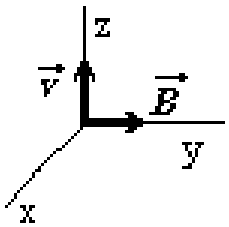
- **Sample Exam, Physics 121 Common Exam 3, Chapters 27 and 28**

1. A beam of electrons passes through a region of uniform magnetic and electrostatic fields at right angles to each other and at right angles to the initial electron velocity. The fields strengths are E = 10,000 V/m and B = 10^{-3} T. What will be the speed of electrons that pass through the region without being deflected?

A) 10 m/s
B) 0.1 m/s
C) 3 x 10^{8} m/s
D) 10^{7} m/s
E) $4\pi x10^{-7}$ m/s

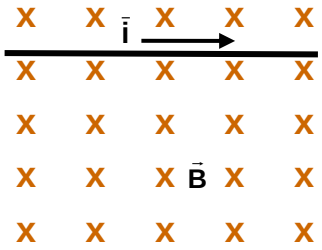
2. A proton is moving with velocity v = 5 x 10^{5} m/s in the positive z direction. It is crossing a region in which a uniform magnetic field with B = 0.20 T points in the positive y direction. Find the force acting on the particle.

A) 10^{-14} N, -z direction
B) 1.6 x 10^{-14} N, +x direction
C) 1.6 x 10^{-14} N, -x direction
D) 8.0 x 10^{-13} N, -y direction
E) 8.0 x 10^{-13} N, +z direction



3. A wire whose length L = 5 cm is placed in a uniform magnetic field of magnitude B = 1 T which points into the page. The wire carries a current of 20 A to the right in the plane of the page. What are the magnitude and direction of the force exerted on the wire by the magnetic field?

A) 1.0 N out of the page
B) 1.0 N, up in the plane of the page
C) 1.0N, down in the plane of the page
D) 2.0 N, up in the plane of the page
E) 2.0 N, down in the plane of the page



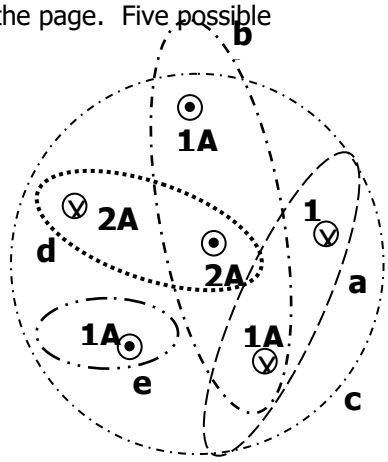
4. The uniform magnetic field over a certain region is given by $\underline{\mathbf{B}} = B_x\mathbf{i} + B_y\underline{\mathbf{j}}$ where B_x = 2 T and B_y = 2 T. An electron moves into the field with a velocity $\underline{\mathbf{v}} = v_x\underline{\mathbf{i}} + v_y\underline{\mathbf{j}} + v_z\underline{\mathbf{k}}$, where v_x = 5 m/s, v_y = 5 m/s and v_z = 5 m/s. The charge on the electron is -1.6×10^{-19} C.
What force **F** does the magnetic field exert on the electron?

A) $\mathbf{F} = 1.6 \times 10^{-18}\,\mathbf{i} + 1.6 \times 10^{-18}\mathbf{k}$
B) $\mathbf{F} = 1.6 \times 10^{-18}\,\mathbf{i} + 1.6 \times 10^{-18}\,\mathbf{j}$
C) $\mathbf{F} = 1.6 \times 10^{-18}\,\mathbf{i} - 1.6 \times 10^{-18}\,\mathbf{j}$
D) $\mathbf{F} = 2.4 \times 10^{-18}\,\mathbf{i} + 2.4 \times 10^{-18}\mathbf{j} + 2.4 \times 10^{-18}\mathbf{k}$
E) $\mathbf{F} = 2.4 \times 10^{-18}\,\mathbf{j} + 2.4 \times 10^{-18}\,\mathbf{k}$

5. The sketch shows a cross-section view of 6 wires carrying current into or out of the page. Five possible Amperian paths labeled a, b, c, d, and e are shown.

For which Amperian paths in the picture is $\oint \vec{B} \circ d\vec{s} = 0$ in Ampere's Law?

A) d
B) a and c
C) b
D) a, b, and c
E) c and d



6. A positively charged particle moving from right to left in the plane of the page enters a region of magnetic field which points directly into the page. The particle will:

A) be deflected out of the plane of the page into a circular path
B) continue moving in a straight line, but it will accelerate
C) continue moving in a straight line, but it will decelerate
D) be deflected down, still in the plane of the page
E) be deflected up, still in the plane of the page

7. A proton moves across the Earth's equator in a northeasterly direction. At this point the Earth's magnetic field points due north and is parallel to the surface. What is the direction of the force acting on the proton at this instant?

