

Problem 3.3

a)

$$V_r + V_C - \varepsilon = 0$$

$$rI_r + \frac{Q}{C} - \varepsilon = 0$$

$$I_r = \frac{\varepsilon}{r} - \frac{Q}{Cr}$$

b)

$$-V_C + V_R = 0$$

$$-\frac{Q}{C} + RI_R = 0$$

$$I_R = \frac{Q}{CR}$$

c)

$$I_r - I_R = \frac{dQ}{dt}$$

d)

$$\frac{dQ}{dt} = \frac{\varepsilon}{r} - Q \left(\frac{1}{CR} + \frac{1}{Cr} \right)$$

$$\frac{dQ}{dt} + \left(\frac{1}{CR} + \frac{1}{Cr} \right) Q = \frac{\varepsilon}{r}$$

$$a = \frac{1}{C} \left(\frac{1}{R} + \frac{1}{r} \right) = \frac{1}{C} \left(\frac{R+r}{Rr} \right), \quad b = \frac{\varepsilon}{r}$$

e)

$$Q(t) = C\varepsilon \frac{R}{R+r} + Ae^{-\frac{1}{C} \left(\frac{R+r}{Rr} \right) t}$$

f)

$$Q(0) = C\varepsilon \frac{R}{R+r} + A$$

$$A = -C\varepsilon \frac{R}{R+r}$$