• You are allowed a pencil and a testing center calculator.
• No scratch paper is allowed.
• Testing center calculators only.
1. A circular coil lays flat on a horizontal table in a region where the magnetic field is straight down. The magnetic field is suddenly removed. When viewed from above, what is the direction of the current in the coil as the field is removed?  
A. clockwise  
B. clockwise initially, then counter-clockwise before going to zero  
C. counter-clockwise  
D. There is no induced current.

2. If the number of turns on the transformer input is greater than the number on the output, then the transformer  
A. outputs greater voltage than at the input.  
B. outputs less current than at the input.  
C. outputs greater voltage and current than at the input.  
D. outputs less voltage than at the input.  
E. increases the voltage but does not affect the current.

3. A series LR circuit includes a 9.00 V battery, a 30.0 mH inductor, and a resistance of 5.00 Ω. What is the time constant of this circuit?  
A. 115 s  
B. 170 s  
C. 4.20 ms  
D. 6.00 ms  
E. 8.30 ms

4. 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 induced emf 2.0 s after the switch has been closed?  
A. 0.0  
B. 9.0 V  
C. 6.4 V  
D. 2.6 V  
E. 19 mV
5. A loop of wire is moved through a region of uniform magnetic field. As it is moved, its orientation with respect to the magnetic field direction does not change. The induced current at this time in the loop: D

A. depends on the shape of the loop
B. depends on the magnitude of the field
C. depends on the speed with which it is moved
D. is zero
E. depends on the acceleration of the loop

6. A 20-turn coil of area 10 cm² 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, what is the emf induced when the field increases to 0.35 T in 2.0 s? C

A. 7.0 mV
B. 2.0 mV
C. 1.0 mV
D. 3.5 mV
E. 4.0 mV

7. A 20-turn coil of area 10 cm² is placed in a magnetic field so that the normal to its area is in the direction of the field. If the field has a value of 0.25 T, what is the total flux through the coil? B

A. 0.0
B. 5.0 x 10⁻³ T·m²
C. 25 x 10⁻⁵ T·m²
D. 50 T·m²
E. 25 T·m²

8. A metal rod of length 2.0 m is moved at 6.0 m/s in a direction perpendicular to its length. A 5.0 T magnetic field is perpendicular to both the rod and its velocity. What is the magnitude of the electric field in the rod? C

A. 12 V/m
B. 60 V/m
C. 30 V/m
D. 15 V/m
E. 0.0
9. A charged particle enters a region of magnetic field at a speed of $2.8 \times 10^4$ m/s, at an angle of 37 degrees relative to the magnetic field direction. What will be the magnitude of the component of the particle’s velocity that is parallel to the magnetic field while it is in this region?  

A. Insufficient information is given.  
B. $2.2 \times 10^4$ m/s  
C. $2.1 \times 10^4$ m/s  
D. $1.7 \times 10^4$ m/s  
E. $2.8 \times 10^4$ m/s

10. One wire, lying on the x-axis, carries a current of 8.0 A in the positive x-direction. Another wire, lying on the y-axis, carries a current of 12 A in the positive y-direction. What is the magnitude of the magnetic field at $(x, y) = (8.0 \text{ cm}, 12.0 \text{ cm})$?  

A. $1.3 \times 10^{-5}$ T  
B. $3.0 \times 10^{-5}$ T  
C. $1.7 \times 10^{-5}$ T  
D. $4.3 \times 10^{-5}$ T  
E. $4.0 \times 10^{-10}$ T

11. A long straight wire is carrying a current of 2.4 A. If the magnetic field in that region is 0.52 mT and makes a 60° angle with the wire, what is the magnitude of the force on 3.0 m of the wire?  

A. 3.2 N  
B. 6.5 N  
C. $1.6 \times 10^{-3}$ N  
D. $3.2 \times 10^{-3}$ N  
E. $6.5 \times 10^{-3}$ N

12. A 3.0 cm section of a horizontal wire carrying a 6.7 A current from east to west is placed in a north to south 0.42 T magnetic field in the lab. In what direction is the magnetic force on the 3.0 cm section?  

