Name: ___________________________ Date: _____________

1. A magnetic field exerts a force on a charged particle:
   A) always
   B) never
   C) if the particle is moving across the field lines
   D) if the particle is moving along the field lines
   E) if the particle is at rest

2. A magnetic field CANNOT:
   A) exert a force on a charge
   B) accelerate a charge
   C) change the momentum of a charge
   D) change the kinetic energy of a charge
   E) exist

3. A beam of electrons is sent horizontally down the axis of a tube to strike a fluorescent screen at the end of the tube. On the way, the electrons encounter a magnetic field directed vertically downward. The spot on the screen will therefore be deflected:
   A) upward
   B) downward
   C) to the right as seen from the electron source
   D) to the left as seen from the electron source
   E) not at all

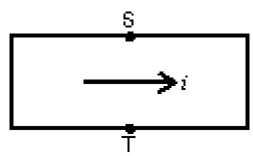
4. At one instant an electron (charge = -1.6×10^{-19} C) is moving in the xy plane, the components of its velocity being $v_x = 5 \times 10^5$ m/s and $v_y = 3 \times 10^5$ m/s. A magnetic field of 0.8 T is in the positive x direction. At that instant the magnitude of the magnetic force on the electron is:
   A) 0
   B) 2.6×10^{-14} N
   C) 3.8×10^{-14} N
   D) 6.4×10^{-14} N
   E) 1.0×10^{-13} N

5. An electron enters a region of uniform perpendicular $\vec{E}$ and $\vec{B}$ fields. It is observed that the velocity $\vec{v}$ of the electron is unaffected. A possible explanation is:
   A) $\vec{v}$ is parallel to $\vec{E}$ and has magnitude E/B
   B) $\vec{v}$ is parallel to $\vec{B}$
   C) $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude B/E
   D) $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude E/B
   E) the given situation is impossible

6. A charged particle is projected into a region of uniform, parallel, $\vec{E}$ and $\vec{B}$ fields. The force on the particle is:

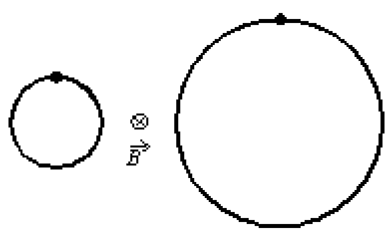
A) zero
B) at some angle < 90° with the field lines
C) along the field lines
D) perpendicular to the field lines
E) unknown (need to know the sign of the charge)

7. The current is from left to right in the conductor shown. The magnetic field is into the page and point S is at a higher potential than point T. The charge carriers are:



A) positive
B) negative
C) neutral
D) absent
E) moving near the speed of light

8. An electron and a proton both each travel with equal speeds around circular orbits in the same uniform magnetic field, as shown in the diagram (not to scale). The field is into the page on the diagram. Because the electron is less massive than the proton and because the electron is negatively charged and the proton is positively charged:



A) the electron travels clockwise around the smaller circle and the proton travels counterclockwise around the larger circle.
B) the electron travels counterclockwise around the smaller circle and the proton travels clockwise around the larger circle
C) the electron travels clockwise around the larger circle and the proton travels counterclockwise around the smaller circle
D) the electron travels counterclockwise around the larger circle and the proton travels clockwise around the smaller circle
E) the electron travels counterclockwise around the smaller circle and the proton travels counterclockwise around the larger circle

9. An electron is launched with velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$. The angle θ between $\vec{v}$ and $\vec{B}$ is between 0 and 90°. As a result, the electron follows a helix, its velocity vector $\vec{v}$ returning to its initial value in a time interval of:

A) $2\pi m/eB$
B) $2\pi mv/eB$
C) $2\pi mv \sin\theta /eB$
D) $2\pi mv \cos\theta /eB$
E) none of these

