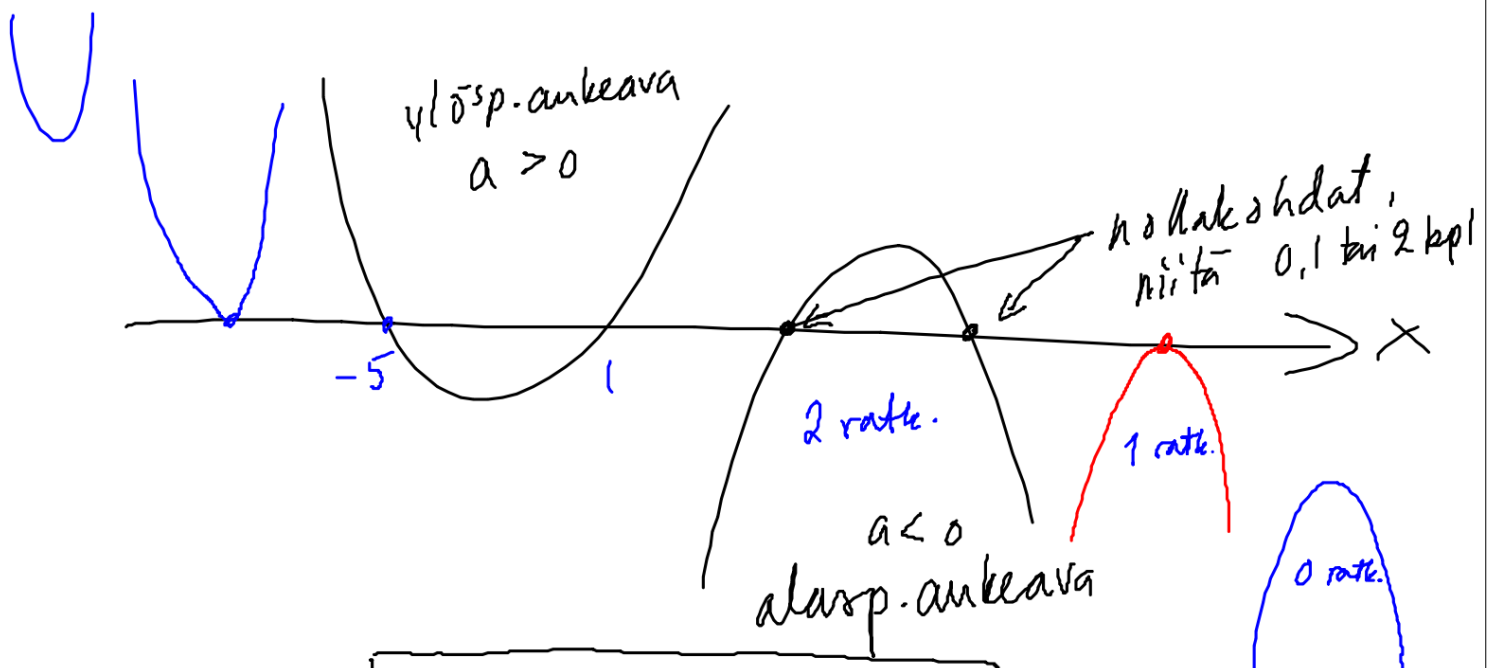


- 2. asteen kuvaaja = paraabeli



$$f(x) = ax^2 + bx + c$$

Toisen asteen yhtälö

- Käytännön ratkaisukaavaa mallin mukaisille yhtälöille:

$$\underline{ax^2 + bx + c = 0}$$

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

MAA

Esim. a) $x^2 - x - 6 = 0$
 $a=1 \quad b=-1 \quad c=-6$

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot 1 \cdot (-6)}}{2 \cdot 1}$$

V: $x=3$ tai
 $x=-2$

$$x = \frac{1 \pm \sqrt{1+24}}{2} = \frac{1 \pm \sqrt{25}}{2} = \frac{1 \pm 5}{2} \sim \begin{cases} \frac{1+5}{2} = 3 \\ \frac{1-5}{2} = -2 \end{cases}$$

b)

$$x^2 - 2 = 2x \quad || -2x$$

$$\begin{array}{l} 1 \cdot x^2 - 2x - 2 = 0 \\ \underline{a=1} \quad \underline{b=-2} \quad \underline{c=-2} \end{array}$$

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

$$x = \frac{2 \pm \sqrt{4 + 8}}{2} = \frac{2 \pm \sqrt{12}}{2}$$

$$x = \frac{2 - \sqrt{12}}{2} \approx \dots \quad \text{+i} \quad \frac{2 + \sqrt{12}}{2} \approx \dots$$

$$c) \quad x(2x-1) = 3$$

$$2x^2 - x = 3 \quad || -3$$

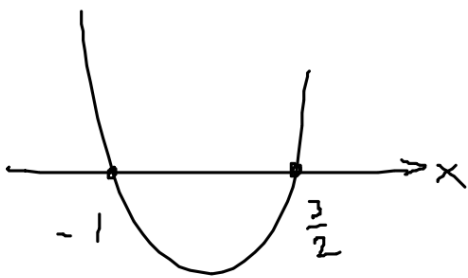
$$2x^2 - x - 3 = 0$$

$$a=2 \quad b=-1 \quad c=-3$$

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

$$x = \frac{1 \pm \sqrt{1+24}}{4} = \frac{1 \pm 5}{4}$$

$$= \begin{cases} \frac{1+5}{4} = \frac{6}{4} = \underline{\underline{\frac{3}{2}}} \\ \frac{1-5}{4} = \frac{-4}{4} = \underline{\underline{-1}} \end{cases}$$

