Conceptual Question 25.01

Part A

If the electric field is zero everywhere inside a region of space, the potential must also be zero in that region.

ANSWER:

- True
- False

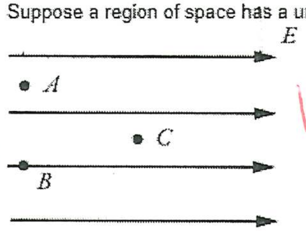
Since $E_s = -\frac{dV}{ds}$, if $E = 0$ then $\frac{dV}{ds} = 0$ or $V = \text{const}$.

Conceptual Question 25.06

Part A

Suppose a region of space has a uniform electric field, directed towards the right, as shown in the figure. Which statement about the electric potential is true?

high pot.



low pot.

$\vec{E}$ points from high to low potential.

$V_A = V_B > V_C$

ANSWER:

- The potential at points A and B are equal, and the potential at point C is higher than the potential at point A.
- The potential at all three locations (A, B, C) is the same because the field is uniform.
- The potential at point A is the highest, the potential at point B is the second highest, and the potential at point C is the lowest.
- The potential at points A and B are equal, and the potential at point C is lower than the potential at point A.

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$

For series caps $Q_1 = Q_2$.

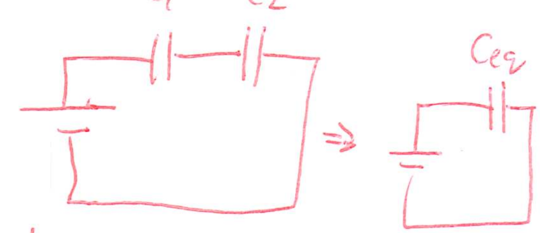
Conceptual Question 26.11

Part A

When two or more capacitors are connected in series across a potential difference

ANSWER:

- the potential difference across the combination is the algebraic sum of the potential differences across the individual capacitors.
- the equivalent capacitance of the combination is less than the capacitance of any of the capacitors.
- each capacitor carries the same amount of charge.
- All of the above choices are correct.
- None of the above choices are correct.

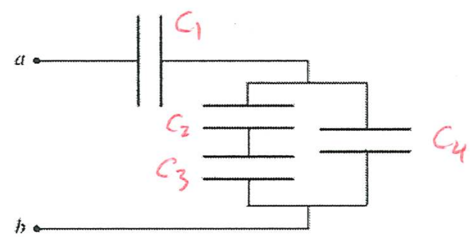


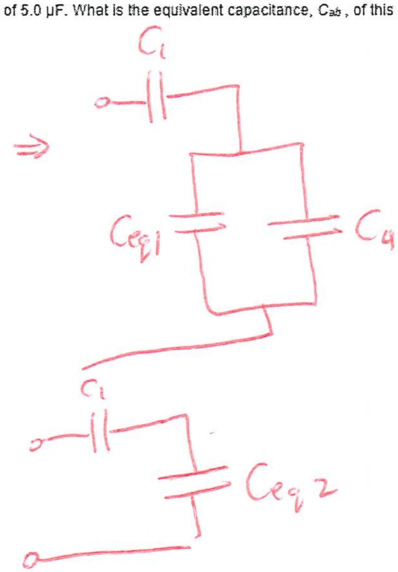
by loop rule $V_{C_1} + V_{C_2} = V_{C_{eq}}$

Problem 26.09

Part A

The capacitors in the network shown in the figure all have a capacitance of 5.0 μF. What is the equivalent capacitance, C_{ab}, of this capacitor network?





