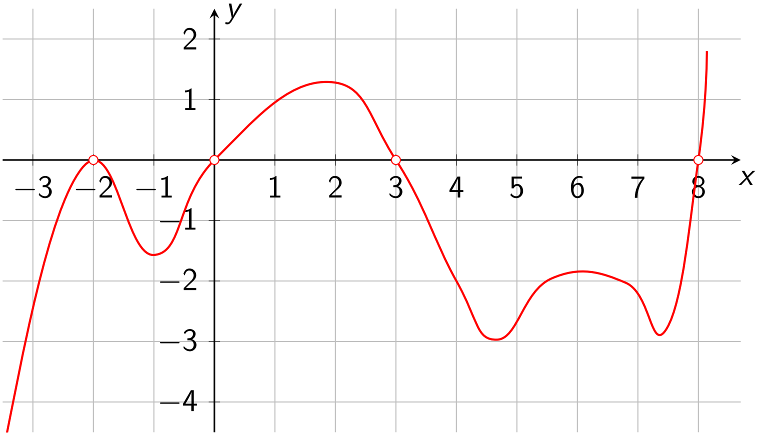
j) *Koliko rješenja ima jednadžba $f(x) = 1$ na segmentu $[-3, 8]$?*

Rješenje



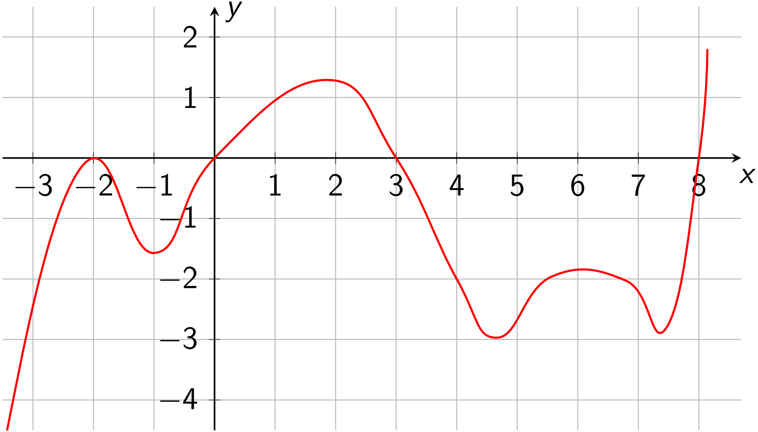
a) Nultočke funkcije *f* su:

Rješenje



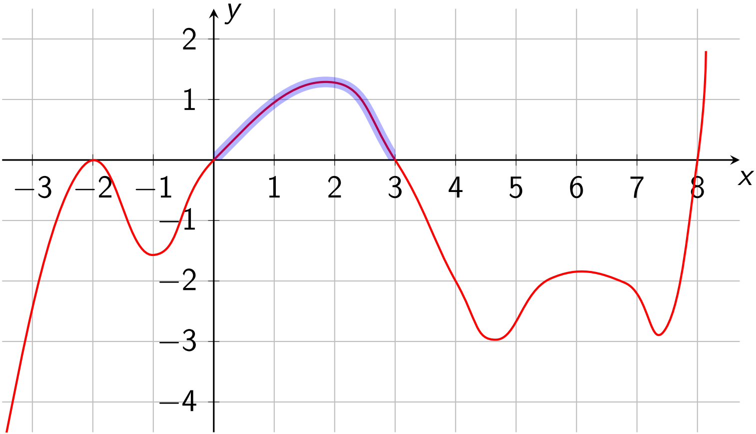
a) Nultočke funkcije f su: $-2, 0, 3, 8$

Rješenje



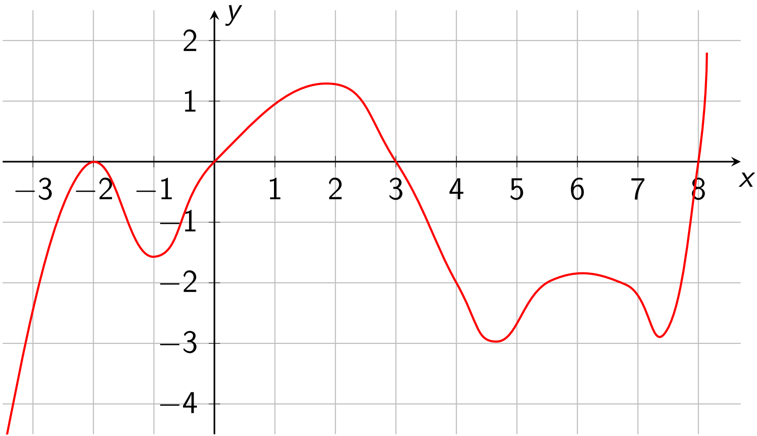
b) Funkcija f je pozitivna na primjer na intervalu

Rješenje



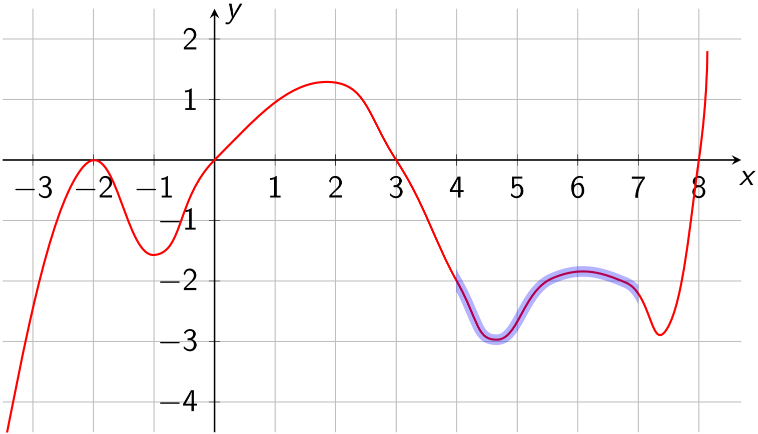
b) Funkcija f je pozitivna na primjer na intervalu $\langle 0, 3\rangle$.

Rješenje



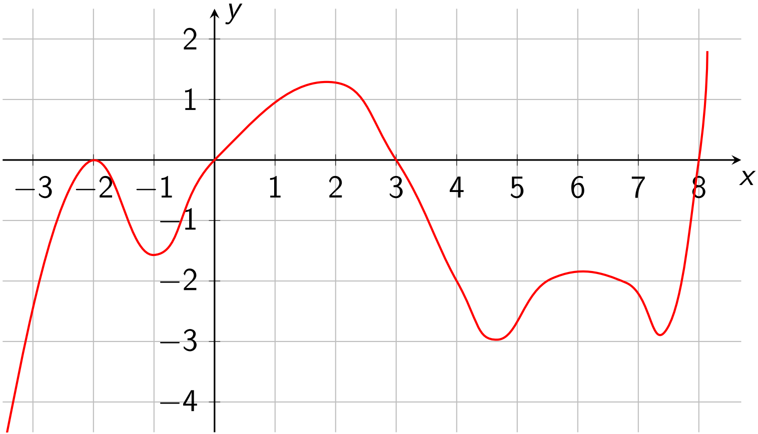
c) Funkcija f je negativna na primjer na intervalu

Rješenje



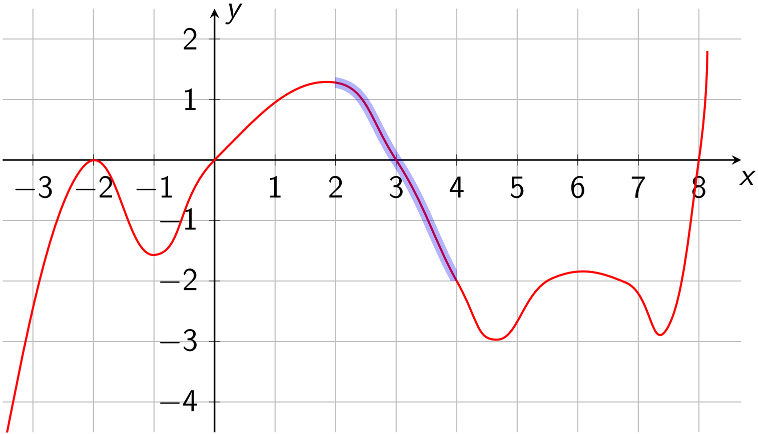
c) Funkcija f je negativna na primjer na intervalu $\langle 4, 7\rangle$.

Rješenje



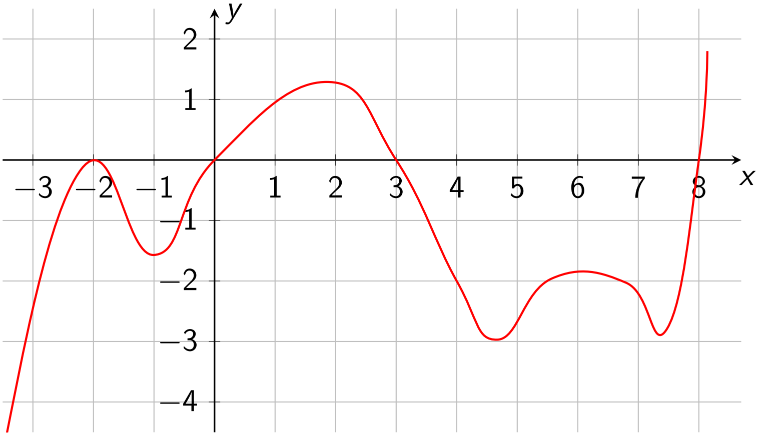
d) Funkcija f pada na primjer na intervalu

Rješenje



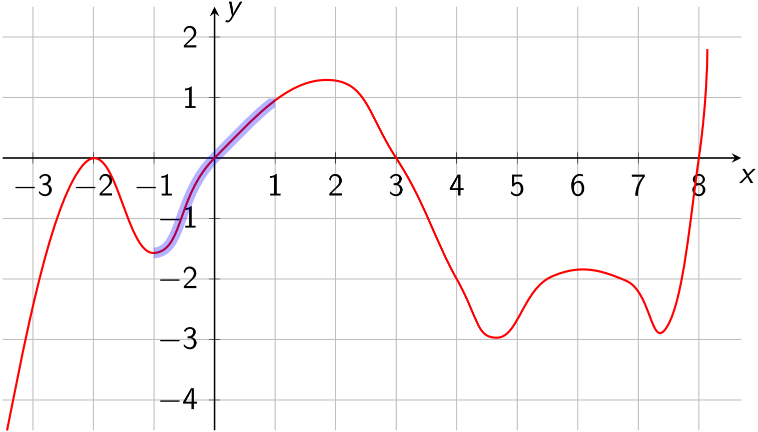
d) Funkcija f pada na primjer na intervalu $\langle 2, 4\rangle$.

Rješenje



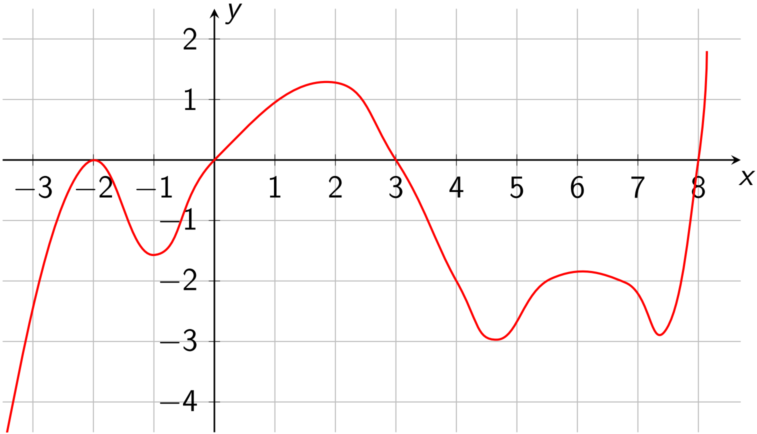
e) Funkcija f raste na primjer na intervalu

Rješenje



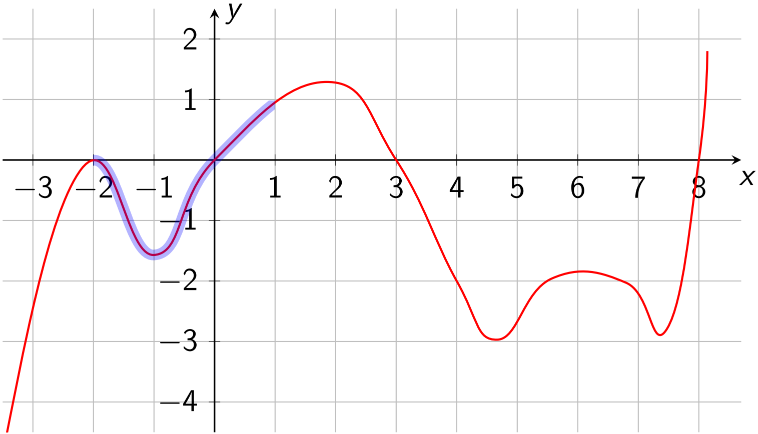
e) Funkcija f raste na primjer na intervalu $\langle -1, 1\rangle$.

Rješenje



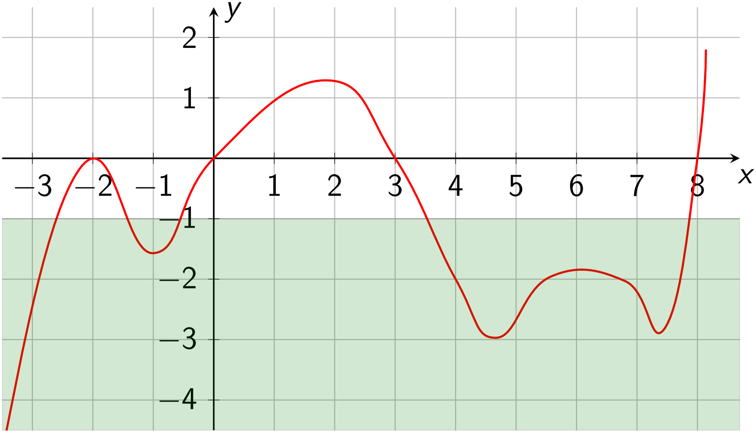
f) Funkcija f nije monotona na primjer na intervalu

Rješenje



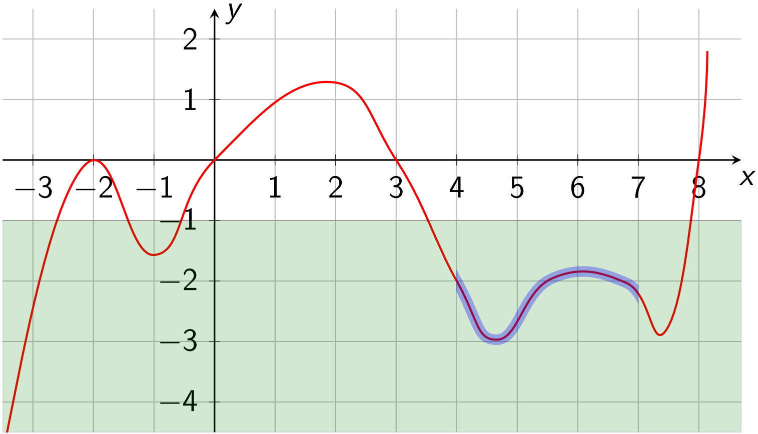
f) Funkcija f nije monotona na primjer na intervalu $\langle -2, 1 \rangle$.

Rješenje



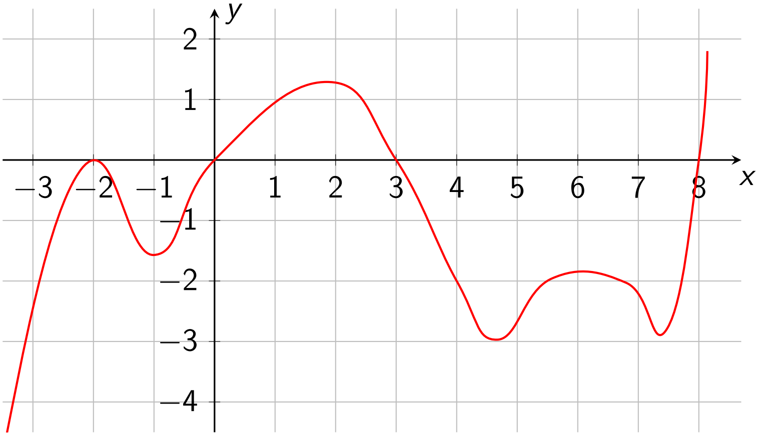
g) $f(x) \leqslant -1$ na primjer na intervalu

Rješenje



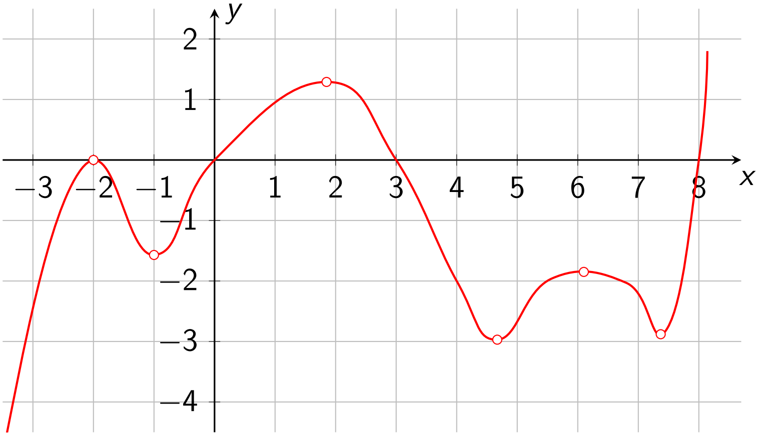
g) $f(x) \leqslant -1$ na primjer na intervalu $\langle 4, 7 \rangle$.

Rješenje



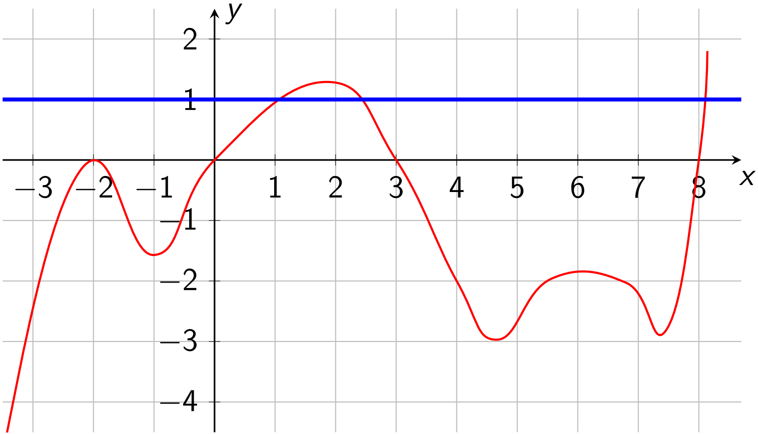
h) f ima ukupno ___ lokalnih ekstrema.

Rješenje



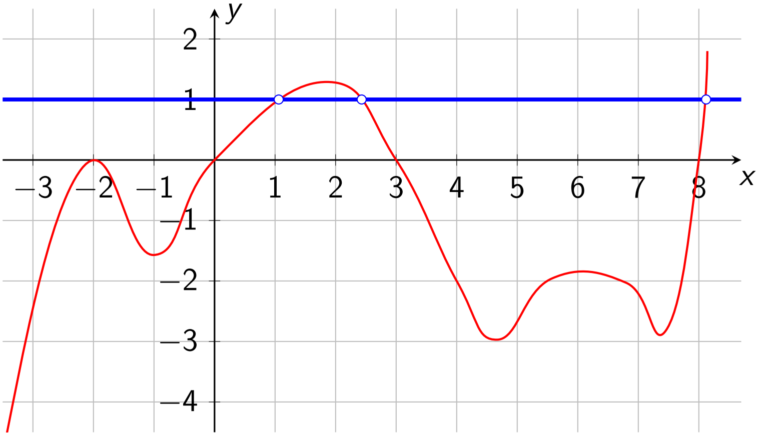
h) f ima ukupno _6_ lokalnih ekstrema.

Rješenje



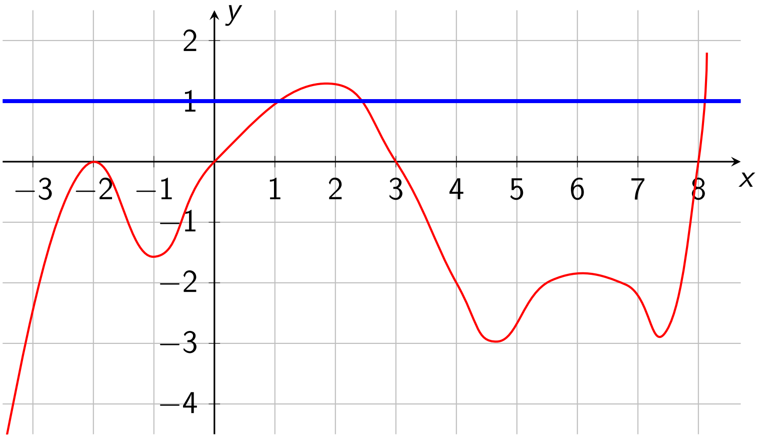
i) Jednadžba $f(x) = 1$ ima ukupno ___ rješenja na segmentu $[-3, 9]$.

Rješenje



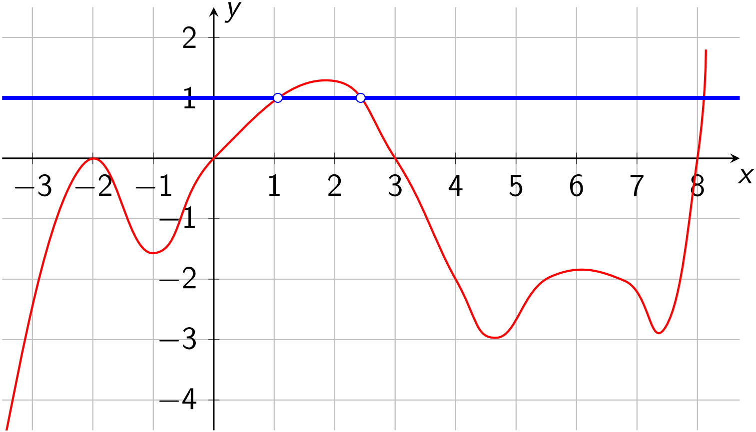
i) Jednadžba $f(x) = 1$ ima ukupno $\underline{\;3\;}$ rješenja na segmentu $[-3, 9]$.

Rješenje



j) Jednadžba $f(x) = 1$ ima ukupno ___ rješenja na segmentu $[-3, 8]$.

Rješenje

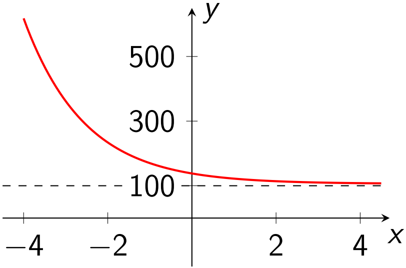


j) Jednadžba $f(x) = 1$ ima ukupno _2_ rješenja na segmentu $[-3, 8]$.

drugi zadatak

Zadatak 2

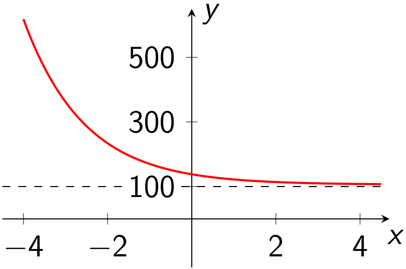
Zadana je funkcija h svojim grafom na donjoj slici.



Ispitajte monotonost, omeđenost i parnost funkcije h na temelju njezinog grafa.

Rješenje

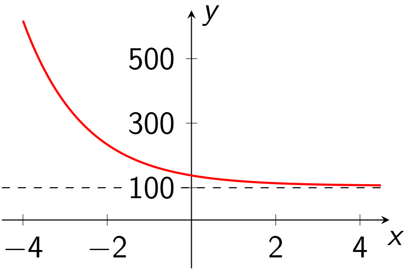
monotonost



Rješenje

monotonost

Funkcija *h* je monotona funkcija jer strogo pada.

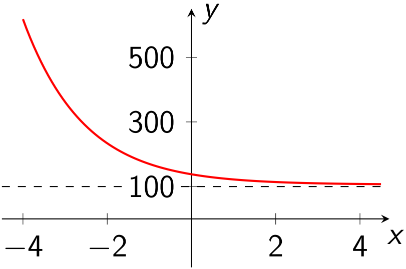


Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost

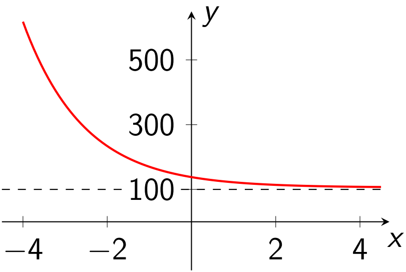


Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost $m \leqslant h(x) \leqslant M$



Rješenje

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Funkcija h je monotona funkcija jer strogo pada.

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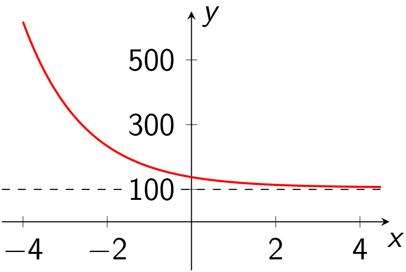

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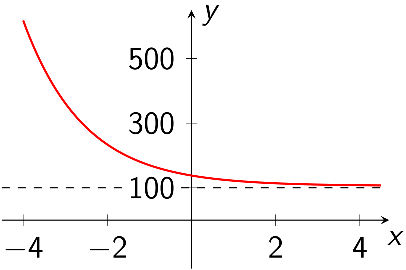

Kada je x jako veliki negativni broj, tada je $h(x)$ jako veliki pozitivni broj.

Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

$$\lim_{x\to-\infty} h(x) = +\infty.$$

kraći zapis

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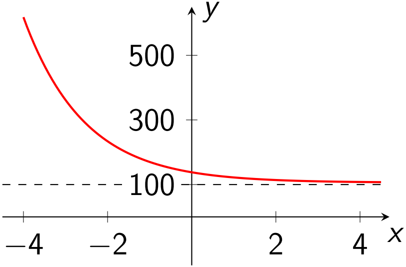

Rješenje

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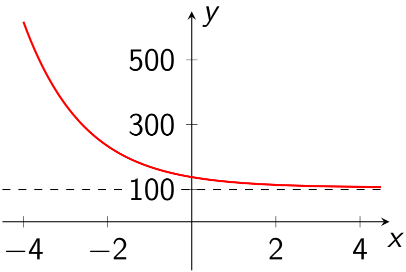

omeđenost $\quad m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

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Rješenje

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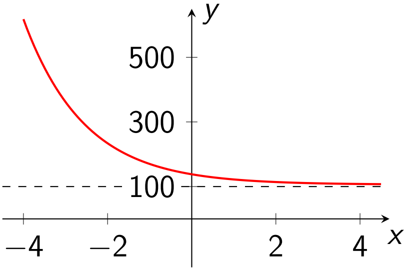


omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

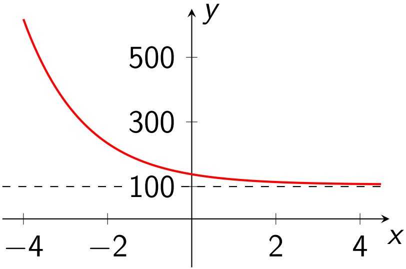
$$\lim_{x\to-\infty} h(x) = +\infty.$$

kraći zapis

Kada je x jako veliki negativni broj, tada je $h(x)$ jako veliki pozitivni broj.