A. North  
B. South  
C. ☐  
D. ☒
13. An electron is moving at $3.0 \times 10^6$ m/s at an angle of $40^\circ$ to a 0.80 T magnetic field. What is the magnitude of the force on the electron? C

A. $4.8 \times 10^{-13}$ N
B. $3.8 \times 10^{-13}$ N
C. $2.5 \times 10^{-13}$ N
D. $2.9 \times 10^{-13}$ N
E. $1.2 \times 10^{-13}$ N

14. An electron is moving at $3.6 \times 10^6$ m/s perpendicular to a uniform magnetic field. If the radius of the motion is 18 mm, what is the magnitude of the magnetic field? B

A. 70 mT
B. 1.14 mT
C. 9.3 mT
D. 1.6 T
E. 8.9 nT

15. A negative ion is moving east near the equator where the Earth's magnetic field is horizontal to the north. The direction of the magnetic force on the ion is D

A. north.
B. south.
C. away from the earth.
D. toward the center of the earth.
E. not meaningful since the force is zero.

16. The SI unit of magnetic field is the tesla, which is equivalent to a C

A. N/C.
B. A/m.
C. N/(A·m).
D. magnon.
E. None of these choices are correct.
17. The magnetic field in a cyclotron is 0.50 T. Find the magnitude of the magnetic force on a proton with velocity of $1.0 \times 10^7$ m/s in a plane perpendicular to the field. 

D. $6.0 \times 10^{-14}$ N

A. $6.0 \times 10^{-13}$ N
B. $8.0 \times 10^{-14}$ N
C. $8.0 \times 10^{-13}$ N

18. If a charged particle is moving through a magnetic field with its velocity at an angle of 45 degrees with respect to the field, what happens to the magnetic force on it if both the speed and magnetic field are doubled? 

C. It quadruples.

A. It stays the same.
B. It doubles.
D. It halves.
E. It increases by a factor of 5.66.

19. A straight wire is carrying a current upward. Observed from above (i.e., looking downward towards the wire), the magnetic field lines are 

D. forming counter-clockwise circles.

A. radially outward.
B. radially inward.
C. forming clockwise circles.
D. forming counter-clockwise circles.
E. directed toward the observer.

20. If the magnetic field from a current-carrying long straight wire has a magnitude $B_0$ at a distance $d$, what is the magnitude of the field at a distance $2d$? 

D. $B_0/2$

A. also $B_0$
B. $0.707 B_0$
C. $0.693 B_0$
D. $B_0/2$
E. $B_0/4$
21. Two parallel wires are each carrying 10 A and are separated by 4.0 m. If the currents are in opposite directions, what is the magnitude of the magnetic field halfway between them?  
A. 0.0  
B. 1.0 µT  
C. 2.0 µT  
D. 4.0 µT  
E. 1.4 µT

22. What current is necessary to generate a field of 0.20 T inside a solenoid of 300 turns per cm?  
B  
A. 530 A  
B. 5.3 A  
C. 33 A  
D. 0.33 A  
E. 3.1 A

23. A proton and electron, each travelling at the same speed, enter a region of uniform magnetic field. They experience  
B  
A. forces in the same direction and having ratio \( \frac{F_p}{F_e} = \frac{m_e}{m_p} \)  
B. forces equal in magnitude, but opposite in direction  
C. forces opposite in direction and having ratio \( \frac{F_p}{F_e} = \frac{m_e}{m_p} \)  
D. the same force

24. A charged particle having electric charge \( Q = 4.0 \, \text{e} \) enters a region of magnetic field 1.2 T at an angle of 37 degrees relative to the magnetic field direction. If the speed of the particle upon entering the region is \( 2.8 \times 10^4 \, \text{m/s} \), what is the magnitude of the force on it?  
B  
A. \( 1.8 \times 10^{-14} \, \text{N} \)  
B. \( 1.3 \times 10^{-14} \, \text{N} \)  
C. \( 3.3 \times 10^{-15} \, \text{N} \)  
D. \( 1.1 \times 10^{-14} \, \text{N} \)  
E. \( 1.4 \times 10^{-14} \, \text{N} \)
25. A generator is designed to produce a maximum emf of 170 V while rotating at 3200 rpm. The coils of the generator are circular with diameter 7.5 cm. Assuming the magnetic field in the generator is 0.075 T, what is the number of loops needed in the generator coil?

A. 160
B. 1530
C. 6120
D. 4810
E. 25