Pracovni list k animacim o funkcich a derivacich. V ramci predmetu PRM 039 Matematika na pocitaci vytvoril Dominik Mokris, pripraveno k odevzdani 15.9.2008.

```
> #pracovni list je pripraven k pouziti, staci execute the
  worksheet. v pripade spousteni procedur samostatne
  #je treba nejprve odenterovat prvni dva radky (oba zacinaji
  with). Obrazky je vhodno roztahnout do sirky,
  #vypadaji pak lip. Prijemne pocitani :-)
```

```
> with(plottools);
```

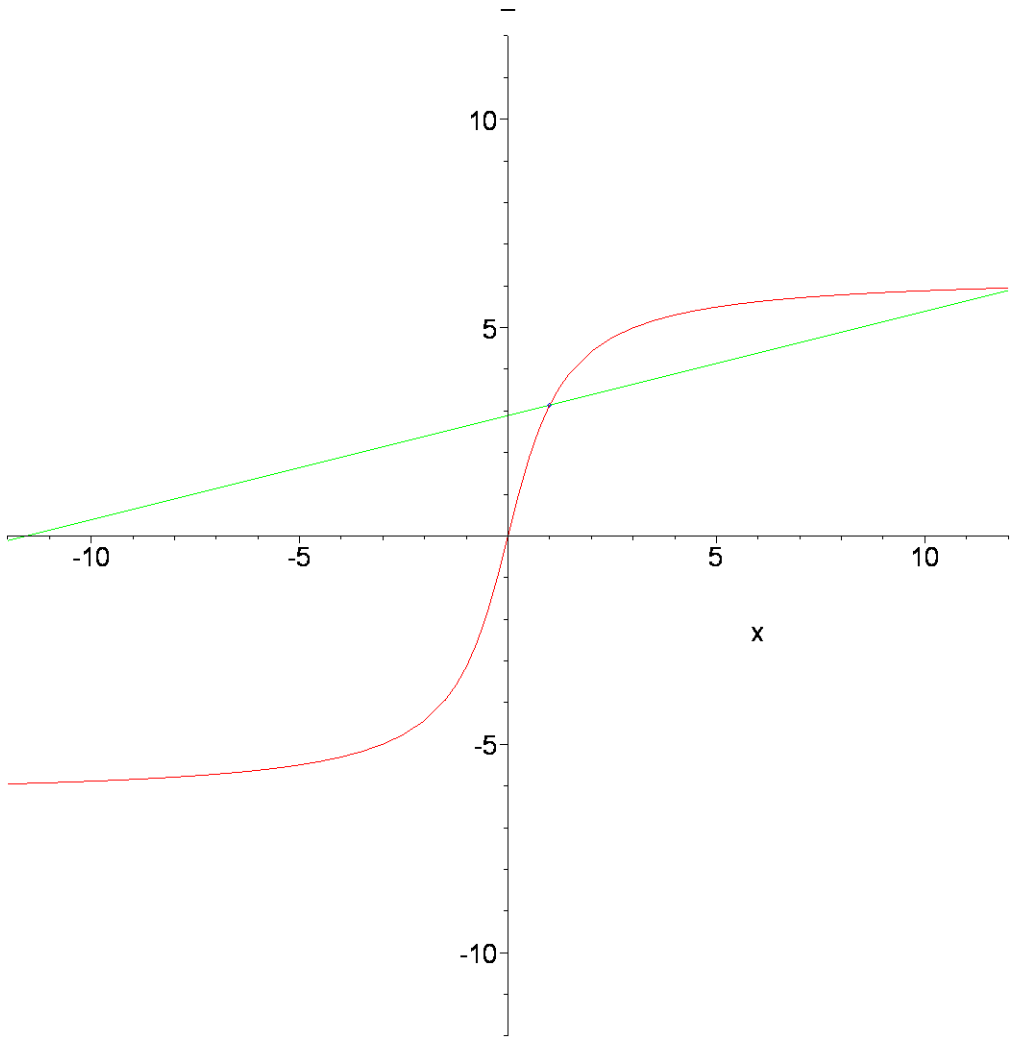
[*arc*, *arrow*, *circle*, *cone*, *cuboid*, *curve*, *cutin*, *cutout*, *cylinder*, *disk*, *dodecahedron*, *ellipse*, *ellipticArc*, *hemisphere*, *hexahedron*, *homothety*, *hyperbola*, *icosahedron*, *line*, *octahedron*, *parallelepiped*, *pieslice*, *point*, *polygon*, *project*, *rectangle*, *reflect*, *rotate*, *scale*, *semitorus*, *sphere*, *stellate*, *tetrahedron*, *torus*, *transform*, *translate*]

```
>
```

```
> with(plots):
```

```
> H0 := proc(t)
  plots[display](
    point([1,Pi],color=blue),
    plot(4*arctan(x),x=-12..12, color=red, view=-12..12),
    plot(Pi+t*(x-1),x=-12..12, color=green, view=-5..5));
  end:
  animate(H0,[theta], theta=.25..2,title='_', frames=50);
```

```
>
```