Funkcija h je omeđena odozdo jer je $h(x) \geqslant 100$,

Rješenje



monotonost

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$$\lim_{x\to-\infty} h(x) = +\infty. \longleftarrow$$

kraći zapis

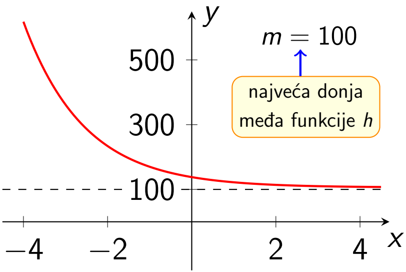
Kada je x jako veliki negativni broj, tada je $h(x)$ jako veliki pozitivni broj.

Funkcija h je omeđena odozdo jer je $h(x) \geqslant 100$, tj. $m = 100$ je jedna donja međa funkcije h.

Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.



$m = 100$

najveća donja međa funkcije h

omeđenost $\quad m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

$$\lim_{x \to -\infty} h(x) = +\infty.$$

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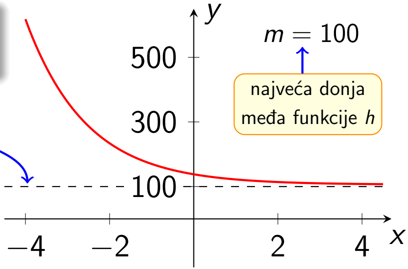
Rješenje



$y = 100$ je horizontalna asimptota funkcije h.

$m = 100$

najveća donja međa funkcije h

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost $m \leqslant h(x) \leqslant M$

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Rješenje

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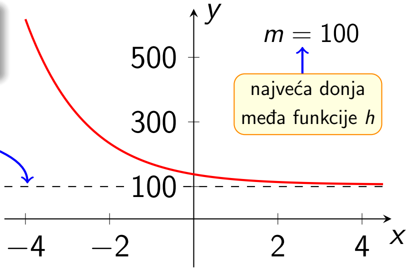

$m = 100$

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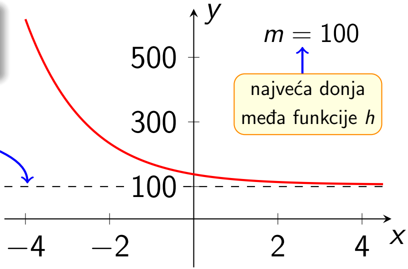
Funkcija h nije omeđena jer nije omeđena odozgo.

Rješenje

$y = 100$ je horizontalna asimptota funkcije h.



$m = 100$

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Funkcija h nije omeđena jer nije omeđena odozgo.

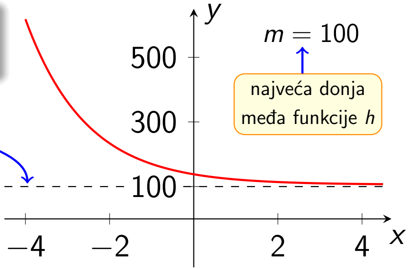
parnost/neparnost

Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.

$y = 100$ je horizontalna asimptota funkcije h.



$m = 100$

najveća donja međa funkcije h

omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

$$\lim_{x \to -\infty} h(x) = +\infty.$$

kraći zapis

Kada je x jako veliki negativni broj, tada je $h(x)$ jako veliki pozitivni broj.

Funkcija h je omeđena odozdo jer je $h(x) \geqslant 100$, tj. $m = 100$ je jedna donja međa funkcije h.

Funkcija h nije omeđena jer nije omeđena odozgo.

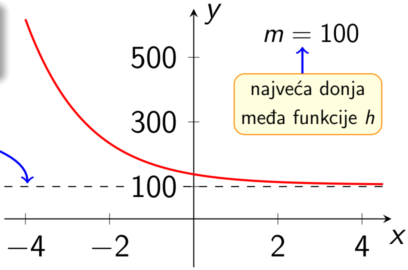
parnost/neparnost

Funkcija h nije parna jer

Rješenje

monotonost

Funkcija h je monotona funkcija jer strogo pada.



$y = 100$ je horizontalna asimptota funkcije h.

$m = 100$

najveća donja međa funkcije h

omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

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Funkcija h je omeđena odozdo jer je $h(x) \geqslant 100$, tj. $m = 100$ je jedna donja međa funkcije h.

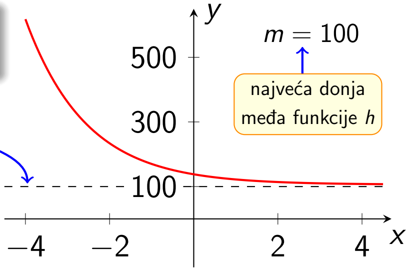
Funkcija h nije omeđena jer nije omeđena odozgo.

parnost/neparnost

Funkcija h nije parna jer njezin graf nije simetričan s obzirom na os y.

Rješenje

$y = 100$ je horizontalna asimptota funkcije h.



$m = 100$

najveća donja međa funkcije h

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

$$\lim_{x \to -\infty} h(x) = +\infty.$$

kraći zapis

Kada je x jako veliki negativni broj, tada je $h(x)$ jako veliki pozitivni broj.

Funkcija h je omeđena odozdo jer je $h(x) \geqslant 100$, tj. $m = 100$ je jedna donja međa funkcije h.

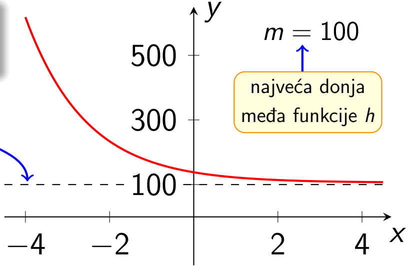
Funkcija h nije omeđena jer nije omeđena odozgo.

parnost/neparnost

Funkcija h nije parna jer njezin graf nije simetričan s obzirom na os y.

Funkcija h nije neparna jer

Rješenje



$y = 100$ je horizontalna asimptota funkcije h.

$m = 100$

najveća donja međa funkcije h

monotonost

Funkcija h je monotona funkcija jer strogo pada.

omeđenost $m \leqslant h(x) \leqslant M$

Funkcija h nije omeđena odozgo jer je

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Funkcija h nije omeđena jer nije omeđena odozgo.

parnost/neparnost

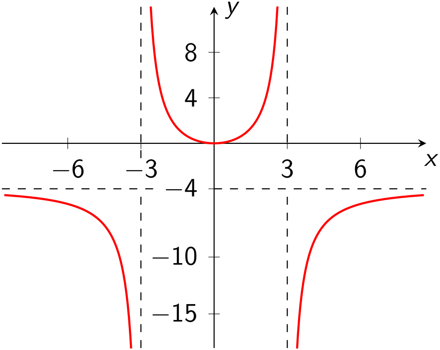
Funkcija h nije parna jer njezin graf nije simetričan s obzirom na os y.

Funkcija h nije neparna jer njezin graf nije simetričan s obzirom na ishodište koordinatnog sustava.

treći zadatak

Zadatak 3

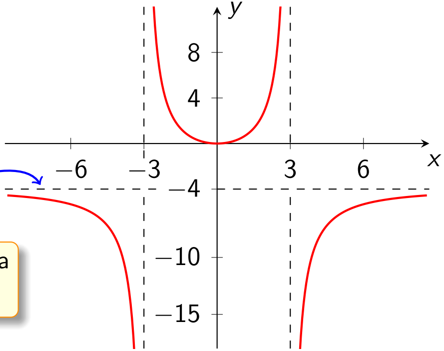
Zadana je funkcija f svojim grafom na donjoj slici.



Ispitajte monotonost, omeđenost i parnost funkcije f na temelju njezinog grafa.

Zadatak 3

Zadana je funkcija f svojim grafom na donjoj slici.

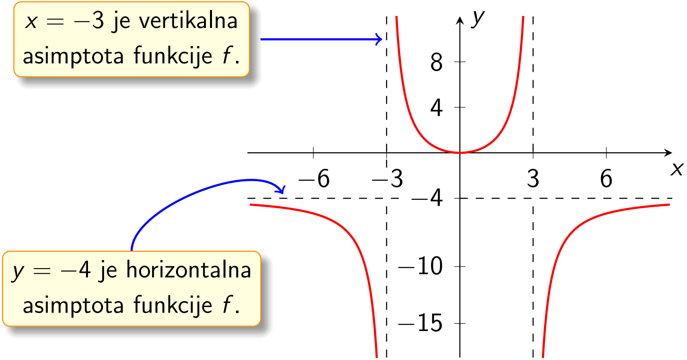


$y = -4$ je horizontalna
asimptota funkcije f.

Ispitajte monotonost, omeđenost i parnost funkcije f na temelju njezinog grafa.

Zadatak 3

Zadana je funkcija f svojim grafom na donjoj slici.



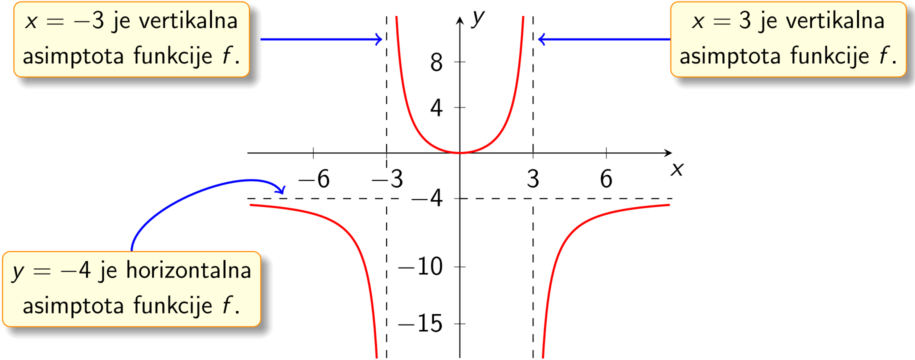
$x = -3$ je vertikalna asimptota funkcije f.

$y = -4$ je horizontalna asimptota funkcije f.

Ispitajte monotonost, omeđenost i parnost funkcije f na temelju njezinog grafa.

Zadatak 3

Zadana je funkcija f svojim grafom na donjoj slici.



$x = -3$ je vertikalna asimptota funkcije f.

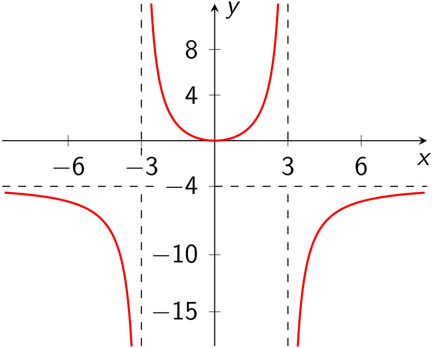
$x = 3$ je vertikalna asimptota funkcije f.

$y = -4$ je horizontalna asimptota funkcije f.

Ispitajte monotonost, omeđenost i parnost funkcije f na temelju njezinog grafa.

Rješenje

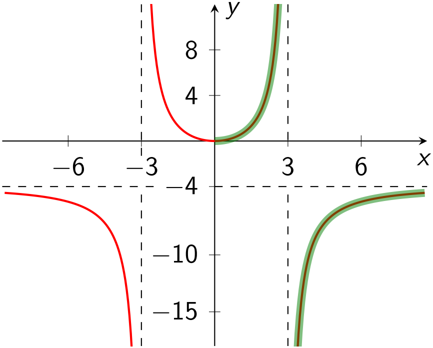
monotonost



Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0, 3\rangle$ i $\langle 3, +\infty\rangle$.

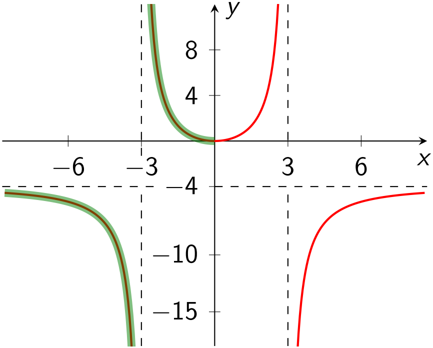


Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0,3\rangle$ i $\langle 3,+\infty\rangle$.

Funkcija f pada na intervalima $\langle -\infty,-3\rangle$ i $\langle -3,0\rangle$.



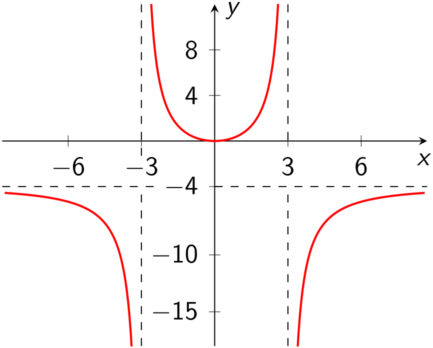
Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0, 3\rangle$ i $\langle 3, +\infty\rangle$.

Funkcija f pada na intervalima $\langle -\infty, -3\rangle$ i $\langle -3, 0\rangle$.

Funkcija f nije monotona funkcija na svojoj domeni.



Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0, 3\rangle$ i $\langle 3, +\infty\rangle$.

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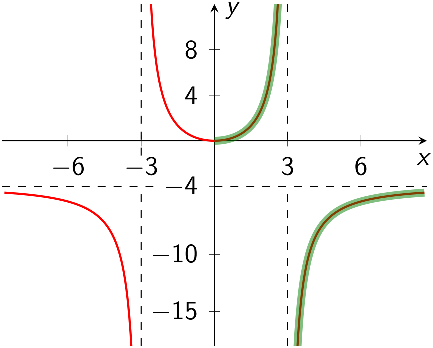

Budite iznimno oprezni

Funkcija f ne raste na skupu $\langle 0, 3\rangle \cup \langle 3, +\infty\rangle$.

Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0, 3\rangle$ i $\langle 3, +\infty\rangle$.

Funkcija f pada na intervalima $\langle -\infty, -3\rangle$ i $\langle -3, 0\rangle$.

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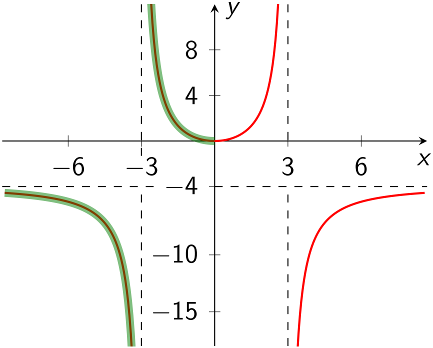

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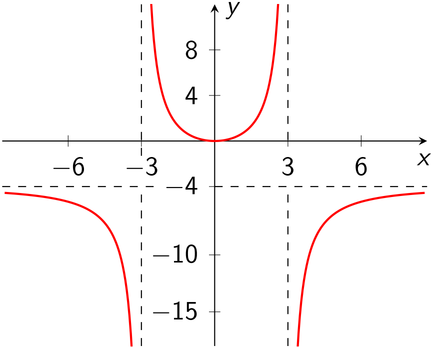
Budite iznimno oprezni

Funkcija f ne pada na skupu $\langle -\infty, -3\rangle \cup \langle -3, 0\rangle$.

Rješenje

monotonost



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Funkcija f pada na intervalima $\langle -\infty,-3\rangle$ i $\langle -3,0\rangle$.

Funkcija f nije monotona funkcija na svojoj domeni.

parnost/neparnost

Budite iznimno oprezni

Funkcija f ne raste na skupu $\langle 0,3\rangle \cup \langle 3,+\infty\rangle$.

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Rješenje

monotonost

Funkcija f raste na intervalima $\langle 0, 3\rangle$ i $\langle 3, +\infty\rangle$.

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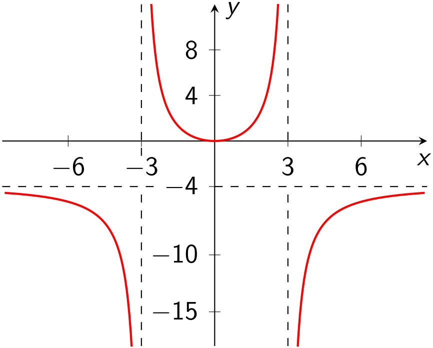


parnost/neparnost

Funkcija f je parna jer je njezin graf simetričan s obzirom na os y.

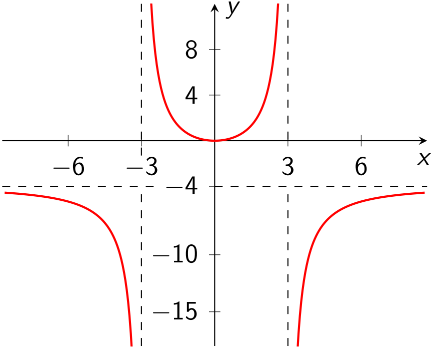
Budite iznimno oprezni

Funkcija f ne raste na skupu $\langle 0, 3\rangle \cup \langle 3, +\infty\rangle$.

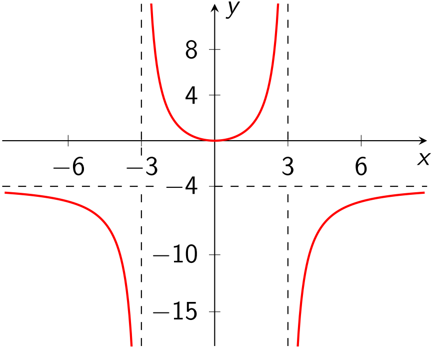
Budite iznimno oprezni

Funkcija f ne pada na skupu $\langle -\infty, -3\rangle \cup \langle -3, 0\rangle$.

omeđenost

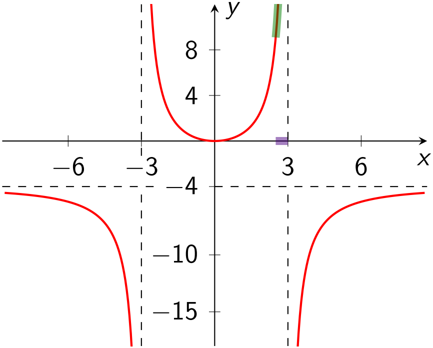


omeđenost $m \leqslant f(x) \leqslant M$



omeđenost $m \leqslant f(x) \leqslant M$

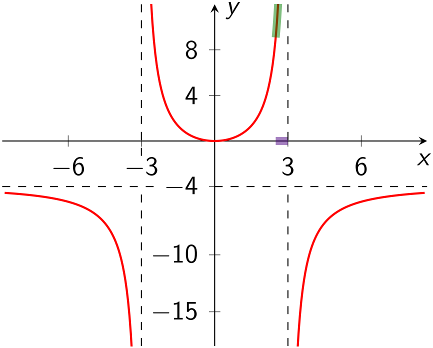
Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti,



omeđenost $m \leqslant f(x) \leqslant M$

Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti, tj.

$$\lim_{x \to 3-} f(x) = +\infty.$$

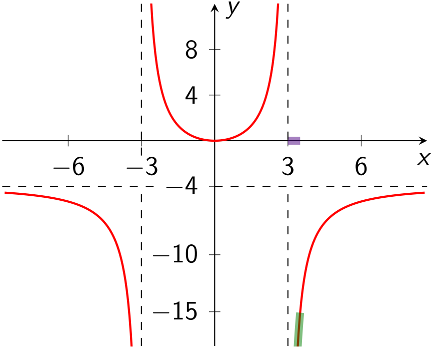


omeđenost $m \leqslant f(x) \leqslant M$

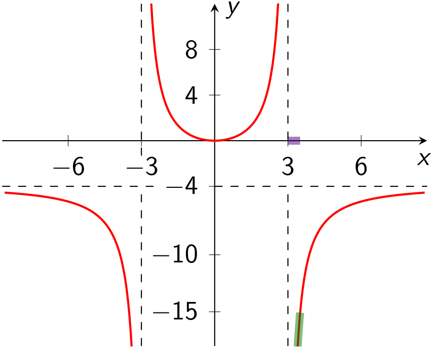
Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti, tj.

$$\lim_{x \to 3-} f(x) = +\infty.$$

Funkcija f nije omeđena odozdo jer u okolini broja 3 s desne (plus) strane poprima beskonačno velike negativne vrijednosti,



omeđenost $m \leqslant f(x) \leqslant M$



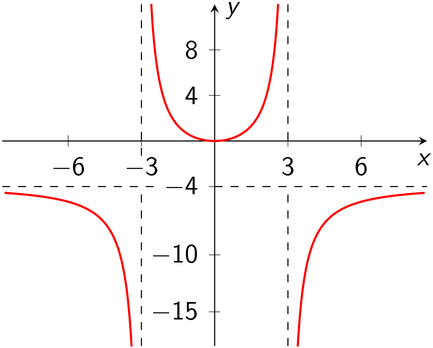
Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti, tj.

$$\lim_{x \to 3-} f(x) = +\infty.$$

Funkcija f nije omeđena odozdo jer u okolini broja 3 s desne (plus) strane poprima beskonačno velike negativne vrijednosti, tj.

$$\lim_{x \to 3+} f(x) = -\infty.$$

omeđenost $m \leqslant f(x) \leqslant M$



Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti, tj.

$$\lim_{x\to 3-} f(x) = +\infty.$$

Funkcija f nije omeđena odozdo jer u okolini broja 3 s desne (plus) strane poprima beskonačno velike negativne vrijednosti, tj.

$$\lim_{x\to 3+} f(x) = -\infty.$$

Funkcija f nije omeđena jer nije omeđena niti odozgo niti odozdo.

omeđenost $m \leqslant f(x) \leqslant M$

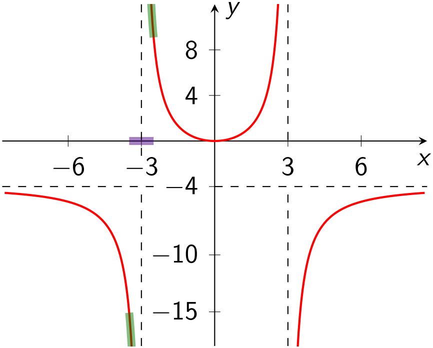
Funkcija f nije omeđena odozgo jer u okolini broja 3 s lijeve (minus) strane poprima beskonačno velike pozitivne vrijednosti, tj.

$$\lim_{x \to 3-} f(x) = +\infty.$$

Funkcija f nije omeđena odozdo jer u okolini broja 3 s desne (plus) strane poprima beskonačno velike negativne vrijednosti, tj.

$$\lim_{x \to 3+} f(x) = -\infty.$$

Funkcija f nije omeđena jer nije omeđena niti odozgo niti odozdo.



Slično je u okolini broja −3

$$\lim_{x \to -3-} f(x) = -\infty$$

$$\lim_{x \to -3+} f(x) = +\infty$$

četvrti zadatak

Zadatak 4

Zadane su funkcije $f(x) = \log_2 x$ *i* $g(x) = \log_3 x$.

a) *Na kojim dijelovima domena vrijedi nejednakost* $f(x) \geqslant g(x)$?

b) *Na kojim dijelovima domena vrijedi nejednakost* $f(x) \leqslant g(x)$?

c) *Na kojem dijelu domene vrijedi* $1 \leqslant f(x) \leqslant 2$?

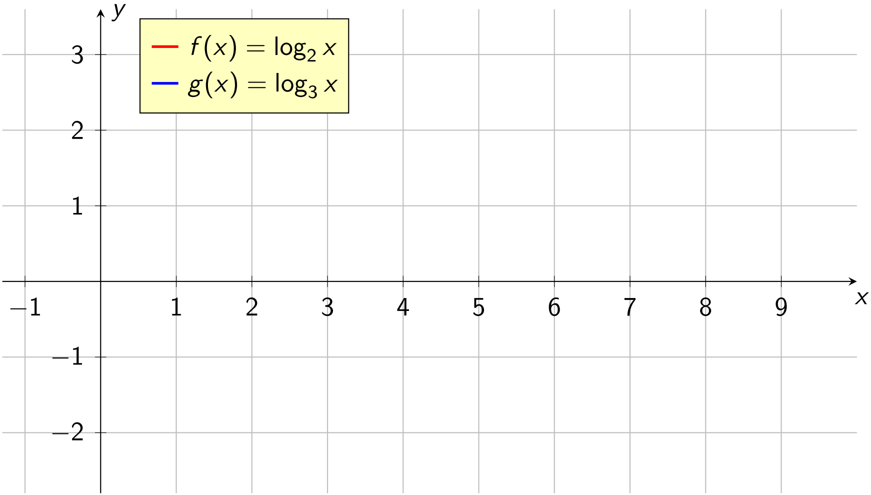
d) *Na kojem dijelu domene vrijedi* $1 \leqslant g(x) \leqslant 2$?

e) *Na kojim dijelovima domena vrijedi nejednakost* $f^{-1}(x) \geqslant g^{-1}(x)$?

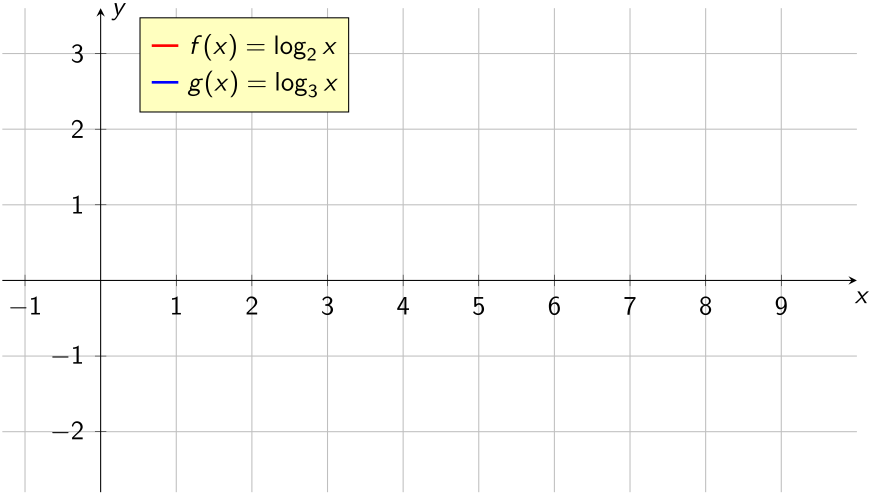
f) *Na kojim dijelovima domena vrijedi nejednakost* $f^{-1}(x) \leqslant g^{-1}(x)$?

g) *Usporedite funkcije* f, g, f^{-1} *i* g^{-1} *na intervalu* $\langle 0, +\infty \rangle$ *s linearnom funkcijom* $h(x) = x$.

