PRACTICE MULTIPLE CHOICE QUESTIONS

ANSWERS AT END

GRACE

ELECTRIC FORCES AND THE ELECTRIC FIELD

____1. Doug rubs a piece of fur on a hard rubber rod, giving the rod a negative charge. What happens?
A. Protons are removed from the rod.
B. Electrons are added to the rod.
C. The fur is also charged negatively.
D. The fur is left neutral.
E. Negative ions added to the fur.

____2. A repelling force must occur between two charged objects under which conditions?
A. charges are of unlike signs
B. charges are of like signs
C. charges are of equal magnitude
D. charges are of unequal magnitude

____3. When a glass rod is rubbed with silk, which of the following statements best describes what happens?
A. electrons are removed from the rod
B. protons are removed from the silk
C. the silk is charged positively
D. the silk remains neutral
E. positive ions are removed from the silk

____4. When charging two objects by rubbing them together:
A. neither may be a conductor.
B. they must be made of different material.
C. they will sometimes end up with both being positively charged.
D. the heat produced by friction is a necessary part of this process.
E. they must have different temperature.

____5. Who was the first to determine the electron's charge?
A. Franklin
B. Coulomb
C. Millikan
D. Faraday
E. Maxwell

____6. An uncharged conductor is supported by an insulating stand. I pass a positively charged rod near the left end of the conductor, but do not touch it. The right end of the conductor will be:
A. negative.
B. positive.
C. neutral.
D. attracted.
E. repulsed.

____7. Of the following substances, which one contains the highest density of free electrons?
A. hard rubber
B. iron
C. amber
D. glass
E. silk

____8. Which of the following best characterizes electrical conductors?
A. low mass density
B. high tensile strength
C. electric charges move freely
D. poor heat conductors
E. total electric charge is zero

____9. Which of the following best characterizes electrical insulators?
A. charges on the surface don't move
B. high tensile strength
C. electric charges move freely
D. good heat conductors
E. low specific heat

____10. If body P, with a positive charge, is placed in contact with body Q (initially uncharged), what will be the nature of the charge left on Q?
A. must be equal in magnitude to that on P
B. must be negative
C. must be positive
D. must be greater in magnitude than that on P
E. must be negative and less in magnitude than that on P

____11. I wish to use a positively charged rod to charge a ball by induction. Which statement is correct?
A. The charge on the ball will be positive.
B. The ball must be a conductor.
C. The ball must be an insulator that is connected temporarily to the ground.
D. The ball is charged as the area of contact between the two increases.
E. The ball must be initially uncharged.

____12. How can a charged object attract an uncharged object made of non-conducting material?
A. The uncharged object must somehow gain a like charge.
B. The uncharged object must somehow gain an unlike charge.
C. The charges in the uncharged object can become polarized.
D. Attraction of an insulator is not possible.
E. Attraction of an insulator is possible only by another insulator.

____13. Two point charges are 4 cm apart. They are moved to a new separation of 2 cm. By what factor does the resulting mutual force between them change?
A. 1/2
B. 2
C. 1/4
D. 4
E. 1

____14. If the distance between two point charges is tripled, the mutual force between them will be changed by what factor?
A. 9.0
B. 3.0
C. 0.33
D. 1/9
E. 6.0

____15. If the size of the charge value is tripled for both of two point charges maintained at a constant separation, the mutual force between them will be changed by what factor?
A. 9.0
B. 3.0
C. 0.33
D. 1/9
E. 6.0

____16. The constant k_e, which appears in Coulomb's law formula, is equivalent dimensionally to which of the following?

A. $N \cdot m/C$
B. N/C
C. $N \cdot m^2/C^2$
D. N/C^2
E. $N \cdot C^2/m^2$

____17. The beam of electrons that hits the screen of an oscilloscope is moved up and down by:

A. gravity.
B. a phosphorescent coating.
C. varying the electron's charge.
D. electrical charges on deflecting plates.
E. electrical repulsion between electrons.

