PHYSICS 121 FINAL

1. Current is a measure of:

A) force that moves a charge past a point
B) resistance to the movement of a charge past a point
C) energy used to move a charge past a point
D) amount of charge that moves past a point per unit time
E) speed with which a charge moves past a point

2. The current is zero in a conductor when no potential difference is applied because:

A) the electrons are not moving
B) the electrons are not moving fast enough
C) for every electron with a given velocity there is another with a velocity of equal magnitude and opposite direction.
D) equal numbers of electrons and protons are moving together
E) otherwise Ohm's law would not be valid

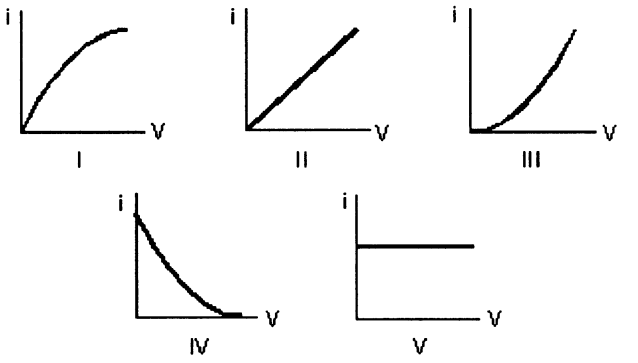
3. If the potential difference across a resistor is doubled:

A) only the current is doubled
B) only the current is halved
C) only the resistance is doubled
D) only the resistance is halved
E) both the current and resistance are doubled

4. A current of 0.5 ampere exists in a 60-ohm lamp. The applied potential difference is:

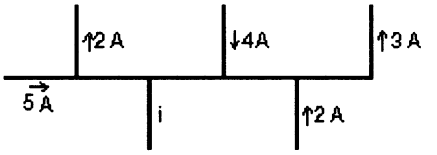
A) 15 V
B) 30 V
C) none of these
D) 120 V
E) 60 V

5. Which of the following graphs best represents the current-voltage relationship for a device that obey Ohm's law?



A) II
B) V
C) IV
D) I
E) III

6. A portion of a circuit is shown, with the values of the currents given for some branches. What is the direction and value of the current i?



A) â, 6A
B) á, 4A
C) â, 2A
D) á, 6A
E) â, 4A

7. Four 20-Ω resistors are connected in parallel and the combination is connected to a 20-V emf device. The current in the device is:

A) 0.25 A
B) 1.0 A
C) 4.0 A
D) 5.0 A
E) 100 A

8. A battery with an emf of 12 V and an internal resistance of 1 Ω is used to charge a battery with an emf of 10 V and an internal resistance of 1 Ω. The current in the circuit is:

A) 1 A
B) 2 A
C) 4 A
D) 11 A
E) 22 A

9. A 120-V power line is protected by a 15-A fuse. What is the maximum number of "120 V, 500 W" light bulbs that can be operated at full brightness from this line?

A) 1
B) 2
C) 3
D) 4
E) 5

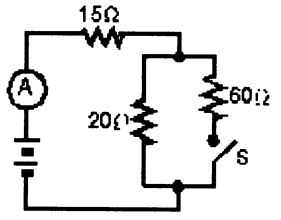
10. A 2-Ω resistor and a 4-Ω resistor are connected in parallel to a 6-V battery. The rate of energy dissipated by the 2-Ω resistor is:

A) 18 W
B) 9 W
C) 8 W
D) none of these
E) 6 W

11. A series circuit consists of a battery with internal resistance r and an external resistor R. If these two resistances are equal
(r = R) then the energy dissipated per unit time by the internal resistance r is:

A) the same as by R
B) half that by R
C) twice that by R
D) one third that by R
E) unknown unless the emf is given

