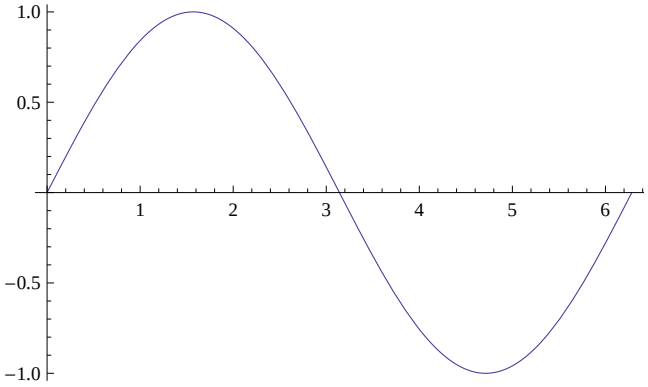
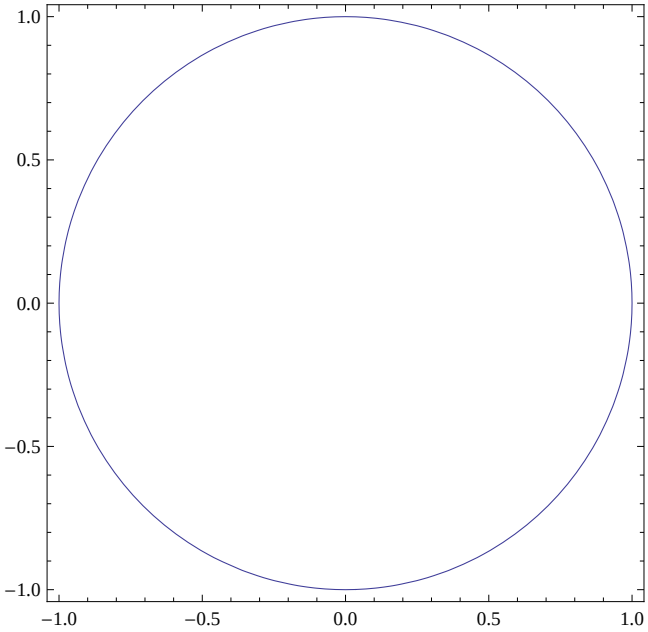
Krivulje v ravnini

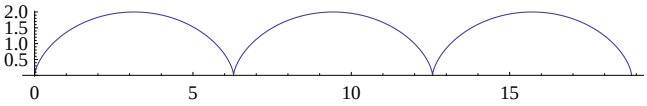
Za risanje ***ravninskih*** krivulj so naslednji ukazi:

Krivuljo podano v ***eksplicitni*** obliki narisemo z ukazom **Plot**.
Krivuljo podano v ***implicitni*** obliki narisemo z ukazom **ContourPlot**.
Krivuljo podano v ***parametri■ni*** obliki narisemo z ukazom **ParametricPlot**.

```
(* Primeri *)
Plot[Sin[x], {x, 0, 2 Pi}]
ContourPlot[x^2 + y^2 == 1, {x, -1, 1}, {y, -1, 1}]
ParametricPlot[{t - Sin[t], 1 - Cos[t]}, {t, 0, 6 Pi}]
```







```
? Plot
? ContourPlot
? ParametricPlot
```

Plot[f, {x, x_{min}, x_{max}}] generates a plot of f as a function of x from x_{min} to x_{max}.
Plot[{f_1, f_2, ...}, {x, x_{min}, x_{max}}] plots several functions f_i. ≫

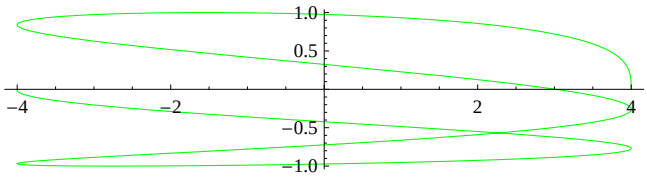
ContourPlot[f, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}] generates a contour plot of f as a function of x and y.
ContourPlot[$f == g$, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}] plots contour lines for which $f = g$.
ContourPlot[{$f_1 == g_1$, $f_2 == g_2$, ...}, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}] plots several contour lines. ≫

ParametricPlot[{f_x, f_y}, {u, u_{min}, u_{max}}] generates
a parametric plot of a curve with x and y coordinates f_x and f_y as a function of u.
ParametricPlot[{{f_x, f_y}, {g_x, g_y}, ...}, {u, u_{min}, u_{max}}] plots several parametric curves.
ParametricPlot[{f_x, f_y}, {u, u_{min}, u_{max}}, {v, v_{min}, v_{max}}] plots a parametric region.
ParametricPlot[{{f_x, f_y}, {g_x, g_y}, ...}, {u, u_{min}, u_{max}}, {v, v_{min}, v_{max}}] plots several parametric regions. ≫

Slika v Mathematici je objekt, ki ga lahko poimenujemo. Obliko krivulje (barva, debelina ...) opisemo z opcijo **PlotStyle**.

