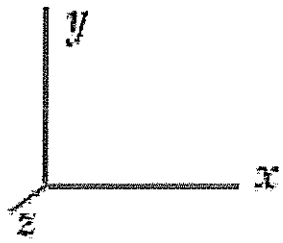
Physics 1520, Spring 2017
Quiz 4, Form: A

Name: Key

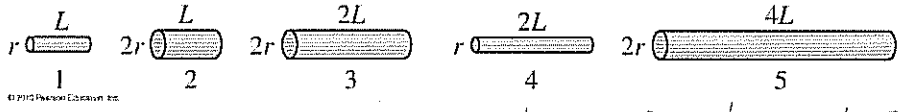
Date: _____

To specify directions, use the coordinate system shown below where $+x$ is to the right, $+y$ is toward the top of the page, and $+z$ is out of the page.



Section 1. Multiple Choice

1. The wires shown below copper wires of varying length and diameter. Which wire has the largest resistance?

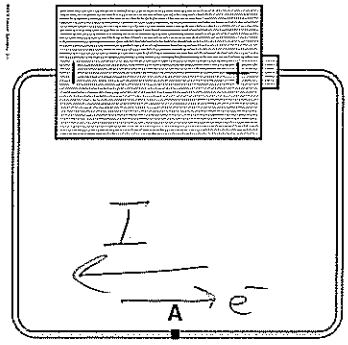


$R = \rho \frac{L}{A}$ $R \propto \frac{L}{A}$ $A = \pi r^2$ so $R \propto \frac{L}{r^2}$

(a) Wire 1
(b) Wire 2
(c) Wire 3
(d) Wire 4
(e) Wire 5

Wire 4 gives $R \propto \frac{2L}{r^2}$ All others are smaller R.

Questions 2–4: A battery is connected to a copper wire as shown below.



2. At point A in the wire, what is the direction of the velocity of a mobile electron in the wire?

(a) to the left
(b) to the right
(c) neither, because its velocity is zero

$\vec{F} = q\vec{E}$
$\vec{F}$ on e^- is opposite $\vec{E}$

3. At point A, what is the direction of the electric field within the wire (due to surface charge on the wire) that pushes electrons through the wire?

(a) to the left
(b) to the right
(c) neither, because the electric field is zero

$\vec{E}$ points toward low potential

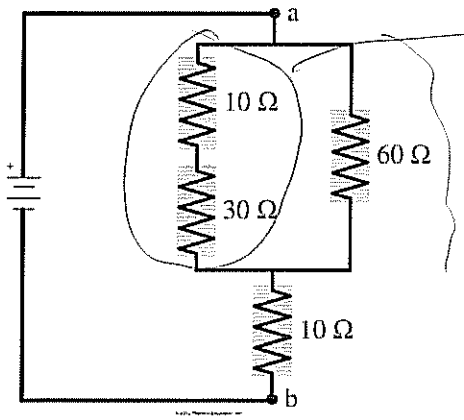
4. If 2 A of current flows past point A, how many mobile electrons flow past point A in one second?

(a) 2 electrons
(b) 0.5 electrons
(c) 3.2×10^{-19} electrons
(d) 6.25×10^{18} electrons
(e) 1.25×10^{19} electrons

$\left(2\frac{C}{s}\right)\left(\frac{1e^-}{1.6\times10^{-19}C}\right) = 1.25\times10^{19}\ \frac{\text{electrons}}{s}$

Questions 5–6:

5. What is the equivalent resistance in the following circuit?



$10\Omega + 30\Omega = 40\Omega$

$\frac{1}{40} + \frac{1}{60} = \frac{1}{R_{eq}}$ so $R_{eq} = 24\Omega$

$R_{eq} = 24\Omega + 10\Omega = 34\Omega$

(a) 110 Ω
(b) 9.1 Ω
(c) 25 Ω
(d) 78 Ω
(e) 34 Ω

6. Through which resistor(s) is the current the greatest?

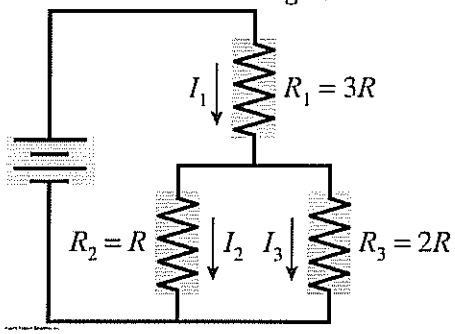
(a) the 30 Ω resistor and the 10 Ω resistor that is connected to point a
(b) the 60 Ω resistor
(c) 10 Ω resistor that is connected to point b
(d) Both (a) and (b)
(e) The current is the same through all of them.