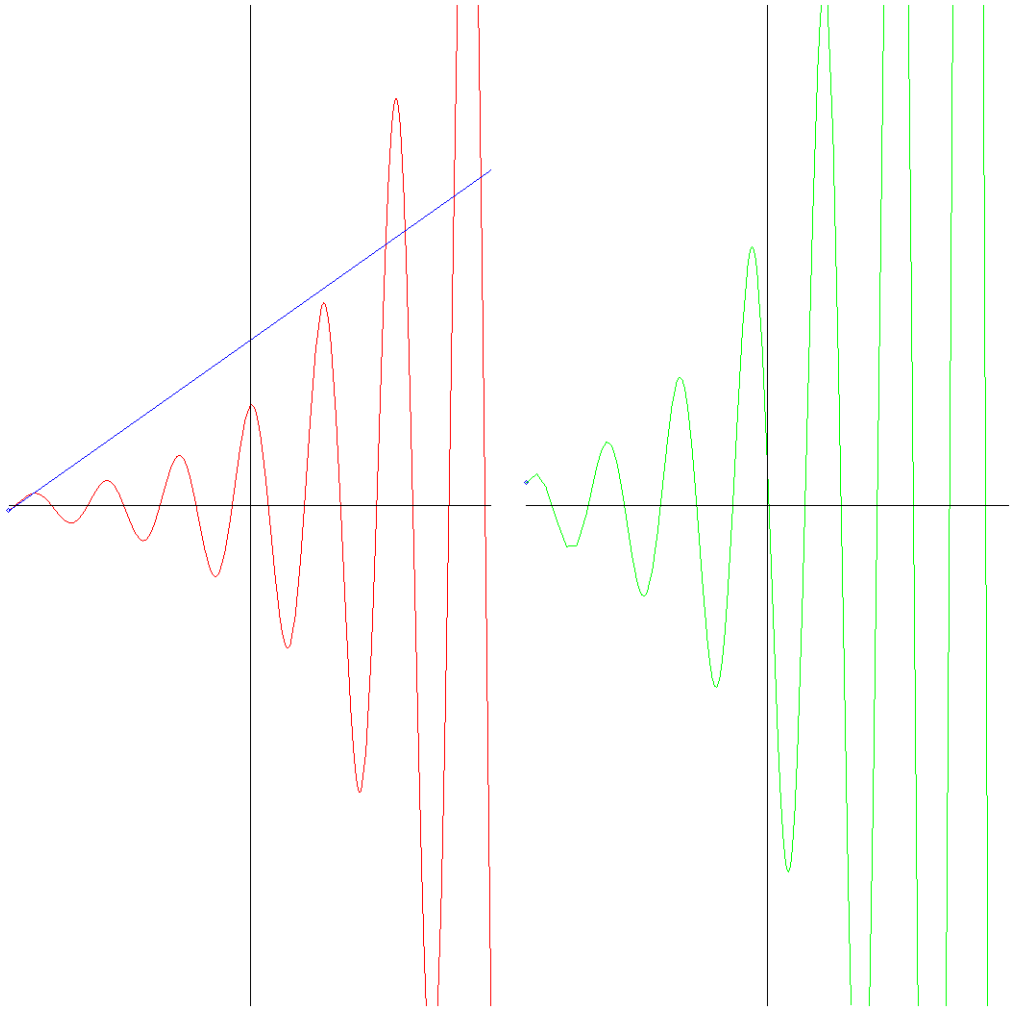

```
> H1 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black),#osa x vlevo
    line([8,0],[22,0], color = black),#osa x vpravo
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo

  point([t+15,(1/3)*(exp((t)/3)*cos(3*(t)))-3*exp((t)/3)*sin(3*(t)
  )], color = blue),
    point([t,exp(t/3)*cos(3*t)], color = blue),

  plot((1/3)*(exp(t/3)*cos(3*t))-3*exp(t/3)*sin(3*(t))*(x-t)+(2/3)
  *exp(t/3)*cos(3*t),x=-7..7, color=blue, view=-5..5),
    #nechapu, proc ty dve tretiny, ale funguje to, rekl bych, je
  to ta modra tecna
    plot(exp(x/3)*cos(3*x),x=-7..7, color=red, view=-5..5),

  plot((1/3)*(exp((x-15)/3)*cos(3*(x-15)))-3*exp((x-15)/3)*sin(3*(
  x-15)),x=8..22, color=green, view=-5..5));
  end:
```

