PHY 103N Cheat Sheet:

Average value of a series of measurements:

$$\bar{x} = \frac{\sum_{i=1}^{N} \frac{x_i}{(\Delta x_i)^2}}{\sum_{i=1}^{N} \frac{1}{(\Delta x_i)^2}} \qquad \text{(eq. 0.1)}$$

Uncertainty for average value:

$$\Delta\bar{x} = s = \sqrt{\frac{1}{\sum_{i=1}^{N} \frac{1}{(\Delta x_i)^2}}} \qquad \text{(eq. 0.2)}$$

Error propagation for a function $f=f(x,y,z,\ldots)$:

$$\Delta f = \left|\frac{\partial f}{\partial x}\right|\Delta x + \left|\frac{\partial f}{\partial y}\right|\Delta y + \left|\frac{\partial f}{\partial z}\right|\Delta z + \ldots \qquad \text{(eq. 0.6)}$$

Useful rules of differentiation:

- $\frac{d}{dx}\left(ax^n\right) = anx^{n-1}$ where $a = const$, $n \in \Re$
- $\frac{d}{dq}\left(\sin(aq)\right) = a\cos(aq)$ and $\frac{d}{dq}\left(\cos(aq)\right) = -a\sin(aq)$
- $\frac{d}{dx}\left(e^{ax}\right) = ae^{ax}$
- $\frac{d}{dx}\left(f(x)+g(x)\right) = \frac{df(x)}{dx} + \frac{dg(x)}{dx}$
- $\frac{d}{dx}\left(f(x)g(x)\right) = g(x)\frac{df(x)}{dx} + f(x)\frac{dg(x)}{dx}$
- $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)\frac{df(x)}{dx} - f(x)\frac{dg(x)}{dx}}{(g(x))^2}$
- $\frac{d}{dx}\left(f(g(x))\right) = \frac{df}{dg}\frac{dg}{dx}$

Observe that all of these equations and rules have to be “translated” to the correct symbols for the problem at hand, when they are to be used!!!