Vi henter inn Maples plottekommandoer og vectorCalculus-kommandoer like godt først som sist:

> $with(plots)$

$[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra\_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot]$ **(1**

> $with(VectorCalculus)$

$[\&x, `*`, `+`, `-`, `.`, <,>, <|>, About, AddCoordinates, ArcLength, BasisFormat, Binormal, Compatibility, ConvertVector, CrossProduct, Curl, Curvature, \mathrm{D}, Del, DirectionalDiff, Divergence, DotProduct, Flux, GetCoordinateParameters, GetCoordinates, GetNames, GetPVDescription, GetRootPoint, GetSpace, Gradient, Hessian, IsPositionVector, IsRootedVector, IsVectorField, Jacobian, Laplacian, LineInt, MapToBasis, Nabla, Norm, Normalize, PathInt, PlotPositionVector, PlotVector, PositionVector, PrincipalNormal, RadiusOfCurvature, RootedVector, ScalarPotential, SetCoordinateParameters, SetCoordinates, SpaceCurve, SurfaceInt, TNBFrame, Tangent, TangentLine, TangentPlane, TangentVector, Torsion, Vector, VectorField, VectorPotential, VectorSpace, Wronskian, diff, eval, evalVF, int, limit, series]$ **(2**

Ekstraoppgave 10.7.1

a)

> $P1 := implicitplot\left(4 - x^2 - y^2 = 2, x = -2 ..2, y = -2 ..2, color = red\right)$

$$P1 := PLOT(\ldots)$$ **(3**

> $P2 := implicitplot\left(4 - x^2 - y^2 = 1, x = -2 ..2, y = -2 ..2, color = \mathrm{blue}\right)$

$$P2 := PLOT(\ldots)$$ **(4**

> $P3 := implicitplot\left(4 - x^2 - y^2 = 3, x = -3 ..3, y = -2 ..2, color = magenta\right)$

(5

$$P3 := PLOT(\ldots) \tag{5}$$

> $G := Gradient\left(4 - x^2 - y^2, [x, y]\right)$

$$G := -2\, x\bar{e}_x - 2\, y\bar{e}_y \tag{6}$$

> $\mathrm{Gs} := subs(\{\mathrm{x} = 1, \mathrm{y} = 1\}, \mathrm{G})$

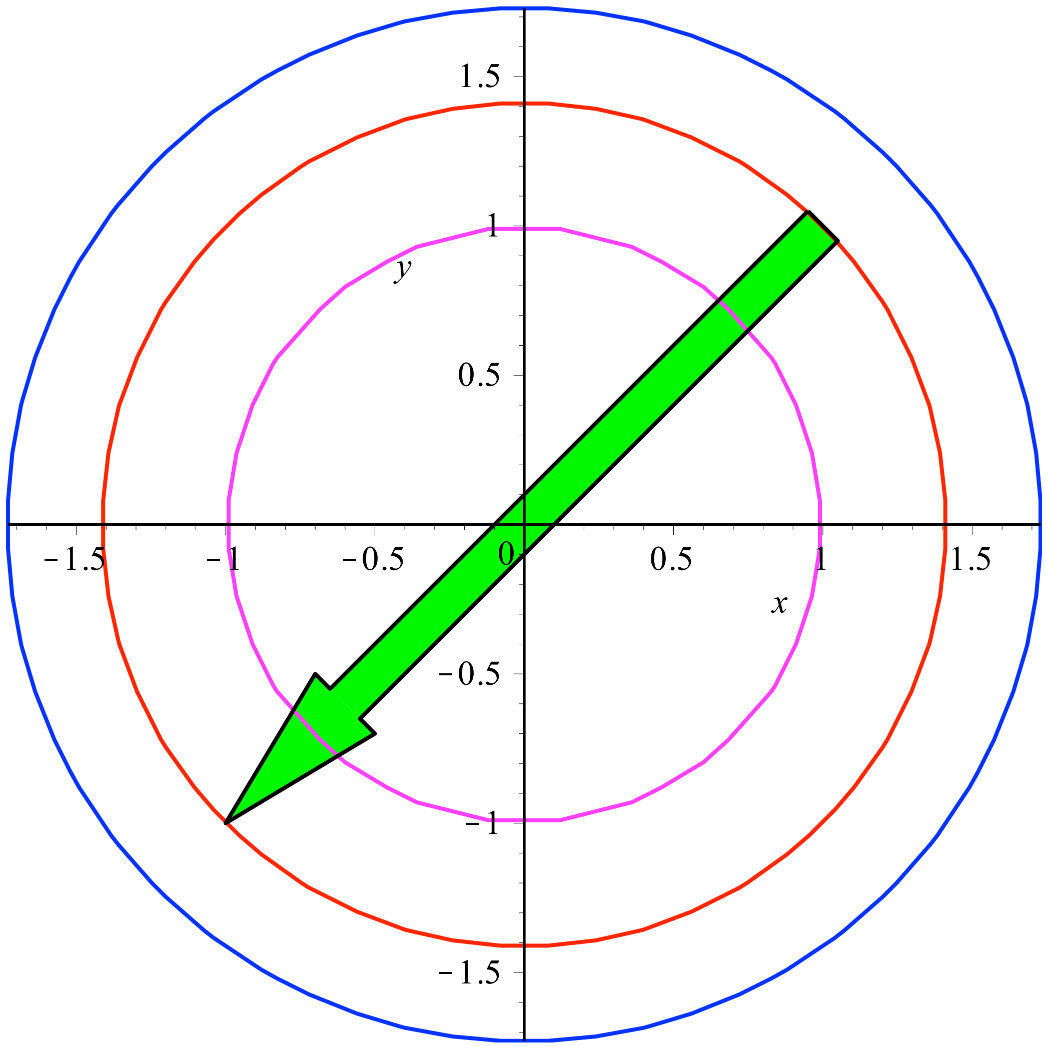
$$Gs := -2\bar{e}_x - 2\bar{e}_y \tag{7}$$

