Open-Access

PHYSICS FOR THE LIFE SCIENCES

Solution Manual

Created by WebStraw

Physics for the Life Sciences – Electricity Solutions

Introduction:

Dear student,

Thank you for opening this solution manual for the Electricity chapter of the Physics for the Life Sciences Question Manual. This resource has been created by members of the Education Team at WebStraw who have previously taken an introductory university physics course.

Purpose:

This resource is meant to supplement the Physics for the Life Sciences Question Manual, by providing solutions to select questions. To access the full question manual, please click here.

Instructions

We recommend first trying to complete the problems in the question manual on your own. If you get stuck, you can use this resource to view the solution provided by one of our Education Team members. Once you are confident you understand how to solve that question, we recommend solving additional related problems in order to successfully master the topic.

Disclaimer

This resource assumes that you have a basic understanding of key concepts related to the Electricity unit in physics. If you are looking to improve your understanding of specific physics content, check out the additional resources provided at the end of the question manual.

Note: There may be more than one correct method to solve some of the problems outlined in the question manual. Thus, the solutions provided may not represent the only acceptable solution.

If you have any comments or feedback regarding this resource or the solutions contained in it, please do not hesitate to contact us at team@webstraw.ca

We wish you the best of luck on your learning journey!

- The WebStraw Education Team

G1:

The equation for force between 2 charges is $F = \frac{kq_1q_2}{r^2}$. If you double the distance ($r \rightarrow 2r$) and halve the charges ($q_1 \rightarrow \frac{1}{2}q_1$ and $q_2 \rightarrow \frac{1}{2}q_2$), we get $F_2 = \frac{k(\frac{1}{2}q_1)(\frac{1}{2}q_2)}{(2r)^2} = \frac{\frac{1}{4}kq_1q_2}{4r^2} = \frac{1}{16}\left(\frac{kq_1q_2}{r^2}\right)$ or $\frac{1}{16}$th of the original force.

G3:

Given: $m = 10kg$ $\quad E = 2\frac{N}{C}$ $\quad a = 20\frac{m}{s^2}$

Required: Charge (q) on object

Solve: $F = qE$ but $F = ma$ so $qE = ma$

$$q = \frac{ma}{E} = \frac{(10kg)(20\frac{m}{s^2})}{(2\frac{N}{C})} = \boxed{100\ C}$$

G5:

Given: $r = 10mm = 0.01m$ $\quad q = 4\cdot10^{-9}C$

Required: Electric field

Solve: $E = \frac{kq}{r^2} = \frac{(8.99\cdot10^9)(4\cdot10^{-9})}{(0.01)^2} = 359600\frac{N}{C}$

G7:

Given: $E = 1.14\cdot10^6\frac{N}{C}$ $\quad v_f = 5.3\cdot10^5\frac{m}{s}$ $\quad v_i = 0\frac{m}{s}$ $\quad q = 1.6\cdot10^{-19}C$

$m = 1.67\cdot10^{-27}kg$

Required: time to reach final velocity

Solve: $F = qE = (1.6\cdot10^{-19}C)(1.14\cdot10^6\frac{N}{C}) = 1.824\cdot10^{-13}N$

$$F = ma \rightarrow a = \frac{F}{m} = \frac{1.824\cdot10^{-13}N}{1.67\cdot10^{-27}kg} = 1.09\cdot10^{14}\frac{m}{s^2}$$

$$v_f = v_0 + at \rightarrow t = \frac{v_f - v_0}{a} = \frac{(5.3\cdot10^5\frac{m}{s} - 0\frac{m}{s})}{(1.09\cdot10^{14}\frac{m}{s^2})} = \boxed{4.8\cdot10^{-9}s}$$

G9:

An electron (negative charge) will move in the direction <u>opposite</u> to the field lines, & experience a force of $F = qE = eE$ where e is the elementary charge. A proton will experience the same force, but move <u>in the direction</u> of the field lines as it is positively charged.

