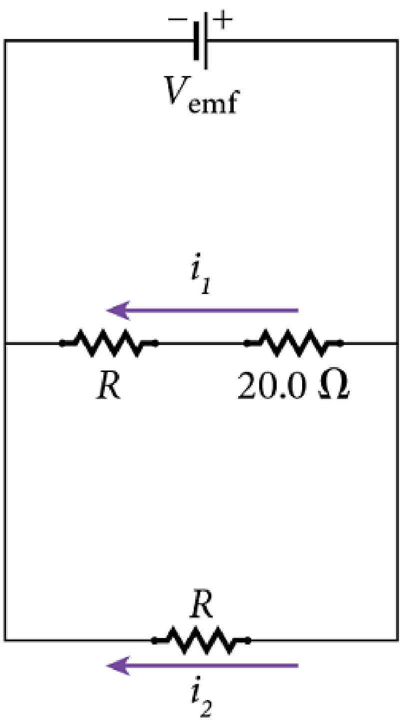
Score: 0/100 Points 0 %

1. Award: **0 out of 10.00 points**



Three resistors are connected across a battery as shown in the figure.

(a) What value of *R* will produce the indicated currents $i_1 = 1.03\ \mathrm{A}$ and $i_2 = 4.95\ \mathrm{A}$?

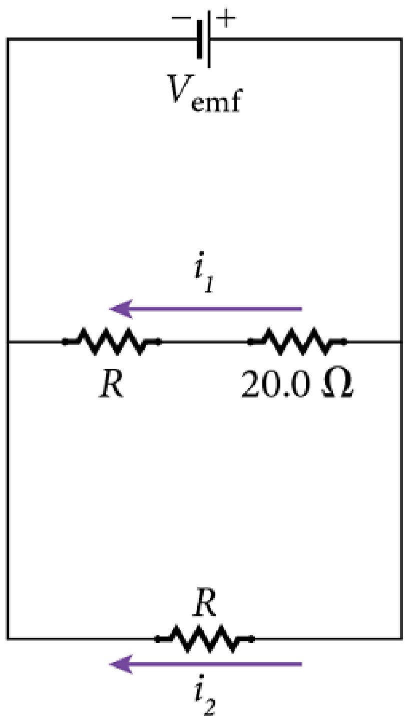
n/r Ω

(b) What value of V_{emf} will produce the indicated currents $i_1 = 1.03\ \mathrm{A}$ and $i_2 = 4.95\ \mathrm{A}$?

n/r V

References

Numeric Response Difficulty: Easy



Three resistors are connected across a battery as shown in the figure.

(a) What value of *R* will produce the indicated currents $i_1 = 1.03\ \text{A}$ and $i_2 = 4.95\ \text{A}$?

5.26 ± 1% Ω

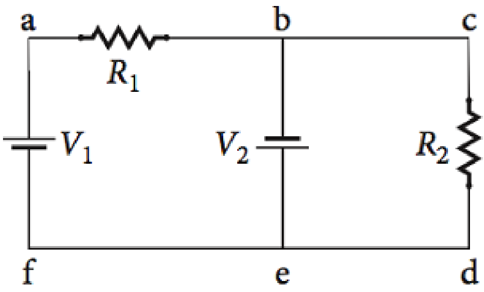
(b) What value of V_{emf} will produce the indicated currents $i_1 = 1.03\ \text{A}$ and $i_2 = 4.95\ \text{A}$?

26.0 ± 1% V

Explanation:

Kirchhoff's Loop Rule around the upper loop yields
$V_{\text{emf}} - i_1 R_{20} - i_1 R = 0$ where $R_{20} = 20.0\ \Omega$
Kirchhoff's Loop Rule around the outer loop yields
$V_{\text{emf}} - i_2 R = 0$
Combining these equations gives
$V_{\text{emf}} - i_1 R_{20} - i_1 R = V_{\text{emf}} - i_2 R$
$i_2 R = i_1 R_{20} + i_1 R$
$R\left(i_2 - i_1\right) = i_1 R_{20}$
$R = \frac{i_1 R_{20}}{i_2 - i_1}$
And
$V_{\text{emf}} = i_2 R$
Calculating
a)
$R = \frac{(1.03\ \text{A})(20.0\ \Omega)}{4.95\ \text{A-}1.03\ \text{A}} = 5.26\ \Omega$
b)
$V_{\text{emf}} = (4.95\ \text{A})\,(5.26\ \Omega) = 26.01\ \text{V}$

2. Award: **0 out of 10.00 points**

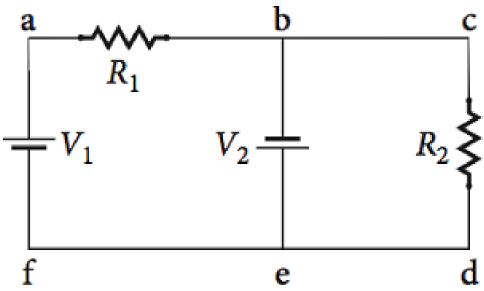


In the circuit shown in the figure, $V_1 = 1.75$ V, $V_2 = 2.95$ V, $R_1 = 3.83\ \Omega$, and $R_2 = 4.83\ \Omega$. What is the magnitude of the current, i_1, flowing through resistor R_1?

n/r A

References

Numeric Response Difficulty: Easy



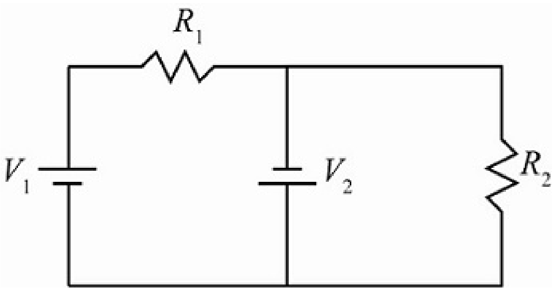
In the circuit shown in the figure, $V_1 = 1.75$ V, $V_2 = 2.95$ V, $R_1 = 3.83\ \Omega$, and $R_2 = 4.83\ \Omega$. What is the magnitude of the current, i_1, flowing through resistor R_1?