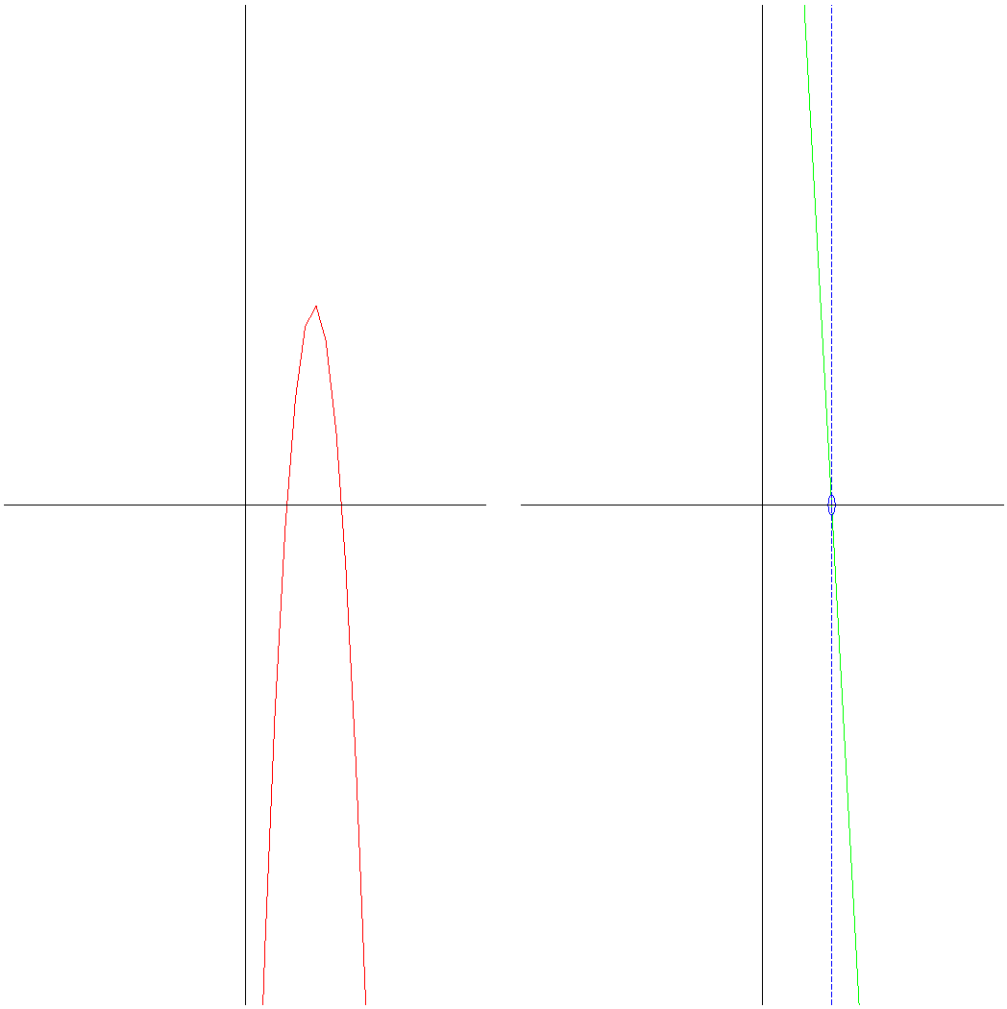
```
  animate(H1,[theta], theta=-7..7, axes=none, title = '_',
  frames=120);
> 
> 
```



```
> with(plottools):
> H2 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black),#osa x vlevo
    line([8,0],[22,0], color = black),#osa x vpravo
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo
    line([17,-5],[17,5],color=blue, linestyle=3),
    circle([17,0],.1,color=blue),#krouzek kolem mista extremu
    plot(piecewise(t<=0, t*(x-2)^2 + 2 , t>0,
  t*abs(x-2)+2),x=-7..7, color=red, view=-5..5),

  plot(piecewise(t<=0,t*(2*(x-16)-2),t>0,piecewise(x<17,-(t),x>17,
  t)),x=8..22,color=green,view=-5..5));
  end:
  animate(H2,[theta], theta=-Pi..Pi, axes=none, title='_',
```

```
frames=120);
```



Tolik ilustrace Fermatovy Vety, pekne, ne? Akorat to dela svislou zelenou caru, nepodarilo se mi to vypnout. Ale takhle to neni moc videt :-]

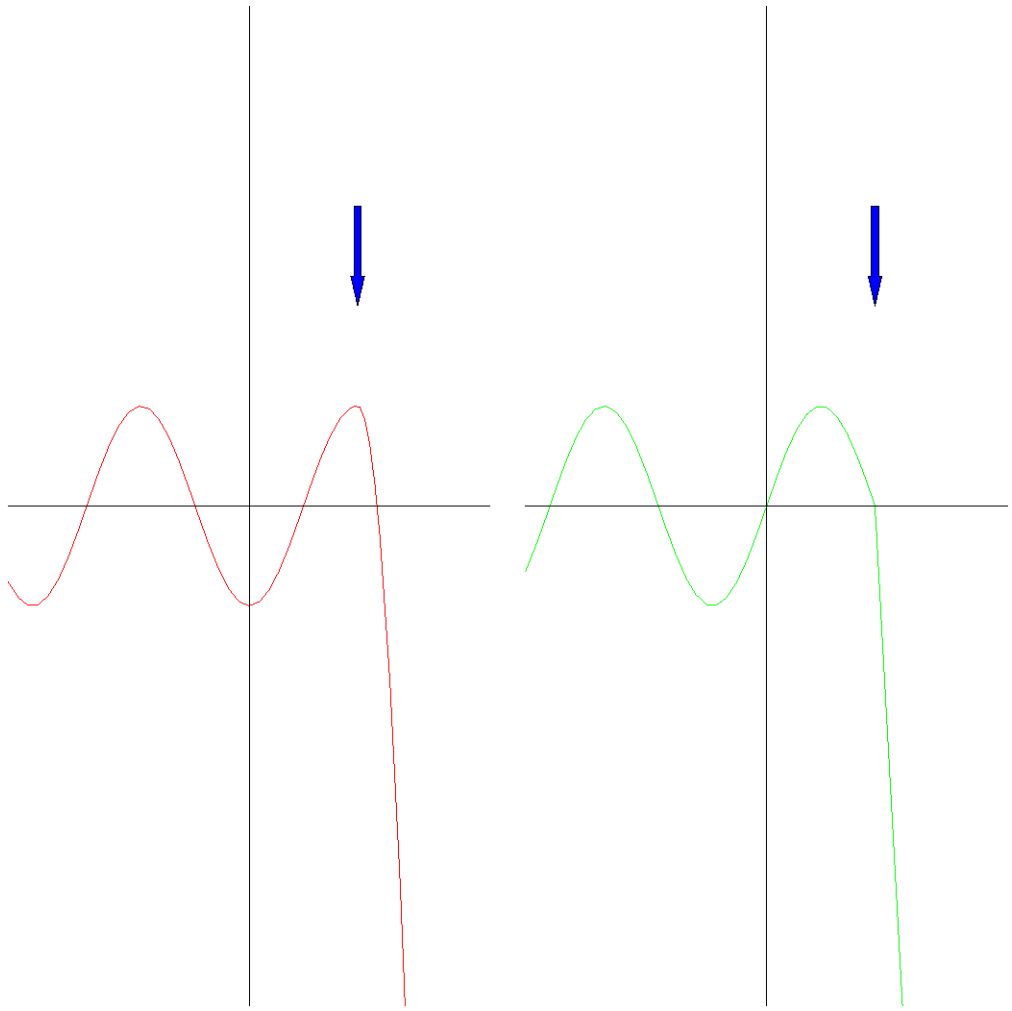
```
>
> H3 := proc(t)
  plots[display](
       line([-7,0],[7,0], color = black),#osa x vlevo
       line([8,0],[22,0], color = black),#osa x vpravo
       line([0,-5],[0,5], color = black),#osa y vlevo
       line([15,-5],[15,5], color = black),#osa y vpravo
       arrow([Pi,3],[Pi,2],.2,.4,.3, color = blue),#sipka vlevo

       arrow([15+Pi,3],[15+Pi,2],.2,.4,.3, color = blue),#sipka
  vpravo
       plot(piecewise(x<=Pi+15,sin(x-15), x > Pi+15
  ,t*(2*(x-15)-2*Pi)),x=8..22, color=green, view=-5..5),
       plot(piecewise(x<Pi, -cos(x), x >= Pi ,t*(x-Pi)^2 +
  1),x=-7..7, color=red, view=-5..5));
  end:
  animate(H3,[theta], theta=-Pi..Pi, axes=none, title='_',
```

```
  frames=120);
```