G11:

Given: $E = 100 \frac{N}{C}$ $\quad q = Q \quad m = M$

Required: m in terms of Q & E

Solve: Object experiences electric force upwards & gravitational force (weight) downwards

$F_e = qE = QE$ when it floats, $F_{net} = 0$ so $F_e = F_g$

$F_g = mg$

$F_g = F_e \longrightarrow mg = QE$ so $m = \frac{QE}{g} = \boxed{\frac{QE}{9.8}}$

G13:

Given: $E = 25000 \frac{N}{C}$ (parallel plate capacitor generates a field between its plates)

$d = 10\,mm = 0.01\,m$ $\quad q = e = 1.6 \cdot 10^{-19} C \quad m = 1.67 \cdot 10^{-27} kg$

Required: Speed of electron at positive plate

Solve: $F = qE = ma \longrightarrow a = \frac{qE}{m} = 2.395 \cdot 10^{12} \frac{m}{s^2}$

$v_f^2 = v_0^2 + 2ad \longrightarrow v_f = \sqrt{v_0^2 + 2ad} = \boxed{2.19 \cdot 10^5 \ m/s}$

G15:

Given: $R = 20\,\Omega$ $P = 750\,W$

Required: V and I

Solve: $P = V^2/R \longrightarrow V = \sqrt{PR} = \boxed{122\,V}$

$P = IV \longrightarrow I = \frac{P}{V} = \boxed{6.12\,A}$

G17:

Given: $q = 1.6 \cdot 10^{-19}\,C$ $v_f = 24.4 \cdot 10^5\,\frac{m}{s}$ $m = 1.67 \cdot 10^{-27}\,kg$

Required: voltage

Solve: All of electric energy is converted into kinetic energy

$E_e = qV$ $E_k = \frac{1}{2}mv^2$

$V = \frac{1}{2}\frac{mv^2}{q} = \boxed{31070\ V}$

G19:

Given: $V = 1000\,V$ $q = C$

Required: Work done

Solve: $W = q\Delta V$

$= \boxed{1000 \cdot C}$

G21:

Given: $E = 5000\,\frac{V}{m}$ travelling to right $d = 2\,m$ $q = 1.6 \cdot 10^{-19}\,C$

$m = 1.67 \cdot 10^{-27}\,kg$

Required: v_f at left plate

Solve: $F = qE = ma \longrightarrow a = \frac{qE}{m} = 4.79 \cdot 10^{11} \frac{m}{s^2}$

$$v_f = \sqrt{v_0^2 + 2ad}$$

$$= \boxed{1.38 \cdot 10^6 \ m/s}$$

G23:

Given: $q = 1.6 \cdot 10^{-19}$ C $\quad m = 1.67 \cdot 10^{-27}$ kg $\quad V = 100$ V $\quad v_i = 100\ 000 \frac{m}{s}$

Required: v_f

Solve: $E_{k_i} + E_{e_i} = E_{k_f} + \cancel{E_{e_f}}$ and all of the E_e is converted to E_k

$$E_{k_i} + E_{e_i} = E_{k_f}$$

$$\frac{1}{2}mv_i^2 + qV = \frac{1}{2}mv_f^2 \longrightarrow 8.35 \cdot 10^{-18} J + 1.6 \cdot 10^{-17} J = \frac{1}{2}mv_f^2$$

$$v_f = \boxed{170768 \ \frac{m}{s}}$$

G25a:

The charge is moving towards A (moving with the field lines) so it must be a positive charge (magnitude cannot be found)

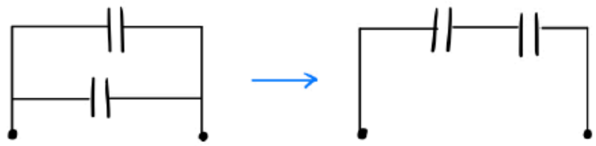
G25b:

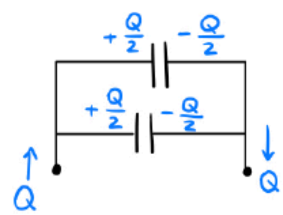
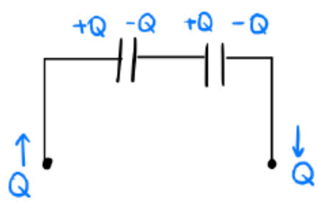
If charge is doubled, it will move in the same direction, but experience a larger force ($F = qE$) so will have greater acceleration & move faster along the path

G25c:

If charge is reversed, it will move in the opposite direction (towards B).

G27



Parallel	Series	
① $C_{eq} = C_1 + C_2 = 2C$	$C_{eq} = \left(\frac{1}{C} + \frac{1}{C}\right)^{-1} = \frac{1}{2}C$	C_{eq} halves.
② Full voltage drop across each capacitor. $U = \frac{1}{2}CV^2$	Each capacitor has half their original voltage drop. $U = \frac{1}{2}C\left(\frac{V}{2}\right)^2 = \frac{1}{4}\left(\frac{1}{2}CV^2\right)$	U at each capacitor decreases by a factor of 4.
③ 		Q doubles.