____18. Electric field is dimensionally equivalent to which of the following?

A. $N \cdot m/C$
B. N/C
C. $N \cdot m^2/C^2$
D. N/C^2
E. $N \cdot m^2/C$

____19. The electric field of a point charge has an inverse ____ behavior.

A. $r^{1/2}$
B. r
C. r^2
D. r^3
E. $r^{7/2}$

____20. The number of electric field lines passing through a unit cross sectional area is indicative of:

A. field direction.
B. charge density.
C. field strength.
D. charge motion.
E. rate of energy transfer.

____21. Relative distribution of charge density on the surface of a conducting solid depends on:

A. the shape of the conductor.
B. mass density of the conductor.
C. type of metal of which the conductor is made.
D. strength of the earth's gravitational field.
E. ambient temperature.

____22. The electric field at the surface of a positively charged conductor has a direction characterized by which of the following?

A. tangent to the surface
B. perpendicular inward toward the charge
C. at a 45° angle to the surface
D. perpendicular outward and away from the charge
E. zero vector

____23. The electric field associated with a uniformly charged hollow metallic sphere is the greatest at:

A. the center of the sphere.
B. the sphere's inner surface.
C. infinity.
D. the sphere's outer surface.
E. points inside the sphere.

____24. At what point is the charge per unit area greatest on the surface of an irregularly shaped conducting solid?

A. where surface curves inward
B. where surface is flat
C. where curvature is least
D. where curvature is greatest
E. where surface curves outward

____25. If a conductor is in electrostatic equilibrium near an electrical charge:

A. the total charge on the conductor must be zero.
B. the electric field inside the conductor must be zero.
C. any charges on the conductor must be uniformly distributed.
D. the sum of all forces between the conductor and the charge must be zero.
E. the total charge of the system must be zero.

____26. A thin uncharged conducting spherical shell has a charge q carefully placed at its center through a small hole in the shell. The charge q does not touch the shell. What is the charge on the shell?

A. q
B. −q
C. 2q
D. 0
E. −2q

____27. The combination of two separated point charges of opposite sign but equal magnitude is called an electric:

A. monopole.
B. dipole.
C. quadrapole.
D. magnapole.
E. octapole.

____28. The Millikan oil-drop experiment demonstrated that:

A. small oil drops fall slowly through the air.
B. light beams can be used to illuminate small oil droplets.
C. the electronic charge is quantized.
D. falling oil droplets reach terminal speed.
E. electric field can be used to control the falling of small oil drops.

____29. A charge, $+Q$, is placed inside a balloon and the balloon is inflated. As the radius of the balloon r increases the number of field lines going through the surface of the balloon:

A. increases proportional to r^2.
B. increases proportional to r.
C. stays the same.
D. decreases as $1/r$.
E. decreases as $1/r^2$.

ELECTRICAL ENERGY AND CAPACITANCE

____1. The unit of electrical potential, the volt, is dimensionally equivalent to:
A. J·C.
B. J/C.
C. C/J.
D. F·C.
E. J/F.

____2. The quantity of electrical potential, the volt, is dimensionally equivalent to:
A. force/charge.
B. force × charge.
C. electric field × distance.
D. electric field/distance.
E. charge × distance.

____3. A free electron is in an electric field. With respect to the field, it experiences a force acting:
A. parallel.
B. anti-parallel (opposite in direction).
C. perpendicular.
D. along a constant potential line.
E. none of the above is correct in the general case.

____4. In which case does an electric field do positive work on a charged particle?
A. a negative charge moves opposite to the direction of the electric field.
B. a positive charge is moved to a point of higher potential energy.
C. a positive charge completes one circular path around a stationary positive charge.
D. a positive charge completes one elliptical path around a stationary positive charge.
E. a negative charge moves in the direction of the electric field.

____5. If the distance between two negative point charges is increased by a factor of three, the resultant potential energy is what factor times the initial potential energy?
A. 3.0
B. 9.0
C. 1/3
D. 1/9
E. 1

____6. Which of the following characteristics are held in common by both gravitational and electrostatic forces when dealing with either point masses or charges?
A. inverse square distance law applies
B. forces are conservative
C. potential energy is a function of distance of separation
D. charge and mass of isolated systems are conserved
E. all of the above choices are valid

____7. Consider two charged spheres, one with charge +2 C and the other with −2 C. A proton (a positively charged particle) is at the point halfway between the spheres. What is not zero?
A. the potential energy of the proton
B. the work to move the proton from infinity to that point
C. the force on the proton
D. the dipole moment of the proton
E. all of the four above are zero

