

Lomené výrazy 8 – Kvadratické a kubické rovnice řešené rozkladem

Urči kdy se rovnice rovná nule

1) *kdy bude levá strana rovna nule? 2)*

$$(x+1)^2=0 \quad 0^2=0 \quad (x-2)^2=0$$

$$\underline{x+1=0} \quad /-1 \quad \underline{x-2=0}$$

$$\underline{x=-1} \quad \underline{x=2}$$

3)

$$(y+3)^2=0$$

$$\underline{y+3=0}$$

$$\underline{y=-3}$$

4)

$$(x-5)^2=0$$

$$\underline{x-5=0}$$

$$\underline{x=5}$$

5) *kdy bude levá strana rovna nule?*

$$(x-3) \cdot (x+1) = 0 \quad \text{L} \rightarrow \text{zobohovír každý nula} = \text{nula}$$

musí být nula *musí být nula*

$$\underline{x-3=0} \quad \underline{x+1=0}$$

$$\underline{x_1=3} \quad \underline{x_2=-1}$$

6)

$$(x-6) \cdot (y+3) = 0$$

$$\underline{x-6=0} \quad \underline{y+3=0}$$

$$\underline{x=6} \quad \underline{y=-3}$$

7)

$$y(y-5) = 0$$

$$\underline{y=0} \quad \underline{y-5=0}$$

$$\underline{y_2=5}$$

8)

$$(z+4) \cdot (z-1) = 0$$

$$\underline{z+4=0}$$

$$\underline{z-1=0}$$

9)

$$(x+5) \cdot (x-1) \cdot (x-6) = 0$$

$$\underline{x+5=0} \quad \underline{x-1=0} \quad \underline{x-6=0}$$

$$\underline{x_1=-5} \quad \underline{x_2=1} \quad \underline{x_3=6}$$

10)

$$x^2 \cdot (x+2)^2 = 0$$

L \rightarrow *zeden z činitele = 0*

$$\underline{x^2=0} \quad \underline{(x+2)^2=0}$$

$$\underline{x_1=0} \quad \underline{x+2=0}$$

$$\underline{x_2=-2}$$

Rozlož a urči kdy se rovnice rovná nule

11)

$$x^2 - 4 = 0$$

$$\underline{(x-2)(x+2) = 0}$$

$$\underline{x_1=2}$$

$$\underline{x_2=-2}$$

12)

$$x^2 + 2x + 1 = 0$$

$$\underline{(x+1)^2 = 0}$$

$$\underline{x = -1}$$

13)

$$4x^2 - 16x = 0$$

$$4x(x-4) = 0$$

$$\underline{4x=0} \quad \underline{x-4=0}$$

$$\underline{x_1=0} \quad \underline{x_2=4}$$

14)

$$4x^2 - 16 = 0$$

$$4 \cdot (x^2 - 4) = 0$$

$$4 \cdot (x-2) \cdot (x+2) = 0$$

$$\underline{x-2=0} \quad \underline{x+2=0}$$

$$\underline{x_1=2} \quad \underline{x_2=-2}$$

např:

$$(2x-4)(2x+4) = 0$$

$$\underline{2x-4=0} \quad \underline{2x+4=0}$$

$$\underline{2x=4} \quad /:2 \quad \underline{2x=-4} \quad /:2$$

$$\underline{x_1=2} \quad \underline{x_2=-2}$$

15)

$$4x^2 + 4x + 1 = 0$$

$$\underline{(2x+1)^2 = 0}$$

$$\underline{2x+1=0}$$

$$\underline{2x=-1} \quad /:2$$

$$\underline{x = -\frac{1}{2}}$$

16)

$$x^2 - 49 = 0$$

$$\underline{(x-7)(x+7) = 0}$$

$$\underline{x_1=7}$$

$$\underline{x_2=-7}$$

Opakování – Rozklady na součin a roznásobení

Zjednoduš:

$$(x+3) \cdot (x+2) = x^2 + 2x + 3x + 6 = x^2 + \overset{2x+3x}{5x} + \underset{2 \cdot 3}{6}$$