G29:

Given: $V = 550V$ $d = 3.6mm = 0.0036m$ initial position $= 2.1mm$ from + plate

Required: work to move it 0.0036 m to − plate

Solve: $W = -qEd = Fd = -qV$

$= -(-1.6 \cdot 10^{-19})(550V)$

$= 8.8 \cdot 10^{-17} J$ (moving an e^- from + to − plate requires work)

G31:

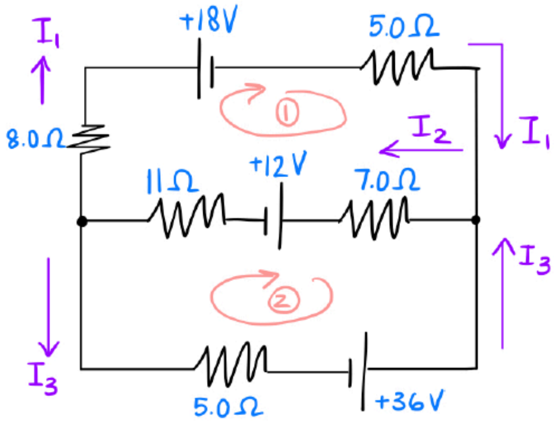
Given: $V = 100{,}000\ V$ $\quad q = 1.6 \cdot 10^{-19} C$

Required: energy gained

Solve: The energy gained = the work performed by the field

$$|W| = |q\,\Delta V| = (1.6 \cdot 10^{-19})(100{,}000) = \boxed{1.6 \cdot 10^{-14}\ J}$$

G33.



* selected random directions of current and random directions of travel to start.

Node Law:

$$I_1 + I_3 - I_2 = 0$$

Loop Law:

① $-18V - (5.0\Omega)I_1 - (7.0\Omega)(I_2) - 12V - (11\Omega)I_2 - (8.0\Omega)I_1 = 0$

$$-30\ V - 13\ I_1 - 18\ I_2 = 0$$

$$-13 I_1 = 30V + 18 I_2$$

$$\boxed{I_1 = \frac{-30 - 18 I_2}{13}}$$

② $+12V + (7.0\Omega)I_2 - 36V + (5.0\Omega)I_3 + (11\Omega)I_2 = 0$

$$-24\ V + 18\ I_2 + 5\ I_3 = 0$$

$$5 I_3 = 24V - 18 I_2$$

$$\boxed{I_3 = \frac{24 - 18 I_2}{5}}$$

Node Law + substitution

$$I_1 + I_3 = I_2$$

$$-\left(\frac{30 + 18I_2}{13}\right) + \frac{24 - 18I_2}{5} = I_2$$

$$\frac{-5(30+18I_2) + 13(24-18I_2)}{65} = I_2$$

$$-150 - 90I_2 + 312 - 234I_2 = 65I_2$$

$$162 = 389I_2$$

$$\boxed{I_2 = 0.42\ A}$$

$$I_1 = -\left(\frac{30 + 18I_2}{13}\right)$$

$$\boxed{I_1 = -2.9}$$

$$I_3 = \frac{24 - 18I_2}{5}$$

$$\boxed{I_3 = 3.3\ A}$$

∴ The current through the 8.0 Ω and the top 5.0 Ω resistors is 2.9 A. The current through the 11 Ω and 7.0 Ω resistors is 0.42 A. The current through the bottom 5.0 Ω resistor is 3.3 A.

No solution available for G35

G37:

Given: $C = 50\,\mu F \quad R_1 = 400\,\Omega \quad R_2 = 800\,\Omega$

Required: time constant τ

Solve: Resistors in series so $R_t = R_1 + R_2 = 1200\,\Omega$

$$\tau = R_t C = (50 \cdot 10^{-6} F)(1200\,\Omega) = \boxed{0.06}$$

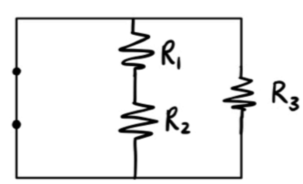
If in parallel, $R_t = \left(\frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}\right) = 266.67\,\Omega$

$$\tau = R_t C = (50 \cdot 10^{-6} F)(266.67\,\Omega) = \boxed{0.013}$$

$\therefore$ τ decreases if resistors arranged in parallel

G39.