Rješenje

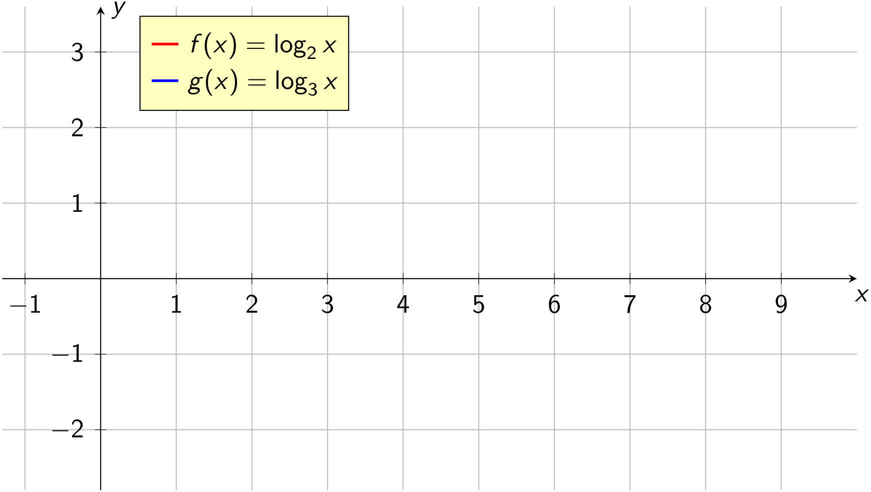


Rješenje $f : \langle 0, +\infty\rangle \to \mathbb{R}$



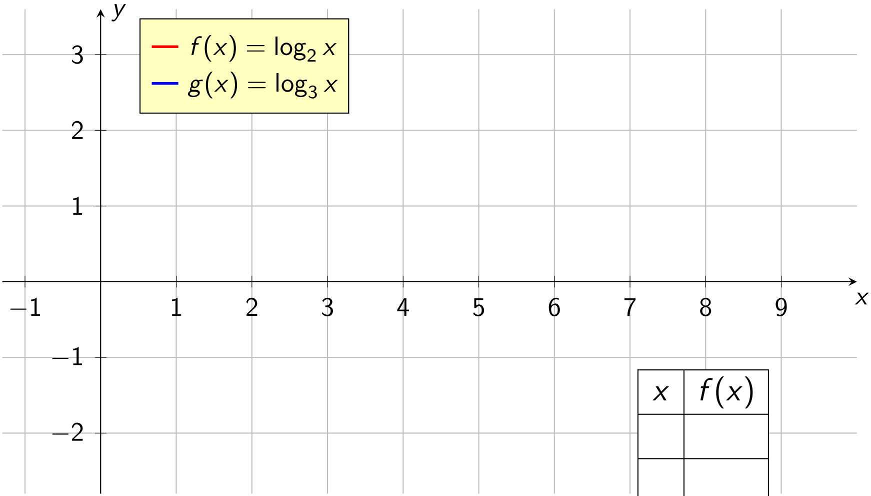
Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R} \qquad g : \langle 0, +\infty \rangle \to \mathbb{R}$



Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R} \qquad g : \langle 0, +\infty\rangle \to \mathbb{R}$

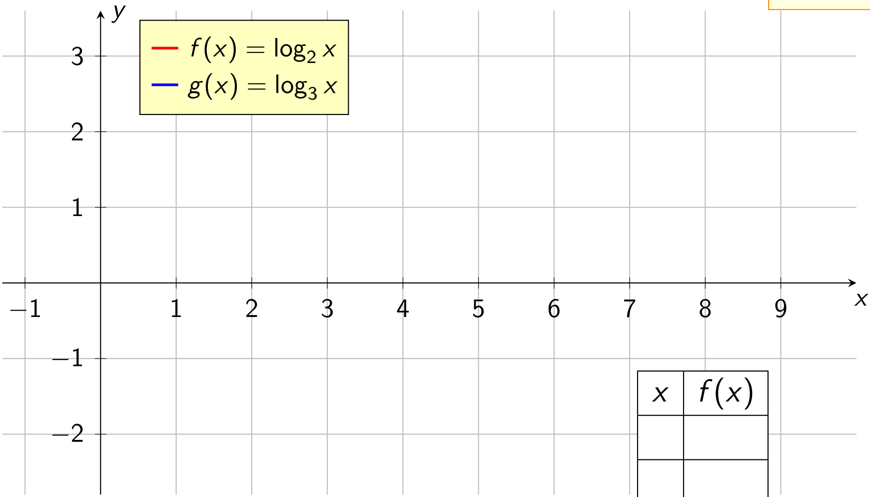


x	$f(x)$

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

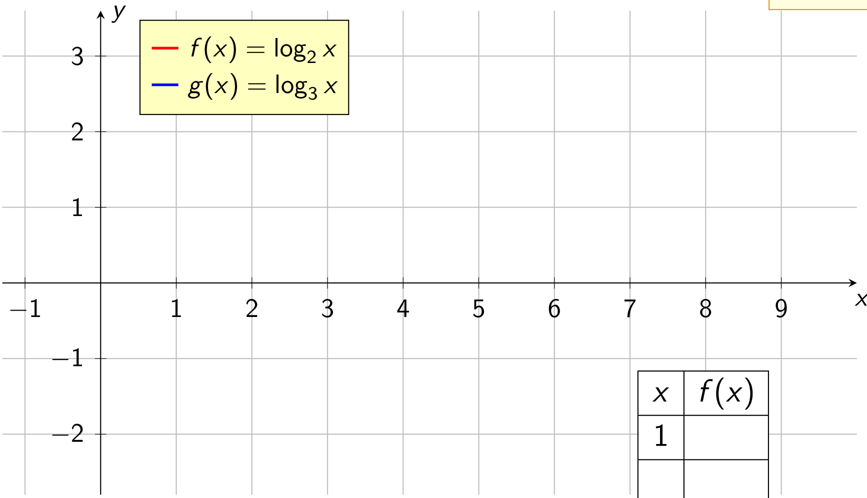


x	$f(x)$

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\log_a a^x = x$

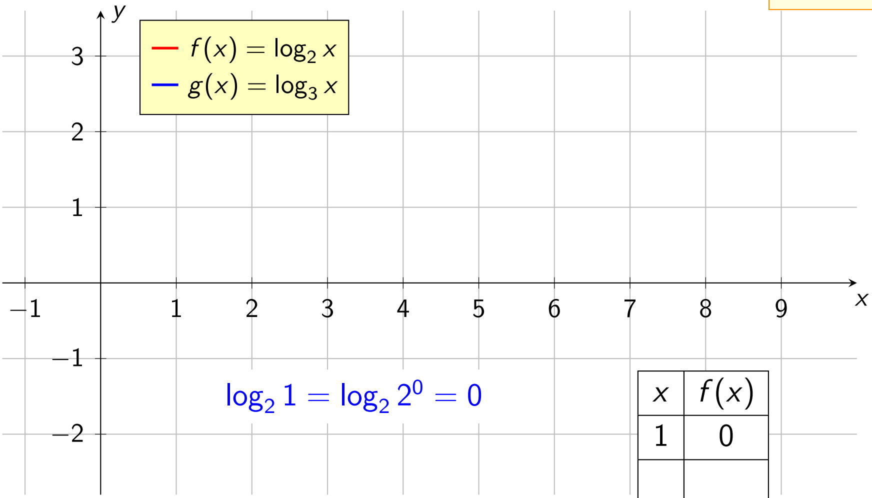


x	$f(x)$
1	

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



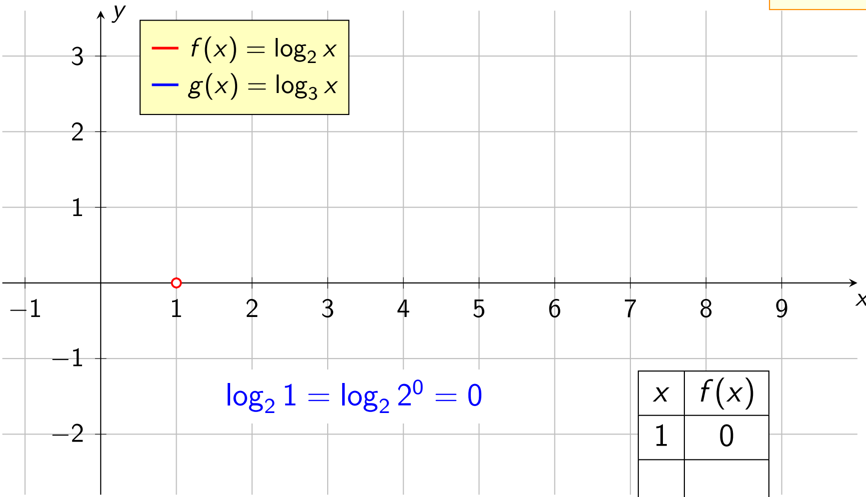
$\log_2 1 = \log_2 2^0 = 0$

x	$f(x)$
1	0

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

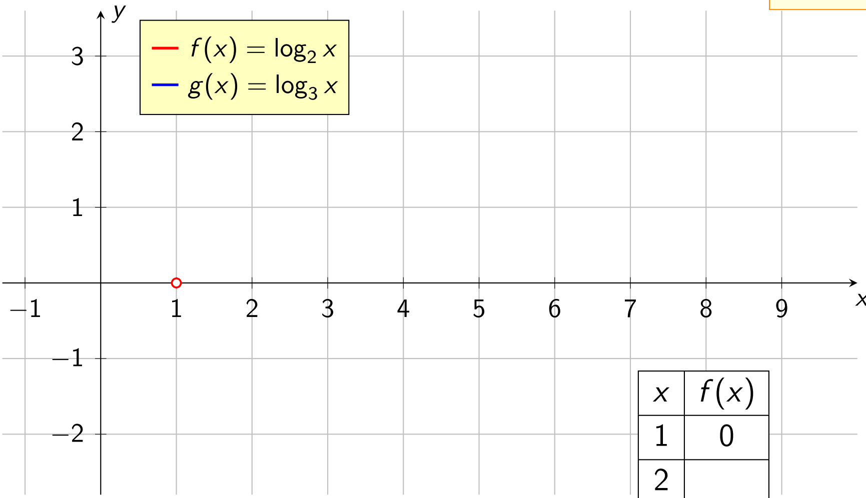


$$\log_2 1 = \log_2 2^0 = 0$$

x	$f(x)$
1	0

Rješenje $f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$$\boxed{\log_a a^x = x}$$

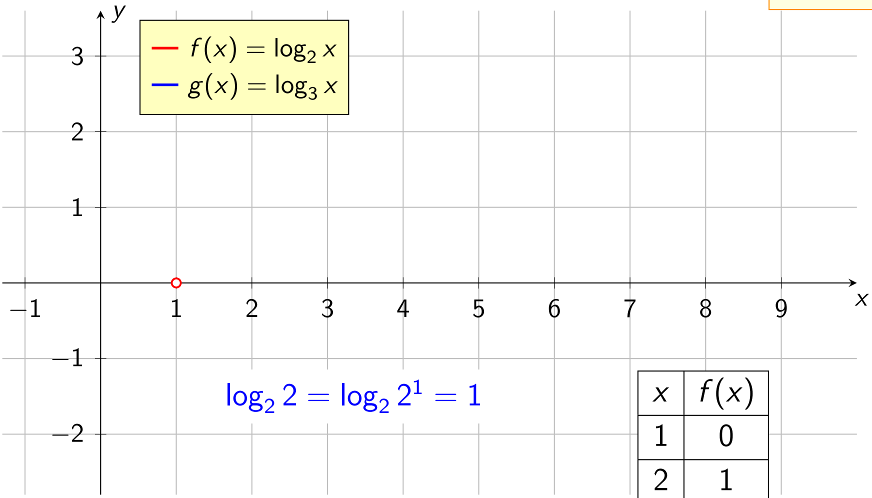


x	$f(x)$
1	0
2	

Rješenje

$f:\langle 0,+\infty\rangle \to \mathbb{R}$ $\qquad$ $g:\langle 0,+\infty\rangle \to \mathbb{R}$

$$\boxed{\log_a a^x = x}$$



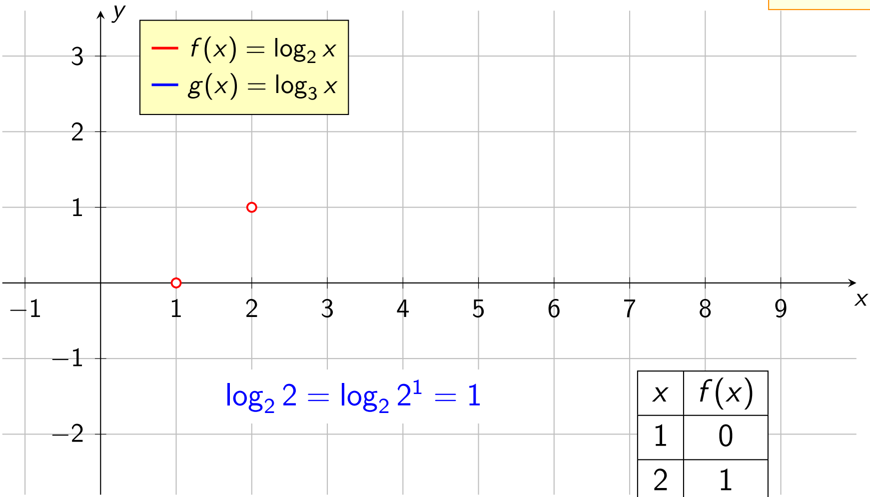
$$\log_2 2 = \log_2 2^1 = 1$$

x	$f(x)$
1	0
2	1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



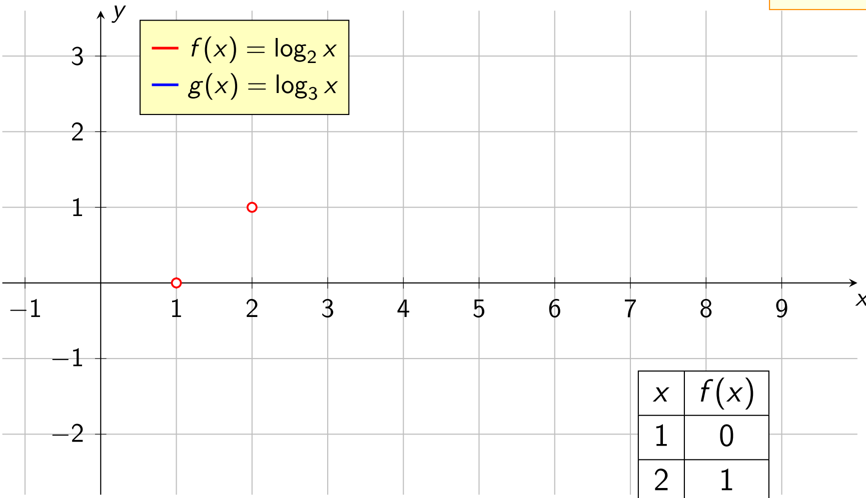
$\log_2 2 = \log_2 2^1 = 1$

x	$f(x)$
1	0
2	1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

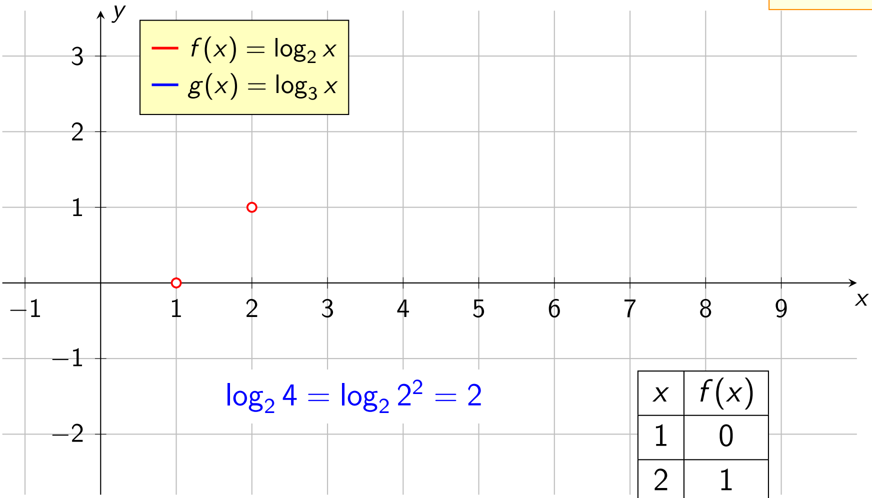


x	$f(x)$
1	0
2	1
4	

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\log_a a^x = x$



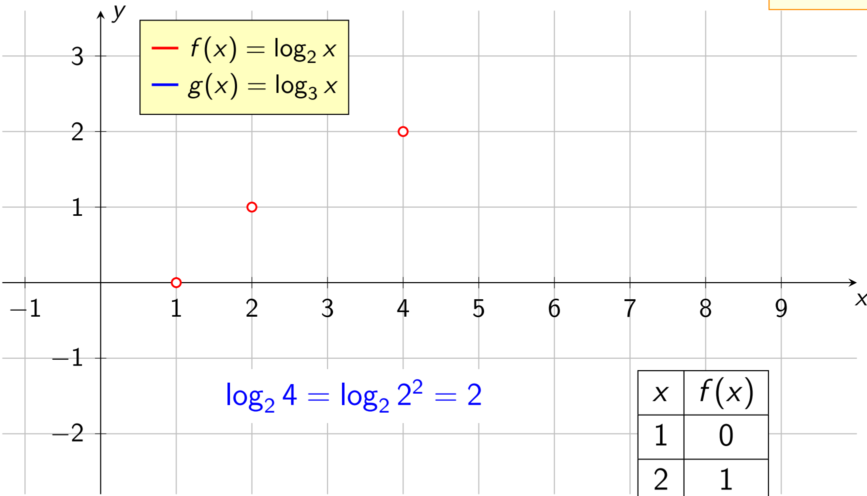
$\log_2 4 = \log_2 2^2 = 2$

x	$f(x)$
1	0
2	1
4	2

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\quad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



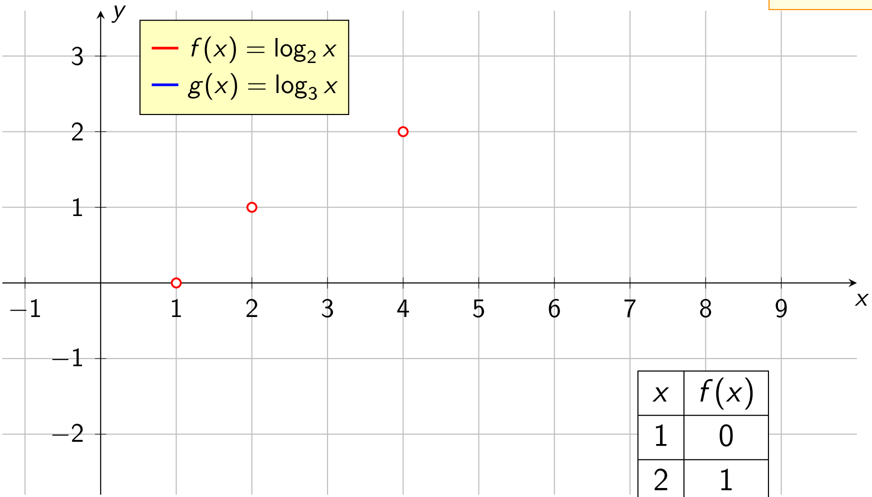
$$\log_2 4 = \log_2 2^2 = 2$$

x	$f(x)$
1	0
2	1
4	2

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\quad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

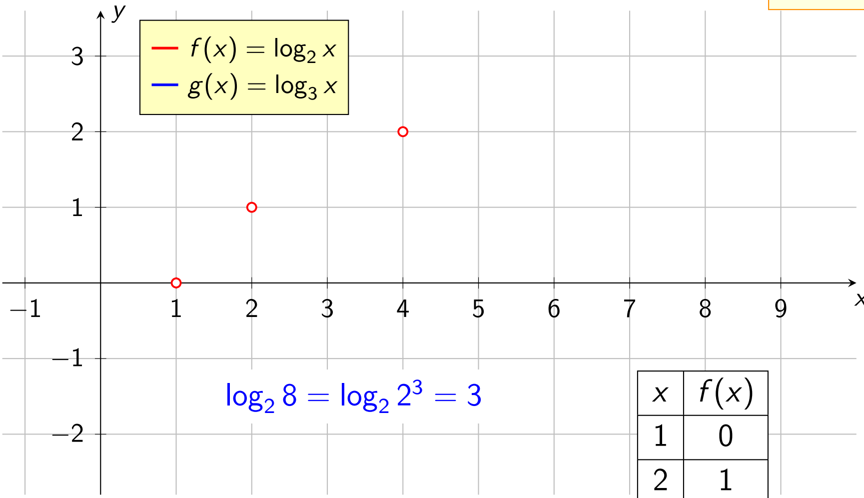


x	$f(x)$
1	0
2	1
4	2
8	

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\log_a a^x = x$



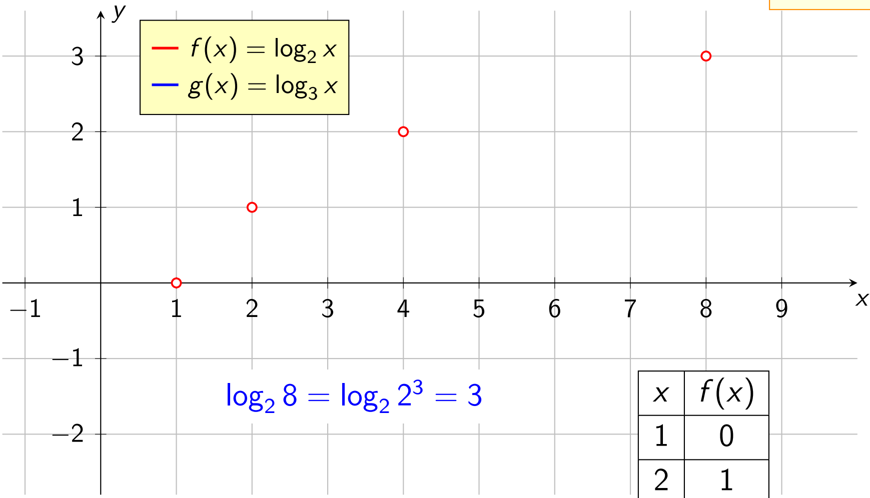
$\log_2 8 = \log_2 2^3 = 3$

x	$f(x)$
1	0
2	1
4	2
8	3

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\quad g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



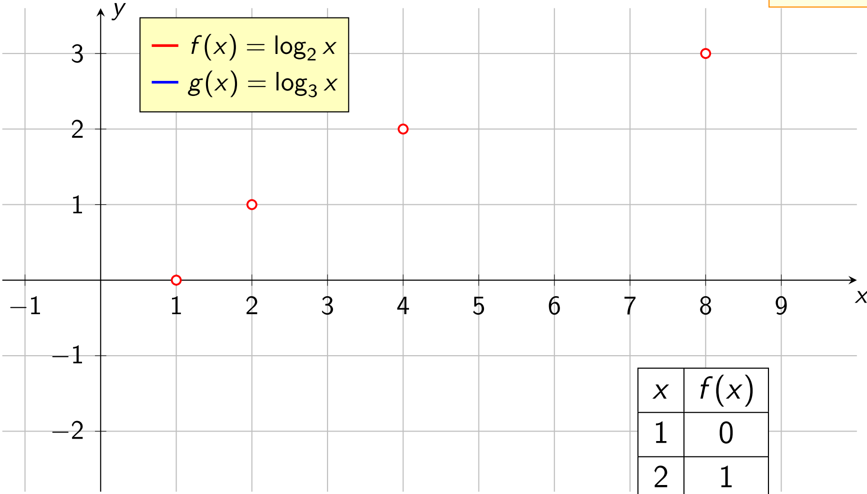
$\log_2 8 = \log_2 2^3 = 3$

x	$f(x)$
1	0
2	1
4	2
8	3

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

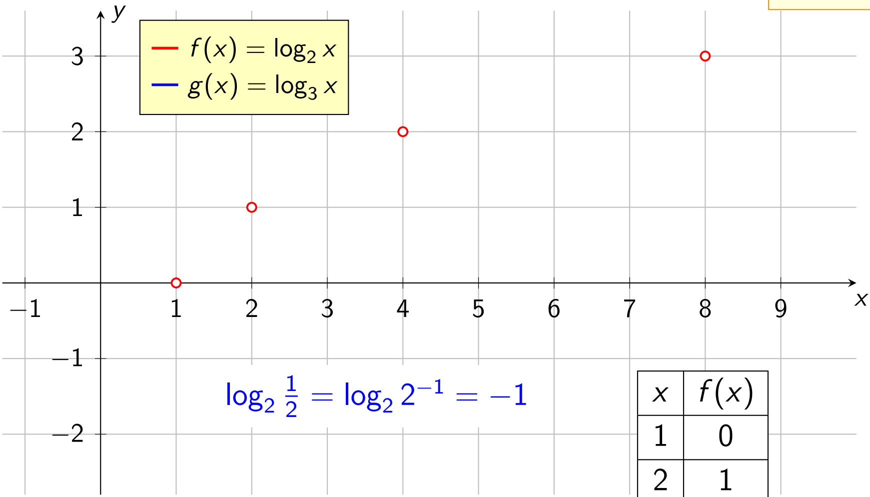


x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	

Rješenje

$f:\langle 0,+\infty\rangle \to \mathbb{R}$ $\qquad g:\langle 0,+\infty\rangle \to \mathbb{R}$

$$\boxed{\log_a a^x = x}$$



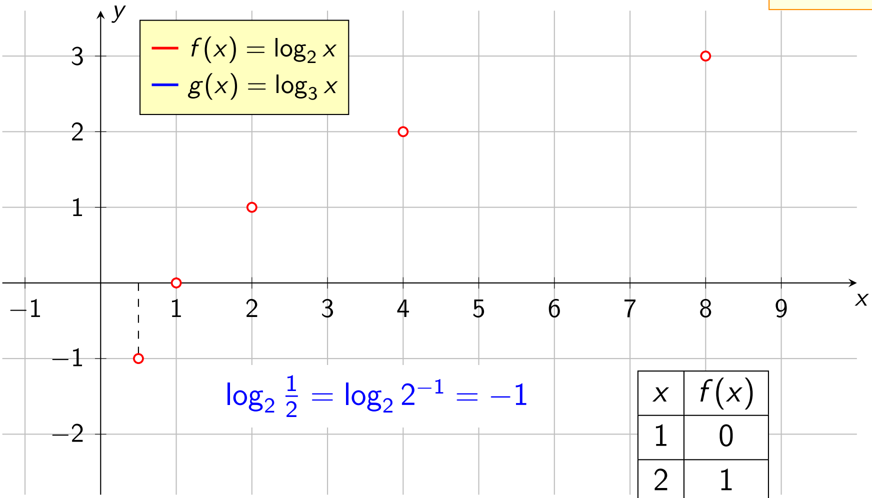
$$\log_2 \frac{1}{2} = \log_2 2^{-1} = -1$$

x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



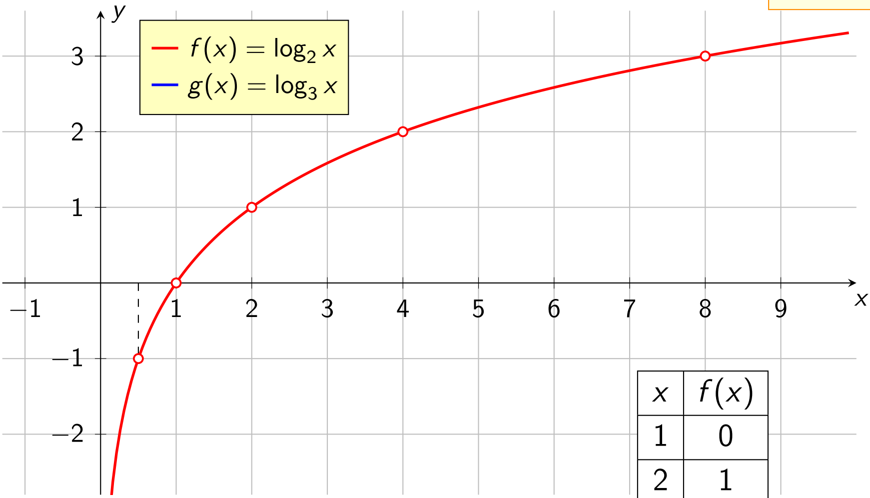
$$\log_2 \frac{1}{2} = \log_2 2^{-1} = -1$$

x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$

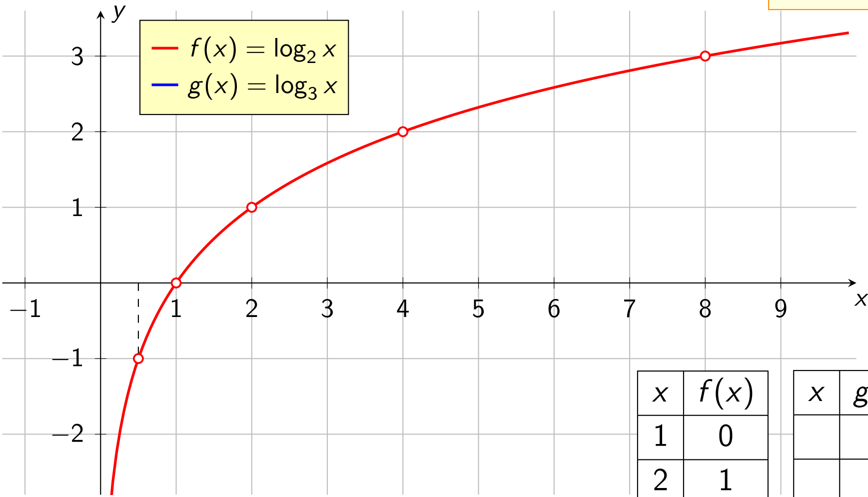


x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\quad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