12. When switch S is open, the ammeter in the circuit shown reads 2.0 A. When S is closed, the ammeter reading will:



A) increase slightly
B) remain the same
C) decrease slightly
D) double
E) halve

13. Resistor 1 has twice the resistance of resistor 2. They are connected in parallel to a battery. The ratio of the energy dissipation by 1 to that by 2 is:

A) 1:4
B) 1:2
C) 1:1
D) 2:1
E) 4:1

14. In an antique automobile, a 6-V battery supplies a total of 48 W to two identical headlights in parallel. The resistance (in ohms) of each bulb is:

A) 0.67
B) 1.5
C) 3
D) 4
E) 8

15. A coulomb is the same as:

A) ampere/second
B) (1/2)ampere ·second^2
C) ampere/meter^2
D) ampere ·second
E) newton ·meter^2

16. A wire contains a steady current of 2 A. The number of electrons that pass a cross section in 2 s is:

A) 2
B) 4
C) 6.3×10^{18}
D) 1.3×10^{19}
E) 2.5×10^{19}

17. Electric field lines:

A) are trajectories of a test charge
B) form closed loops
C) cross each other in the region between two point charges
D) are vectors in the direction of the electric field
E) are none of the above

18. A point charge is placed in an electric field that varies with location. No force is exerted on this charge:

A) at locations where the electric field is zero
B) at locations where the electric field strength is $1/(1.6\text{x}10^{-19})$ N/C
C) if the charge is moving along a field line
D) if the charge is moving perpendicular to a field line
E) if the field is caused by an equal amount of positive and negative charge

19. A 200-N/C electric field is in the positive x direction. The force on an electron in this field is:

A) $2.9\text{x}10^{13}$ m/s^2, in the positive x direction
B) $2.9\text{x}10^{13}$ m/s^2, in the negative x direction
C) $3.2\text{x}10^{-17}$ m/s^2, in the positive x direction
D) $3.2\text{x}10^{-17}$ m/s^2, in the negative x direction
E) 0

20. A total charge of $6.3\text{x}10^{-8}$ C is distributed uniformly throughout a 2.7-cm radius sphere. The volume charge density is:

A) $3.7\text{x}10^{-7}$ C/m^3
B) $6.9\text{x}10^{-6}$ C/m^3
C) $6.9\text{x}10^{-6}$ C/m^2
D) $2.5\text{x}10^{-4}$ C/m^3
E) $7.6\text{x}10^{-4}$ C/m^3

21. A cylinder has a radius of 2.1 cm and a length of 8.8 cm. Total charge $6.1\text{x}10^{-7}$ C is distributed uniformly throughout. The volume charge density is:

A) $5.3\text{x}10^{-5}$ C/m^3
B) $5.3\text{x}10^{-5}$ C/m^2
C) $8.5\text{x}10^{-4}$ C/m^3
D) $5.0\text{x}10^{-3}$ C/m^3
E) $6.3\text{x}10^{-2}$ C/m^3

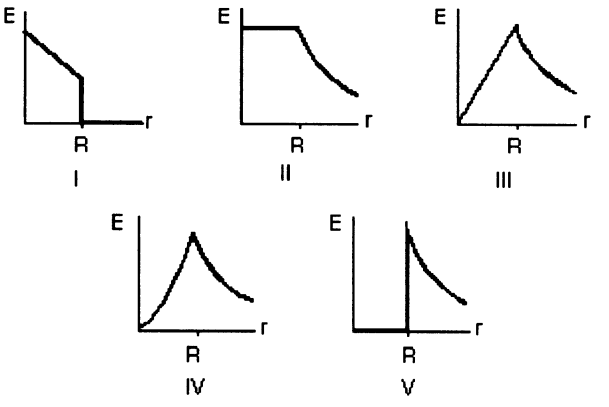
22. The flux of the electric field ($24\hat{\mathbf{i}} + 30\mathbf{C} + 16\mathbf{B}$) N/C through a 2.0 m^2 portion of the yz plane is:

