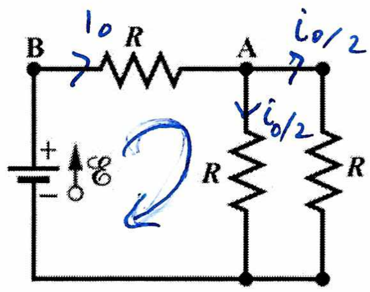
Quiz # 8 Ch.#27 T131-Sec. 7-9-v1

Student ID:……… …… Student Name:………… ………. Section # ……….

Q#1 In the circuit of Figure: $\varepsilon = 30$ V, and the resistance of each resistor is 10 Ω. What is the potential difference $V_A - V_B$? A) – 20 V



$V_B - i_0 R = V_A \Rightarrow V_A - V_B = -i_0 R$.

For. i_0 calculations

$\varepsilon - i_0(R + \frac{R}{2}) = \varepsilon - i_0 \times \frac{3R}{2} = 0$

$i_0 = \frac{2\varepsilon}{3R} = \frac{2\times 30}{3\times 10} = 2A$

$V_A - V_B = -i_0 R = -2\times 10 = -20V$

4/4

Q#2 Find the value of R_1 in the circuit of figure (5). (Ans: A1 6.0 ohms.

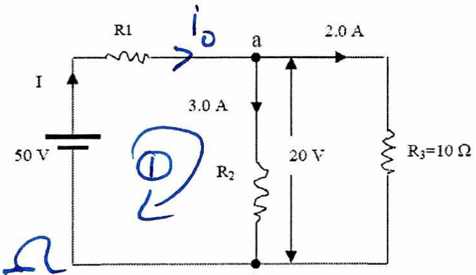


Figure 5

$i_0 = 2 + 3 = 5A$

in the loop ①

$50 - i_0 R_1 - 20 = 0$

$R_1 = \frac{20-50}{-i_0} = \frac{-30}{-5} = 6\Omega$

3/3

Q#3: A capacitor of 4 x 10^{-3} F capacitance is discharged through a 4 kΩ resistor. How long will it take for the capacitor to lose half its initial stored energy? A) 5.5 s

$U(t) = \frac{1}{2} C V^2(t) = \frac{1}{2} C V_0^2 e^{-\frac{2t}{RC}} = U_0 e^{-2t/RC}$

$\frac{U(t)}{U_0} = \frac{1}{2} = e^{-2t/RC} \Rightarrow \ln(\frac{1}{2}) = -\frac{2t}{RC}$

$t = -\frac{RC}{2} \ln(\frac{1}{2}) = -\frac{4\times 10^{3} \times 4\times 10^{-3}}{2} \times \ln(\frac{1}{2})$

$t = -8 \times \ln(\frac{1}{2}) = 5.55 s.$

4/4

Quiz # 8 Ch.#27 T131-Sec. 7-9-v2

Student ID:……… …… Student Name:………… ………. Section # ……….

Q#1 In the circuit shown in figure 1, calculate potential difference V_B-V_A. The points A, B and C are three junctions. [Take the current I=2.0 A] (Ans: A1 8.0 V.

$V_A - 3I + 6 + 2I + 4 = V_B$

$V_B - V_A = -3I + 6 + 2I + 4$

$= -I + 10$

$= -2 + 10 = 8.0\ V$

3/3

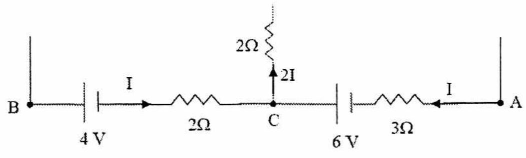


Figure (1)

Q#2: In the circuit shown in figure 4, I=0.65A and R=15 Ohms. What is the value of the emf of the battery? (Ans: A1 39 V

$\mathcal{E} - 2IR - 2IR = 0$

$\mathcal{E} - 4IR = 0$

$\mathcal{E} = 4IR$

$= 4 \times 0.65 \times 15$

$\mathcal{E} = 39\ V$

4/4

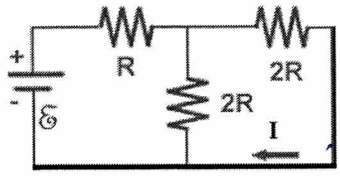
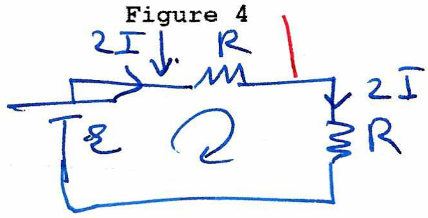


