Quiz #9 Ch#27 T122 Phys101.28-30-v1

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

Q#1: If the current I in figure (5) is equal to 4.0 A, then the potential difference between point 1 and 2, i.e. (V2 -V1), is: (A. 40 Volts.)

$V_1 - 4\times3 - 12 - 5\times4 + 4 = V_2$

$V_2 - V_1 = -12 - 12 - 20 + 4$

$= -40V$

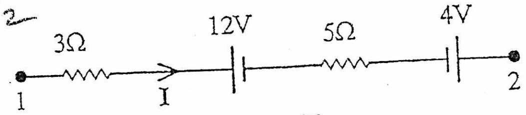


Figure (5)

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: 5V)

$-\varepsilon_2 - 0.5\times R_3 + 1.5\times R_2 = 0$

$-\varepsilon_2 - (0.5 - 1.5) R_3 = 0$

$-\varepsilon_2 + 1.0\times R_3 = -\varepsilon_2 + 5 = 0$

$\varepsilon_2 = 5V$

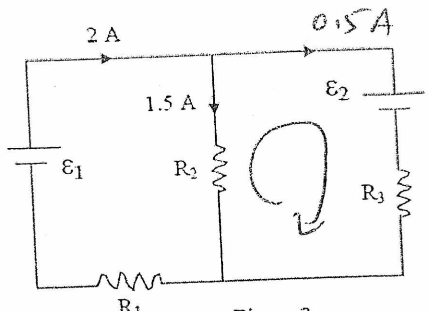


Figure 2

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.(Ans; 1.0 mA)

$U_0 = 0.50\ J = \frac{1}{2} C V_0^2$

$V_0 = \sqrt{\frac{2U_0}{C}} = \sqrt{\frac{2\times0.5}{10^{-6}}} = 10^3\ V$

$i(t) = i_0 e^{-t/RC} = \left(\frac{V_0}{R}\right) e^{-t/RC}$

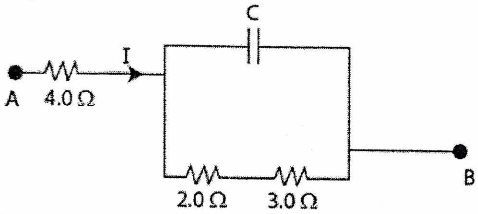
$i_0 = \frac{V_0}{R} = \frac{10^3}{10^{+6}} = 10^{-3}\ A = 1\ mA$

Quiz #9 Ch#27 T122 Phys101.28-30-v2

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

Q#1: Consider the circuit shown in Figure 7. When the capacitor is fully charged the current I is 3.00 A. What is the charge on the capacitor if its capacitance is 10.0 μF? (Ans: 150 μC)

Fig#



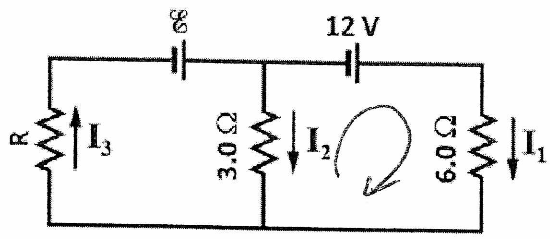
$q = CV$, $V = i \times (2+3)$

$= 3 \times 5 = 15\ V$

$q = CV = 10 \times 10^{-6} \times 15 = 150\ \mu C$

Q#2 In the circuit of **FIGURE 3**, the current I1 = 3.0 A. What is the value of current I3? (Ans: 5A)

Fig#



$12 - 6I_1 + 3I_2 = 0$

$I_2 = \frac{6I_1 - 12}{3}$

$= \frac{6 \times 3 - 12}{3} = 2A$

$I_3 = I_1 + I_2 = 3 + 2 = 5A$

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? (Ans: 5.5 s)

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

$\frac{U(t)}{U_0} = e^{-2t/RC} = 0.5$

$\ln(0.5) = -2t/RC$

$t = \frac{-RC \ln(0.5)}{2}$

$= -\frac{4 \times 10^3 \times 4 \times 10^{-3} \ln(0.5)}{2} = 5.5\ s$

Quiz #9 Ch#27 T122 Phys101.28-30-v3

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)

$V_P - 20 - i \times 6 = V_Q$.