$$(x-3) \cdot (x+2) = x^2 + 2x - 3x - 6 = x^2 - \overset{-3x+2x}{x} - \underset{(-3) \cdot 2}{6}$$

$$(x-3) \cdot (x-2) = x^2 - 2x - 3x + 6 = x^2 - \overset{-2x-3x}{5x} + \underset{(-3) \cdot (-2)}{6}$$

$$(x+3) \cdot (x-2) = x^2 - 2x + 3x - 6 = x^2 + \overset{3x-2x}{x} - \underset{3 \cdot (-2)}{6}$$

$$(x+1) \cdot (x+5) = x^2 + 5x + x + 5 = x^2 + \overset{5+1}{6x} + \underset{5 \cdot 1}{5}$$

$$(x-1) \cdot (x+5) = x^2 + 5x - x - 5 = x^2 + \overset{+}{4x} - \underset{-1}{5}$$

$$(x+1) \cdot (x-5) = x^2 - 5x + x - 5 = x^2 - \overset{+}{4x} - \underset{-5+1}{5}$$

$$(x-1) \cdot (x-5) = x^2 - 5x - x + 5 = x^2 - \overset{(-) \cdot (-)}{6x} + \underset{-5-1}{5}$$

Doplň hodnoty aby platila rovnost:

$$(y+2) \cdot (y+4) = y^2 + \underset{2y+4y}{6} y + \underset{8}{8}$$

$$(y+3) \cdot (y+1) = y^2 + 4y + \underset{y+3y}{3}$$

$$(y+5) \cdot (y-1) = y^2 + \overset{5y-y}{4y} - \underset{5 \cdot 1 = 5}{5}$$

$$(y+2) \cdot (y-3) = y^2 - \overset{\oplus \cdot \ominus \checkmark}{y} - \underset{2 \cdot 3 = 6}{6}$$

$-3y + 2y = -y$

$$(y-5) \cdot (y-1) = y^2 - \overset{-y}{6y} + \underset{\ominus \cdot \ominus = \oplus}{5}$$

$5 \cdot 1 = 5$

$$(y-2) \cdot (y+3) = y^2 + \overset{3y}{y} - \underset{\ominus \oplus \checkmark}{6}$$

$2 \cdot 3 = 6$

(cermat)

$$(y+6) \cdot (2y+3) = 2y^2 + 15y + \underset{3y+12y}{18}$$

$12y = 6 \cdot 2y$

$$(y+3) \cdot (2y-3) = 2y^2 + 15y - \underset{-3y+18y=15y}{27}$$

$18y = 3 \cdot 2y$

Kvadratická rovnice 1 - výpočet přes rozklad

Rozlož na součin a najdi kořeny rovnice

Vzor: $(x+3) \cdot (x+2) = x^2 + 5x + 6$ $\xrightarrow{+6} (x+?) \cdot (x+?)$
 $(x-3) \cdot (x-2) = x^2 - 5x + 6$ $\xrightarrow{-6} (x-?) \cdot (x-?)$

Součinový kvocient

$6 = 2 \cdot 3$ $6 = 6 \cdot 1$
 $2+3=5$ $6+1=7$
 $-2-3=-5$ $-6-1=-7$

$(x-3) \cdot (x+2) = x^2 - x - 6$ $\xrightarrow{-6} (x+?) \cdot (x-?)$
 $6 = 2 \cdot 3$ $6 = 1 \cdot 6$
 $2-3=-x$ $-6+1=-5$
 $-2+3$

$(x+3) \cdot (x-2) = x^2 + x - 6$ $\xrightarrow{-6} (x+?) \cdot (x-?)$
 $6 = 2 \cdot 3$ $6 = 1 \cdot 6$
 $2-3=-x$ $-6+1=-5$
 $-2+3$

1) $x^2 + 3x + 2 = 0$
 $(x+2) \cdot (x+1) = 0$ $\begin{matrix} 2 \cdot 1 \\ 2+1=3 \end{matrix}$
 $\hookrightarrow x+2=0$ $x+1=0$
 $x_1 = -2$ $\hookrightarrow x_2 = -1$
 $K = \{-2; -1\}$