Figure 4



Q#3: Initially, for the circuit shown in **Figure 5**, the switch S is open and the capacitor is uncharged. The switch S is closed at time t = 0. At what time will the current be half its initial value? (12.5 s)

$i(t) = \frac{\mathcal{E}}{R} e^{-t/RC} = i_0 e^{-t/RC}$

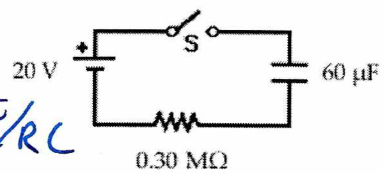
$\frac{i(t)}{i_0} = e^{-t/RC} \Rightarrow \ln\left(\frac{i(t)}{i_0}\right) = -t/RC$

$\ln\left(\frac{1}{2}\right) = -\frac{t}{RC}$

$t = -RC \ln\left(\frac{1}{2}\right) = -3\times10^{5} \times 60 \times 10^{-6} \ln\left(\frac{1}{2}\right)$

$t = -18 \ln\left(\frac{1}{2}\right) = 12.47\ s$

4/4



Quiz # 8 Ch.#27 T131-Sec. 7-9-v3

Student ID:…………… Student Name:………………….. Section # ……….

Q#1: Three resistors are connected as shown in figure 3. The potential difference between points A and B is 26 V. How much current flows through the 4-Ohm resistor? A1 2.0 A)

at Junction C: $I = I_2 + I_4$

but $I \times 3 + I \times \frac{2 \times 4}{2+4} = 26$

$I(3 + \frac{8}{6}) = 26 \Rightarrow I = \frac{26}{4.33} = 6.0\ A$

Then $I_4 \times 4 = (I - I_4) \times 2$

$4I_4 = 2I - 2I_4 \Rightarrow 6I_4 = 2I$

$I_4 = \frac{2}{6}I = \frac{2}{6} \times 6 = 2.0\ A$

4/4

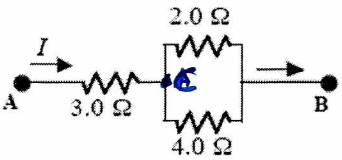


Figure 3

Q#2: In the circuit shown in figure 5, what is the current in the 8.00-Ohm resistor? A1 2.25 A to the left

Considering the outer most loop

$3 \times 4 - I_8 \times 8 - 5 \times 6 = 0$

$8I_8 = 12 - 30 = -18$

$I_8 = -\frac{18}{8} = -2.25\ A$

2.25 A to the left.

3/3

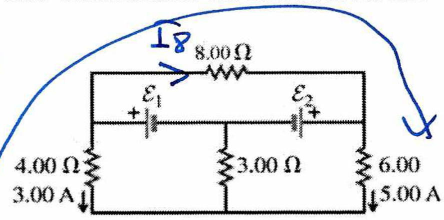


Figure 5

Q#3 A 5.0 μF capacitor is fully charged by connecting it to a 12-V battery. After disconnecting the battery, it was allowed for capacitor to discharge through a simple RC circuit, with a time constant of 4.0 s. What is the charge on the capacitor after one time constant has elapsed? (Ans: A1 2.2×10^{-5}) C

$q(t) = q_0 e^{-t/RC} = q_0 e^{-t/\tau} = q_0 e^{-1}$

$\frac{q(t)}{q_0} = e^{-1} \Rightarrow q(t) = e^{-1} q_0 = 0.368 \times q_0$

$q_0 = CV_0 = 5 \times 10^{-6} \times 12\ C$

$q(t) = 0.368 \times q_0 = 0.368 \times 5 \times 10^{-6} \times 12 = 22\ \mu C$

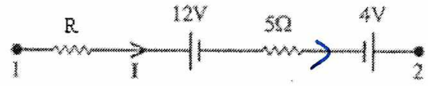
$= 2.2 \times 10^{-5}\ C$

4/4

Quiz # 8 Ch.#27 T131-Sec. 7-9-v4

Student ID:……… …… Student Name:……… ………..… Section # ……….

