

Potential Energy of the Spring

$$F = -\frac{dU}{dx}$$

$$F \cdot dx = -dU$$

$$\int F \cdot dx = -U$$

$$-U(x) = \int 27.007x = \frac{27.007x^2}{2}$$

$$-U(x) = 13.504x^2$$

$$\boxed{U(x) = -13.504x^2}$$

$$f(x) = 27.007x + \cancel{0.7536}^{\text{disregard error}}$$