A) 32 N $\cdot m^2/C$
B) 34 N $\cdot m^2/C$
C) 42 N $\cdot m^2/C$
D) 48 N $\cdot m^2/C$
E) 60 N $\cdot m^2/C$

23. A conducting sphere of radius 0.01 m has a charge of 1.0×10^{-9} C deposited on it. The magnitude of the electric field in N/C just outside the surface of the sphere is:

A) zero
B) 450
C) 900
D) 4500
E) 90,000

24. A solid insulating sphere of radius R contains a uniform volume distribution of positive charge. Which of the graphs below correctly gives the magnitude E of the electric field as a function of r?



A) I.
B) II.
C) III.
D) IV.
E) V.

25. If 500 J of work are required to carry a 40 C charge from one point to another, the potential difference between these two points is:

A) 12.5 V
B) none of these
C) 20,000 V
D) 0.08 V
E) depends on the path

26. A 5-cm radius conducting sphere is charged until the electric field just outside its surface is 2000 V/m. The electric potential of the sphere, relative to the potential far away, is:

A) 0
B) 5 V
C) 100 V
D) 4×10^4 V
E) 8×10^5 V

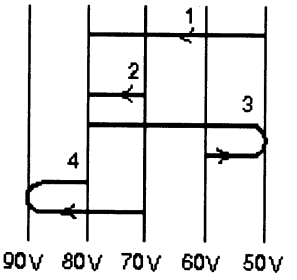
27. A metal sphere carries a charge of 5×10^{-9} C and is at a potential of 400 V, relative to the potential far away. The potential at the center of the sphere is:

A) 2×10^{-6} V
B) none of these
C) -400 V
D) 400 V
E) 0

28. If the electric field is in the positive x direction and has a magnitude given by $E = Cx$, where C is a constant, then the electric potential is given by V =:

A) C
B) -C
C) Cx
D) $(1/2)Cx^2$
E) $-(1/2)Cx^2$

29. An electron goes from one equipotential surface to another along one of the four paths shown below. Rank the paths according to the work done by the electric field, from least to greatest.



A) 1, 3, 4 and 2 tie
B) 1, 2, 3, 4
C) 4, 3, 1, 2
D) 4 and 2 tie, then 3, then 1
E) 4, 3, 2, 1

30. A parallel-plate capacitor has a plate area of 0.2 m^2 and a plate separation of 0.1 mm. If the charge on each plate has a magnitude of $4x10^{-6}$ C the potential difference across the plates is approximately:

A) 0
B) $4x10^{-2}$ V
C) $1x10^{2}$ V
D) $2x10^{2}$ V
E) $4x10^{8}$ V

31. Two identical capacitors are connected in series and two, each identical to the first, are connected in parallel. The equivalent capacitance of the series connection is _____ the equivalent capacitance of parallel connection.

A) twice
B) four times
C) half
D) one fourth
E) the same as

32. A 20-F capacitor is charged to 200 V. Its stored energy is:

A) 4000 J
B) 4 J
C) 0.4 J
D) 2000 J
E) 0.1 J

33. 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

34. 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

35. An electron travels due north through a vacuum in a region of uniform magnetic field **B** that is also directed due north. It will:

A) be unaffected by the field
B) speed up
C) slow down
D) follow a right-handed corkscrew path
E) follow a left-handed corkscrew path

36. A proton is in a region where a uniform electric field of $5x10^4$ V/m is perpendicular to a uniform magnetic field of 0.8 T. If its acceleration is zero then its speed must be:

A) 0
B) $1.6x10^4$ m/s
C) $4.0x10^5$ m/s
D) $6.3x10^5$ m/s
E) any value but 0

37. Two long parallel straight wires carry equal currents in opposite directions. At a point midway between the wires, the magnetic field they produce is:

A) non-zero and parallel to the wires
B) non-zero and along a line connecting the wires
C) zero
D) non-zero and perpendicular to the plane of the two wires
E) none of the above