Takhle se mi to libi, myslim, ze to je docela nazorne.

```
>
```

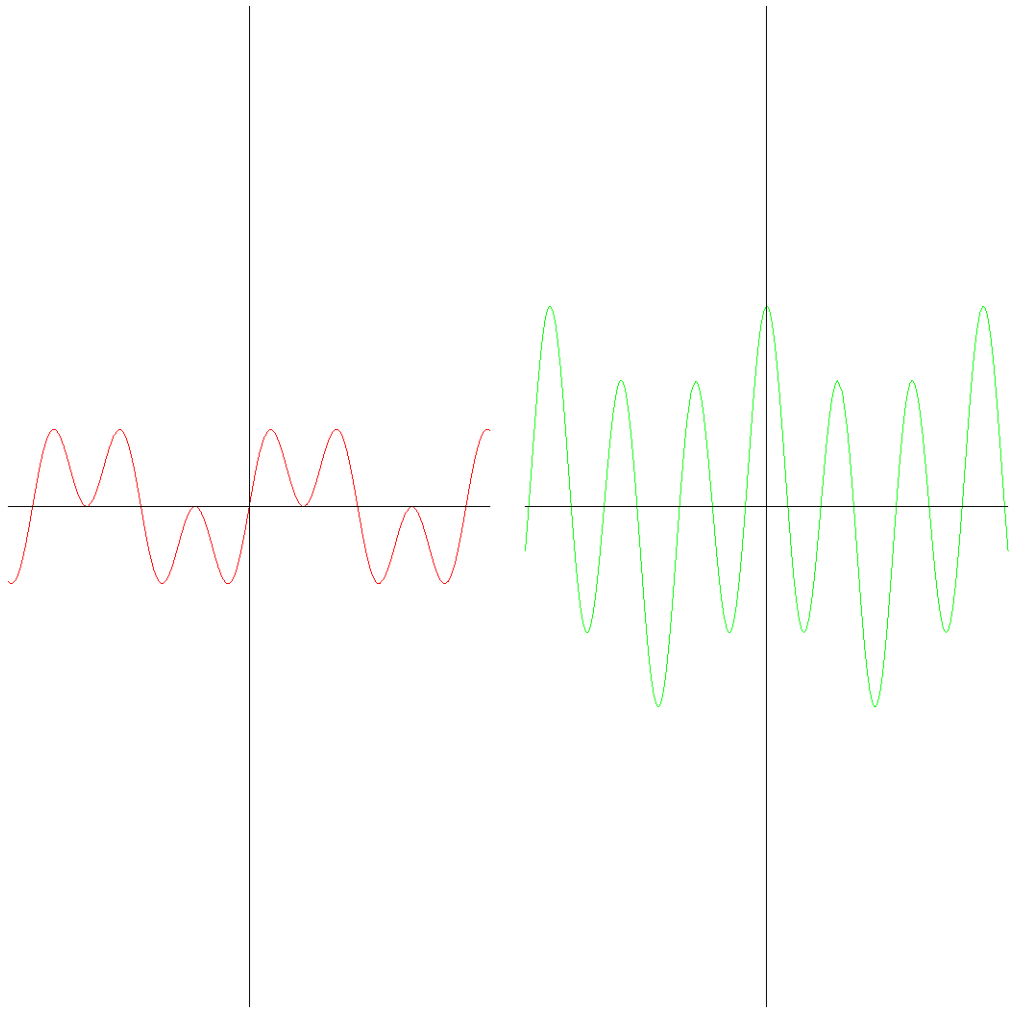


```
> with(plottools);
> H4 := proc(t)
  plots[display](
       line([-7,0],[7,0], color = black),#osa x vlevo
       line([8,0],[22,0], color = black),#osa x vpravo
       line([0,-5],[0,5], color = black),#osa y vlevo
       line([15,-5],[15,5], color = black),#osa y vpravo
       plot(sin(2*x)*cos(x) + 3*sin(t)*cos(2*t),x=-7..7,
  color=red, view=-5..5),

  plot(cos(2*(x-15))*2*cos(x-15)-sin(2*(x-15))*sin(x-15),x=8..22,c
  olor=green, view=-5..5));
  end:
  animate(H4,[theta], theta=-Pi..Pi, axes=none, title='_',
  frames=150);
```

