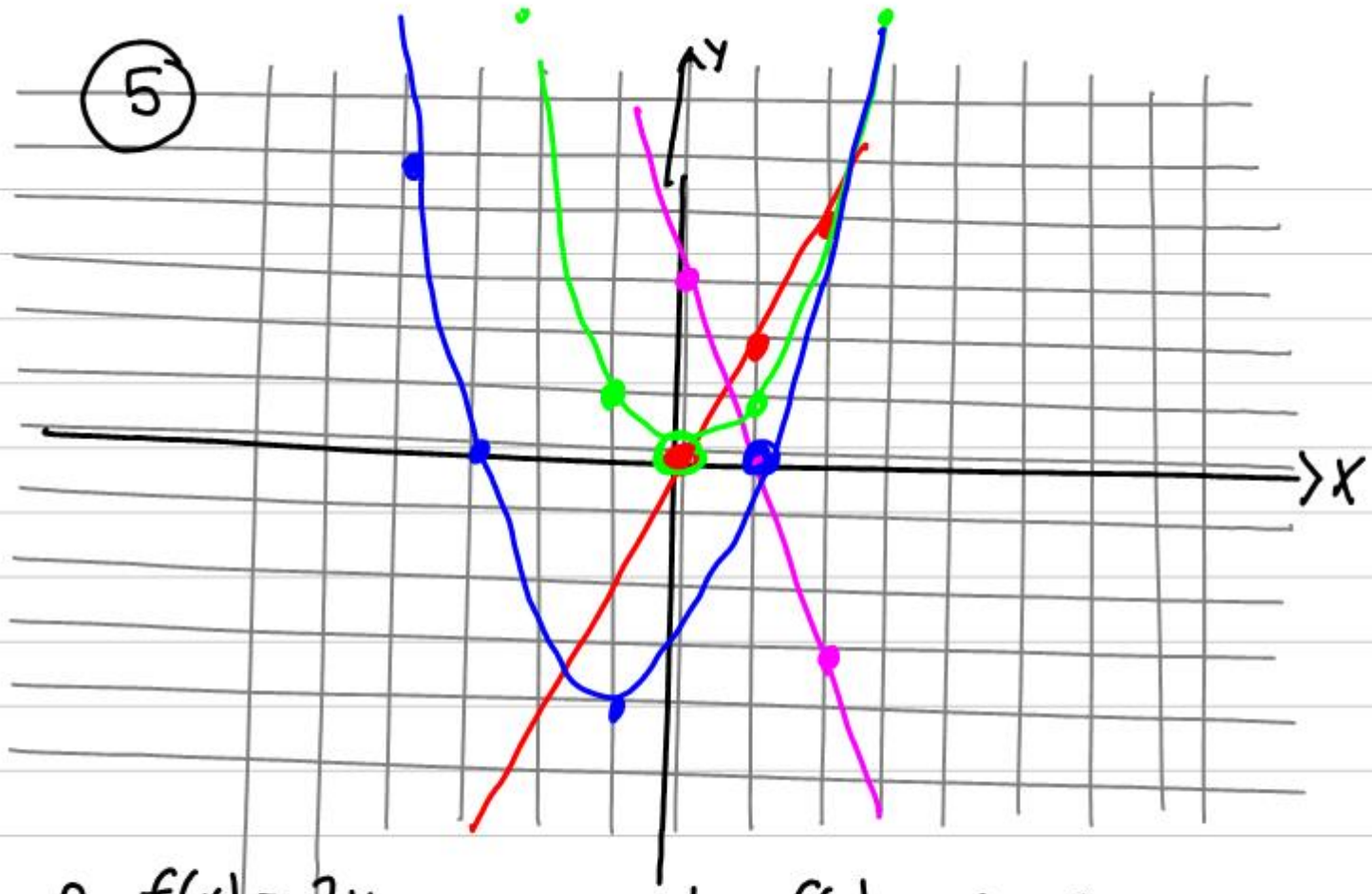
5



a. $f(x) = 2x$

pirkti ō

x	y
0	$2 \cdot 0 = 0$
1	$2 \cdot 1 = 2$
2	$2 \cdot 2 = 4$

b. $f(x) = -3x + 3$

x	y
0	$-3 \cdot 0 + 3 = 3$
1	$-3 \cdot 1 + 3 = 0$
2	$-3 \cdot 2 + 3 = -3$

6

a. $f(x) = x^2$

x	y
-3	$(-3)^2 = 9$
-1	$(-1)^2 = 1$
0	$0^2 = 0$
1	$1^2 = 1$
3	$3^2 = 9$

b. $f(x) = x^2 + 2x - 3$

0-kohact $\begin{cases} 1 \\ -3 \end{cases}$

x	y
-4	$(-4)^2 + 2(-4) - 3 = 5$
-3	$(-3)^2 + 2 \cdot (-3) - 3 = 0$
-1	-4
1	0
3	12

