Shock Value
JC Booth Invitational, 1/22/11

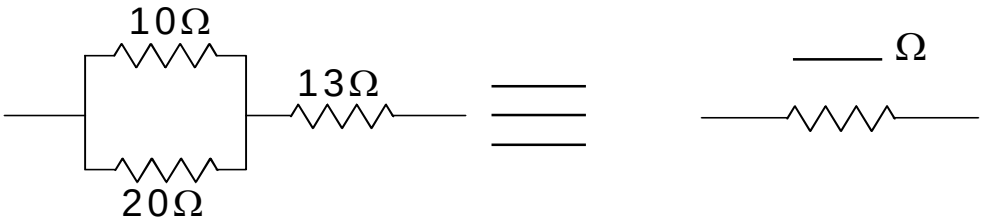
Team Name: _____ Score: _____

Team Members: _____

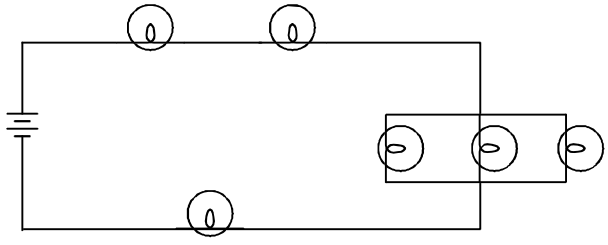
1) Please give the schematic symbol for each item listed below

Resistor	Variable resistor	Capacitor	Battery
Switch	Ammeter	Push button	Coil

2) What is the equivalent resistance of the circuit below?



3) The six bulbs below are identical. Circle the three that will burn brightest.



4) A battery converts _____ energy into _____ energy.

5) A motor converts _____ energy into _____ energy.

6) A generator converts _____ energy into _____ energy.

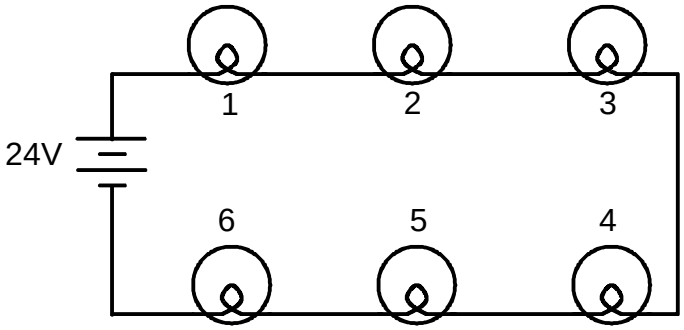
7) In a circuit, resistance is measured with what device? _____

8) In a circuit, current is measured with what device? _____

9) In a circuit, voltage is measured with what device? _____

10) You are given 6 identical lightbulbs and a power supply. Draw a schematic showing how you would connect the bulbs so that three burn very brightly, one less bright, and two even less bright.

11) The short string of Christmas lights below is made up of three different types of bulbs. If bulbs 1 and 4 each have X resistance, bulbs 2 and 5 each have 2X resistance, and bulbs 3 and 6 each have 3X resistance, what is the voltage drop across each bulb?

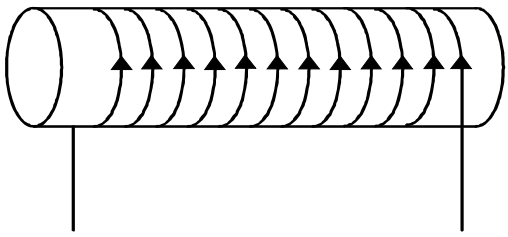


V1= _____ V4= _____
V2= _____ V5= _____
V3= _____ V6= _____

12) In the circuit above, if 0.78A is flowing through each bulb, what power is being dissipated in the circuit?

_____

13) A coil of wire is wrapped around a metal bar as shown below. Conventional current flow is in the direction of the arrows. Please label which end of the bar will be a north pole and which end will be a south pole.



