

## General Physics: Class Exam II

20 March 2013

Name: \_\_\_\_\_

Total:

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### Instructions

- There are 8 questions on 5 pages.
- Show your reasoning and calculations and always justify your answers.

### Physical constants and useful formulae

Coulomb's constant:  $k = 9.0 \times 10^9 \text{ Nm}^2/\text{C}^2$

Electron charge:  $q_{\text{electron}} = -1.60 \times 10^{-19} \text{ C}$

Proton charge:  $q_{\text{proton}} = +1.60 \times 10^{-19} \text{ C}$

Permeability constant:  $\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$

Electron mass:  $m_e = 9.11 \times 10^{-31} \text{ kg}$

Proton mass:  $m_p = 1.67 \times 10^{-27} \text{ kg}$

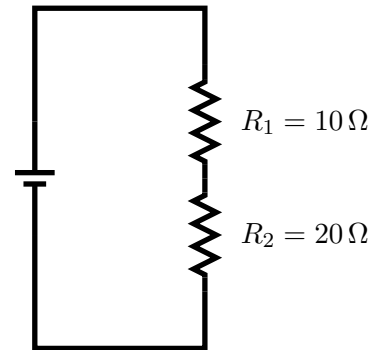
### Question 1

In a procedure to coat an object with copper, copper ions flow through a solution and accumulate on the object. Each copper ion has the same charge as two protons. The current that flows is 0.025 A and it flows for 30 min. Determine the total number of copper ions that accumulate on the object.

### Question 2

Two resistors are connected to a battery as illustrated. Let  $I_1$  and  $I_2$  denote the currents through resistor 1 and resistor 2 respectively. Which of the following (choose one) is true?

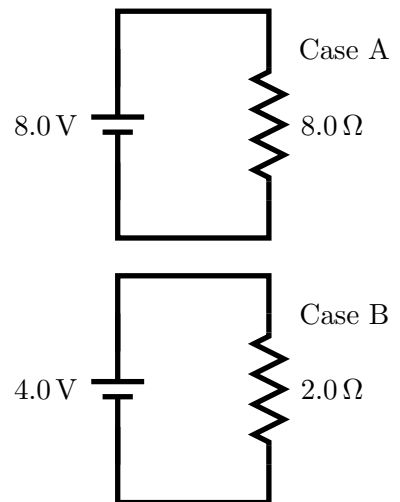
- a)  $I_2 < \frac{1}{2} I_1$
- b)  $I_2 = \frac{1}{2} I_1$
- c)  $I_2 = I_1$
- d)  $I_2 = 2I_1$



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### Question 3

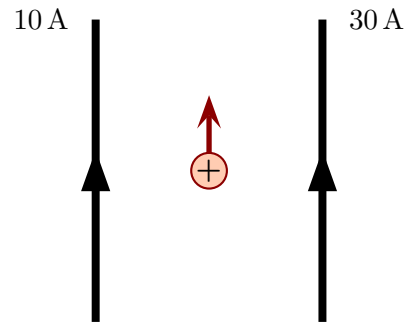
A 8.0 V battery is connected to resistor A, which has resistance 8.0  $\Omega$ . A 4.0 V battery is connected to resistor B, which has resistance 2.0  $\Omega$ . Zog claims that the *power* provided by resistor A is double that provided by B. Geraldine claims that the power delivered for resistor B is double that for resistor A. Is either correct? Explain your answer.



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#### Question 4

Two very long parallel wires are 0.20 m apart. The left wire carries a current of 10 A vertically up and the right wire 30 A vertically up. At one instant a particle with charge  $6.0 \times 10^{-6} \text{ C}$  is midway between the wires and is moving with speed  $5.0 \times 10^3 \text{ m/s}$  vertically.



- a) Determine the net magnetic field produced by both currents at the location of the charged particle.

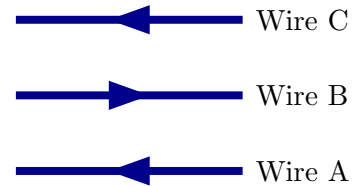
- b) Determine the magnitude and direction of the net force exerted on the charged particle.

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### Question 5

Three wires carry currents as illustrated. The magnitudes of the currents are equal. The distances between *adjacent* wires are equal. Let  $F_A$  denote the *magnitude of the net force* on wire A, etc., . . . Which of the following (choose one) is true?

- a)  $F_A = F_B = F_C$
- b)  $F_A = F_C < F_B$
- c)  $F_A = F_C > F_B$
- d)  $F_C < F_B < F_A$



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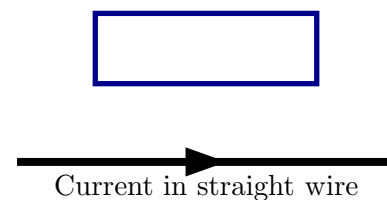
### Question 6

A collection of source magnets produces a uniform magnetic field that points directly right. A straight wire carries a current and this wire can be oriented in any direction. In which direction the wire be oriented to give the smallest possible force exerted by the magnetic field? Explain your answer.

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### Question 7

A current flows through an infinitely long straight wire as illustrated. A rectangular loop held fixed as illustrated. Which of the following (choose one) is true while current through the straight wire is increased?



- a) There is no current in the rectangular loop
- b) There is a counterclockwise current in the rectangular loop.
- c) There is a clockwise current in the rectangular loop.
- d) There is a current (in the rectangular loop) which repeatedly changes direction.

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### Question 8

The flux through a loop of fixed area varies with time as illustrated. Indicate the time(s) or period of time when the EMF induced in the loop is largest and determine the maximum value of the EMF induced in the loop.

