

Řešte rovnici  $x^3 - 5x + 4 = 0$

```
[ > restart;  
> rov:=x^3-5*x+4=0;  
  
rov := x3 - 5 x + 4 = 0
```

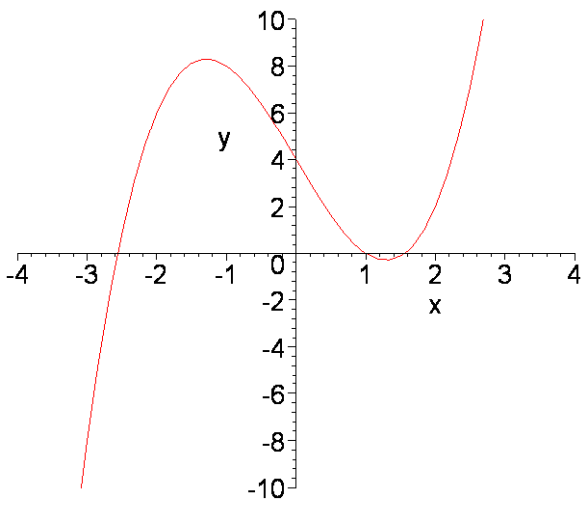
Přímé řešení užitím funkce "solve"

```
[ > solve(rov,x);  
  
1, - $\frac{1}{2} + \frac{\sqrt{17}}{2}$ , - $\frac{1}{2} - \frac{\sqrt{17}}{2}$ 
```

Použití Cardanových vzorců (ve tvaru s diskriminantem D3)

```
[ > D3:=-4*p^3-27*q^2;  
  
D3 := -4 p3 - 27 q2  
  
> p:=-5; q:=4;  
  
p := -5  
q := 4  
  
> D3;  
  
68  
  
> u1:=(-q/2+1/18*sqrt(-3*D3))^(1/3);  
v1:=(-q/2-1/18*sqrt(-3*D3))^(1/3); epsilon:=-1/2+I*sqrt(3)/2;  
  
u1 :=  $\left(-2 + \frac{1}{9} I \sqrt{51}\right)^{(1/3)}$   
v1 :=  $\left(-2 - \frac{1}{9} I \sqrt{51}\right)^{(1/3)}$   
  
ε :=  $-\frac{1}{2} + \frac{1}{2} I \sqrt{3}$   
  
> x1:=u1+v1; x2:=epsilon*u1+epsilon^2*v1;  
x3:=epsilon^2*u1+epsilon*v1;  
  
x1 :=  $\left(-2 + \frac{1}{9} I \sqrt{51}\right)^{(1/3)} + \left(-2 - \frac{1}{9} I \sqrt{51}\right)^{(1/3)}$   
x2 :=  $\left(-\frac{1}{2} + \frac{1}{2} I \sqrt{3}\right) \left(-2 + \frac{1}{9} I \sqrt{51}\right)^{(1/3)} + \left(-\frac{1}{2} + \frac{1}{2} I \sqrt{3}\right)^2 \left(-2 - \frac{1}{9} I \sqrt{51}\right)^{(1/3)}$   
x3 :=  $\left(-\frac{1}{2} + \frac{1}{2} I \sqrt{3}\right)^2 \left(-2 + \frac{1}{9} I \sqrt{51}\right)^{(1/3)} + \left(-\frac{1}{2} + \frac{1}{2} I \sqrt{3}\right) \left(-2 - \frac{1}{9} I \sqrt{51}\right)^{(1/3)}$   
  
> evalf(x1); evalf(x2); evalf(x3);  
  
1.561552813 + 0. I  
-2.561552814 + 0.4 10-9 I  
1.000000001 + 0. I
```

## Řešení "casus irreducibilis" užitím trigonometrické substituce

```
[ > restart;  
[ > rov:=x^3-5*x+4=0;  
[                                     rov := x3 - 5 x + 4 = 0  
[ > p:=-5; q:=4;  
[                                     p := -5  
[                                     q := 4  
[ > alpha:=1/3*arccos((-q/2)/sqrt((-p/3)^3));  
[                                      $\alpha := \frac{\pi}{3} - \frac{1}{3} \arccos\left(\frac{6\sqrt{15}}{25}\right)$   
[ > x1:=2*sqrt(-p/3)*cos(alpha); x2:=2*sqrt(-p/3)*cos(alpha+2*Pi/3);  
[ x3:=2*sqrt(-p/3)*cos(alpha+4*Pi/3);  
[                                      $x1 := \frac{2}{3}\sqrt{15} \sin\left(\frac{\pi}{6} + \frac{1}{3} \arccos\left(\frac{6\sqrt{15}}{25}\right)\right)$   
[                                      $x2 := -\frac{2}{3}\sqrt{15} \cos\left(\frac{1}{3} \arccos\left(\frac{6\sqrt{15}}{25}\right)\right)$   
[                                      $x3 := \frac{2}{3}\sqrt{15} \sin\left(\frac{\pi}{6} - \frac{1}{3} \arccos\left(\frac{6\sqrt{15}}{25}\right)\right)$   
[ > evalf(x1); evalf(x2); evalf(x3);  
[                                     1.561552813  
[                                     -2.561552813  
[                                     1.000000000  
[ > plot(lhs(rov),x=-4..4,y=-10..10);  
[                                       
[ >
```