Current splits at (a) and comes back together at (b)

7. Which of these laws is a result of Conservation of Energy?

(a) Kirchhoff's Current Law
(b) Kirchhoff's Voltage Law
(c) Both (a) and (b)
(d) Neither (a) nor (b)

8. Which current is the largest?



$I_1 = I_2 + I_3$ so $I_1 > I_2$ and $I_1 > I_3$

(a) I_1

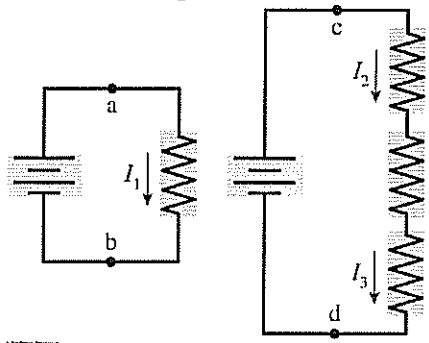
(b) I_2

(c) I_3

(d) $I_2 = I_3$ which are greater than I_1

(e) None of the above because they are all equal.

9. In the following two circuits, the batteries are identical, and the resistors are identical.



Which current is the smallest?

(a) I_1

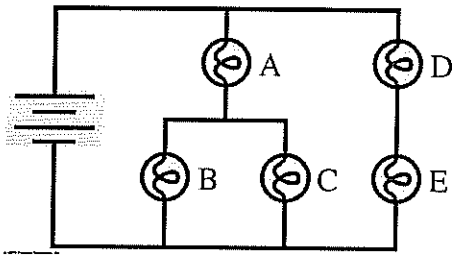
(b) I_2

(c) I_3

(d) $I_2 = I_3$, which is less than I_1

(e) None of the above because they are all equal.

10. Which of these identical bulbs will be brightest?



$R_{BC} < R_E$

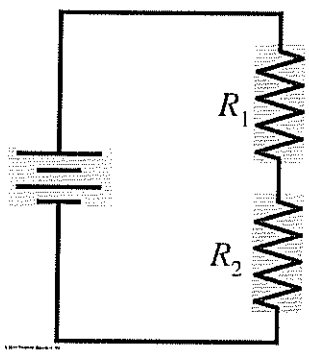
So $I_A > I_D$

Since $R_{BC} < R_A$, then $\Delta V_A > \Delta V_{BC}$

Thus $P_A = I_A \Delta V_A$ is greatest for A.

(a) A
(b) B
(c) C
(d) D
(e) D and E are equally bright and are the brightest
(f) B and C are equally bright and are the brightest
(g) All bulbs have the same brightness.

Questions 11–12: In the circuit below, the voltage across the battery is 5 V, $R_1 = 10\ \Omega$, and $R_2 = 15\ \Omega$.



$R_{eq} = 25\ \Omega$

$\Delta V = I R_{eq}$

So $I = \frac{5V}{25\Omega} = 0.2\ A$

$\Delta V_1 = I_1 R_1 = (0.2A)(10\Omega) = 2V$

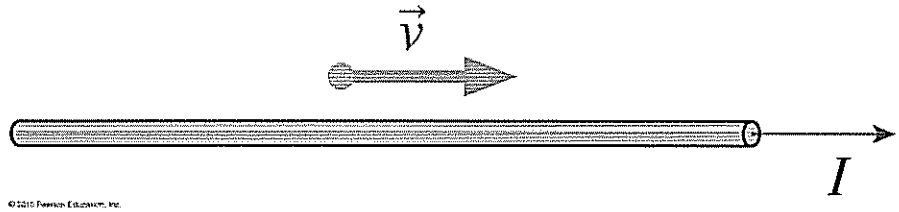
11. What is the voltage across R_1?