Possible circuit diagram:



$R_1 = 2.0\,\Omega$
$R_2 = 3.0\,\Omega$
$R_3 = 4.0\,\Omega$

① $R_{12} = R_1 + R_2 = 2.0\,\Omega + 3.0\,\Omega = 5.0\,\Omega$

② $$\frac{1}{R_{123}} = \frac{1}{R_{12}} + \frac{1}{R_3}$$

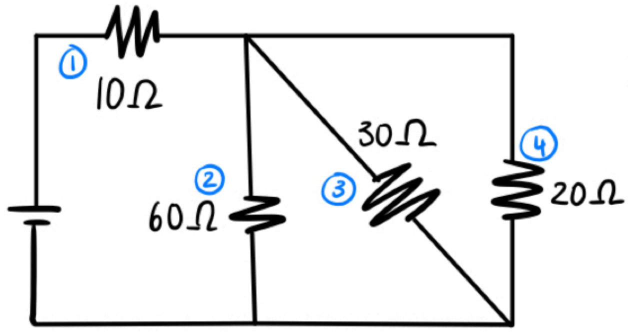
$$\frac{1}{R_{123}} = \frac{1}{5.0\,\Omega} + \frac{1}{4.0\,\Omega}$$

$$\frac{1}{R_{123}} = \frac{9}{20}$$

$$\boxed{R_{123} = 2.2\,\Omega}$$

$\therefore$ The equivalent resistance in this circuit is $2.2\,\Omega$.

G41.

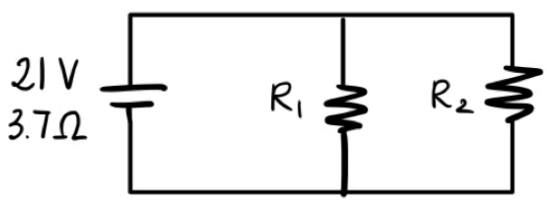


①
$$\frac{1}{R_{234}} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$
$$\frac{1}{R_{234}} = \frac{1}{60\Omega} + \frac{1}{30\Omega} + \frac{1}{20\Omega}$$
$$\frac{1}{R_{234}} = \frac{6}{60}$$
$$\boxed{R_{234} = 10\Omega}$$

②
$$R_{eq} = R_{1234} = R_1 + R_{234} = 10\Omega + 10\Omega = 20\Omega$$

Therefore, the equivalent resistance in the circuit is 20Ω.

G43.



The voltage across each resistor is 21 V.

a)
$$P = \frac{V^2}{R} = \frac{(21V)^2}{5\Omega} = 88\ W$$

∴ 88 W of power is expended at the $5.0\text{-}\Omega$ resistor.

b)
$$P = \frac{V^2}{R}$$
$$R = \frac{V^2}{P} = \frac{(21V)^2}{30W} = 15\ \Omega$$

∴ The resistance of the second resistor is 15Ω.

G45.

$I = 1.0\,A$
$V = 800\,V$

$$P = IV = \frac{\Delta E}{\Delta t}$$

$$(1.0A)(800V) = \frac{0.88\,J}{\Delta t}$$

$$\boxed{\Delta t = 0.0011\ s}$$

$\therefore$ The shock is delivered over 0.0011 s (1.1 ms).

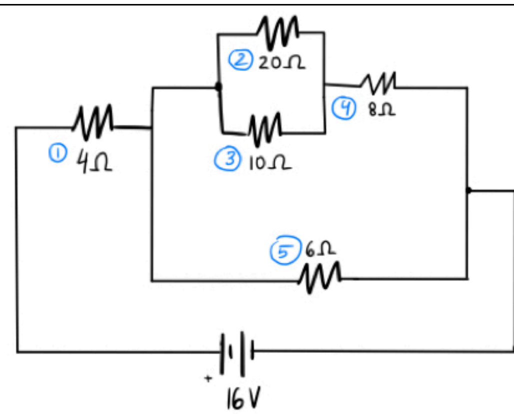
G47. a)

$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{23}} = \frac{1}{20\Omega} + \frac{1}{10\Omega}$$

$$\frac{1}{R_{23}} = \frac{3}{20\Omega}$$

$$R_{23} = 6.67\Omega$$



Therefore, the combined resistance of the 20-Ω and 10-Ω resistors is 6.67 Ω.