Q1 In the figure shown, the potential difference between point 1 and 2, (V_2-V_1), is -40 V, and the current is equal to 4.0 A, then, the value of the resistance R is : (Ans: 3.0 Ω.



$V_1 - IR - 12 - 5I + 4 = V_2$

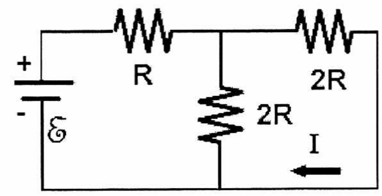
$-IR = (V_2 - V_1) + 12 + 5I - 4$

$-IR = -40 + 12 + 5\times4 - 4 = -12$

$R = \frac{12}{I} = \frac{12}{4} = 3\Omega.$

4/4

Q#2: In Fig. 4, I = 0.5 A and R = 12 Ω. What is the value of the emf ε?A) 24 V

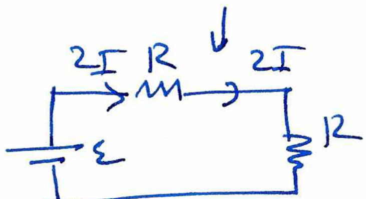


$\mathcal{E} - 2IR - 2IR = 0$

$\mathcal{E} - 4IR = 0$

$\mathcal{E} = 4\times0.5\times12$

$\mathcal{E} = 24\ V$



3/3

Q3. A capacitor, initially uncharged in a single-loop RC circuit, charged to 85% of its final potential difference in 2.4 s. What is its time constant in seconds? . (Ans: A1 1.3

$V(t) = V_0(1 - e^{-t/RC})$

$\frac{V(t)}{V_0} = 1 - e^{-t/RC} \Rightarrow \frac{V(t)}{V_0} - 1 = -e^{-t/RC}$

$0.85 - 1 = -0.15 = -e^{-t/RC} = -e^{-t/\tau}$

$-0.15 = -e^{-t/\tau}$

$\ln(0.15) = -t/\tau$

$\tau = \frac{-t}{\ln(0.15)} = \frac{-2.4}{\ln(0.15)} = 1.27\ s$

4/4

Quiz # 8 Ch.#27 T131-Sec. 7-9-v5

Student ID:........... Student Name:........... .... Section # ....

Q#1: The potential at point P shown in figure 1 is 20 V. What is the potential at point **Q**. (Ans: -18 V.)

$V_P - 20 - 6I = V_Q$

$20 - 20 - 6I = V_Q \Rightarrow V_Q = -6I$

To calculate I

$50 - 4I - 20 + 6I = 0$

$30 - 10I = 0 \Rightarrow I = 3A$

$V_Q = -6I = -6\times 3 = -18V$

4/4

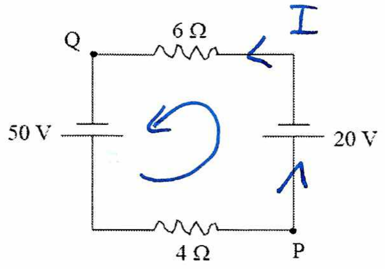


Figure 1

Q#2: In Figure 2, $R_1 = R_2 = R_3 = 5\ \Omega$. What is the value of the emf of the second battery ε_2. (Ans: 5 V.

$-\varepsilon_2 - 0.5\times 5 + 1.5\times 5 = 0$

$-\varepsilon_2 - 2.5 + 7.5 = 0$

$\varepsilon_2 = 5V$

3/3

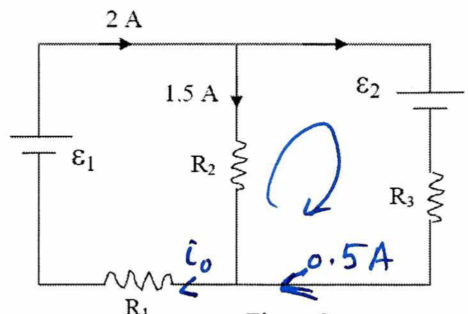


Figure 2

Q#3: An uncharged capacitor is connected as in the circuit shown. When the switch is closed, the charge on the capacitor reaches half its maximum value in 20 ms. If R=500 Ω and the voltage of the battery is 10 V, then the capacitance of the capacitor is:

