Physics 202 Midterm Practice Exam 3

Name: _____________________________  Student ID: ____________

Section: _____________________________

TA (please circle):

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Instructions:

1. Don't forget to write down your name, student ID#, and section number. You need to do this on this page of your test book and on your Scantron sheet as well, where you should fill in your student ID number under Identification Number and your three digit section number starting with "3" under special codes.

2. Answer all multiple questions in this test book by indicating the best answer among choices. You must do this both on your test book and on your Scantron sheet. Follow instructions on the Scantron sheet on how to mark valid answers.

3. When you finish, you need to turn in both this test book and the Scantron sheet.

4. Use the blank sides of question pages as additional draft spaces. An extra bank sheet is provided at the end of the test book.

5. Only one answer is allowed per problem/question/ All problems have equal weight.

Constants: \( k_e = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \)

magnetic vacuum permeability \( \mu_0 = 4\pi\times10^{-7} \text{ Tm/A} \)
1. A coil with a self-inductance of 6.5 H carries a current that is changing at a rate of 50 A/s. What is the induced EMF in the coil?
   A) 0.13 V
   B) 7.7 V
   C) 32 V
   D) 65 V
   E) 0.32 kV

2. The self-inductance of a wire coil is a proportionality constant that relates
   A) electric field to current.
   B) electric flux to current.
   C) magnetic flux to current.
   D) magnetic field to current.
   E) voltage to current.

3. For the two solenoids above, if \( l = 50 \) cm, \( N_1 = N_2 = 200 \) turns and \( r_1 = 5 \) cm and \( r_2 = 10 \) cm, the mutual inductance of the two solenoids
   A) 1.58 mH
   B) 0.790 mH
   C) 3.20 mH
   D) 6.31 mH
   E) None of these is correct.

4. How much does the energy stored in an inductor change if the current through the inductor is doubled?
   A) it is the same
   B) it is doubled
   C) it is quadrupled
   D) it is halved
   E) it is quartered
5. A solenoid is 15 cm long, has a radius of 5 cm, and has 400 turns. If it carries a current of 4 A, the magnetic energy stored in the solenoid is
   A) 84.2 mJ
   B) 0.562 J
   C) 3.37 J
   D) 12.6 mJ
   E) None of these is correct.

6. An open switch in an RL circuit is closed at time \( t = 0 \), as shown. The curve that best illustrates the variation of current with time is
   ![Diagram of RL circuit]
   A) 1
   B) 2
   C) 3
   D) 4
   E) 5

7. How much does the maximum EMF produced by a generator (a rotating coil) change if its magnetic field is halved?
   A) it is the same
   B) it is increased by a factor of sixteen
   C) it is decreased by a factor of two
   D) it is increased by a factor of four
   E) it is impossible to tell given the information provided

8. Two heaters are plugged into the same 120-V AC outlet. If one heater is rated at 1100 W, then what can be the maximum rating of the second heater in order not to exceed the 20 A trip rating on the circuit?
   A) 1100 W
   B) 1300 W
   C) 1200 W
   D) 2400 W
   E) 920 W
9. The figure shows the voltage and current for a device. The frequency of the voltage is
   A) 0.2 Hz
   B) 0.4 Hz
   C) 1.2 Hz
   D) 2.0 Hz
   E) 2.5 Hz

10. If you double the frequency in the circuit shown, the capacitative reactance of the circuit

   A) increases by a factor of 2.
   B) does not change.
   C) decreases by a factor of 2.
   D) increases by a factor of 4.
   E) decreases by a factor of 4.
11. A 5-µF capacitor is charged to 30 V and is then connected in series with a 10-µH inductor and a 50-Ω resistor. The current in this circuit after a long time has passed will be
   A) 0
   B) 8.83 A
   C) 15.4 A
   D) 21.2 A
   E) some value that cannot be determined from the given information.

12. You have a 30-µH inductor and want to form a 1.0-MHz parallel, resonant circuit. You need a capacitor of
   A) approximately 0.84 nF.
   B) approximately 1.2 nF.
   C) approximately 2.1 µF.
   D) approximately 33 µF.
   E) None of these is correct.

13. As you increase the frequency in this circuit from zero,

\[ \begin{array}{ccc}
     & L \\
   \bigcirc & R & C \\
   \end{array} \]

   A) the impedance increases to a maximum and then decreases.
   B) the impedance decreases to a minimum and then increases.
   C) the impedance will decrease continuously.
   D) the impedance does not change.
   E) None of these is correct.

14. A parallel-plate capacitor has closely spaced circular plates of radius \( R = 3.00 \text{ cm} \). Charge is flowing onto the positive plate at the rate \( I = \frac{dQ}{dt} = 3.65 \text{ A} \). The magnetic field at a distance \( r = 1.50 \text{ cm} \) from the axis of the plates is approximately
   A) 135 mT
   B) 256 µT
   C) 1.35 µT
   D) 457 mT
   E) 88.3 µT
15. Which of the following statements is true?
   A) Maxwell's equations apply only to fields that are constant in time.
   B) Electromagnetic waves are longitudinal waves.
   C) The electric and magnetic fields are out of phase in an electromagnetic wave.
   D) The electric- and magnetic-field vectors $\vec{E}$ and $\vec{B}$ are equal in magnitude in an
      electromagnetic wave.
   E) None of these statements is true.

16. The visible portion of the electromagnetic spectrum is closest to which of the following
    intervals?
   A) 200 to 500 nm
   B) 300 to 600 nm
   C) 400 to 700 nm
   D) 500 to 800 nm
   E) 600 to 900 nm

17. The intensity of a laser beam is 450 W/m². What is the rms value of the electric field of this
    laser beam? (The permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$ and the
    permeability of free space $\mu_0 = 4\pi \times 10^{-7} \text{ N} \cdot \text{A}^2$.)
   A) $1.7 \times 10^5$ V/m
   B) $5.8 \times 10^2$ V/m
   C) $3.4 \times 10^5$ V/m
   D) $4.1 \times 10^2$ V/m
   E) $1.3 \times 10^3$ V/m

18. You are using an antenna consisting of a single loop of wire of radius 15.0 cm to detect
    electromagnetic waves for which $E_{\text{rms}} = 0.200$ V/m. If the wave frequency is 600 Hz, the
    rms value of the emf induced in the loop is approximately
   A) 32.1 nV
   B) 84.3 nV
   C) 66.7 nV
   D) 178 nV
   E) 643 nV
19. A 60-W light bulb emits spherical electromagnetic waves uniformly in all directions. If 50% of the power input to such a light bulb is emitted as electromagnetic radiation, what is the maximum value of the magnetic field at a distance of 2.0 m from the light bulb?
   A) 71 nT
   B) 0.35 µT
   C) 0.14 µT
   D) 0.20 µT
   E) 0.10 µT

20. Electromagnetic waves are produced when
   A) free electric charges accelerate.
   B) conduction electrons move with a constant drift velocity in a conductor.
   C) a conductor moves with constant velocity through a magnetic field.
   D) electrons bound to atoms and molecules make transitions to higher energy states.
   E) All of these are correct.
Answer Key - Midterm3_draft_practice

1. E
2. C
3. B
4. C
5. A
6. B
7. C
8. B
9. E
10. C
11. A
12. A
13. A
14. C
15. E
16. C
17. D
18. D
19. A
20. A