1. $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos t & -\sin t \\ 0 & \sin t & \cos t \end{pmatrix}$ et si $(x1, y1, z1)$ est le transformé de (x, y, z), alors $x1^2 = x^2$ et $y1^2+z1^2 = y^2+z^2$ donc la surface est invariante par toutes ces rotations ie elle est de révolution d'axe Ox.
2. M annule $surf$ et n'est pas point critique donc $\overrightarrow{grad}_M(surf)$ est un vecteur normal en M.
3. C a l'aspect attendu d'une méridienne de S.

O18-C042

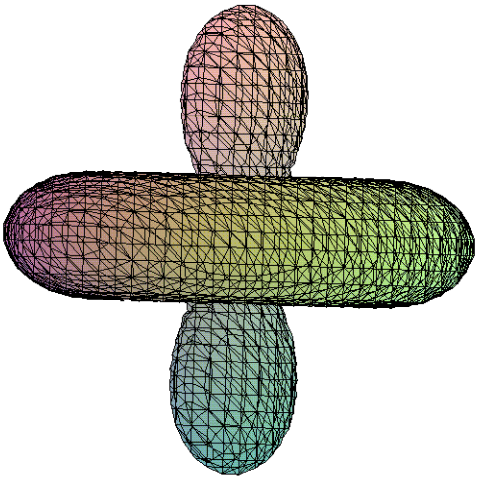
```
> restart;
> with(plots);
```

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *conformal3d*, *contourplot*, *contourplot3d*, *coordplot*, *coordplot3d*, *densityplot*, *display*, *dualaxisplot*, *fieldplot*, *fieldplot3d*, *gradplot*, *gradplot3d*, *graphplot3d*, *implicitplot*, *implicitplot3d*, *inequal*, *interactive*, *interactiveparams*, *intersectplot*, *listcontplot*, *listcontplot3d*, *listdensityplot*, *listplot*, *listplot3d*, *loglogplot*, *logplot*, *matrixplot*, *multiple*, *odeplot*, *pareto*, *plotcompare*, *pointplot*, *pointplot3d*, *polarplot*, *polygonplot*, *polygonplot3d*, *polyhedra_supported*, *polyhedraplot*, *rootlocus*, *semilogplot*, *setcolors*, *setoptions*, *setoptions3d*, *spacecurve*, *sparsematrixplot*, *surfdata*, *textplot*, *textplot3d*, *tubeplot*]

```
> surf:=(x^2+y^2+z^2)^3-(x^2-y^2-z^2)^2;
```

$$surf := (x^2+y^2+z^2)^3 - (x^2-y^2-z^2)^2$$

```
> implicitplot3d(surf, x=-1..1, y=-1..1, z=-1..1, grid=[30,30,30]);
```



```
> with(VectorCalculus):
>
> g1:=Gradient( surf, [x,y,z] );gg1:=op(2,g1);
```

$$g1 := (6\,(x^2+y^2+z^2)^2\,x - 4\,(x^2-y^2-z^2)\,x)\,\bar{e}_x + (6\,(x^2+y^2+z^2)^2\,y + 4\,(x^2-y^2-z^2)\,y)\,\bar{e}_y + (6\,(x^2+y^2+z^2)^2\,z + 4\,(x^2-y^2-z^2)\,z)\,\bar{e}_z$$

$$gg1 := \{(1) = 6\,(x^2+y^2+z^2)^2\,x - 4\,(x^2-y^2-z^2)\,x,\ (2) = 6\,(x^2+y^2+z^2)^2\,y + 4\,(x^2-y^2-z^2)\,y,\ (3) = 6\,(x^2+y^2+z^2)^2\,z + 4\,(x^2-y^2-z^2)\,z\}$$

```
> gg1:=subs(x=1/4,y=sqrt(3)/8,z=3/8,g1);
```

$$gg1 := \frac{7}{32}\,\bar{e}_x - \frac{\sqrt{3}}{64}\,\bar{e}_y - \frac{3}{64}\,\bar{e}_z$$

```
> P:=simplify(14*(x-1/4)-sqrt(3)*(y-sqrt(3)/8)-3*(z-3/8));
```

$$P := 14\,x - 2 - \sqrt{3}\,y - 3\,z$$

```
> C:=subs(z=0,surf);
```

$$C := (x^2 + y^2)^3 - (x^2 - y^2)^2$$

```
> Cpolar:=simplify(subs([x=r*cos(t),y=r*sin(t)],C));
```

$$Cpolar := -r^4\,(4\cos(t)^4 - 4\cos(t)^2 + 1 - r^2)$$

```
> solve(Cpolar,r);
```