____8. An electron in a TV picture tube is accelerated through a potential difference of 10 kV before it hits the screen. What is the kinetic energy of the electron in electron volts? (1 eV = 1.6×10^{-19} J)
A. 1.0×10^{4} eV
B. 1.6×10^{-15} eV
C. 1.6×10^{-22} eV
D. 6.25×10^{22} eV
E. 2.5×10^{23} eV

____9. Electrons in an x-ray machine are accelerated from rest through a potential difference of 50 000 V. What is the kinetic energy of each of these electrons in eV?
A. 50 eV
B. 80 eV
C. 330 eV
D. 50 keV
E. 80 keV

____10. At which location will the electric field between the two parallel plates of a charged capacitor be the strongest in magnitude?
A. near the positive plate
B. near the negative plate
C. midway between the two plates at their ends
D. midway between the two plates nearest their center
E. anywhere between the two plates

____11. The unit of capacitance, the farad, is dimensionally equivalent to which of the following?
A. V/C
B. V·C
C. J/V
D. C/V
E. V/J

____12. Increasing the voltage across the two plates of a capacitor will produce what effect on the capacitor?
A. increase charge
B. decrease charge
C. increase capacitance
D. decrease capacitance
E. decrease charge and increase capacitance

____13. A 0.25-μF capacitor is connected to a 400-V battery. Find the charge on the capacitor.
A. 1.2×10^{-12} C
B. 1.0×10^{-4} C
C. 0.040 C
D. 0.020 C
E. 0.010 C

____14. If two parallel, conducting plates have equal positive charge, the electric field lines will:
A. leave one plate and go straight to the other plate.
B. leave both plates and go to infinity.
C. enter both plates from infinity.
D. be parallel to both plates.
E. none of the above.

____15. A 20-μF capacitor is attached across a 1000-V power supply. What is the net charge on the capacitor?
A. 10 mC
B. 20 mC
C. 40 mC
D. 80 mC
E. none of the above

____16. Increasing the separation of the two charged parallel plates of a capacitor, which are disconnected from a battery, will produce what effect on the capacitor?
A. increase charge
B. decrease charge
C. increase capacitance
D. decrease capacitance
E. decrease charge and increase capacitance

____17. If three 4.0-μF capacitors are connected in parallel, what is the combined capacitance?
A. 12 μF
B. 0.75 μF
C. 8.0 μF
D. 0.46 μF
E. 5.5 μF

____18. Inserting a dielectric material between two charged parallel conducting plates, originally separated by air and disconnected from a battery, will produce what effect on the capacitor?
A. increase charge
B. increase voltage
C. increase capacitance
D. decrease capacitance
E. decrease voltage

CURRENT AND RESISTANCE

____1. The current in an electron beam in a cathode-ray tube is measured to be 70 μA. How many electrons hit the screen in 5.0 s? ($e = 1.6 \times 10^{-19}$ C)

A. 2.2×10^{11} electrons
B. 8.8×10^{13} electrons
C. 2.2×10^{15} electrons
D. 8.8×10^{18} electrons
E. 2.2×10^{20} electrons

____2. A wire carries a steady current of 0.1 A over a period of 20 s. What total charge passes through the wire in this time interval?

A. 200 C
B. 20 C
C. 2 C
D. 0.005 C
E. 0.002 C

____3. If the current in a wire is tripled, what effect does this have on the electron drift velocity in the wire?

A. It stays the same.
B. It triples.
C. It decreases by a factor of three.
D. It increases by a factor of nine.
E. It decreases by a factor of nine.

____4. The size of the electric current in an electrical conductor is a function of which of the following?

A. velocity of charge carriers
B. conductor cross sectional area
C. density of charge carriers
D. conductor length
E. All of the above choices are valid.

____5. When an electric current exists within a conducting wire, which of the following statements describes the condition of any accompanying electric field?

A. must be zero
B. must be parallel to current flow
C. must be anti-parallel (opposite direction) to current flow
D. must be perpendicular to current flow
E. None of the above choices is valid.