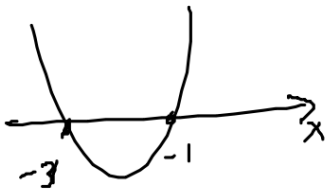


$$ax^2 + bx + c = 0$$

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

300. a) $x^2 + 4x + 3 = 0$

$\uparrow$ $\uparrow$ $\uparrow$
 $a=1$ $b=4$ $c=3$



$$x = \frac{-4 \pm \sqrt{4^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} = \frac{-4 \pm \sqrt{16 - 12}}{2}$$

$$= \frac{-4 \pm \sqrt{4}}{2} = \frac{-4 \pm 2}{2} = \begin{cases} \frac{-4+2}{2} = -\frac{2}{2} = -1 \\ \frac{-4-2}{2} = -\frac{6}{2} = -3 \end{cases}$$

N: $x = -1$ tai $x = -3$

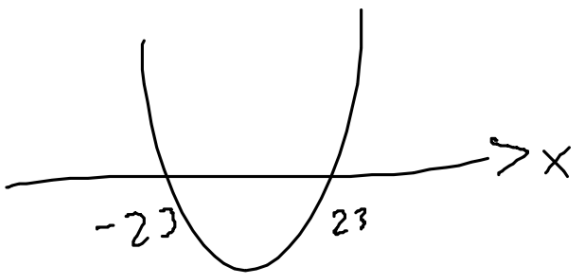
305. a) $3x^2 - 1587 = 0$

$a=3$ $b=0$ $c=-1587$

$$x = \frac{-\underline{0} \pm \sqrt{\underline{0}^2 - 4 \cdot 3 \cdot (-1587)}}{2 \cdot 3}$$

$$x = \frac{0 \pm \sqrt{0 + 19044}}{6}$$

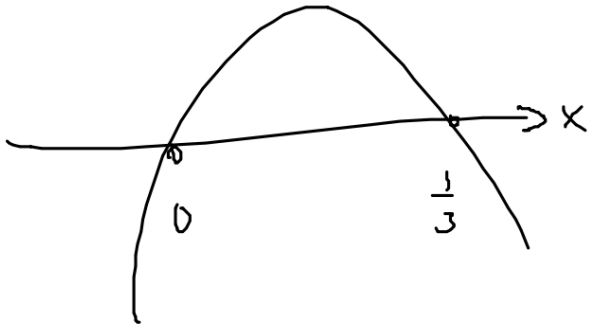
$$= \frac{0 \pm 138}{6} = \pm 23$$



307. a) $-3z^2 + z = 0$

$$a = -3 \quad b = 1 \quad c = \underline{0}$$

$$z = \frac{-1 \pm \sqrt{1}}{-6} = \frac{-1 \pm 1}{-6} = \begin{cases} \frac{-1+1}{-6} = 0 \\ \frac{-1-1}{-6} = \frac{-2}{-6} = \frac{1}{3} \end{cases}$$



301.

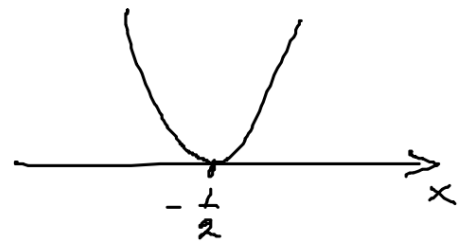
$$a/ \quad 4y^2 + 4y + 1 = 0$$

$\uparrow \quad \quad \uparrow \quad \quad \uparrow$
 $a \quad \quad b \quad \quad c$

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

$$y = \frac{-4 \pm \sqrt{16 - 16}}{8}$$

$$y = \frac{-4 \pm \sqrt{0}}{8} = -\frac{4}{8} = -\frac{1}{2}$$



$$b) \quad -5x^2 - \frac{1}{2} = 2x \quad || -2x$$

$$-5x^2 - \frac{1}{2} - 2x = 0$$

$\uparrow$ $\uparrow$ $\uparrow$
 $a = -5$ $c = -\frac{1}{2}$ $b = -2$



$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot (-5) \cdot (-\frac{1}{2})}}{2 \cdot (-5)}$$

$$x = \frac{2 \pm \sqrt{4 - 10}}{-10} = \frac{2 \pm \sqrt{-6}}{-10}$$

V: ei ratkeu

s. 119: 299 →