Physics 161 Fall 2011 Midterm Exam 3
10 Answer scantron. Last Name first.
Sit in odd # seats. Cell phones off. Closed Book.
Please keep your eyes on your own paper.
You may be photographed during this exam (by me) if you appear to be copying, using a cell phone, or otherwise cheating.
Equations

Sources of B

$\mu_0 = 4\pi \cdot 10^{-7}$ Tm/A

$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$

$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \hat{r}}{r^2}$

$d\vec{B} = \frac{\mu_0}{4\pi} \frac{Id\vec{l} \times \hat{r}}{r^2}$

Responses to B

$\vec{F} = q\vec{v} \times \vec{B}$

$d\vec{F} = Id\vec{l} \times \vec{B}$

Torque on current loop:

$\vec{\tau} = \vec{\mu} \times \vec{B} \qquad \vec{\mu} = I\vec{A}$

Resistors and Circuits

$I = nqv_d A$

$\vec{J} = nq\vec{v}_d$

$V = IR$ Ohm's Law

$R = \frac{\rho L}{A}$ cylindrical resistor

$P = IV$

$P_R = I^2R = V^2/R$ power in a resistor

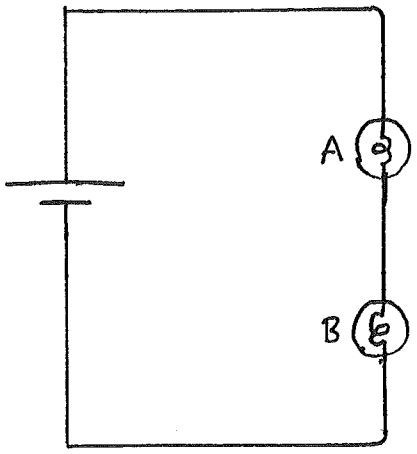
$R_{eq} = R_1 + R_2 + \ldots$ in series

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ in parallel

$q = C\mathcal{E}(1 - e^{-t/RC})$ charging

$q = q_0 e^{-t/RC}$ discharging

The power rating (wattage) on two low-voltage light bulbs is the power dissipated when 6V is applied. Assume that the brightness of a bulb is proportional to the power dissipated.



1. Two **identical** bulbs are wired as shown. The battery emf is 6V. Which bulb is brighter?
A] A B] B C] they are the same.

2. Now instead, bulb A is a 1 W bulb and bulb B is a 4 W bulb. Which is brighter?
(Choose answers from above.)

3. If either bulb will blow up if the voltage across it exceeds 6.4V, what is the highest voltage battery that can be used in this circuit? (to the nearest V, use 9 for 9 or greater.)

4. A resistor has the shape of a truncated cone. The small end has a diameter of 1 mm. The large end has a diameter of 2 mm. A current of 1 ampere flows through the resistor. What is the ratio of the electric field just inside the small end to the field just inside the large end?

A] 4 B] 2 C] they are equal D] ½ E] ¼ F] Both fields are zero
G] Cannot determine without knowing the resistor length

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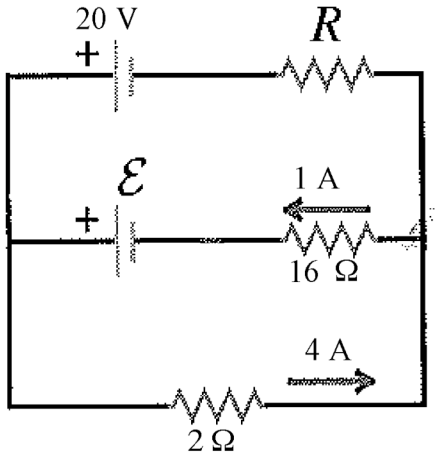
5. In the circuit at right, what is the current through resistor R, to the nearest ampere?