b)

$$R_{234} = R_{23} + R_4$$
$$= 6.67\Omega + 8\Omega$$
$$= 14.67\Omega$$

Therefore, R_{234} is 14.67Ω.

c)

$$\frac{1}{R_{2345}} = \frac{1}{R_{234}} + \frac{1}{R_5}$$

$$\frac{1}{R_{2345}} = \frac{1}{14.67\Omega} + \frac{1}{6\Omega}$$

$$R_{2345} = 4.26\,\Omega$$

Therefore, $R_{2345} = 4.26\,\Omega$

d) $R_{12345} = R_1 + R_{2345}$
$R_{12345} = 4\Omega + 4.26\Omega$
$\boxed{R_{eq} = 8.3\Omega}$ Therefore, R_{eq} is 8.3Ω.

e) $I = \frac{V}{R} = \frac{16V}{8.26\Omega} = \boxed{1.9\ A}$ Therefore, the total current in the circuit is 1.9 A.

f) $R_5 = 0.409\ R_{234} \approx \frac{2}{5} R_{234}$ $\therefore$ R_5 will have $\frac{5}{2}$ times more current than R_{234}.
$\left[V = IR \quad I \propto \frac{1}{R} \right]$

$I_5 + I_{234} = I_{total} = 1.9A$
$\frac{5}{2} I_{234} + I_{234} = 1.9A$
$\frac{7}{2} I_{234} = 1.9\ A$
$I_{234} = 0.543\ A$

$\therefore I_5 = 1.9\ A - 0.543\ A = \boxed{1.4\ A}$

Therefore, the current through the 6-Ω resistor is 1.4 A.

g) $R_1 = 4.0\Omega$
$I_1 = 1.9\ A$

$\therefore V_1 = I_1 R_1$
$V_1 = (1.9A)(4.0\Omega)$
$\boxed{V_1 = 7.6\ V}$

$\therefore$ The voltage drop across the 4.0-Ω resistor is 7.6 V.

G49. recall: $R = \frac{\rho \ell}{A}$ where ℓ = length of wire and A = area of the cross-section and ρ = resistivity

$R = \frac{\rho \ell}{\pi r^2}$

Wire 1 – radius R, length L $\to r$

Wire 2 – radius 4R, length 16L

Wire 3 – radius 5R, length L/3

Wire 4 – radius R/2, length 3L/2

<u>Wire 1</u> $R = \frac{\rho L}{\pi r^2}$

wire 2 $$R = \frac{\rho(16L)}{\pi(4r)^2} = \frac{16(\rho L)}{16(\pi r^2)} = \frac{\rho L}{\pi r^2}$$

wire 3 $$R = \frac{\rho(\frac{L}{3})}{\pi(5r)^2} = \frac{\rho L}{3(25)(\pi r^2)} = \frac{1}{75}\cdot\frac{\rho L}{\pi r^2}$$

wire 4 $$R = \frac{\rho(\frac{3L}{2})}{\pi(\frac{r}{2})^2} = \frac{3(\rho L)}{2(\frac{1}{4})(\pi r^2)} = 6\cdot\frac{\rho L}{\pi r^2}$$

$\therefore$ Greatest R ⟶ Smallest Resistance

wire 4 > wires 1 and 2 > wire 3

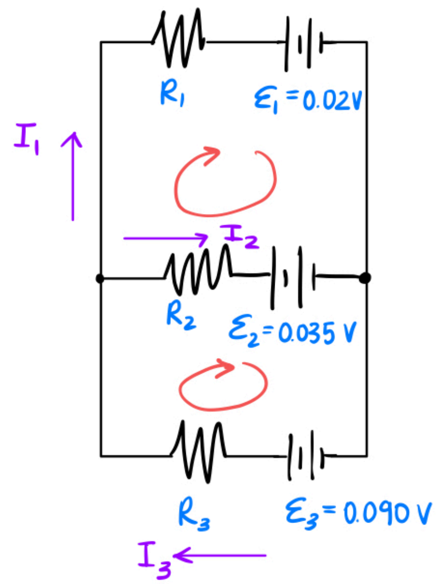
G51.

