Name:

Your code is: AAAAAA

Put your name here:

Keep this exam **CLOSED** until advised by the instructor.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

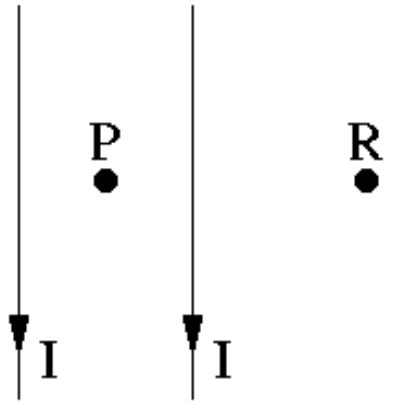
60 minute long closed book exam.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **bubble sheet** and your **exam**.

Possibly useful constants:

- $k_e = 8.99 \times 10^9$ Nm^2/C^2
- $\epsilon_0 = 8.85 \times 10^{-12}$ As/(Vm)
- $\mu_0 = 4\pi \times 10^{-7}$ Vs/(Am)
- $c = 3.00 \times 10^8$ m/s
- $g = 9.81$ m/s^2
- $e = 1.60 \times 10^{-19}$ C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- $h = 6.63 \times 10^{-34}$ Js
- $h = 4.14 \times 10^{-15}$ eVs
- $hc = 1240$ eVnm
- $\sigma = 5.67 \times 10^{-8}$ W/(m^{2}K^4)
- Wien's constant $= 2.898 \times 10^{-3}$ Km
- $R_H = 1.097 \times 10^7$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV $= 1.60 \times 10^{-19}$ J
- 1 AMU (1 u) $= 931.494$ MeV/c^2 $= 1.67 \times 10^{-27}$kg
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page
- 1 pico (p) $= 10^{-12}$



12 pt
Two very long parallel wires are carrying electric currents of the same magnitude in the same direction as shown in the figure. Point **P** is exactly halfway between the wires, point **R** is at an arbitrary distance from the right wire. Select True or False for the following statements.

▷ The magnetic field at **P** is zero.
1. **A**◯ True **B**◯ False

▷ The magnetic field at **R** points out of the page.
2. **A**◯ True **B**◯ False

▷ The two wires attract each other.
3. **A**◯ True **B**◯ False

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10 pt A very large electric current can flow inside a tornado from the clouds to the ground. If the magnetic field is measured to be 1.53×10^{-8} T at a distance of 8.88 km from the tornado, then what is the magnitude of this current?
(in A)

4.**A**◯ 6.81×10^2 **B**◯ 7.97×10^2 **C**◯ 9.32×10^2
D◯ 1.09×10^3 **E**◯ 1.28×10^3 **F**◯ 1.49×10^3
G◯ 1.75×10^3 **H**◯ 2.04×10^3

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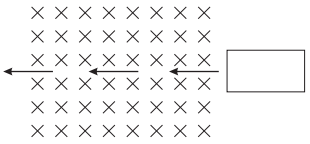
8 pt A square loop of wire with a small resistance is moved with constant speed from a field free region into a region of uniform B field (B is constant in time) and then back into a field free region to the left. The self inductance of the loop is negligible.



▷ Upon leaving the field, a counterclockwise current flows in the loop.
5. **A**◯ True **B**◯ False

▷ While the loop is entirely in the field, the magnetic force on the loop is not zero.
6. **A**◯ True **B**◯ False

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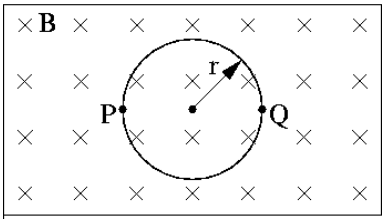
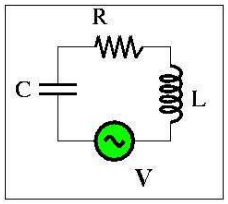
10 pt A flexible loop has a radius of 0.499 m and it is inside a constant magnetic field of 0.361 T. The resistance of the loop is 2.38 Ω. The loop is grasped at points P and Q and stretched until its area is zero. It takes 0.15 seconds to close the loop.



What is the average induced current (in amps) in the loop during the stretching process?

7.**A**◯ 0.25 **B**◯ 0.34 **C**◯ 0.45 **D**◯ 0.59
E◯ 0.79 **F**◯ 1.05 **G**◯ 1.40 **H**◯ 1.86

10 pt Consider the RLC circuit shown in the figure below. If the circuit is running at its resonanant frequency and the RMS current through the resistor is 0.233 A, what is the RMS voltage across the capacitor?
Use the following data:
R = 870 Ω, L = 4.7 H, C = 19.7 μF.



