2.2 $\ddot{x} = \frac{d\dot{x}}{dt} = v_x \frac{dv_x}{dx} = \dot{x}\frac{d\dot{x}}{dx}$ (2.3.2 p 50)

also $\ddot{x} = \frac{F_x}{m} \implies \dot{x}\,d\dot{x} = \frac{F_x}{m}\,dx$

a) $F_x = F_0 + cx$ [$\dot{x} = 0$ when $x = 0$ is given]

$$\int_0^{\dot{x}} \dot{x}\,d\dot{x} = \int_0^{x} \left(\frac{F_0 + cx}{m}\right) dx$$

$$\frac{\dot{x}^2}{2} = \frac{1}{m}\left(F_0 x + \frac{c}{2}x^2\right)$$

$$\dot{x} = \sqrt{\frac{2}{m}\left(F_0 x + \frac{c}{2}x^2\right)}$$

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

$$\frac{\dot{x}^2}{2} = \frac{F_0}{m}\int_0^{x} e^{-cx}\,dx$$

$$\dot{x} = \sqrt{\frac{2F_0}{mc}\left(1 - e^{-cx}\right)}$$

c) $F_x = F_0 \cos cx$

$$\frac{\dot{x}^2}{2} = \frac{F_0}{m}\int_0^{x} \cos cx\,dx$$

$$\dot{x} = \sqrt{\frac{2F_0}{cm}\left(\sin cx\right)}$$

2.3 $V(x) = -\int_0^x F_x\,dx$ by defn

a) $F_x = F_0 + cx$

$$V(x) = -\int_0^x (F_0 + cx)\,dx = -\left(F_0 x + \frac{cx^2}{2}\right)$$

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

$$V(x) = F_0 \int_0^x e^{-cx}\,dx = -\frac{F_0}{c}\left(e^{-cx} - e^{-c \cdot 0}\right)$$

$$= +\frac{F_0}{c}\left(e^{-cx} - 1\right)$$

c) $F_x = F_0 \cos cx$

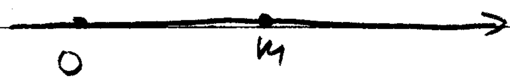
$$V(x) = -F_0 \int_0^x \cos cx\,dx = -\frac{F_0}{c}\left(\sin cx - \sin c\cdot 0\right)$$

$$= -\frac{F_0}{c} \sin cx$$

Note: I've let the integration constant that appears in each case just be zero.

($i.e.$ $x_0 = 0$)

2.4



$F = -kx$

$x_0 = 0$

$T_0 = \frac{1}{2}kA^2$

a) $W = -\Delta V(x)$

$\int_0^x -kx\,dx = -\Delta V(x)$

$-\frac{1}{2}kx^2 + 0 = -\Delta V(x) = -V(x) - V(0)$

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

b) $W = \Delta T$

$\int_0^x -kx\,dx = \int_{T_0}^{T} dT$

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

$T(x) = \frac{1}{2}kA^2 - \frac{1}{2}kx^2$

c) $E(x) = \frac{1}{2}kA^2 - \frac{1}{2}kx^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2 = \text{Const.}$

d) $T = 0$ when $x = \pm A$.

e)