$q(t) = q_0(1 - e^{-t/RC})$

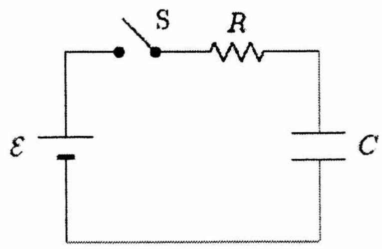
$\frac{q(t)}{q_0} - 1 = -e^{-t/RC}$

$0.5 - 1 = -0.5 = -e^{-t/RC}$

$\ln(0.5) = -t/RC$

$C = \frac{-t}{R\ln(0.5)} = \frac{-20\times 10^{-3}}{500\times \ln(0.5)} = 57.7\mu F$

4/4



Quiz # 8 Ch.#27 T131-Sec. 7-9-v6

Student ID:……… …… Student Name:………… ………. Section # ……….

If Q= 400 μC and the potential difference V_A-V_B = - 30 V in the circuit segment shown in Fig. 3, what is the current in the resistor R? (Ans) 1.0 mA counterclockwise

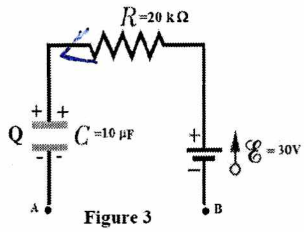


Figure 3

$V_A + \frac{Q}{C} + iR - 30 = V_B$

$V_A - V_B + \frac{Q}{C} + iR - 30 = 0$

$-30 + \frac{400\times10^{-6}}{10\times10^{-6}} + i\times20\times10^{3} - 30 = 0$

$-60 + 40 + 20\times10^{3}\times i = 0$

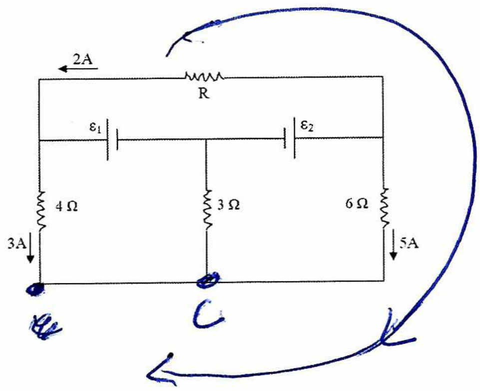
$-20 + 20\times10^{3}\, i = 0$

$-1 + 10^{3} i = 0$

$i = +10^{-3}\,A$

4/4

Q#2 In the following figure, find the current in 3 Ω resistor and the resistance R for the given currents. A) 8 A, 9 Ω



in the outer most loop, starting from C junction

$3 + 5 = i_3 \Rightarrow i_3 = 8A$

going around outer most loop starting at C

$3\times4 + 2R + 5\times6 = 0$

$12 + 2R - 30 = 0$

$R = \frac{-18}{-2} = 9\,\Omega$

4/4

Q#3: A capacitor of capacitance 5.0x10^{-6} F is discharging through a 4.0 M Ω resistor. At what time will the energy stored in the capacitor be half of its initial value? (Ans: 7 s

$U(t) = \frac{1}{2} C V(t)^2 = \frac{1}{2} C V_0^2 e^{-2t/RC} = U_0 e^{-2t/RC}$

$\frac{U(t)}{U_0} = \frac{1}{2} = e^{-2t/RC}$

$\ln\left(\frac{U(t)}{U_0}\right) = \ln\left(\frac{1}{2}\right) = -2t/RC$

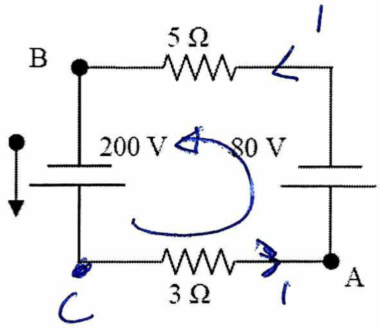
$t = -\frac{RC}{2}\ln\left(\frac{1}{2}\right) = -\frac{4\times10^{6}\times5\times10^{-6}}{2}\ln\left(\frac{1}{2}\right) = 6.93\,s$

3/3

Quiz # 8 Ch.#27 T131-Sec. 7-9-v7

Student ID:......... ...... Student Name:............ .... Section # ....