(1)

a. $4(3x+1) = 1-8x$

$12x + 4 = 1 - 8x$

$12x + 8x = 1 - 4$

$20x = -3$

$x = -\frac{3}{20}$

$12x+4 = 1-8x \quad | -4$

$12x = 1-8x-4 \quad | +8x$

$12x+8x = 1-4$

⋮

b. $x = -5$

c. $x+1 = x$

$x - x = -1$

$0 = -1$

Ei ratk.

d. $2x+6 = 3(x+2) - x$

$2x+6 = 3x+6-x$

$2x+6 = 2x+6$

$2x-2x = 6-6$

$0 = 0$

$\forall x$:n arvot

Kaikki

(2) a. $x^2 = 8$

$x = \pm\sqrt{8}$

$x = \pm\sqrt{2^3}$

$x = \pm 2\sqrt{2}$

b. $x^2 = -9$

Ei ratkaisu reaaliluvuilla!

c. $4x^2 = 36 \quad \| :4$

$x^2 = 9 = 3^2$

$x = \pm 3$

(3)

a. $8x^{12} = 40 \quad \| : 8$

$x^{12} = \frac{40}{8} = 5$ $\boxed{x\sqrt{\ }}$

$x = \pm \sqrt[12]{5}$

$x \approx \pm 1.14$

$\Rightarrow$ TARK. $8 \cdot (1.14)^{12} = \ldots (40)$

b. $16^x = 8 \quad | \lg (\log \ln)$

$\lg 16^x = \lg 8$ $\boxed{\log}$ $\boxed{\lg}$ $\boxed{\ln}$

$x \cdot \lg 16 = \lg 8$

$x = \frac{\lg 8}{\lg 16} = 0.75$

(4) a. $3x^2 - 5x - 2 = 0$
$ax^2 + bx + c = 0$

$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4 \cdot 3 \cdot (-2)}}{2 \cdot 3}$

$x = \frac{5 \pm \sqrt{25 + 24}}{6}$

$x = \frac{5 \pm \sqrt{49}}{6}$

$x = \frac{5 \pm 7}{6}$ $\begin{cases} \frac{5+7}{6} = 2 \\ \frac{5-7}{6} = -\frac{1}{3} \end{cases}$

b. $\begin{cases} 1 - \frac{\sqrt{6}}{3} \\ 1 + \frac{\sqrt{6}}{3} \end{cases}$

c. $x^2 + 1 = 0$

$x^2 = -1$

$x = \frac{-0 \pm \sqrt{0^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$

$x = \frac{\pm \sqrt{-4}}{2}$

$D < 0$ (diskriminant)

ei reaalilukuratkaisua.

