Your code is: ABFAIB

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:

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

What is the direction of the magnetic field at point \( a \)?

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

What is the direction of the magnetic field at point \( b \)?

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

What is the direction of the magnetic field at point \( c \)?

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

The near point of an eye is 110 cm. A corrective lens is to be used to allow this eye to focus clearly on objects 17 cm in front of it. What should be the focal length of this lens (in cm)?

4. A ○ 13.9
   B ○ 15.7
   C ○ 17.8
   D ○ 20.1
   E ○ 22.7
   F ○ 25.7
   G ○ 29.0
   H ○ 32.8

Select True or False to each of the following questions.

5. A ○ True   B ○ False

6. A ○ True   B ○ False

7. A ○ True   B ○ False

Select True or False for the following statements.

8. A ○ 14.94   B ○ 19.87   C ○ 26.42
   D ○ 35.14   E ○ 46.74   F ○ 62.16
   G ○ 82.67   H ○ 109.96

9. A ○ True   B ○ False

10. A ○ True   B ○ False

11. A ○ True   B ○ False
Starting with a real object, answer the following statements (True or False) about the image formed by a single optical element.

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

13. A converging lens can never produce a virtual, upright and reduced image.
   A ☐ True  B ☐ False

14. A diverging lens always produces a virtual, upright and reduced image.
   A ☐ True  B ☐ False

15. An object placed between a convex mirror and its focal point will produce an image which is bigger than the object, virtual and upright.
   A ☐ True  B ☐ False

What is the maximum angle $\theta$ (in degrees) which allows the light to escape through the surface?

- $n_1 = 1.69$
- $n_2 = 1.2$

   $E$ ☐ 23.16  $F$ ☐ 28.96  $G$ ☐ 36.19  $H$ ☐ 45.24

Select True or False for the following statements.

17. A capacitor and a resistor in series with an AC generator draws no current.
   A ☐ True  B ☐ False

18. As the frequency increases, the impedance of a capacitor increases.
   A ☐ True  B ☐ False

19. If a resistor, capacitor and inductor in a series circuit are at resonance, then the voltage across the capacitor is zero.
   A ☐ True  B ☐ False

Consider the RLC circuit shown in the figure below. If the circuit is running at its resonant frequency and the RMS current through the resistor is 0.149 A, what is the RMS voltage across the inductor?

Use the following data:
- $R = 590 \, \Omega$
- $L = 12.2 \, H$
- $C = 16.3 \, \mu F$

10. $A$ ☐ $5.28 \times 10^1$  $B$ ☐ $6.60 \times 10^1$  $C$ ☐ $8.25 \times 10^1$
    $D$ ☐ $1.03 \times 10^2$  $E$ ☐ $1.29 \times 10^2$  $F$ ☐ $1.61 \times 10^2$
    $G$ ☐ $2.01 \times 10^2$  $H$ ☐ $2.52 \times 10^2$

The figure shows three charges $Q_1$, $Q_2$ and $Q_3$ fixed in place at the corners of an equilateral triangle. The length of each side of the triangle is 20.0 cm. Recall that all of the interior angles of an equilateral triangle are 60°.

For $Q_1 = 17.00 \, \mu C$, $Q_2 = 17.00 \, \mu C$, and $Q_3 = 4.60 \, \mu C$ find the net electrostatic force acting on charge $Q_3$.

    $D$ ☐ $1.25 \times 10^1$  $E$ ☐ $1.56 \times 10^1$  $F$ ☐ $1.95 \times 10^1$
    $G$ ☐ $2.44 \times 10^1$  $H$ ☐ $3.05 \times 10^1$