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PHYSICS DEPARTMENT

PHY 2054 Exam 2 March 17, 2015

Name (PRINT, last, first): _____ Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

DIRECTIONS

(1) **Code your test number on your answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your student number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout with scratch work most questions demand.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or <u>blue</u> or <u>black</u> ink**. Do not make any stray marks or the answer sheet may not read properly.
(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing.

>>>>>>>>**WHEN YOU FINISH** <<<<<<<<
Hand in the answer sheet separately.

Constants			
$\epsilon_0 = 8.85 \times 10^{-12}$ F/m	$m_e = 9.11 \times 10^{-31}$ kg	$m_p = m_n = 1.67 \times 10^{-27}$ kg	$e = 1.6 \times 10^{-19}$ C
$k = 9 \times 10^9$ N m^2/C^2	$\mu_0 = 12.56 \times 10^{-7}$ H/m	$N_A = 6.02 \times 10^{23}$ atoms/mole	$c = 3 \times 10^8$ m/s
$n_{H_2O} = 1.333$	micro $= 10^{-6}$	nano $= 10^{-9}$	pico $= 10^{-12}$

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1. A series circuit consists of a 24.0 V source of emf, a 2.00 mF capacitor, a 500 Ω resistor, and a switch. When the switch is closed, how long does it take for the current to reach one-tenth its maximum value?

(1) 2.30 s (2) 12.5 s (3) 0.35 s (4) 4.50 s (5) 9.0 s

2. A mass spectrometer splits a beam of ^{12}C and ^{14}C singly charged ions having the same velocity by passing the beam through a uniform magnetic field. If the radius of the path for the ^{12}C ions is 15.0 cm, what will be the radius for the ^{14}C ions?

(1) 17.5 cm (2) 12.9 cm (3) 15.0 cm (4) 9.90 cm (5) 18.5 cm

3. A cyclotron with a magnetic field of 2.4 T is used to accelerate protons. How long does it take for the protons to make one complete trip around the cyclotron at a radius of 22 cm?

(1) 27 ns (2) 14 ns (3) 16 ns (4) 24 ns (5) 5.6 ns

4. A cyclotron with a magnetic field of 1.2 T is used to accelerate protons. How long does it take for the protons to make one complete trip around the cyclotron at a radius of 25 cm?

(1) 55 ns (2) 27 ns (3) 32 ns (4) 48 ns (5) 11 ns

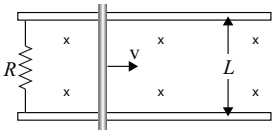
5. A power line carries 1000 A at a height of 20 m above the ground. What is the resulting magnetic field at ground level?

(1) 10 μT (2) 0.13 mT (3) 13 μT (4) 50 mT (5) 5.0 mT

6. Two concentric circular wire loops in the same plane each carry a current. The larger loop has a current of 8.46 A circulating clockwise and has a radius of 6.20 cm. The smaller loop has a radius of 4.42 cm. What is the magnitude and direction of the current in the smaller loop if the total magnetic field at the center of the system is zero?

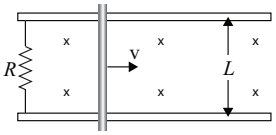
(1) 6.03 A CCW (2) 6.03 A CW (3) 12.8 A CCW (4) 12.8 A CW (5) 3.01 A CW

7. A conducting rod slides at 3.0 m/s on metal rails separated by 2.0 m. The 0.66 mT magnetic field is into the paper. If the resistance is 220 mΩ, what is the current in the circuit?



(1) 18 mA (2) 9.0 mA (3) 87 μA (4) 3.0 μA (5) 4.5 mA

8. A conducting rod slides at 3.0 m/s on metal rails separated by 2.0 m. The 0.66 mT magnetic field is into the paper. If the resistance is 440 mΩ, what is the current in the circuit?



(1) 9.0 mA (2) 4.5 mA (3) 44 μA (4) 1.5 μA (5) 18 mA

9. A 10 turn coil of area 20 cm^2 is placed in a magnetic field so that the normal to its area is in the direction of the field. If the field originally has a value of 0.25 T that increases to 0.45 T in 2.0 s, what is the average emf induced in the coil?

(1) 2.0 mV (2) 4.0 mV (3) 14.0 mV (4) 7.0 mV (5) 8.0 mV

10. A 20 turn coil of area 10 cm^2 is placed in a magnetic field so that the normal to its area is in the direction of the field. If the field originally has a value of 0.25 T that increases to 0.35 T in 2.0 s, what is the average emf induced in the coil?

(1) 1.0 mV (2) 2.0 mV (3) 7.0 mV (4) 3.5 mV (5) 4.0 mV

11. The south end of a bar magnet is pushed downward toward a wire loop in the plane of the paper. In which direction is the induced current, and which way is the induced magnetic field?

(1) clockwise, into the paper
(2) clockwise, out of the paper
(3) counter-clockwise, into the paper
(4) counter-clockwise, out of the paper
(5) there is no induced current

12. A series LR circuit includes a 4.5 V battery, a resistance of 0.50 Ω and an inductance of 0.80 H. What is the energy stored by the inductor 2.0 s after the switch is closed?

(1) 17 J (2) 7.5 mJ (3) 3.3 J (4) 8.3 mJ (5) 8.3 J

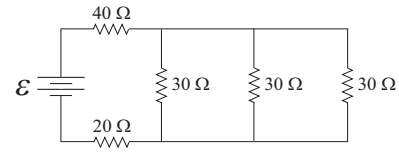
13. A series LR circuit includes a 9.0 V battery, a resistance of 0.50 Ω and an inductance of 0.80 H. What is the energy stored by the inductor 2.0 s after the switch is closed?