1.2 ± 1% A

Explanation:

THINK: There is only one unknown, so one equation is sufficient to solve the problem. Use Kirchhoff's Loop Law to obtain the answer.

SKETCH:

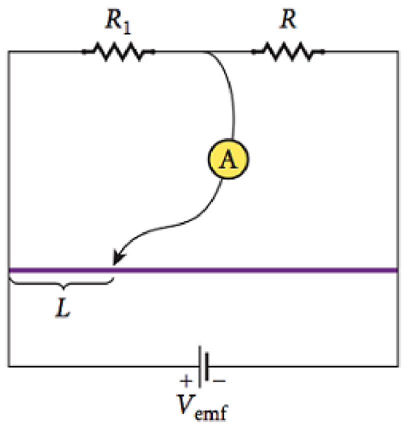


RESEARCH: Kirchhoff's Loop Law gives $V_1 - i_1 R_1 + V_2 = 0$ for the first loop.

SIMPLIFY: $i_1 = \frac{V_2 + V_1}{R_1}$

CALCULATE: $i_1 = \frac{2.95\ \mathrm{V} + 1.75\ \mathrm{V}}{3.83\ \Omega} = 1.2\ \mathrm{A}$

3. Award: **0 out of 10.00 points**

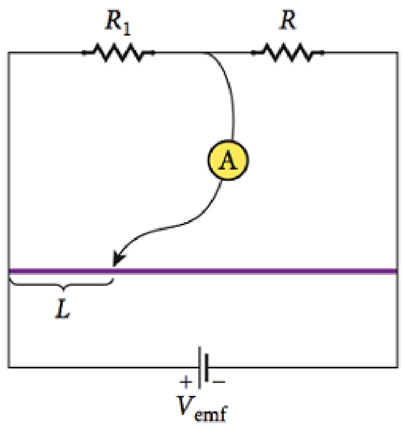


A Wheatstone bridge is constructed using a 1.00-m-long Nichrome wire (the purple line in the figure) with a conducting contact that can slide along the wire. A resistor $R_1 = 111\ \Omega$ is placed on one side of the bridge, and another resistor *R* of unknown resistance is placed on the other side. The contact is moved along the Nichrome wire, and it is found that the ammeter reading is zero for *L* = 27.6 cm. Knowing that the wire has a uniform cross-section throughout its length, determine the unknown resistance.

n/r Ω

References

Numeric Response Difficulty: Easy



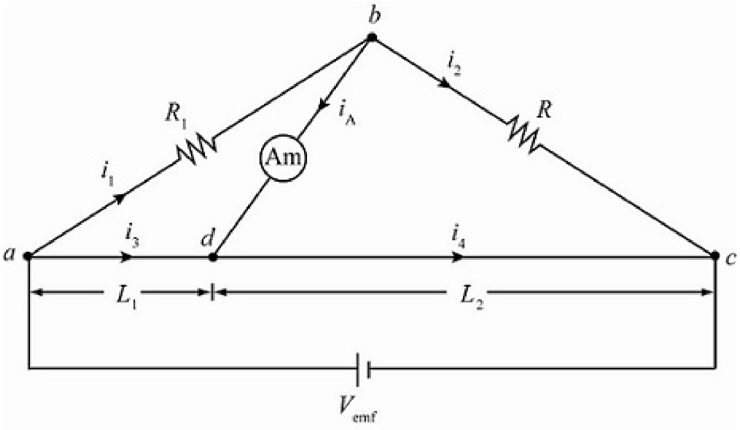
A Wheatstone bridge is constructed using a 1.00-m-long Nichrome wire (the purple line in the figure) with a conducting contact that can slide along the wire. A resistor $R_1 = 111\ \Omega$ is placed on one side of the bridge, and another resistor *R* of unknown resistance is placed on the other side. The contact is moved along the Nichrome wire, and it is found that the ammeter reading is zero for *L* = 27.6 cm. Knowing that the wire has a uniform cross-section throughout its length, determine the unknown resistance.

291.2 ± 1% Ω

Explanation:

THINK: When the potential difference between *a* and *b* is zero, no current will flow. The potential difference will be zero when the ratio of the resistances above the ammeter is equal to the ratio of the resistances below the ammeter. Use $L_1 = 27.6\ \text{cm}$ and $L_2 = 72.4\ \text{cm}.$

SKETCH:



RESEARCH: The current is zero when $\frac{R_1}{R_x} = \frac{R_{L_1}}{R_{L_2}} \Rightarrow R_1 R_{L_2} = R_x R_{L_1}$, $R_1 = 111\ \Omega$. $R_{L_1} = \rho \frac{L_1}{A}$ and $R_{L_2} = \rho \frac{L_2}{A}$.

SIMPLIFY: $R_1 \rho \left(\frac{L_2}{A}\right) = R_x \rho \left(\frac{L_1}{A}\right)$, $R_x = R_1 \frac{L_2}{L_1}$

CALCULATE: $R_x = (111\ \Omega)\left(\frac{72.4\text{ cm}}{27.6\text{ cm}}\right) = 291.2\ \Omega$

4.

Award: **0 out of 10.00 points**

A circuit consists of two 133-kΩ resistors in series with an ideal 17.3-V battery.

(a) Calculate the potential drop across one of the resistors.

n/r V

(b) A voltmeter with internal resistance 13.5 MΩ is connected in parallel with one of the two resistors in order to measure the potential drop across the resistor. By what percentage will the voltmeter reading deviate from the value you determined in part (a)?

n/r %

References

Numeric Response Difficulty: Easy

A circuit consists of two 133-kΩ resistors in series with an ideal 17.3-V battery.

(a) Calculate the potential drop across one of the resistors.

8.7 ± 1% V

(b) A voltmeter with internal resistance 13.5 MΩ is connected in parallel with one of the two resistors in order to measure the potential drop across the resistor. By what percentage will the voltmeter reading deviate from the value you determined in part (a)?