Kommandoen for å plotte en pil, er *arrow*. Vi skriver først startpunktet for pilen som en vektor (her $\langle 1, 1\rangle$).
Deretter kommer selv pil-vektoren (her Gs)

> $Q := arrow(\langle 1, 1\rangle, Gs, color = \mathrm{green})$

$$Q := PLOT(\ldots) \tag{8}$$

> $display(P1, P2, P3, Q)$

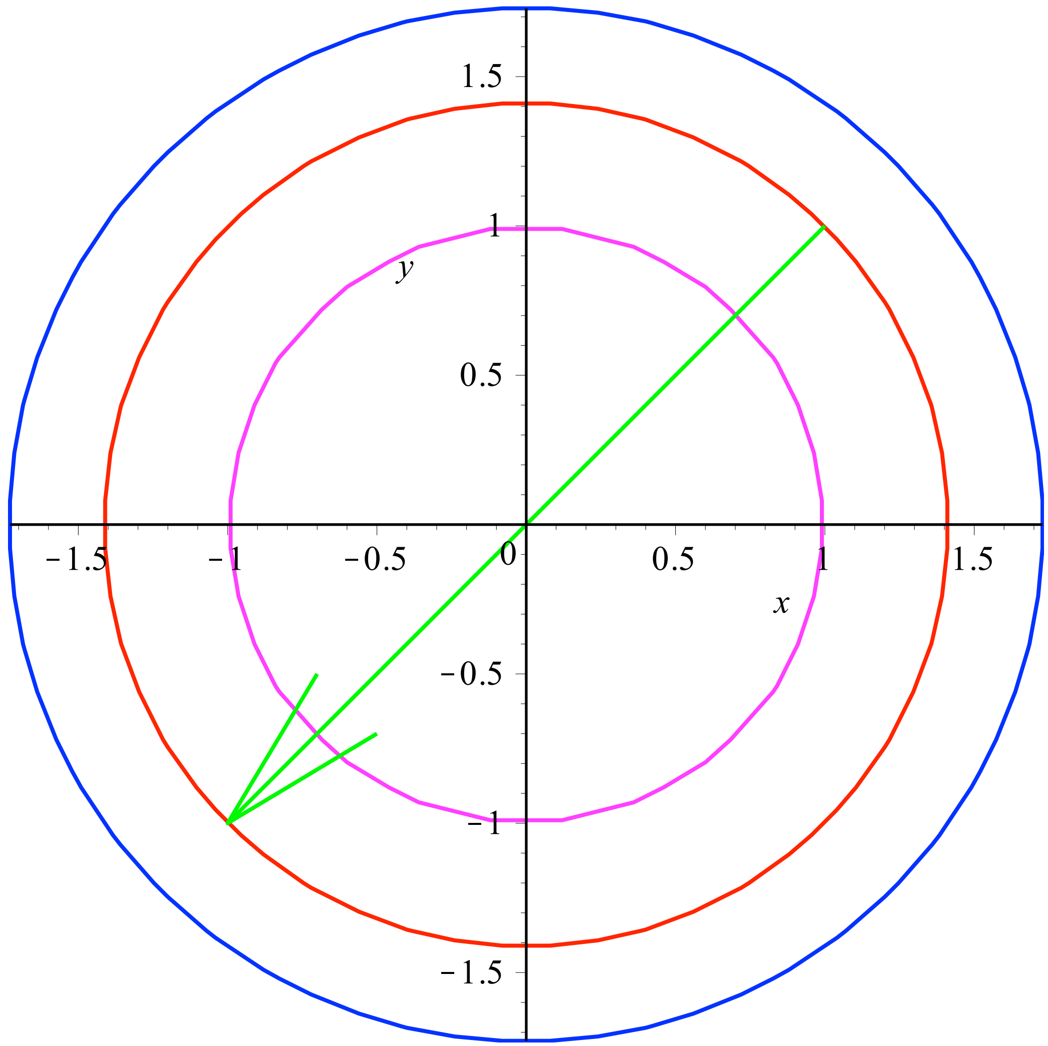


Denne vektoren ble ganske voldsom. Vi kan be om en tynnere vektor ved å skrive $shape = arrow$

> $Q := arrow(\langle 1, 1\rangle, \text{Gs}, color = \text{green}, shape = arrow)$

$$Q := PLOT(\ldots) \qquad (9$$

> $display(P1, P2, P3, Q)$



Ser du at den grønne gradienvektoren står normal på nivåkurven gjennom punktet (1,1), og peker i retning av voksende funksjonsverdi for F (den lilla nivåkurven går gjennom punkter med større funksjonsverdi enn den røde.)

b)

> $P1 := implicitplot(\exp(x)\cdot\sin(y) = 1, x = -5 ..5, y = -5 ..5, color = \mathrm{red}, gridrefine = 2)$

$$P1 := PLOT(\ldots) \tag{10}$$

> $P2 := implicitplot(\exp(x)\cdot\sin(y) = 2, x = -5 ..5, y = -5 ..5, color = blue, gridrefine = 2)$

$$P2 := PLOT(\ldots) \tag{11}$$

> $P3 := implicitplot(\exp(x)\cdot\sin(y) = -1, x = -5 ..5, y = -5 ..5, color = magenta, gridrefine = 2)$

$$P3 := PLOT(\ldots) \tag{12}$$

> $G := Gradient(\exp(x)\cdot\sin(y), [x, y])$

$$G := \left(\mathrm{e}^{x}\sin(y)\right)\bar{e}_{x} + \left(\mathrm{e}^{x}\cos(y)\right)\bar{e}_{y} \tag{13}$$