$\frac{1}{C_{eq_1}} = \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{C} + \frac{1}{C} = \frac{2}{C}$

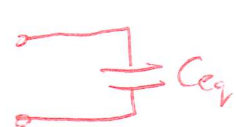
$\therefore C_{eq_1} = \frac{C}{2}$

$C_{eq2} = C_{eq1} + C_4 = \frac{C}{2} + C = \frac{3C}{2}$

ANSWER:

- 20 μF
- 1.0 μF
- 3.0 μF
- 5.0 μF
- 10 μF

$\frac{3C}{5} = \frac{3(5\mu F)}{5} = 3\mu F$

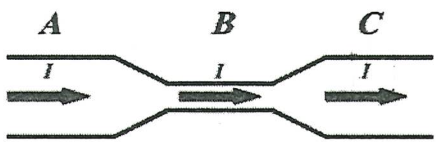


$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_{eq2}} = \frac{1}{C} + \frac{2}{3C} = \frac{5}{3C}$ $\boxed{C_{eq} = \frac{3C}{5}}$

Conceptual Question 27.01

Part A

The figure shows a steady electric current passing through a wire with a narrow region. What happens to the drift velocity of the moving charges as they go from region A to region B and then to region C?



$J = \frac{I}{A} = q n v_d$

ANSWER:

- The drift velocity remains constant.
- The drift velocity increases from A to B and decreases from B to C.
- The drift velocity increases all the time.
- The drift velocity decreases from A to B and increases from B to C.
- The drift velocity decreases all the time.

$I_A = I_B = I_C$

$J_A = J_C < J_B$

$\therefore V_{dA} = V_{dC} < V_{dB}$

Problem 27.20

Part A

A 2.0 mm diameter wire of length 20 m has a resistance of 0.25 Ω. What is the resistivity of the wire?

ANSWER:

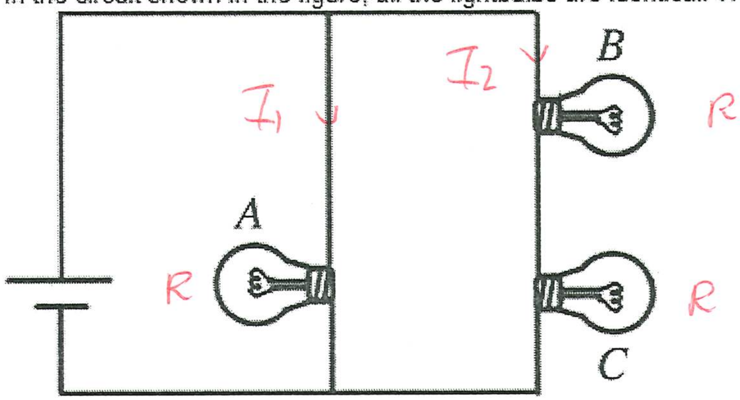
- 0.25 Ω · m
- 4.0×10^{-7} Ω · m
- 3.9×10^{-8} Ω · m
- 16×10^{-8} Ω · m
- 5.0×10^{-7} Ω · m

$R = \rho \frac{L}{A} \therefore \rho = \frac{A}{L} R = \frac{\pi \left(\frac{d}{2}\right)^2}{L} R = 3.93 \times 10^{-8}\ \Omega m$

Conceptual Question 28.03

Part A

In the circuit shown in the figure, all the lightbulbs are identical. Which of the following is the correct ranking of the brightness of the bulbs?



Greatest current through A

A brightest

B & C equally bright

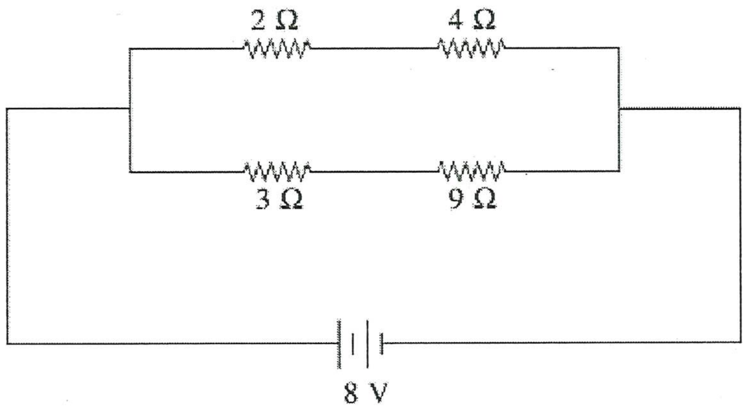
ANSWER:

- ○ A is brightest, C is dimmest, and B is in between.
- ○ A and B have equal brightness, and C is the dimmest.
- ○ A is the brightest, and B and C have equal brightness but less than A.
- ○ B and C have equal brightness, and A is the dimmest.
- ○ All three bulbs have the same brightness.

