Quiz #1 Solution

Name:_____ **Student#:**_____ [Points Acquired: ( ) /100]

Problem 1: O/X Quiz. [10 points]

① All circuits must have a complete path for current. (모든 회로는 전류를 위한 완전한 경로를 가져야 한다.) [O / X] O

② The unit of charge is the ampere. (전하의 단위는 암페어이다.) [O / X] X

③ If the total resistance of a circuit increases, current decreases. (회로의 전체 저항이 증가하면 전류는 감소한다.) [O / X] O

④ If a 10 kΩ resistor is connected to a 10 V source, the current in the resistor will be 1 A. (10 kΩ 저항이 10 V 전원에 연결되면 저항에 흐르는 전류는 1 A가 된다.) [O / X] X

⑤ If three equal resistors are used in a voltage divider, the voltage across each one will be one-third of the source voltage. (만약 3개의 동일한 저항이 전압 분배에 사용된다면 각각에 걸리는 전압은 전원전압의 1/3일 것이다.) [O / X] O

⑥ In a parallel circuit, the voltage is larger on a larger resistor and smaller on a smaller resistor. (병렬회로에서 큰 저항의 전압은 높고 작은 저항의 전압은 낮다.) [O / X] X

⑦ In a series-parallel combinational circuit, the same current will always be in parallel resistors. (직렬-병렬 조합회로에서 동일한 전류가 병렬 저항들에 항상 흐를 것이다.) [O / X] X

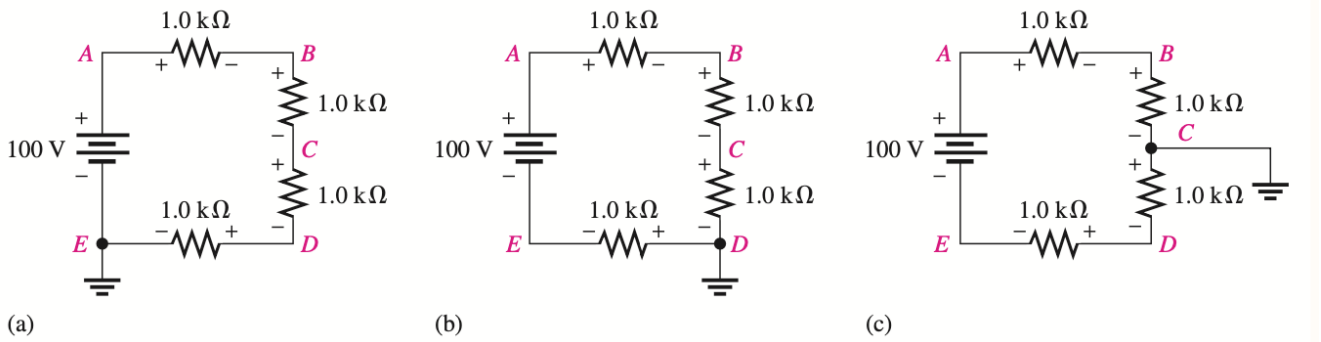
⑧ The peak value of a sine wave is the same as its amplitude. (싸인파의 피크값(최대값)은 진폭과 같다.) [O / X] O

⑨ When two capacitors are in series with a voltage source, the smaller capacitor will have the larger voltage. (2개의 커패시터가 전압원과 직렬로 연결될 때, 작은 커패시터가 큰 전압을 갖을 것이다.) [O / X] O

⑩ Admittance is the reciprocal of susceptance. (어드미턴스는 서셉턴스의 역수이다.) [O / X] X

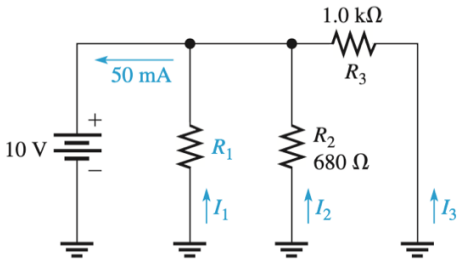
Problem 2: [15 Points]

Determine the voltages at each of the indicated points (A, B, C, D, and E) in each circuit of the Figure with respect to ground. Since each of the four resistors has the same value, 25 V are dropped across each one. (그림의 각회로에 표시된 각 점(A, B, C, D 및 E)의 전압을 접지에 대하여 결정하라. 4개의 저하이 모두 같은 값이므로 각 저항 양단의 전압 강하는 25 V이다.)