[*arc, arrow, circle, cone, cuboid, curve, cutin, cutout, cylinder, disk, dodecahedron, ellipse,*

ellipticArc, hemisphere, hexahedron, homothety, hyperbola, icosahedron, line, octahedron, parallelepiped, pieslice, point, polygon, project, rectangle, reflect, rotate, scale, semitorus, sphere, stellate, tetrahedron, torus, transform, translate]



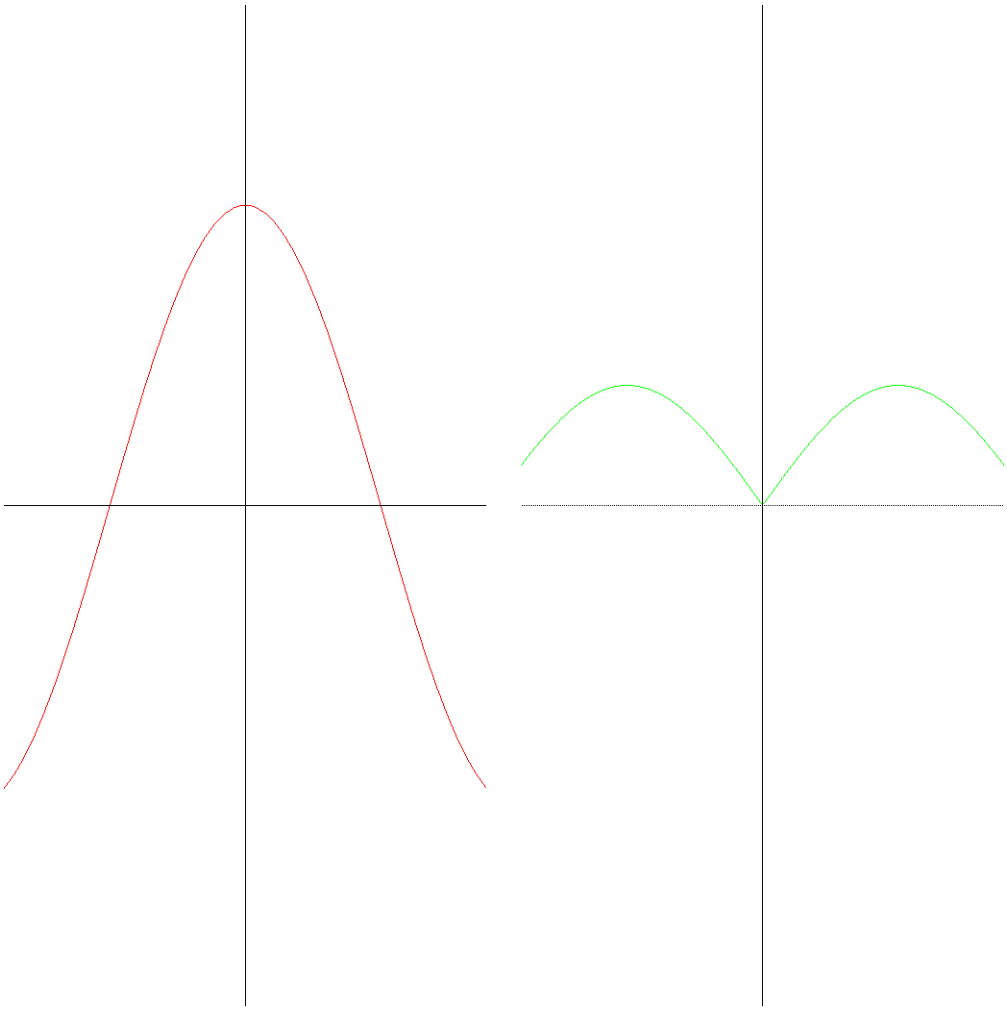
Vidime, ze posun ve smeru osy y nic nemeni na derivaci.

```
> with(plottools):
> H5 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black),#osa x vlevo
    line([8,0],[22,0], color = black, linestyle=2),#osa x vpravo,
  tentokrat pro prehlednost teckovane
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo

  plot(piecewise(x<-3*sin(t),3*cos(.4*(x+3*sin(t))),x>3*sin(t),3*c
  os(.4*(x-3*sin(t))), 3),x=-7..7, color=red, view=-5..5),
  # musi mitstejne parametru, jinak se zobrazi jen jeden

  plot(piecewise(x<15-3*sin(t),-1.2*sin(.4*(x-15+3*sin(t))),x>15+3
  *sin(t),1.2*sin(.4*(x-15-3*sin(t))),0),
  x=8..22,color=green,view=-5..5));
```