6. What is the resistance R, to the nearest ohm? (Use 9 for 9 or greater.)

7. What is the magnitude of the unknown emf, to the nearest volt? (Use 9 for 9 or greater.)



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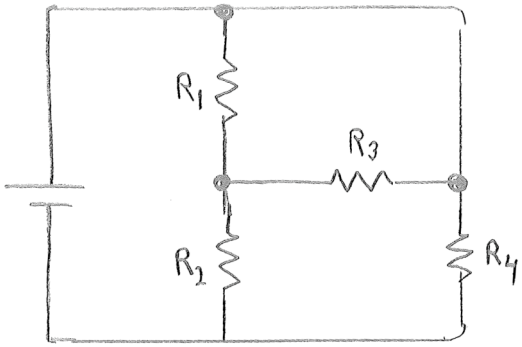
8. In the circuit shown, are any resistors **in series**?

A] R_1 & R_2 B] R_2 & R_3 C] R_3 & R_4
D] R_1 & R_3 E] R_1, R_3 & R_4 F] R_2 & R_4
G] Both R_1 & R_2 and R_3&R_4
H] Both R_1 & R_3 and R_2&R_4 I] none

9. In the circuit shown, are any resistors **in parallel**? (choose from the answers to Q9)

10. If all resistors are the same, what fraction of the current from the battery flows through R_4 ?

A] ¼ B] 1/3 C] 2/5
D] ½ E] 3/5 F] 2/3
G] ¾ H] 7/9 I] 0 J] Correct answer not given



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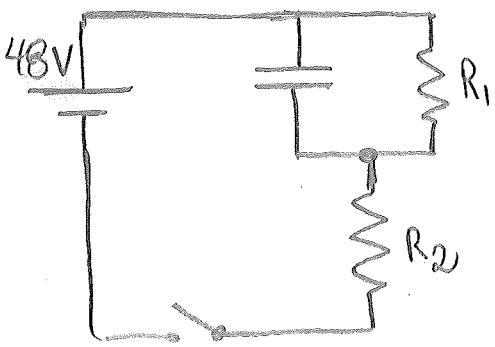
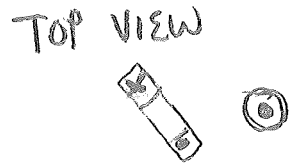
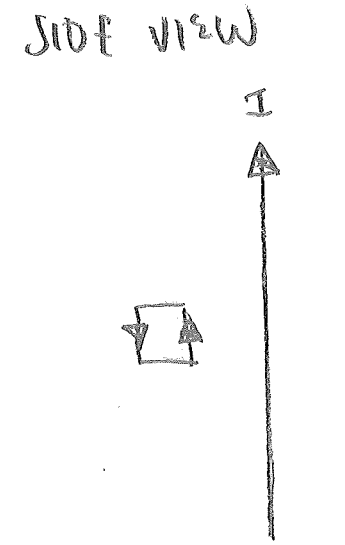
11. R_1 = 16 Ohms and R_2 = 8 Ohms. Immediately after closing the switch, what is the current through R_2, to the nearest ampere?

12. A long time after closing the switch, what is the current through R_2, to the nearest ampere?



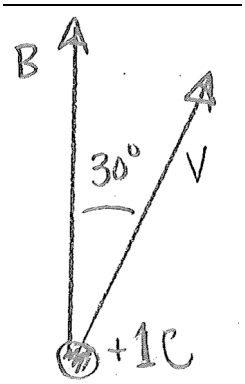


13. A very long wire carries a current I, as shown at right.
A current loop is near the wire.
Is there a **net** torque or a **net** force on the current loop?
A] torque only B] force only
C] both D] neither



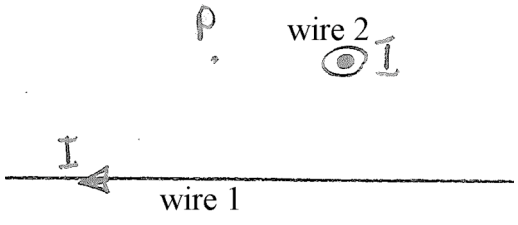
14. If there is a net torque, in what direction does it tend to rotate the loop as seen in the **top view**?
A] CW B] CCW
C] there is no torque

15. If there is a net force, in what direction does it push as seen in the **side view**?
A] right B] left C] up
D] down E] out of page F] into page
G] there is no net force



16. A charge of +1 C is moving a 3 m/s in the direction shown. A uniform B field of 2 T exists throughout all space. What is the magnitude of the force on the charge (to the nearest N)?