Q#1: Two ideal emf sources along with two resistors are connected as shown in the following figure. If the potential at A is 150 V, what would be the potential at point B? A) - 5 V



$V_A - 80 - 5I = V_B$

For calculation of I, starting at C

$-3i - 80 - 5i + 200 = 0$

$-8i + 120 = 0$

$i = \frac{-120}{-8} = 15\,A$

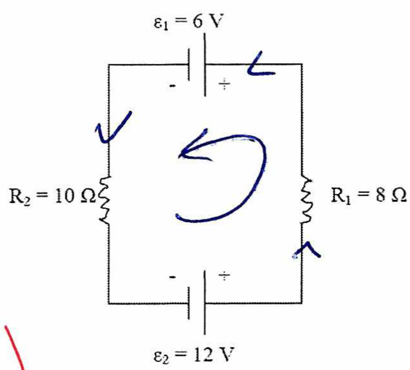
Then

$V_A - 80 - 5I = V_B$

$150 - 80 - 5 \times 15 = V_B \Rightarrow V_B = 150 - 155 = -5\,V$

4/4

Q#2: A single loop circuit contains two external resistors and two emf sources as shown in the figure. Assume the emf sources are ideal, what is the power dissipation across resistor R1. A) 0.9 W



$P_{R_1} = i^2 R$

to calculate i

$12 - 8i - 6 - 10i = 0$

$6 - 18i = 0$

$i = \frac{6}{18} = \frac{1}{3}\,A$

$P_{R_1} = i^2 R = \left(\frac{1}{3}\right)^2 \times 8 = \frac{8}{9}\,W$

4/4

Q#3: A 1.0 μF capacitor with an initial stored energy of 0.50 J is discharged through a 1.0 M Ω resistor. Find the current through the resistor when the discharge starts. A) 1.0 mA

$C = 1.0\,\mu F$, $U = \frac{1}{2} C V_0^2 \Rightarrow V_0 = \sqrt{\frac{2U}{C}} = \sqrt{\frac{2 \times 0.5}{10^{-6}}}$

$V_0 = 1000\,V$

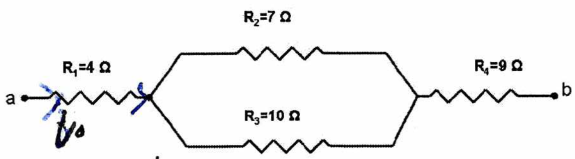
$i_0 = \frac{V_0}{R} = \frac{1000}{10^6} = 10^{-3}\,A$

3/3

Quiz # 8 Ch.#27 T131-Sec. 7-9-v8

Student ID:……… …… Student Name:………… ……..… Section # ……….

Q#1: Four resistors are connected as shown in the figure. What is the current through R_1, when a potential difference of 30.0 Volts is applied between points a and b? (Ans: A) 1.75 A



$V_a - i_0 R' = V_b$

$V_a - V_b = i_0 R'$

$i_0 = \frac{V_a - V_b}{R'}$

$i_0 = \frac{30}{17.11} = 1.75A$

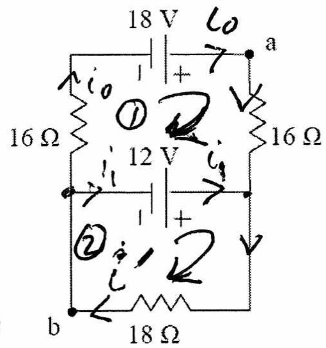
V_a → 4 Ω, R_{eq}, 9 Ω → V_b

V_a → i_0 R' → V_b

$R' = 4 + \frac{7 \times 10}{7+10} + 9 = 4 + \frac{70}{17} + 9 = 17.11\,\Omega$

4/4

Q2 Three resistors and two batteries are connected as shown in the circuit diagram below. What is the potential difference $V_a - V_b$? A) 15 V



$V_a - 16 i_0 - 18 i' = V_b$

in loop ①

$-16 i_0 + 18 - 16 i_0 - 12 = 0 \Rightarrow -32 i_0 + 6 = 0$

$i_0 = \frac{6}{32} = 0.188A$

in loop ②

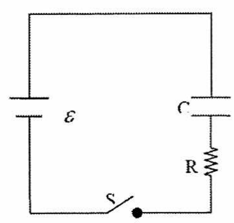
$12 - 18 i' = 0 \Rightarrow i' = \frac{12}{18} = 0.67A$