14) What are the commonly used units for ... (Please spell out, i.e., no symbols)

a. Current _____
b. Voltage _____
c. Resistance _____
e. Power _____
f. Magnetic field strength _____

15) What are three elements capable of being permanently magnetized? _____

_____

16) Name three materials that can be used for battery electrodes. _____

_____

17) List two ways to magnetize a permanent magnet. _____

_____

18) List two ways to de-magnetize a permanent magnet. _____

_____

19) Conventional current flow in a long wire is shown below by the arrow. Please draw the resultant magnetic field.

20) The magnetic field strength of a solenoid is a function of its permeability, _____ and _____ .

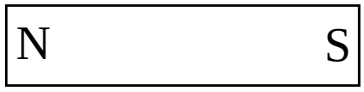
21) What is a dry cell? _____

_____

22) What is a wet cell? _____

_____

23) Please draw several magnetic field lines for the bar magnet below.



24) The strongest permanent magnetic material is (circle one):
   a. AlNiCo
   b. Fe
   c. NdFeB
   d. SmCo

25) The insulator between two plates of a capacitor is called (circle one)
   a. Electrolyte
   b. Dielectric
   c. Insulator
   d. Spacer

25) What is the unit of capacitance? _____

26) What is the unit of inductance? _____

27) The unit of electrical charge is the Coulomb. What is the charge of a proton? _____

28) The unit of electrical charge is the Coulomb. What is the charge of an electron? _____

29) The capacitance between two plates is proportional to the relative permeability of the material between the plates and the _____ and inversely proportional to the _____

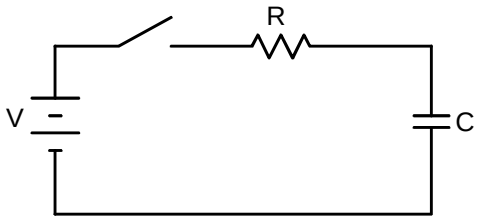
30) The anode of the battery is the (circle one)
- a. Current carrying medium
- b. Electrolyte
- c. Negative electrode
- d. Positive electrode

31) Electric current that flows from negative to positive is called (circle one)
- a. Conventional current flow
- b. Electron current flow
- c. Energy flow
- d. Ionic current flow

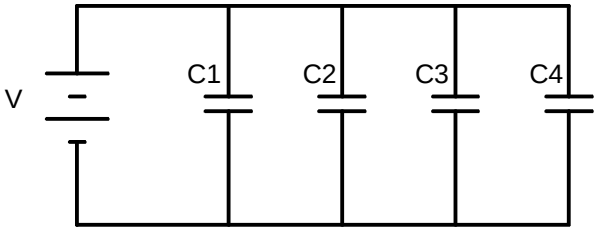
32) The cathode of the battery is the (circle one)
- a. Current carrying medium
- b. Electrolyte
- c. Negative electrode
- d. Positive electrode

33) Electricity can be considered (circle one)
- a. Charged particles
- b. Dipoles
- c. Electrodes
- d. Magnetic charges

34) In the circuit below, V = 12VDC, R = 200Ω, and C = 12μF. If the switch closes at time t = 0, how long will it be before the capacitor is fully charged? _____



35) In the circuit below, V = 24VDC, C1 = C2 = 10μF, and C3 = C4 = 20μF. The four capacitors can be replaced with one that has a value of _____



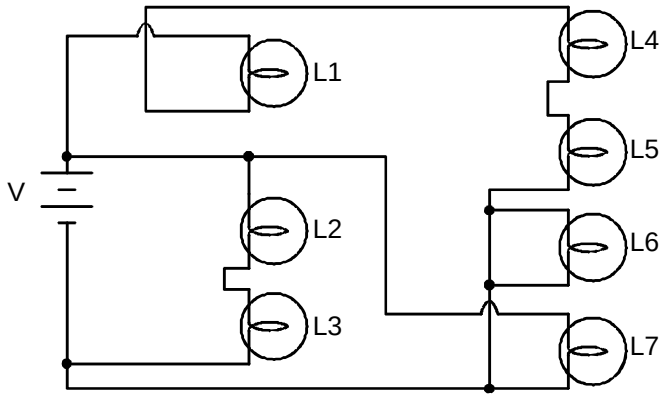
36) The small groups of atoms that behave like small magnets inside a large magnet are called (circle one)
- a. Iron filings
- b. Domains
- c. Poles

37) An LR circuit has a resistor value of 1.5kΩ. If the time constant is 0.243mS, what is the inductance value?

