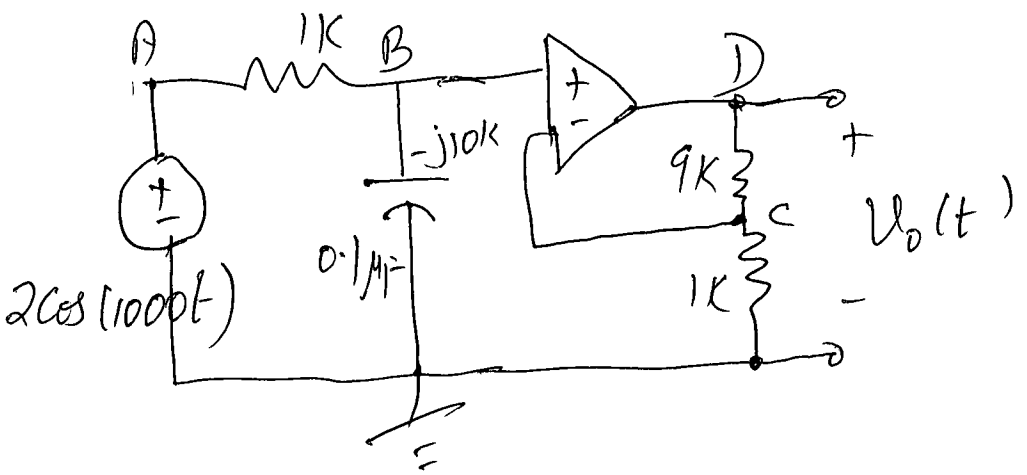
# ECE 210 Solutions to Final Practice Problems – Fall 2014