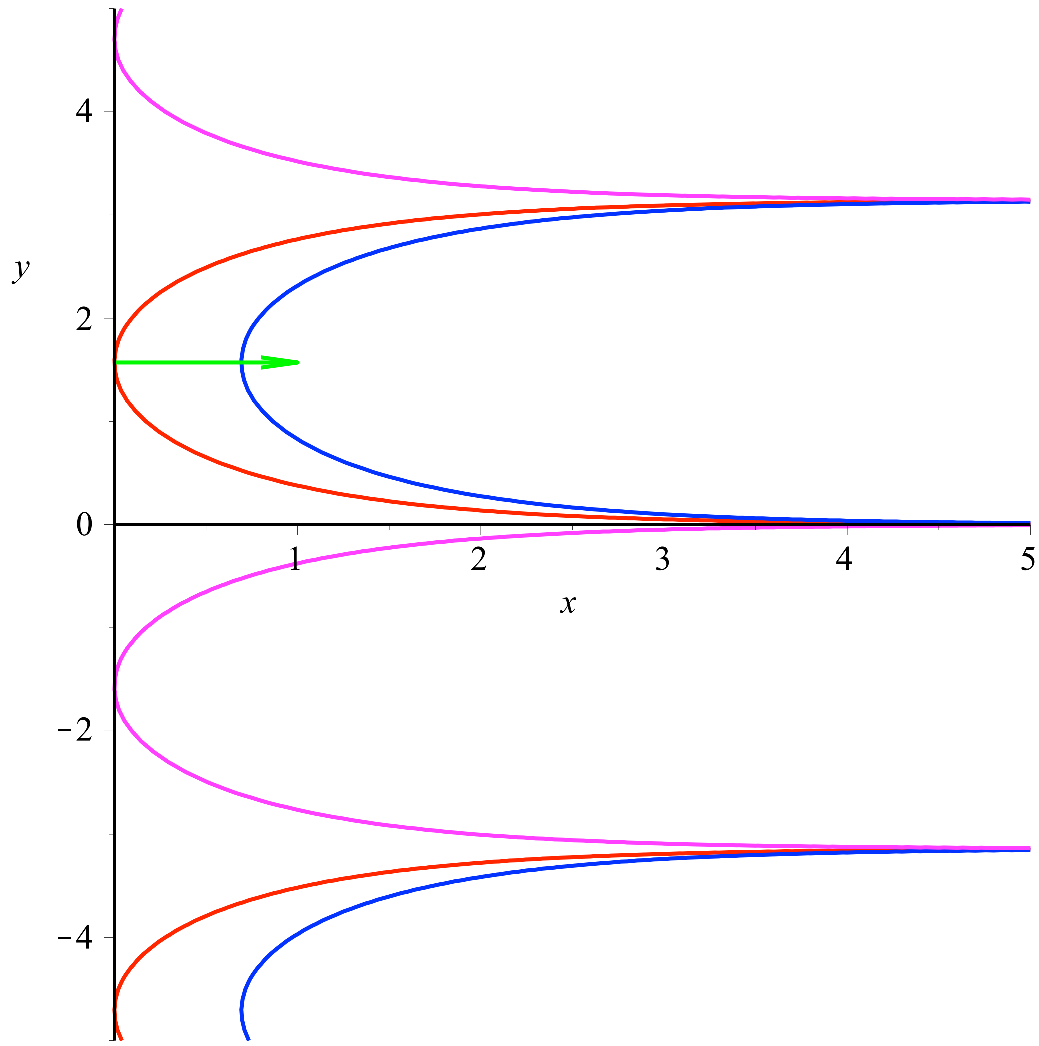
> $Gs := subs\left(\left\{x = 0, y = \frac{\mathrm{Pi}}{2}\right\}, G\right)$

$$Gs := \bar{e}_{x} \tag{14}$$

> $Q := arrow\left(\left\langle 0, \frac{\mathrm{Pi}}{2}\right\rangle, Gs, color = \mathrm{green}, shape = arrow\right)$

$$Q := PLOT(\ldots) \tag{15}$$

> $display(P1, P2, P3, Q)$



Ekstraoppgave 10.7.2.

a)

> $P := implicitplot3d\left(x^2 + y^2 + 2\,z^2 = 5, x = -3\,..3, y = -2\,..2, z = -2\,..2, style = surfacecontour, color = yellow, numpoints = 10000\right)$