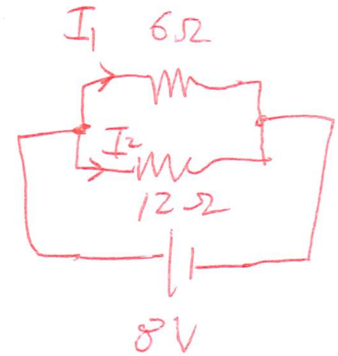
Problem 28.24

Part A

Four resistors are connected across an 8-V DC battery as shown in the figure. The current through the 9-Ω resistor is closest to



$\Rightarrow$



ANSWER:

- 0.5 A.
- 2 A.
- 0.7 A.
- 1 A.
- 0.9 A.

by loop rule $8V - 12 I_2 = 0$

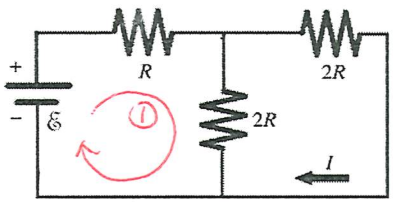
$\therefore I_2 = \frac{8V}{12\Omega} = 0.67A$

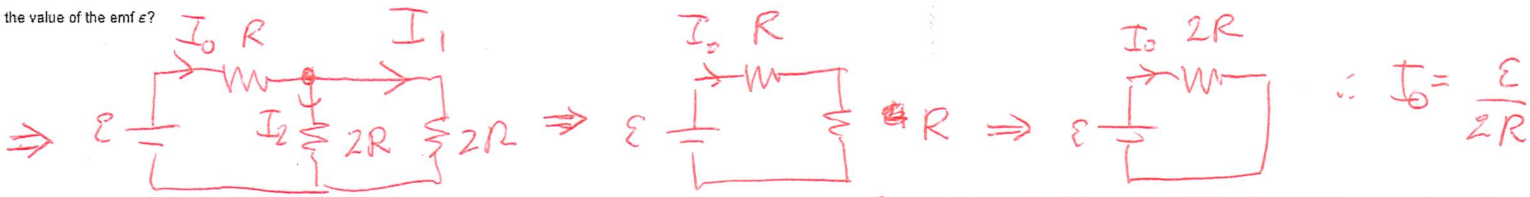
current through 3Ω & 9Ω resistors is 0.67A.

Problem 28.27

Part A

For the circuit shown in the figure, I = 0.50 A and R = 12 Ω. What is the value of the emf ε?





$\therefore I_0 = \frac{\varepsilon}{2R}$

by symmetry $I_1 = I_2 = I$

by jcn rule $I_0 = I_1 + I_2 = 2I$

$\therefore I = \frac{I_0}{2} = \frac{\varepsilon}{4R}$

$\varepsilon = 4IR = 4(0.5A)(12\Omega) = 24V$

By loop rule ① (Check)

$\varepsilon - I_0 R - I(2R) = 0$

$\varepsilon - \frac{\varepsilon}{2} - \frac{\varepsilon}{2} = 0$ ✓

ANSWER:

- 48 V
- 12 V
- 6.0 V
- 18 V
- 24 V

Conceptual Question 26.16

Part A

An ideal parallel-plate capacitor consists of a set of two parallel plates of area A separated by a very small distance d. When the capacitor plates carry charges $+Q$ and $-Q$, the capacitor stores energy U_0. If the separation between the plates is doubled how much electrical energy is stored in the capacitor?

ANSWER:

- U_0
- $2U_0$
- $U_0/2$
- $U_0/4$
- $4U_0$

$U_0 = \frac{Q^2}{2C}$ $\quad C = \varepsilon_0 \frac{A}{d}$

$U_0 = \frac{Q^2 d}{2\varepsilon_0 A}$ $\quad U_1 = \frac{Q^2(2d)}{2\varepsilon_0 A}$ $\quad \therefore \frac{U_1}{U_0} = 2$

or $U_1 = 2U_0$