PHY 2049C Solutions to Practice Quiz 8.

Problem 1a) Inductor is just a wire Inductor is like a battery
$1 = 2 = 3$; 1b) $1 = 3 > 2$

1c) Inductor is just a wire, there is no battery
$1 = 2 = 3$

Problem 2. A stays the same

$$\mathcal{E}_{left} + \mathcal{E}_{in} = -\frac{d}{dt}\iint B \cdot dA + \mathcal{E}_{Bat} = \iint \frac{dB}{dt} \cdot dA + \mathcal{E}_{Bat}$$

$$\frac{dB}{dt} = -0.870$$

$$\mathcal{E}_{in} = 0.870 \iint dA = -0.870 \left(\frac{2\times 2}{2}\right) = -1.740 \text{ V}$$

$$\mathcal{E}_{Total} = 20 + 1.740 = 21.74 \text{ V}$$

Problem 3. do a loop

$$\frac{Q}{C} - \frac{dQ}{dt}R = \mathcal{E}_0 \cos(\omega t)$$

Let $Q = Q_0 e^{i\omega t}$ Take to complex plane

$$Q_0 e^{i\omega t}\left(\frac{1}{C} - i\omega R\right) = \mathcal{E}_0 e^{i\omega t}$$

$$Q_0 = \left(\frac{\mathcal{E}_0}{\frac{1}{C} - i\omega R}\right)$$

$$V_C = \frac{Q}{C} = R\,\mathrm{Re}\left[\left(\frac{\mathcal{E}_0}{1 - i\omega RC}\right) e^{i\omega t}\right]$$

$\omega = \frac{2\pi}{T}$, $R = 150$
$C = 50\,\mu F$
$\mathcal{E}_0 = 10 V$

$$V_c = Re\left[\frac{10}{1 - i\frac{20}{10}}\, e^{i\frac{20}{10}t}\right] V$$

$$V_R = Re\left[\frac{dQ}{dt} R\right] = Re\left(\frac{i\omega R \mathcal{E}_0}{\left(\frac{1}{C} - i\omega R\right)} e^{i\omega t}\right]$$

Replace numerical values & simplify

Problem 4 (B is constant)

$$\mathcal{E} = \frac{d}{dt}\iint B \cdot dA = \frac{B\,dA}{dt}$$

$A = N b \frac{dy}{dt} = Nbv$ ← y coordinate of the edge of B as it enters the loop

$C = \frac{Q}{V}$

$V = QC$

(c)

$$\boxed{\mathcal{E} = BNbv}$$

(b) $C = 0$ No charge will flow

Problem 5. { The peak is the same as saying the amplitude.

$V_{out} = V_0 e^{i\omega t}$; $C_{eq} = \left(\frac{1}{4+2} + \frac{1}{3}\right)^{-1} = 2$

The first capacitor has half the capacitance so it stores twice the voltage $\boxed{V_{peak} = \frac{2}{3} V_0}$