2) $x^2 - x - 2 = 0$
 $(x+1) \cdot (x-2) = 0$ $\begin{matrix} 2 \cdot 2 \cdot 1 \\ 1-2=-1 \end{matrix}$
 $x_1 = -1$
 $x_2 = 2$
 $K = \{-1; 2\}$

3) $x^2 + x - 2 = 0$
 $(x+2) \cdot (x-1) = 0$
 $x_1 = -2$ $x_2 = 1$
 $K = \{-2; 1\}$

4) $x^2 - 3x + 2 = 0$
 $(x-2) \cdot (x-1) = 0$
 $x_1 = 2$
 $x_2 = 1$
 $K = \{1; 2\}$

5) $x^2 + 7x + 12 = 0$
 $(x+3) \cdot (x+4) = 0$ $\begin{matrix} 12 \\ 1 \cdot 12 \\ 2 \cdot 6 \\ 3 \cdot 4 \end{matrix}$
 $x_1 = -3$
 $x_2 = -4$
 $K = \{-4; -3\}$

6) $x^2 + 6x + 8 = 0$
 $(x+2) \cdot (x+4) = 0$ $\begin{matrix} 8 \\ 1 \cdot 8 \\ 2 \cdot 4 \end{matrix}$
 $x_1 = -2$
 $x_2 = -4$
 $K = \{-4; -2\}$

7) $x^2 + x - 6 = 0$
 $(x+3) \cdot (x-2) = 0$ $\begin{matrix} 6 \\ 1 \cdot 6 \\ 2 \cdot 3 \end{matrix}$ $\begin{matrix} 6-1 \neq 1 \\ 3-2=1 \end{matrix}$
 $x_1 = -3$
 $x_2 = 2$
 $K = \{-3; 2\}$

8) $x^2 - x - 6 = 0$
 $(x+2) \cdot (x-3) = 0$ $\begin{matrix} 6 \\ 6 \cdot 1 \\ 2 \cdot 3 \end{matrix}$
 $x_1 = -2$
 $x_2 = 3$
 $K = \{-2; 3\}$

9) $x^2 + x - 20 = 0$
 $(x+5) \cdot (x-4) = 0$ $\begin{matrix} 20 \\ 20 \cdot 1 \\ 10 \cdot 2 \\ 5 \cdot 4 \end{matrix}$ $\begin{matrix} x \\ x \\ 5-4=1 \end{matrix}$
 $x_1 = -5$
 $x_2 = 4$
 $K = \{-5; 4\}$

10) $x^2 - x - 20 = 0$
 $(x-5) \cdot (x+4) = 0$ $5 \cdot 4$
 $x_1 = 5$
 $x_2 = -4$
 $K = \{-4; 5\}$

11) $x^2 + 10x + 16 = 0$
 $(x+2) \cdot (x+8) = 0$ $\begin{matrix} 16 \\ 16 \cdot 1 \\ 2 \cdot 8 \end{matrix}$ $\begin{matrix} x \\ x \end{matrix}$
 $x_1 = -2$
 $x_2 = -8$
 $K = \{-8; -2\}$

12) $x^2 - 10x + 16 = 0$
 $(x-8) \cdot (x-2) = 0$ $8 \cdot 2$
 $x_1 = 8$
 $x_2 = 2$
 $K = \{2; 8\}$

Než rozložíš vytkni:

13) $2x^2 + 10x + 12 = 0$
 $2 \cdot (x^2 + 5x + 6) = 0$ $\begin{matrix} 6 = 6 \cdot 1 \\ 3 \cdot 2 \end{matrix}$
 $2 \cdot (x+3) \cdot (x+2) = 0$
 $x_1 = -3$
 $x_2 = -2$
 $K = \{-3; -2\}$

14) $3x^2 + 9x - 54 = 0$
 $3 \cdot (x^2 + 3x - 18) = 0$ $\begin{matrix} 18 \\ 18 \cdot 1 \\ 3 \cdot 2 \end{matrix}$
 $3 \cdot (x+6) \cdot (x-3) = 0$ $\begin{matrix} 6 \cdot 3 \end{matrix}$
 $x_1 = -6$
 $x_2 = 3$
 $K = \{-6; 3\}$

