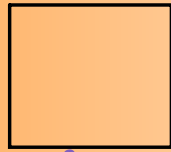


NELIÖJUURI /st

esim



3 cm

$$A = 3 \text{ cm} \cdot 3 \text{ cm} = (3 \text{ cm})^2 \\ = 9 \text{ cm}^2$$

km² hm² dam² m² dm² cm² mm²
(100)

$$\sqrt{4} = 2, \text{ koska } 2^2 = 4$$

$$\sqrt{9} = 3, \text{ koska } 3^2 = 9$$

$$\sqrt{25} = 5, \text{ koska } 5^2 = 25$$

$$\sqrt{36} = 6, \text{ koska } 6^2 = 36$$

$$\sqrt{a^2} = a, \text{ koska } (a^2)^2 = a^4$$

Neliöjuuren määritelmä

Merkintä \sqrt{a} tarkoittaa sellaista ei-negatiivista lukua, jonka neliö on a .

$$\boxed{\sqrt{a}^2 = a}, \quad a \geq 0$$

$$\boxed{\sqrt{a} = b \iff b \geq 0 \text{ ja } b^2 = a}$$

juurettava

esim $(\sqrt{7})^2 = 7, \text{ koska } 7 > 0$

esim Onko a) $\sqrt{9^2} = 9$, on sillä $9 > 0$

b) $\sqrt{(-7)^2} = -7$, ei ole sillä $-7 < 0$

$$\sqrt{49} = 7$$

$$\sqrt{7^2} = 7$$

Olkoon a mielivaltainen reaaliluku

$$\boxed{\sqrt{a^2} = |a| \iff |a| \geq 0 \text{ ja } |a|^2 = a^2}$$

esim a) $\sqrt{16x^2} = 4|x|$

b) $\sqrt{49x^4} = 7|x^2| = 7x^2, \quad x^2 \geq 0$
 $\sqrt{(7x^2)^2} =$

$$\sqrt{ab} = \sqrt{a} \sqrt{b}$$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

exam a) $\sqrt{45} = \sqrt{9 \cdot 5} = \sqrt{9} \sqrt{5} = \underline{\underline{3\sqrt{5}}}$

b) $\sqrt{2} \sqrt{32} = \sqrt{2 \cdot 32} = \sqrt{64} = \underline{\underline{8}}$

c) $\sqrt{\frac{81}{121}} = \frac{\sqrt{81}}{\sqrt{121}} = \frac{9}{\underline{\underline{11}}}$

d) $\frac{\sqrt{64}}{\sqrt{4}} = \frac{8}{2} = \sqrt{\frac{64}{4}} = \sqrt{16} = \underline{\underline{4}}$

e) $\frac{\sqrt[3]{6}}{\sqrt{3}} = \frac{6\sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \frac{6\sqrt{3}}{(\sqrt{3})^2} = \frac{6\sqrt{3}}{3} = \underline{\underline{2\sqrt{3}}}$

esim $x^2 = 36 \quad | \sqrt{\quad}$

1. tyyppi $x = \pm \sqrt{36}$

$x = \pm 6$

2. tyyppi $x = \sqrt{36}$ tai $x = -\sqrt{36}$

$x = 6$ tai $x = -6$

$x^2 = a \Leftrightarrow x = \sqrt{a}$ tai $x = -\sqrt{a}, a \geq 0$

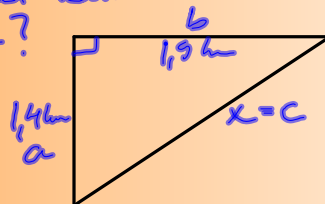
esim $3x^2 = 108$

$x^2 = \frac{108}{3}$

$x^2 = 36 \quad | \sqrt{\quad}$

$x = \pm 6$

esim Matti on kulkenut ensin pohjoiseen 1,4 km ja sitten itään 1,9 km. Kuinka kaukana hän on lähtökohdastaan?



$a^2 + b^2 = c^2$

$1,4^2 + 1,9^2 = x^2$

$x^2 = 1,96 + 3,61$

$x^2 = 5,57 \quad | \sqrt{\quad}$

$x = \pm \sqrt{5,57}$

(pituus) $x \approx \pm 2,36008$

$x \approx 2,4$

V: Matti on 2,4 km...

esim $\sqrt{0} = 0$

$\sqrt{1} = 1$

$\sqrt{-b}$ = ei ole määritelty \mathbb{R} -ssä

$x = \sqrt{-b} \quad | (\quad)^2$

$x^2 = -b$ mahdotonta

esim $(\sqrt{\sqrt{3}})^2$
 $= \sqrt{3}$

esim $(3\sqrt{7})^2 =$
 $= 3^2(\sqrt{7})^2$
 $= 9 \cdot 7 = \underline{\underline{63}}$

potenssi-
opin
säännöt!

esim 170a) $(\sqrt{7} - \sqrt{21})\sqrt{7}$

Kertaa
polynomi-
opin
säännöt!

$$= \sqrt{7} \cdot \sqrt{7} - \sqrt{21} \cdot \sqrt{7}$$

$$= (\sqrt{7})^2 - \sqrt{21 \cdot 7}$$

$$= \text{me.}$$

esim $2\sqrt{5} + 4\sqrt{5} = \underline{\underline{6\sqrt{5}}}$

$$2\sigma + 4\sigma = \underline{\underline{6\sigma}} \text{ omppu}$$

$$161 \text{ b) } (\sqrt{\sqrt{2}})^2 = \underline{\underline{\sqrt{2}}}$$

$$162 \text{ a) } (2\sqrt{7})^2 = 2^2(\sqrt{7})^2 = 4 \cdot 7 = \underline{\underline{28}}$$

$$\text{c) } (\sqrt{7})^4 = ((\sqrt{7})^2)^2 = 7^2 = \underline{\underline{49}}$$

$$163 \text{ b) } \frac{15}{\sqrt{3}} = \frac{15\sqrt{3}}{\underbrace{\sqrt{3} \cdot \sqrt{3}}_{(\sqrt{3})^2}} = \frac{15\sqrt{3}}{3} = 5\sqrt{3}$$

$$166 \text{ a) } \sqrt{75} = \sqrt{3 \cdot 25} = \sqrt{3} \sqrt{25} = 5\sqrt{3}$$

$$167 \text{ c) } \sqrt{90x^4} = \sqrt{10 \cdot 9} \sqrt{(x^2)^2} = 3\sqrt{10} |x^2| \\ = \underline{\underline{3\sqrt{10} x^2}}$$

$$\begin{aligned}
 & \frac{\text{com}}{170 \text{ b}} \quad \sqrt{6} (\sqrt{5} + 2\sqrt{3}) \\
 & = \sqrt{6} \sqrt{5} + \sqrt{6} \cdot 2\sqrt{3} \\
 & = \sqrt{30} + 2\sqrt{18} \\
 & = \sqrt{30} + 2 \cdot \sqrt{2 \cdot 9} \\
 & = \sqrt{30} + 2 \cdot 3\sqrt{2} \\
 & = \sqrt{30} + 6\sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{\text{com}}{170 \text{ c}} \quad 1\sqrt{5} - 3\sqrt{5} + 8\sqrt{5} \\
 & \quad \quad \quad x \quad -3x \quad +8x \\
 & = 6\sqrt{5}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{\text{com}}{177 \text{ a)}} \quad \sqrt{(1-\sqrt{3})^2} \\
 & = |1-\sqrt{3}| \\
 & = -(1-\sqrt{3}) \\
 & = \sqrt{3}-1
 \end{aligned}$$