$$P := PLOT3D(\ldots) \quad \textbf{(16}$$

> $G := Gradient\left(x^2 + y^2 + 2\,z^2, [x, y, z]\right)$

$$G := 2\,x\bar{e}_x + 2\,y\bar{e}_y + 4\,z\bar{e}_z \quad \textbf{(17}$$

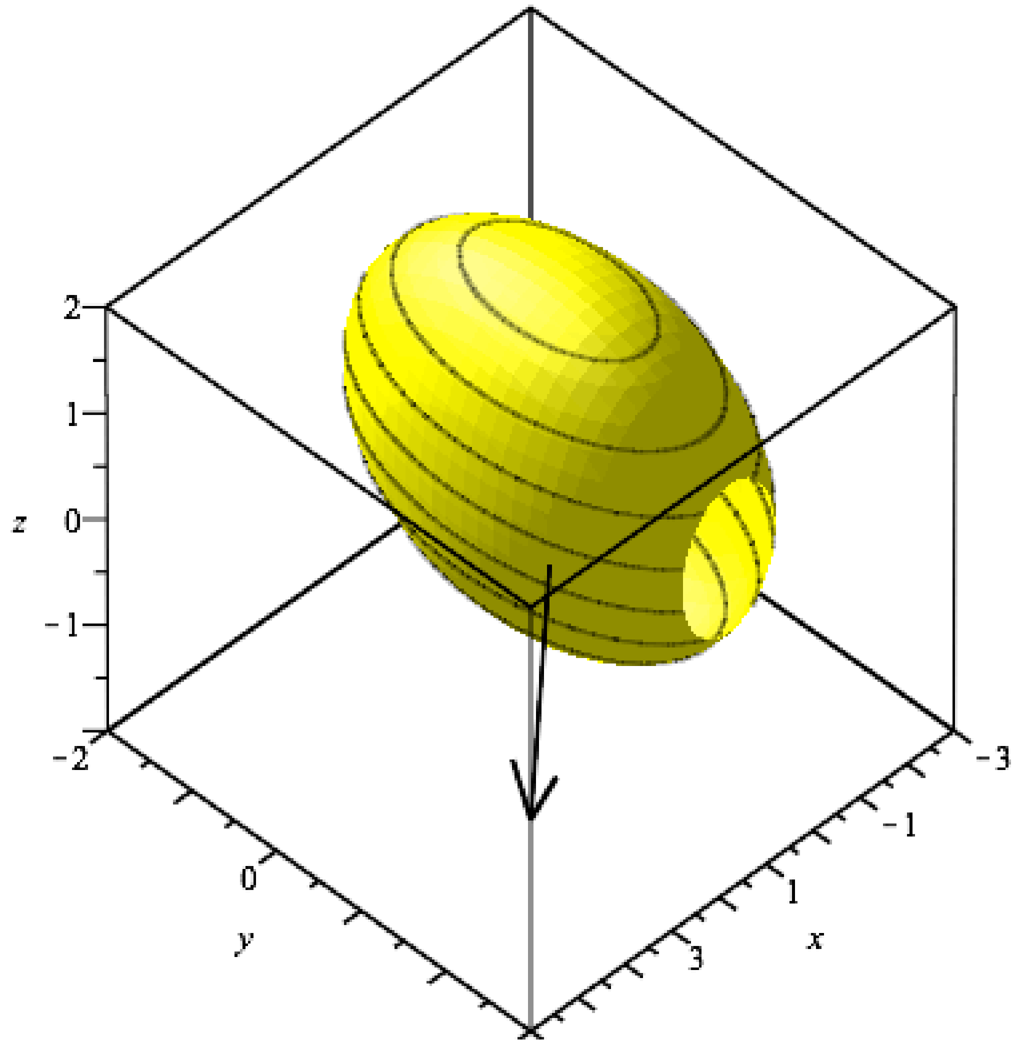
> $Gs := subs(\{x = 2, y = 1, z = 0\}, G)$

$$Gs := 4\bar{e}_x + 2\bar{e}_y \quad \textbf{(18}$$

> $Q := arrow(\langle 2, 1, 0\rangle, Gs, shape = arrow, color = black)$

$$Q := PLOT3D(\ldots) \quad \textbf{(19}$$

> $display(P, Q, axes = boxed)$



Husk: du kan rotere bildet. Trykk først på bildet. Vil det ikke roteres, så trykk på rotasjonsknappen i den nederste kommandolinjen på toppen av arbeidsarket.

d)

> $P := implicitplot3d\left(\sin(x)\cdot\cos(y)\cdot\tan(z) = \frac{1}{2}, x = 0..\frac{3\cdot\mathrm{Pi}}{4}, y = -0..\frac{3\cdot\mathrm{Pi}}{4}, z = 0..\frac{3\cdot\mathrm{Pi}}{4}, style = surfacecontour, color = yellow, numpoints = 10000\right)$

$$P := PLOT3D(\ldots) \quad \textbf{(20}$$

> $G := Gradient(\sin(x)\cdot\cos(y)\cdot\tan(z), [x, y, z])$

$$G := (\cos(x)\ \cos(y)\ \tan(z))\bar{e}_x - \sin(x)\ \sin(y)\ \tan(z)\bar{e}_y + \left(\sin(x)\ \cos(y)\ \left(1 + \tan(z)^2\right)\right)\bar{e}_z \quad \textbf{(21}$$