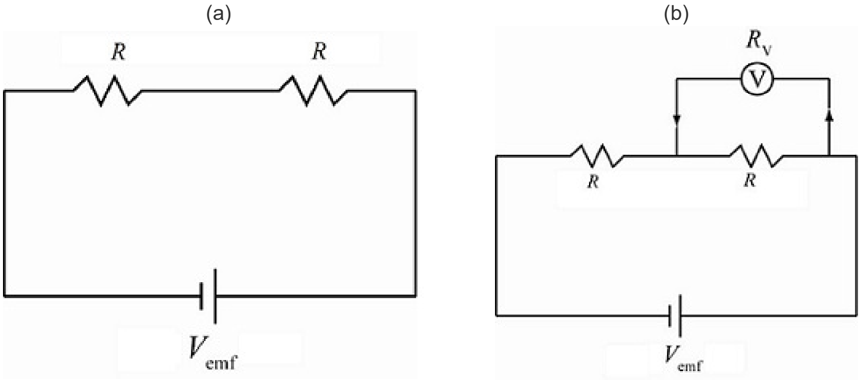
0.490 ± 1% %

Explanation:

THINK:
(a) You need to find the total resistance and then find the potential drop in each resistor.

(b) When a voltmeter is connected across one of the resistors, the combination of the resistor and the voltmeter will have an equivalent resistance slightly different from that of the resistor alone. This will cause a change in the potential drop across the resistor/voltmeter combination. You need to calculate the new potential drop.

SKETCH:



R = 133 kΩ
$V_{emf} = 17.3\ V$

RESEARCH:

(a) Since they are identical and in series, the resistors have the same potential drop of $\frac{V}{2}$.

(b) The total resistance is now given by $R_{\text{total}} = R + \left(\frac{R_{\text{voltmeter}}R}{R_{\text{voltmeter}}+R}\right)$. The potential drop across the voltmeter is then $V_{\text{voltmeter}} = iR = \left(\frac{V}{R_{\text{total}}}\right)\left(\frac{R_{\text{voltmeter}}R}{R_{\text{voltmeter}}+R}\right)$.

SIMPLIFY: Not required.

CALCULATE:

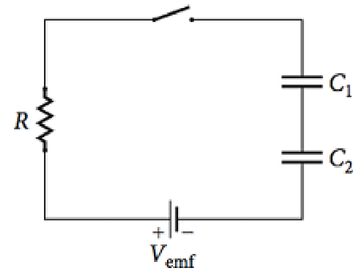
(a) $\frac{17.3\ \mathrm{V}}{2} = 8.7\ \mathrm{V}$

(b) $R_{\text{total}} = 133\ \mathrm{k\Omega} + \frac{(13.5\ \mathrm{M\Omega})(133\ \mathrm{k\Omega})}{(13.5\ \mathrm{M\Omega}+133\ \mathrm{k\Omega})} = 264.702487\ \mathrm{k\Omega}$

$V_{\text{voltmeter}} = \frac{17.3\ \mathrm{V}}{264.702\ \mathrm{k\Omega}}\left[\frac{(13.5\ \mathrm{M\Omega})(133\ \mathrm{k\Omega})}{(13.5\ \mathrm{M\Omega}+133\ \mathrm{k\Omega})}\right] = 8.61\ \mathrm{V}$

The percentage change is $\frac{8.7\ \mathrm{V}-8.61\ \mathrm{V}}{8.7\ \mathrm{V}} = 0.490\ \%$.

5. Award: **0 out of 10.00 points**



Two parallel plate capacitors, C_1 and C_2, are connected in series with a 51.3-V battery and a 299-kΩ resistor, as shown in the figure. Both capacitors have plates with an area of $2.51\ \mathrm{cm}^2$ and a separation of 0.103 mm. Capacitor C_1 has air between its plates, and capacitor C_2 has the gap filled with porcelain (dielectric constant of 7.00 and dielectric strength of 5.70 kV/mm). The switch is closed, and a long time passes. (You may enter your calculation using scientific notation.)

(a) What is the charge on capacitor C_1?

n/r C

(b) What is the charge on capacitor C_2?

n/r C

(c) What is the total energy stored in the two capacitors?

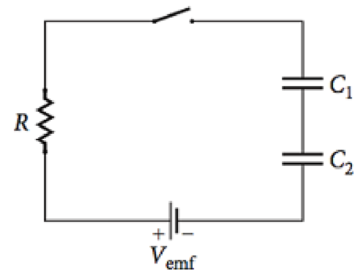
n/r J

(d) What is the electric field inside capacitor C_2?

n/r V/m

References

Numeric Response Difficulty: Easy



Two parallel plate capacitors, C_1 and C_2, are connected in series with a 51.3-V battery and a 299-kΩ resistor, as shown in the figure. Both capacitors have plates with an area of $2.51\ \mathrm{cm}^2$ and a separation of 0.103 mm. Capacitor C_1 has air between its plates, and capacitor C_2 has the gap filled with porcelain (dielectric constant of 7.00 and dielectric strength of 5.70 kV/mm). The switch is closed, and a long time passes. (You may enter your calculation using scientific notation.)

(a) What is the charge on capacitor C_1?

9.685E-10 ± 1% C

(b) What is the charge on capacitor C_2?

9.685E-10 ± 1% C

(c) What is the total energy stored in the two capacitors?

2.484E-8 ± 1% J

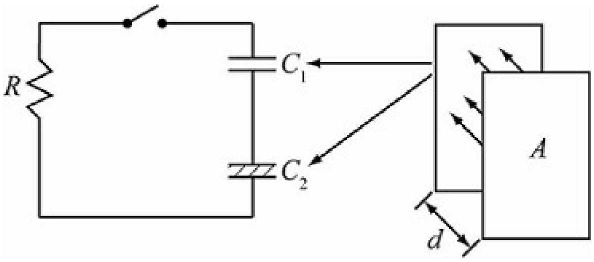
(d) What is the electric field inside capacitor C_2?

6.226E4 ± 1% V/m

Explanation:

THINK: After sufficient time, the potential on both plates (area $\mathrm{A} = 2.51 \ \mathrm{cm}^2$ and separation *d* = 0.103 mm) will be Δ*V* = 51.3 V. Since the capacitors are in series, the total charge on each will be the same. The potential drop across a capacitor is needed to find its electric field. The second capacitor has dielectric constant *k* = 7 and dielectric strength S = 5.7 kV/mm.