$\omega = 1000$ r/s

$0.1\mu F \Rightarrow \frac{1}{j(1000)10^{-7}}$

$= -j10^4\,\Omega$

$= -j10K\,\Omega$

$$C: \quad V_C = \frac{1K}{9K+1K} V_D = 0.1 V_D$$

$$B: \quad V_B = \frac{-j10K}{1K - j10K} 2\angle 0^\circ = \frac{-j20}{1-j10}$$

$$V_B = \frac{-j20}{1-j10} \cdot \frac{1+j10}{1+j10} = \frac{200-j20}{101}$$

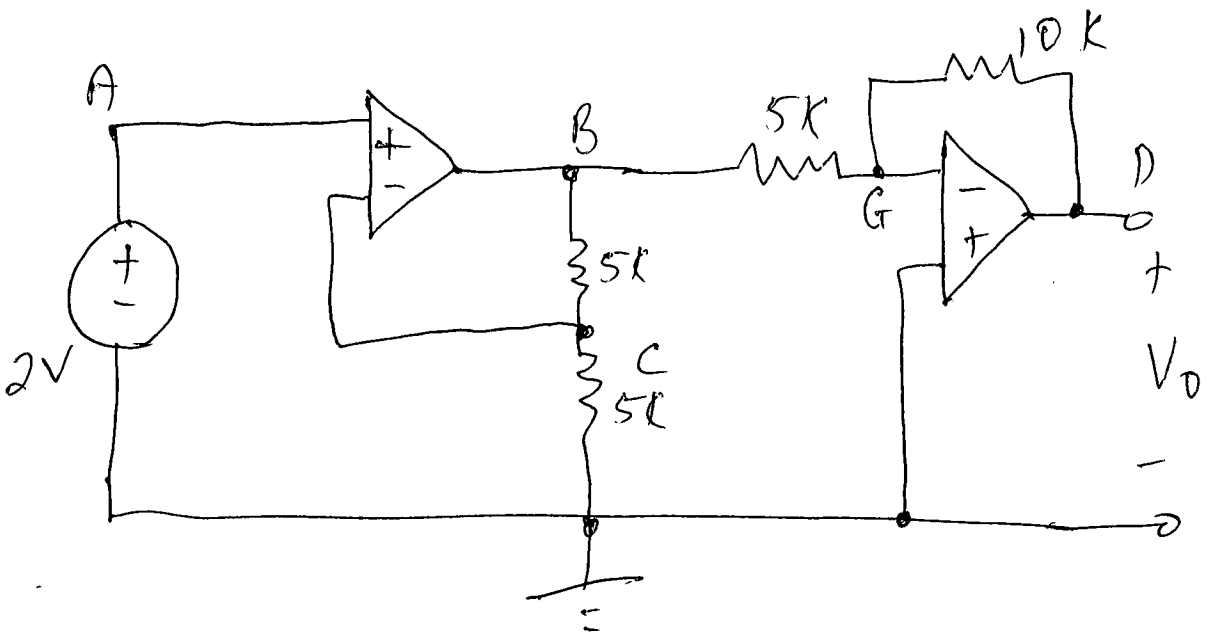
But $V_B = V_C = 0.1 V_D$

$$V_D = 10 V_B = \frac{10(200-j20)}{101} = 19.9\angle -5.7^\circ$$

$$\boxed{v_o(t) = 19.9\cos(1000t - 5.7^\circ)}$$

NAME: ID:

2)




C: $V_C = \frac{V_B}{2} = 0.5\,V_B$

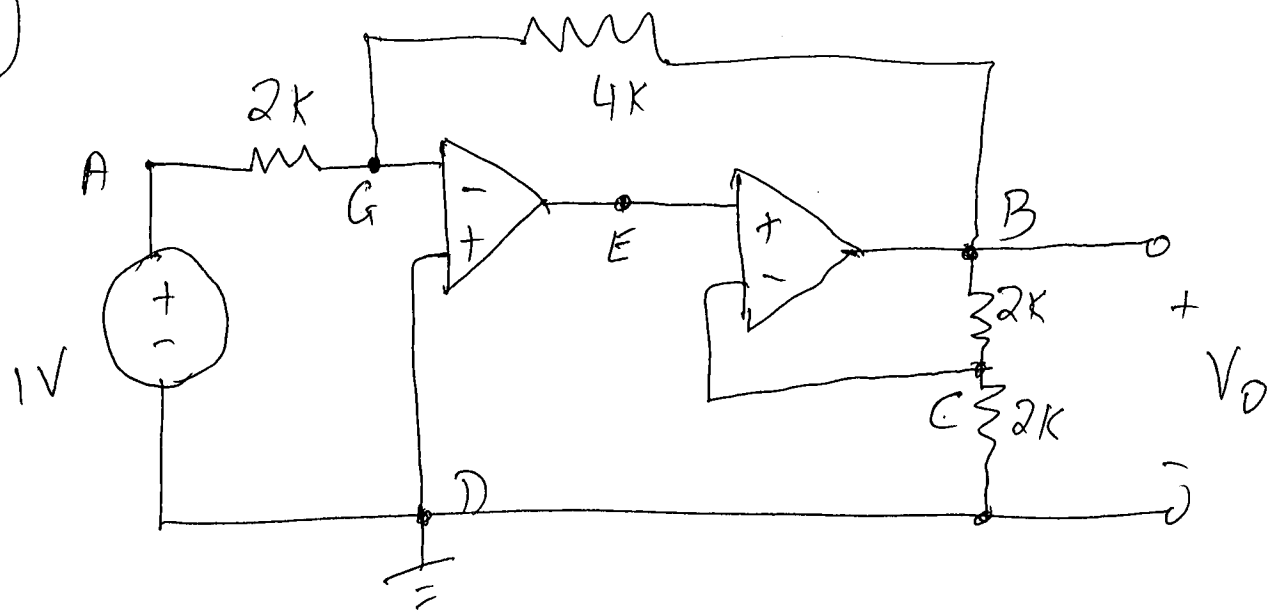
Note: $V_C = V_A = 2V \Rightarrow$ $\boxed{V_B = 4V}$

Note: $V_G = 0$

$$V_D = -\frac{10K}{5K} V_B = -2V_B = -8V$$

$$\boxed{V_O = V_D = -8V}$$

3)




$V_A = 1V$ , $V_G = 0$

$$G: \quad -\frac{1}{4K} V_B - \frac{1}{2K} V_A = 0 \Rightarrow -\frac{1}{4K} V_B = \frac{1}{2K} V_A$$