(a) 1.5 V
(b) 2.0 V
(c) 2.5 V
(d) 3.0 V
(e) 5.0 V

12. What is the current through R_1?

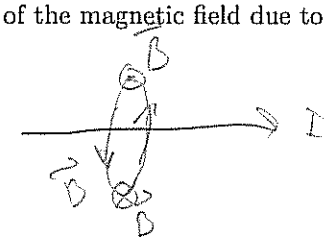
(a) 0.08 A
(b) 0.12 A
(c) 0.2 A
(d) 0.33 A
(e) 0.5 A

Questions 13–15: Current flows through a wire as shown below. Near the wire, a positively charged ion travels in the direction shown.



13. What is the direction of the magnetic field due to the wire at the location of the ion?

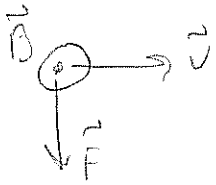
(a) $+x$
(b) $-x$
(c) $+y$
(d) $-y$
(e) $+z$
(f) $-z$



RHR.
$\vec{B}$ tangent to circle around I

14. What is the direction of the magnetic force on the ion due to the wire?

(a) $+x$
(b) $-x$
(c) $+y$
(d) $-y$
(e) $+z$
(f) $-z$



15. If the ion is 1 cm from the wire and 2 A of current flows in the wire, what is the magnitude of the magnetic field at the location of the ion?

(a) 4.0×10^{-7} T
(b) 1.6×10^{-8} T
(c) 4.0×10^{-5} T
(d) 1.6×10^{-6} T
(e) 1.3×10^{-4} T

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7})(2)}{2\pi (0.01\,m)}$$

$$= 4 \times 10^{-5}\ T$$

16. The magnetic field at the center of a 1.0-cm diameter loop is 2.5 mT. What is the current in the loop?

(a) 2.0×10^4 A
(b) 250 A
(c) 63 A
(d) 4000 A
(e) 20 A

$$B = \frac{\mu_0 I}{2R}$$

$$I = \frac{2RB}{\mu_0} = \frac{2(0.005\,m)(2.5 \times 10^{-3}\,T)}{4\pi \times 10^{-7}}$$

$$= 20\ A$$

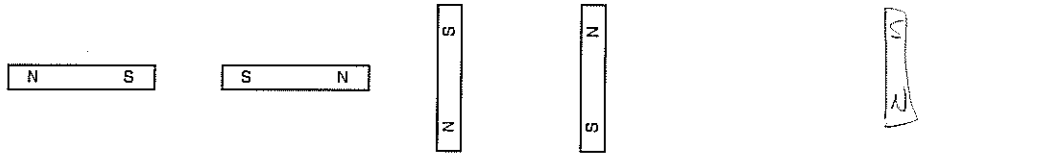
Questions 17–18: A constant current flows through the coil shown in a top view below.

17. What is the direction of the magnetic field at location A that is along the axis of the coil?

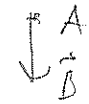
(a) $+x$
(b) $-x$
(c) $+y$
(d) $-y$
(e) $+z$
(f) $-z$

Curl fingers around coil.

18. If you model the electromagnet above as a magnetic dipole, which picture below shows the orientation of the poles of the coil?



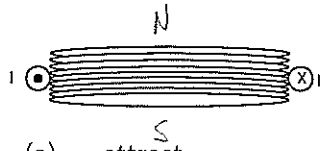
(a) A
(b) B
(c) C
(d) D



$\vec{B}$ points away from N pole.

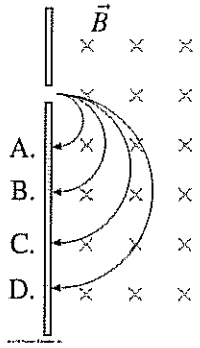
19. A current-carrying coil and magnet are shown below. The coil is shown from a top view, and the magnet lies along the axis of the coil. Will the coil and magnet attract or repel?

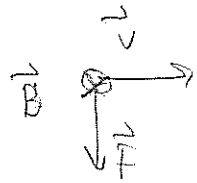
N poles will repel.



(a) attract
(b) repel
(c) neither; they will not exert forces on each other

20. The figure below shows four particles moving to the right as they enter a region of uniform magnetic field. All particles move at the same speed and have the same charge.





must use left-hand, so particles are —.

Are the particles negatively charged or positively charged?

(a) negatively charged

(b) positively charged

(c) neither; they are neutral

(d) It cannot be determined from the picture alone.