38. Two parallel long wires carry the same current and repel each other with a force F per unit length. If both these currents are doubled and the wire separation tripled, the force per unit length becomes:

A) 2F/9
B) 4F/9
C) 2F/3
D) 4F/3
E) 6F

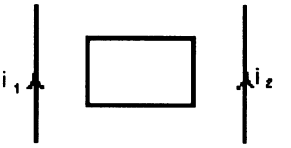
39. The units of motional emf are:

A) volt/second
B) volt ·meter/second
C) volt/tesla
D) tesla/second
E) tesla ·meter^2/second

40. At any instant of time the total magnetic flux through a stationary conducting loop is less in magnitude than the flux associated with an externally applied field. This might occur because:

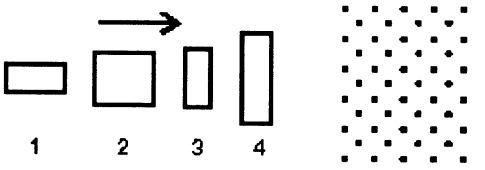
A) the applied field is normal to the loop and increasing in magnitude
B) the applied field is normal to the loop and decreasing in magnitude
C) the applied field is parallel to the plane of the loop and increasing in magnitude
D) the applied field is parallel to the plane of the loop and decreasing in magnitude
E) the applied field is tangent to the loop

41. A rectangular loop of wire is placed midway between two long straight parallel conductors as shown. The conductors carry currents i_1 and i_2 as indicated. If i_1 is increasing and i_2 is constant, then the induced current in the loop is:



A) zero
B) clockwise
C) counterclockwise
D) depends on $i_1 - i_2$
E) depends on $i_1 + i_2$

42. The four wire loops shown have edge lengths of either L, 2L, or 3L. They will move with the same speed into a region of uniform magnetic field B, directed out of the page. Rank them according to the maximum magnitude of the induced emf, least to greatest.



A) 3 and 4 tie, then 1 and 2 tie
B) 4, 2, 3, 1
C) 1 and 2 tie, then 3 and 4 tie
D) 1, 2, 3, 4
E) 4, 2 and 3 tie, then 1

43. The impedance of an RLC series circuit is definitely increased if:

A) C decreases
B) L increases
C) L decreases
D) R increases
E) R decreases

44. An RLC series circuit, connected to a source E, is at resonance. Then:

A) the voltage across R is zero
B) the voltage across R equals the applied voltage
C) the voltage across C is zero
D) the voltage across L equals the applied voltage
E) the applied voltage and current differ in phase by 90°

45. Iron, rather than copper, is used in the core of transformers because:

A) iron can withstand a higher temperature
B) iron has a greater resistivity
C) iron has a very high permeability
D) iron makes a good permanent magnet
E) iron insulates the primary from the secondary

46. The primary of an ideal transformer has 100 turns and the secondary has 600 turns. Then:

A) the power in the primary circuit is less than that in the secondary circuit
B) the currents in the two circuits are the same
C) the voltages in the two circuits are the same
D) the primary current is six times the secondary current
E) the frequency in the secondary circuit is six times that in the primary circuit

47. In an ideal 1:8 step-down transformer, the primary power is 10 kW and the secondary current is 25 A. The primary voltage is:

A) 25,600 V
B) 3200 V
C) 400 V
D) 50 V
E) 6.25 V

Answer Key

1. D
2. C
3. A
4. B
5. A
6. A
7. C
8. A
9. C
10. A
11. A
12. A
13. B
14. B
15. D
16. E
17. E
18. A
19. B
20. E
21. D
22. D
23. C
24. C
25. A
26. C
27. D
28. E
29. D
30. D
31. D
32. C
33. C
34. C
35. A
36. D
37. D
38. D
39. E
40. A
41. C
42. E
43. D
44. B
45. C
46. D
47. B