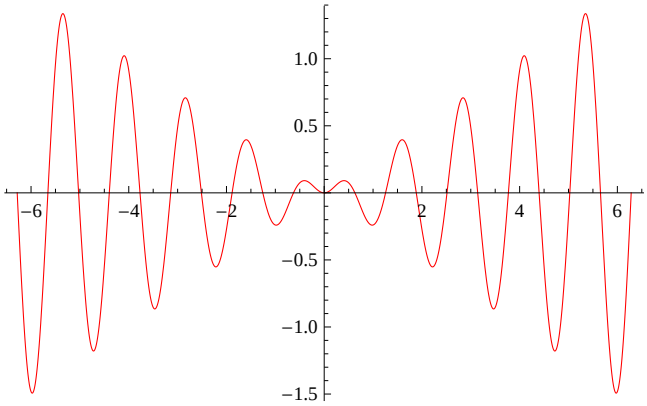
1.a) Narisi krivuljo, dano v parametri■ni obliki $x(t) = 4\cos\left(t^{1.5}\right)$, $y(t) = \sin(t)$. Krivulja naj bo zelene barve. Slika naj ima ime **slika1**.

```
Slika1 = ParametricPlot[{4 Cos[t^1.5], Sin[t]}, {t, 0, 2 Pi}, PlotStyle → {Green}]
```



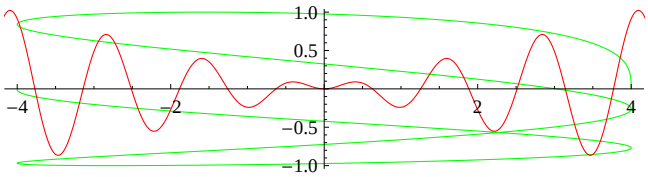
1.b) Narisi krivuljo $y(x) = x / 4\sin(5x)$. Krivulja naj bo rde■e barve. Slika naj ima ime **slika2**.

```
Slika2 = Plot[x / 4 Sin[5 x], {x, -2 Pi, 2 Pi}, PlotStyle → {Red}]
```



1.c) S pomo■jo ukaza **Show** narisi obe krivulji na isti sliki.

```
Show[Slika1, Slika2]
```



1.d) Epicikloida je krivulja, ki jo opise to■ka kroznice, ki se kotali po drugi kroznici zunaj nje.

Njena parametri■na ena■ba je

$x=(R+r)\cos\varphi-r\cos(\frac{R+r}{r}\varphi)$, $y=(R+r)\sin\varphi-r\sin(\frac{R+r}{r}\varphi)$

kjer so R=polmer mirujo■e kro"znice, r=polmer kotale■e kroznice in φ=polarni kot.

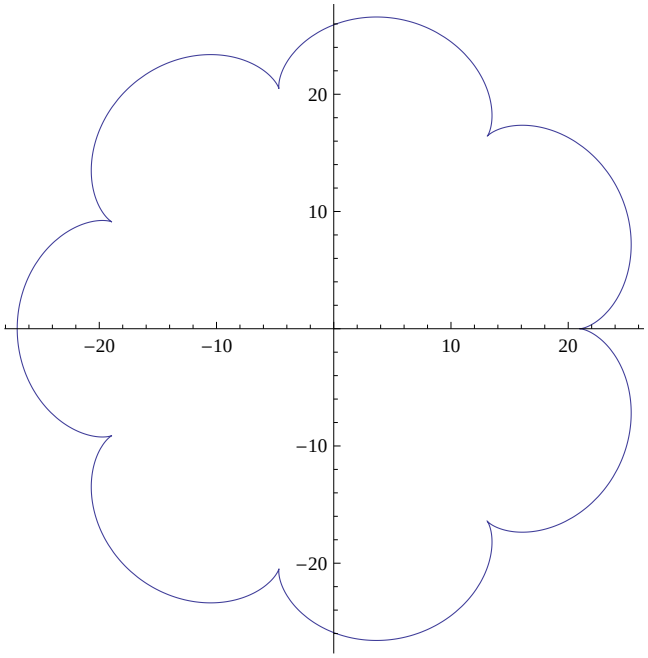
Narisi epicikloido s pomo■jo ukaza **ParametricPlot**! Razmerje polmerov R/r naj bo celo stevilo.

