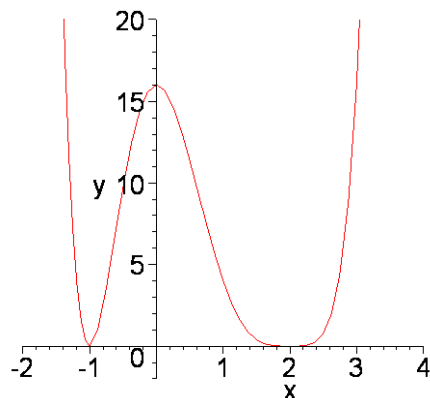**ÚKOL:** Rozhodněte o násobnosti kořenů daných polynomů

```
> restart;
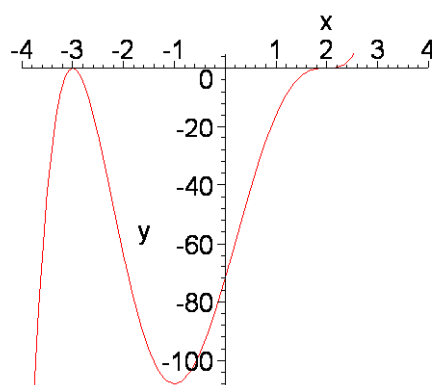```

a)
```
> f1:=x^6-6*x^5+9*x^4+8*x^3-24*x^2+16;
```
$$f1 := x^6 - 6\,x^5 + 9\,x^4 + 8\,x^3 - 24\,x^2 + 16$$
```
> roots(f1,x);
```
$$[[2, 4], [-1, 2]]$$
```
> factor(f1);
```
$$(x + 1)^2\,(x - 2)^4$$
```
> plot(f1,x=-2..4,y=-2..20);
```



b)
```
> f2:=x^5-15*x^3+10*x^2+60*x-72;
```
$$f2 := x^5 - 15\,x^3 + 10\,x^2 + 60\,x - 72$$
```
> roots(f2,x);
```
$$[[2, 3], [-3, 2]]$$
```
> factor(f2);
```
$$(x + 3)^2\,(x - 2)^3$$
```
> plot(f2,x=-4..4,y=-110..5);
```



c)
```
> f3:=27*x^5+81*x^4+117*x^3+98*x^2+44*x+8;
```
$$f3 := 27\,x^5 + 81\,x^4 + 117\,x^3 + 98\,x^2 + 44\,x + 8$$

```
> roots(f3,x);
```
$$\left[\left[\frac{-2}{3}, 3\right]\right]$$
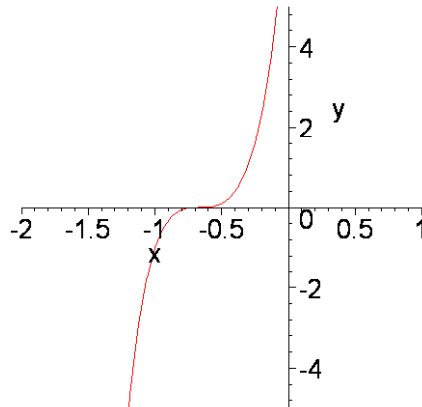
```
> factor(f3);
```
$$(x^2 + x + 1)(3x + 2)^3$$

```
> factor(f3,complex);
```
$$27.(x + 0.6666666667)^3 (x + 0.5000000000 + 0.8660254038\,I)$$
$$(x + 0.5000000000 - 0.8660254038\,I)$$

```
> plot(f3,x=-2..1,y=-5..5);
```


d)
```
> f4:=4*x^4+12*x^3-11*x^2-60*x-45;
```
$$f4 := 4x^4 + 12x^3 - 11x^2 - 60x - 45$$

