Your code is: AAHHDA

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**.

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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 = 3.00×10^8 m/s
- e = 1.60×10^{-19} C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- h = 6.63×10^{-34} Js
- h = 4.14×10^{-15} eVs
- hc = 1240 eVnm
- $\sigma = 5.67 \times 10^{-8}$ W/(m^{2}K^4)
- Wien's constant = 2.898×10^{-3} Km
- $R_H = 1.097 \times 10^7$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV = 1.60×10^{-19} J
- 1 AMU = 931.494 MeV/c^2
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page

Name:

$\boxed{\textit{8 pt}}$ An AM radio station broadcasts at a frequency of 980 kHz. What is the corresponding wavelength in meters?

1.A◯ 73.6 **B**◯ 97.8 **C**◯ 130.1 **D**◯ 173.1
E◯ 230.2 **F**◯ 306.1 **G**◯ 407.1 **H**◯ 541.5

$\boxed{\textit{9 pt}}$ Select True or False for the following statements.

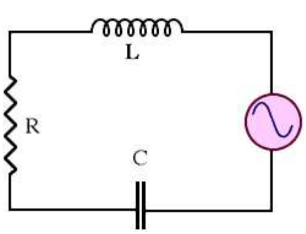
▷ If a resistor, capacitor and inductor in a series circuit are at resonance, then the voltage across the resistor is equal to the voltage supplied by the AC generator.
2. **A**◯ True **B**◯ False

▷ As the frequency decreases, the impedance of a capacitor increases.
3. **A**◯ True **B**◯ False

▷ A capacitor and a resistor in series with an AC generator draws current.
4. **A**◯ True **B**◯ False

$\boxed{\textit{9 pt}}$
The RLC circuit here is running at a frequency of 68 Hz with a supplied voltage of 190 volts rms. What is the rms current through the resistor?

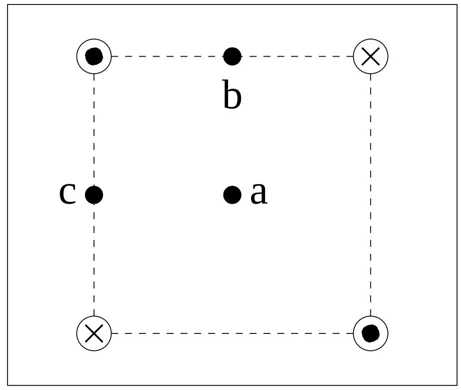
R = 260 Ω,
L = 52 H,
C = 0.1 μF (microfarad)



5.A◯ 8.83×10^{-2} **B**◯ 1.17×10^{-1} **C**◯ 1.56×10^{-1}
D◯ 2.08×10^{-1} **E**◯ 2.76×10^{-1} **F**◯ 3.68×10^{-1}
G◯ 4.89×10^{-1} **H**◯ 6.50×10^{-1}

Name:

Four electric currents, equal in magnitude are arranged at the corners of a square as shown in the figure.



Two currents go into the page, and two are pointing out of the page. Point **a** is at the center of the square, and points **b** and **c** are in the middle of two of the sides.

$\boxed{\textit{4 pt}}$ What is the direction of the magnetic field at point **a**?

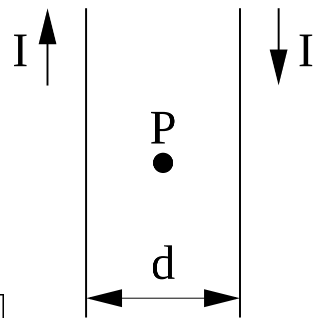
6. **A**◯ Down (to the bottom of the page).
B◯ Up (to the top of the page).
C◯ The magnetic field is zero at this point.
D◯ To the right.
E◯ To the left.

$\boxed{\textit{4 pt}}$ What is the direction of the magnetic field at point **b**?

7. **A**◯ The magnetic field is zero at this point.
B◯ To the right.
C◯ Up (to the top of the page).
D◯ To the left.
E◯ Down (to the bottom of the page).

$\boxed{\textit{4 pt}}$ What is the direction of the magnetic field at point **c**?

8. **A**◯ To the left.
B◯ Up (to the top of the page).
C◯ Down (to the bottom of the page).
D◯ The magnetic field is zero at this point.
E◯ To the right.



8 pt
The two parallel wires shown in the figure carry currents of I = 7.69 A in opposite directions and are separated by a distance of d = 8.73 cm. Calculate the net magnetic field at point **P** midway between the wires. Use the direction out of the page as the positive direction and into the page as the negative direction in your answer.
(in T*)*

9. **A**◯ -2.11×10^{-4} **B**◯ -1.41×10^{-4} **C**◯ -7.05×10^{-5}
D◯ -3.52×10^{-5} **E**◯ 0.00 **F**◯ 3.52×10^{-5}
G◯ 7.05×10^{-5} **H**◯ 1.41×10^{-4}

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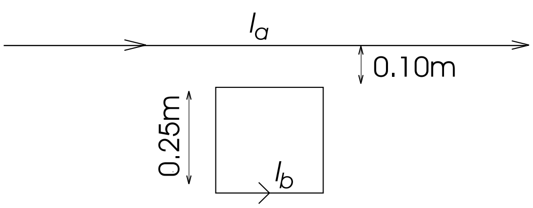
8 pt In the figure below, a long straight wire carries a current of I_a= 5.00 A. A square loop with a side of length 0.250m is placed a distance 0.100 m away from the wire. The square loop carries a current I_b=2.50 A.



