Diffop expressions in various systems PhL 11.15.13

Tired of not having this ready to paste. Starting 11/15/13 to build this doc.

Cartesian Coordinates (x,y,z0

$\mathbf{F} = \hat{\mathbf{x}}\ F_x + \hat{\mathbf{y}}\ F_x + \hat{\mathbf{z}}\ F_x$

grad $\psi = \hat{\mathbf{x}}\ \partial_x\psi + \hat{\mathbf{y}}\ \partial_y\psi\ + \hat{\mathbf{z}}\ \partial_z\psi$

div $\mathbf{F} = \partial_x F_x + \partial_y F_y + \partial_z F_z$

curl $\mathbf{F} = \hat{\mathbf{x}}\ (\partial_y F_z\ - \partial_z F_y)\ + \hat{\mathbf{y}}\ (\partial_z F_x\ - \partial_x F_z) + \ \hat{\mathbf{z}}\ (\partial_x F_y\ - \partial_y F_x)$ // each term cyclic x,y,z

Cylindrical Coordinates (r,θ,z)

$\mathbf{F} = \hat{\mathbf{r}}\ F_r + \hat{\boldsymbol{\theta}}\ F_\theta + \hat{\mathbf{z}}\ F_z$

grad $\psi = \hat{\mathbf{r}}\ \partial_r\psi + \hat{\boldsymbol{\theta}}\ r^{-1}\partial_\theta\psi + \hat{\mathbf{z}}\ \partial_z\psi$

div $\mathbf{F} = r^{-1}\partial_r(rF_r) + r^{-1}\partial_\theta F_\theta + \partial_z F_z$

curl $\mathbf{F} = \hat{\mathbf{r}}\ [\ r^{-1}\partial_\theta F_z - \partial_z F_\theta] + \hat{\boldsymbol{\theta}}\ [\partial_z F_r - \partial_r F_z] + \hat{\mathbf{z}}\ [\ r^{-1}\partial_r(rF_\theta) - r^{-1}\partial_\theta F_r\ ]$

$\nabla^2\psi\ = r^{-1}\partial_r(r\partial_r\psi) + r^{-2}\partial_\theta^2\psi + \partial_z^2\psi$

$\nabla^2\mathbf{F}\ = \hat{\mathbf{r}}\ [\nabla^2 F_r - 2\ r^{-2}\partial_\theta F_\theta\ -\ r^{-2}F_r] + \ \hat{\boldsymbol{\theta}}\ [\nabla^2 F_r + 2\ r^{-2}\partial_\theta F_r\ -\ r^{-2}F_\theta]\ + \hat{\mathbf{z}}\nabla^2 F_z$

Spherical coordinates (r,θ,φ)

grad $\psi = \ \hat{\mathbf{r}}\ \partial_r\psi\ \ + \hat{\boldsymbol{\theta}}\ (1/r)\partial_\theta\psi\ \ + \hat{\boldsymbol{\varphi}}\ [r\sin\theta]^{-1}\ \partial_\varphi\psi$

div $\mathbf{F} = r^{-2}\partial_r(r^2F_r) + [r\sin\theta]^{-1}\partial_\theta[\sin\theta F_\theta] + [r\sin\theta]^{-1}\partial_\varphi F_\varphi$