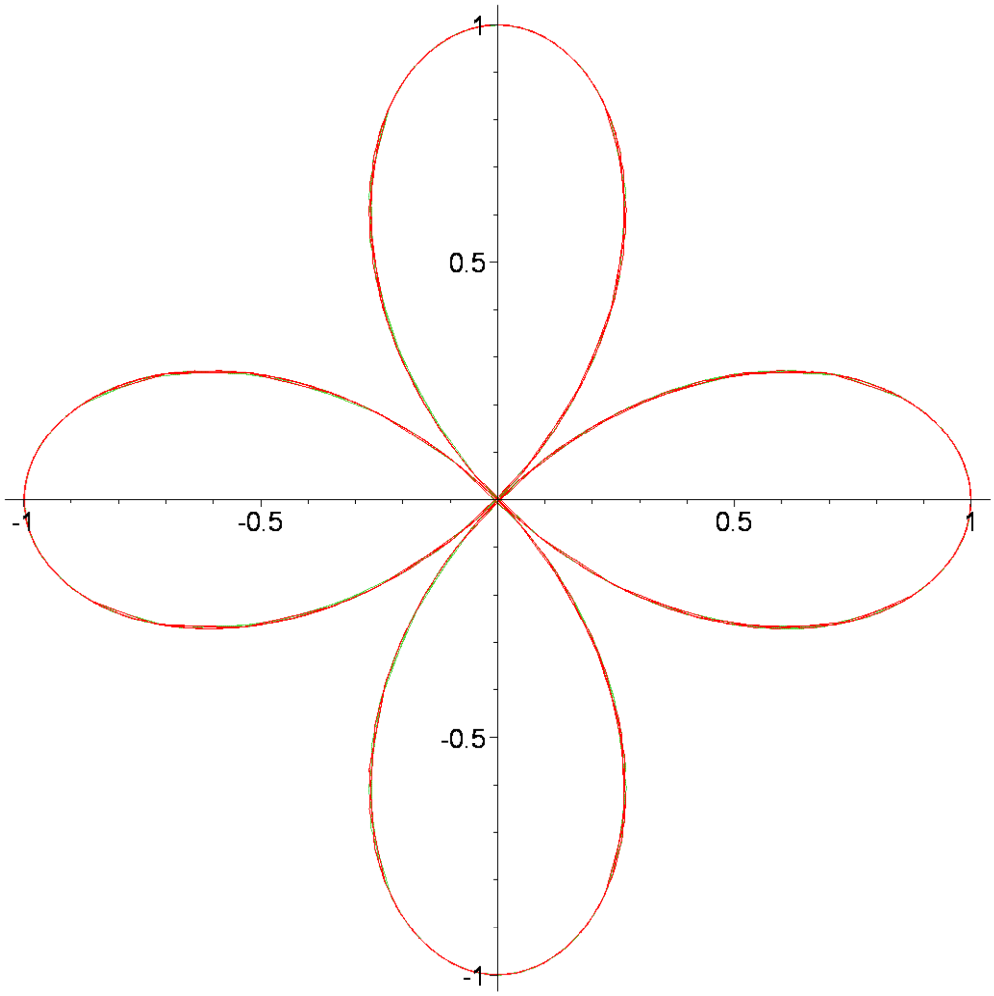
$$0, 0, 0, 0, 1 - 2\cos(t)^2, -1 + 2\cos(t)^2$$

```
> r1:=-1+2*cos(t)^2;r2:=-(-1+2*cos(t)^2);
```

$$r1 := -1 + 2\cos(t)^2$$

$$r2 := 1 - 2\cos(t)^2$$

```
> polarplot([r1,r2]);
```




```
>
```