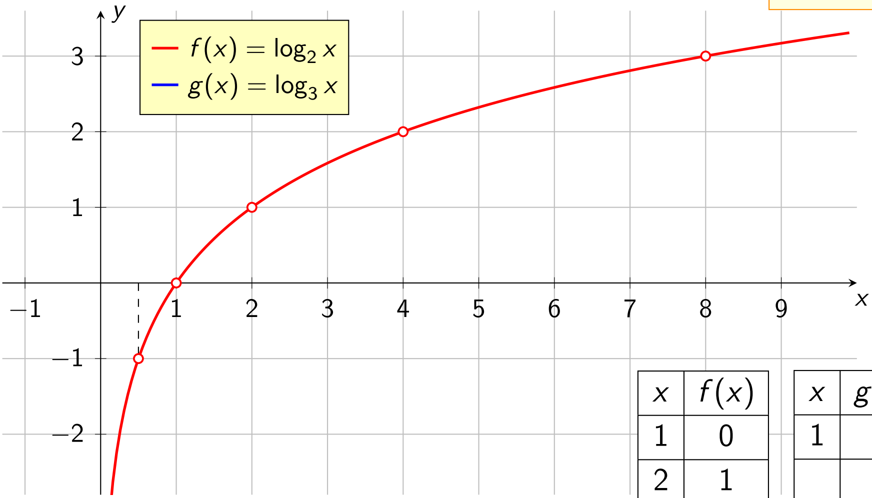
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



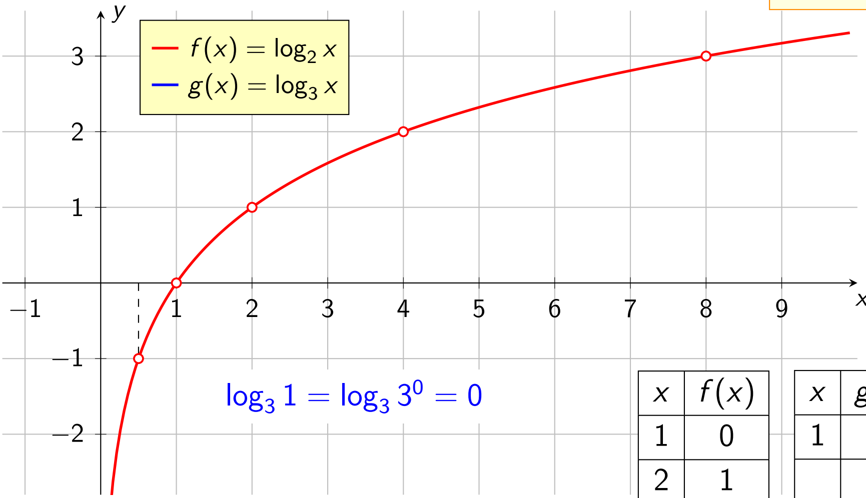
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$\log_3 1 = \log_3 3^0 = 0$

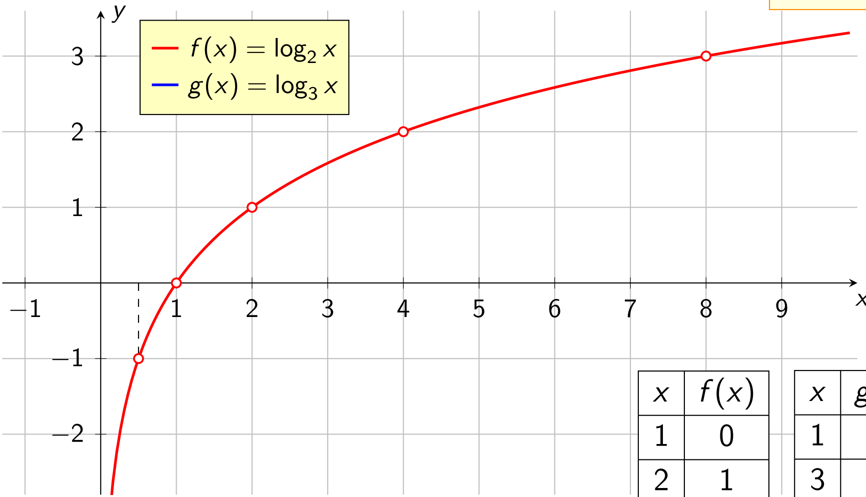
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\quad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



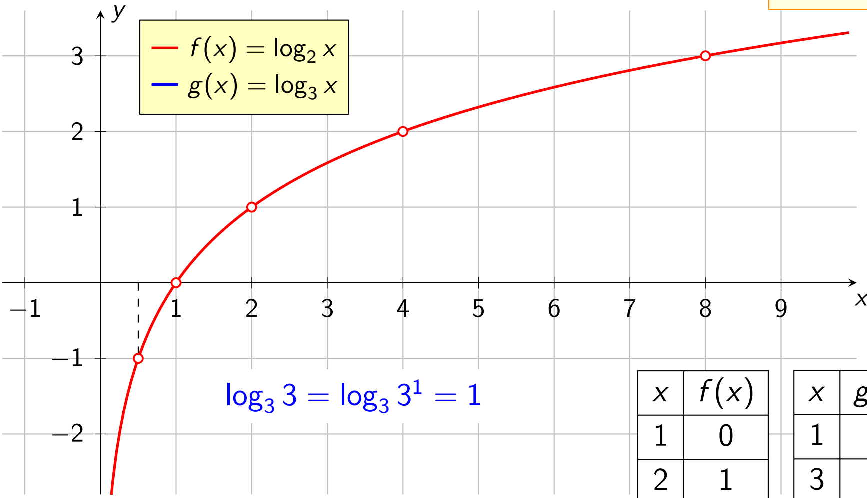
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$\log_3 3 = \log_3 3^1 = 1$

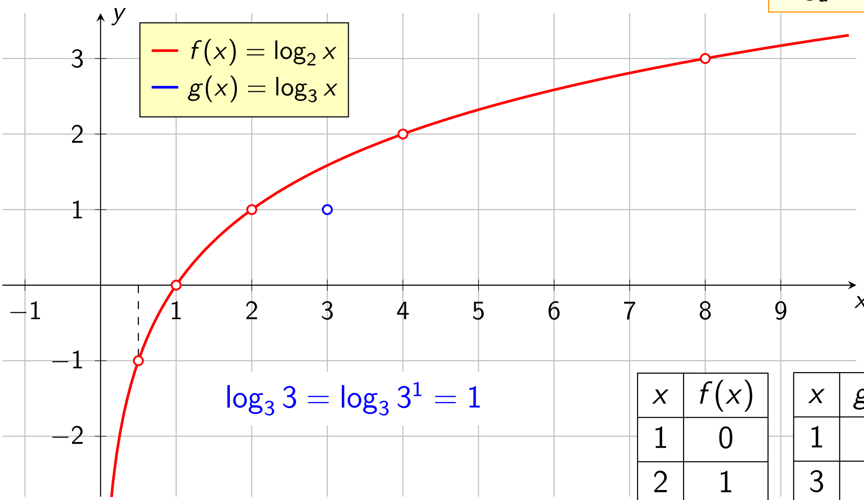
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$$\boxed{\log_a a^x = x}$$



$\log_3 3 = \log_3 3^1 = 1$

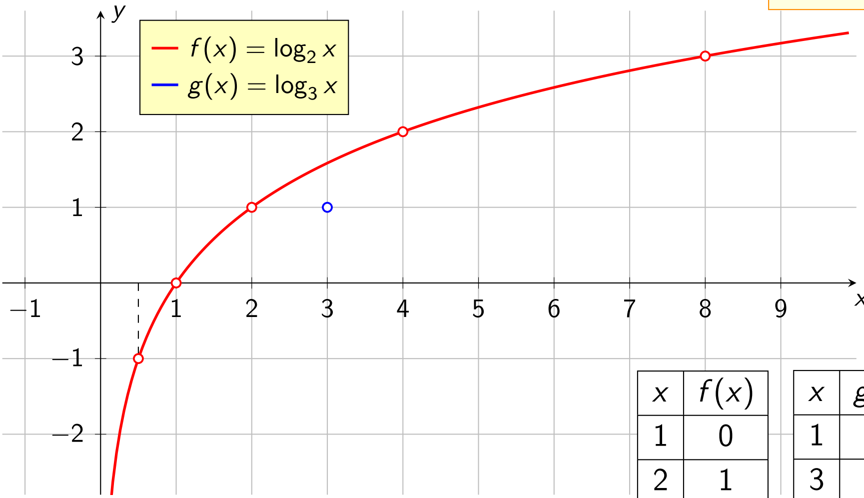
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\log_a a^x = x$



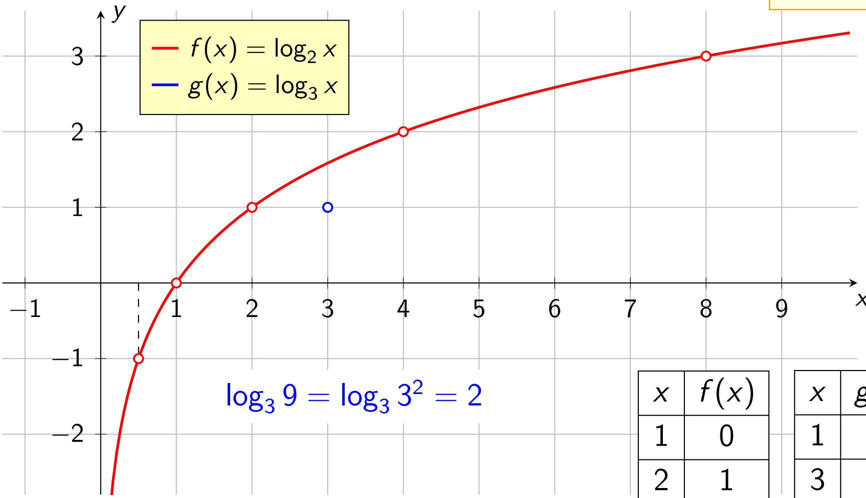
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$\log_3 9 = \log_3 3^2 = 2$

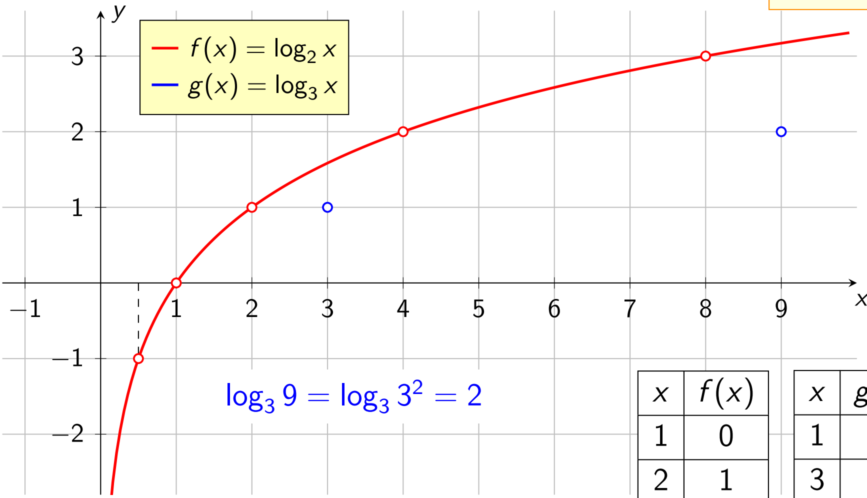
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$\log_3 9 = \log_3 3^2 = 2$

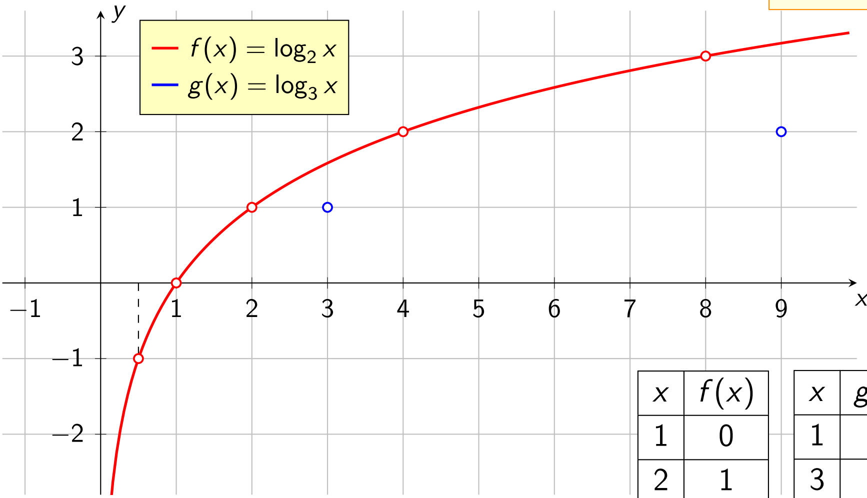
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



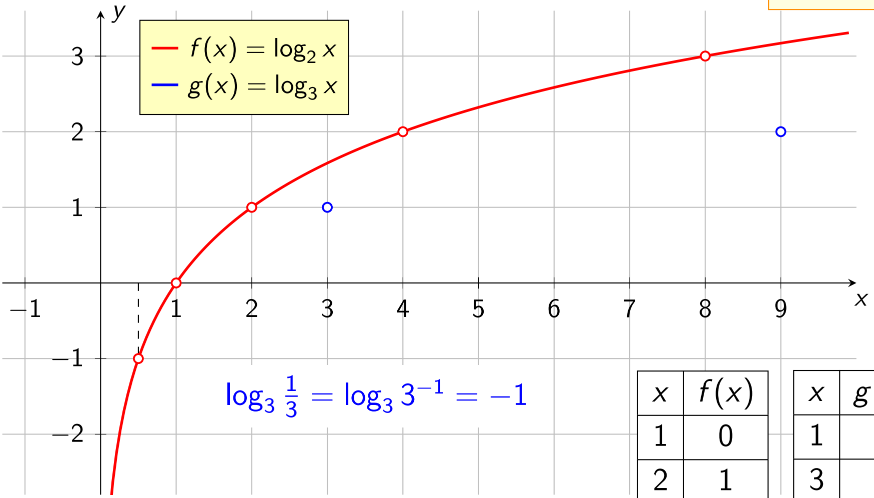
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\quad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$$\log_3 \frac{1}{3} = \log_3 3^{-1} = -1$$

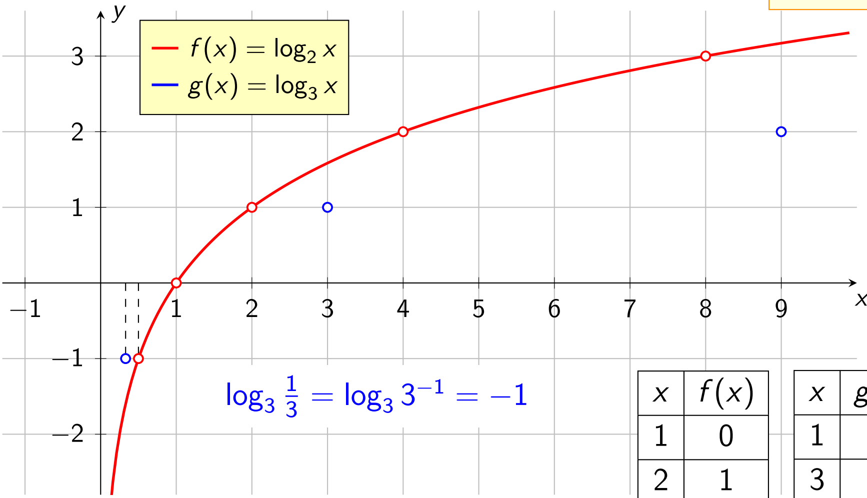
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



$\log_3 \frac{1}{3} = \log_3 3^{-1} = -1$

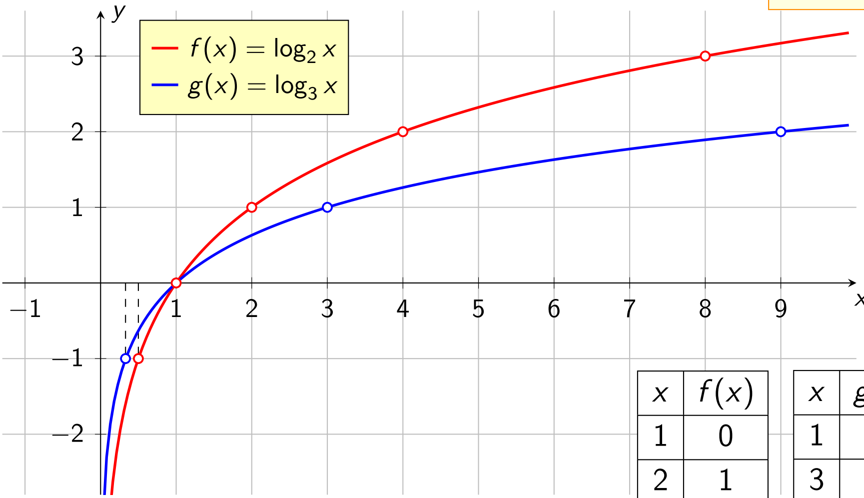
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



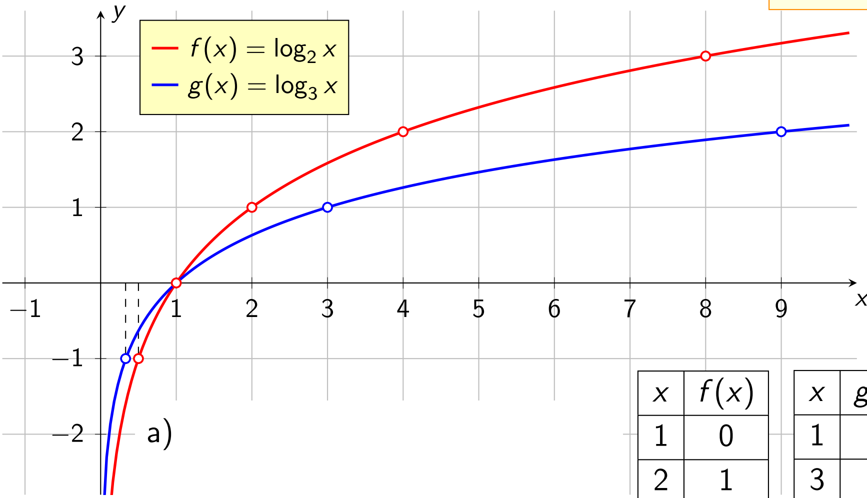
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



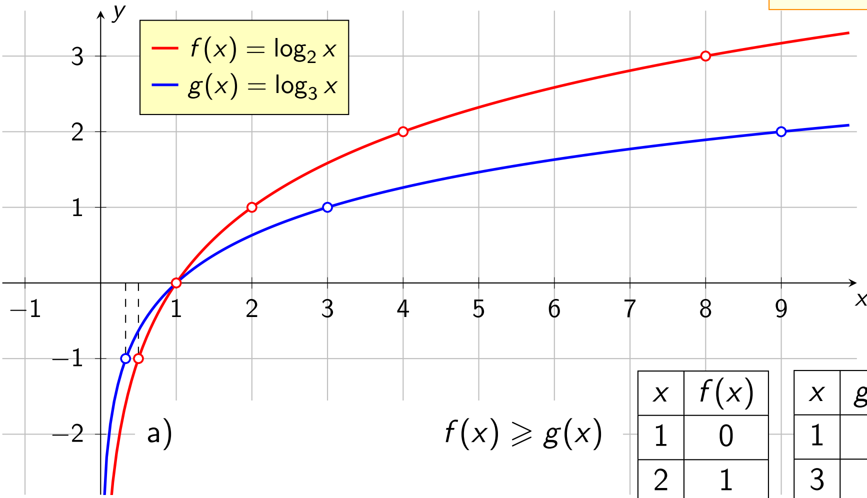
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a)

$f(x) \geqslant g(x)$

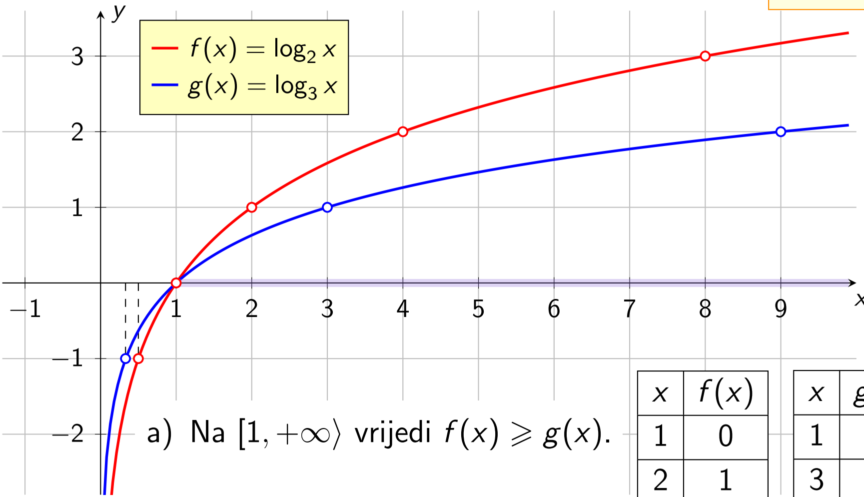
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

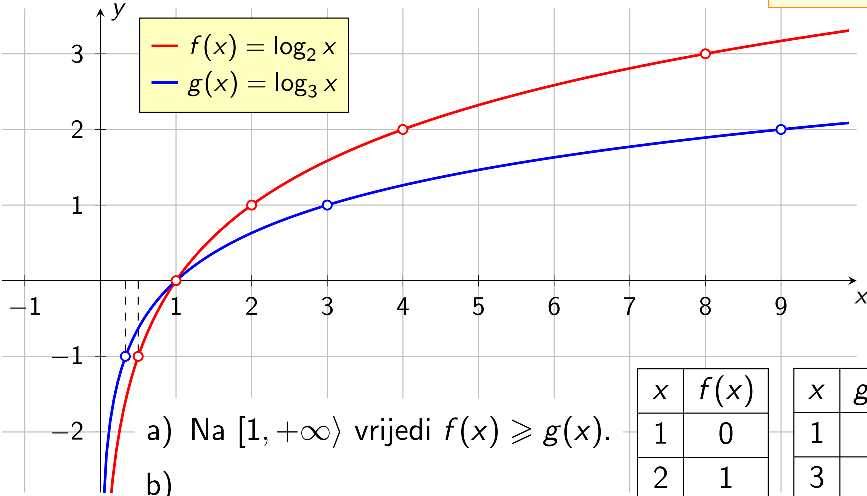
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b)

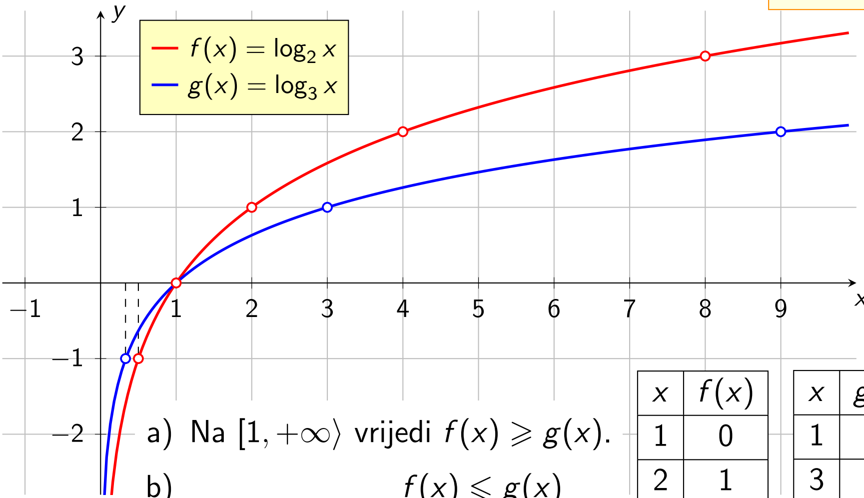
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) $f(x) \leqslant g(x)$

