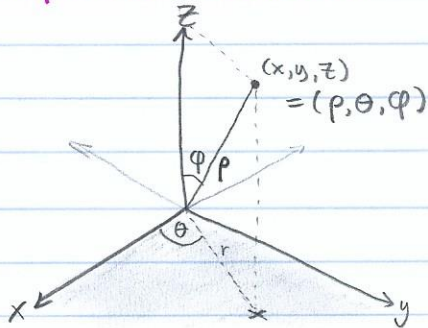


## Spherical coordinates:



→ Our coordinates have the following properties:

$$\rho \geq 0, 0 \leq \varphi \leq \pi, \theta \text{ anything}$$

→ Converting: spherical  $\leftrightarrow$  cylindrical

$$r = \rho \sin \varphi$$

$$\theta = \theta$$

$$z = \rho \cos \varphi$$

$$\rho^2 = z^2 + r^2$$

→ converting: spherical  $\leftrightarrow$  cartesian

$$x = \rho \sin \varphi \cos \theta$$

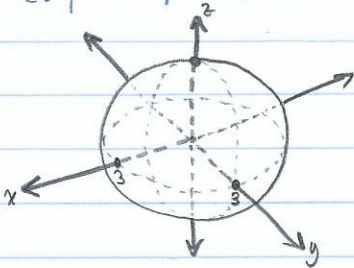
$$y = \rho \sin \varphi \sin \theta$$

$$z = \rho \cos \varphi$$

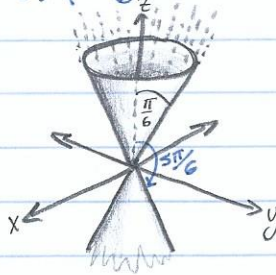
$$\rho^2 = z^2 + y^2 + x^2$$

→ Graphs of some basic spherical equations:

(a)  $\rho = 3$  sphere of radius 3



(b)  $\varphi = \frac{\pi}{6}$



(c)  $\rho \sin \varphi = 2$

$r = 2$  cylinder

