

Recall that

$$q(t) = \frac{10}{100 - \mu^2} (10 \sin \mu t - \mu \sin 10t) \quad \text{if } \mu \neq 10$$

5.1 #56 with  $\mu = 10$

$$q'' + 100q = 1000 \sin(10t)$$

$$1) \quad \delta^2 + 100 = 0 \quad \delta_{1,2} = \pm 10i \quad y_{\text{hom}} = C_1 \sin(10t) + C_2 \cos(10t)$$

$$2) \quad q_p = A t \sin(10t) + B t \cos(10t)$$

$$q_p' = A (\sin 10t + 10t \cos 10t) + B (\cos 10t - 10t \sin 10t)$$

$$q_p'' = A (10 \cos 10t + 10 \cos 10t - 100t \sin 10t) + B (-10 \sin 10t - 10 \sin 10t - 100t \cos 10t)$$

~~$$A (20 \cos 10t - 100t \sin 10t) + B (20 \sin 10t - 100t \cos 10t) + 100(A t \sin 10t + B t \cos 10t) = 1000 \sin 10t$$~~

$$A (20 \cos 10t - 100t \sin 10t) - B (20 \sin 10t + 100t \cos 10t) +$$

$$+ 100(A t \sin 10t + B t \cos 10t) = 1000 \sin(10t)$$

$$20A \cos 10t - 100A t \sin 10t - 20B \sin 10t - 100B t \cos 10t$$

$$+ 100A t \sin 10t + 100B t \cos 10t = 1000 \sin 10t$$

$$\begin{cases} 20A = 0 \\ -20B = 1000 \end{cases}$$

$$\begin{cases} A = 0 \\ B = -50 \end{cases}$$

$$q_p(t) = -50t \cos(10t)$$

$$3) \quad p(t) = C_1 \sin 10t + C_2 \cos 10t - 50t \cos 10t$$

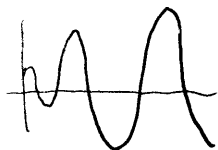
$$q'(t) = 10C_1 \cos 10t - 10C_2 \sin 10t - 50 \cos 10t + 500t \sin 10t$$

$$\text{So } 0 = 0 + C_2 - 0 \quad C_2 = 0$$

$$0 = 10C_1 - 0 - 50 + 0 \quad C_1 = 5$$

$$\boxed{q(t) = 5 \sin 10t - 50t \cos 10t}$$

$$i(t) = 50 \cos 10t - 50 \cos 10t + 500t \sin 10t$$



Note that  $q(t)$  can become arbitrarily large as  $t \rightarrow \infty$