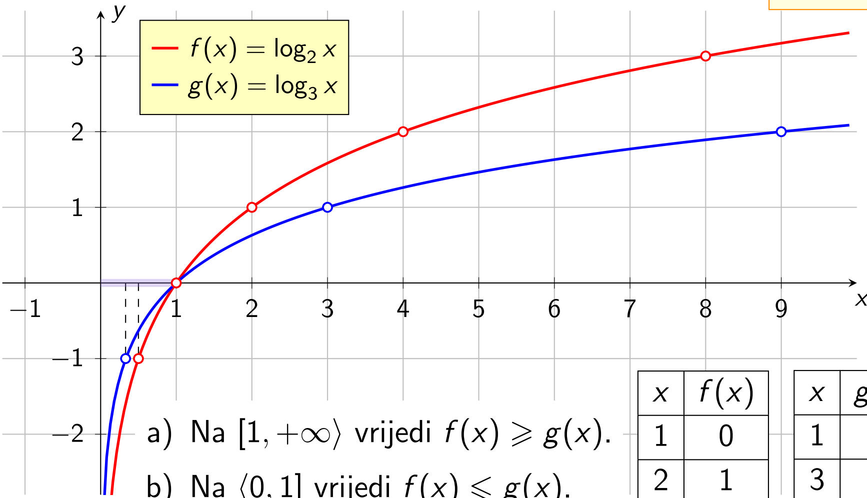
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

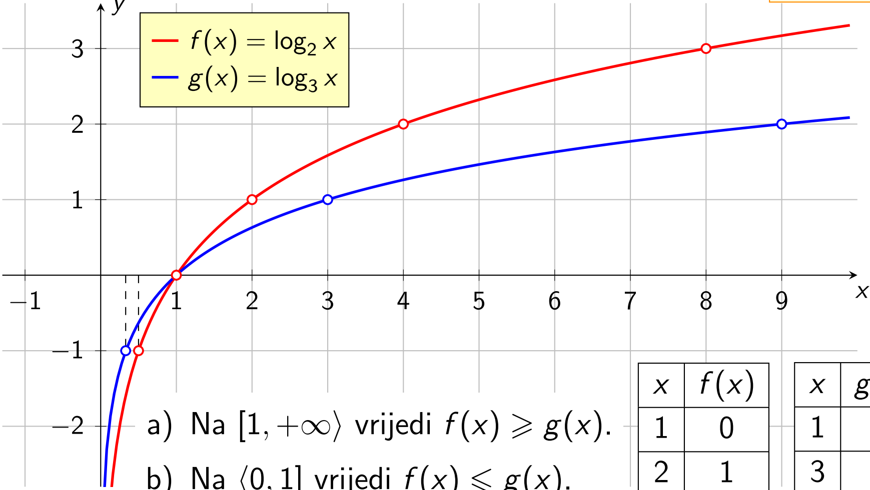
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c)

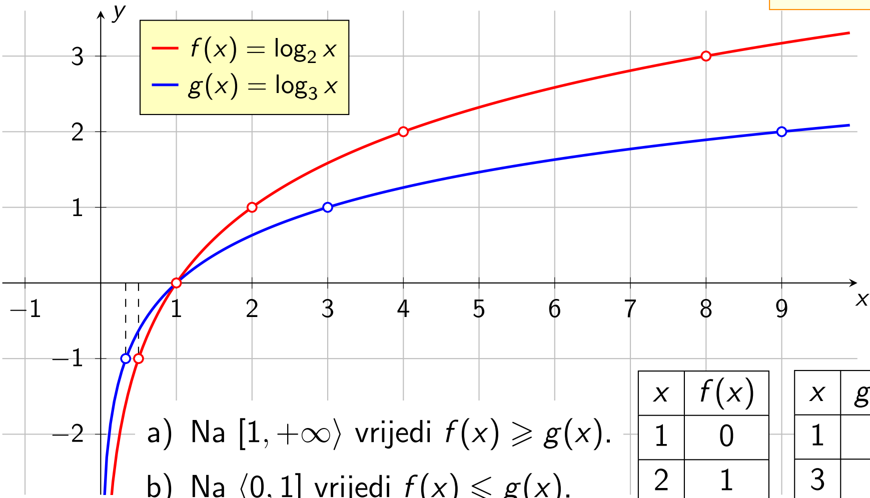
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$$\boxed{\log_a a^x = x}$$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) $$1 \leqslant f(x) \leqslant 2$$

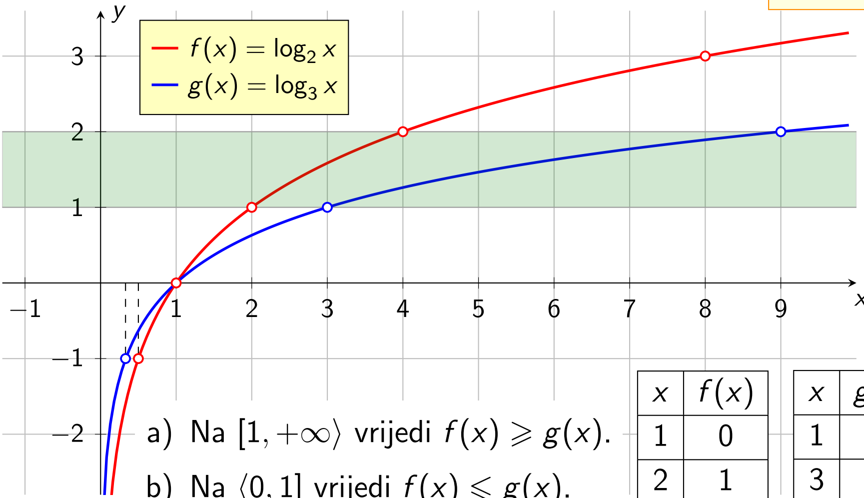
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\log_a a^x = x$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) $$1 \leqslant f(x) \leqslant 2$$

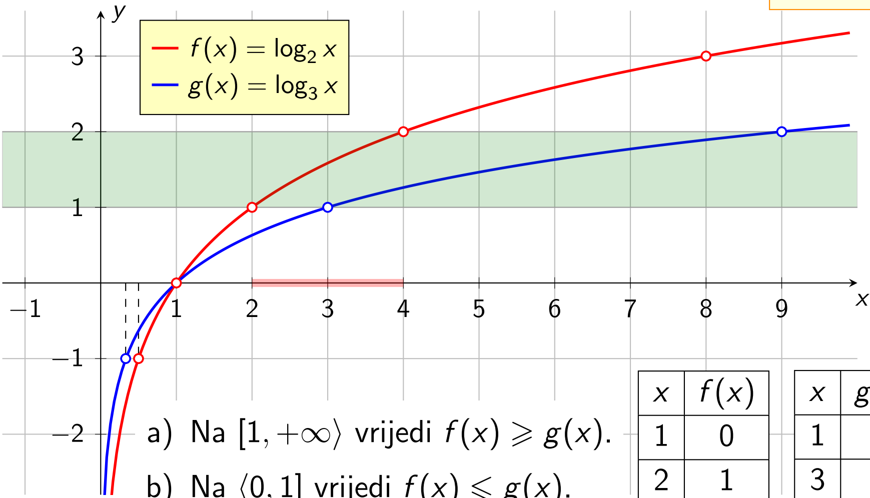
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) Na $[2, 4]$ vrijedi $1 \leqslant f(x) \leqslant 2$.

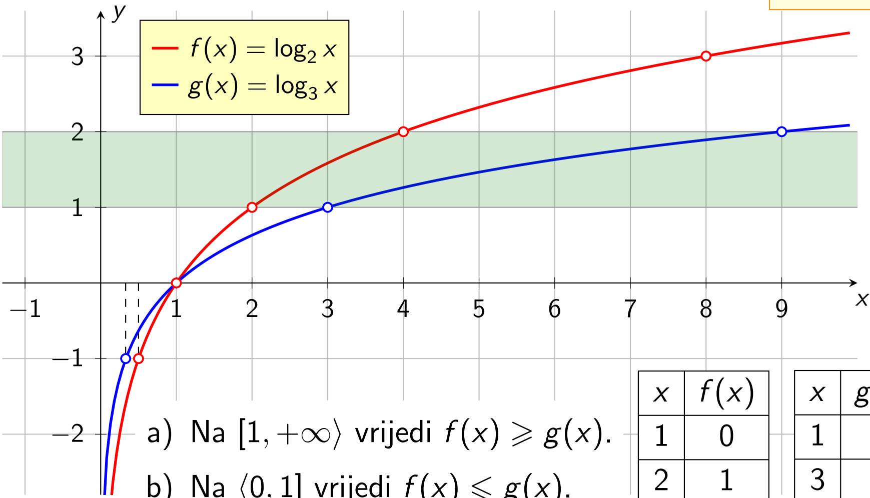
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) Na $[2, 4]$ vrijedi $1 \leqslant f(x) \leqslant 2$.

d)

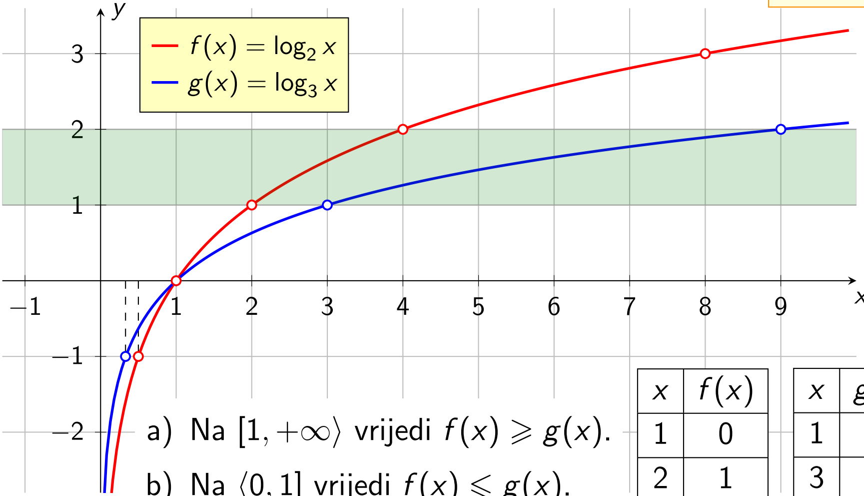
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty \rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty \rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) Na $[2, 4]$ vrijedi $1 \leqslant f(x) \leqslant 2$.

d) $1 \leqslant g(x) \leqslant 2$

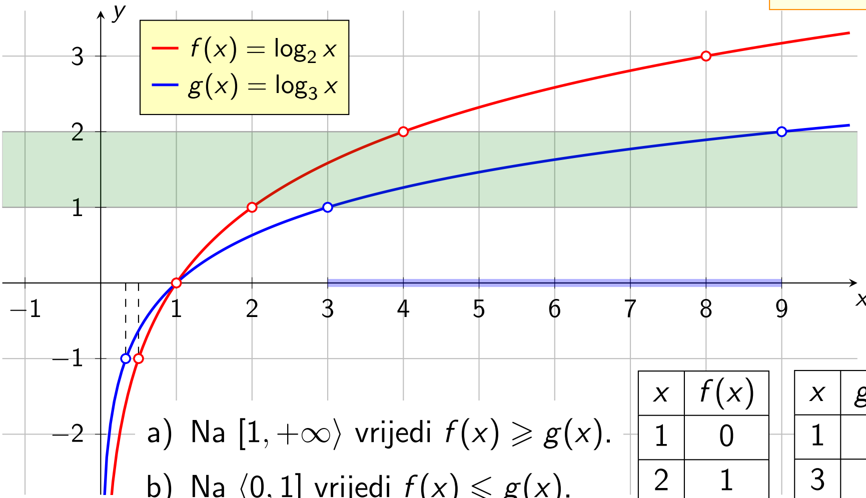
x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1

Rješenje

$f : \langle 0, +\infty\rangle \to \mathbb{R}$ $\qquad$ $g : \langle 0, +\infty\rangle \to \mathbb{R}$

$\boxed{\log_a a^x = x}$



a) Na $[1, +\infty\rangle$ vrijedi $f(x) \geqslant g(x)$.

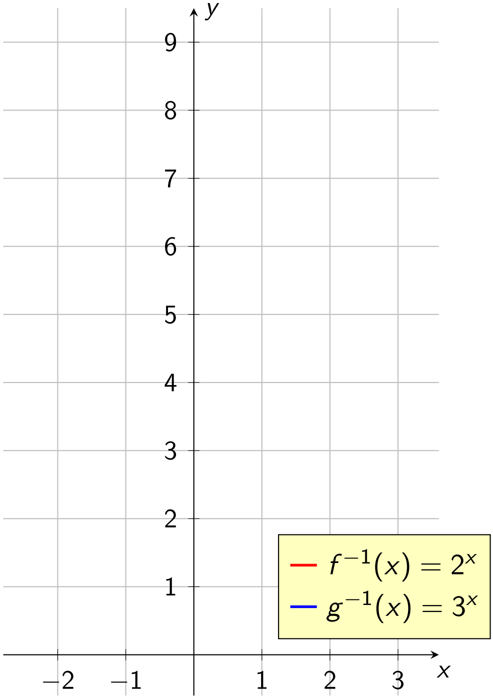
b) Na $\langle 0, 1]$ vrijedi $f(x) \leqslant g(x)$.

c) Na $[2, 4]$ vrijedi $1 \leqslant f(x) \leqslant 2$.

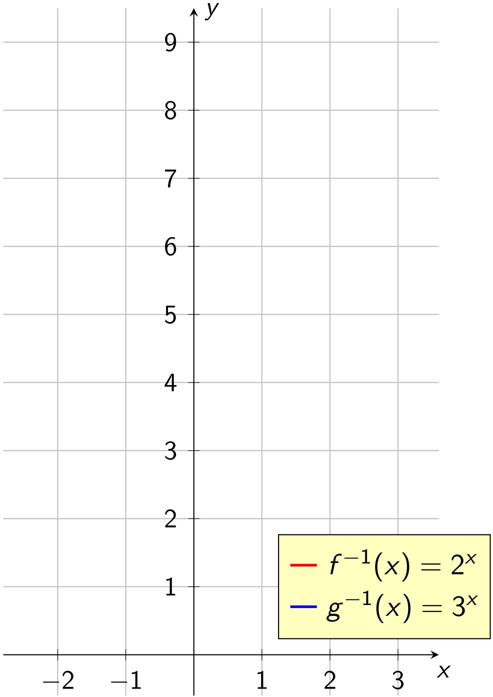
d) Na $[3, 9]$ vrijedi $1 \leqslant g(x) \leqslant 2$.

x	$f(x)$
1	0
2	1
4	2
8	3
$\frac{1}{2}$	-1

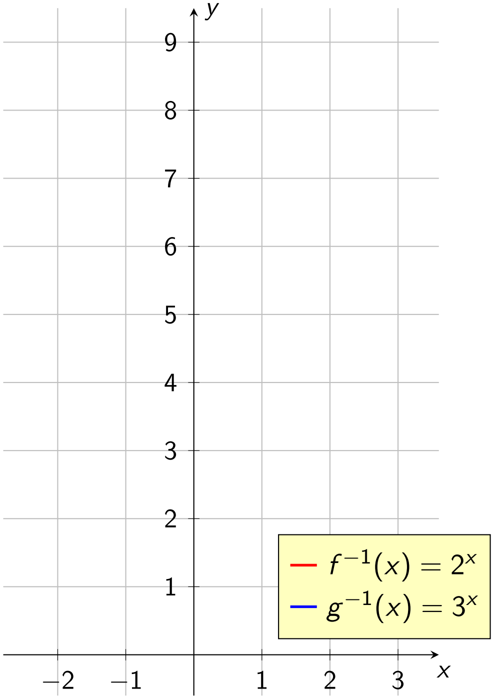
x	$g(x)$
1	0
3	1
9	2
$\frac{1}{3}$	-1



y
9
8
7
6
5
4
3
2
1
−2
−1
1
2
3
x
$f^{-1}(x) = 2^x$
$g^{-1}(x) = 3^x$



$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$

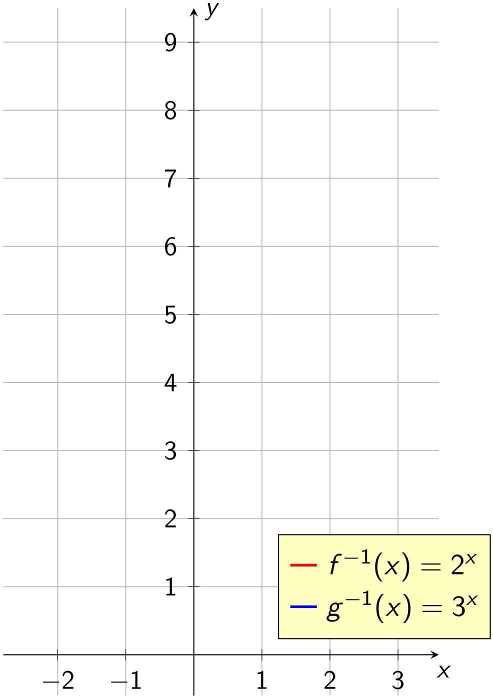


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

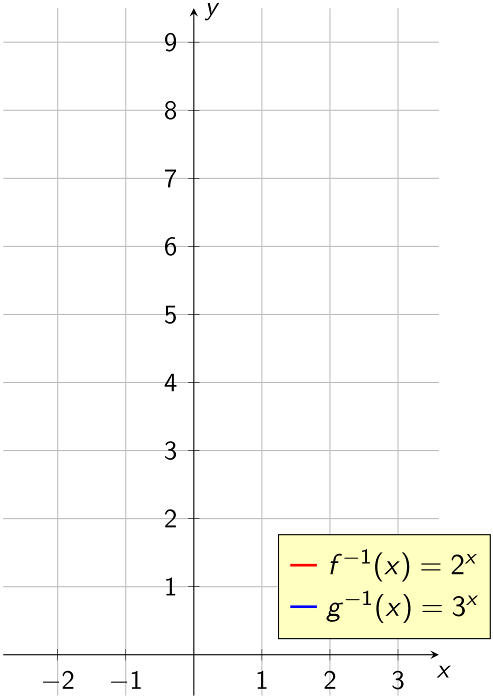
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



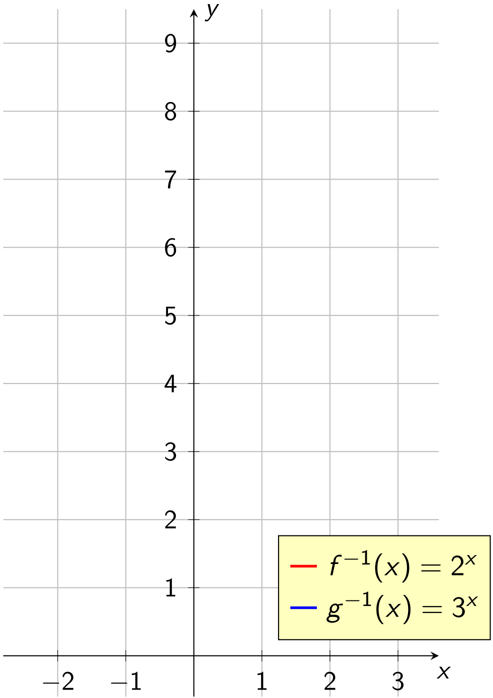
x	$f^{-1}(x)$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	



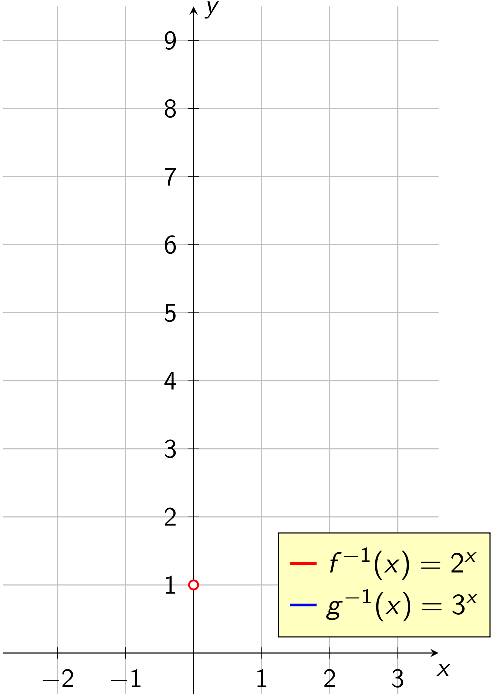
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

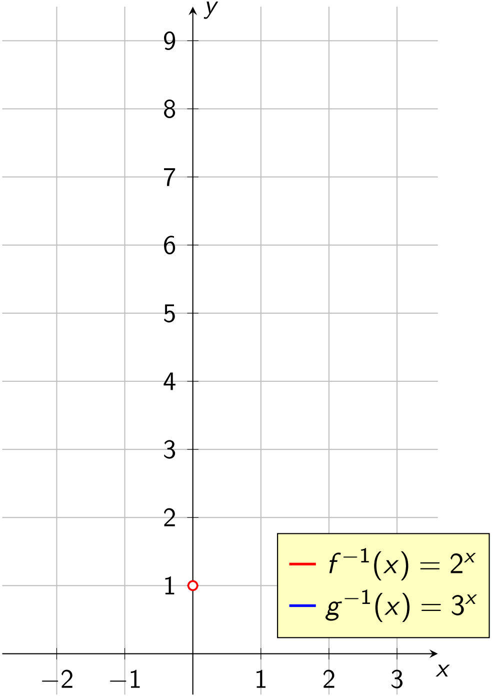
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

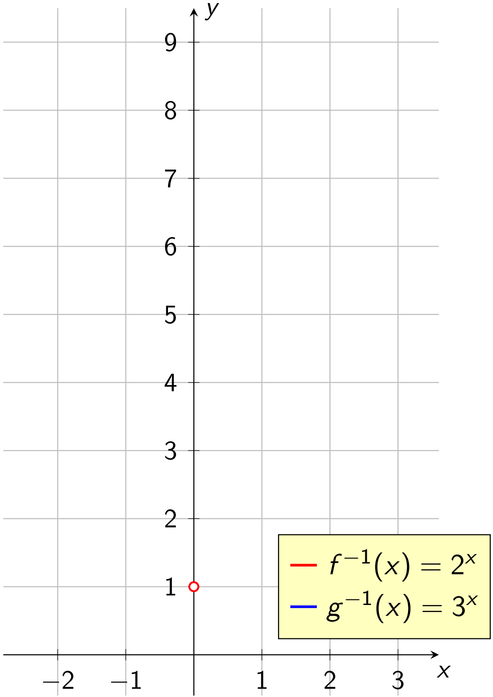
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



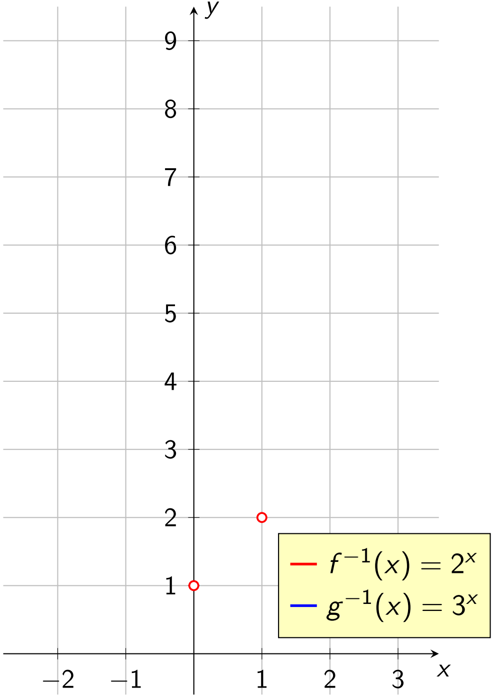
x	$f^{-1}(x)$
0	1
1	

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2



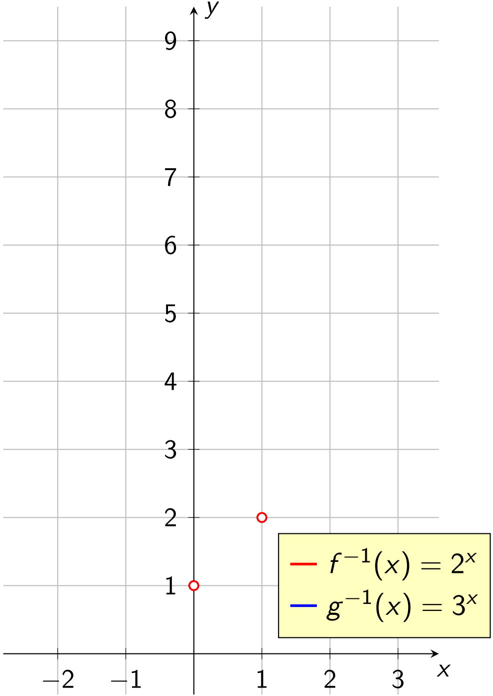
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

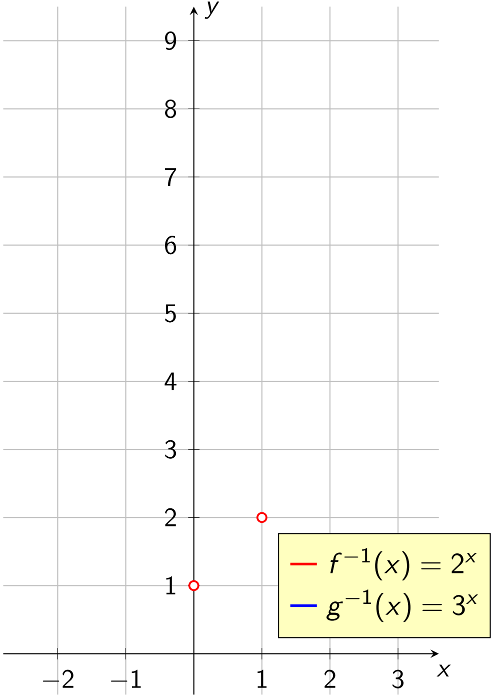
x	$f^{-1}(x)$
0	1
1	2

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	



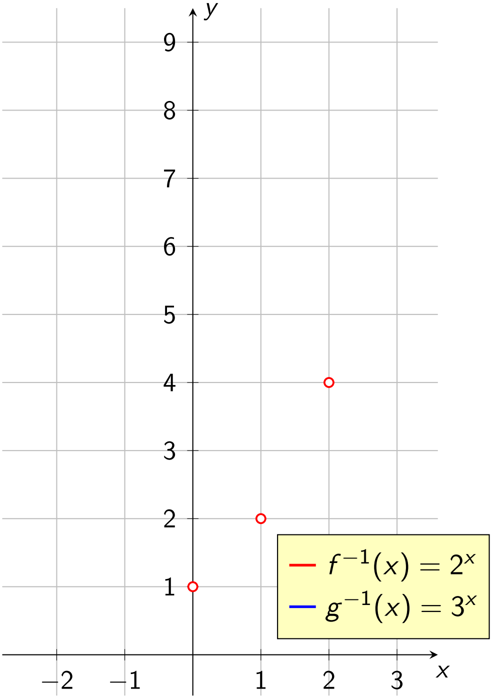
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

