Homework for PHYS 266 Mathematical Methods of Physics

Due date: 18 June 2020, Friday

- Starting from
- $(\partial^2 \Phi/\partial x^2) + (\partial^2 \Phi/\partial y^2) + (\partial^2 \Phi/\partial z^2) = 0$
- Derive

$$\nabla^2\Phi = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\Phi}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial\Phi}{\partial\theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2\Phi}{\partial\phi^2} = 0$$

- Hint: You may use the chain rule of differentiation, and
- $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, $z = r\cos\theta$,
- i.e.
- $r = (x^2 + y^2 + z^2)^{1/2}$, $\theta = \tan^{-1}[(x^2 + y^2)^{1/2}/z]$, $\phi = \tan^{-1}(y/x)$