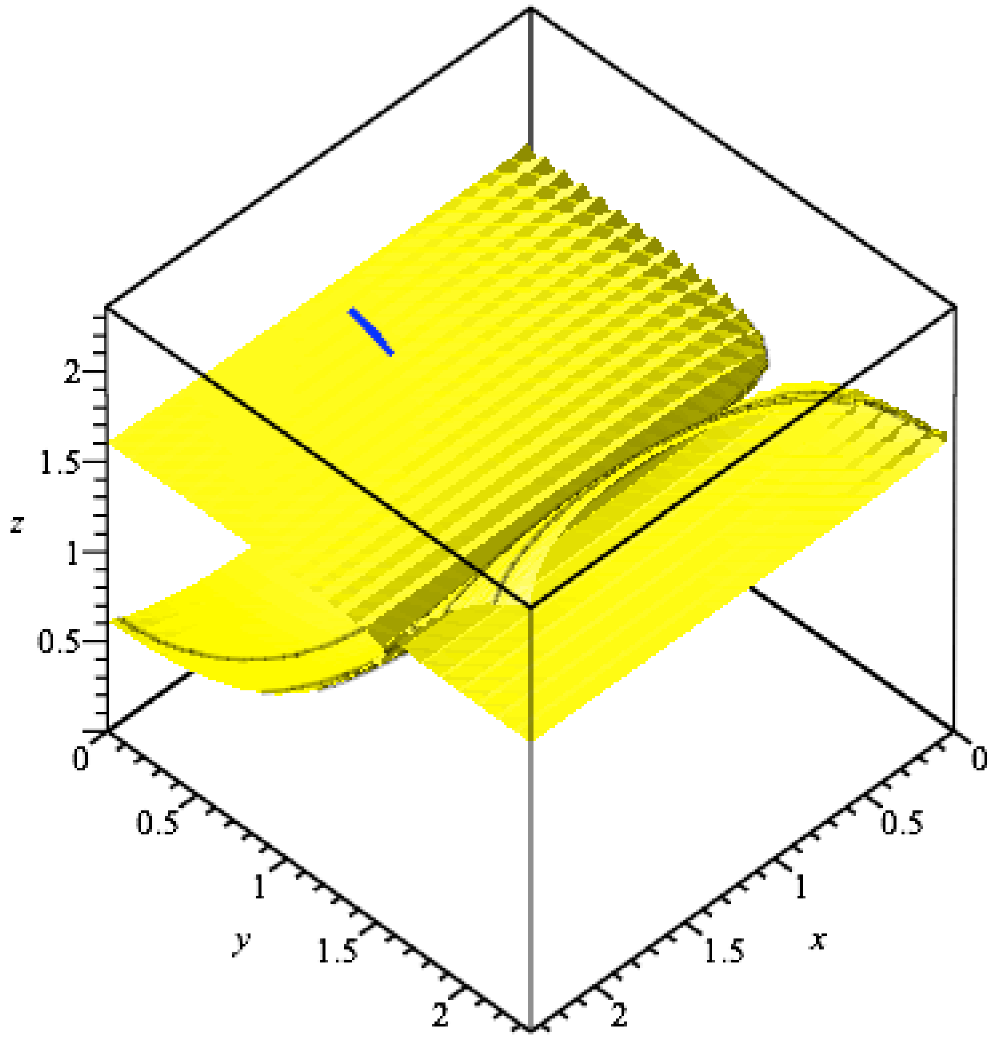
> $Gs := subs\left(\left\{x = \frac{\mathrm{Pi}}{4}, y = \frac{\mathrm{Pi}}{4}, z = \frac{\mathrm{Pi}}{4}\right\}, G\right)$

$$Gs := \left(\frac{1}{2}\right)\bar{e}_x + \left(-\frac{1}{2}\right)\bar{e}_y + \bar{e}_z \quad \textbf{(22}$$

> $Q := arrow\left(\left\langle \frac{\mathrm{Pi}}{4}, \frac{\mathrm{Pi}}{4}, \frac{\mathrm{Pi}}{4}\right\rangle, Gs, shape = arrow, color = blue\right)$

$$Q := PLOT3D(\ldots) \quad \textbf{(23}$$

> $display(P, Q, axes = boxed)$


z
2
1.5
1
0.5
0
0.5
1
1.5
2
y
0
0.5
1
1.5
2
x

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