For calculation of $\vec{i}$

$50 - 4i - 20 - 6i = 0$

$50 - 20 - 10i = 0$

$i = \frac{30}{10} = 3\,A$ Then

$V_Q = V_P - 20 - 6i = 20 - 20 - 6\times3 = -18\,V$

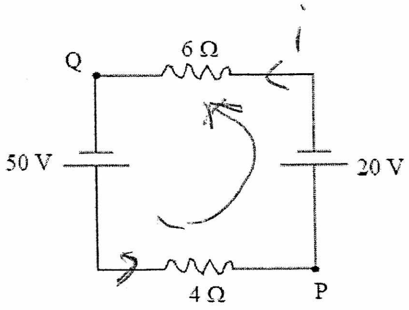


Figure 1

Q#21 Three resistors and two batteries are connected as shown in the circuit diagram below. What is the potential difference Va – Vb? (Ans: 15 V)

$V_b - 16 i_{16} + 18 = V_a \Rightarrow V_a - V_b = 18 - 16 i_{16}$

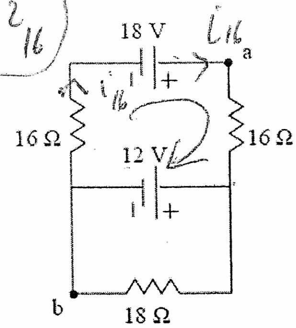
to Calculate i_{16}

$18 - 16 i_{16} - 12 - 16 i_{16} = 0$

$6 - 32 i_{16} = 0$

$i_{16} = \frac{6}{32} = 0.188\,A$

$V_a - V_b = 18 - 16 i_{16} = 18 - 16 \times 0.188 = 18 - 3 = 15\,V$



Q#3A power supply charges a 6.00-μF capacitor to a potential difference of 100 V. The power supply is removed and the capacitor is connected to a 1.50 kΩ resistor at time t = 0. What is the potential energy stored in the capacitor at t = 2.00 ms? (Ans: 19.2 mJ)

$V_0 = 100\,V,\ R = 1.5\times10^{3}\,\Omega,\ C = 6\times10^{-6}\,F$

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

$U(t = 2\times10^{-3}\,s) = \frac{1}{2}\times6\times10^{-6}\times(100)^2 \times e^{-\left(\frac{2\times2\times10^{-3}}{6\times10^{-6}\times1.5\times10^{3}}\right)}$

$(-4/9)$

$= 3\times10^{-2} \times e^{-4/9} = 1.92\times10^{-2}\,J$

$= 19.2\,mJ$

Quiz #9 Ch#27 T122 Phys101.28-30-v4

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

Q#1: If Q= 400 μC and the potential difference VA-VB = - 30 V in the circuit segment shown in Fig. 3, what is the current in the resistor R? (Ans: 1.0 mA counterclockwise)

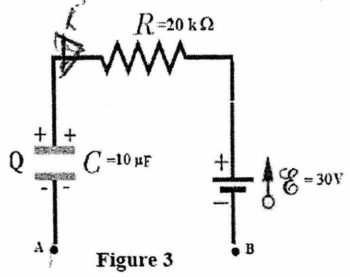


Figure 3

$V_A - V_B = -30V$

$V_A + V_c - i \times 20 \times 10^3 - 30 = V_B$

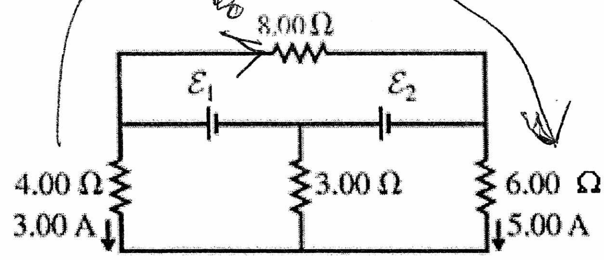
$V_A - V_B = V_c + i \times 20 \times 10^3 + 30$