$R_1 = R_2 = R_3 = 0.0025\,\Omega$

$\mathcal{E}_1 = 0.020\ V$

$\mathcal{E}_2 = 0.035\ V$

$\mathcal{E}_3 = 0.090\ V$



Kirchhoff's Node Law:

$$I_3 - I_1 - I_2 = 0$$
$$I_3 = I_1 + I_2$$

kirchhoff's loop law:

① $$+\mathcal{E}_2 + I_2R_2 - I_1R_1 - \mathcal{E}_1 = 0$$

$$0.035\ V + 0.0025\,I_2 - 0.0025\,I_1 - 0.020\ V = 0$$

$$0.0025\,I_1 = 0.0025\,I_2 - 0.015\ V$$

$$\boxed{I_1 = I_2 - 6V}$$

②
$$+\mathcal{E}_3 - I_3R_3 - I_2R_2 - \mathcal{E}_2 = 0$$
$$0.090\,V - 0.0025 I_3 - 0.0025 I_2 - 0.035\,V = 0$$
$$0.0025 I_3 + 0.0025 I_2 = 0.055\,V$$
$$0.0025 I_3 = 0.055\,V - 0.0025 I_2$$
$$\boxed{I_3 = 22\,V - I_2}$$

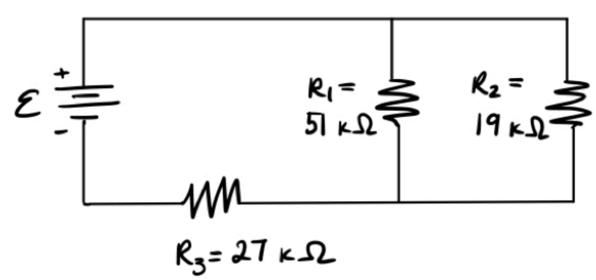
Return to the Node Law & Substitute

$$I_3 = I_1 + I_2$$
$$22V - I_2 = I_2 - 6V + I_2$$
$$28V = 3I_2$$
$$\boxed{I_2 = 9.3\,A}$$

$$\therefore \quad I_3 = 22 - 9.33 = \boxed{13\,A}$$
$$I_1 = 9.33 - 6 = \boxed{3.3\,A}$$

∴ The current through $\mathcal{E}_1$ is 3.3 A and it moves from the positive terminal to the negative terminal.

G53.



① $R_{12} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}$

$R_{12} = \left(\frac{1}{51\,k\Omega} + \frac{1}{19\,k\Omega}\right)^{-1}$

$R_{12} = 13.8\,k\Omega$

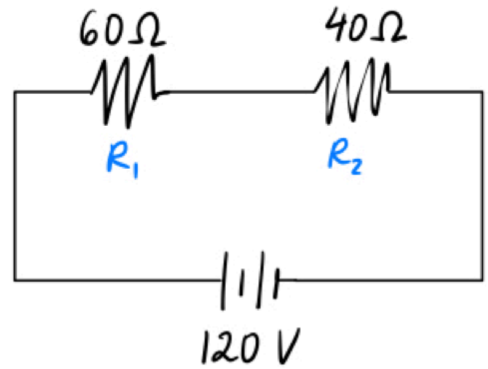
② $R_{eq} = R_{12} + R_3$

$R_{eq} = 13.8\,k\Omega + 27\,k\Omega$

$R_{eq} = 41\,k\Omega$

∴ The equivalent resistance in the circuit is 41 kΩ.

G55.

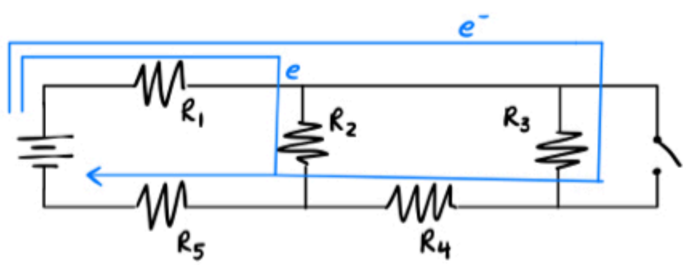


$$120\,V = V_1 + V_2$$
$$120\,V = IR_1 + IR_2$$
$$120\,V = 60I + 40I$$
$$120\,V = 100I$$
$$I = 1.2\,A$$

$$V_1 = IR_1$$
$$V_1 = (1.2\,A)(60\,\Omega)$$
$$\boxed{V_1 = 72\,V}$$

∴ The voltage across the 60-Ω resistor is 72 V.

G57.



Paths electrons can take through the circuit with the switch open.

