

Unit 2 Practice NAB solutions.

1. $E = QV$ ($\frac{1}{2}$)

$= (1 \times 10^{-5}) \times 600$ ($\frac{1}{2}$)

$= \underline{6 \times 10^{-3} \text{ J}}$ ($\frac{1}{2}$ value, $\frac{1}{2}$ unit)

2. (a)(i) $E = I(R+r)$ ($\frac{1}{2}$)

$6 = I(22+2)$ ($\frac{1}{2}$)

$I = \frac{6}{24} = \underline{0.25 \text{ A}}$. ($\frac{1}{2}$ value, $\frac{1}{2}$ unit)

(ii) $V = IR$ ($\frac{1}{2}$)

$= 0.25 \times 22$ ($\frac{1}{2}$)

$= \underline{5.5 \text{ V}}$. ($\frac{1}{2}$ value, $\frac{1}{2}$ unit)

(iii) lost volts = Ir

$= 0.25 \times 2$

$= \underline{0.5 \text{ V}}$ (1)

(b) total resistance has decreased

current will increase ($\frac{1}{2}$)

lost volts = Ir ($\frac{1}{2}$)

r is constant ($\frac{1}{2}$)

lost volts will increase. ($\frac{1}{2}$)

$$3. (a) T = 2 \times 2 = 4 \text{ ms} = 0.004 \text{ s} \quad \left(\frac{1}{2}\right)$$

$$f = \frac{1}{T} = \frac{1}{0.004} = \underline{250 \text{ Hz}} \quad \left(\frac{1}{2} \text{ value}, \frac{1}{2} \text{ unit}\right)$$

$$(b) V_{\text{peak}} = \sqrt{2} V_{\text{RMS}} \quad \left(\frac{1}{2}\right)$$

$$V_{\text{peak}} = \sqrt{2} \times 12 \quad \left(\frac{1}{2}\right)$$

$$V_{\text{peak}} = \underline{17 \text{ V}}. \quad \left(\frac{1}{2} \text{ value}, \frac{1}{2} \text{ unit}\right)$$

$$4. (a) I = \frac{V_s}{R} \quad \left(\frac{1}{2}\right)$$

$$= \frac{9}{100} \quad \left(\frac{1}{2}\right)$$

$$= \underline{0.09 \text{ A}}. \quad \left(\frac{1}{2} \text{ value}, \frac{1}{2} \text{ unit}\right)$$

$$(b) V_s = V_R + V_C$$

$$9 = 6 + V_C$$

$$V_C = 9 - 6 = \underline{3 \text{ V}}. \quad (1)$$

$$(c) (i) Q = CV \quad \left(\frac{1}{2}\right)$$

$$= (2200 \times 10^{-6}) \times 9 \quad \left(\frac{1}{2}\right)$$

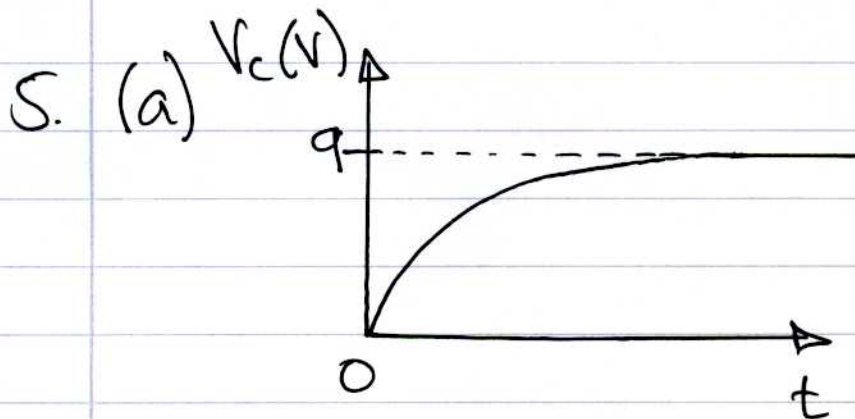
$$= \underline{19.8 \text{ mC}} \quad (0.0198 \text{ C})$$

$$\left(\frac{1}{2} \text{ value}, \frac{1}{2} \text{ unit}\right)$$

$$4. (c) (ii) E = \frac{1}{2} C V^2 \quad \left(\frac{1}{2}\right)$$

$$= \frac{1}{2} \times (2200 \times 10^{-6}) \times 9^2 \quad \left(\frac{1}{2}\right)$$

$$= \underline{89.1 \text{ mJ}} \quad \left(\frac{1}{2} \text{ value, } \frac{1}{2} \text{ unit}\right)$$



$\left(\frac{1}{2} \text{ shape, } \frac{1}{2} \text{ y-axis values}\right)$

(b) It will take less time⁽¹⁾ for the capacitor to charge.

$$6. V_o = \frac{R_f}{R_i} (V_2 - V_1) \quad \left(\frac{1}{2}\right)$$

$$V_o = \frac{100}{5} (0.5 - 0.4) \quad \left(\frac{1}{2}\right)$$

$$V_o = 20 \times 0.1$$

$$\underline{V_o = 2 \text{ V.}} \quad \left(\frac{1}{2} \text{ value, } \frac{1}{2} \text{ unit}\right)$$

7. (a) inverting node. (1)

$$(b) (i) \text{ gain} = - \frac{V_{out}}{V_{in}} \quad \left(\frac{1}{2}\right)$$

$$= - \frac{-6}{0.2} \quad \left(\frac{1}{2}\right)$$

$$= \underline{30.} \quad (1) \quad \left(-\frac{1}{2} \text{ if unit given}\right)$$

$$7 \text{ (b) (ii) } \text{ gain} = \frac{R_f}{R_1} \quad \left(\frac{1}{2}\right)$$

$$30 = \frac{R_f}{R_1} \quad \left(\frac{1}{2}\right)$$

$$\begin{aligned} R_f &= 30 \times R_1 \\ &= 30 \times 10 \text{ k}\Omega \\ &= \underline{300 \text{ k}\Omega}. \quad \left(\frac{1}{2} \text{ value, } \frac{1}{2} \text{ unit}\right) \end{aligned}$$

(iii) The output voltage from the op amp cannot exceed the $\pm 15\text{V}$ provided by the power supply. (1)