____6. Materials having resistance changes as voltage or current varies are called:

A. ohmic.
B. inohmic.
C. nonohmic.
D. deohmic.
E. ohmless.

____7. You measure a 25.0-V potential difference across a 5.00-Ω resistor. What is the current flowing through it?

A. 125 A
B. 5.00 A
C. 4.00 A
D. 1.00 A
E. 0.125 A

____8. The unit of electric current, the ampere, is equivalent to which of the following?
A. V·Ω
B. V/Ω
C. Ω·m
D. V/s
E. Ω/V

____9. The unit of electric resistance, the ohm, is equivalent to which of the following?
A. V/A
B. V·m
C. A/s
D. A/m
E. A/V

____10. If a certain resistor obeys Ohm's law, its resistance will change:
A. as the voltage across the resistor changes.
B. as the current through the resistor changes.
C. as the energy given off by the electrons in their collisions changes.
D. as the electric field inside the resistor changes.
E. none of the above, since resistance is a constant for the given resistor.

____11. A 60-W light bulb is in a socket supplied with 120 V. What is the current in the bulb?
A. 0.50 A
B. 2.0 A
C. 60 A
D. 7 200 A
E. 10 000 A

____12. The quantity volt is equivalent to which of the following?
A. J·m
B. J·C
C. C/Ω
D. J/C
E. C/J

____13. The unit for rate of energy transformation, the watt, in an electric circuit is equivalent to which of the following?
A. V/s
B. A·Ω
C. V·A
D. V/Ω
E. A/V

____14. If a 500-W heater carries a current of 4.00 A, what is the voltage across the ends of the heating element?
A. 2 000 V
B. 125 V
C. 250 V
D. 0.008 V
E. 0.125 V

____15. A light bulb has resistance of 240 Ω when operating at 120 V. Find the current in the light bulb.
A. 2.0 A
B. 1.0 A
C. 0.50 A
D. 0.20 A
E. 0.30 A

____16. Which is a unit of power?

A. kWh
B. W/s
C. A·Ω
D. J/s
E. J/kg

____17. Which is not a force?

A. gravity
B. electrical force
C. voltage
D. friction
E. sliding resistance force

____18. A light bulb with a tungsten filament is attached to a source of variable voltage. As the voltage is increased on the bulb,

A. the bulb's resistance decreases.
B. the bulb's resistance increases.
C. the current in the bulb decreases.
D. the power dissipated remains constant.
E. the bulb's resistance remains constant.

DIRECT-CURRENT CIRCUITS

____1. The two ends of a 3.0-Ω resistor are connected to a 9.0-V battery. What is the current through the resistor?
A. 27 A
B. 6.3 A
C. 3.0 A
D. 0.33 A
E. 0.17 A

____2. The two ends of a 3.0-Ω resistor are connected to a 9.0-V battery. What is the total power delivered by the battery to the circuit?
A. 3.0 W
B. 27 W
C. 0.33 W
D. 0.11 W
E. 0.067 W

____3. The basic function of an electromotive force in a circuit is to do which of the following?
A. Convert electrical energy into some other form.
B. Convert some other form of energy into electrical.
C. Both choices (a) and (b) are valid.
D. None of the above choices are valid.

____4. Which voltage is not caused by a source of emf?
A. the voltage across a charged capacitor
B. the voltage across two copper-iron junctions at different temperatures
C. the voltage across the terminals of a dry cell battery
D. the voltage from an electric generator
E. None of the above choices is valid.

____5. Three 8.0-Ω resistors are connected in series. What is their equivalent resistance?
A. 24.0 Ω
B. 8.0 Ω
C. 0.38 Ω
D. 0.13 Ω
E. 0.075 Ω

____6. Three resistors connected in series each carry currents labeled I_1, I_2 and I_3. Which of the following expresses the value of the total current I_T in the system made up of the three resistors in series?
A. $I_T = I_1 + I_2 + I_3$
B. $I_T = (1/I_1 + 1/I_2 + 1/I_3)$
C. $I_T = I_1 = I_2 = I_3$
D. $I_T = (1/I_1 + 1/I_2 + 1/I_3)^{-1}$
E. $I_T = 3I_1 = 3I_2 = 3I_3$

____7. Three resistors connected in series have individual voltages labeled ΔV_1, ΔV_2 and ΔV_3, respectively. Which of the following expresses the value of the total voltage ΔV_T taken over the three resistors together?
A. $\Delta V_T = \Delta V_1 + \Delta V_2 + \Delta V_3$
B. $\Delta V_T = (1/\Delta V_1 + 1/\Delta V_2 + 1/\Delta V_3)$
C. $\Delta V_T = \Delta V_1 = \Delta V_2 = \Delta V_3$
D. $\Delta V_T = (1/\Delta V_1 + 1/\Delta V_2 + 1/\Delta V_3)^{-1}$
E. $\Delta V_T = 3\Delta V_1 = 3\Delta V_2 = 3\Delta V_3$

____8. Three resistors with values of R_1, R_2 and R_3, respectively, are connected in series. Which of the following expresses the total resistance, R_T, of the three resistors?