Merilo v koordinatah x in y se uravnava z opcijo **AspectRatio** (glej "Help").

```
R = 21
r = 3
ParametricPlot[
 {(R + r) Cos[ϕ] - r * Cos[(R + r) / r * ϕ], (R + r) Sin[ϕ] - r * Sin[(R + r) / r * ϕ]}, {ϕ, 0, 2 Pi}]
```

```
21
```

```
3
```



Krivulje v prostoru in Ploskve

Za risanje ***tri-dimezionalnih*** objektov uporabljamo ukaza **Plot3D** in **Parametric-Plot3D**.

```
? Plot3D
? ParametricPlot3D
```

Plot3D[f, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}] generates a three−dimensional plot of f as a function of x and y.
Plot3D[{f_1, f_2, ...}, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}] plots several functions. ≫

ParametricPlot3D[{f_x, f_y, f_z}, {u, u_{min}, u_{max}}] produces a
three−dimensional space curve parametrized by a variable u which runs from u_{min} to u_{max}.
ParametricPlot3D[{f_x, f_y, f_z}, {u, u_{min}, u_{max}}, {v, v_{min}, v_{max}}] produces a three−dimensional surface parametrized by u and v.
ParametricPlot3D[{{f_x, f_y, f_z}, {g_x, g_y, g_z} ...} ...] plots several objects together. ≫

3. Narisi krivuljo (t cos t, t sin t, t)
s pomočjo ukaza **ParametricPlot3D** z zeleno barvo.

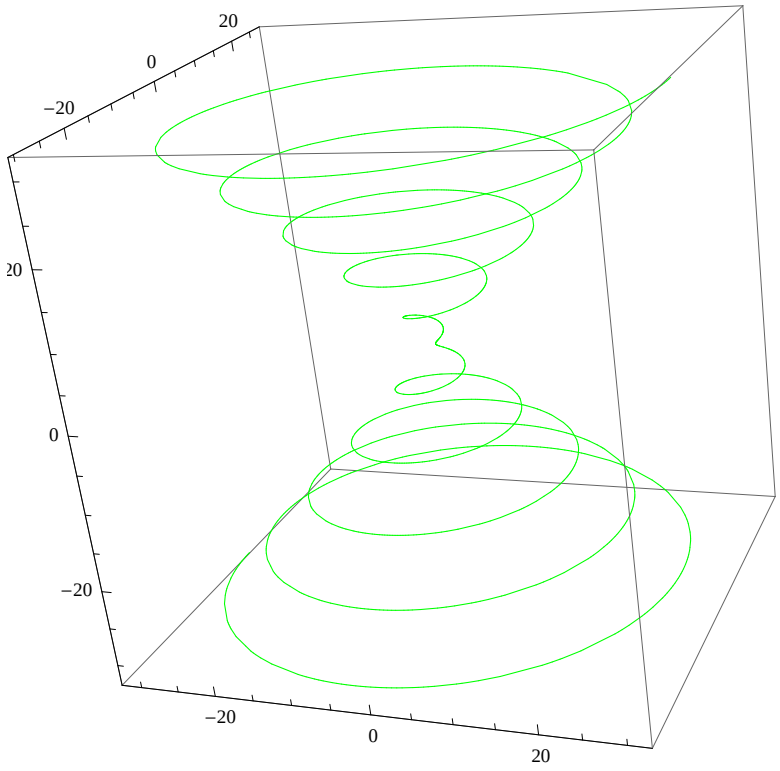
Izračunaj enačbo tangente na to krivuljo v točki $\left(\frac{\pi\sqrt{2}}{8}, \frac{\pi\sqrt{2}}{8}, \frac{\pi}{4}\right)$.

Tangento tudi narisi z modro barvo in
prikaži oba objekta v isti sliki.

