- 1. Differentiate the following functions:
 - (a) xe^{ax}

(b)
$$\sin(x^2)$$

(c)
$$\frac{\sqrt{1+x}}{\sqrt{1-x}}$$

- 2. Calculate the Taylor Series up to second order terms for
 - (a) e^{ax} about x = 0.
 - (b) 1/x about x = r.
- 3. Consider the following function (for A > 0, B > 0):

$$f(x) = \frac{A}{x^{12}} - \frac{B}{x^6}$$

- (a) Sketch f(x).
- (b) Find the value x_0 at which f(x) is minimized.
- (c) Calculate the Taylor Series to second order around x_0 . Sketch this on the same figure you drew above.
- (d) Where might this function and expansion come in useful in physics?
- 4. Consider the scalar function $\phi(\mathbf{r})$:

$$\phi(\mathbf{r}) = \frac{1}{\sqrt{x^2 + y^2 + z^2}} = \frac{1}{r}$$
 ($\mathbf{r} = \{x, y, z\}$).

- (a) Compute the components of $\nabla \phi$.
- (b) Compute $\mathbf{r} \times \nabla \phi$.
- 5. Compute the curl of the vector field $\mathbf{F} = xy\,\hat{i} + x\sin z\,\hat{j} z^2\,\hat{k}$.