A. $R_T = R_1 + R_2 + R_3$
B. $R_T = (1/R_1 + 1/R_2 + 1/R_3)$
C. $R_T = R_1 = R_2 = R_3$
D. $R_T = (1/R_1 + 1/R_2 + 1/R_3)^{-1}$
E. $R_T = 3R_1 = 3R_2 = 3R_3$

____9. Three resistors, with values of 2.0, 4.0 and 8.0 Ω, respectively, are connected in series. What is the overall resistance of this combination?

A. 0.58 Ω
B. 1.1 Ω
C. 7.0 Ω
D. 14.0 Ω
E. 19.0 Ω

____10. Three resistors, each with resistance R_1, are in series in a circuit. They are replaced by one equivalent resistor, R. Comparing this resistor to the first resistor of the initial circuit, which of the following is true?

A. The current through R equals the current through R_1.
B. The voltage across R equals the voltage across R_1.
C. The power given off by R equals the power given off by R_1.
D. R is less than R_1.
E. R is equal to R_1.

____11. When a light bulb is turned on, its resistance increases until it reaches operating temperature. What happens to the current in the bulb as it is warming up?

A. It stays constant.
B. It increases.
C. It decreases.
D. It increases at first and then decreases.
E. It decreases at first and then increases.

____12. Three resistors connected in parallel each carry currents labeled I_1, I_2 and I_3. Which of the following expresses the value of the total current I_T in the combined system?

A. $I_T = I_1 + I_2 + I_3$
B. $I_T = (1/I_1 + 1/I_2 + 1/I_3)$
C. $I_T = I_1 = I_2 = I_3$
D. $I_T = (1/I_1 + 1/I_2 + 1/I_3)^{-1}$
E. $I_T = 3I_1 = 3I_2 = 3I_3$

____13. Three resistors connected in parallel have the individual voltages labeled ΔV_1, ΔV_2 and ΔV_3, respectively. Which of the following expresses the total voltage ΔV_T across the three resistors when connected in this manner?

A. $\Delta V_T = \Delta V_1 + \Delta V_2 + \Delta V_3$
B. $\Delta V_T = (1/\Delta V_1 + 1/\Delta V_2 + 1/\Delta V_3)$
C. $\Delta V_T = \Delta V_1 = \Delta V_2 = \Delta V_3$
D. $\Delta V_T = (1/\Delta V_1 + 1/\Delta V_2 + 1/\Delta V_3)^{-1}$
E. $\Delta V_T = 3\Delta V_1 = 3\Delta V_2 = 3\Delta V_3$

____14. Three resistors with values R_1, R_2 and R_3, respectively, are connected in parallel. Which of the following expresses the total resistance, R_T, of the three resistors when connected in parallel?

A. $R_T = R_1 + R_2 + R_3$
B. $R_T = (1/R_1 + 1/R_2 + 1/R_3)$
C. $R_T = R_1 = R_2 = R_3$
D. $R_T = (1/R_1 + 1/R_2 + 1/R_3)^{-1}$
E. $R_T = 3R_1 = 3R_2 = 3R_3$

____15. Three resistors, each with resistance R_1, are in parallel in a circuit. They are replaced by one equivalent resistor, R. Compare this resistor to the first resistor of the initial circuit. Which of the following statements is true?
A. The current through R equals the current through R_1.
B. The voltage across R equals the voltage across R_1.
C. The power given off by R equals the power given off by R_1.
D. R is greater than R_1.
E. R is less than R_1.

____16. If $R_1 < R_2 < R_3$, and if these resistors are connected in parallel in a circuit, which one has the highest current?
A. R_1
B. R_2
C. R_3
D. All have the same current.
E. The answer depends on the internal resistance of the battery.