$= \frac{Q}{C} + 30 + i \times 20 \times 10^3$

$= \frac{400 \times 10^{-6}}{10 \times 10^{-6}} + 30 + i \times 20 \times 10^3 = -40 + 30 + 20 \times 10^3 \times i = -30$

$i = \frac{+40 - 60}{20 \times 10^3} = \frac{-20}{20 \times 10^3}$ = −1.0 mA

Q#2: Find the current in 8.00-Ω resistor in the circuit shown in **Figure 4**? (Ans: 2.25 A toward the left)



in the outer loop

$3 \times 4 - 8 i_0 - 6 \times 5 = 0$

$12 - 8 i_0 - 30 = 0$

$8 i_0 = -18$

$i_0 = -\frac{18}{8} = -2.25 A$

2.25 A toward left

Q#3 A certain capacitor, C, in series with a resistor, R, is being charged. At the end of 10 ms its charge is half the maximum value. The time constant of the RC circuit is: (Ans: 14 ms)

$q(t) = C\varepsilon(1 - e^{-t/RC})$

$t = 10 ms = 10 \times 10^{-3} s$; $\frac{q(t)}{C\varepsilon} = 0.5$

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

$0.5 - 1 = -e^{-t/RC} \Rightarrow 0.5 = e^{-(10^{-2}/RC)}$

$\ln(0.5) = -\frac{10^{-2}}{RC} = -\frac{10^{-2}}{\tau}$

$\tau = \frac{-10^{-2}}{\ln(0.5)} = 14.4 \times 10^{-3} s = 14.4 ms$

Quiz #9 Ch#27 T122 Phys101.28-30-v5

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

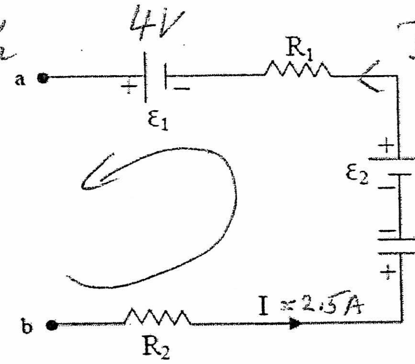
Q#1: In Figure 10, $\varepsilon_1 = 4.0$ V, $\varepsilon_2 = 12$ V, R1 = 4.0 Ω, R2 = 12 Ω, C = 3.0 μF, Q = 18 μC, and I = 2.5 A. What is the potential difference $Va - Vb$? (Ans: –30 V)

$V_b - 12\times2.5 - 6 + 12 - 4\times2.5 + 4 = V_a$

$V_a - V_b = -30 - 6 + 12 - 10 + 4$

$= -46 + 16$

$V_a - V_b = -30\,V$



Q#2 Q13. 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 (Ans: 0.9 W)

