

Name \_\_\_\_\_ ID # \_\_\_\_\_

Section # \_\_\_\_\_ TA Name \_\_\_\_\_

Fill in your name, student ID # (not your social security #), and section # (under ABC of special codes) on the Scantron sheet. Fill in the letters given for the first 5 questions on the Scantron sheet. These letters determine which version of the test you took, and it is very important to get this right. Make sure your exam has questions 6—25.

1. A
2. B
3. E
4. C
5. D
6. A proton moving with a speed of  $3.0 \times 10^5$  m/s perpendicular to a uniform magnetic field of 0.20 T will follow which of the paths described below? ( $q_p = 1.6 \times 10^{-19}$  C and  $m_p = 1.67 \times 10^{-27}$  kg)
  - a. a straight line path
  - b. a circular path of 3.1 cm radius
  - c. a circular path of 1.6 cm radius
  - d. a circular path of 0.78 cm radius
  - e. a circular path of 16 cm radius
7. Two parallel conductors each of 0.50 m length, separated by  $5.0 \times 10^{-3}$  m and carrying 3.0 A in opposite directions, will experience what type and magnitude of mutual force? (magnetic permeability in empty space  $\mu_0 = 4\pi \times 10^{-7}$  T·m/A)
  - a. attractive,  $0.06 \times 10^{-4}$  N
  - b. repulsive,  $1.8 \times 10^{-4}$  N
  - c. repulsive,  $0.60 \times 10^{-4}$  N
  - d. attractive,  $1.8 \times 10^{-4}$  N
  - e. repulsive,  $3.6 \times 10^{-4}$  N

8. A solenoid with 500 turns, 0.10 m long, carrying a current of 4.0 A and with a radius of  $10^{-2}$  m will have what strength magnetic field at its center? (magnetic permeability in empty space  $\mu_0 = 4\pi \times 10^{-7}$  T·m/A)
- $250 \times 10^{-4}$  T
  - $31 \times 10^{-4}$  T
  - $62 \times 10^{-4}$  T
  - $125 \times 10^{-4}$  T
  - $500 \times 10^{-4}$  T
9. The magnetic field of the Earth is believed responsible for which of the following?
- deflection of both charged and uncharged cosmic rays
  - ozone in the upper atmosphere
  - solar flares
  - gravity
  - deflection of charged cosmic rays
10. If an electron is released at the equator and falls toward the Earth under the influence of gravity, the magnetic force on the electron will be toward the:
- north
  - south
  - west
  - east
  - Earth
11. The basic function of the electric generator is which of the following conversion processes?
- electrical energy to mechanical
  - low voltage to high voltage
  - alternating current to direct
  - high voltage to low voltage
  - mechanical energy to electrical

12. A square coil, enclosing an area with sides 2.0 cm long, is wrapped with 250 turns of wire. A uniform magnetic field perpendicular to its plane is turned on and increases to 0.25 T during an interval of 1.0 s. What average voltage is induced in the coil?
- 12 mV
  - 200 mV
  - 250 mV
  - 25 mV
  - 20 mV
13. An airplane with a wingspan of 60.0 m flies parallel to the Earth's surface at a point where the downward component of the Earth's magnetic field is  $0.400 \times 10^{-4}$  T. If the induced potential between wingtips is 0.900 V, what is the plane's speed?
- 250 m/s
  - 338 m/s
  - 417 m/s
  - 375 m/s
  - 300 m/s
14. A 12-V battery is connected in series with a switch, resistor and inductor. If the circuit's time constant is  $2.0 \times 10^{-4}$  s and the final steady current after the switch is closed becomes 1.0 A, what is the value of the inductance?
- 2.4 mH
  - 1.2 mH
  - 9.6 mH
  - 48 mH
  - 4.8 mH
15. If a bar magnet is falling through a loop of wire, the induced current in the loop of wire sets up a field which exerts a force on the magnet. This force between the magnet and the loop will be attractive when:
- the magnet enters the loop
  - the magnet is halfway through
  - the magnet is leaving the loop
  - never
  - always