Rezultat (enačba tangente): $\left\{\frac{\pi}{4\sqrt{2}} + \left(\frac{1}{\sqrt{2}} - \frac{\pi}{4\sqrt{2}}\right) t, \frac{\pi}{4\sqrt{2}} + \left(\frac{1}{\sqrt{2}} + \frac{\pi}{4\sqrt{2}}\right) t, \frac{\pi}{4} + t\right\}$

```
Clear[er, R, t]
er[t_] = {t Cos[t], t Sin[t], t}
slikaS = ParametricPlot3D[{t Cos[t], t Sin[t], t},
  {t, -10 Pi, 10 Pi}, PlotStyle → {Green}]
Clear[t]
erpika[t_] = D[er[t], t]
tangenta = er[Pi / 4] + t erpika[Pi / 4]
```

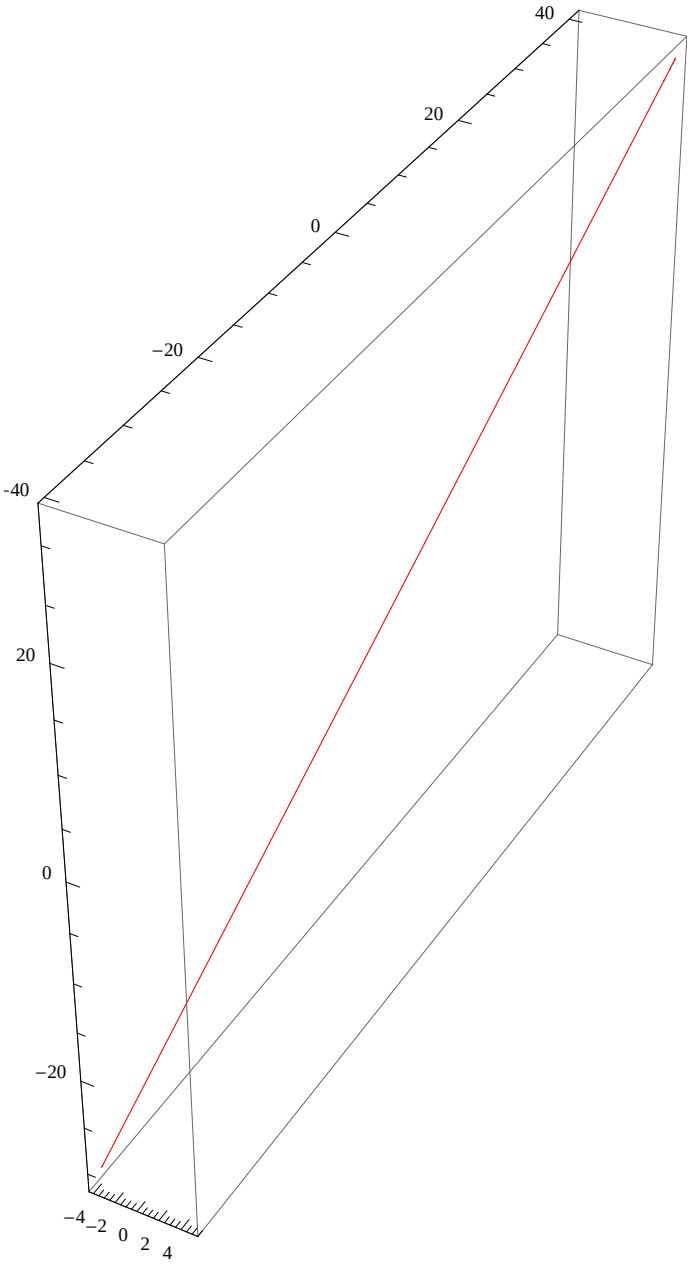
```
{t Cos[t], t Sin[t], t}
```




```
{Cos[t] - t Sin[t], t Cos[t] + Sin[t], 1}
```

$$\left\{\frac{\pi}{4\sqrt{2}} + \left(\frac{1}{\sqrt{2}} - \frac{\pi}{4\sqrt{2}}\right) t,\ \frac{\pi}{4\sqrt{2}} + \left(\frac{1}{\sqrt{2}} + \frac{\pi}{4\sqrt{2}}\right) t,\ \frac{\pi}{4} + t\right\}$$

```
slikaT = ParametricPlot3D[tangenta, {t, -10 Pi, 10 Pi}, PlotStyle → {Red}]
```




```
Show[slikaS, slikaT]
```

Show::gcomb : Could not combine the graphics objects in Show[slikaS, slikaT]. ≫

```
Show[slikaS, slikaT]
```

4. Izra■unaj dolzino krivulje iz 3. naloge od to■ke t=0 do to■ke 7Pi/11.

Rezultat: 3.59373

```
? NIntegrate
```

NIntegrate[f, {x, x_{min}, x_{max}}] gives a numerical approximation to the integral $\int_{x_{min}}^{x_{max}} f\, dx$.