SKETCH:



RESEARCH: The capacitance of the air-filled capacitor is $C_1 = \frac{\varepsilon_0 \mathrm{A}}{d}$, and that with the dielectric is $C_2 = \frac{\kappa\varepsilon_0 \mathrm{A}}{d}$. The charge on a capacitor is $Q = C\Delta V$. The energy stored in a capacitor is $U = \frac{Q^2}{2C}$. The electric field inside a capacitor is $E = \frac{V}{d}$.

SIMPLIFY:

(a) The equivalent capacitance is
$C_{\text{eq}} = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1} = \left(\frac{d}{\varepsilon_0 \mathrm{A}} + \frac{d}{\kappa\varepsilon_0 \mathrm{A}}\right)^{-1} = \frac{\varepsilon_0 \mathrm{A}}{d}\left(1 + \frac{1}{\kappa}\right)^{-1} = \frac{\varepsilon_0 \mathrm{A}}{d}\left(\frac{\kappa}{\kappa+1}\right).$
Charge on the first capacitor is $Q = Q_1 = C_{\text{eq}}\Delta V.$

(b) Charge on the second capacitor is $Q = Q_2 = C_{\text{eq}}\Delta V.$

(c) The total energy on both plates is $U = \frac{Q^2}{2C_{\text{eq}}} = \frac{C_{\text{eq}}^2 \Delta V^2}{2C_{\text{eq}}} = \frac{1}{2}C_{\text{eq}}\Delta V^2.$

(d) The potential drop across the second capacitor is $\Delta V_2 = \frac{Q_2}{C_2} = \frac{Qd}{\kappa\varepsilon_0 \mathrm{A}}$. The electric field across it is then
$E_2 = \frac{\Delta V_2}{d} = \frac{Q}{\kappa\varepsilon_0 \mathrm{A}}.$

CALCULATE:

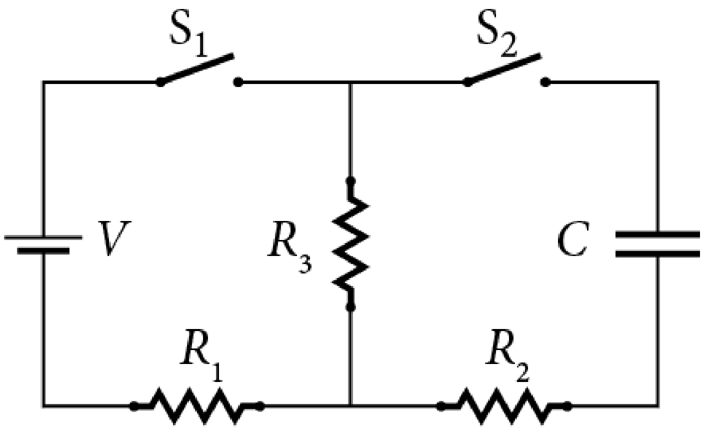
(a) $C_{\text{eq}} = \frac{7}{7+1}\left[\frac{\left(8.854 \cdot 10^{-12}\ \mathrm{C}^2/\left(\mathrm{N\ m}^2\right)\right)\left(2.51 \cdot 10^{-4}\ \mathrm{m}^2\right)}{1.0\text{E-}4\ \mathrm{m}}\right] = 1.88792\text{E-}11\ \mathrm{F}$
$Q_1 = (1.88792\text{E-}11\ \mathrm{F})\,(51.3\ \mathrm{V}) = 9.6850\text{E-}10\ \mathrm{C}$

(b) $Q_2 = 9.6850\text{E-}10\ \mathrm{C}$

(c) $U = \frac{1}{2}\,(1.88792\text{E-}11\ \mathrm{F})(51.3\ \mathrm{V})^2 = 2.484\text{E-}8\ \mathrm{J}$

(d) $E_2 = \frac{9.6850\text{E-}10\ \mathrm{C}}{7\left(8.854 \cdot 10^{-12}\ \mathrm{C}^2/\left(\mathrm{N\ m}^2\right)\right)\left(2.51 \cdot 10^{-4}\ \mathrm{m}^2\right)} = 6.226\text{E}4\ \mathrm{V/m}$

6. Award: **0 out of 10.00 points**



The circuit in the figure has a capacitor, *C* = 4.17 mF, connected to a *V* = 13.5-V battery, two switches, and three resistors ($R_1 = 321\ \Omega$, $R_2 = 239\ \Omega$, and $R_3 = 145\ \Omega$.) Initially, the capacitor is uncharged and both of the switches are open.

(a) Switch S_1 is closed. What is the current flowing out of the battery immediately after switch S_1 is closed? (You may enter your calculation using scientific notation.)

n/r ⊗ A

(b) After 10 min, switch S_2 is closed. What is the current flowing out of the battery immediately after switch S_2 has been closed? (You may enter your calculation using scientific notation.)

n/r ⊗ A

(c) What is the current flowing out of the battery 10 min after switch S_2 has been closed? (You may enter your calculation using scientific notation.)

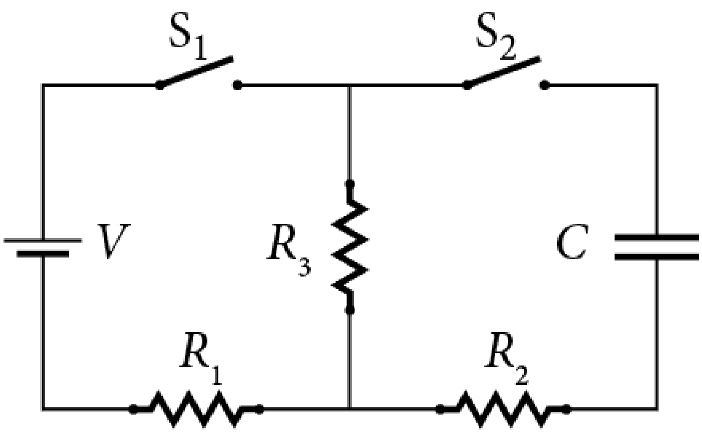
n/r ⊗ A

(d) After another 10 min, switch S_1 is opened. How long will it take until the current in the $R_2 = 239 - \Omega$ resistor is below 1.00 mA?

n/r ⊗ s

References

Numeric Response Difficulty: Easy



The circuit in the figure has a capacitor, *C* = 4.17 mF, connected to a *V* = 13.5-V battery, two switches, and three resistors ($R_1 = 321\ \Omega$, $R_2 = 239\ \Omega$, and $R_3 = 145\ \Omega$.) Initially, the capacitor is uncharged and both of the switches are open.

