$$\overline{F}_{el} = -kx\,\overline{u}_x$$

$$O \equiv c$$

$$W_{A \to B} = \int_A^B \overline{F}_{el}\,d\overline{s} = \int_{x_A}^{x_B} -kx\,dx = -\frac{1}{2}kx^2 \Big|_{x_A}^{x_B} =$$

$$= -\left(\frac{1}{2}kx_B^2 - \frac{1}{2}kx_A^2\right) = -\Delta E_{P,el}$$

$$\boxed{E_{P,el} = \frac{1}{2}kx^2}$$
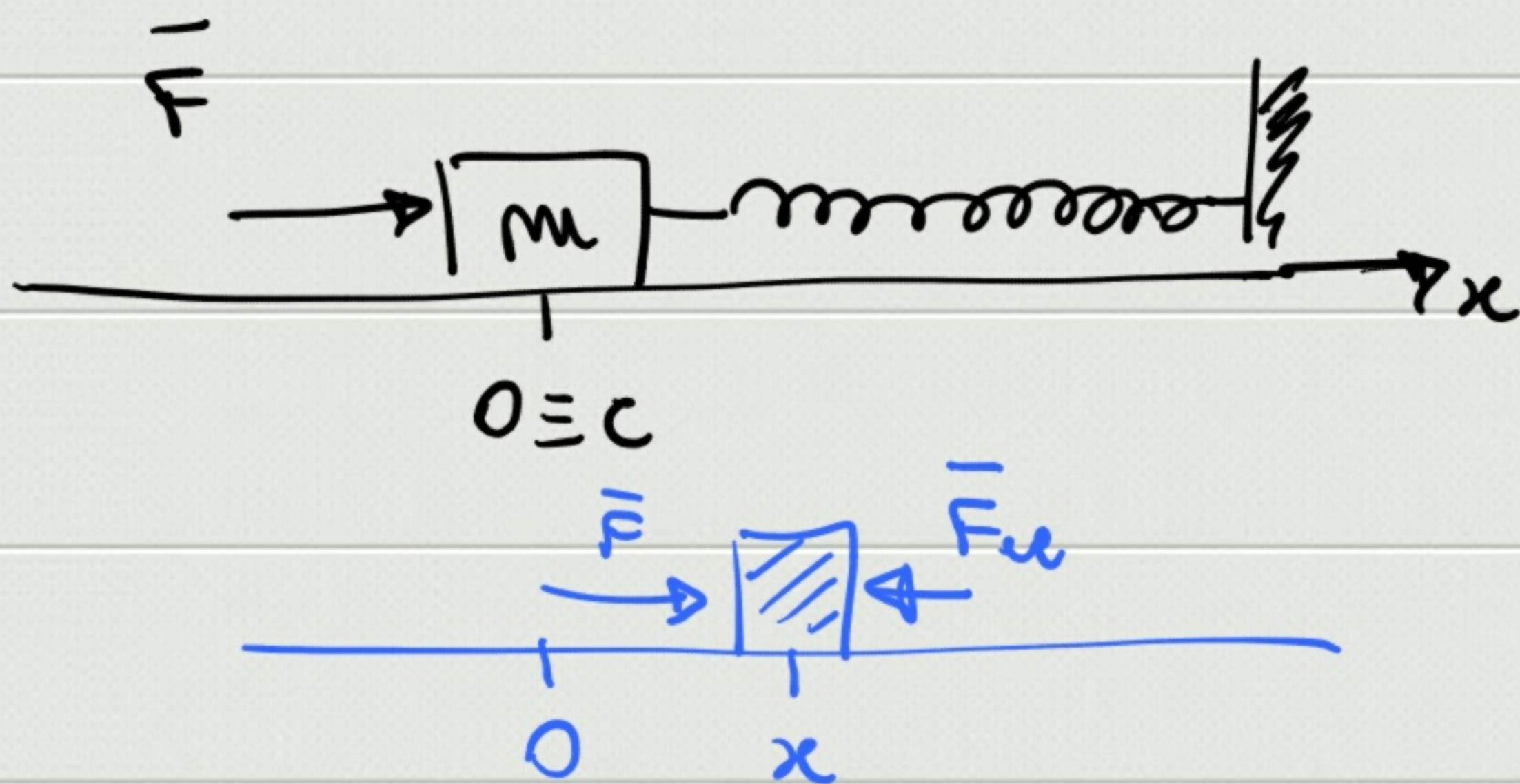
$$\overline{F} = F\,\overline{u}_x \quad (F > 0)$$

