

Instructor(s): *P. Kumar*PHYSICS DEPARTMENT
Exam 2

July 11, 2011

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.**

- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID 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. **Circle your answers on the test form.** 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.
- (4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
- (5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
- (6) Hand in the answer sheet separately.

Constants: $e = 1.6 \times 10^{-19} \text{ C}$ $m_p = 1.67 \times 10^{-27} \text{ kg}$ $m_e = 9.1 \times 10^{-31} \text{ kg}$ $g = 9.8 \text{ m/s}^2$ micro = 10^{-6}
 $\epsilon_o = 8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$ $k = 1/(4\pi\epsilon_o) = 9 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$ $\mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m}/\text{A}$ nano = 10^{-9} pico = 10^{-12}

1. Two wires each carry 10 A current in opposite direction and are 3.0 mm apart. What is the magnetic field at a point P, 25 cm away and in the plane of the wires?

(1) 8.6 nT (2) 151 nT (3) 0.0 T (4) 75 nT (5) None of these

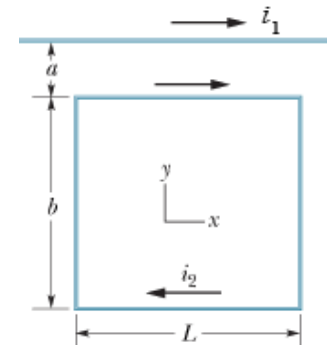
2. A straight stiff wire of length 1.00 m and mass 25 g is suspended in a magnetic field $B = 0.75 \text{ T}$. How much current must flow in the wire so that the wire is suspended with no tension in the springs?



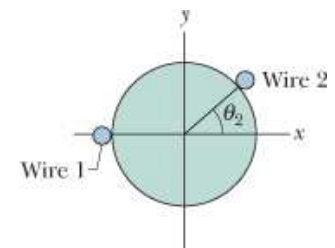
(1) 0.33 A (2) 0.25 A (3) 330 A (4) 250 A (5) None of these

3. A long straight wire carries a current $i_1 = 30 \text{ A}$ and a rectangular loop carries a current $i_2 = 20 \text{ A}$. Taking $a = 1.00 \text{ cm}$, $b = 8.00 \text{ cm}$ and $L = 30.00 \text{ cm}$, what is the net force on the loop due to the wire i_1 ?

(1) 3.2 mN
 (2) 1.6 mN
 (3) 0.8 mN
 (4) 0.4 mN
 (5) 0.2 mN



4. Two long straight wires have been held against a plastic cylinder of radius 20 cm. Wire 1 carries a current $i_1 = 60 \text{ mA}$ out of the page and it is fixed in place at the left side of the cylinder. Wire 2 carries current $i_2 = 40 \text{ mA}$ out of the page and can be moved around the cylinder. At what angle θ_2 (in positive degrees) should wire 2 be so that the net magnetic field at the origin is 30 nT?

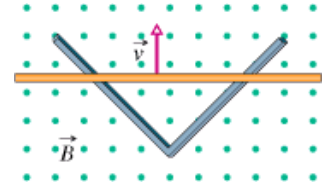


(1) 26 (2) 104 (3) 0 (4) 84 (5) None of these

5. A loop antenna of area 2.00 cm^2 and resistance $5.21 \mu\Omega$ is perpendicular to a uniform magnetic field of magnitude $17.0 \mu\text{T}$. The field magnitude drops to zero in 2.96 ms . How much thermal energy (in nJ) is produced in the loop by the change in field?

(1) 0.75 (2) 0.25 (3) 1.00 (4) 1.5 (5) 2.00

6. Two straight conducting rails meet at a right angle. A conducting bar in contact with the rails starts at the vertex at time $t = 0$ and moves with a constant velocity of $v \text{ m/s}$ along them. A magnetic field with $B = 0.350 \text{ T}$ is directed out of the page. If the emf generated in the triangular loop at time $t = 3 \text{ s}$ is 56.8 V , what is v (in m/s)?