(a) Switch S_1 is closed. What is the current flowing out of the battery immediately after switch S_1 is closed? (You may enter your calculation using scientific notation.)

2.897E-2 ± 1% A

(b) After 10 min, switch S_2 is closed. What is the current flowing out of the battery immediately after switch S_2 has been closed? (You may enter your calculation using scientific notation.)

3.283E-2 ± 1% A

(c) What is the current flowing out of the battery 10 min after switch S_2 has been closed? (You may enter your calculation using scientific notation.)

2.897E-2 ± 1% A

(d) After another 10 min, switch S_1 is opened. How long will it take until the current in the $R_2 = 239 - \Omega$ resistor is below 1.00 mA?

3.83 ± 1% s

Explanation:

THINK:

(a) When switch S_1 is closed, the current flows solely through resistors $R_1 = 321\ \Omega$ and $R_3 = 145\ \Omega$ which are in series with a battery $V_{emf} = 13.5\ V$.

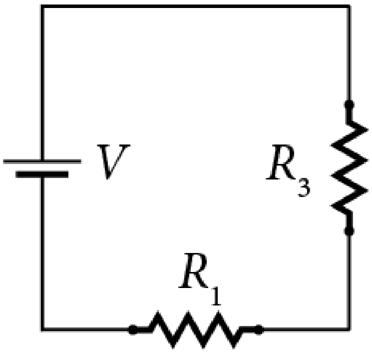
(b) When switch S_2 is closed, there is no charge on the capacitor, so there is no potential drop across it, meaning it does not initially contribute to the circuit. Now the resistors $R_2 = 239\ \Omega$ and $R_3 = 145\ \Omega$ are in parallel, giving an equivalent resistance $R_{23} = \frac{R_2 R_3}{R_2 + R_3} = 90.25\ \Omega$. R_{23} is in series with R_1 and the battery with $V_{emf} = 13.5\ V$.

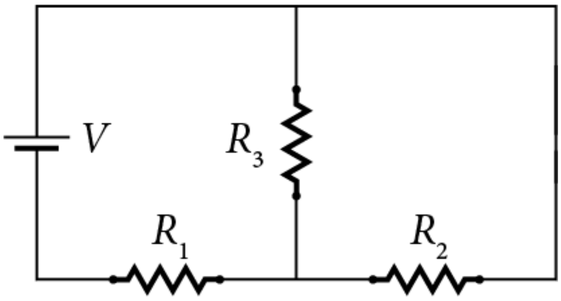
(c) The capacitor *C* = 4.17 mF will charge but only through resistor $R_2 = 239\ \Omega$, so as to give a time constant τ. As it charges over *t* = 10 min = 600 s, the current through that branch will decrease exponentially.

(d) When the capacitor, *C* = 4.17 mF, is fully charged, no current flows through that branch. This means that initially, the battery $V_{emf} = V = 13.5$ V is in series with resistors $R_1 = 321\ \Omega$ and $R_3 = 145\ \Omega$. The initial potential in the capacitor must still equal the potential drop across resistor R_3. When switch S_1 is opened, the capacitor begins to discharge though resistors $R_2 = 239\ \Omega$ and $R_3 = 145\ \Omega$. As the capacitor discharges, the current will decrease exponentially to $i_f = 01\ mA$.

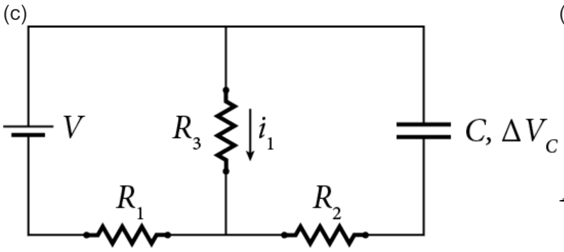
SKETCH:

(a) (b)

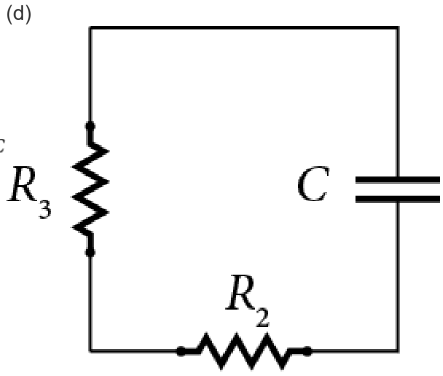




(c)



(d)



RESEARCH:

(a) The equivalent resistance is $R_{\mathrm{eq}} = R_1 + R_3$. By Ohm's Law, the current through circuit is $i_1 = \frac{V_{\mathrm{emf}}}{R_{\mathrm{eq}}}$.

(b) The equivalent resistance of resistors 2 and 3 is $R_{23} = \frac{R_2 R_3}{R_2 + R_3}$. The total equivalent resistance is then $R_{\mathrm{eq}} = R_1 + R_{23}$. By Ohm's Law, the current through the circuit is $I_2 = \frac{V_{\mathrm{emf}}}{R_{eq}}$.

(c) As the capacitor charges, the current through it decrease as $i_C\left(t\right) = i_0 e^{-\frac{t}{\tau}}$ where, $\tau = R_2 C$. The current through resistor R_1 is i_{R} and the total current out of the battery is $i \ = \ i_R \ + i_C$.

(d) The potential drop across R_3 initially is $i_1 R_3 = \Delta V_3 = \Delta V_C$. Current decays exponentially as $i\left(t\right) = i_0 e^{-\frac{t}{\tau}}$, where $\tau = (R_2 + R_3)C$ and by Ohm's Law, $i_0 = \frac{\Delta V_C}{(R_2 + R_3)}$.