38) What is the capacitance if a capacitor uses a dielectric with k = 1.324, an area of 12mm^2, and plates separated by a distance of 0.02mm? _____

39) A step up transformer has a ratio of 1:10. If 100Watts of power goes into the primary coil, the power coming from the secondary coil is approximately (circle one)
- a. 1W
- b. 100W
- c. 1000W
- d. 10W

Use the circuit below for questions 40 - 47



40) Which bulb(s) will be the brightest? _____

41) Which bulb(s) will be the darkest? _____

42) Which bulbs comprise the longest series current path? _____

43) Which bulb(s) will draw the most current from the source? _____

44) Which bulb(s) will draw the least current from the source? _____

45) If bulb L1 burns out, what bulb(s) would stop working? _____

46 If bulb L2 were to short, what bulb(s) would stop working? _____

47) If 1A flows through bulb L2, how much current flows through bulb L3? _____

48) A piece of iron has a resistivity of 9.71×10^{-8} ohm-meters. If its length is 1.2m and has a cross sectional area of $65 cm^2$, what is its resistance? _____

49) What is the electric force on two positive charges separated by a distance of 0.5mm? _____

_____

50) An inductor is 1.3cm long and has 350 coils wrapped around it. The current flowing through it is measured at 0.28A. What is the magnetic field? _____

51) Two wires sometimes touch, creating an unsafe path for current. This is called a (circle one)
- a. Short circuit
- b. Open circuit
- c. Parallel circuit
- d. Electric circuit

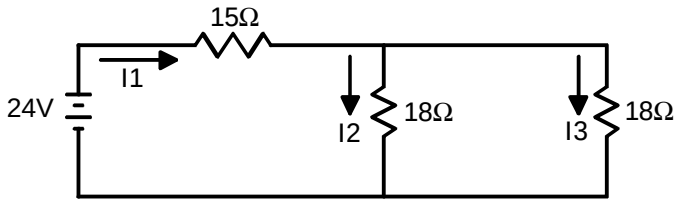
52) Conventional current (circle one)
- a. Flows from plus to minus
- b. Flows from minus to plus
- c. Cannot flow in an ionized gas
- d. Is measured in amps per second

53) The person credited with discovering that electricity can be produced from magnetism was (circle one)
- a. Hans Oersted
- b. Albert Einstein
- c. Benjamin Franklin
- d. Michael Faraday

54) What is the voltage across the resistor if a current of 0.5A flows through a 20Ω resistor? (circle one)
- a. 4V
- b. 10V
- c. 0.25V
- d. 8V

55) What is the current flowing through a 24Ω resistor connected across 240V? (circle one)
- a. 25kA
- b. 0.1A
- c. 10A
- d. 216A

56) What are the three currents, I1, I2, and I3?

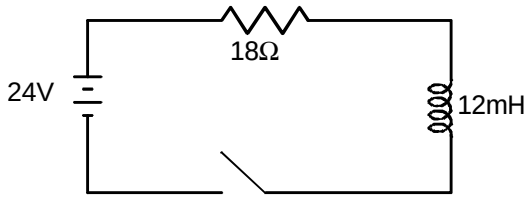


I1 = _____

I2 = _____

I3 = _____

57) At time t = 0, the switch closes. How much time will it take before the inductor is fully charged?



_____

58) A toroid with diameter 2.56cm, and a relative permeability of 500, has 162 turns, and 1.15A flowing through it. What is the magnetic field strength? _____

STATION 1

What is the current flowing through every resistor?

I1 = _____ I4 = _____

I2 = _____ I5 = _____

I3 = _____

STATION 2

What is the power dissipated by every resistor?

P1 = _____ P4 = _____

P2 = _____ P5 = _____

P3 = _____

TIEBREAKER: Simplify the circuit. What is the value of R_E? _____