$$v = v(x)$$

$$x^* : \quad v(x^*) = 0$$
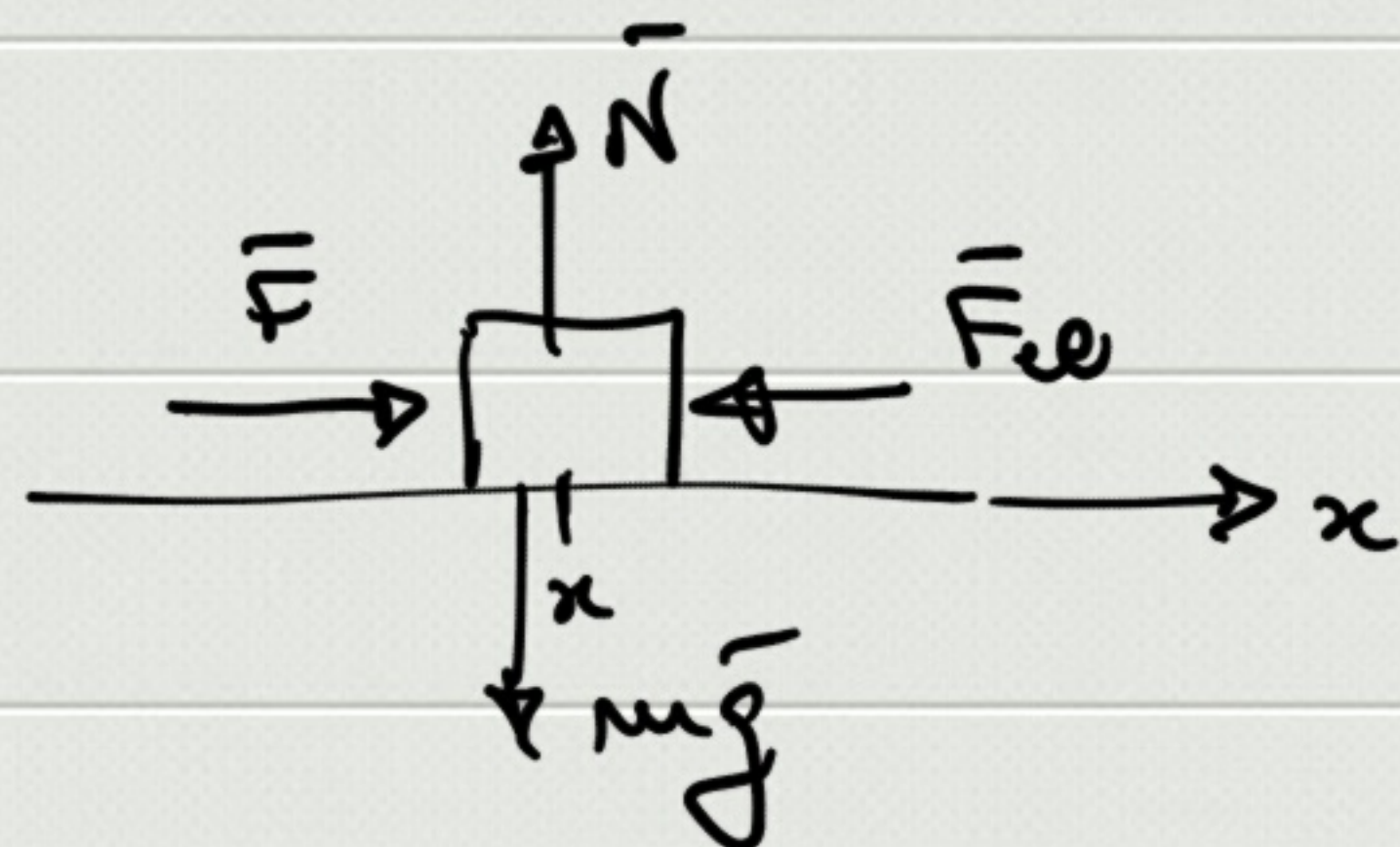
$$F - kx = ma = m\frac{d^2x}{dt^2}$$

$$\Rightarrow \quad \frac{d^2x}{dt^2} + \frac{k}{m}x = \frac{F}{m}$$

$$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx}$$

$$\Rightarrow F - kx = ma = mv\frac{dv}{dx} \Rightarrow \int(F-kx)\,dx = \int mv\,dv$$