(1) 66 J (2) 30 mJ (3) 13 J (4) 33 mJ (5) 33 J

14. Two 200 W bulbs differ in that one is designed for the American 120 V rms and the other is designed for the European 220 V rms. Which bulb has the greater resistance, and what is that resistance?

(1) European, 242 Ω (2) American, 72 Ω (3) American, 144 Ω (4) European, 121 Ω (5) they are the same, 123 Ω

15. If $\mathcal{E} = 20$ V, at what rate is thermal energy being generated in the 20-Ω resistor?



(1) 1.6 W (2) 6.5 W (3) 15 W (4) 26 W (5) 2.1 W

16. A rectangular coil (0.20 m × 0.8 m) has 200 turns and is in a uniform magnetic field of 0.30 T. If the orientation of the coil is varied through all possible positions, the maximum torque on the coil by magnetic forces is 0.080 N·m. What is the current in the coil?

(1) 8.3 mA (2) 1.7 mA (3) 5.0 mA (4) 1.0 mA (5) 10.7 mA

17. An electron is moving at a speed of 6.0×10^6 m/s at an angle of 30° with respect to a uniform magnetic field of 8.0×10^{-4} T. What is the radius of the resulting helical path? ($m_e = 9.11 \times 10^{-31}$ kg, $q_e = 1.6 \times 10^{-19}$ C)

(1) 2.1 cm (2) 4.3 cm (3) 3.2 cm (4) 8.5 cm (5) 12.3 cm

18. An electron is moving at a speed of 9.0×10^6 m/s at an angle of 30° with respect to a uniform magnetic field of 8.0×10^{-4} T. What is the radius of the resulting helical path? ($m_e = 9.11 \times 10^{-31}$ kg, $q_e = 1.6 \times 10^{-19}$ C)

(1) 3.2 cm (2) 4.3 cm (3) 8.5 cm (4) 2.1 cm (5) 12.3 cm

19. Two long parallel wires 20 cm apart carry currents of 5.0 A and 8.0 A in the same direction. Is there any point between the two wires where the magnetic field is zero?

(1) yes, 7.7 cm from the 5-A wire
(2) yes, 12 cm from the 5-A wire
(3) yes, midway between the wires
(4) no
(5) yes, 9.5 cm from the 5-A wire

20. Niobium metal becomes a superconductor (with electrical resistance equal to zero) when cooled below 9 K. If superconductivity is destroyed when the surface magnetic field exceeds 0.100 T, determine the maximum current a 4.00-mm-diameter niobium wire can carry and remain superconducting. ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A) Assume that the current is uniformly distributed in the wire.

(1) 1000 A (2) 250 A (3) 500 A (4) 125 A (5) 750 A

21. A loop of area 0.250 m^2 is in a uniform 0.020 T magnetic field. If the flux through the loop is 3.83×10^{-3} T·m^2, what angle does the normal to the plane of the loop make with the direction of the magnetic field?

(1) 40.0° (2) 50.0° (3) 37.5° (4) This is not possible. (5) 20.0°

22. A 10-turn square coil of area 0.036 m^2 and a 20-turn circular coil are both placed perpendicular to the same changing magnetic field. The voltage induced in each of the coils is the same. What is the area of the circular coil?

(1) 0.018 m^2 (2) 0.072 m^2 (3) 0.60 m^2 (4) 0.036 m^2 (5) 0.024 m^2

23. A 10-turn square coil of area 0.072 m^2 and a 20-turn circular coil are both placed perpendicular to the same changing magnetic field. The voltage induced in each of the coils is the same. What is the area of the circular coil?

(1) 0.036 m^2 (2) 0.072 m^2 (3) 0.60 m^2 (4) 0.018 m^2 (5) 0.024 m^2

24. A rectangular loop (area = 0.15 m^2) turns in a uniform magnetic field with $B = 0.20$ T. At an instant when the angle between the magnetic field and the normal to the plane of the loop is $\pi/2$ rads and increasing at the rate of 0.60 rad/s, what is the magnitude of the emf induced in the loop?

(1) 18 mV (2) zero (3) 24 mV (4) 30 mV (5) 12 mV

25. By what factor is the self inductance of an air solenoid changed if its length and number of coil turns are both tripled?

(1) 3 (2) 1/3 (3) 6 (4) 9 (5) 1/9

26. By what factor is the self inductance of an air solenoid changed if its length and number of coil turns are both increased nine times?

(1) 9 (2) 1/3 (3) 6 (4) 3 (5) 1/9

27. An AC voltage source, with a peak output of 200 V, is connected to a 50-Ω resistor. What is the rate of energy dissipated due to heat in the resistor?

(1) 400 W (2) 200 W (3) 566 W (4) 800 W (5) 650 W

28. An AC voltage source, with a peak output of 200 V, is connected to a 100-Ω resistor. What is the rate of energy dissipated due to heat in the resistor?

(1) 200 W (2) 400 W (3) 566 W (4) 800 W (5) 650 W

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 3
Q# S 4
TYPE 2
Q# S 7
Q# S 8
TYPE 3
Q# S 9
Q# S 10
TYPE 4
Q# S 12
Q# S 13
TYPE 5
Q# S 17
Q# S 18
TYPE 6
Q# S 22
Q# S 23
TYPE 7
Q# S 25
Q# S 26
TYPE 8
Q# S 27
Q# S 28