2.2

a) $F_x = F_0 + Cx = m\frac{dv}{dt}$

writing $\frac{dv}{dt} = \frac{dv}{dx}\underbrace{\frac{dx}{dt}}_{v} = v\frac{dv}{dx}$

$\Rightarrow$ $F_0 + Cx = mv\frac{dv}{dx}$

Now, we can integrate:

$$\int_0^x (F_0 + Cx)\,dx = \int_0^v mv\,dv$$

$$F_0 x + \frac{1}{2}Cx^2 \Big|_0^x = \frac{1}{2}mv^2 \Big|_0^v$$

solving for v $\Rightarrow$

$$\boxed{v = \sqrt{\frac{2}{m}\left(F_0 x + \frac{1}{2}Cx^2\right)}}$$

2-2

b) $F_x = F_0 e^{-cx}$

$$F_x = F_0 e^{-cx} = m \frac{dv}{dx} v \Rightarrow$$

$$\int_0^x \frac{F_0}{m} e^{-cx}\, dx = \int_0^v v\, dv$$

$$\frac{F_0}{m}\left(-\frac{1}{c}\right) e^{-cx} \Big|_0^x = \frac{v^2}{2}\Big|_0^v \Rightarrow$$

$$v^2 = \frac{2F_0}{cm}\left(1 - e^{-cx}\right)$$

$$\boxed{v = \sqrt{\frac{2F_0}{cm}\left(1 - e^{-cx}\right)}}$$

2-2

c) $F_x = F_0 \cos cx$

$$\downarrow$$

$$F_0 \cos cx = m v \frac{dv}{dx} \rightarrow$$

$$\frac{F_0}{m} \int_0^x \cos cx \, dx = \int_0^v v \, dv$$

$$\frac{F_0}{m} \frac{1}{c} \left(\sin cx \right)_0^x = \frac{v^2}{2} \Big|_0^v$$

$$v^2 = \frac{2F_0}{cm} \sin cx$$

$$\boxed{v = \sqrt{\frac{2F_0}{cm} \sin cx}}$$

2-4

$$F(x) = -kx$$

$t=0 \quad x=0 \quad T_0 = \frac{1}{2}kA^2$

a) $$F(x) = -\frac{dV(x)}{dx} = -kx.$$

$$\frac{dV(x)}{dx} = kx\,dx$$

$$\boxed{V(x) = \frac{1}{2}kx^2}$$

b) $$E_0 = T_0 + V\Big|_{x=0} = \frac{1}{2}kA^2$$

$$E = T + V = T + \frac{1}{2}kx^2$$

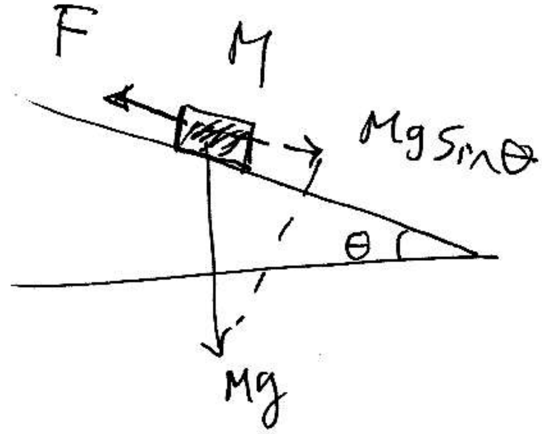
$$\Rightarrow \frac{1}{2}kA^2 = T + \frac{1}{2}kx^2$$

$$\boxed{T = \frac{1}{2}k(A^2 - x^2)}$$

c) $$E = E_0 = \frac{1}{2}kA^2$$

d) $T \to 0 \Rightarrow \frac{1}{2}k(A^2 - x^2) = 0 \Rightarrow \boxed{x = \pm A \text{ turning points}}$

2-7



The force of string on the block is "F".

However, F must be more than

Mg sinθ in order to be able to pull the

block :

$$F > Mg\sin\theta$$