15) $2x^2 - 10x + 12 = 0$
 $2 \cdot (x^2 - 5x + 6) = 0$ $\begin{matrix} 6 \\ 6 \cdot 1 \Rightarrow -7 \\ 2 \cdot 3 \Rightarrow -5 \end{matrix}$
 $2 \cdot (x-2) \cdot (x-3) = 0$
 $x_1 = 2$
 $x_2 = 3$
 $K = \{2; 3\}$

16) $5x^2 + 35x + 60 = 0$
 $5 \cdot (x^2 + 7x + 12) = 0$ $\begin{matrix} 12 \\ 12 \cdot 1 \\ 6 \cdot 2 \\ 3 \cdot 4 \end{matrix}$
 $5 \cdot (x+3) \cdot (x+4) = 0$
 $x_1 = -3$
 $x_2 = -4$
 $K = \{-3; -4\}$

Kvadratická rovnice 2 - výpočet diskriminantu

Najdi kořeny rovnice.

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

$$D = b^2 - 4ac$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$$

1) $ax^2 + bx + c = 0$
 $1x^2 + 5x + 6 = 0$

$$a=1 \quad b=5 \quad c=6$$

$$D = b^2 - 4ac = 5^2 - 4 \cdot 1 \cdot 6 = 25 - 24 = 1$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-5 \pm \sqrt{1}}{2 \cdot 1} = \frac{-5 \pm 1}{2} \begin{cases} \frac{-5+1}{2} = \frac{-4}{2} = -2 \\ \frac{-5-1}{2} = \frac{-6}{2} = -3 \end{cases}$$

Roštl. $(x+2)(x+3) = 0 \rightarrow x_1 = -2 \quad x_2 = -3$

$$K = \{-2, -3\}$$

2) $ax^2 + bx + c = 0$
 $1x^2 - 6x + 9 = 0$

$$a=1 \\ b=-6 \\ c=9$$

$$D = (-6)^2 - 4 \cdot 1 \cdot 9 = 36 - 36 = 0$$

$$x_{1,2} = \frac{-(-6) \pm \sqrt{0}}{2} = \frac{6}{2} = 3 \quad x = 3$$

120REČ $(x-3)^2 = 0 \rightarrow K = \{3\}$

3) $ax^2 + bx + c = 0$
 $1x^2 - 2x - 8 = 0$

$$a=1 \\ b=-2 \\ c=-8$$

$$D = b^2 - 4ac = (-2)^2 - 4 \cdot 1 \cdot (-8) = 4 + 32 = 36$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-2) \pm \sqrt{36}}{2 \cdot 1} = \frac{2 \pm 6}{2} \begin{cases} \frac{2+6}{2} = \frac{8}{2} = 4 \\ \frac{2-6}{2} = \frac{-4}{2} = -2 \end{cases}$$

$(x+2)(x-4) = 0$

$$K = \{-2, 4\}$$

4) $ax^2 + bx + c = 0$
 $1x^2 + 8x + 16 = 0$

$$D = b^2 - 4ac = 8^2 - 4 \cdot 1 \cdot 16 = 64 - 64 = 0$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-8 \pm \sqrt{0}}{2 \cdot 1} = \frac{-8}{2} = -4 \quad x = -4$$

120REČ $(x+4)^2 = 0 \rightarrow K = \{-4\}$

5) $1x^2 + 3x + 2 = 0$

$$D = b^2 - 4ac = 3^2 - 4 \cdot 1 \cdot 2 = 9 - 8 = 1$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-3 \pm \sqrt{1}}{2 \cdot 1} = \frac{-3 \pm 1}{2} \begin{cases} \frac{-3+1}{2} = \frac{-2}{2} = -1 \\ \frac{-3-1}{2} = \frac{-4}{2} = -2 \end{cases}$$

$(x+2)(x+1) = 0$

$$x_1 = -1 \\ x_2 = -2 \\ K = \{-2, -1\}$$

6) $ax^2 + bx + c = 0$
 $2x^2 + 6x + 4 = 0$

$$a=2 \\ b=6 \\ c=4$$

$$D = b^2 - 4ac = 6^2 - 4 \cdot 2 \cdot 4 = 36 - 32 = 4$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-6 \pm \sqrt{4}}{2 \cdot 2} = \frac{-6 \pm 2}{4} \begin{cases} \frac{-6+2}{4} = \frac{-4}{4} = -1 \\ \frac{-6-2}{4} = \frac{-8}{4} = -2 \end{cases}$$