$V_a - 16 \times 0.188 - 18 \times 0.67 = V_b$

$V_a - V_b = 16 \times 0.188 + 18 \times 0.67 = 15.06V$

4/4

Q#:3 Consider a series RC circuit as shown in the following circuit, where R= 1.0 x 10^6 Ω , C=5.0 μF and ε = 30 V. If the switch is closed at t =0, what is the current in resistance R at time 10 s after the switch is closed? (Ans; 4.1×10^{-6} A



$i(t) = \frac{\varepsilon}{R} \times e^{-t/RC}$

$= \frac{30}{10^6} \times e^{-10/(10^6 \times 5 \times 10^{-6})} = \frac{30}{10^6} e^{-(10/5)}$

$= \frac{30}{10^6} \times e^{-(+2)}$

$i(t) = 30 \times 10^{-6} \times e^{-2} = 30 \times 10^{-6} \times 0.135 = 4.1 \times 10^{-6} A$

3/3

Quiz # 8 Ch.#27 T131-Sec. 7-9-v9

Student ID:……… …… Student Name:………… ……..… Section # ………

Q1: If $V_a - V_b = 3.2$ V, what is $V_d - V_c$?

$-i_4 = \frac{(V_a - V_b)}{R}$; $i_4 = +\frac{V_b - V_a}{R} = \frac{-3.2}{2} = -1.6A$

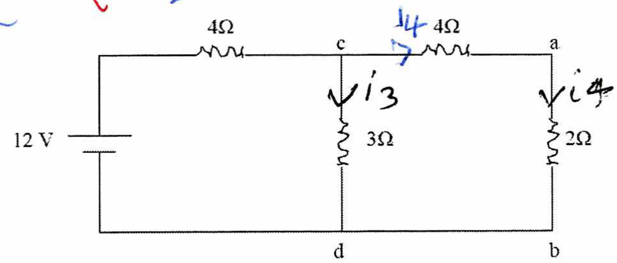
$V_c - i_4(4+2) = V_d$

$V_d - V_c = -i_4 \times 6$

$= -1.6 \times 6$

$V_d - V_c = -9.6V$

3/3



Q#2: In the circuit shown in Figure 6, $\varepsilon_1 = 6.00$ V, $\varepsilon_2 = 12.0$ V, $R_1 = 200\ \Omega$, and $R_2 = 100\ \Omega$. What is the power supplied by ε_1? (Consider the two emf to be ideal).

$P_{\varepsilon_1} = i_2 \varepsilon_1$

in loop (2)

$i_1 R_1 - i_2 R_2 + 6 = 0$

in loop (1)

$i_1 R_1 - 12 = 0$

$i_1 = \frac{12}{R_1} = \frac{12}{200} = 0.06A$

Then $i_1 R_1 - i_2 R_2 + 6 = 0$

$i_2 = \frac{6 - i R_1}{R_2} = \frac{6 - 0.06 \times 200}{100} = 0.18A$

$P_{\varepsilon_1} = i_2 \varepsilon_1 = 0.18 \times 6 = 1.08 W$

4/4

Fig#

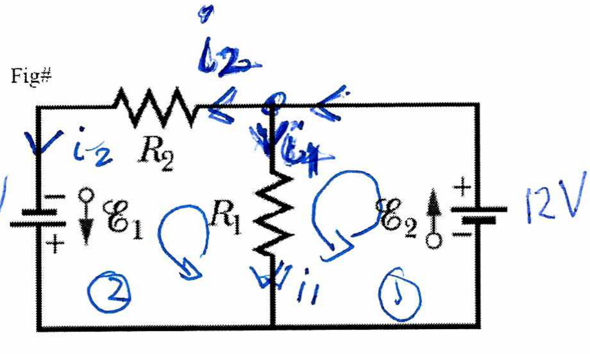


Figure 6

Q#3: A capacitor of capacitance C takes 2 s to reach 63 % of its maximum charge when connected in series to a resistance R and a battery of emf ε. How long does it take for this capacitor to reach 95 % of its maximum charge (from zero initial charge)?