____17. Household circuits are wired in ____.
A. series
B. parallel
C. both series and parallel
D. neither series nor parallel

____18. In applications where electrical shocks may be more likely, such as around water in kitchens and bathrooms, special outlets called GFI's are used. What does GFI stand for?
A. get free instantly
B. ground-fault interrupter
C. give fast interruption
D. gravity-free insulator
E. guided fault isolation

____19. Household 120-V outlets are made to accept three-pronged plugs. One of the prongs attaches to the "live" wire at 120 V, and another attaches to the "neutral" wire that is connected to ground. What is the round third prong for?
A. It serves as a backup to the hot wire.
B. It lets the appliance run if the neutral wire breaks.
C. It connects the case of the appliance directly to ground for safety purposes.
D. It serves for direct current feed.
E. Nothing electrical, it is for mechanical sturdiness.

MAGNETISM

____1. Electrical charges and magnetic poles have many similarities, but one difference is:
A. opposite magnetic poles repel.
B. one magnetic pole cannot create magnetic poles in other materials.
C. a magnetic pole cannot be isolated.
D. magnetic poles do not produce magnetic fields.
E. magnetic poles produce only alternating fields.

____2. Which of the following is <u>not</u> a *hard* magnetic material?
A. iron
B. cobalt
C. nickel
D. neodymium
E. both b and c

____3. Geophysicists today generally attribute the existence of the Earth's magnetic field to which of the following?
A. convection currents within the liquid interior
B. iron ore deposits in the crust
C. nickel-iron deposits in the crust
D. solar flares
E. iron-cobalt deposits in the crust

____4. The term magnetic declination refers to which of the following?
A. angle between Earth's magnetic field and Earth's surface
B. Earth's magnetic field strength at the equator
C. tendency for Earth's field to reverse itself
D. angle between directions to true north and magnetic north
E. angle between Earth's magnetic field and Earth's rotational axis

____5. The magnetic field of the Earth is believed responsible for which of the following?
A. deflection of both charged and uncharged cosmic rays
B. deflection of charged cosmic rays
C. ozone in the upper atmosphere
D. solar flares
E. deflection of uncharged cosmic rays

____6. The magnetic pole of the Earth nearest the geographic North Pole corresponds to which of the following?
A. a magnetic north pole
B. a magnetic south pole
C. a magnetic arctic pole
D. a magnetic antarctic pole

____7. The force on a charged particle created by its motion in a magnetic field is maximum at what angle between the particle velocity and field?
A. zero
B. 180°
C. 90°
D. 45°
E. 135°

____8. Assume that a uniform magnetic field is directed into this page. If an electron is released with an initial velocity directed from the bottom edge to the top edge of the page, which of the following describes the direction of the resultant force acting on the electron?

A. out of the page
B. to the right
C. to the left
D. into the page
E. from top edge to bottom edge of the page

____9. A proton moves across the Earth's equator in a northeasterly direction. At this point the Earth's magnetic field has a direction 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. toward the southwest

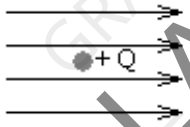
____10. Different units can be used to measure the same physical quantity, differing only by some multiplicative factor. The cgs unit for magnetic field, the gauss, is equal to ____ tesla.

A. 10^4
B. 10^{-4}
C. 0.5
D. 4π
E. These units do not measure the same physical quantity.

____11. If a proton is released at the equator and falls toward the Earth under the influence of gravity, the magnetic force on the proton will be toward the:

A. north.
B. south.
C. east.
D. west.

____12. A stationary positive charge $+Q$ is located in a magnetic field B, which is directed toward the right as indicated. The direction of the magnetic force on Q is:



A. toward the right.
B. up.
C. down.
D. toward the left.
E. There is no magnetic force.

____13. There is a magnetic force on a particle. It is possible that the particle is:

A. uncharged.
B. stationary.
C. moving in the direction of the magnetic field.

____14. Which of the following devices makes use of an electromagnet?

A. loudspeaker
B. galvanometer
C. gyrocompass
D. both A and B
E. none of the above

____15. The direction of the force on a current carrying wire located in an external magnetic field is which of the following?

A. perpendicular to the current
B. perpendicular to the field
C. parallel to the wire
D. Both choices A and B are valid.
E. None of the above are valid.

____16. A circular current loop is placed in an external magnetic field. How is the torque related to the radius of the loop?