SIMPLIFY:

(a) $i_1 = \frac{V_{\mathrm{emf}}}{R_{\mathrm{eq}}} = \frac{V_{\mathrm{emf}}}{R_1 + R_3}$

(b) $R_{12} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} = \frac{R_1 R_2}{R_1 + R_2}, i_2 = \frac{V_{\mathrm{emf}}}{R_{\mathrm{eq}}} = \frac{V_{\mathrm{emf}}}{R_3 + R_{12}}$

(c) Calculate $i_C(t)$ and infer *i* from it.

(d) Initial current is $i_0 = \frac{\Delta V_C}{R_2 + R_3} = \frac{R_3 i_1}{R_2 + R_3}$ when $i(t) = i_f$. Therefore, $i_{\mathrm{f}} = \frac{R_3 i_1}{R_2 + R_3} e^{-\frac{t}{\tau}} \Rightarrow \frac{i_{\mathrm{f}}(R_2 + R_3)}{R_3 i_1} = e^{-\frac{t}{\tau}} \Rightarrow t = -\tau \ln\left(\frac{i_{\mathrm{f}}(R_2 + R_3)}{R_3 i_1}\right)$

CALCULATE:

(a) $i_1 = \frac{13.5 \text{ V}}{145 \ \Omega + 321 \ \Omega} = 2.897\text{E-}2 \text{ A} = 29.0 \text{ mA}$

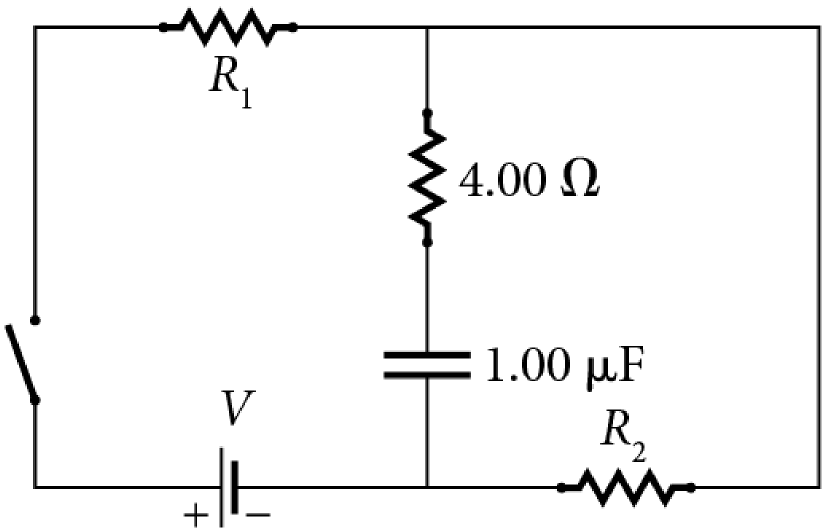
(b) $R_{12} = \frac{(145 \ \Omega)(239 \ \Omega)}{145 \ \Omega + 239 \ \Omega} = 90.25 \ \Omega, i_2 = \frac{13.5 \text{ V}}{321 \ \Omega + 90.25 \ \Omega} = 3.283\text{E-}2 \text{ A} = 32.83 \text{ mA}$

(c) $\tau = (239 \ \Omega)\left(4.17 \text{ mF}\right) = 0.997 \text{ s}. \ i_{\mathrm{C}}\left(t\right) = i_0 e^{\frac{-600 \text{ s}}{0.997 \text{ s}}} = i_0 e^{-602} \approx 0 \text{ A}$. Regardless of what i_0 is after 10 min, the current through that branch is effectively 0 A. Therefore, $i = i_R = 2.897\text{E-}2 \text{ A}$. Since there is no current through the capacitor, the circuit is equivalent to having switch S_2 open, as in part (a), so current through battery is then the same as in part (a).

(d) $\tau = \left(145 \ \Omega + 239 \ \Omega\right)\left(4.17 \text{ mF}\right) = 1.60 \text{ s}$ and $t = -\left(1.60 \text{ s}\right) \ln\left(\frac{(1.00 \text{ mA})(145 \ \Omega + 239 \ \Omega)}{(145 \ \Omega)(29.0 \text{ mA})}\right) = 3.8308 \text{ s}$

7.

Award: **0 out of 10.00 points**



In the circuit in the figure, the capacitors are completely uncharged. The switch is then closed for a long time. As shown, $R_1 = 6.23\ \Omega$, $R_2 = 8.21\ \Omega$, and *V* = 12.1 V.

(a) Calculate the current through the 4.00-Ω resistor.

n/r

(b) Find the potential difference across the 4.00-Ω resistor.

n/r

(c) Find the potential difference across the $R_1 = 6.23\ \Omega$ resistor.

n/r V

(d) Find the potential difference across the $R_2 = 8.21\ \Omega$ resistor.

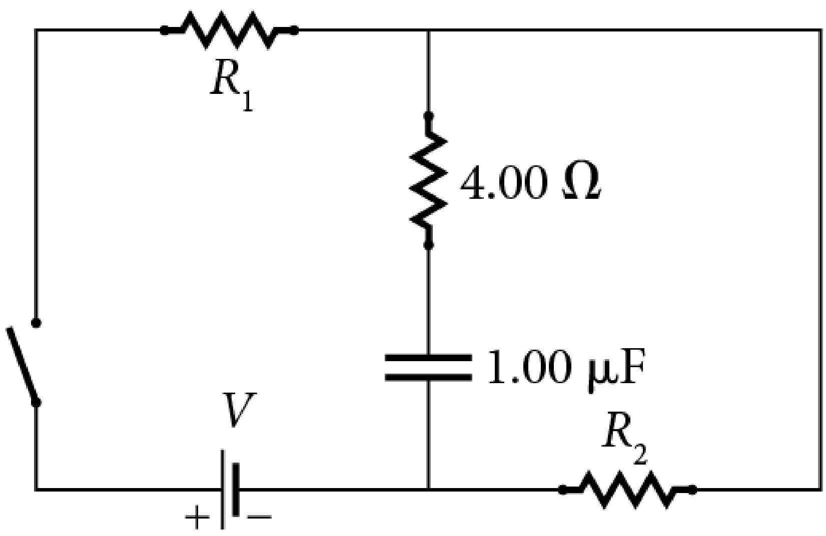
n/r V

(e) Find the potential difference across the 1.00-μF capacitor.

n/r V

References

Numeric Response Difficulty: Easy



In the circuit in the figure, the capacitors are completely uncharged. The switch is then closed for a long time. As shown, $R_1 = 6.23\ \Omega$, $R_2 = 8.21\ \Omega$, and V = 12.1 V.