$q(t) = q_0(1 - e^{-t/RC}) \Rightarrow \frac{q(t)}{q_0} - 1 = 0.63 - 1 = -e^{-t/RC}$

$0.37 = e^{-t_1/RC} \Rightarrow \ln(0.37) = -t_1/RC$

Since $\frac{q(t_2)}{q_0} - 1 = 0.95 - 1 = 0.05 = e^{-t_2/RC}$

$\ln(0.05) = -\frac{t_2}{RC}$ Then $\frac{\ln(0.05)}{\ln(0.37)} = \frac{t_2/RC}{t_1/RC} = \frac{t_2}{t_1}$

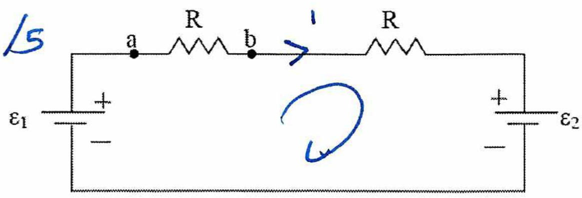
$t_2 = t_1 \frac{\ln(0.05)}{\ln(0.37)} = \frac{2 \times \ln(0.05)}{\ln(0.37)} = 6.0 s$

4/4

Quiz # 8 Ch.#27 T131-Sec. 7-9-v10

Student ID:……… …… Student Name:………… ………. Section # ……….

Q#1 The figure shows two resistors, each of the resistance R, connected to two ideal batteries of emf ε1 and ε_2 ($\varepsilon_1 > \varepsilon_2$). The potential difference $V_a - V_b$ is equal to $\varepsilon_1/5$. What is the ratio $\varepsilon_2/\varepsilon_1$? (Ans: A) 3/5



$V_a - iR = V_b$

$iR = V_a - V_b = \varepsilon_1/5$

$i = \frac{\varepsilon_1}{5R}$

in the loop

$\varepsilon_1 - iR - iR - \varepsilon_2 = 0$

$\varepsilon_1 - 2iR = \varepsilon_2$

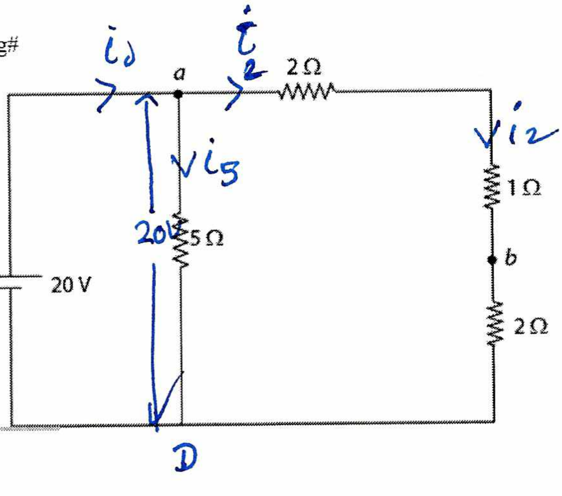
$\frac{\varepsilon_2}{\varepsilon_1} = 1 - \frac{2iR}{\varepsilon} = 1 - \frac{2R}{\varepsilon} \times i = 1 - \frac{2R}{\varepsilon} \times \frac{\varepsilon_1}{5R} = 1 - \frac{2}{5} = \frac{3}{5}$

$\frac{\varepsilon_2}{\varepsilon_1} = \frac{3}{5}$

4/4

Q#2 In Fig 3, what is the potential difference V_a-V_b?

Fig#



$V_a - i_2 \times 2 - i_2 \times 1 = V_b$

$V_a - V_b = i_2(2+1) = 3i_2$

but

$V_a - i_2 \times 2 - i_2 \times 1 - i_2 \times 2 = V_D$

$V_a - V_D = 2i_2 + i_2 + 2i_2 = 5i_2$

but $V_a - V_D = 20\,V$

$V_a - V_D = 20 = 5i_2$

$i_2 = \frac{20}{5} = 4\,A$

then $V_a - V_b = 3 \times i_2 = 3 \times 4 = 12\,V$

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Q#3: A capacitor of capacitance C is discharging through a resistor of resistance R. In terms of RC, when will the energy stored in the capacitor reduces to one fifth of its initial value? (Ans: A1 0.80 RC.

$U(t) = \frac{1}{2} C V^2(t) = \frac{1}{2} C V_0^2 e^{-2t/RC} = U_0 e^{-\frac{2t}{RC}}$

$\frac{U(t)}{U_0} = e^{-2t/RC}$

$\frac{1}{5} = e^{-2t/RC} \Rightarrow \ln\left(\frac{1}{5}\right) = -\frac{2t}{RC}$

$t = -\frac{RC}{2} \ln\left(\frac{1}{5}\right) = 0.805 \times RC$

3/3