A. directly proportional to radius
B. inversely proportional to radius
C. directly proportional to radius squared
D. inversely proportional to radius squared
E. directly proportional to square root of radius

____17. Magnetism had been a known phenomenon for some time before its relation to electric currents was found. That a current in a wire produces a magnetic field was discovered by:

A. Maxwell.
B. Ampere.
C. Oersted.
D. Tesla.
E. Faraday.

____18. A current in a long, straight wire produces a magnetic field. The magnetic field lines:

A. go out from the wire to infinity.
B. come in from infinity to the wire.
C. form circles that pass through the wire.
D. form circles that go around the wire.
E. are parallel to the wire.

____19. Two parallel wires are separated by 0.25 m. Wire A carries 5.0 A and Wire B carries 10 A, both currents in the same direction. The force on 0.80 m of Wire A is:

A. half that on 0.80 m of wire B.
B. one-fourth that on 0.80 m of wire B.
C. toward Wire B.
D. away from Wire B.
E. one-eighth that on 0.80 m of wire B.

____20. A current in a solenoid coil creates a magnetic field inside that coil. The field strength is directly proportional to:

A. the solenoid area.
B. the current.
C. the solenoid diameter.
D. Both A and B are valid choices.
E. None of the above choices are valid.

____21. A current in a coil with *N* turns creates a magnetic field at the center of that loop. The field strength is directly proportional to:

A. number of turns in the loop.
B. current strength.
C. length of the coil.
D. Both choices A and B are valid.
E. None of the above are valid.

____22. The magnetic domains in a non-magnetized piece of iron are characterized by which orientation?

A. parallel to the magnetic axis
B. anti-parallel (opposite direction) to the magnetic axis
C. random
D. perpendicular to the magnetic axis
E. any of the above is possible.

____23. When an electromagnet has an iron core inserted, what happens to the strength of the magnet?

A. It increases.
B. It remains the same.
C. It decreases.
D. Since it depends on the metal used in the wires of the electromagnet, any of the above.

INDUCED VOLTAGES AND INDUCTANCE

____1. A uniform 4.5-T magnetic field passes perpendicularly through the plane of a wire loop 0.10 m^2 in area. What flux passes through the loop?
A. 5.0 $T \cdot m^2$
B. 0.45 $T \cdot m^2$
C. 0.25 $T \cdot m^2$
D. 0.135 $T \cdot m^2$
E. 0.15 $T \cdot m^2$

____2. The units $T \cdot m^2/s$ are equivalent to:
A. W.
B. V.
C. N/m.
D. webers.
E. F

____3. A sensitive ammeter is connected to a wire loop and placed within the magnetic field of a strong horseshoe magnet. The ammeter shows a deflection when:
A. the wire is moved parallel to the field.
B. the wire is moved perpendicularly to the field.
C. neither wire nor magnet is moving.
D. the wire's axis is parallel to the field.
E. the wire's axis is perpendicular to the field.

____4. According to Lenz's law the direction of an induced current in a conductor will be that which tends to produce which of the following effects?
A. enhance the effect which produces it
B. produce a greater heating effect
C. produce the greatest voltage
D. oppose the effect which produces it
E. produce the greatest magnetic field

____5. "GFI" stands for:
A. grand flux indicator.
B. ground forcing indicator.
C. ground fault interrupter.
D. gauss-free invention.
E. guided fault isolation.

____6. The principle or law that says "an induced emf in a circuit loop produces a current whose magnetic field opposes further change of magnetic flux" is credited to:
A. Faraday.
B. Lenz.
C. Ampere.
D. Volta.
E. Maxwell.

____7. A coil is placed in a changing magnetic field and an emf is induced. What happens to the induced emf if the rate of change of magnetic field quadruples?
A. There is no change.
B. The emf doubles.
C. The emf quadruples.
D. The emf increases by a factor of 16.
E. The emf halves.

____8. The magnet moving past an object will produce eddy currents in the object if the object:
A. is magnetic material only.
B. is a conductor.
C. is an insulator.
D. is a liquid.
E. is a paramagnetic material only..

