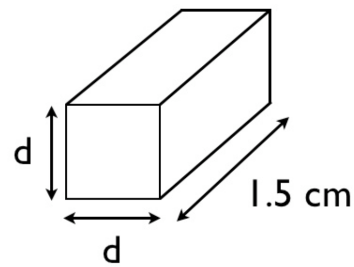
*Closed book. No work needs to be shown for multiple-choice questions.*

**1.** A 200.0 Ω resistor is constructed by forming a material of resistivity 2.5 Ω·m. The cross-section of this resistor is shaped like a square with side length *d*. The resistor is 1.5 cm long. What is the value of the side length *d*?

a. 0.19 mm.
b. 3.0 mm.
c. 1.4 cm.
d. 7.3 cm.
e. 1.2 m.

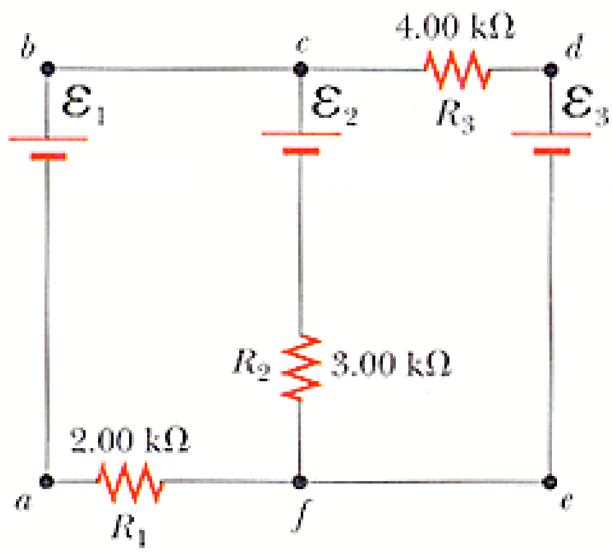



**2.** Consider a series *RC* circuit for which $C = 6.0\ \mu F$, $R = 2.0x10^6\ \Omega$, and $\mathcal{E} = 2.0$ V. Find the time constant of this circuit.

a. 6.0 s.
b. 12 s.
c. 24 s.
d. 4.0 μs.
e. 3.0 ms

**3.** For the circuit below the $\varepsilon_1 = 14V$, $\varepsilon_2 = 3V$ and $\varepsilon_3 = 20V$. What is the value of the difference of potential (voltage) in $R_3$?

a. 4 V.
b. 12 V.
c. 8 V.
d. 2 V.
e. 16 V.

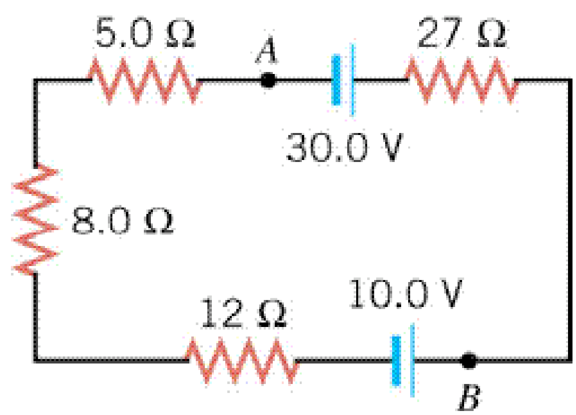


**4.** Two resistors have the same power dissipated by them. The potential difference measured across resistor *A* is twice that across resistor *B*. If the resistance of resistor *B* is *R*, what is the resistance of *A*?

a. *R*/2.
b. 2*R*.
c. *R*/4.
d. 4*R*.
e. 16*R*.

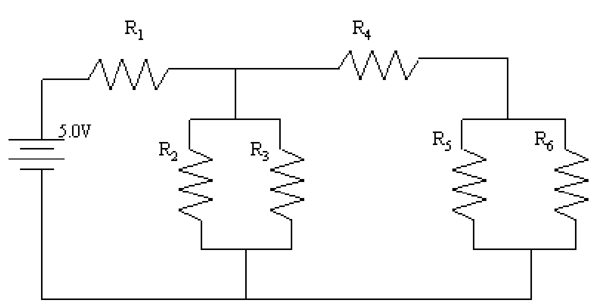
**5.** In the circuit below, what is the power dissipated in the 12 Ω resistor?

a. 1.78 W.
b. 0.38 W.
c. 4.62 W.
d. 7.10 W.
e. 0.77 W.

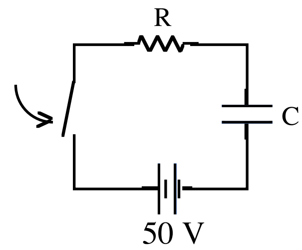



**6.** If $R_1 = R_5 = R_6 = 2\ \Omega$, $R_4 = 5\ \Omega$ and $R_2 = R_3 = 6\ \Omega$, the equivalent resistor connected to the battery is:

a. 4 Ω
b. 7 Ω.
c. 8 Ω.
d. 6 Ω.
e. 2 Ω.