(in V)

8.A◯ 1.14×10^2 **B**◯ 1.29×10^2 **C**◯ 1.45×10^2
D◯ 1.64×10^2 **E**◯ 1.86×10^2 **F**◯ 2.10×10^2
G◯ 2.37×10^2 **H**◯ 2.68×10^2

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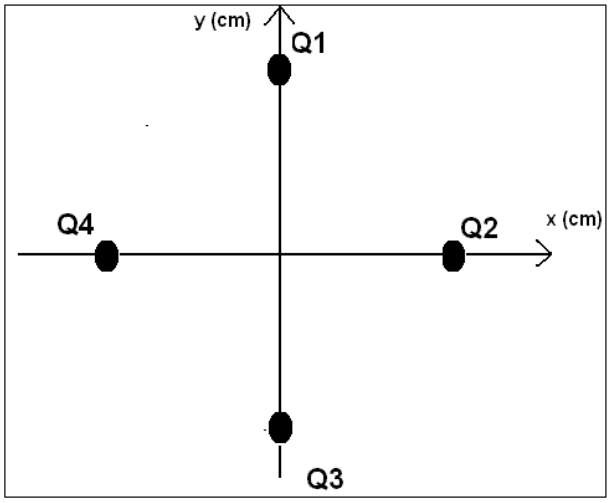
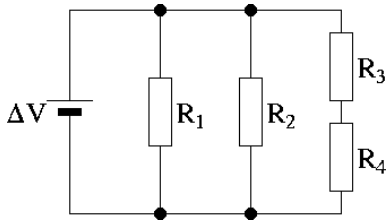
10 pt Consider the system of four charges in the diagram below. Each charge is 37 cm from the origin.



If Q1= 6.3 μC, Q2= 6.3 μC, Q3= 6.3 μC and Q4= -6.3 μC what is the magnitude of the electric field at the origin in N/C?

9.A◯ 4.50×10^5 **B**◯ 5.08×10^5 **C**◯ 5.74×10^5
D◯ 6.49×10^5 **E**◯ 7.33×10^5 **F**◯ 8.28×10^5
G◯ 9.36×10^5 **H**◯ 1.06×10^6



10 pt
Four resistors are connected to a battery as shown in the figure. The resistors have the following resistances:
$R_1 = 95\ \Omega$, $R_2 = 110\ \Omega$, $R_3 = 20\ \Omega$ and $R_4 = 75\ \Omega$.
Select True or False for the following statements.

▷ R_1 produces less heat than R_2.
10. **A**◯ True **B**◯ False

▷ R_3 produces the same amount of heat as R_4.
11. **A**◯ True **B**◯ False

▷ R_3 and R_4 together produce more heat than R_1.
12. **A**◯ True **B**◯ False

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8 pt An external AC voltage source provides a 100 V peak voltage to each of the circuits described below. Assume the peak voltage remains 100 V when the frequency is changed. Select Decrease, Increase or Remain Unchanged to each of the following statements.

▷ The AC voltage source is connected to an inductor and a resistor in series. If the frequency of the source is increased the current in the circuit will _____.
13. **A**◯ Increase **B**◯ Decrease
C◯ Remain Unchanged

▷ A resistor, capacitor and an inductor are connected to the voltage supply and the circuit is at resonance. If the frequency of the source is increased, the current in the circuit will _____.
14. **A**◯ Increase **B**◯ Decrease
C◯ Remain Unchanged

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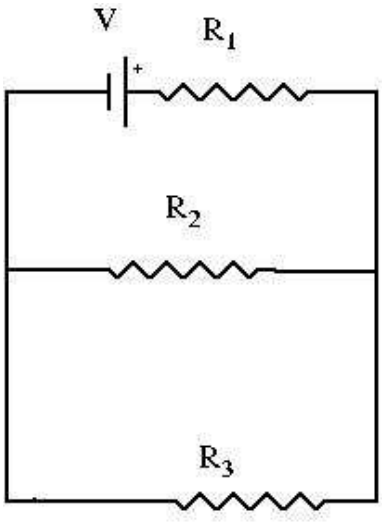
10 pt A 15.1 μF capacitor in an RC circuit is initially charged up to a potential difference of 125 V. Then it is discharged through a resistor with a resistance of 45.9 kΩ. What is the voltage across the capacitor 753 ms after the discharge begins?
(in V)

15.A◯ 3.73×10^1 **B**◯ 4.22×10^1 **C**◯ 4.77×10^1
D◯ 5.39×10^1 **E**◯ 6.09×10^1 **F**◯ 6.88×10^1
G◯ 7.77×10^1 **H**◯ 8.78×10^1

10 pt In the circuit below find the current flowing through resistor R_1 (in A) when $R_1 = 34\ \Omega$, $R_2 = 36\ \Omega$, $R_3 = 99\ \Omega$ and $V_1 = 150$ V.



16.A◯ 0.814 **B**◯ 1.017 **C**◯ 1.272 **D**◯ 1.589
E◯ 1.987 **F**◯ 2.483 **G**◯ 3.104 **H**◯ 3.880