____9. The operation of a tape player to play music depends on which of the following?
A. the Doppler effect
B. the Meissner effect
C. the photoelectric effect
D. the force acting on a current-carrying wire in a magnetic field
E. induced current from the motion of a magnet past a wire

____10. If the induced current in a wire loop were such that the flux it produces were in the same direction as the change in external flux causing the current, which of the following conservation laws would end up being violated?
A. momentum
B. charge
C. energy
D. angular momentum
E. mass

____11. The operation of an electric motor depends on which of the following effects?
A. the Doppler effect
B. the Meissner effect
C. the photoelectric effect
D. the force acting on a current-carrying wire in a magnetic field
E. current from the motion of a wire in a magnetic field

____12. The basic function of the electric generator is which of the following conversion processes?
A. mechanical energy to electrical
B. electrical energy to mechanical
C. low voltage to high or vice versa
D. alternating current to direct
E. direct current to alternating

____13. The function of the electric motor is which one of the following conversion processes?
A. mechanical energy to electrical
B. electrical energy to mechanical
C. low voltage to high or vice versa
D. alternating current to direct
E. direct current to alternating

____14. The back emf in an electric motor is its maximum value under which condition?
A. motor speed is zero
B. current is a maximum
C. voltage is a maximum
D. motor speed is a maximum
E. minimal heating effect

____15. Electricity may be generated by rotating a loop of wire between the poles of a magnet. The induced current is greatest when:
A. the plane of the loop is parallel to the magnetic field.
B. the plane of the loop is perpendicular to the magnetic field.
C. the magnetic flux through the loop is a maximum.
D. the plane of the loop makes an angle of 45° with the magnetic field.
E. the plane of the loop makes an angle of 60° with the magnetic field.

____16. The "back emf" of a motor refers to a source of voltage that:
A. occurs when the motor runs backwards.
B. occurs when the motor is used as a generator.
C. is biggest when the current through the motor is biggest.
D. is biggest when the motor turns fastest.
E. is biggest when the motor is accelerating.

____17. When a voltage is generated by rotating a coil in a magnetic field at a constant rate, the period of the voltage equals the time that it takes for the coil to rotate through ____ radians.
A. 1
B. $\pi/2$
C. π
D. 2π
E. $\pi/4$

____18. The self-inductance of a solenoid increases under which of the following conditions?
A. only the solenoid length is increased
B. only the cross sectional area is decreased
C. only the number of coils per unit length is decreased
D. only the number of coils is increased
E. only the solenoid length is decreased

____19. By what factor is the self-inductance of an air solenoid changed if only its cross-sectional area, *A*, is tripled?
A. 1/3
B. 3
C. 6
D. 9
E. 1/9

____20. An inductor, battery, resistance, and ammeter and switch are connected in series. If the switch, initially open, is now closed, what is the current's final value?
A. zero
B. battery voltage divided by inductance
C. battery voltage times inductance
D. battery voltage divided by resistance
E. resistance times inductance

____21. In a circuit made up of inductor, resistance, ammeter, battery and switch in series, at which of the following times after the switch is closed is the rate of current increase greatest?

A. zero
B. one time constant
C. reciprocal of one time constant
D. ten time constants
E. infinity

____22. How is the energy stored in a current-carrying inductor related to its self-inductance, L?

A. directly proportional to L^2
B. directly proportional to $L^{1/2}$
C. directly proportional to L
D. inversely proportional to L
E. inversely proportional to L^2

____23. How is the energy stored in a current-carrying inductor related to the current value, I?

A. directly proportional to I^2
B. directly proportional to $I^{1/2}$
C. directly proportional to I
D. inversely proportional to I
E. inversely proportional to I^2

ANSWERS TO MULTIPLE CHOICE QUESTIONS

	Charge, Force, Fields	Potential Energy, Capacitance	Current, Resistance	DC Circuits	Magnetism	Induction	
1	B	B	C	C	C	B	1
2	B	C	C	B	A	B	2
3	A	B	B	B	A	B	3
4	B	A	E	A	D	D	4
5	C	C	B	A	B	C	5
6	B	E	C	C	B	B	6
7	B	C	B	A	C	C	7
8	C	A	B	A	B	B	8
9	A	D	A	D	B	E	9
10	C	D	E	A	B	C	10
11	B	D	A	C	C	D	11
12	C	D	D	A	E	A	12
13	D	B	C	C	D	B	13
14	D	B	B	D	D	D	14
15	A	D	C	B	D	A	15
16	C	D	D	A	C	D	16
17	D	A	C	B	C	D	17
18	B	C	B	B	D	D	18
19	C			C	C	B	19
20	C				B	D	20
21	A				D	A	21
22	D				C	C	22
23	D				A	A	23
24	D						24
25	B						25
26	D						26
27	B						27
28	C						28
29	C						29


GRACE