(a) Calculate the current through the 4.00-Ω resistor.

0 ± 0.1

(b) Find the potential difference across the 4.00-Ω resistor.

0 ± 0.1

(c) Find the potential difference across the $R_1 = 6.23\ \Omega$ resistor.

5.220 ± 1% V

(d) Find the potential difference across the $R_2 = 8.21\ \Omega$ resistor.

6.880 ± 1% V

(e) Find the potential difference across the 1.00-μF capacitor.

6.880 ± 1% V

Explanation:

(a) If the switch is closed for a long time, the capacitor is fully charged and there is no current through that branch. Therefore, the current through the 4.00-Ω resistor is *i* = 0 A.

(b) With no current through R_2, the potential drop across it is $\Delta V_2 = 0\ \mathrm{V}$.

(c) The two resistors, $R_1 = 6.23\ \Omega$ and $R_2 = 8.21\ \Omega$ Ω, are in series with each other, so the current through them is $i = \frac{\Delta V}{(R_1+R_3)} = \frac{(12.1\ \mathrm{V})}{(14.44\ \Omega)} = 0.838\ \mathrm{A}$. The potential drop across the 6.23-Ω resistor is $\Delta V_1 = iR_1 = (0.838\ \mathrm{A})\,(6.23\ \Omega) = 5.220\ \mathrm{V}$.

(d) The potential drop across the 8.21-Ω resistor is $\Delta V_3 = iR_3 = (0.838\ \mathrm{A})\,(8.21\ \Omega) = 6.880\ \mathrm{V}$.

(e) The potential on the capacitor is the same as the potential drop across the 8.21-Ω resistor since they are parallel, so $\Delta V_C = \Delta V_3 = 6.880\ \mathrm{V}$.

8. Award: **0 out of 10.00 points**

An ammeter with an internal resistance of 53.1 Ω measures a current of 5.11 mA in a circuit containing a battery and a total resistance of 1,050 Ω. The insertion of the ammeter alters the resistance of the circuit, and thus the measurement does not give the actual value of the current in the circuit without the ammeter. Determine the actual value of the current.

n/r mA

References

Numeric Response Difficulty: Easy

An ammeter with an internal resistance of 53.1 Ω measures a current of 5.11 mA in a circuit containing a battery and a total resistance of 1,050 Ω. The insertion of the ammeter alters the resistance of the circuit, and thus the measurement does not give the actual value of the current in the circuit without the ammeter. Determine the actual value of the current.

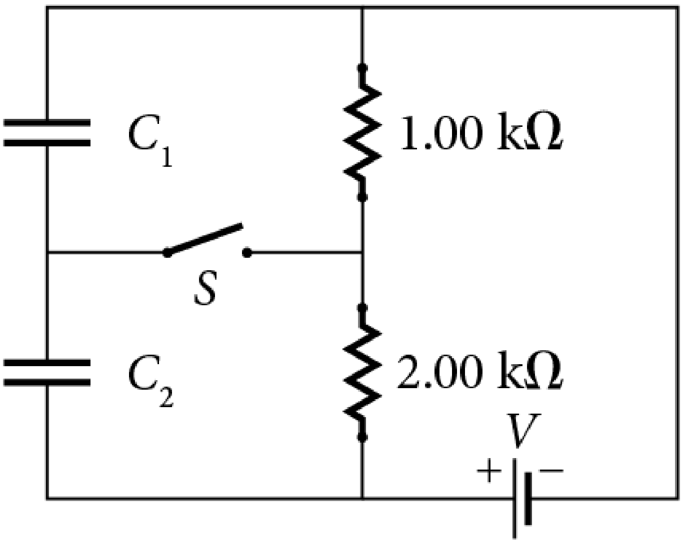
5.368 ± 1% mA

Explanation:

The potential, V_{emf}, of the battery is the same with ammeter, $R_0 = 53.1\ \Omega$, as without. The external resistance *R* = 1,050 Ω has a current of *I* = 5.11 mA with ammeter, so by Ohm's Law

$$V_{\mathrm{emf}} = i\left(R_0 + R\right) = i'R \Rightarrow i' = \frac{i(R_0+R)}{R} = \frac{(5.11\ \mathrm{mA})(53.1\ \Omega+1{,}050\ \Omega)}{1{,}050\Omega} = 5.3684\ \mathrm{mA} = 5.37\ \mathrm{mA}$$

9. Award: **0 out of 10.00 points**



As shown in the figure, $C_1 = 1.65\ \mu F$, $C_2 = 2.85\ \mu F$, and *V* = 12.5 V. (You may enter your calculation using scientific notation.)

(a) For the circuit shown in the figure, determine the charge on capacitor C_1 when switch *S* has been closed for a long time.

n/r ⊗ C

(b) Determine the charge on capacitor C_2 when switch *S* has been closed for a long time.

n/r ⊗ C

(c) Determine the charge on capacitor C_1 when switch *S* has been open for a long time.

