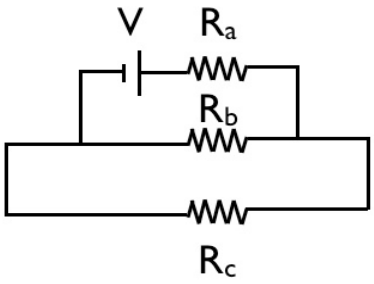
Closed book. No work needs to be shown for multiple-choice questions.

1. The time constant for one RC circuit is known to be 1.2 seconds (we will call this the first RC circuit). A second RC circuit is known to have a time constant of 3.6 seconds. Initially, the two capacitors are fully charged and both circuits have open switches. The circuits are then closed and the capacitors are discharged until they have one-fourth of their original charge. Which of the following is **true**?

a) The first RC circuit takes one-third as long to complete this process as the second.
b) The first RC circuit takes three times as long to complete this process as the second.
c) The first RC circuit takes one-fourth as long to complete this process as the second.
d) The first RC circuit takes four times as long to complete this process as the second.
e) The first RC circuit takes 2.4 seconds longer to compete this process than the second.

2. Which of the following is **true** about the circuit shown below containing resistors R_a, R_b, and R_c?



a) All resistors in the circuit (R_a, R_b, and R_c) are connected in parallel.
b) None of the resistors are connected in parallel.
c) Only resistors R_a and R_b are connected in parallel.
d) Only resistors R_b and R_c are connected in parallel.
e) Only resistors R_a and R_c are connected in parallel.

3. Next, replace R_a in the circuit from Question 2 with a 10 micro farad capacitor. What is the time constant of the resulting circuit if R_b and R_c are 100 kilo Ohm each?

a) 5 seconds
b) 1 second
c) 0.5 seconds
d) 0.1 seconds
e) 0.05 seconds

4. The SI unit for magnetic field strength, B, can be described as:

a) $1\ \frac{\mathrm{N \cdot s}}{\mathrm{C \cdot m^2}}$

b) $1\ \frac{\mathrm{N}}{\mathrm{A \cdot m^2}}$

c) $1\ \frac{\mathrm{N \cdot s}}{\mathrm{C}}$

d) $1\ \frac{\mathrm{N \cdot s}}{\mathrm{C \cdot m}}$

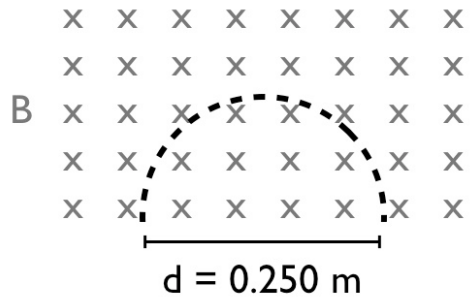
e) $1\ \frac{\mathrm{N \cdot A}}{\mathrm{s}}$

5. A charged particle moves in a straight line through a region of space where a magnetic field is present. Which of the following answers **must** be true?

a) The magnetic field has a magnitude of 0 T.
b) There is no component of the magnetic field perpendicular to the particle's velocity.
c) There is no component of the magnetic field parallel to the particle's velocity.
d) The particle feels the maximum magnetic torque due to the magnetic field.
e) The particle is an electron.

6. A particle with charge $+2.25 \times 10^{-15}$ C enters a uniform magnetic field of 0.500 T in a direction perpendicular to the field. Its velocity when it enters the magnetic field is 5.00×10^{5} m/s. The particle exits the magnetic field 0.250 m from where it entered. Its path is shown with a dotted line in the picture to the right. What is the particle's mass?