(7) a. $x-5>3x$

$x-3x>5$

$-2x>5 \quad \| :-2$

$x<\frac{5}{-2}$

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

$x<-2{,}5$

$x-5>3x$

$x-3x-5>0$

$-2x-5>0$

b. $x \geq -\frac{5}{3}$

c. $-3x+3<0$

$-3x<-3 \quad \| :-3$

$x>1$

d. $8x \geq 16 \quad \| :8$

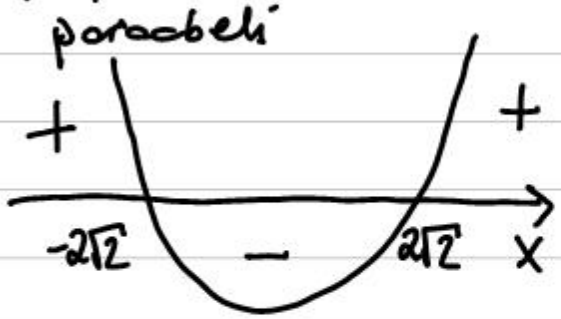
$x \geq 2$

(8) a. $x^2>8$

$x^2-8>0$

0-kohad $\int_{\sqrt{8}}^{-\sqrt{8}} = \int_{2\sqrt{2}}^{-2\sqrt{2}}$

ülesp. allpool parabeli

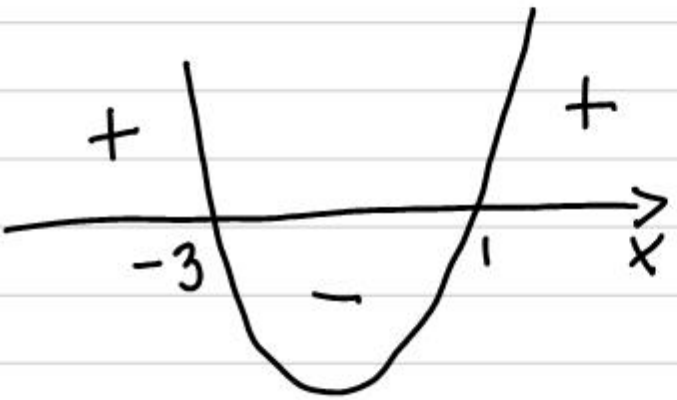


$x<-2\sqrt{2}$ ehk $x>2\sqrt{2}$

8 b. $x^2+2x-3<0$

0-kohdat $\begin{cases}1\\-3\end{cases}$

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

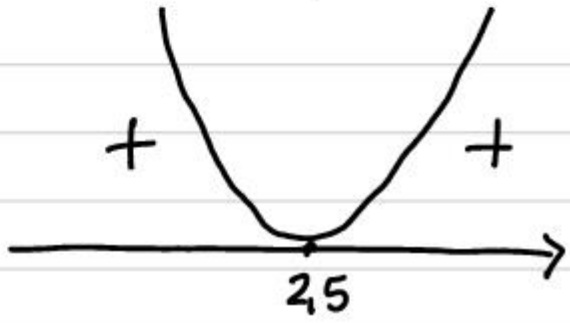


$-3<x<1$

c. $4x^2+25>20x$

$4x^2-20x+25>0$

0-kohta $\{2{,}5$



$x<2.5$ tai

$x>2.5$

d. $-x^2+2x-3<0$

alaspäin auk. paraabeli

0-kohdat

$x=\frac{-2\pm\sqrt{2^2-4\cdot(-1)\cdot(-3)}}{2\cdot(-1)}$

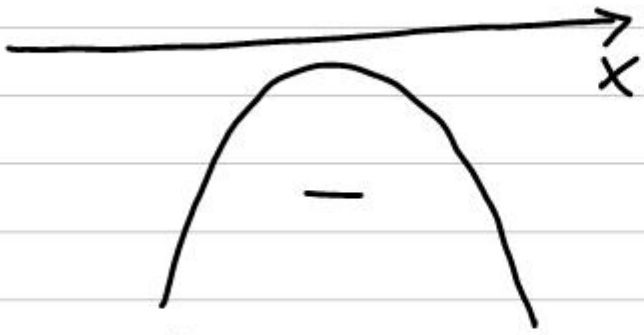
$x=\frac{-2\pm\sqrt{-8}}{-2}$

$D=-8$

$D<0$

ei ratkaisu

$\Rightarrow$ ei 0-kohtia !



$\forall x$:n arvoilla

$\mathbb{Z}$ kok. luvut

$\mathbb{Z}_+$ pos. kok. luvut

$\mathbb{Z}_-$ neg. kok.

$\mathbb{Q}$

$\mathbb{R}$

$\not\subset$

$\uparrow \mathbb{N}$

① $x^2 + 1 = 0$

$x^2 = -1$ (ei ratk. $\mathbb{R}$:ssä)

Kompleksiluvuratkaisu

$i^2 = -1 \Rightarrow \sqrt{-1} = i$

$x^2 = i^2 \quad \lfloor\sqrt{}$

$x = \pm i$

$x^2 + 9 = 0$

$x^2 = -9$

$x = \pm\sqrt{-9}$!

$x = \pm\sqrt{-3^2}$

$x = \pm\sqrt{-1 \cdot 3^2}$

$x = \pm\sqrt{i^2 \cdot 3^2}$

$x = \pm 3i$

(2) $(3+2i)+(-1+4i) = 2+6i$

$(-2+i)+(-3i) = -2+i-3i = -2-2i$

$(3-3i)+(2+3i) = 3-3i+2+3i = 5$

(3) $(3+2i)-(-1+4i) = 3+2i+1-4i = 4-2i$

$(-2+i)-(-3i) = -2+i+3i = -2+4i$

$= 4i-2$

$(3-3i)-(2+3i) = 3-3i-2-3i = 1-6i$

$(x+1)(3-x)$ $\qquad$ $(x+1)(x-5)$

(4) $(3+2i)(-1+4i) = -3+12i-2i+8\underbrace{i^2}_{=-1}$

$= -3+12i-2i-8 = 10i-11$

$(-2+i)(-3i) = (-3i)\cdot(-2+i) = 6i-3\underbrace{i^2}_{=-1} = 6i+3$

$(3-3i)(2+3i) = 15+3i$

z^* $\overline{z}$

(5) $z = 3+2i$ $\quad z^* = 3-2i$

$z = -1+4i$ $\quad z^* = -1-4i$

$z = 3-3i$ $\quad z^* = 3+3i$

$z = -3i$ $\quad z^* = 3i$

(6) $(3+2i)(3-2i) = 9 - \cancel{6i} + \cancel{6i} - 4i^2 = 9+4 = 13$

$i^2 = -1$

4

КОПТЕНТ. 11-18