PHY 321 February 11, 2022

conservative force

$$\vec{F} = \vec{F}(\vec{r})$$

$$\vec{F} = -\vec{\nabla} V(\vec{r})$$

Ex 3

$$V(x,y,z) = A e^{-\frac{x^2+z^2}{2a^2}}$$

constant

$$\vec{F}(x,y,z) = -\vec{\nabla} V(\vec{r})$$

$$F_x = -\frac{\partial V}{\partial x} = -\frac{xA}{a^2} e^{-\frac{x^2-z^2}{2a^2}}$$

$$F_y = -\frac{\partial V}{\partial y} = 0$$

conserved energy

$$\vec{\nabla} \times \vec{F} = 0$$

HW 1

$$\vec{a} \times \vec{b} = (a_y b_z - a_z b_y)\vec{i} + (a_z b_x - a_x b_z)\vec{j} + (a_x b_y - a_y b_y)\vec{k}$$

$$= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

$$\vec{\nabla} \times \vec{F} = \left(\frac{\partial}{\partial y} F_z - \frac{\partial}{\partial z} F_y\right)\vec{i} + \left(\frac{\partial}{\partial x} F_z - \frac{\partial}{\partial z} \partial F_x\right)\vec{j} + \left(\frac{\partial}{\partial x} F_y - \frac{\partial}{\partial y} F_x\right)\vec{k}$$

Ex 5

$$v = \alpha / x$$

assume $F = F(x)$

$$\vec{\nabla} \times \vec{F} = 0$$

Energy at $t = 0$

$$E_0 = V(x) + \frac{1}{2} m \alpha^2 / x^2$$

$$\frac{dE_0}{dx} = 0 = \frac{dV}{dx} - m\alpha^2 / x^3$$

$$\|$$

$$-F(x)$$

$$F(x) = - m\alpha^2 / x^3$$

Given $F(x)$, find $V(x)$

$$V(x) - V(x_0) = -\int_{x_0}^{x} F(x')\,dx'$$

$$x_0 = 0 = V(x_0)$$

$$V(x) = \frac{kx^2}{2} - \frac{kx^4}{4a^2}$$