A) toward the northwest
B) out of the Earth's surface
C) into the Earth's surface
D) toward the northeast
E) zero

8. A negatively charged particle (an electron) with charge -1.6×10^{-19} C is moving at a velocity $v = 10^6$ m/s in the positive x direction. It is crossing a region where a uniform magnetic field with B = 500 kT (kilo-Teslas) points in the negative y direction. Find the force acting on the particle.

F) 8.0×10^{-8} N, -x direction
G) 8.0×10^{-8} N, -y direction
H) 8.0×10^{-8} N, +y direction
I) 8.0×10^{-8} N, -z direction
J) 8.0×10^{-8} N, +z direction

9. The magnetic field and **speed** are the same as in the previous problem, but the electron's velocity has equal x and y components. The force acting on the particle is closest to:

A) 11.4×10^{-8} N, -y direction
B) 5.7×10^{-8} N, -x direction
C) 8.0×10^{-8} N, -z direction
D) 5.7×10^{-8} N, +z direction
E) 5.7×10^{-8} N, +y direction

10. A wire whose length L = 4 m is placed in a uniform magnetic field of magnitude B = 0.5 T. which points out of the page. The wire carries a current of 8 A to the left in the plane of the page. What are the magnitude and direction of the force exerted on the wire by the magnetic field?

A) 0. 16 N, out of the page
B) 0.08 N, up in the plane of the page
C) 0.08 N, down in the plane of the page
D) 16 N, up in the plane of the page
E) 16 N, down in the plane of the page

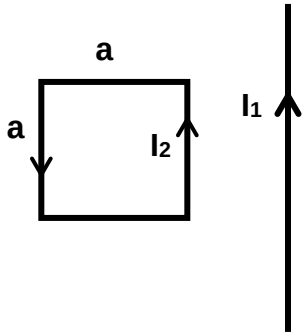
11. A proton is moving with a speed of 3×10^5 m/s in an uniform magnetic field of B = 0.01 Tesla. The field points directly out of the page, and the velocity of the proton lies within in the plane of the page. Find the frequency of revolution and the direction (CW or CCW) The frequency is the reciprocal of the period. The mass of the proton is approximately 1.7×10^{-27} kg. The answer is closest to:

A) 150 kHz, CCW
B) 150 kHz, CW
C) 150 MHz, CCW
D) 150 MHz, CW
E) the particle keeps moving in a straight line

12. Two parallel wires are each 5 meters long. They are separated by a perpendicular distance of 100 cm and carry currents of 40 A. and 50 A. in the same direction. Find the interaction force between the wires:

A) zero
B) 0.2 N, attraction
C) 0.2 N, repulsion
D) 2×10^{-3} N, attraction
E) 2×10^{-3} N, repulsion

13. In the sketch (not to scale) a long straight wire in the plane of the page carries a vertical current $I_1 = 5$ A. A square frame whose side a = 0.2 cm is also in the plane of the page and to the left of the straight wire. It carries a counterclockwise current of $I_2 = 8$ A. and is oriented parallel to the wire. Which of the following statements correctly describes the net force on the frame? Ignore gravitation.

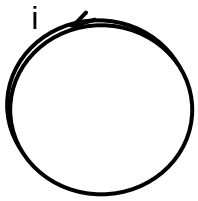


A) the frame is attracted to the wire
B) the frame is repelled by the wire
C) the net force on the frame is zero, but there is a torque which attempts to turn it around a vertical axis
D) the net force on the frame is zero, but there is a torque which attempts to turn it around a horizontal axis
E) both the net force and torque are zero

14. For the previous problem, calculate the magnitude of the force which acts on the frame if the distance from the straight wire to the closest side of the square is also 0.2 cm = a.

A) 4.0×10^{-6} N
B) 3.2×10^{-4} N
C) 3.2×10^{-3} N
D) 2×10^{-5} N
E) 0 N

15. A flat circular coil of wire has 100 turns each of which is carrying current i = 10 A. in the counterclockwise direction as shown. The radius of each loop in the coil is r = 10 mm. The magnetic field at the center of the loop is closest to:



A) zero
B) 0.063 T , out of the page
C) 0.063 T , into the page
D) 0.63 mT , into the page
E) 0.63 mT, out of the page

16. A long solenoid has 500 turns of wire per meter. It carries a current of 10 A. Find the magnetic field at the center of the solenoid.

A) 0.63 mT
B) 0.0063 T
C) 0.063 T
D) 0.63 T
E) 6.3 T