$$W_{TOT, 0 \to x} = ?$$

$$\frac{1}{2} W_{F, 0 \to x} + W_{Fel, 0 \to x} =$$

$$E_{P,F} = -Fx$$

$$E_{P,el} = \frac{1}{2} kx^2$$

$$= -\Delta E_{P,F} - \Delta E_{P,el} =$$

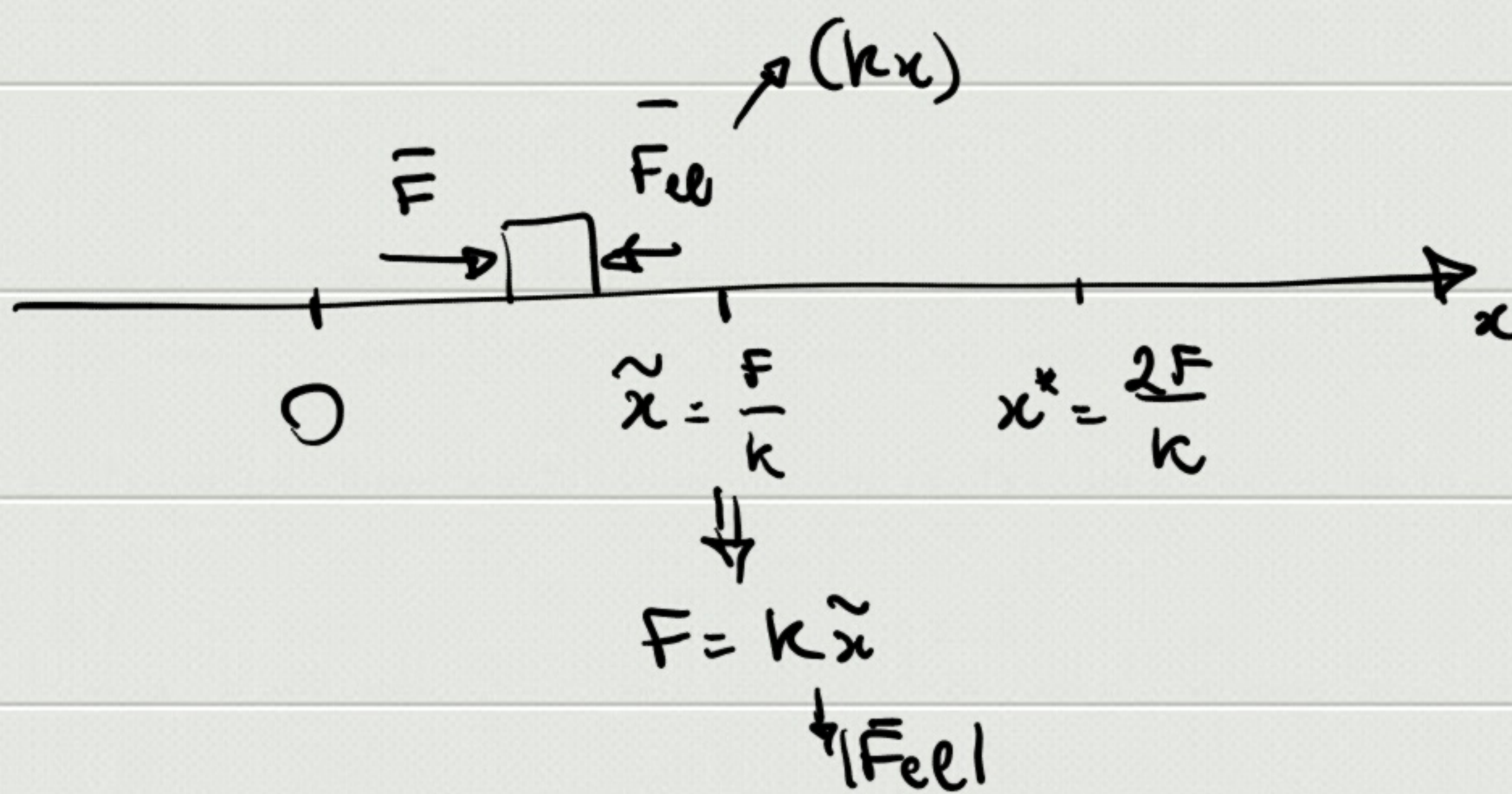$$= -\left(-Fx - \emptyset \right) - \left(\frac{1}{2} kx^2 - \emptyset \right) = Fx - \frac{1}{2} kx^2$$

