

$$\Leftrightarrow x - x^3 = 0$$

$$\Leftrightarrow x(1 - x^2) = 0$$

$$\Leftrightarrow x = 0 \text{ tai } 1 - x^2 = 0$$

$$\Leftrightarrow 1 = x^2 \quad | \sqrt{\quad} \quad \Leftrightarrow x = \pm 1$$

$$\text{Tark. } x = 0: \sqrt[3]{0} = 0 \quad \checkmark$$

$$x = 1: \sqrt[3]{1} = 1 \quad \checkmark$$

$$x = -1: \sqrt[3]{-1} = -1 \quad \checkmark$$

$$\text{Vast. } \underline{x = 0 \text{ tai } x = \pm 1}$$

Yleistä: Kun korotetaan yhtälö puolittain

1° parillisessa potenssissa, on saadut ratkaisut tarkistettava

2° parittomassa — — —, ei ratkaisuja tarvitse tarkistaa

$$24.2 \text{ a) } 2\sqrt[3]{x} = x \quad | ()^3$$

$$\Leftrightarrow (2\sqrt[3]{x})^3 = x^3$$

$$\Leftrightarrow 2^3 \cdot (\sqrt[3]{x})^3 = x^3$$

$$\Leftrightarrow 8x = x^3$$

$$\Leftrightarrow 8x - x^3 = 0$$

$$\Leftrightarrow x(8 - x^2) = 0$$

$$\Leftrightarrow \underline{x = 0 \text{ tai } 8 - x^2 = 0}$$

$$\Leftrightarrow 8 = x^2 \quad | \sqrt{\quad} \quad \Leftrightarrow \underline{x = \pm \sqrt{8} = \pm \sqrt{4 \cdot 2} = \pm 2\sqrt{2}}$$

$$b) \sqrt[3]{x^3 - 1} + x = 0$$

$$\Leftrightarrow \sqrt[3]{x^3 - 1} = -x \quad | ()^3$$

$$\Leftrightarrow (\sqrt[3]{x^3 - 1})^3 = (-x)^3$$

$$\Leftrightarrow x^3 - 1 = -x^3$$

$$\Leftrightarrow 2x^3 = 1 \quad | :2$$

$$\Leftrightarrow x^3 = \frac{1}{2} \quad | \sqrt[3]{\quad}$$

$$\Leftrightarrow \underline{x = \sqrt[3]{\frac{1}{2}} = \frac{\sqrt[3]{1}}{\sqrt[3]{2}} = \frac{1}{\sqrt[3]{2}}}$$

$$24.4 \text{ a) } \sqrt[8]{4 - 3x} = \sqrt[8]{x^2} \quad | ()^8$$

$$\Leftrightarrow (\sqrt[8]{4 - 3x})^8 = (\sqrt[8]{x^2})^8$$

$$\Leftrightarrow 4 - 3x = x^2 \quad \Leftrightarrow 0 = x^2 + 3x - 4 \quad \Leftrightarrow x = \begin{cases} 1 \\ -4 \end{cases}$$

$$\text{Tark. } x = 1: \sqrt[8]{4 - 3 \cdot 1} = \sqrt[8]{1^2} \quad \Leftrightarrow \sqrt[8]{1} = \sqrt[8]{1} \quad \checkmark$$

$$x = -4: \sqrt[8]{4 - 3 \cdot (-4)} = \sqrt[8]{(-4)^2} \quad \Leftrightarrow \sqrt[8]{16} = \sqrt[8]{16} \quad \checkmark$$

$$\text{Vast. } \underline{x = -4 \text{ tai } x = 1}$$

$$b) \sqrt[4]{4x^2} + x = 0 \quad \Leftrightarrow \sqrt[4]{4x^2} = -x \quad | ()^4$$

$$\Leftrightarrow (\sqrt[4]{4x^2})^4 = (-x)^4 \quad \Leftrightarrow 4x^2 = x^4$$

$$\Leftrightarrow -x^4 + 4x^2 = 0 \quad \Leftrightarrow x^2(-x^2 + 4) = 0$$

$$\Leftrightarrow x^2 = 0 \quad | \sqrt{\quad} \quad \text{tai} \quad -x^2 + 4 = 0$$