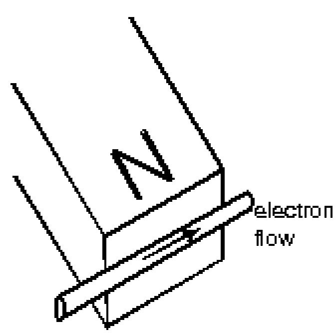
10. Electrons (mass m, charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a magnetic field $\vec{B}$ that is perpendicular to their velocity. The radius of the resulting electron trajectory is:

A) $\left(\sqrt{2eV/m}\right)/B$
B) $B\sqrt{2eV}/m$
C) $\left(\sqrt{2mV/e}\right)/B$
D) $B\sqrt{2mV}/e$
E) none of these

11. A cyclotron operates with a given magnetic field and at a given frequency. If R denotes the radius of the final orbit, the final particle energy is proportional to:

A) $1/R$
B) R
C) R^2
D) R^3
E) R^4

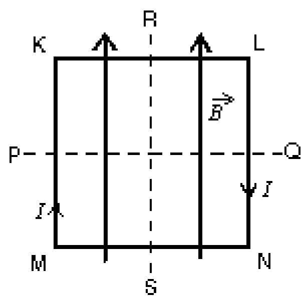
12. The figure shows the motion of electrons in a wire which is near the N pole of a magnet. The wire will be pushed:



A) toward the magnet
B) away from the magnet
C) downwards
D) upwards
E) along its length

13. A loop of wire carrying a current of 2.0 A is in the shape of a right triangle with two equal sides, each 15 cm long. A 0.7 T uniform magnetic field is parallel to the hypotenuse. The resultant magnetic force on the two sides has a magnitude of:
A) 0
B) 0.21 N
C) 0.30 N
D) 0.41 N
E) 0.51 N

14. A square loop of wire lies in the plane of the page and carries a current I as shown. There is a uniform magnetic field $\vec{B}$ parallel to the side MK as indicated. The loop will tend to rotate:

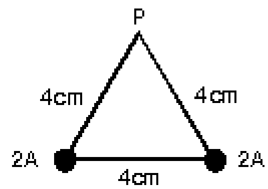


A) about PQ with KL coming out of the page
B) about PQ with KL going into the page
C) about RS with MK coming out of the page
D) about RS with MK going into the page
E) about an axis perpendicular to the page

15. A circular loop of wire with a radius of 20 cm lies in the *xy* plane and carries a current of 2 A, counterclockwise when viewed from a point on the positive *z* axis. Its magnetic dipole moment is:
A) $0.25 \text{ A} \cdot \text{m}^2$, in the positive *z* direction
B) $0.25 \text{ A} \cdot \text{m}^2$, in the negative *z* direction
C) $2.5 \text{ A} \cdot \text{m}^2$, in the positive *z* direction
D) $2.5 \text{ A} \cdot \text{m}^2$, in the negative *z* direction
E) $0.25 \text{ A} \cdot \text{m}^2$, in the *xy* plane

16. Two long straight wires are parallel and carry current in the same direction. The currents are 8.0 and 12 A and the wires are separated by 0.40 cm. The magnetic field in tesla at a point midway between the wires is:
A) 0
B) 4.0×10^{-4}
C) 8.0×10^{-4}
D) 12×10^{-4}
E) 20×10^{-4}

17. Two long straight wires pierce the plane of the paper at vertices of an equilateral triangle as shown below. They each carry 2 A, out of the paper. The magnetic field at the third vertex (P) has magnitude (in T):



A) 1.0×10^{-5}
B) 1.7×10^{-5}
C) 2.0×10^{-5}
D) 5.0×10^{-6}
E) 8.7×10^{-6}

18. Two long straight wires enter a room through a window. One carries a current of 3.0 A into the room while the other carries a current of 5.0 A out. The magnitude in T·m of the path integral $\oint \vec{B} \cdot d\vec{s}$ around the window frame is:

A) 2.5×10^{-6} T · m
B) 3.8×10^{-6} T · m
C) 6.3×10^{-6} T · m
D) 1.0×10^{-5} T · m
E) none of these