Hints for Chapter 3

#2. Easy. Just make change of units

#4. The time average of any veriable x is

$$\langle x \rangle = \frac{1}{T}\int_0^T \langle x \rangle^2 \, dt$$ where T is the periode

so $$\langle K.E \rangle = \frac{1}{T}\int_0^T \langle K.E \rangle^2 \, dt$$

and $$\langle P.E. \rangle = \frac{1}{T}\int_0^T \langle P.E \rangle^2 \, dt$$

#10. amplitude $(t+nT)$ = $\frac{\text{amplitude initial}(t=0)}{e^1}$ ------ [where amplitude $= Ae^{-\beta t}$]

e^1: exponential 1

small m $\Rightarrow$ $(1+x)^m = 1 + mx + \cdots$

#15. write $x(t)$ and $\dot{x}(t)$ for critical case

plot the phase diagram $\dot{x}$ vs x

and x vs. t, $\dot{x}$ vs. t } on the same graph.

21. critical damping

write $x(t) = --$ find A and B

$\dot{x}(t) = ---$

t is large compared to β $\overset{\text{show}}{\Rightarrow}$ $\dot{x} = -\beta x$

Choose these points to plot $\dot{x}$ vs. x } $\Rightarrow$ $(-2, 4)$, $(1, 4)$ and $(4, -1)$ above

$(x_0, \dot{x}_0)$

6 graphs and $(-1, -4)$, $(1, -4)$ and $(-4, 0)$ below

22. a) overdamping

$$x(t) = e^{-\beta t}\left(A_1 e^{\omega_2 t} + A_2 e^{-\omega_2 t}\right)$$

$$x(t) = A e^{-\beta_1 t} + A_2 e^{-\beta_2 t}$$

$$\dot{x}(t) = \text{- - - —}$$

use at $t=0$ $\quad x(0) = x_0$ and $\dot{x}(0) = \dot{x}_0$

find A_1 and A_2

b) t large compared to β $\quad (A_1 \neq 0)$

show that $\dot{x} = -\beta_1 x \quad (\underline{\beta_2 > \beta_1})$

when $A_1 = 0$

show that $\dot{x} = -\beta_2 x$

27. easy! Compare mechanical and electrical systems!