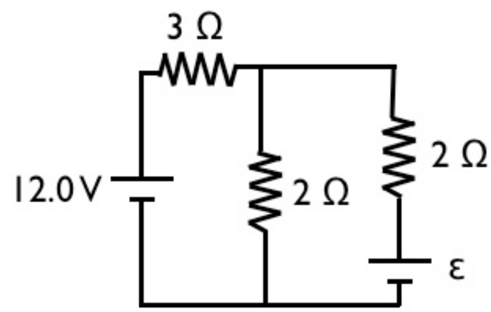


**7**. A series *RC* circuit has a time constant of 1.0 s. The battery has a voltage of 50 V and the maximum current just after closing the switch is 500 mA. The capacitor is initially uncharged. What is the charge on the capacitor 2.0 s after the switch is closed?




a. 0.43 C
b. 0.66 C
c. 0.86 C
d. 0.29 C
e. 0.17 C

**8.** In the picture below, the current through the 3.0 Ω resistor is 2.0 A. What is the potential difference of the battery marked ε?




a. 2.0 V.
b. 4.0 V.
c. 5.0 V.
d. 6.0 V.
e. 8.0 V.

*Recall that*

$F = k_e \frac{|q_1||q_2|}{r^2}$; $k_e = 8.99\times10^9\ \frac{\mathrm{N\cdot m^2}}{\mathrm{C^2}}$; $e = 1.60\times10^{-19}\,\mathrm{C}$; $\varepsilon_o = 8.85\times10^{-12}\ \frac{\mathrm{C^2}}{\mathrm{N\cdot m^2}}$;

$m_e = 9.11\times10^{-31}$ kg; $m_p = 1.673\times10^{-27}$ kg; $m_n = 1.675\times10^{-27}$ kg; 1 eV $= 1.602\times10^{-19}$ J;

1 kWh $= 3.60\times10^6$ J; $\vec{\mathbf{F}} = q_o\vec{\mathbf{E}}$; $E = k_e\frac{|q|}{r^2}$; $\Phi_E = EA\cos\theta$; $\Phi_E = \frac{Q_{inside}}{\varepsilon_0}$; $PE_{elec,\mathrm{point}} = k_e\frac{qq_0}{r}$;

$V_{point\ charge} = k_e\frac{q}{r}$; $\Delta PE_{elec} = q_0\Delta V$; $C = \frac{Q}{\Delta V}$; $C_{parllel\ plate} = \varepsilon_0\frac{A}{d}$; $C_{dielectric} = \kappa\varepsilon_0\frac{A}{d}$;

$\frac{1}{C_{series\ eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$; $C_{parallel\ eq} = C_1 + C_2 + C_3 + \ldots$;

$Energy_{capacitor} = \frac{1}{2}Q(\Delta V) = \frac{1}{2}C(\Delta V)^2 = \frac{Q^2}{2C}$; $I = \frac{\Delta Q}{\Delta t}$;

$R = \frac{\Delta V}{I} = \rho\frac{L}{A}$; $\rho = \rho_o[1 + \alpha(T - T_o)]$; $R = R_o[1 + \alpha(T - T_o)]$; $Power = I(\Delta V) = I^2R = \frac{(\Delta V)^2}{R}$;

$\rho_{Silver} = 1.59\times10^{-8}\,\Omega\cdot\mathrm{m}$; $\rho_{Copper} = 1.7\times10^{-8}\,\Omega\cdot\mathrm{m}$

$I_{in} = I_{out}$; $\frac{1}{R_{parallel\ eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$; $R_{series\ eq} = R_1 + R_2 + R_3 + \ldots$; $\sum \Delta V_{loop} = 0$;

$\tau = RC$; $q_{\mathrm{charge}} = Q_{final}\left(1 - e^{-t/RC}\right)$; $q_{\mathrm{discharge}} = Q_0 e^{-t/RC}$;

$A_{circle} = \pi r^2$; $A_{cyl.side} = 2\pi rh$; $A_{sphere} = 4\pi r^2$; $g = 9.80\ \mathrm{m/s^2}$; $x = \frac{b \pm \sqrt{b^2 \quad 4ac}}{2a}$;

100 cm = 1 m; 1 $\mu$F = 1.0 $10^{\#6}$F; 1 MW = 1.0 $10^6$W; 1,000 W = 1 kW; 60 s = 1 min;

60 min = 1 hr; 2.54 cm = 1 in; 12 in = 1 ft; 5,280 ft = 1 mi; 1,609 m = 1 mi; 0.3048 m = 1 ft.