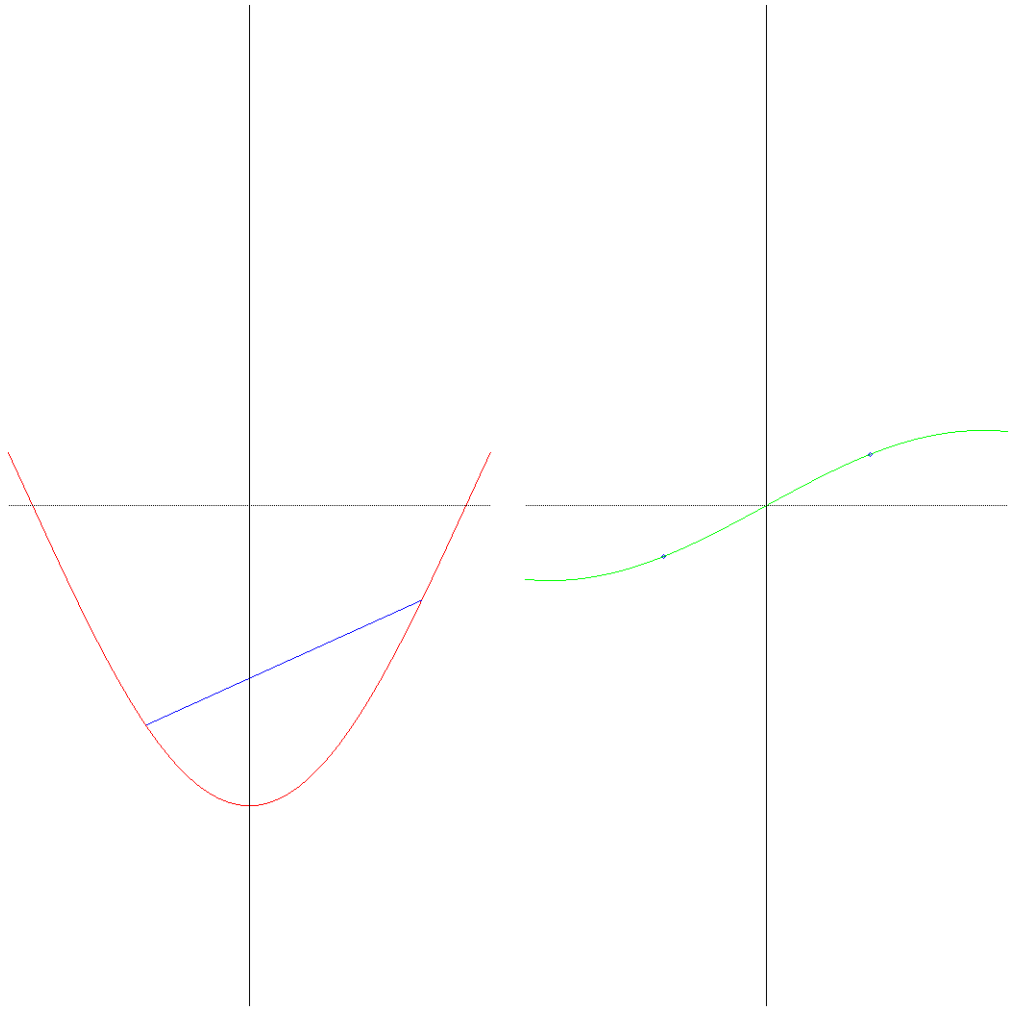
```
  end:
  animate(H5,[theta], theta=0..Pi, axes=none, title='_');
>
```



Tedy pokud ma funkce na nejakem intervalu nulovou derivaci, je na nem konstantni. Pokud je kladna derivace, funkce stoupa, pokud je zaporna, derivace klesa. Dalo to zabrat.

```
> H6 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black, linestyle=2),#osa x vlevo
    line([8,0],[22,0], color = black, linestyle=2),#osa x vpravo,
  tentokrat pro prehlednost teckovane
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo
    line([-3,-3*cos(t)*cos(-3/4)],[5,-3*cos(t)*cos(5/4)], color =
  blue),
    point([12,3*cos(t)/4*sin(-3/4)], color = blue),
    point([18,3*cos(t)/4*sin(3/4)], color = blue),
    plot(-3*cos(t)*cos(x/4),x=-7..7, color=red, view=-5..5),
  # musi mit stejne parametru, jinak se zobrazi jen jeden
```

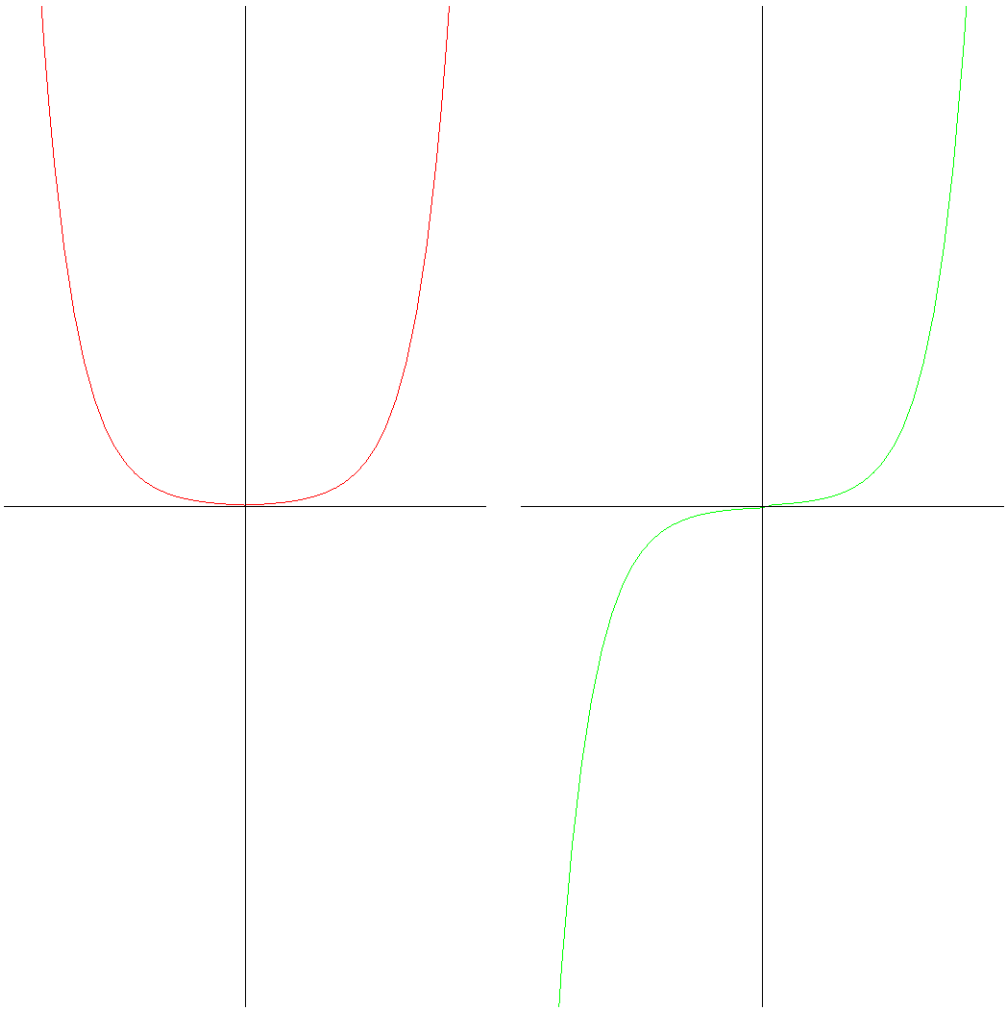
```
  plot((3*cos(t)/4)*sin((x-15)/4),
x=8..22,color=green,view=-5..5));
end:
animate(H6,[theta], theta=0..2*Pi, axes=none, title='_',
frames=76);
```