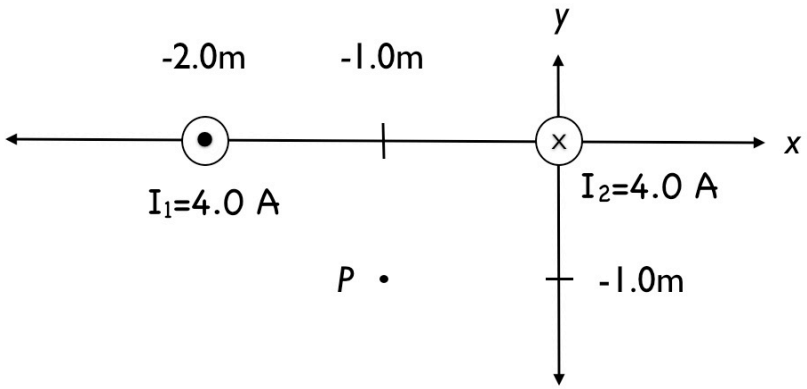
a) 1.41×10^{-11} kg.
b) 2.81×10^{-22} kg.
c) 5.62×10^{-22} kg.
d) 9.00×10^{-27} kg.
e) 1.67×10^{-27} kg.



7. A wire carries a steady current of 2.4 A. A straight section of the wire is 0.75m long and lies along the x-axis within a uniform magnetic field B = 1.6 T along the y-axis. What is the absolute value of the magnetic force on the section of wire? Pick the closest answer.

a) Zero
b) 1 N
c) 3 N
d) 9 N
e) 27 N

Question 8 refers to the picture, shown below. In the picture, a very long wire intersecting the page perpendicularly at the origin carries a current of 4.0 A ***into the page***. Another wire intersects the page perpendicularly at (–2.0 m, 0 m) and carries current of 4.0 A ***out of the page***. Point *P* is located at (–1.0 m, –1.0 m).



8. What is the magnitude of the magnetic field at point *P* due to the two current-carrying wires?

a) 0 T.
b) 4.0×10^{-7} T.
c) 5.7×10^{-7} T.
d) 8.0×10^{-7} T.
e) 1.1×10^{-6} T.

9. Figure 9 shows a circuit with 5 resistors and two batteries. The currents I_1, I_2, I_3, are indicated in the figure. Calculate their values, and chose the answer below that most accurately describes them.

a) $I_1 = 0.9$ A, $I_2 = 0.5$ A, $I_3 = 1.3$ A
b) $I_1 = -0.9$ A, $I_2 = 0.5$ A, $I_3 = 1.3$ A
c) $I_1 = 1.0$ A, $I_2 = 0.3$ A, $I_3 = 1.0$ A
d) $I_1 = 850$ mA, $I_2 = -460$ mA, $I_3 = 1.3$ A
e) $I_1 = 0.5$ A, $I_2 = 0.9$ A, $I_3 = 1.3$ A

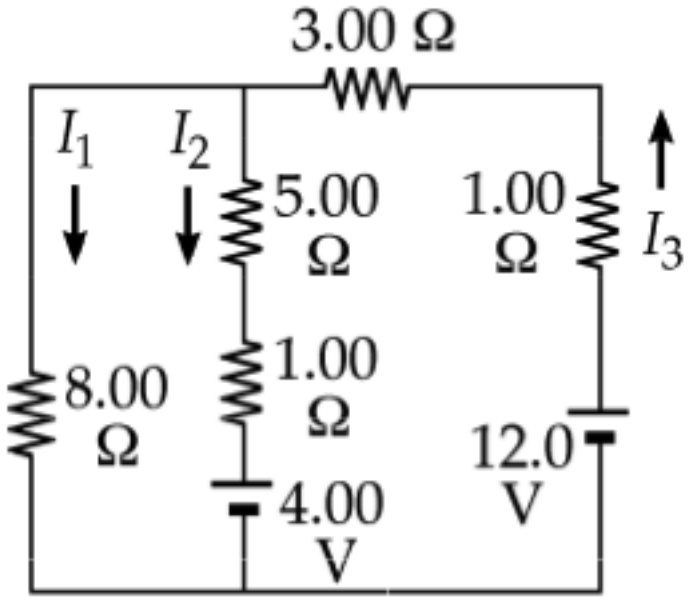


Figure 9: A circuit with 5 resistors and 2 batteries.

10. Assume that the circuit of Figure 9 runs for 2 minutes. What is the energy provided by the 12V battery during that time? Pick the closest answer.

a) -200 Joules
b) +500 Joules
c) +1000 Joules
d) +2000 Joules
e) +4000 Joules