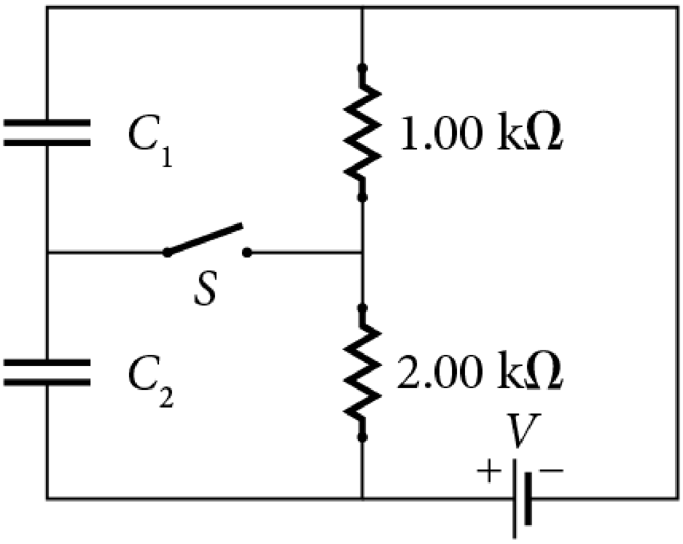
n/r ⊗ C

(d) Determine the charge on capacitor C_2 when switch *S* has been open for a long time.

n/r ⊗ C

References

Numeric Response Difficulty: Easy



As shown in the figure, $C_1 = 1.65\ \mu F$, $C_2 = 2.85\ \mu F$, and *V* = 12.5 V. (You may enter your calculation using scientific notation.)

(a) For the circuit shown in the figure, determine the charge on capacitor C_1 when switch *S* has been closed for a long time.

6.875E-6 ± 1% C

(b) Determine the charge on capacitor C_2 when switch *S* has been closed for a long time.

2.375E-5 ± 1% C

(c) Determine the charge on capacitor C_1 when switch *S* has been open for a long time.

1.306E-5 ± 1% C

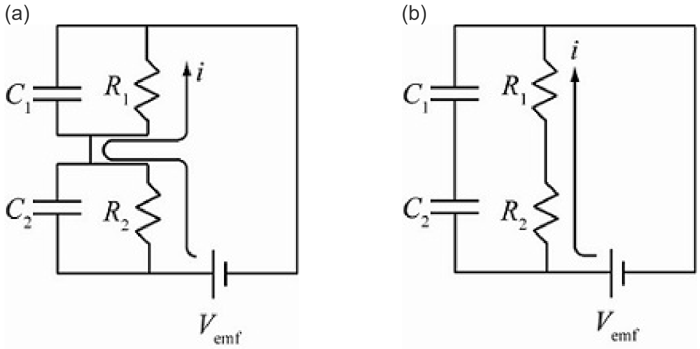
(d) Determine the charge on capacitor C_2 when switch *S* has been open for a long time.

1.306E-5 ± 1% C

Explanation:

THINK: When the switch is closed for a long time, the capacitors, $C_1 = 1.65\ \mu F$ and $C_2 = 2.85\ \mu F$, are fully charged so no current flows through them, and thus the current only flows through the two resistors, $R_1 = 1\ k\Omega$ and $R_2 = 2\ k\Omega$, driven by a battery $V_{emf} = 12.5$ V. At this point, the potential drop across each resistor is equal to the potential on its complementary capacitor. Since the capacitors are in series, they have the same charge on them.

SKETCH:



RESEARCH: The current, by Ohm's Law is found in both cases as $i = \frac{V_{\text{emf}}}{(R_1+R_2)}$. When the switch is closed, the potential drop across capacitor C_j is $\Delta V_j = \frac{Q_j}{C_j} = IR_j \left(\text{for } j = 1, 2\right)$. When the switch is open, the charge on each plate is $Q = C_{eq}V_{\text{emf}}$.

SIMPLIFY:

(a) The charges on the capacitor are given by $\frac{Q_j}{C_j} = iR_j \Rightarrow Q_j = iR_jC_j = \frac{\Delta V_{\text{emf}} R_j C_j}{(R_1+R_2)}$.

$Q_1 = \frac{V_{\text{emf}} R_1 C_1}{(R_1 + R_2)}$

(b) $Q_2 = \frac{V_{\text{emf}} R_2 C_2}{(R_1 + R_2)}$.

(c & d) The charge on each capacitor is $Q = C_{eq} V_{\text{emf}} = \left(\frac{1}{C_1} + \frac{1}{C_2} \right)^{-1} V_{\text{emf}} = \frac{V_{\text{emf}} C_1 C_2}{(C_1 + C_2)}$.

CALCULATE:

(a) $Q_1 = \frac{(12.5\text{ V})(1\text{ k}\Omega)(1.65\ \mu\text{F})}{1\text{ k}\Omega + 2\text{ k}\Omega} = 6.875\text{E-6 C}$ and

(b) $Q_2 = \frac{(12.5\text{ V})(2\text{ k}\Omega)(2.85\ \mu\text{F})}{1\text{ k}\Omega + 2\text{ k}\Omega} = 2.375\text{E-5 C}$

(c & d) $Q = \frac{(12.5\text{ V})(1.65\ \mu\text{F})(2.85\ \mu\text{F})}{1.65\ \mu\text{F} + 2.85\ \mu\text{F}} = 1.306\text{E-5 C}$

10.

Award: **0 out of 10.00 points**

A capacitor with *C* = 18.87 mF is fully charged using a battery with $V_{emf} = 152.7\ V$. The battery is disconnected and a resistor with *R* = 689.1 Ω is connected across the capacitor. What is the magnitude of the current that will be flowing in the resistor after 3.043 s?

n/r A

References

Numeric Response Difficulty: Easy

A capacitor with *C* = 18.87 mF is fully charged using a battery with $V_{emf} = 152.7\ V$. The battery is disconnected and a resistor with *R* = 689.1 Ω is connected across the capacitor. What is the magnitude of the current that will be flowing in the resistor after 3.043 s?

0.175 ± 1% A

Explanation:

When the resistor is connected to the charged capacitor, the initial current i_0 will be given by $V_{\text{emf}} = i_0 R \Rightarrow i_0 = \frac{V_{\text{emf}}}{R}$. The time constant is $\tau = RC$. The current after time *t* is $i = i_0 e^{-\frac{t}{\tau}} = \frac{V_{\text{emf}}}{R} e^{-\frac{t}{(RC)}}$.

$$i = \frac{V_{\text{emf}}}{R} e^{-\frac{t}{(RC)}} = \frac{152.7\text{ V}}{689.1\ \Omega} e^{-\frac{(3.043\text{ s})}{\left((689.1\ \Omega)\left(18.87 \cdot 10^{-3}\text{ F}\right)\right)}} = 0.1754\text{ A}$$