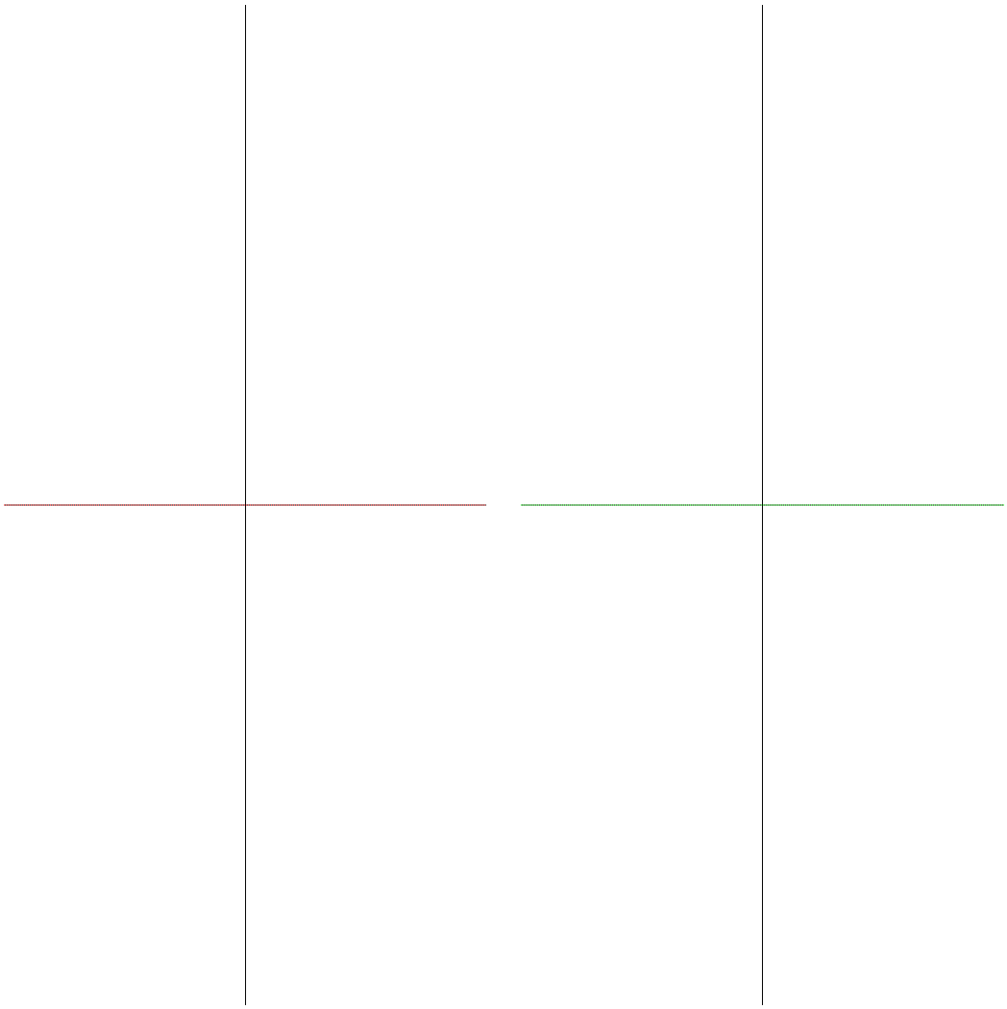
```
> H7 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black),#osa x vlevo
    line([8,0],[22,0], color = black),#osa x vpravo
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo
    plot(exp(abs(x))*cos(4*x*sin(t))/74,x=-7..7, color=red,
  view=-5..5),
  # musi mit stejne parametru, jinak se zobrazi jen jeden

  plot(1/74*abs(1,x-15)*exp(abs(x-15))*cos(4*(x-15)*sin(t))-2/37*e
  xp(abs(x-15))*sin(4*(x-15)*sin(t))*sin(t),
  x=8..22,color=green,view=-5..5));
  end:
  animate(H7,[theta], theta=0..Pi, axes=none, title='_',
```

```
  frames=120);
>
```



```
> H8 := proc(t)
  plots[display](
    line([-7,0],[7,0], color = black, linestyle = 2),#osa x vlevo
    line([8,0],[22,0], color = black, linestyle = 2),#osa x
  vpravo
    line([0,-5],[0,5], color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo
    plot(sin(t)*sinh(x),x=-7..7, color=red, view=-5..5),
  # musi mit stejne parametru, jinak se zobrazi jen jeden
    plot(sin(t)*cosh(x-15), x=8..22,color=green,view=-5..5));
  end:
  animate(H8,[theta], theta=0..2*Pi, axes=none, title='_',
  frames=132);
```



```
> prusecik := 4*arctan(x)=Pi+(x-1)*t;
```