```
> roots(f4,x);
```
$$\left[\left[\frac{-3}{2}, 2\right]\right]$$

```
> factor(f4);
```
$$(x^2 - 5)(2x + 3)^2$$
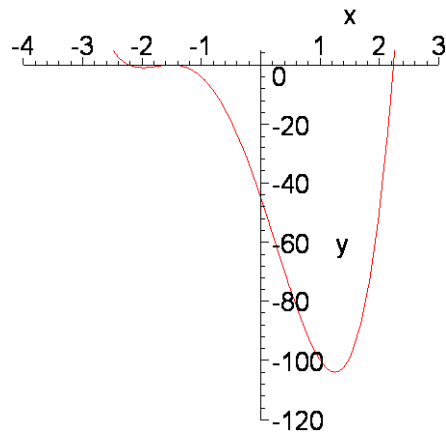
```
> roots(f4,sqrt(5));
```
$$\left[[\sqrt{5}, 1], [-\sqrt{5}, 1], \left[\frac{-3}{2}, 2\right]\right]$$

```
> factor(f4,real);
```
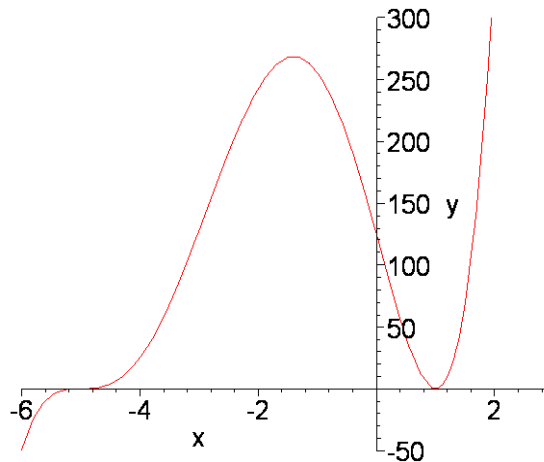$$4.(x + 2.236067977)(x + 1.500000000)^2 (x - 2.236067977)$$
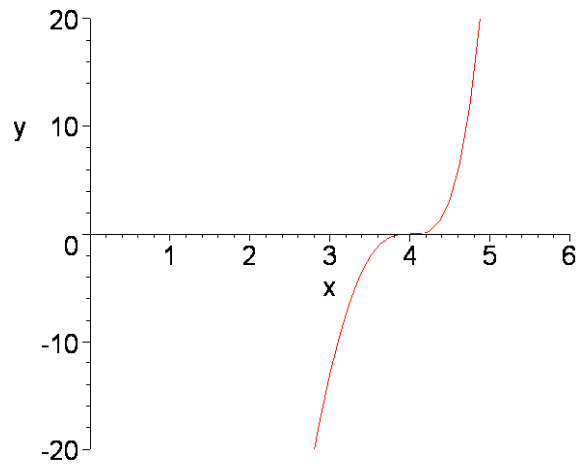
```
> plot(f4,x=-4..3,y=-120..5);
```

e)

```
> f5:=x^5+13*x^4+46*x^3-10*x^2-175*x+125;
```

$$f5 := x^5 + 13\,x^4 + 46\,x^3 - 10\,x^2 - 175\,x + 125$$

```
> roots(f5,x);
```

$$[\,[1, 2], [-5, 3]\,]$$

```
> factor(f5);
```

$$(x - 1)^2\,(x + 5)^3$$

```
> plot(f5,x=-6..3,y=-50..300);
```


f)

```
> f6:=x^5-11*x^4+37*x^3-28*x^2-16*x-64;
```

$$f6 := x^5 - 11\,x^4 + 37\,x^3 - 28\,x^2 - 16\,x - 64$$

```
> roots(f6,x);
```

$$[\,[4, 3]\,]$$

```
> factor(f6);
```

$$(x^2 + x + 1)\,(x - 4)^3$$

```
> roots(f6,{sqrt(3),I});
```

$$\left[\left[-\frac{1}{2} + \frac{1}{2}\,I\,\sqrt{3}, 1\right], \left[-\frac{1}{2} - \frac{1}{2}\,I\,\sqrt{3}, 1\right], [4, 3]\right]$$

```
> factor(f6,complex);
```

$$(x + 0.5000000000 + 0.8660254038\,I)\,(x + 0.5000000000 - 0.8660254038\,I)\,(x - 4.)^3$$

> plot(f6,x=0..6,y=-20..20);

>