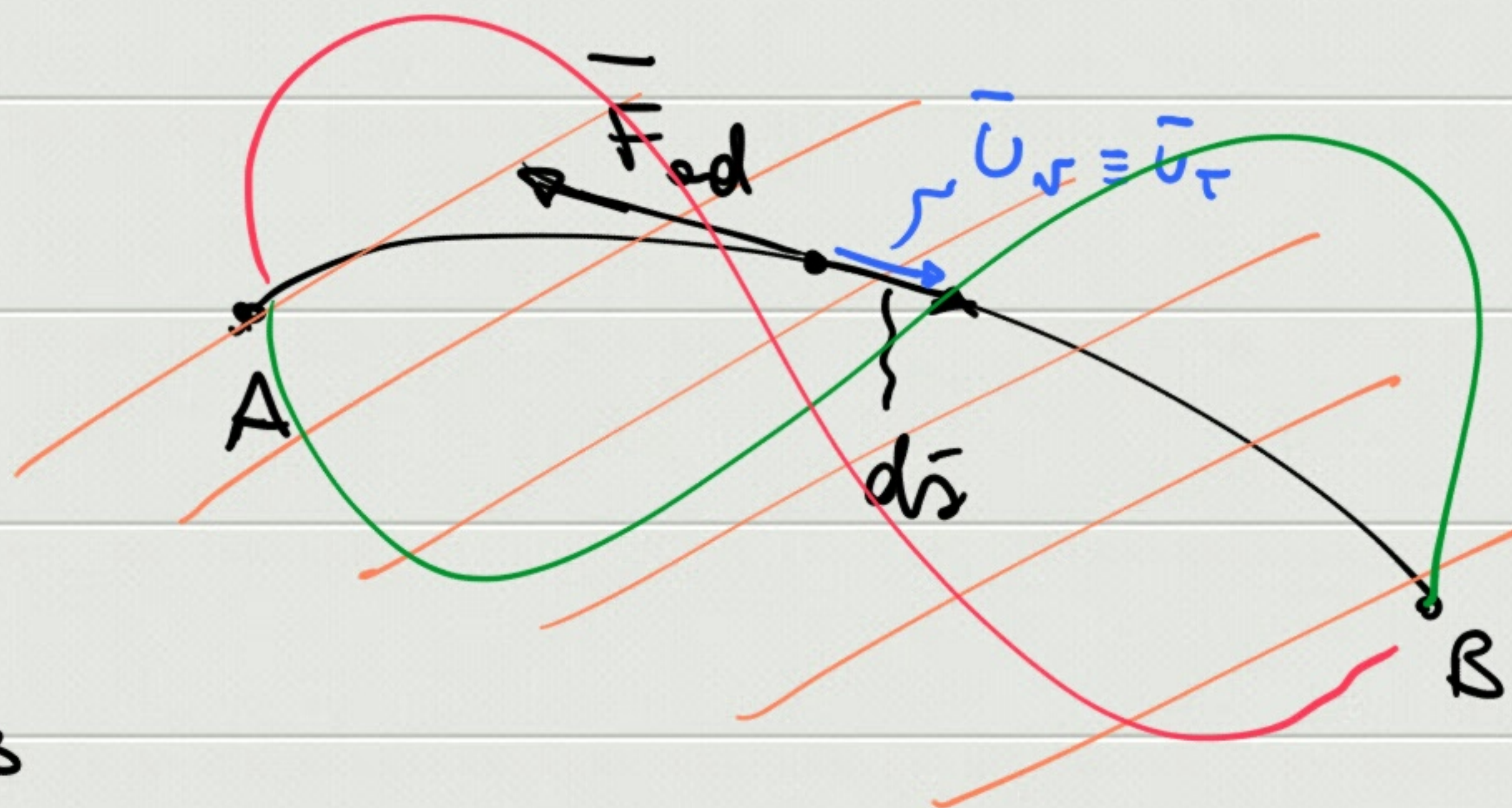$$W_{TOT} = \Delta E_k = \frac{1}{2} m v^2(x) - \frac{1}{2} m v_0^2$$

$$\frac{1}{2} m v^2(x) = Fx - \frac{1}{2} k x^2$$

$$\boxed{v(x) = \sqrt{\frac{x}{m}\left(2F - kx \right)}}$$

$$v(x^*) = 0 \implies x^* = 0$$

$$\boxed{x^* = \frac{2F}{k}}$$

$$F = k\tilde{x}$$

$$\tilde{x} = \frac{F}{k} \qquad x^* = \frac{2F}{k}$$

$$|Fel|$$

$$W_{A \to B} = \int_A^B \bar{F}_{ad} \, d\bar{s} = \int_A^B \left(-\mu_d \, N \, \bar{U}_N \right) d\bar{s} = \qquad \bar{U}_N = \bar{U}_T$$

$$= -\mu_d \, N \int_A^B d s$$