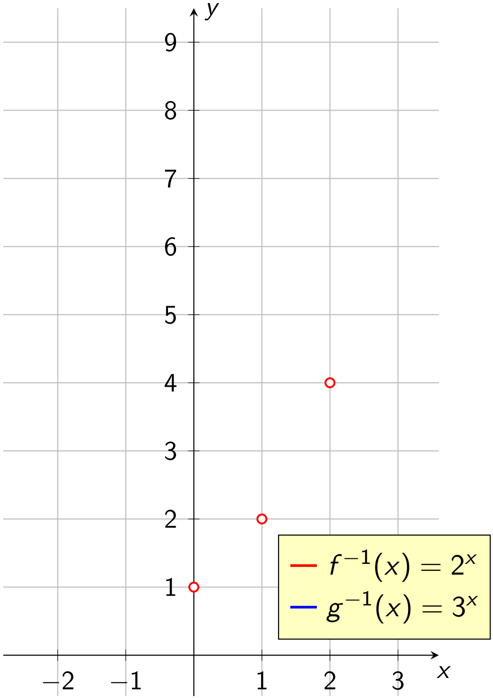
x	$f^{-1}(x)$
0	1
1	2
2	4

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



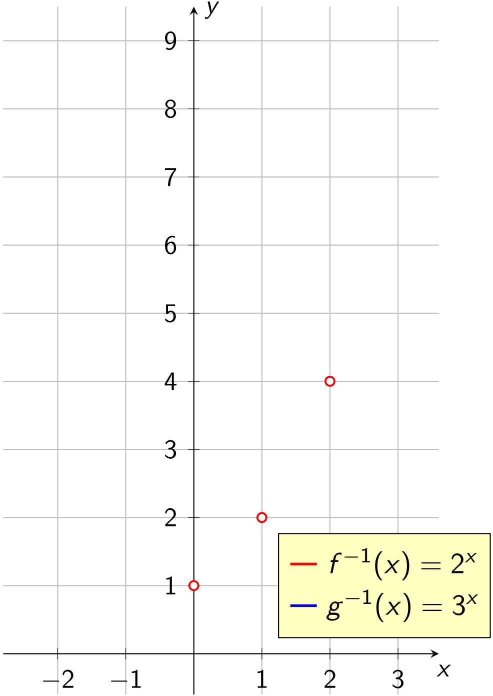
x	$f^{-1}(x)$
0	1
1	2
2	4



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	



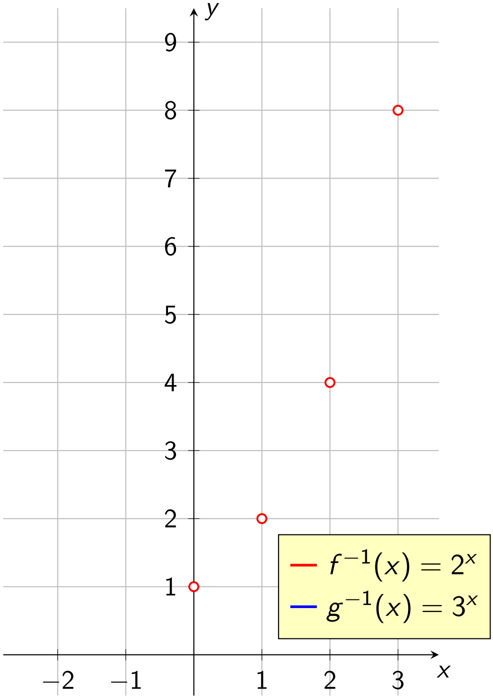
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

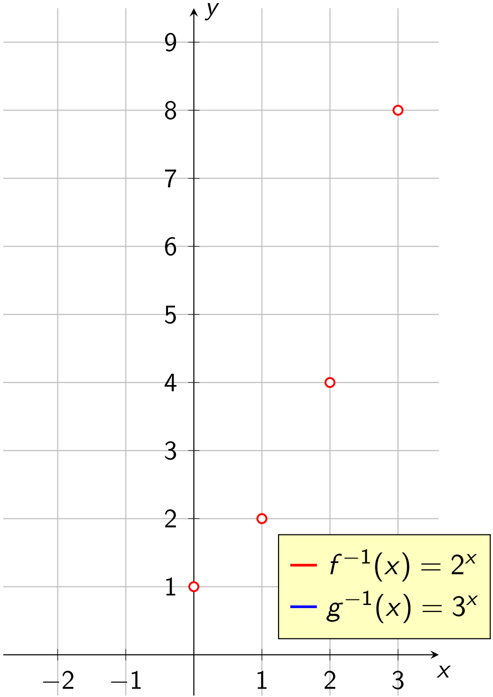
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



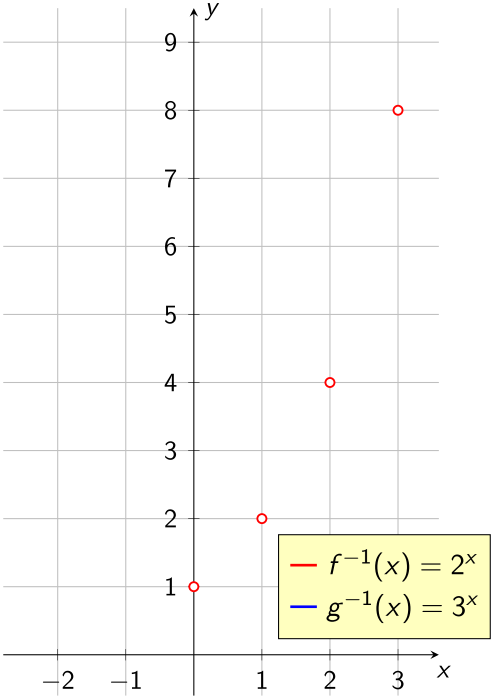
x	$f^{-1}(x)$
0	1
1	2
2	4
3	8

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
−1	



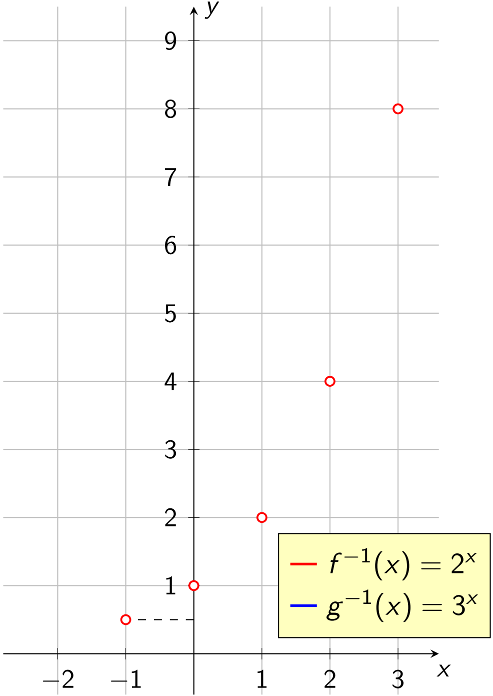
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

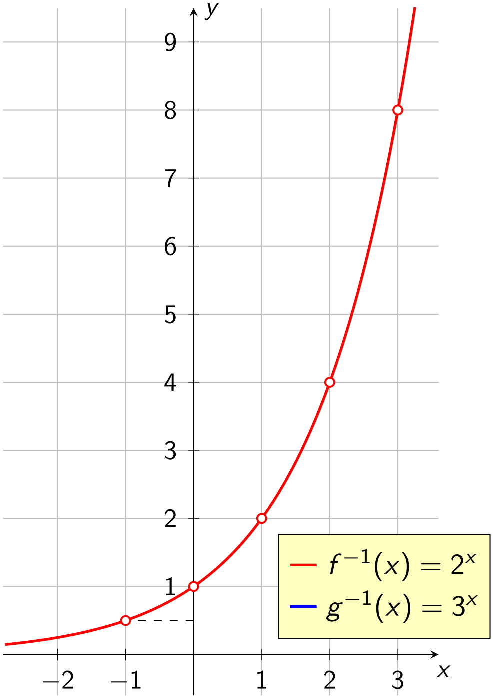
x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$



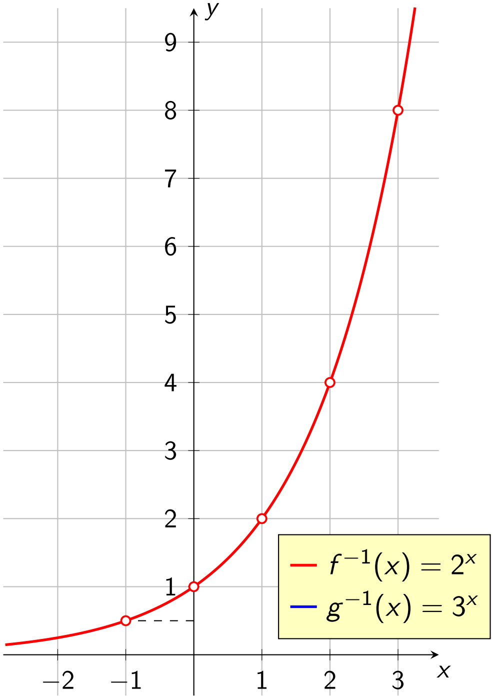
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
−1	$\frac{1}{2}$

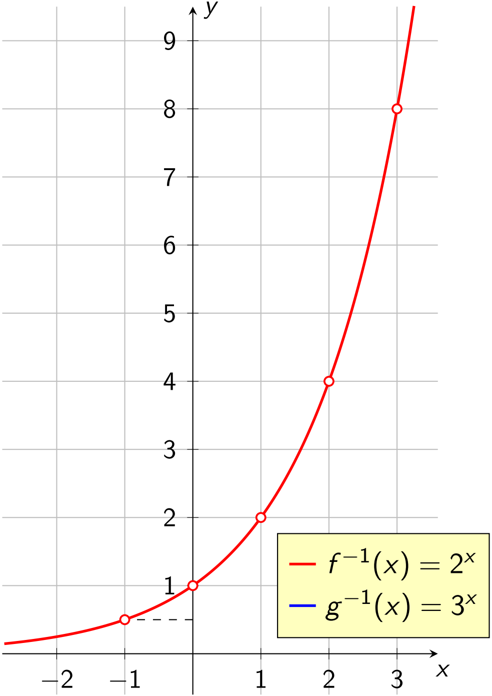
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$

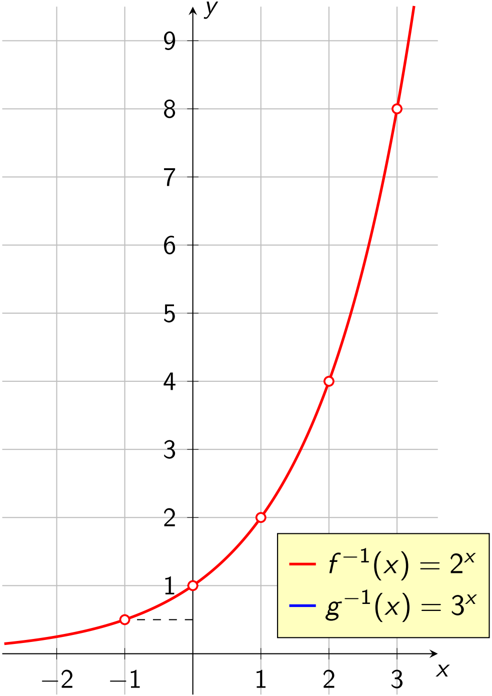


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	

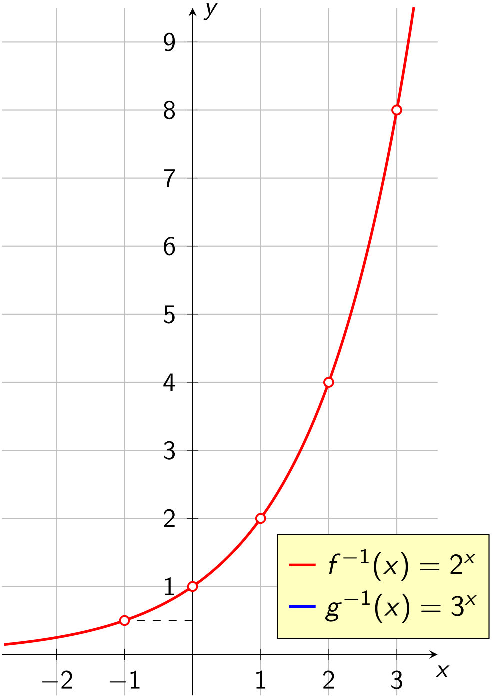


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1

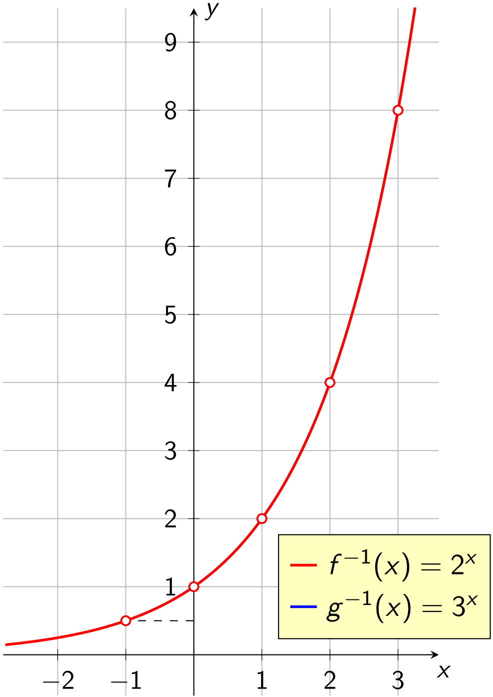


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	

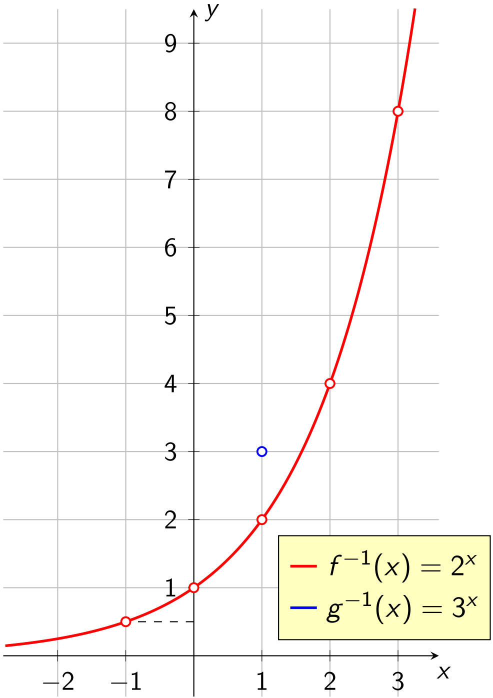


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3

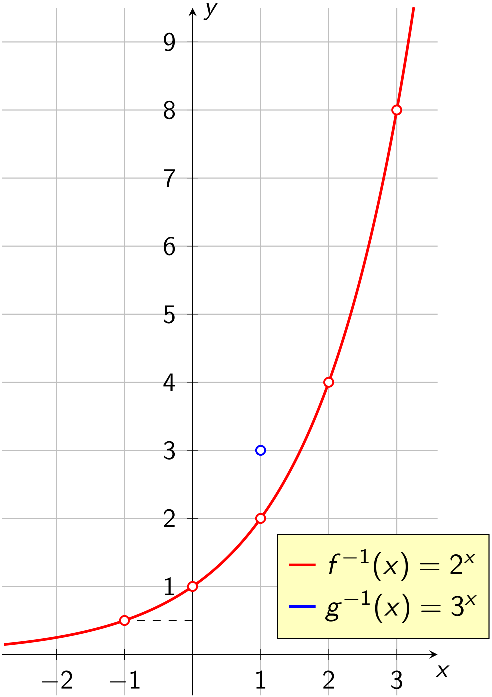


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

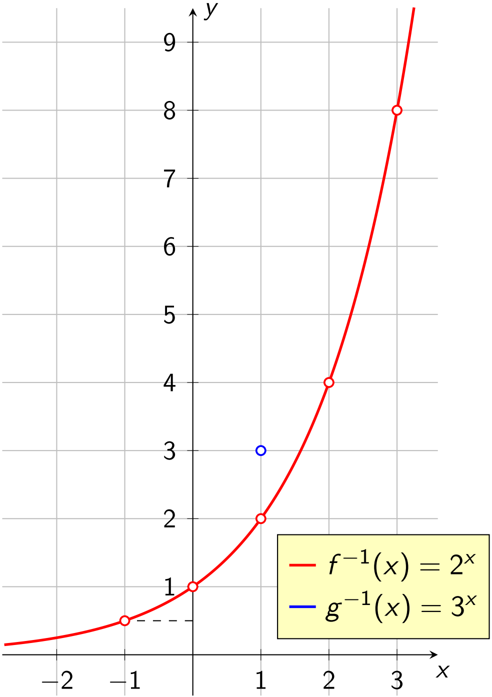
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	

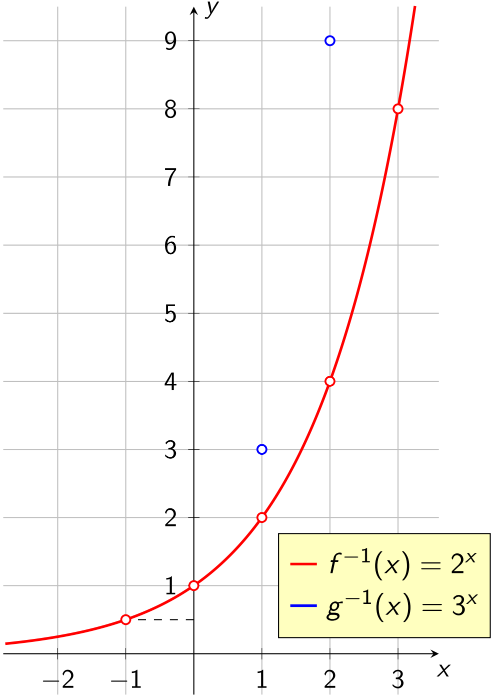
$$f^{-1}: \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1}: \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
−1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

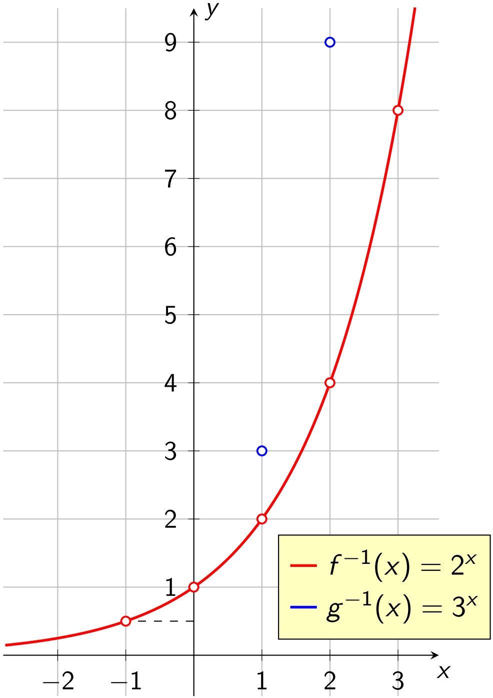
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9

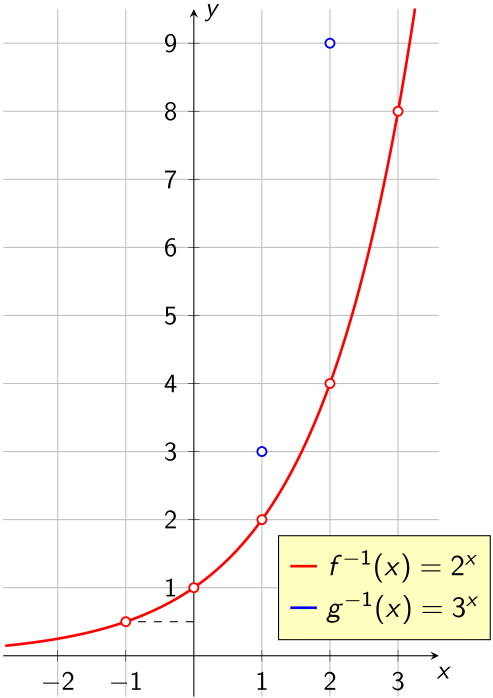
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty\rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty\rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
−1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
−1	

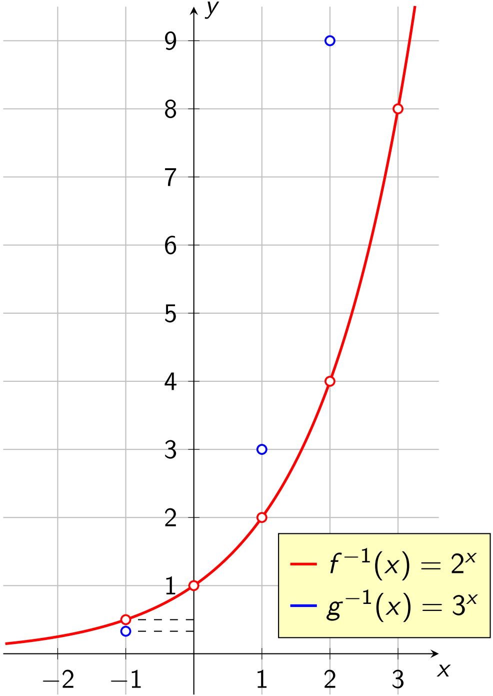


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

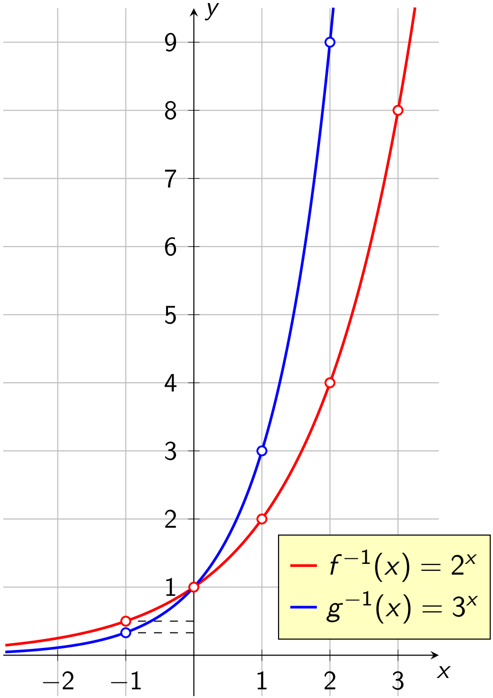
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$

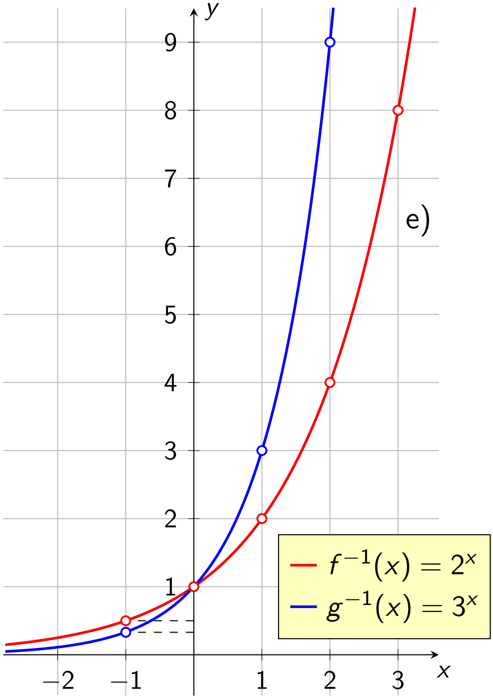
$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$

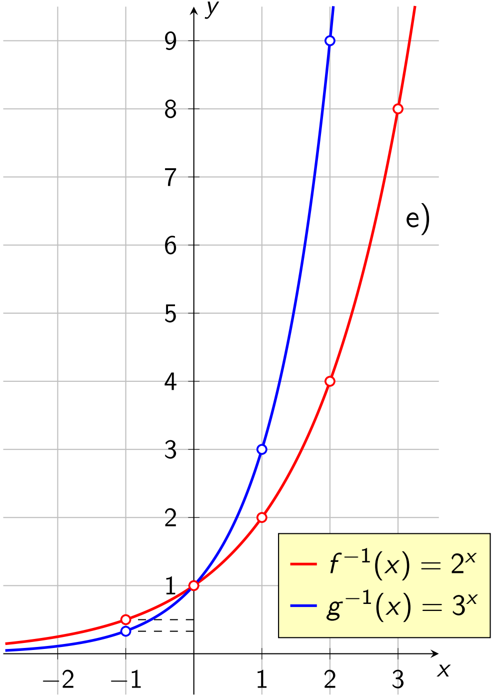


$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

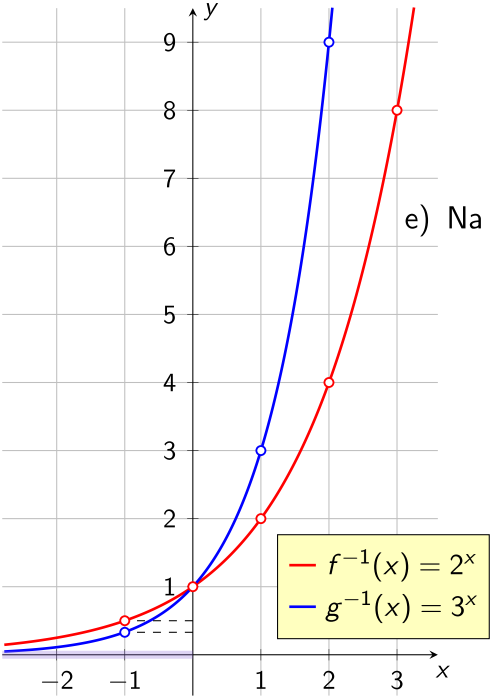
$$f^{-1}(x) \geqslant g^{-1}(x)$$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$

$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

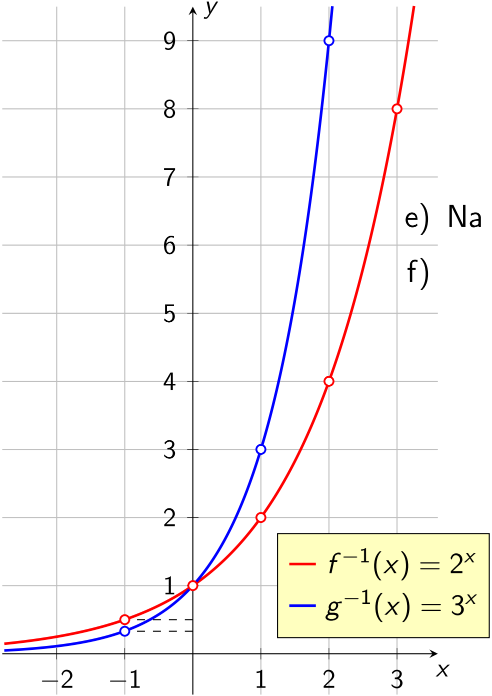
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$



e) Na $\langle -\infty, 0]$ vrijedi $f^{-1}(x) \geqslant g^{-1}(x)$.