16. An AC series circuit has  $12\ \Omega$  resistance,  $15\ \Omega$  inductive reactance and  $10\ \Omega$  capacitive reactance. If an effective (rms) voltage of  $120\ \text{V}$  is applied, what is the effective (rms) current value?
- $5.31\ \text{A}$
  - $10.8\ \text{A}$
  - $26.0\ \text{A}$
  - $9.23\ \text{A}$
  - $18.5\ \text{A}$
17. Resonance occurs in an AC series circuit when which of the following conditions is met?
- capacitive reactance equals inductive reactance
  - resistance equals capacitive reactance
  - resistance equals inductive reactance
  - capacitive reactance equals zero
  - inductive reactance equals zero
18. A  $200\text{-}\Omega$  resistor is connected in series with a  $10\text{-}\mu\text{F}$  capacitor and a  $60\text{-Hz}$ ,  $120\text{-V}$  (rms) line voltage. If electrical energy costs  $5.0\text{¢}$  per kWh, how much does it cost to leave this circuit connected for 24 hours?
- $3.1\text{¢}$
  - $62\text{¢}$
  - $31\text{¢}$
  - $5.2\text{¢}$
  - $8.6\text{¢}$
19. Which condition of motion must be met with regard to a charged particle if it is in the process of emitting electromagnetic waves?
- accelerates
  - moves at constant velocity
  - moves at the speed of light
  - oscillates periodically
  - moves in a circle

20. A radio wave transmits  $1.2 \text{ W/m}^2$  average power per unit area. What is the peak value of the associated magnetic field? ( $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$  and  $c = 3.00 \times 10^8 \text{ m/s}$ )
- $8.4 \times 10^{-3} \text{ T}$
  - $1.2 \text{ T}$
  - $1.0 \times 10^{-7} \text{ T}$
  - $30 \text{ T}$
  - $7.1 \times 10^{-8} \text{ T}$
21. A container of flint glass ( $n = 1.66$ ) holds a small quantity of benzene ( $n = 1.501$ ). What is the critical angle for internal reflection of a ray in the glass when it is incident on the glass-to-liquid surface?
- $64.7^\circ$
  - $89.5^\circ$
  - $41.1^\circ$
  - $37.0^\circ$
  - $0^\circ$
22. A monochromatic beam of light in air has a wavelength of  $589 \text{ nm}$  in air. It passes through glass ( $n = 1.52$ ) and then through carbon disulfide ( $n = 1.63$ ). What is its wavelength in the carbon disulfide?
- $361 \text{ nm}$
  - $387.5 \text{ nm}$
  - $895 \text{ nm}$
  - $960 \text{ nm}$
  - $589 \text{ nm}$
23. A ray of light passing through a liquid is incident on a liquid-to-glass interface at an angle of  $35^\circ$ . Indices of refraction for the liquid and glass are, respectively,  $1.63$  and  $1.52$ . What is the angle of refraction for the ray moving through the glass?
- $23^\circ$
  - $38^\circ$
  - $30^\circ$
  - $46^\circ$
  - $35^\circ$

24. Dispersion occurs when:

- a. some materials bend light more than other materials.
- b. a material changes some frequencies more than others.
- c. a material slows down some wavelengths more than others.
- d. light has different speeds in different materials.
- e. light is scattered in all different directions.

25. Helium-neon laser light has a wavelength in air of 632.8 nm. What is the energy of a single photon in the beam? ( $h = 6.626 \times 10^{-34}$  J·s and  $c = 3.00 \times 10^8$  m/s).

- a.  $3.14 \times 10^{-19}$  J
- b.  $5.40 \times 10^{-19}$  J
- c.  $7.62 \times 10^{-19}$  J
- d.  $1.15 \times 10^{-18}$  J
- e.  $6.28 \times 10^{-19}$  J