$$prusecik := 4\arctan(x) = \pi + (x-1)\,t$$

```
> solve(prusecik,x);
```

$$\frac{4\,\mathrm{RootOf}(-\tan(\_Z)\,t + 4\,\_Z - \pi + t) - \pi + t}{t}$$

```
> evalf(%);
```

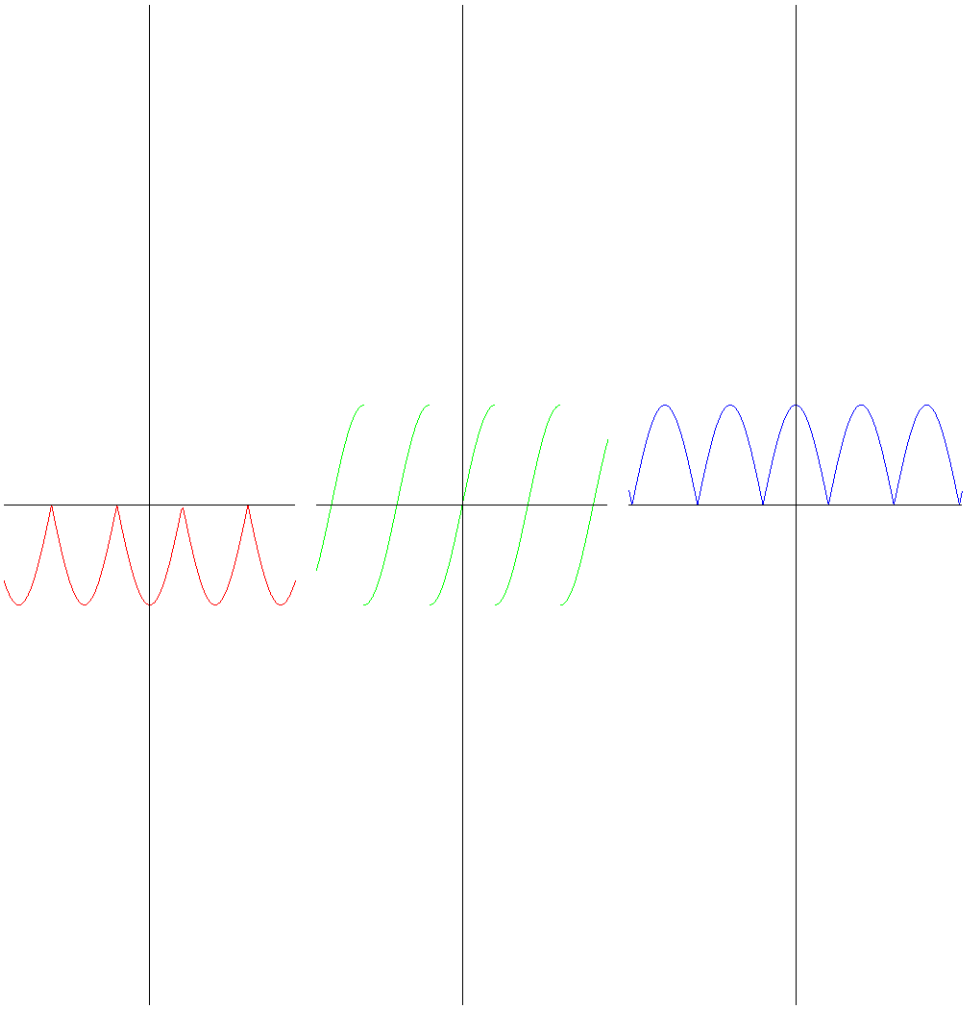
$$\frac{4.\,\mathrm{RootOf}(-\tan(\_Z)\,t + 4\,\_Z - \pi + t) - 3.141592654 + t}{t}$$

Myslel jsem, ze to budou dva body a budou se priblizovat. V nulte animaci.

```
> H9 := proc(t)
  plots[display](
    line([-7,0], [7,0],  color = black),#osa x vlevo
    line([8,0],  [22,0], color = black),#osa x vpravo
    line([0,-5], [0,5],  color = black),#osa y vlevo
    line([15,-5],[15,5], color = black),#osa y vpravo
    line([23,0], [39,0], color = black),
    line([31,-5],[31,5], color = black),
    plot(sin(t)*sin(x)-abs(cos(x)), x=-7..7, color = red, view=
  -5..5, discont=true),
```

```
  plot(sin(t)*cos(x-15)+abs(1,cos(x-15))*sin(x-15),x=8..22,
color = green, view=-5..5, discont=true),

plot(-sin(t)*sin(x-31)+signum(1,cos(x-31))*sin(x-31)+abs(1,cos(x
-31))*cos(x-31),x=23..39, color = blue, view=-5..5,
discont=true),
  plot(sin(x),x=40..41, color = white, view=-5..5,
discont=true));#jinak se nezobrazil graf druhe derivace
end:
animate(H9,[theta], theta=0..2*Pi,axes=none, title='_',
frames=50);
```



```
>
>
>
```