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

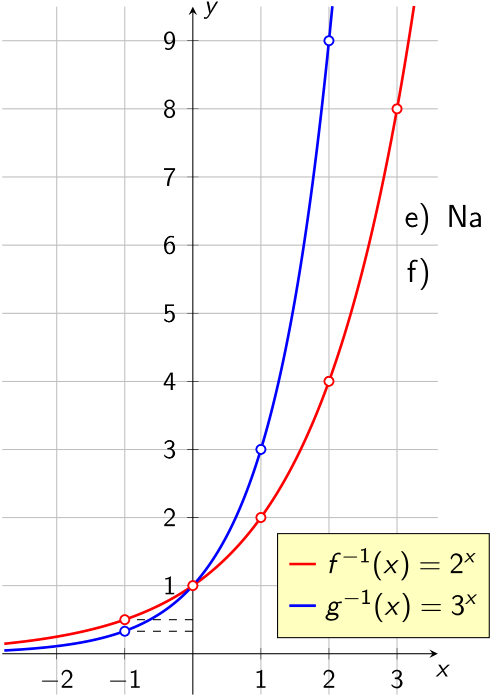
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

e) Na $\langle -\infty, 0]$ vrijedi $f^{-1}(x) \geqslant g^{-1}(x)$.

f)

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

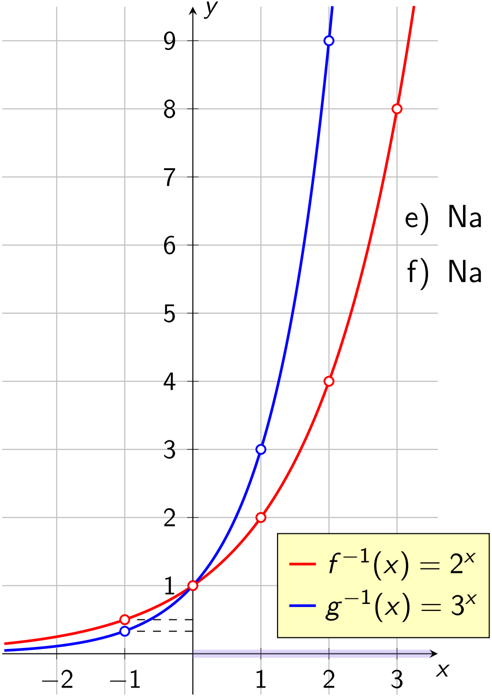
$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

e) Na $\langle -\infty, 0]$ vrijedi $f^{-1}(x) \geqslant g^{-1}(x)$.

f) $f^{-1}(x) \leqslant g^{-1}(x)$

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$



$$f^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

$$g^{-1} : \mathbb{R} \to \langle 0, +\infty \rangle$$

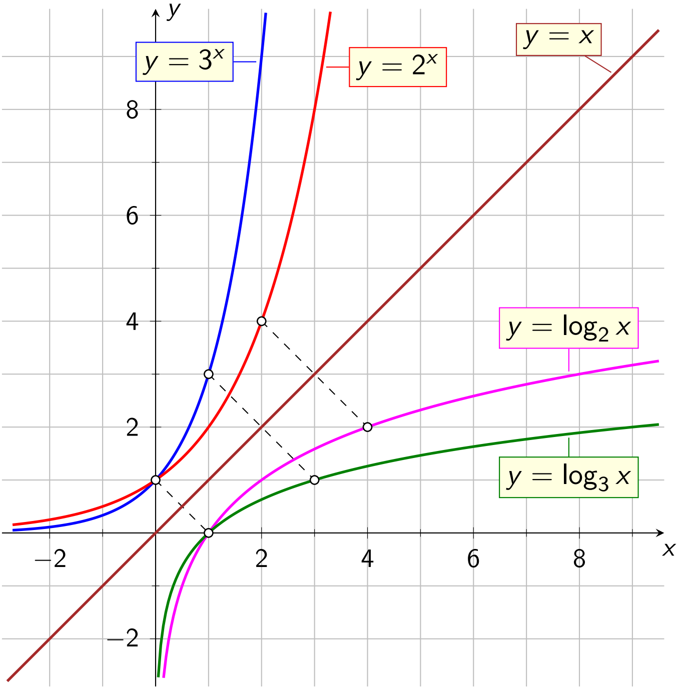
e) Na $\langle -\infty, 0]$ vrijedi $f^{-1}(x) \geqslant g^{-1}(x)$.

f) Na $[0, +\infty\rangle$ vrijedi $f^{-1}(x) \leqslant g^{-1}(x)$.

x	$f^{-1}(x)$
0	1
1	2
2	4
3	8
-1	$\frac{1}{2}$

x	$g^{-1}(x)$
0	1
1	3
2	9
-1	$\frac{1}{3}$

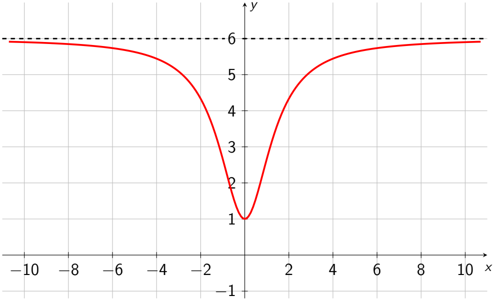
g)



peti zadatak

Zadatak 5

Zadan je graf funkcije $g : \mathbb{R} \to \operatorname{Im} g$*, a funkcije* g_1, g_2 *i* g_3 *imaju isto pravilo pridruživanja kao i funkcija* g*.*



a) *Ispitajte omeđenost funkcije* g*.*

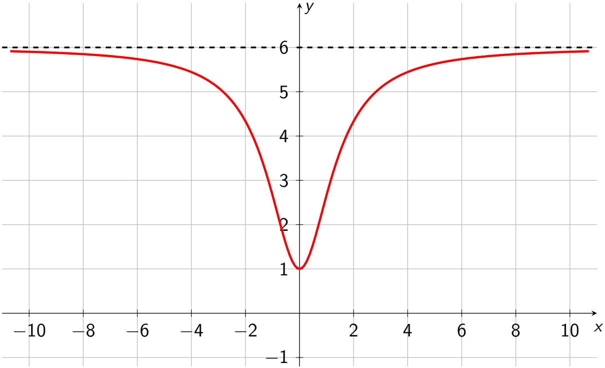
b) *Je li funkcija* $g : \mathbb{R} \to \operatorname{Im} g$ *bijekcija?*

c) *Je li funkcija* $g_1 : \langle -\infty, 0] \to \mathbb{R}$ *bijekcija?*

d) *Je li funkcija* $g_2 : \langle -\infty, 0] \to [1, 6\rangle$ *bijekcija?*

e) *Je li funkcija* $g_3 : [0, +\infty\rangle \to [1, 6]$ *bijekcija?*

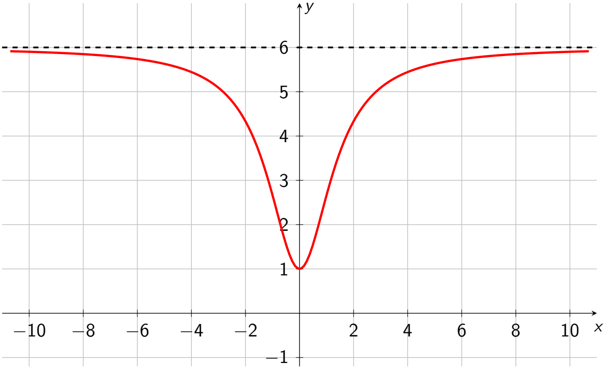
Rješenje



omeđenost $m \leqslant g(x) \leqslant M$

a)

Rješenje

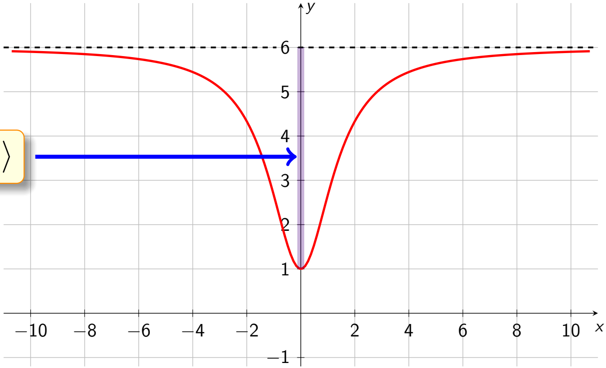


omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \operatorname{Im} g$

a)

Rješenje



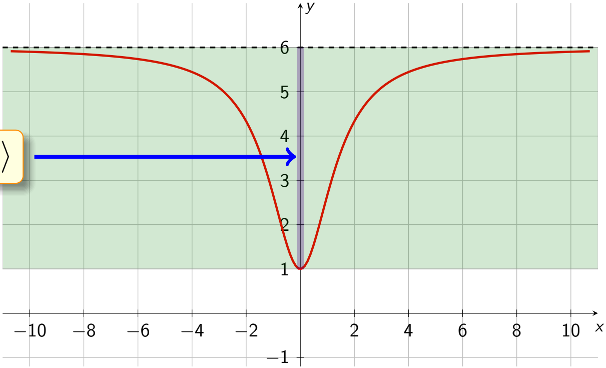
$\operatorname{Im} g = [1, 6\rangle$

omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \operatorname{Im} g$

a)

Rješenje



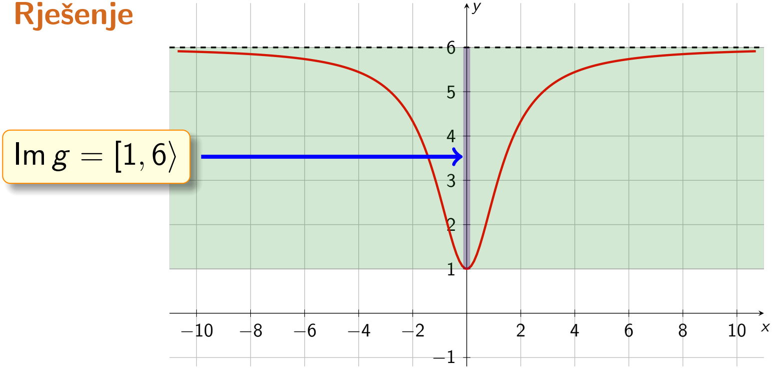
$\text{Im}\, g = [1, 6\rangle$

omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \text{Im}\, g$

a)

Rješenje



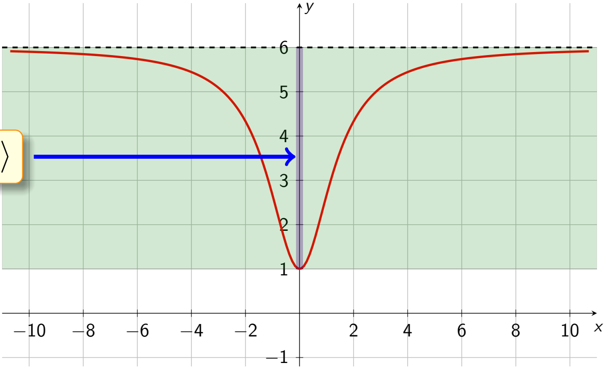
$\operatorname{Im} g = [1, 6\rangle$

omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \operatorname{Im} g$

a) Funkcija g je omeđena jer je $1 \leqslant g(x) \leqslant 6$.

Rješenje



$\text{Im}\, g = [1, 6\rangle$

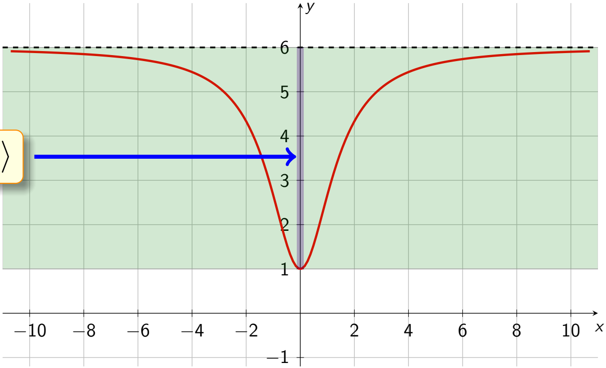
omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \text{Im}\, g$

a) Funkcija g je omeđena jer je $1 \leqslant g(x) \leqslant 6$.

$$m = 1$$

Rješenje



$\operatorname{Im} g = [1, 6\rangle$

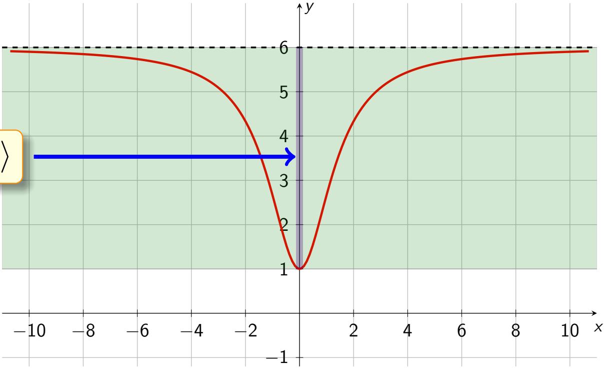
omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \operatorname{Im} g$

a) Funkcija g je omeđena jer je $1 \leqslant g(x) \leqslant 6$.

$m = 1 \longleftarrow$ najveća donja međa funkcije g

Rješenje



$\operatorname{Im} g = [1, 6\rangle$

omeđenost $m \leqslant g(x) \leqslant M$

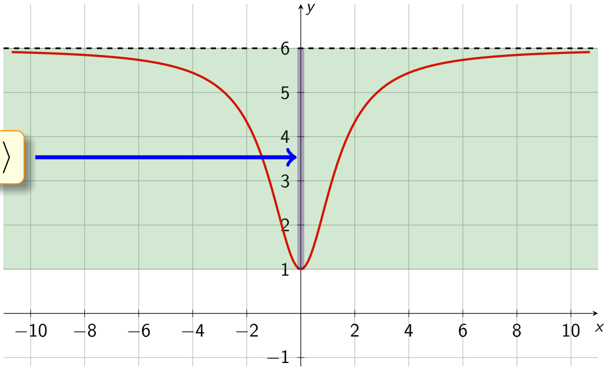
$g : \mathbb{R} \to \operatorname{Im} g$

a) Funkcija g je omeđena jer je $1 \leqslant g(x) \leqslant 6$.

$m = 1 \longleftarrow$ najveća donja međa funkcije g

$M = 6$

Rješenje



$\operatorname{Im} g = [1, 6\rangle$

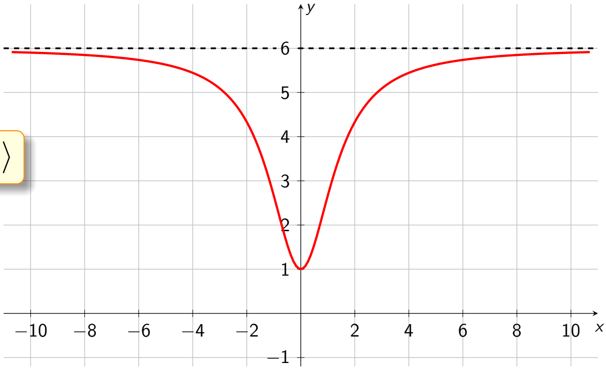
omeđenost $m \leqslant g(x) \leqslant M$

$g : \mathbb{R} \to \operatorname{Im} g$

a) Funkcija g je omeđena jer je $1 \leqslant g(x) \leqslant 6$.

$m = 1 \longleftarrow$ najveća donja međa funkcije g

$M = 6 \longleftarrow$ najmanja gornja međa funkcije g

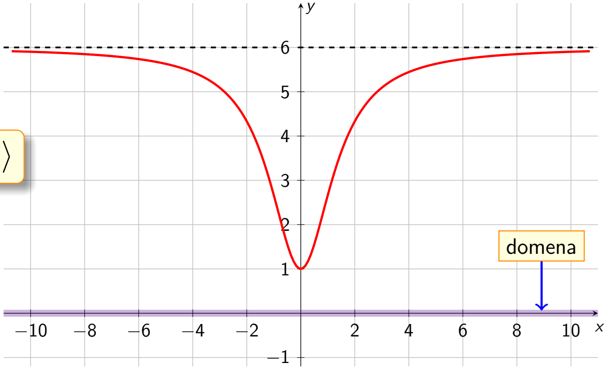


$\mathrm{Im}\, g = [1, 6\rangle$

$g : \mathbb{R} \to \mathrm{Im}\, g$

b)

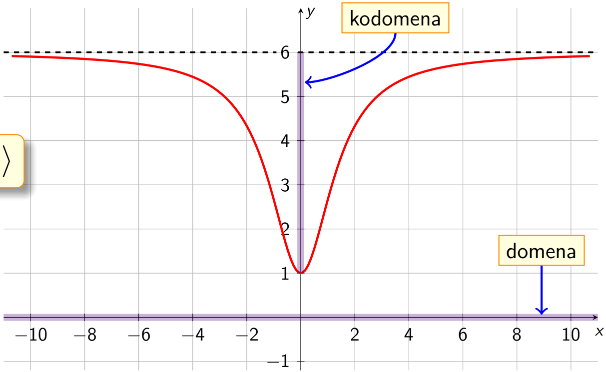
$\operatorname{Im} g = [1, 6\rangle$



domena

$g : \mathbb{R} \to \operatorname{Im} g$

b)



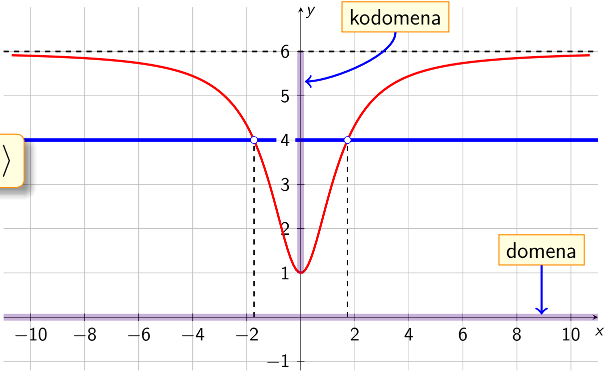
kodomena

domena

$\operatorname{Im} g = [1, 6\rangle$

$g : \mathbb{R} \to \operatorname{Im} g$

b)

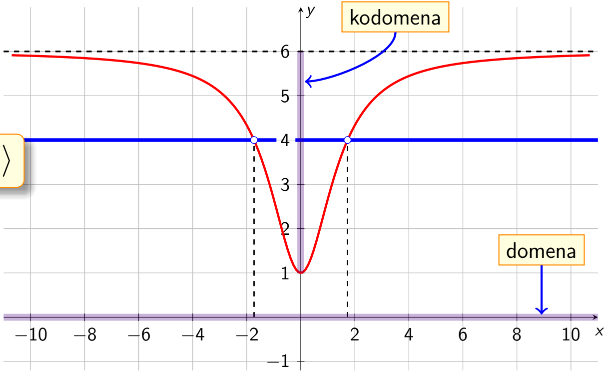


$\mathrm{Im}\, g = [1, 6\rangle$

$g : \mathbb{R} \to \mathrm{Im}\, g$

b)

✏ g nije injekcija jer, na primjer, pravac $y = 4$ siječe graf funkcije g u više od jedne točke.



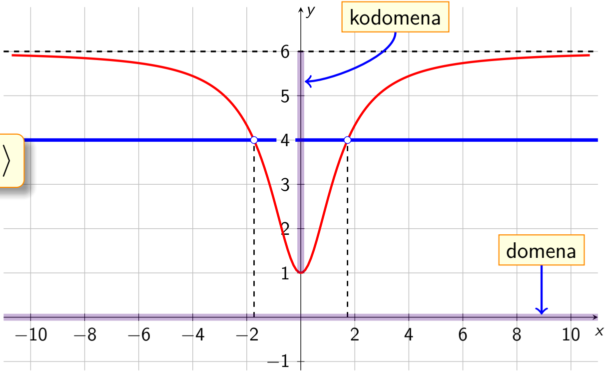
$\operatorname{Im} g = [1, 6\rangle$

$g : \mathbb{R} \to \operatorname{Im} g$

b)

- ✏ g nije injekcija jer, na primjer, pravac $y = 4$ siječe graf funkcije g u više od jedne točke.
- ✏ g je surjekcija jer je njezina kodomena jednaka $\operatorname{Im} g$.

$\mathrm{Im}\, g = [1, 6\rangle$

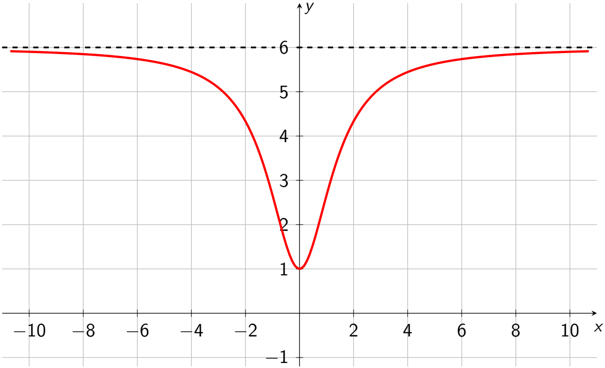


$g : \mathbb{R} \to \mathrm{Im}\, g$

b) Funkcija g nije bijekcija (jer nije injekcija).

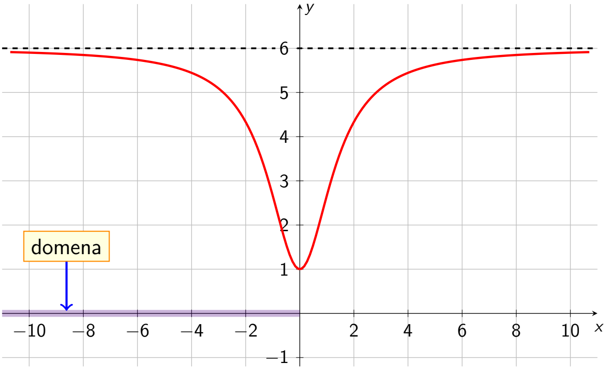
✏ g nije injekcija jer, na primjer, pravac $y = 4$ siječe graf funkcije g u više od jedne točke.

✏ g je surjekcija jer je njezina kodomena jednaka $\mathrm{Im}\, g$.



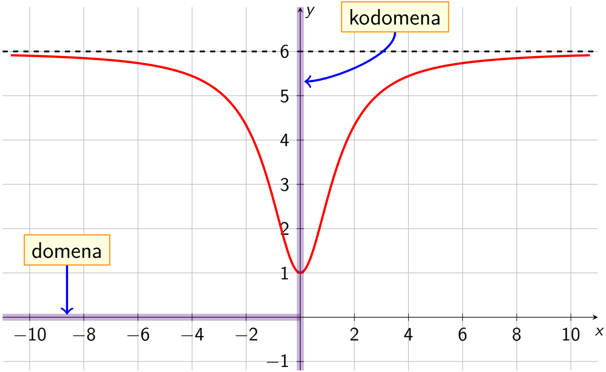
$$\boxed{g_1 : \langle -\infty, 0] \to \mathbb{R}}$$

c)



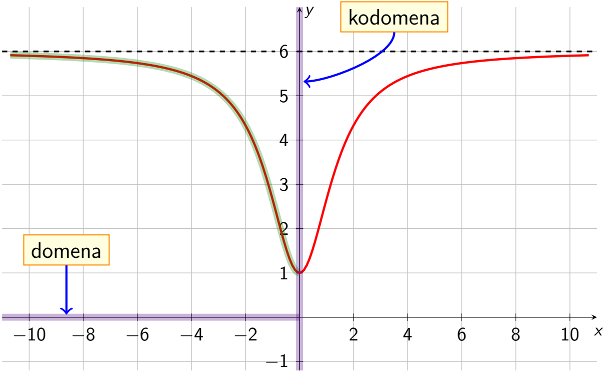
$g_1 : \langle -\infty, 0] \to \mathbb{R}$

c)



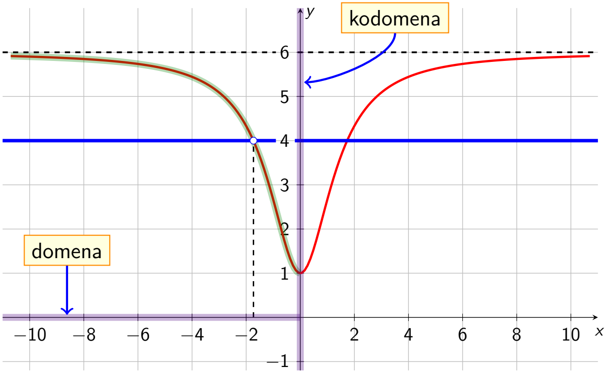
$$\boxed{g_1 : \langle -\infty, 0] \to \mathbb{R}}$$

c)



$$\boxed{g_1 : \langle -\infty, 0] \to \mathbb{R}}$$

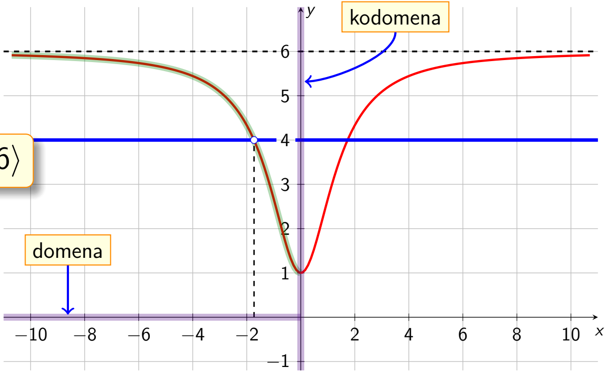
c)



$$\boxed{g_1 : \langle -\infty, 0] \to \mathbb{R}}$$

c)

✏ g_1 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_1 u najviše jednoj točki.



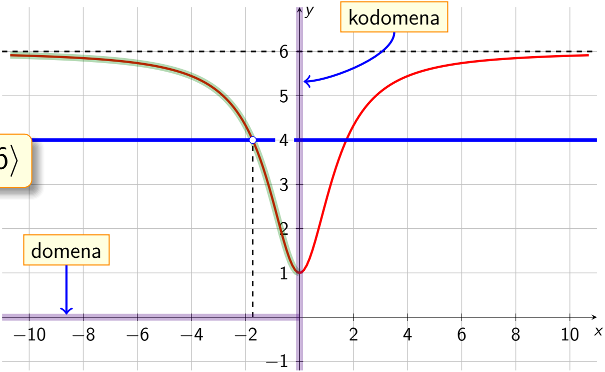
$\operatorname{Im} g_1 = [1, 6\rangle$

$g_1 : \langle -\infty, 0] \to \mathbb{R}$

c)

- ✏ g_1 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_1 u najviše jednoj točki.

$\operatorname{Im} g_1 = [1, 6\rangle$

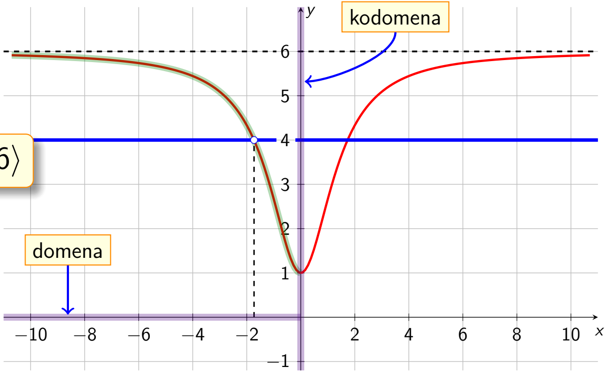


$g_1 : \langle -\infty, 0] \to \mathbb{R}$

c)

- ✏ g_1 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_1 u najviše jednoj točki.
- ✏ g_1 nije surjekcija jer je $\operatorname{Im} g_1 \neq \mathbb{R}$.