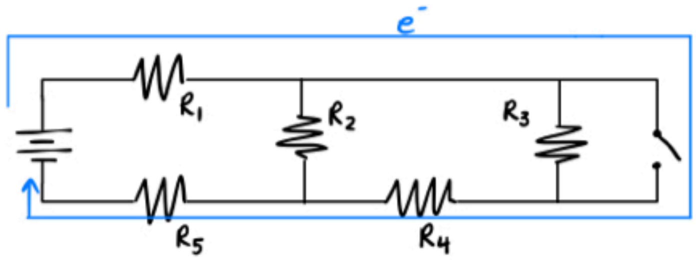
Calculation for R_{eq}:

① $R_{34} = R_3 + R_4 = 2R$

② $$\frac{1}{R_{234}} = \frac{1}{R_2} + \frac{1}{R_{34}}$$
$$\frac{1}{R_{234}} = \frac{1}{R} + \frac{1}{2R}$$
$$R_{234} = \frac{2}{3}R$$

③ $$R_{eq} = R_1 + R_{234} + R_5$$
$$R_{eq} = R + \frac{2}{3}R + R$$
$$\boxed{R_{eq} = \frac{8}{3}R}$$

When the switch, there is a new path for electrons to flow through that has no resistance. Electrons like to follow the path of least resistance, therefore the paths involving resistors 2 and 3 will be effectively short-circuited (ie. no electrons will flow through them).



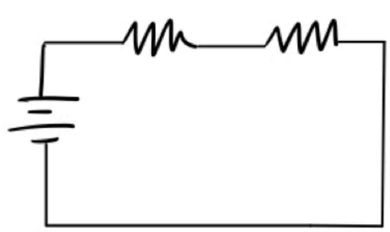
New Req:

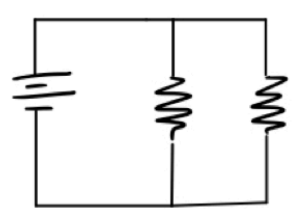
$$R_{eq} = R_1 + R_4 + R_5 = 3R$$

$$3R > \frac{8}{3}R$$

$\therefore$ The overall resistance of the circuit increases when the switch is closed.

G59.





Req in series:

$$R_{eq} = R_1 + R_2$$

$\therefore$ must be greater than both R_1 and R_2.

Req in parallel:

$$R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}$$

$\therefore$ must be smaller than both R_1 and R_2.

$$V = IR$$

constant and determined by EMF source.

$$I \propto \frac{1}{R}$$

$\because$ The greater R is, the smaller I is.

∴ the bulbs will be brighter in the parallel circuit. More current will be drawn since resistance is smaller than if the bulbs were connected in series.

B is correct.

G61.

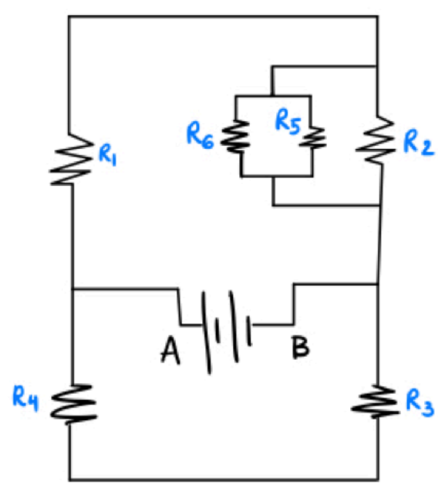
$$R = \frac{\rho l}{A}$$

Resistance is directly proportional to the length of wire.

$$R \propto l$$

Therefore, if the length of wire increases by 0.5%, and assuming resistivity ρ and area of cross-section A remain unchanged, the resistance of the wire will likewise increase by 0.5%.

G63. $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 100\,\Omega$



① $R_{56} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1}\,\Omega$
$= 50\,\Omega$

② $R_{256} = \left(\frac{1}{50} + \frac{1}{100}\right)^{-1}\,\Omega$
$= 33.33\,\Omega$

③ $R_{1256} = 100\,\Omega + 33.33\,\Omega = 133.33\,\Omega$

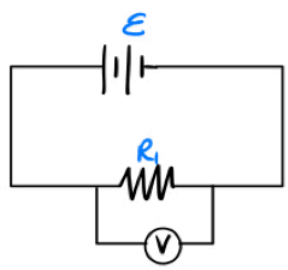
④ $R_{34} = 100\,\Omega + 100\,\Omega = 200\,\Omega$

⑤ $R_{123456} = R_{eq} = \left(\frac{1}{133.33} + \frac{1}{200} \right)^{-1} \Omega$

$$\boxed{R_{eq} = 80.0\,\Omega}$$

Therefore, the equivalent resistance between terminals A and B is 80.0 Ω.