NIntegrate[f, {x, x_{min}, x_{max}}, {y, y_{min}, y_{max}}, ...]

gives a numerical approximation to the multiple integral $\int_{x_{min}}^{x_{max}} dx \int_{y_{min}}^{y_{max}} dy \ldots f$. ≫

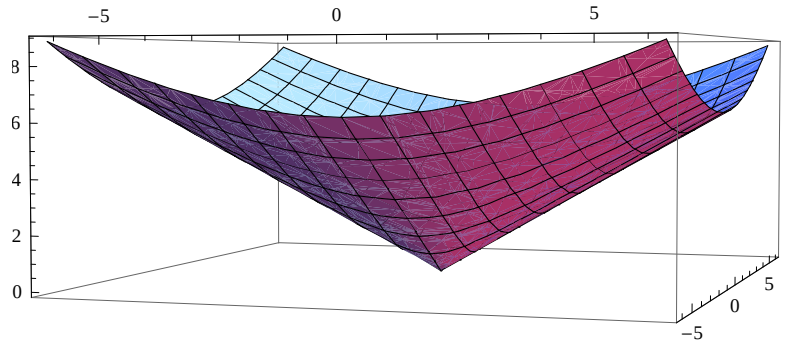
```
r[t_] = {t Cos[t], t Sin[t], t}
dolzina = NIntegrate[Sqrt[erpika[t].erpika[t]], {t, 0, 7 Pi / 11}]
```

```
{t Cos[t], t Sin[t], t}
```

```
3.59373
```

5. a) Narisi stozec $z(x, y) = (x^2 + y^2)^{1/2}$ s pomočjo ukaza **Plot3D**.

```
Plot3D[Sqrt[x^2 + y^2], {x, -2 Pi, 2 Pi}, {y, -2 Pi, 2 Pi}]
```



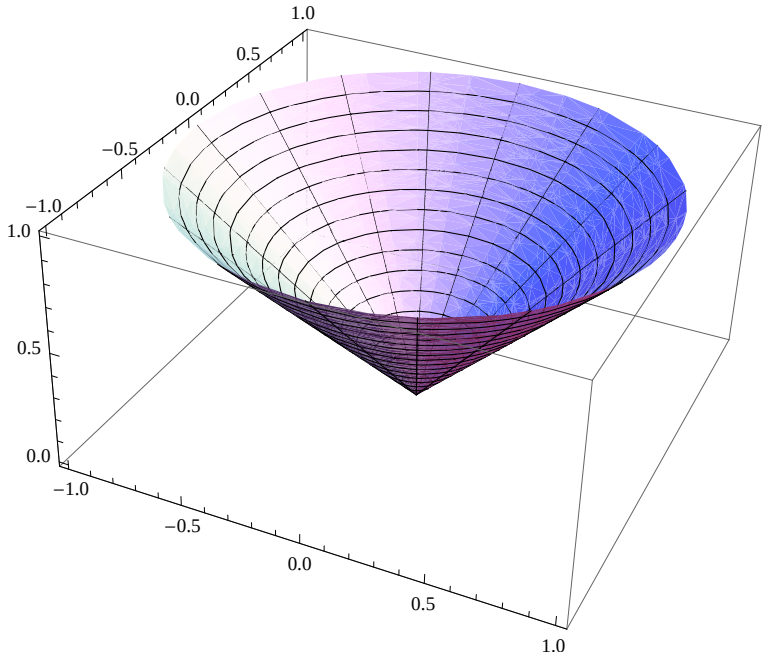
5. b) Lepsa slika stozca nastane z ukazom **ParametricPlot3D**,
če izberemo za parametra polarne koordinate.
Kako je potrebno spremeniti enačbo, da bo stozec bolj zaprt (odprt)?

```
Clear[x, y, z, r]
x = r Cos[ϕ]
y = r Sin[ϕ]
z = r
ParametricPlot3D[{x, y, z}, {ϕ, 0, 2 Pi}, {r, 0, 1}]
```

```
r Cos[ϕ]
```

```
r Sin[ϕ]
```

```
r
```



6. NariSi valj x^2+y^2=1,-3<z<3 z ukazom **ParametricPlot3D.**

```
Clear[x, y, z, r]
x = Cos[ϕ]
y = Sin[ϕ]
z = r
ParametricPlot3D[{x, y, z}, {ϕ, 0, 2 Pi}, {r, 0, 1}]
```

```
Cos[ϕ]
```

```
Sin[ϕ]
```

```
r
```