Find the magnitude of the net force on the square loop.
(in N*)*

10. **A**◯ 3.82×10^{-6} **B**◯ 4.46×10^{-6} **C**◯ 5.22×10^{-6}
D◯ 6.11×10^{-6} **E**◯ 7.15×10^{-6} **F**◯ 8.37×10^{-6}
G◯ 9.79×10^{-6} **H**◯ 1.15×10^{-5}

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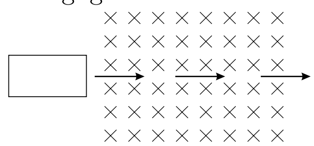
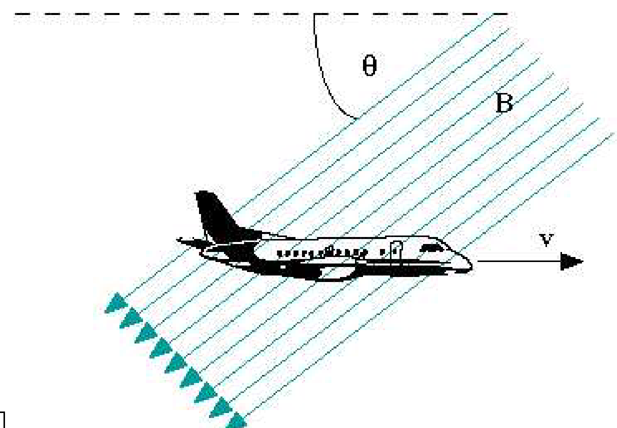
9 pt A square loop of wire with a small resistance is moved with constant speed from a field free region into a region of uniform B field (B is constant in time) and then back into a field free region to the right. The self inductance of the loop is negligible.



▷ When entering the field the coil experiences a magnetic force to the left.
11. **A**◯ True **B**◯ False

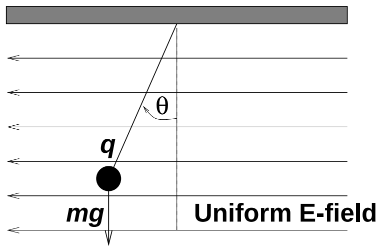
▷ While the loop is entirely in the field, a current flows in the loop.
12. **A**◯ True **B**◯ False

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



9 pt
An airplane with a wingspan of 29 m is flying due north at 478 km/h. The Earth's field is $1.2 \cdot 10^{-4}$ T and inclined at an angle of 46^o below horizontal. What is the magnitude of the potential difference, in volts between the ends of the wing?

14. **A**◯ 0.2941 **B**◯ 0.3324 **C**◯ 0.3756
D◯ 0.4244 **E**◯ 0.4796 **F**◯ 0.5419
G◯ 0.6124 **H**◯ 0.6920



8 pt As shown in the figure above, a ball with a mass of 0.420 g and positive charge of q=33.8 μC is suspended on a string of negligible mass in a uniform electric field. We observe that the ball hangs at an angle of θ=20.0^o from the vertical. What is the magnitude of the electric field?
(in N/C*)*

15.A◯ 1.004×10^1 **B**◯ 1.455×10^1
C◯ 2.110×10^1 **D**◯ 3.060×10^1
E◯ 4.437×10^1 **F**◯ 6.433×10^1
G◯ 9.328×10^1 **H**◯ 1.353×10^2

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12 pt Starting with a real object, answer the following statements (True or False) about the image formed by a single optical element.

▷ An object placed between a convex mirror and its focal point will produce an image which is smaller than the object, virtual and upright.
16. **A**◯ True **B**◯ False

▷ A converging lens can produce a virtual, upright and enlarged image.
17. **A**◯ True **B**◯ False

▷ A diverging lens always produces a virtual, upright and reduced image.
18. **A**◯ True **B**◯ False

▷ An object placed between a concave mirror and its focal point will produce an image which is smaller than the object, virtual and upright.
19. **A**◯ True **B**◯ False

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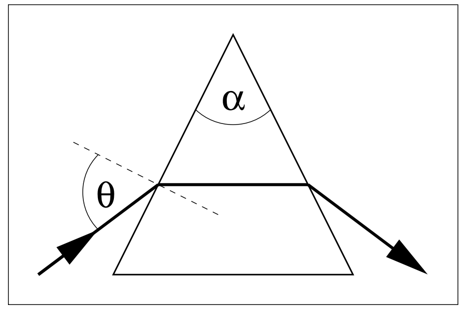
8 pt A glass prism has a cross section of an isosceles triangle with $\alpha = 57.6°$.



A light beam is incident at an angle of $\Theta = 49.9°$ and passes through the prism parallel to the base of the triangle as shown in the figure. What is the index of refraction of the glass? (Recall that the sum of all the internal angles of a triangle is 180°.)

20.A◯ 6.19×10^{-1} **B**◯ 7.24×10^{-1} **C**◯ 8.47×10^{-1}
D◯ 9.91×10^{-1} **E**◯ 1.16 **F**◯ 1.36
G◯ 1.59 **H**◯ 1.86