Roštladem

$$2 \cdot (x^2 + 3x + 2) = 0$$

$$2 \cdot (x+2)(x+1) = 0 \rightarrow K = \{-2, -1\}$$

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

$$D = b^2 - 4ac$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$$

7) $x^2 + x - 20 = 0$

$$D = b^2 - 4ac = 1^2 - 4 \cdot 1 \cdot (-20) = 1 + 80 = 81$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-1 \pm \sqrt{81}}{2 \cdot 1} = \frac{-1 \pm 9}{2} \begin{cases} \frac{-1+9}{2} = \frac{8}{2} = 4 \\ \frac{-1-9}{2} = \frac{-10}{2} = -5 \end{cases}$$

Roštladem:

$(x-4)(x+5) = 0$

$$x_1 = 4 \\ x_2 = -5 \\ K = \{4, -5\}$$

8) $x^2 + x + 6 = 0$

$$D = b^2 - 4ac = 1 - 4 \cdot 1 \cdot 6 = 1 - 24 = -23$$

NEMÁ ŘEŠENÍ



$$x_{1,2} = \frac{-1 \pm \sqrt{-23}}{2}$$

9) $x^2 + 4x - 21 = 0$

$$D = b^2 - 4ac = 4^2 - 4 \cdot 1 \cdot (-21) = 16 + 84 = 100$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-4 \pm \sqrt{100}}{2 \cdot 1} = \frac{-4 \pm 10}{2} \begin{cases} \frac{-4+10}{2} = \frac{6}{2} = 3 \\ \frac{-4-10}{2} = \frac{-14}{2} = -7 \end{cases}$$

$$x_1 = 3 \\ x_2 = -7 \\ K = \{3, -7\}$$

10) $x^2 - x - 42 = 0$

$$D = b^2 - 4ac = (-1)^2 - 4 \cdot 1 \cdot (-42) = 1 + 168 = 169$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-1) \pm \sqrt{169}}{2 \cdot 1} = \frac{1 \pm 13}{2} \begin{cases} \frac{1+13}{2} = 7 \\ \frac{1-13}{2} = -6 \end{cases}$$

$$x_1 = 7 \quad x_2 = -6$$

$$K = \{-6, 7\}$$

Kvadratická rovnice 3 - výpočet diskriminantu

Pozor! Některé rovnice nemají řešení nebo vychází v podobě $x = 2 \pm \sqrt{2}$

1) $x^2 - 7x + 12 = 0$

$$D = 49 - 4 \cdot 1 \cdot 12 = 49 - 48 = 1$$

$$x_{1,2} = \frac{-(-7) \pm \sqrt{1}}{2} = \frac{7 \pm 1}{2} \begin{cases} \frac{8}{2} = 4 \\ \frac{6}{2} = 3 \end{cases}$$

$$K = \{4; 3\}$$

2) $2x^2 + 10x - 12 = 0$

$$D = 100 - 4 \cdot 2 \cdot (-12) = 100 + 96 = 196$$

$$x_{1,2} = \frac{-10 \pm \sqrt{196}}{2 \cdot 2} = \frac{-10 \pm 14}{4} \begin{cases} \frac{4}{4} = 1 \\ \frac{-24}{4} = -6 \end{cases}$$

$$K = \{-6; 1\}$$

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

$$D = b^2 - 4ac$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$$

3) $3x^2 - 15x + 18 = 0$

$$D = 225 - 4 \cdot 3 \cdot 18 = 225 - 216 = 9$$

$$x_{1,2} = \frac{-(-15) \pm \sqrt{9}}{2 \cdot 3} = \frac{15 \pm 3}{6} \begin{cases} \frac{18}{6} = 3 \\ \frac{12}{6} = 2 \end{cases}$$