$\operatorname{Im} g_1 = [1, 6\rangle$



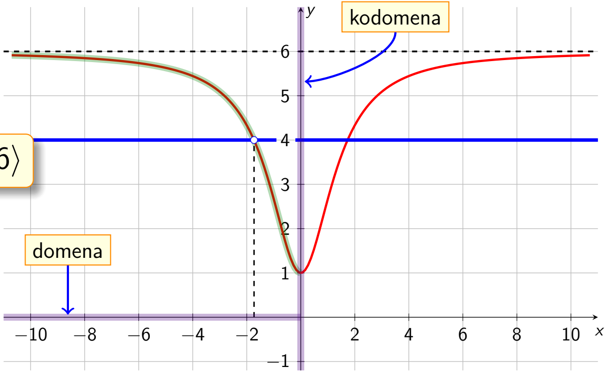
kodomena

domena

$g_1 : \langle -\infty, 0] \to \mathbb{R}$

c)

- g_1 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_1 u najviše jednoj točki.
- g_1 nije surjekcija jer je $\operatorname{Im} g_1 \neq \mathbb{R}$.



kodomena

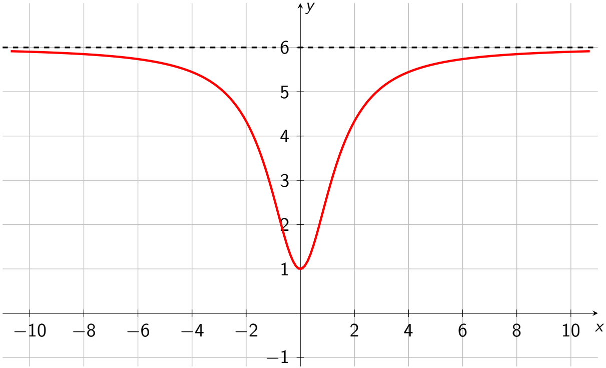
$\operatorname{Im} g_1 = [1, 6\rangle$

domena

$g_1 : \langle -\infty, 0] \to \mathbb{R}$

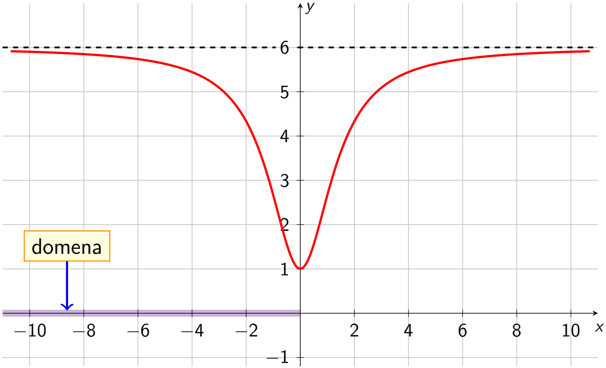
c) Funkcija g_1 nije bijekcija (jer nije surjekcija).

- g_1 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_1 u najviše jednoj točki.
- g_1 nije surjekcija jer je $\operatorname{Im} g_1 \neq \mathbb{R}$.



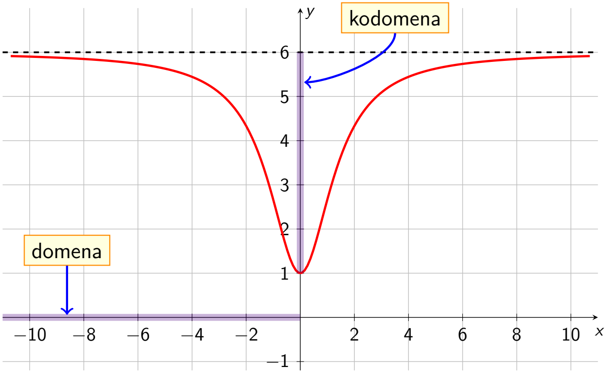
$$\boxed{g_2 : \langle -\infty, 0] \rightarrow [1, 6\rangle}$$

d)



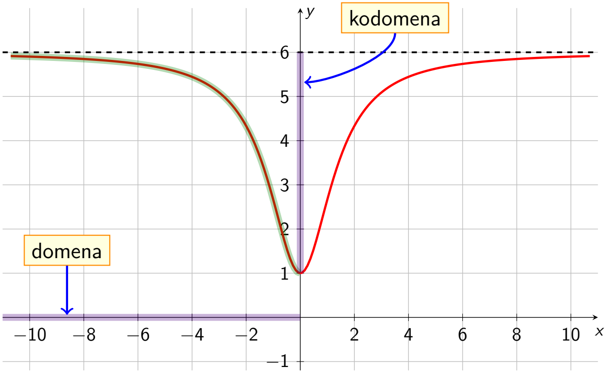
$$g_2 : \langle -\infty, 0] \to [1, 6\rangle$$

d)



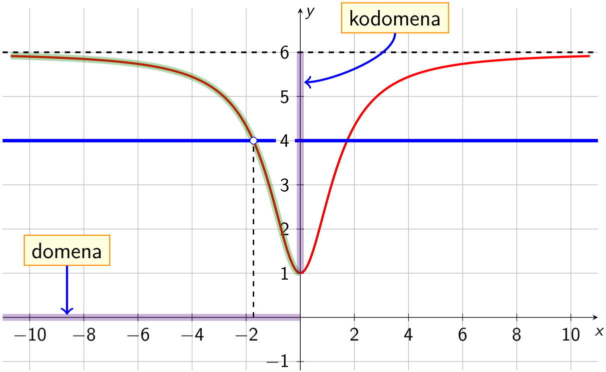
$$\boxed{g_2 : \langle -\infty, 0] \to [1, 6\rangle}$$

d)



$$\boxed{g_2 : \langle -\infty, 0] \to [1, 6\rangle}$$

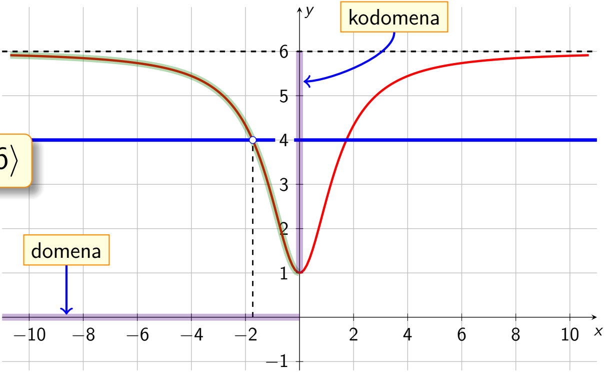
d)



$$\boxed{g_2 : \langle -\infty, 0] \to [1, 6\rangle}$$

d)

✏ g_2 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_2 u najviše jednoj točki.



kodomena

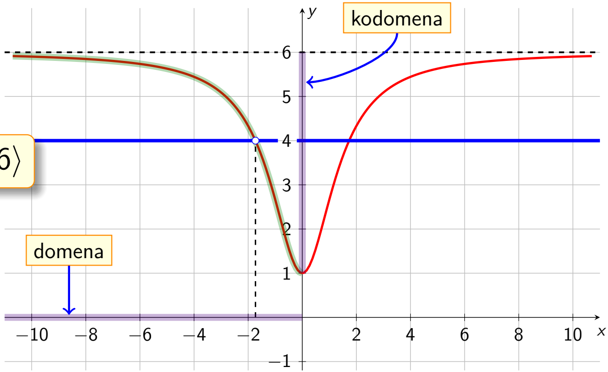
domena

$\operatorname{Im} g_2 = [1, 6\rangle$

$g_2 : \langle -\infty, 0] \to [1, 6\rangle$

d)

- ✏ g_2 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_2 u najviše jednoj točki.



$\operatorname{Im} g_2 = [1, 6\rangle$

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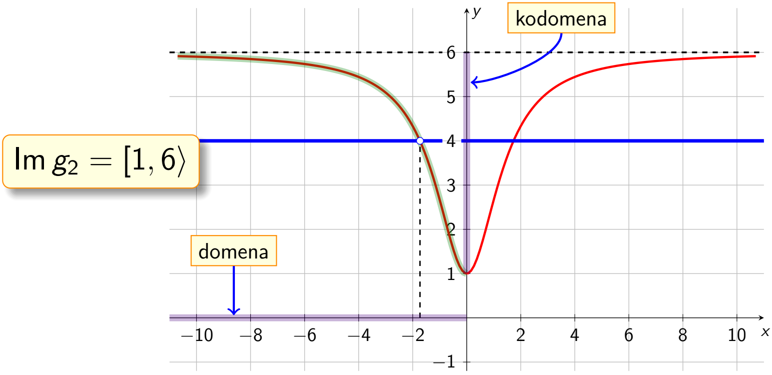
d)

- ✏ g_2 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_2 u najviše jednoj točki.
- ✏ g_2 jest surjekcija jer je $\operatorname{Im} g_2 = [1, 6\rangle$.



kodomena

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domena

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✏ g_2 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_2 u najviše jednoj točki.

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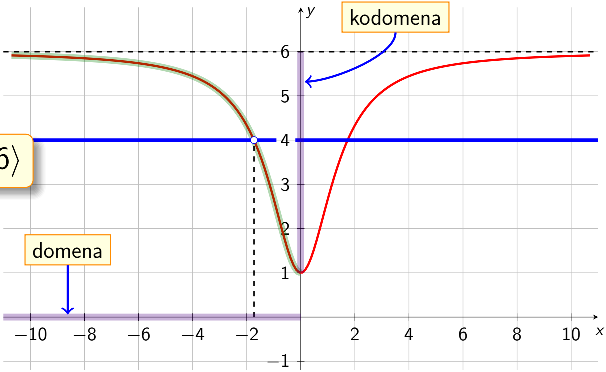
$\operatorname{Im} g_2 = [1, 6\rangle$



$g_2 : \langle -\infty, 0] \to [1, 6\rangle$

d) Funkcija g_2 je bijekcija.

- ✏ g_2 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_2 u najviše jednoj točki.
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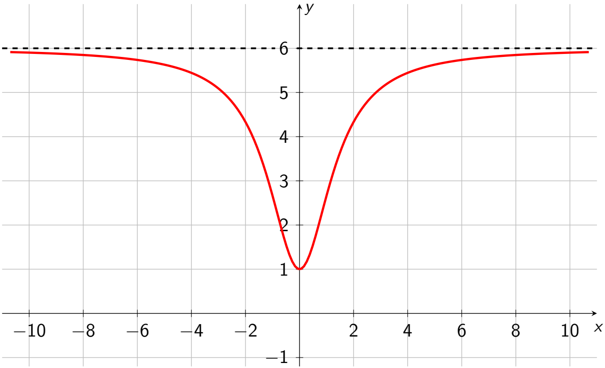
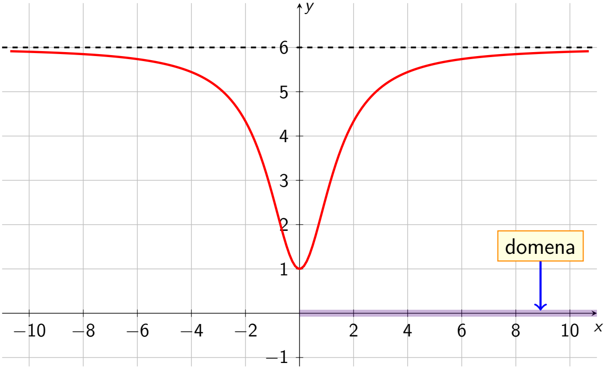


$$\boxed{g_3 : [0, +\infty\rangle \to [1, 6]}$$

e)



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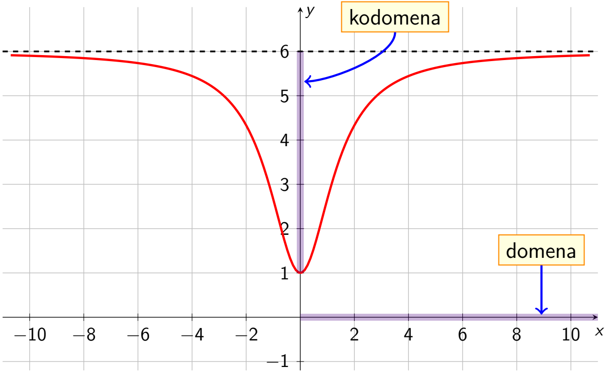

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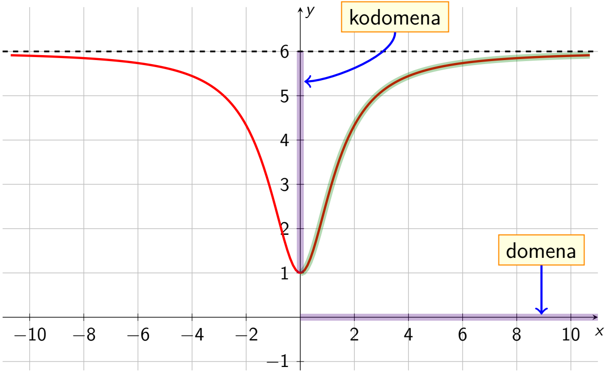

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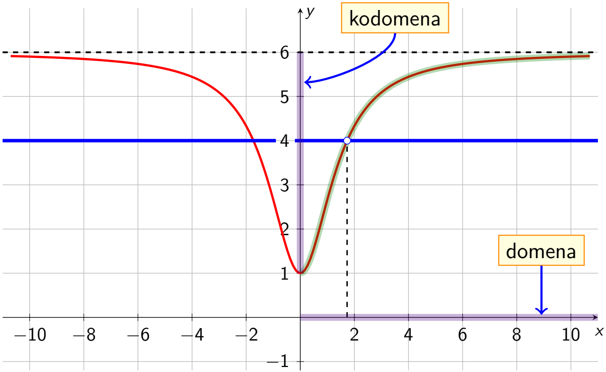

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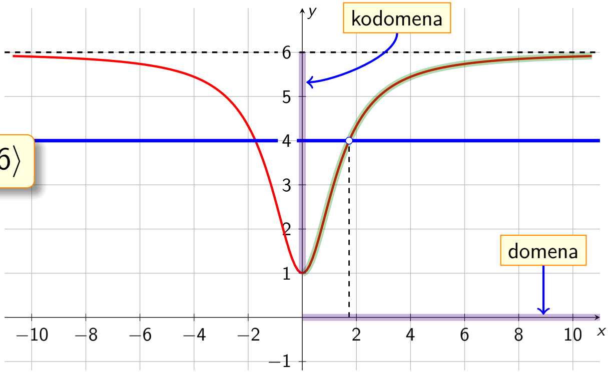

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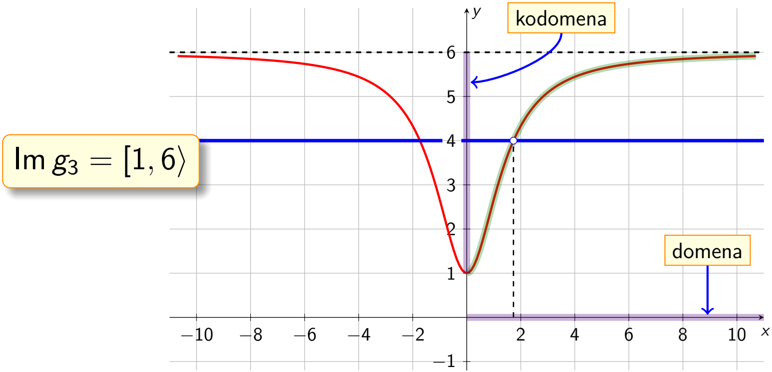

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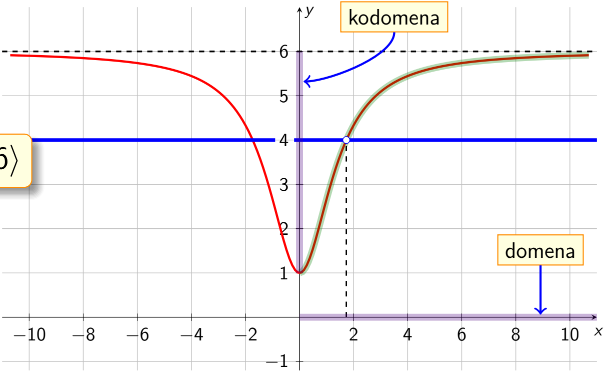

$\operatorname{Im} g_3 = [1, 6\rangle$

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- ✏ g_3 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_3 u najviše jednoj točki.
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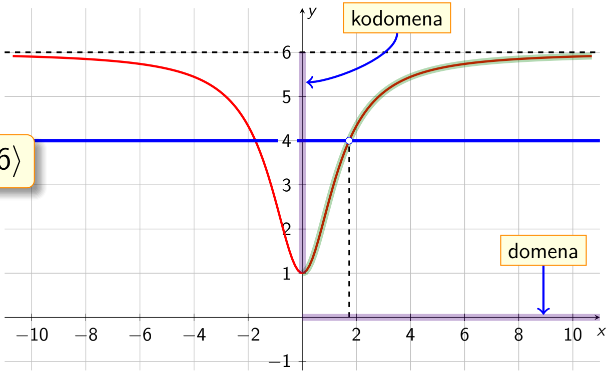
$6 \notin \operatorname{Im} g_3$

$\operatorname{Im} g_3 = [1, 6\rangle$



$g_3 : [0, +\infty\rangle \to [1, 6]$

e) Funkcija g_3 nije bijekcija (jer nije surjekcija).

- ✏ g_3 jest injekcija jer svaki pravac paralelan s x-osi siječe graf funkcije g_3 u najviše jednoj točki.
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$6 \notin \operatorname{Im} g_3$

šesti zadatak

Zadatak 6

Ispitajte parnost sljedećih funkcija:

a) $f(x) = \dfrac{2x^2}{3 - x^2}$

b) $h(x) = 2^{5-x} + 50$

c) $g(x) = \log_4 \dfrac{3 + 2x}{3 - 2x}$

Zadatak 6

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- $x \in D_f \;\Rightarrow\; -x \in D_f$
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Neparna funkcija

- $x \in D_f \;\Rightarrow\; -x \in D_f$
- $f(-x) = -f(x),\ \forall x \in D_f$

Rješenje

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

a) domena

Rješenje

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

a) domena

$$3 - x^2 \neq 0$$

Rješenje

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

a) $\boxed{\text{domena}}$

$$3 - x^2 \neq 0 \leadsto x^2 \neq 3$$

Rješenje

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

a) domena

$$3 - x^2 \neq 0 \rightsquigarrow x^2 \neq 3 \rightsquigarrow x \neq \pm\sqrt{3}$$

Rješenje

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

a) domena $D_f = \mathbb{R} \setminus \{-\sqrt{3}, \sqrt{3}\}$

$$3 - x^2 \neq 0 \rightsquigarrow x^2 \neq 3 \rightsquigarrow x \neq \pm\sqrt{3}$$

Rješenje

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$$f(-x) =$$

Rješenje

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Rješenje

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Rješenje

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Rješenje

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$$\boxed{h(x) = 2^{5-x} + 50}$$

b) $\boxed{\text{domena}}$

Rješenje

$$\boxed{f(x) = \frac{2x^2}{3 - x^2}}$$

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$$\boxed{h(x) = 2^{5-x} + 50}$$

b) $\boxed{\text{domena}}$ $D_h = \mathbb{R}$

Rješenje

$$\boxed{f(x) = \frac{2x^2}{3 - x^2}}$$

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$$h(-x) = 2^{5-(-x)} + 50 = 2^{5+x} + 50$$

Rješenje

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Funkcija h nije niti parna niti neparna.

Rješenje

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

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Protuprimjer

Rješenje

$$\boxed{f(x) = \frac{2x^2}{3 - x^2}}$$

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Protuprimjer

$$h(1) =$$

Rješenje

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

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Protuprimjer

$$h(1) = 2^4 + 50$$

Rješenje

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Funkcija f je parna funkcija.

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Funkcija h nije niti parna niti neparna.

Protuprimjer

$$h(1) = 2^4 + 50 = 66$$

Rješenje

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

a) domena $D_f = \mathbb{R} \setminus \{-\sqrt{3}, \sqrt{3}\}$

$3 - x^2 \neq 0 \rightsquigarrow x^2 \neq 3 \rightsquigarrow x \neq \pm\sqrt{3}$

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b) domena $D_h = \mathbb{R}$

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Funkcija h nije niti parna niti neparna.

Protuprimjer

$$h(1) = 2^4 + 50 = 66, \quad h(-1) =$$

Rješenje

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

a) domena $D_f = \mathbb{R} \setminus \{-\sqrt{3}, \sqrt{3}\}$

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Funkcija f je parna funkcija.

$$h(x) = 2^{5-x} + 50$$

b) domena $D_h = \mathbb{R}$

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Funkcija h nije niti parna niti neparna.

Protuprimjer

$$h(1) = 2^4 + 50 = 66, \quad h(-1) = 2^6 + 50$$

Rješenje

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

a) domena $D_f = \mathbb{R} \setminus \{-\sqrt{3}, \sqrt{3}\}$

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Funkcija h nije niti parna niti neparna.

Protuprimjer

$$h(1) = 2^4 + 50 = 66, \quad h(-1) = 2^6 + 50 = 114$$

Rješenje

$$\boxed{f(x) = \frac{2x^2}{3 - x^2}}$$

a) domena $D_f = \mathbb{R} \setminus \{-\sqrt{3}, \sqrt{3}\}$

$$3 - x^2 \neq 0 \rightsquigarrow x^2 \neq 3 \rightsquigarrow x \neq \pm\sqrt{3}$$

$$f(-x) = \frac{2 \cdot (-x)^2}{3 - (-x)^2} = \frac{2x^2}{3 - x^2} = f(x)$$

Funkcija f je parna funkcija.

$$\boxed{h(x) = 2^{5-x} + 50}$$

b) domena $D_h = \mathbb{R}$

$$h(-x) = 2^{5-(-x)} + 50 = 2^{5+x} + 50 \neq \pm h(x)$$

Funkcija h nije niti parna niti neparna.

Protuprimjer $h(-1) \neq \pm h(1)$

$$h(1) = 2^4 + 50 = 66, \quad h(-1) = 2^6 + 50 = 114$$

$$\boxed{g(x) = \log_4 \frac{3+2x}{3-2x}}$$

c) domena

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

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

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

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

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

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$\frac{3+2x}{3-2x}$		$-$		⊕		$-$	

$$g(-x) =$$

$$\boxed{D_g = \left\langle -\frac{3}{2},\ \frac{3}{2} \right\rangle}$$

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$\frac{3+2x}{3-2x}$		$-$		⊕		$-$	

$$g(-x) = \log_4 \underline{\qquad\qquad\qquad}$$

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

$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{}$$

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$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{3-2\cdot(-x)} = \log_4 \underline{\qquad\qquad}$$

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$$g(-x) = \log_4 \frac{3 + 2\cdot(-x)}{3 - 2\cdot(-x)} = \log_4 \frac{3-2x}{\ }$$

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$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{3-2\cdot(-x)} = \log_4 \frac{3-2x}{3+2x} = \log_4 \left(\frac{3+2x}{3-2x}\right)^{-1} =$$

$$\log_a x^k = k \cdot \log_a x$$

$$D_g = \left\langle -\frac{3}{2},\ \frac{3}{2} \right\rangle$$

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$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{3-2\cdot(-x)} = \log_4 \frac{3-2x}{3+2x} = \log_4 \left(\frac{3+2x}{3-2x}\right)^{-1} =$$

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

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

$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{3-2\cdot(-x)} = \log_4 \frac{3-2x}{3+2x} = \log_4 \left(\frac{3+2x}{3-2x}\right)^{-1} =$$

$$= -\log_4 \frac{3+2x}{3-2x} = -g(x)$$

$$\boxed{\log_a x^k = k \cdot \log_a x}$$

$$\boxed{D_g = \left\langle -\frac{3}{2}, \frac{3}{2} \right\rangle}$$

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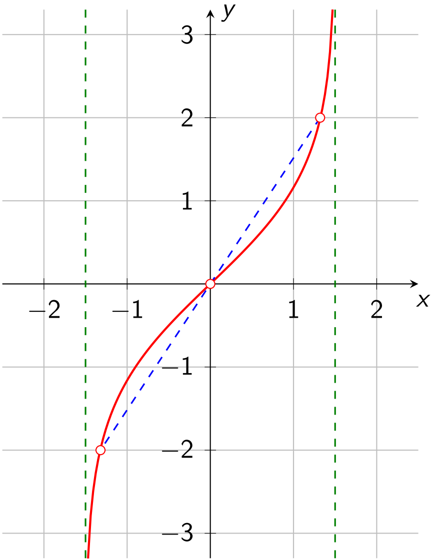
$\frac{3+2x}{3-2x}$		$-$		$\oplus$		$-$	

$$g(-x) = \log_4 \frac{3+2\cdot(-x)}{3-2\cdot(-x)} = \log_4 \frac{3-2x}{3+2x} = \log_4 \left(\frac{3+2x}{3-2x}\right)^{-1} =$$

$$= -\log_4 \frac{3+2x}{3-2x} = -g(x)$$

g je neparna funkcija

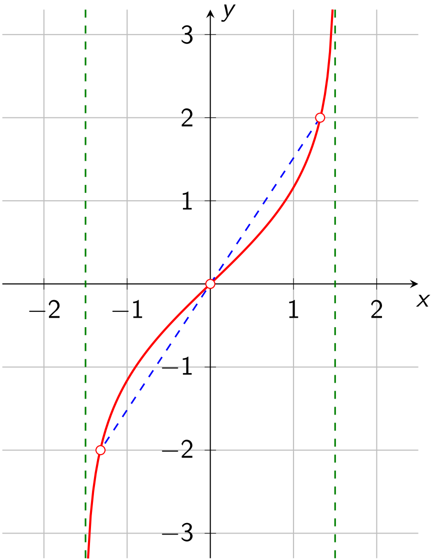
Graf funkcije g



$$g(x) = \log_4 \frac{3+2x}{3-2x}$$

$$D_g = \left\langle -\frac{3}{2},\ \frac{3}{2} \right\rangle$$

Graf funkcije g

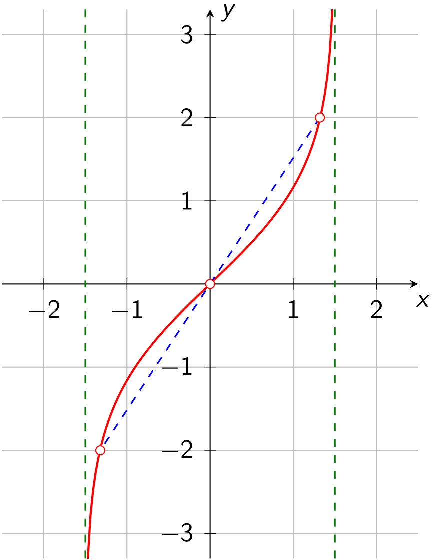


$$\boxed{g(x) = \log_4 \frac{3+2x}{3-2x}}$$

$$\boxed{D_g = \left\langle -\frac{3}{2},\ \frac{3}{2} \right\rangle}$$

$$\lim_{x \to \frac{3}{2}-} g(x) = +\infty$$

Graf funkcije g



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