G65.



$\varepsilon = 15.0V$

$R_1 = 5.0V$

$I_V = 0.05\, I_{total}$

Since this is a parallel circuit, $V_R = V_V = 15.0\,V$.

Furthermore, recall that Ohm's law tells us that $I \propto \frac{1}{R}$. Since electrons only have 2 possible paths to follow at the first junction in the circuit, the 5.0-Ω resistor must recieve 95% of the total current.

Since the 5.0-Ω resistor receives 19 times more current, it must have 19 times less resistance than the voltmeter. Therefore, the voltmeter has a resistance of $19 \times 5.0\,\Omega = \boxed{95\,\Omega}$.

To calculate the current through the EMF source:

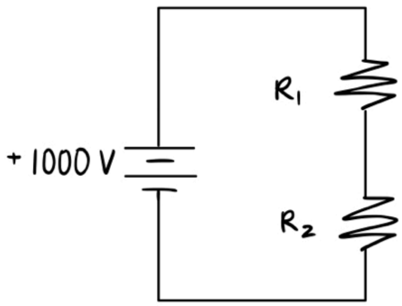
$$I_V = 0.05\, I_t = \frac{V}{R}$$

$$I_t = 20\left(\frac{15.0\,V}{95\,\Omega}\right)$$

$$\boxed{I_t = 3.2\,A}$$

Therefore, the current passing through the EMF source is 3.2 A.

G67.



$R_1 > R_2$

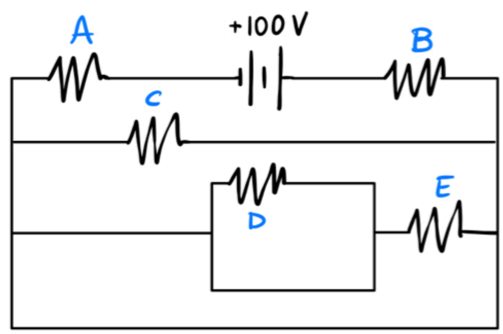
$I_1 = I_2$

Power formula : $P = I^2 R$

$\because$ Power is directly proportional to resistance and the current is the same for both resistors,

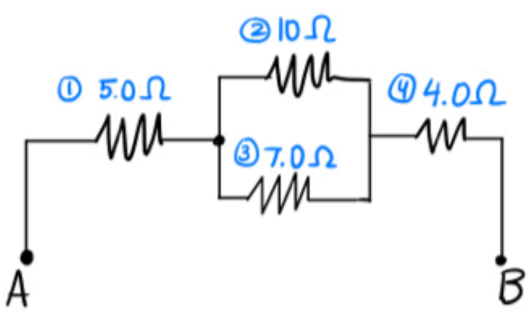
$\therefore$ resistor 1 will dissipate more power.

G69.



combinations of resistors in series: A and B

G71.



1) <u>Solving for Req</u>

① $\frac{1}{R_{23}} = \frac{1}{10} + \frac{1}{7}$

$R_{23} = 4.12\,\Omega$

② $R_{eq} = R_1 + R_{23} + R_4$

$R_{eq} = 5.0\,\Omega + 4.12\,\Omega + 4.0\,\Omega$

$\boxed{R_{eq} = 13\,\Omega}$

Therefore, the equivalent resistance between points A and B is 13Ω.

2) Solving for Current

① $I_t = \dfrac{V_{AB}}{R_{eq}} = \dfrac{100\,V}{13.12\,\Omega} = \boxed{7.6\,A}$

All current must go through resistors 1 and 4. This current is 7.6 A.

② $I \propto \dfrac{1}{R}$ $\quad R_2 = 10\Omega$ $\quad R_3 = 7\Omega$ $\quad R_3 = \dfrac{7}{10} R_2$

$\therefore\ I_3 = \dfrac{10}{7} I_2$ because V is constant.

$$I_2 + I_3 = I_t$$
$$I_2 + \frac{10}{7} I_2 = 7.6\,A$$
$$\frac{17}{7} I_2 = 7.6\,A$$
$$\boxed{I_2 = 3.1\,A}$$

$$I_3 = \frac{10}{7}(3.1\,A) = \boxed{4.5\,A}$$

The current through the $10\text{-}\Omega$ resistor is 3.1A. The current through the $7.0\text{-}\Omega$ resistor is 4.5 A.