$$K = \{2; 3\}$$

4) $x^2 + x + 1 = 0$

$$D = 1 - 4 \cdot 1 \cdot 1 = -3$$

NEMA ŘEŠENÍ

5) $x^2 - 11x + 30 = 0$

$$D = 121 - 4 \cdot 1 \cdot 30 = 1$$

$$x_{1,2} = \frac{-(-11) \pm \sqrt{1}}{2 \cdot 1} = \frac{11 \pm 1}{2} \begin{cases} \frac{12}{2} = 6 \\ \frac{10}{2} = 5 \end{cases}$$

$$K = \{5; 6\}$$

6) $x^2 - 0,4x + 0,04 = 0$

VZOREC $\rightarrow (x - 0,2)^2$

$$D = (-0,4)^2 - 4 \cdot 1 \cdot 0,04 = 0,16 - 0,16 = 0$$

$$x_{1,2} = \frac{-(-0,4) \pm \sqrt{0}}{2 \cdot 1} = \frac{0,4}{2} = 0,2$$

$$K = \{0,2\}$$

ZK: $(0,2)^2 - 0,4 \cdot 0,2 + 0,04 = 0,04 - 0,08 + 0,04 = 0$
 $P_{(0,2)} = 0$ $L = P$

7) $3x^2 - 36x + 105 = 0$

$$D = 36^2 - 4 \cdot 3 \cdot 105 = 1296 - 1260 = 36$$

$$x_{1,2} = \frac{-(-36) \pm \sqrt{36}}{2 \cdot 3} = \frac{36 \pm 6}{6} \begin{cases} \frac{42}{6} = 7 \\ \frac{30}{6} = 5 \end{cases}$$

$3 \cdot (x^2 - 12x + 35) = 0$ $K = \{5; 7\}$

$$D = 144 - 4 \cdot 1 \cdot 35 = 144 - 140 = 4$$

$$x_{1,2} = \frac{-(-12) \pm \sqrt{4}}{2 \cdot 1} = \frac{12 \pm 2}{2} \begin{cases} \frac{14}{2} = 7 \\ \frac{10}{2} = 5 \end{cases}$$

8) $x^2 - 77x + 1452 = 0$

$$D = 77^2 - 4 \cdot 1 \cdot 1452 = 5929 - 5808 = 121$$

$$x_{1,2} = \frac{77 \pm \sqrt{121}}{2} = \frac{77 \pm 11}{2} \begin{cases} \frac{88}{2} = 44 \\ \frac{66}{2} = 33 \end{cases}$$

$$K = \{33; 44\}$$

9) $x^2 + 2x + 3 = 0$

$$D = 4 - 4 \cdot 1 \cdot 3 = 4 - 12 = -8$$

Rovnice nemá řešení

10) $x^2 - 8x + 14 = 0$

$$\sqrt{8} = \sqrt{4 \cdot 2} = \sqrt{4} \cdot \sqrt{2} = 2 \cdot \sqrt{2}$$

$$D = 64 - 4 \cdot 1 \cdot 14 = 64 - 56 = 8$$

$$x_{1,2} = \frac{8 \pm \sqrt{8}}{2} \begin{cases} \frac{8 + 2\sqrt{2}}{2} = \frac{8}{2} + \frac{2\sqrt{2}}{2} = 4 + \sqrt{2} \\ \frac{8 - 2\sqrt{2}}{2} = \frac{8}{2} - \frac{2\sqrt{2}}{2} = 4 - \sqrt{2} \end{cases}$$

$$K = \{4 - \sqrt{2}; 4 + \sqrt{2}\}$$

Kvadratická rovnice 4 – slovní úlohy

1) Vypočítejte odvěsny pravoúhlého trojúhelníku, pokud víte, že má obsah $S = 180 \text{ m}^2$ a jedna jeho odvěsna je o 31 m delší než druhá.

$S_2 = \frac{a \cdot b}{2}$
 $180 = \frac{(x+31) \cdot x}{2} \quad /:2$
 $360 = (x+31) \cdot x$
 $360 = x^2 + 31x$
 $0 = x^2 + 31x - 360$

$D = b^2 - 4ac = 31^2 - 4 \cdot 1 \cdot (-360)$
 $D = 961 + 1440 = 2401$
 $x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-31 \pm 49}{2}$
 $\frac{18}{2} = 9$
 $-\frac{80}{2} = -40 \text{ X}$

$S = \frac{3 \cdot 40}{2} = 180 \checkmark$

O: Rozměry odvěsen jsou 3 cm a 40 cm.