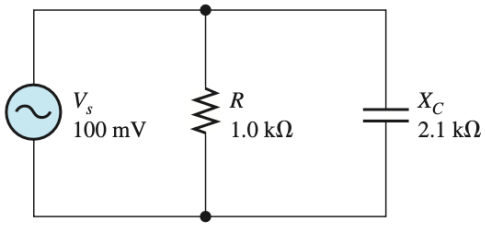
Problem 3: [10 Points]

Find the values of the unspecified quantities (I_1, I_2, I_3, and R_1) in the circuit given below. (아래 회로에서 숫자로 표기되지 않은 값들(I_1, I_2, I_3, and R_1)을 찾아라.)



Problem 4: [40 Points]

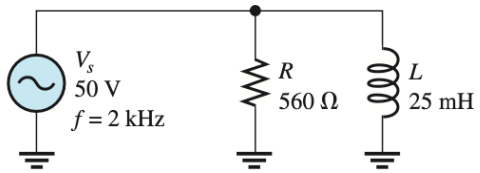
4-1. For the circuit given below, determine the following: (a) Z, (b) I_R, (c) I_C, (d) I_{tot}, (e) θ.
(아래 회로에 대하여 다음 값들을 결정하여라: (a) Z, (b) I_R, (c) I_C, (d) I_{tot}, (e) θ.)



4-2. Repeat Problem 4-1 for $R = 4.7\ \text{k}\Omega$, $C = 0.047\ \mu\text{F}$, $f = 500\ \text{Hz}$.
($R = 4.7\ \text{k}\Omega$, $C = 0.047\ \mu\text{F}$, $f = 500\ \text{Hz}$ 일 때 문제 4-1을 반복하여라.)

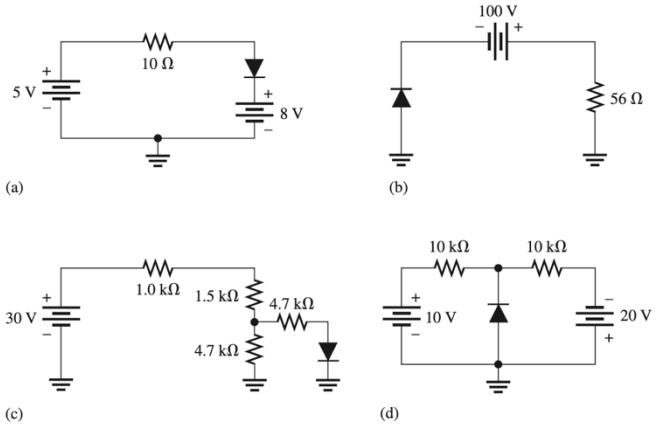
Problem 5: [20 Points]

Determine the following quantities in the circuit: (a) Z, (b) I_R, (c) I_L, (d) I_{tot}, (e) θ.
(아래 회로에 대하여 다음 값들을 결정하여라: (a) Z, (b) I_R, (c) I_L, (d) I_{tot}, (e) θ.)



Problem 6: [5 Points]

Determine whether each diode in the circuit is forward-biased or reverse-biased.
(회로에서 각각의 Diode가 순방향 바이어스인지 또는 역방향 바이어스인지 결정하여라.)



Solutions

Problem 1:

(1) O, (2) X, (3) O, (4) X, (5) O, (6) X, (7) X, (8) O, (9) O, (10) X

Problem 2:

(a) $V_A = +100$ V, $V_B = +75$ V, $V_C = +50$ V, $V_D = +25$ V, $V_E = 0$ V
(b) $V_A = +75$ V, $V_B = +50$ V, $V_C = +25$ V, $V_D = 0$ V, $V_E = -25$ V
(c) $V_A = +50$ V, $V_B = +25$ V, $V_C = 0$ V, $V_D = -25$ V, $V_E = -50$ V

Problem 3:

$I_3 = V_{R3} / R_3 = V_S / R_3 = 10\text{ V} / 1.0\text{ k}\Omega = 10\text{ mA}$
$I_2 = V_{R2} / R_2 = V_S / R_2 = 10\text{ V} / 680\ \Omega = 14.7\text{ mA}$
$I_1 = I_T - (I_2 + I_3) = 50\text{ mA} - (14.7\text{ mA} + 10\text{ mA}) = 25.3\text{ mA}$
$R_2 = V_{R1} / I_1 = V_S / I_1 = 10\text{ V} / 25.3\text{ mA} = 395\ \Omega$