$P_{8\Omega} = i_o^2 R = 8 i_o^2$

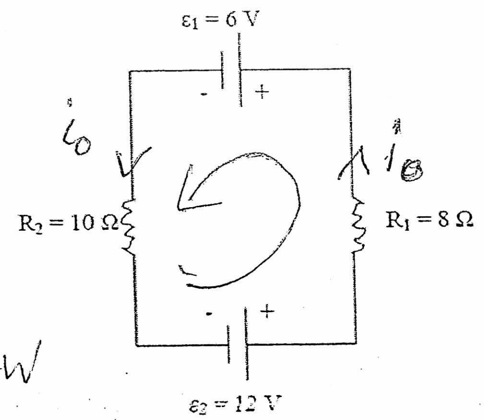
to calculate i_o

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

$6 - 18 i_o = 0$

$i_o = \frac{6}{18} A = 0.33 A$

$P_{8\Omega} = i_o^2 R = (0.33)^2 \times 8 = 0.87 W$

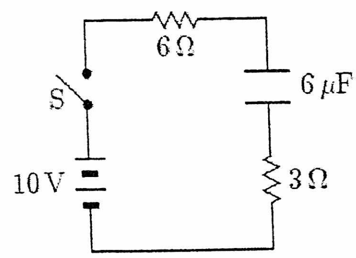


Q#3: In the circuit shown in **Figure 4**, the capacitor is initially uncharged. At time t = 0, switch S is closed. If τ denotes the time constant, the approximate current through the 3 Ω resistor when t = τ/10 is: (Ans: 1.0 A)

$i(t) = \frac{\varepsilon}{R_{eq}} e^{-t/R_{eq}C}$

$t = \frac{\tau}{10}$, $R_{eq}C = \tau$

$i(t) = \frac{10}{9} e^{-0.1} = 1.0\,A$



Quiz #9 Ch#27 T122 Phys101.28-30-v6

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

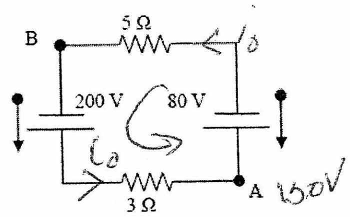
Q#1. Two ideal emf sources along with two resistors are connected as shown in the following figure. If the potential at A is 150 V, what would be the potential at point B? (Ans: - 5 V)

Calculate i_0 first

$200 - 3i_0 - 80 - 5i_0 = 0$

$+8i_0 = +120$

$i_0 = 15$ A



$V_A - 80 - 5i_0 = V_B$

$V_B = V_A - 80 - 5i_0 = 150 - 80 - 75 = -5$ V

Q#2 In the circuit shown in Figure 6, ε1 = 6.00 V, ε2 = 12.0 V, R1 = 200 Ω, and R2 = 100 Ω. What is the power supplied by ε1? (Consider the two emf to be ideal). (Ans: 1.08 W)

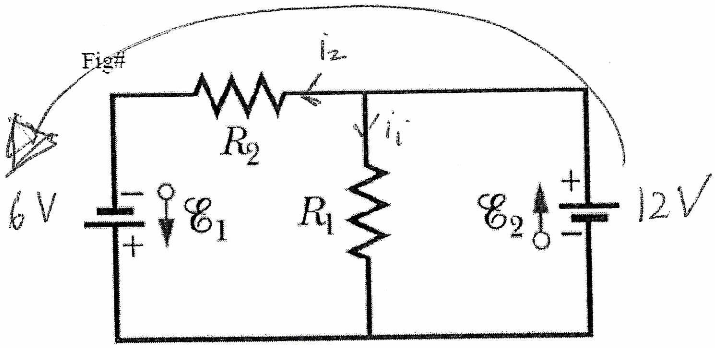
$12 - i_2 R_2 + 6 = 0$

$18 - i_2 \times 100 = 0$

$i_2 = \frac{18}{100} = 0.18$ A

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

$= 1.08$ W



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)? (Ans: 6 s)

$q(t) = C\varepsilon(1 - e^{-t/RC}) = q_{max}(1 - e^{-t/RC})$

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

$0.63 - 1 = -e^{-2/RC}$

$+0.37 = +e^{-2/\tau} \Rightarrow \ln(0.37) = -\frac{2}{\tau}$

$\tau = \frac{-2}{\ln(0.37)} = 2.011$ sec

6

$0.95 - 1 = -e^{-t/\tau} \Rightarrow +0.05 = +e^{-t/\tau} \Rightarrow \ln(0.05) = -\frac{t}{\tau}$

$t = -\tau(\ln(0.05)) = 6.02$ sec