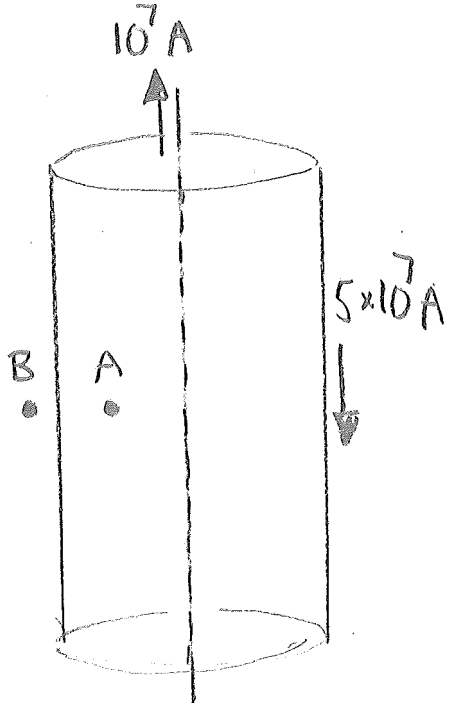
17. What is the trajectory of the charge?
A] a circle, above the page except at this point
B] a circle, below the page except at this point
C] a helix, mostly above the page, moving upward (along B)
D] a helix, mostly below the page, moving upward (along B)
E] a helix, mostly above the page, moving along v
F] a helix, mostly below the page, moving along v
G] a parabola, arcing down to the right
H] a parabola, arcing to the left



18. Two long wires are oriented as shown at right; each carries a current 10^7 A. What is the magnitude of the magnetic field at point P, 1 m from each wire (to the nearest T; use 9 for 9 or greater)?

19. Is there a force or torque on wire 2?
A] torque only B] force only
C] both D] neither

20. A long thin wire carries a current of 10^7 A upward. A concentric cylindrical shell carries a current of 5×10^7 A downward (uniformly distributed over the shell). What is the magnitude of the magnetic field at point A, 1 meter from the wire, inside the shell (to the nearest T, use 9 for 9 or greater)?



21. What is the direction of the magnetic field at point A?
A] left (away from wire) B] right, toward wire
C] down D] up
E] into page F] out of page
G] insufficient information

22. What is the magnitude of the magnetic field at point B, 2 m away from the wire, outside the shell (to the nearest T)?

23. What is the direction of the magnetic field at B? Choose from the answers to Q21.

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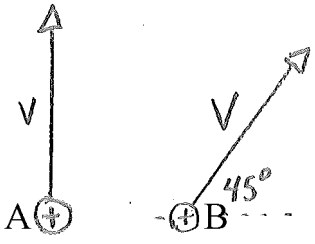
24. Two equal positive charges move with the same speed, but B is moving at 45° to the line between them, as shown. If the magnetic force on particle A is 1 N, what is the magnetic force on B, in N?

A] ¼	B] $1/(2\sqrt{2})$	C] ½	D] $1/\sqrt{2}$	E] 1
F] $\sqrt{2}$	G] 2	H] $2\sqrt{2}$	I] 4	J] 0

25. What is the direction of the **magnetic** forces on these particles?
A] Directly away from each other
B] Directly towards each other
C] Force on A is towards B; Force on B is 45° up and left
D] Force on A is 45° down and right; Force on B is 45° up and left
E] Force on A is towards B; Force on B is 45° down and right
F] Force on both is out of the page
G] Force on A is out of the page; Force on B is into the page
H] Force on both is into the page
I] Force on A is down; Force on A is 45° up and left
J] Force on A is out of the page; there is no force on B.



26. Are the linear momentum and angular momentum of these two particles conserved?
A] yes, both are conserved
B] linear momentum is, but angular momentum is not
C] angular momentum is, but linear momentum is not
D] neither angular nor linear momentum is conserved