Problem 4:

4-1

(a) $Z_{tot} = \dfrac{RX_C}{\sqrt{R^2 + X_C^2}} = \dfrac{(1.0\text{ k}\Omega)(2.1\text{k}\Omega)}{\sqrt{(1.0\text{ k}\Omega)^2 + (2.1\text{ k}\Omega)^2}} = \mathbf{903\ \Omega}$

(b) $I_R = \dfrac{V_S}{R} = \dfrac{100\text{ mV}}{1.0\text{ k}\Omega} = \mathbf{100\ \mu A}$

(c) $I_C = \dfrac{V_S}{X_C} = \dfrac{100\text{ mV}}{2.1\text{ k}\Omega} = \mathbf{47.6\ \mu A}$

(d) $I_{tot} = \dfrac{V_S}{Z_{tot}} = \dfrac{100\text{ mV}}{903\ \Omega} = \mathbf{111\ \mu A}$

(e) $\theta = \tan^{-1}\left(\dfrac{R}{X_C}\right) = \tan^{-1}\left(\dfrac{1.0\text{ k}\Omega}{2.1\text{ k}\Omega}\right) = \mathbf{25.5°\ (}\boldsymbol{I_{tot}}\mathbf{\ leads\ }\boldsymbol{V_s}\mathbf{)}$

4-2

$X_C = \dfrac{1}{2\pi(500\text{ Hz})(0.047\ \mu\text{F})} = 6.77\text{ k}\Omega$

(a) $Z = \dfrac{(4.7\text{ k}\Omega)(6.77\text{ k}\Omega)}{\sqrt{(4.7\text{ k}\Omega)^2 + (6.77\text{ k}\Omega)^2}} = \mathbf{3.86\ k\Omega}$

(b) $I_R = \dfrac{V_S}{R} = \dfrac{100\text{ mV}}{4.7\text{ k}\Omega} = \mathbf{21.3\ \mu A}$

(c) $I_C = \dfrac{V_S}{X_C} = \dfrac{100\text{ mV}}{6.77\text{ k}\Omega} = \mathbf{14.8\ \mu A}$

(d) $I_{tot} = \dfrac{V_S}{Z} = \dfrac{100\text{ mV}}{3.86\text{ k}\Omega} = \mathbf{25.9\ \mu A}$

(e) $\theta = \tan^{-1}\left(\dfrac{4.7\text{ k}\Omega}{6.77\text{ k}\Omega}\right) = \mathbf{34.8°\ (}\boldsymbol{I_{tot}}\mathbf{\ leads\ }\boldsymbol{V_s}\mathbf{)}$

Problem 5:

(a) $2\pi(2.0\text{ kHz})(25\text{ mH}) = 314\ \Omega$

$$Z = \frac{RX_L}{\sqrt{R^2+X_L^2}} = \frac{(560\ \Omega)(314\ \Omega)}{\sqrt{(560\ \Omega)^2+(314\ \Omega)^2}} = \mathbf{274\ \Omega}$$

(b) $$I_R = \frac{V_S}{R} = \frac{50\text{ V}}{560\ \Omega} = \mathbf{89.3\ mA}$$

(c) $$I_L = \frac{V_S}{X_L} = \frac{50\text{ V}}{314\ \Omega} = \mathbf{159\ mA}$$

(d) $$I_{tot} = \frac{V_S}{Z} = \frac{50\text{ V}}{274\ \Omega} = \mathbf{182\ mA}$$

(e) $$\theta = \tan^{-1}\left(\frac{R}{X_L}\right) = \tan^{-1}\left(\frac{560\ \Omega}{314\ \Omega}\right) = \mathbf{60.7°\ (}\boldsymbol{I_{tot}}\mathbf{\ lags\ }\boldsymbol{V_S}\mathbf{)}$$

Problem 6:

(a) The diode is reverse-biased because the anode is at 5.0 V and the cathode is at 8.0 V.
(b) The diode is forward-biased because the anode is at ground and the cathode is at -100 V.
(c) The diode is forward-biased by the positive voltage produced by the voltage divider.
(d) The diode is forward-biased because its cathode is more negative than the anode due to the -80 V source.