3) Vypočítej poloměr válce, který má povrch $S = 78\pi$ a výšku 10 cm. Vzorec: $S = 2\pi r \cdot (r + v)$

$78\pi = 2\pi r \cdot (r + 10) \quad /:2\pi$
 $39 = r \cdot (r + 10)$
 $39 = r^2 + 10r$
 $0 = r^2 + 10r - 39$

$D = b^2 - 4ac = 10^2 - 4 \cdot 1 \cdot (-39) = 100 + 156$
 $D = 256$
 $r_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-10 \pm 16}{2}$
 $\frac{6}{2} = 3$
 $-\frac{26}{2} = -13 \text{ X}$

O: Poloměr válce je 3 cm.

5) Vypočítej délku h

$h + x = 36 \rightarrow x = 36 - h$
 $h^2 + 12^2 = x^2$
 $h^2 + 12^2 = (36 - h)^2$
 $h^2 + 144 = 1296 - 72h + h^2$
 $72h = 1152 \quad /:72$
 $h = 16 \text{ m}$

2) Obdélník má obsah 42 cm^2 a obvod 26 cm . Jaké jsou jeho rozměry?

$S = 42 \text{ cm}^2 = a \cdot b$
 $O = 26 \text{ cm} = 2a + 2b$

$a \cdot b = 42$
 $2a + 2b = 26 \quad /:2$
 $a + b = 13 \rightarrow a = 13 - b$
 $(13 - b) \cdot b = 42$
 $13b - b^2 = 42$
 $0 = b^2 - 13b + 42$
 $(b - 6)(b - 7)$

$x^2 - 13x + 42 = 0$
 $D = b^2 - 4ac = 169 - 168 = 1$
 $x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$
 $x_{1,2} = \frac{-(-13) \pm \sqrt{1}}{2} = \frac{13 \pm 1}{2}$
 $a_1 = 7 \text{ cm} \quad a_2 = 6 \text{ cm}$
 $b_1 = 6 \text{ cm} \quad b_2 = 7 \text{ cm}$

O: Rozměry jsou 6x7 cm.

4) Myslím si dvě čísla. Jejich rozdíl je 8, součet jejich druhých mocnin je 24. Která to jsou čísla?

$x - y = 8 \rightarrow x = 8 + y$
 $x^2 + y^2 = 24$
 $(8 + y)^2 + y^2 = 24$
 $64 + 16y + y^2 + y^2 = 24$
 $2y^2 + 16y + 40 = 0 \quad /:2$
 $y^2 + 8y + 20 = 0$
 $D = 8^2 - 4 \cdot 1 \cdot 20 = 64 - 80 = -16$
NEMÁ ŘEŠENÍ

O: Taková čísla neexistují.

6) Obvod obdélníku je 34 m a délka jeho úhlopříčky je 13 m. Určete rozměry obdélníku.

$O = 2a + 2b = 34 \text{ m}$
 $u^2 = a^2 + b^2 = 13^2$

$2a + 2b = 34 \quad /:2$
 $a + b = 17 \rightarrow a = 17 - b$
 $a^2 + b^2 = 169$
 $(17 - b)^2 + b^2 = 169$
 $289 - 34b + b^2 + b^2 = 169$
 $2b^2 - 34b + 120 = 0 \quad /:2$
 $b^2 - 17b + 60 = 0$

$x^2 - 17x + 60 = 0$
 $D = b^2 - 4ac = 289 - 4 \cdot 1 \cdot 60$
 $D = 49$
 $x_{1,2} = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-17) \pm \sqrt{49}}{2 \cdot 1}$
 $= \frac{17 \pm 7}{2}$
 $a_1 = 12 \text{ cm} \quad a_2 = 5 \text{ cm}$
 $b_1 = 5 \text{ cm} \quad b_2 = 12 \text{ cm}$

O: Rozměr obdélníku je 12x5 cm.