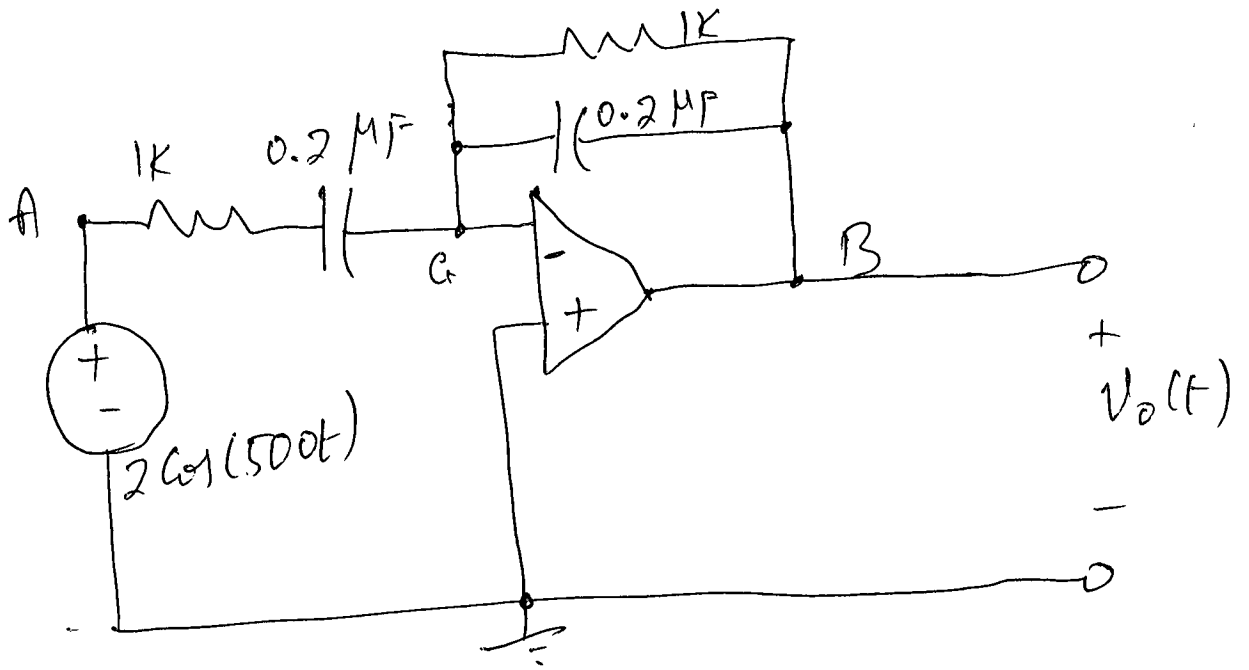
$$-\frac{1}{4} V_B = \frac{1}{2}(1) = \frac{1}{2} \Rightarrow \boxed{V_B = -2V}$$

$$\boxed{V_E = V_C = \frac{V_B}{2} = -1V}$$

$$\boxed{V_O = -2V}$$

(3)

4)




$$0.2\,\mu F \rightarrow \frac{1}{j(500)(0.2)10^{-6}} = -j10K$$

$$V_G = 0 \quad , \quad V_A = 2\angle 0^\circ ,$$

$$1K + 0.2\,\mu F \rightarrow 1K - j10K$$

$$(1K)\,||\,(0.2\,\mu F) \rightarrow \frac{(1K)(-j10K)}{1K - j10K} = \frac{-j10K}{1 - j10}$$

$$V_B = -\frac{\frac{-j10K}{1-j10}\cdot 2\angle 0^\circ}{1K - j10K} = -\frac{(-j10K)2\angle 0^\circ}{(1K - j10K)(1 - j10)}$$

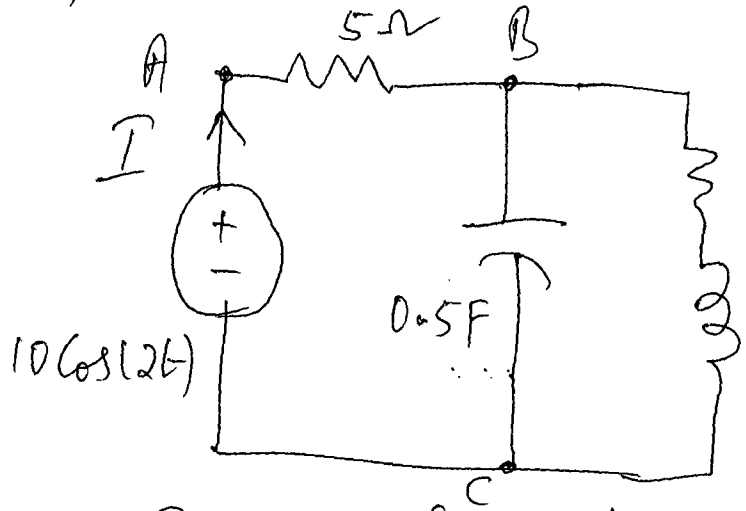
$$= \frac{(-j10)2\angle 0^\circ)}{(1-j10)(1-j10)} = \frac{(-j10)2\angle 0^\circ}{1-100-j20} = \frac{(-j10)2}{-99-j20}$$