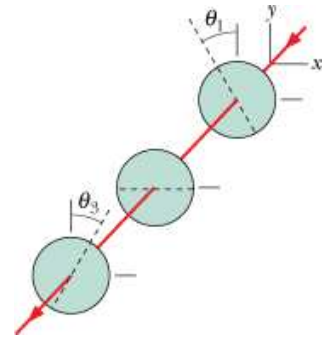


(1) 5.2 (2) 2.6 (3) 1.3 (4) 6.5 (5) None of these

7. In an oscillating LC circuit, $L = 3.00 \text{ mH}$ and $C = 2.70 \mu\text{F}$. At $t = 0$ the charge on the capacitor is zero and the current is 2.00 A . What is the maximum charge (in mC) that will appear on the capacitor?

(1) 0.18 (2) 0.54 (3) 0.90 (4) 0.09 (5) None of these

8. Unpolarized light is sent into the system of three polarizing sheets, where the polarizing directions of the first and third sheets are at angles $\theta_1 = 30^\circ$ (counterclockwise) and $\theta_3 = 30^\circ$ (clockwise) with respect to the y axis. What fraction of the initial light intensity emerges from the system if the middle sheet has its axis lined along the x -axis?

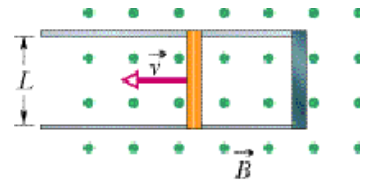


(1) $1/32$
 (2) $1/8$
 (3) $1/2$
 (4) $1/4$
 (5) $1/16$

9. In the problem above, put the optical axis of the middle sheet at some arbitrary angle θ , measured clockwise from the y axis. At what angle θ (in degrees) is the emergent light of minimum intensity?

(1) 60 (2) 30 (3) 90 (4) 45 (5) 120

10. A metal rod is forced to move with constant velocity along two parallel metal rails, which are connected with a strip of metal (see figure). A magnetic field of 0.5 T points out of the page. The separation between the rails is $L = 30 \text{ cm}$, the rod has resistance 40Ω , and velocity 70 cm/s . What force (in mN) must be applied to the rod to keep it moving at the constant velocity?



(1) 0.4 (2) 0.5 (3) 0.3 (4) 0.2 (5) 0.1

11. Of the three chief kinds of magnetic materials (diamagnetic [a], paramagnetic [b], and ferromagnetic [c]) which ones are used to make compass needles?

(1) c (2) b (3) a (4) Either a or b (5) Either a or c.

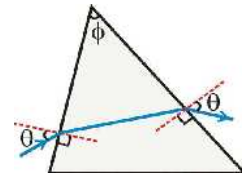
12. If the electric field in a plane electromagnetic wave is given by $E(x, t) = 8500 \sin(33x - \omega t)$, in SI units, the frequency of the wave (in GHz) is:

(1) 1.6 (2) 9.9 (3) 5.0 (4) 3.15 (5) None of these

13. A wire of length L carries a current i . If the wire is bent into a circular coil of N turns and placed into a uniform magnetic field B , what is the magnitude of the maximum possible torque on the loop?

- (1) $L^2iB/4\pi N$ (2) $LiB\pi/2N$ (3) $2L^2iB/\pi^2N^2$ (4) $3LiB/\pi N$ (5) $L^2\pi iB/4N^2$

14. A ray is incident on one face of a triangular glass prism in air. The angle of incidence θ is chosen so that the emerging ray also makes the same angle θ with the normal to the other face, as shown. If the apex angle of the prism is $\phi = 72^\circ$, and the index of refraction of the prism is $n = 1.60$, what is θ (in degrees)?



- (1) 70 (2) 52 (3) 34 (4) 64 (5) 88

15. In a uniform magnetic field, an electron undergoes a circular motion with a kinetic energy of 6.4×10^{-17} J. The radius of the orbit is 23.0 mm. What is the magnetic field in T?

- (1) 2.93×10^{-3} (2) 3.2×10^{-4} (3) 1.28×10^{-7} (4) 3.52×10^{-5} (5) 1.35×10^{-2}

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 9