$$V_B = \frac{-j20}{-99-j20} = \frac{j20}{99+j20} = 0.039 - j0.194 = 0.198\angle +78.5^\circ$$

$$0.198\cos(500t + 78.5^\circ) = v_o(t)$$

(4)

5)




$\omega = 2$ rad/s

$0.5F \rightarrow \frac{1}{j(2)(0.5)} = -$

$2h \rightarrow j(2)(2) = j4$

Find Power delivered by voltage Source

Note : 0.5F is || with 2Ω + 2h.

$$\frac{(-j)(2+j4)}{2+j4-j} = \frac{4-j2}{2+j3} = \frac{4-j2}{2+j3}\cdot\frac{2-j3}{2-j3}$$

$$= \frac{8-j4-j12-6}{4+9} = \frac{2-j16}{13}$$

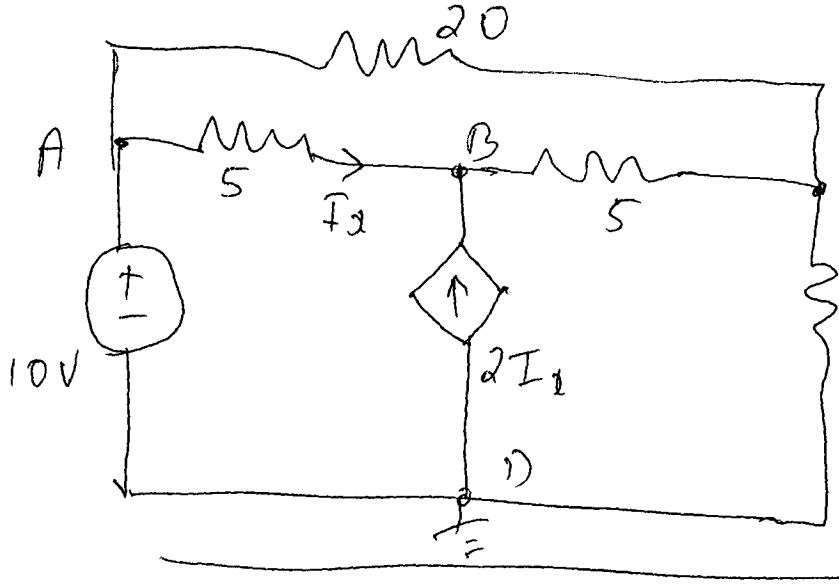
$$\text{Total Impedance} = 5 + \frac{2-j16}{13} = \frac{67-j16}{13}$$

$$I = \frac{10\angle 0^\circ}{(67-j16)/13} = \frac{130\angle 0^\circ}{67-j16} = 1.88\angle 13.4^\circ$$

$$P = \frac{10}{\sqrt{2}}\cdot\frac{1.88}{\sqrt{2}}\cos(13.4^\circ) = 5(1.88)\cos(13.4^\circ)$$

$$\boxed{P = 9.143\ W}$$

6)




$$I_x = \frac{10 - V_B}{2}$$

$$10 = \frac{10 - \frac{110}{12}}{2}$$

$$= \frac{10}{24} \Rightarrow \boxed{I_x = \frac{5}{12} A}$$

$V_A = 10V$, $I_x = \dfrac{V_A - V_B}{5}$

B: $$-\frac{1}{5}V_A + \left(\frac{1}{5} + \frac{1}{5}\right)V_B - 2I_x - \frac{1}{5}V_C = 0$$

$$\frac{2}{5}V_B - \frac{2(V_A - V_B)}{5} - \frac{1}{5}V_C = \frac{1}{5}V_A$$

$$2V_B - 2(V_A - V_B) - V_C = V_A = 10$$

$$4V_B - V_C = 2V_A + 10 = 30 \quad \text{—— (1)}$$

C:

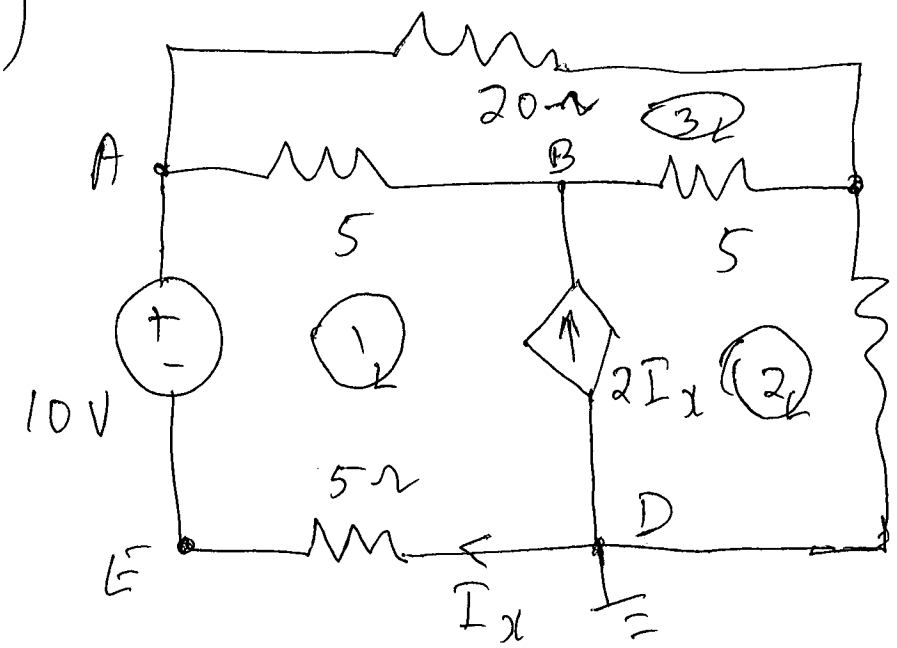
$$-\frac{1}{20}V_A - \frac{1}{5}V_B + \left(\frac{1}{5} + \frac{1}{10} + \frac{1}{20}\right)V_C = 0$$

$$-4V_B + 7V_C = V_A = 10 \quad \text{—— (2)}$$

Add (1) + (2) $\Rightarrow$ $6V_C = 40 \Rightarrow \boxed{V_C = \frac{20}{3} V}$

$$4V_B = V_C + 30 = \frac{20}{3} + 30 = \frac{110}{3} \Rightarrow \boxed{V_B = \frac{110}{12} V}$$

7)




- Note

$V_A - V_E = 10V$

Note : (A-E) is Super node

(A-E): $\left(\frac{1}{5} + \frac{1}{20}\right)V_A - \frac{1}{5}V_B - \frac{1}{20}V_C + \frac{1}{5}V_E = 0$

Four nodes → Two complex

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Loop Analysis. Note (1-2) is Super loop

(1-2): $10I_1 - 5I_3 - 10 + 15I_2 - 5I_3 = 0$

$10I_1 + 15I_2 - 10I_3 = 10$ ——— (1)

3 : $-5I_1 - 5I_2 + 30I_3 = 0$ ——— (2)

Note : $I_x = I_1$ , $2I_x = I_2 - I_1 = I_2 - I_x$

$3I_x = I_2 = 3I_1$

We have

$$10I_1 + 15I_2 - 10I_3 = 10 \quad \text{—} \quad (1)$$

$$-5I_1 - 5I_2 + 30I_3 = 0 \quad \text{—} \quad (2)$$

$$I_2 = 3I_1 \quad \text{—} \quad (3)$$

Eliminate $I_2$

$$10I_1 + 45I_1 - 10I_3 = 10$$

$$-5I_1 - 15I_1 + 30I_3 = 0$$

$$55I_1 - 10I_3 = 10 \qquad \times 3$$

$$-20I_1 + 30I_3 = 0$$

$$165I_1 - 30I_3 = 30$$

$$145I_1 = 30 \Longrightarrow \boxed{I_1 = \frac{30}{145}\ A}$$

$$\boxed{I_2 = 3I_1 = \frac{90}{145}\ A}$$

$$\boxed{V_0 = 10I_2 = \frac{900}{145} = 6.207\ V}$$