**Electric Circuits**

**Question 1:**

aa. Consider the diagram at the right of two points located within a uniform electric field. The electric potential is greatest at point \_\_\_\_.

a. A b. B

c. The electric potential is the same at each point.

**Question 2:**

aa. The quantity electric potential is defined as the amount of \_\_\_\_\_.

a. force per charge b. electric potential energy

c. potential energy per charge d. force acting upon a charge

**Question 3:**

aa. Moving an electron within an electric field would change the \_\_\_\_ of the electron.

a. mass b. potential energy c. amount of charge

**Question 4:**

aa. The quantity **electric potential difference** is denoted by the symbol \_\_\_\_.

a. Q b. V c. E•d F

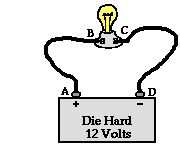
e. PE ab. ∆V ac. W d. none of these

**Question 5:**

aa. If work is done upon a + charge to move it from one position to another, then the charge will \_\_\_ potential energy and \_\_\_ electric potential during the motion.

a. gain, gain b. lose, lose c. lose, gain d. gain, lose

**Questions 6-9:**

The diagram below at the right shows a light bulb connected by wires to the + and - terminals of a car battery.

aa. Compared to point D, point A is \_\_\_\_\_ electric potential.

a. 12 V higher in

b. 12 V lower in

c. exactly the same

d. ... impossible to tell

aa. The electric potential energy of a charge is zero at point \_\_\_\_\_.

a. A b. B c. C d. D

aa. Energy is required to force a positive charge to move \_\_\_.

a. through the wire from point A to point B

b. through the wire from point C to point D

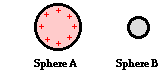
c. through the light bulb from point B to point C

d. through the battery from point D to point A

aa. The energy required to move +2 C of charge between points D and A is \_\_\_\_ J.

a. 0.167 b. 2.0 c. 6.0 d. 12 e. 24

**Questions 10-13:**

Two conducting spheres of unequal size are shown in the diagram at the right. Conducting sphere A is charged positively. Conducting sphere B is neutral.

aa. When a wire connects the two spheres, there will be \_\_\_\_\_ positively charged.

a. less b. more

aa. Sphere B will become \_\_\_\_\_ .

a, become positively charged

b. become negatively charged

c. remain as neutral

aa. This flow of charge occurs because charge on sphere A is said to be at a \_\_\_\_\_ electric potential.

a. high b. low c. zero

aa. The flow of charge between the two spheres will continue until \_\_\_\_\_.

a. sphere A runs out of its positive charge

b. the two spheres are at the same electric potential

c. the two spheres have the same amount of charge on them

**Question 14:**

aa. Complete the following statement:

Moving a positive test charge against the direction of the electric field \_\_\_\_\_\_\_\_\_\_ (requires work, occurs naturally). This causes the test charge to \_\_\_\_\_\_\_\_\_\_ (gain, lose) energy. On the other hand, the movement of a positive test charge in the same direction as the electric field \_\_\_\_\_\_\_\_\_\_ (requires work, occurs naturally). This causes the test charge to \_\_\_\_\_\_\_\_\_\_ (gain, lose) energy.

**Question 15:**

aa. The gravitational potential of an object is the \_\_\_\_\_.

a. amount of potential energy per kilogram of mass

b. amount of height that the object possesses

c. amount of potential energy and height possessed by the object

d. amount of potential energy possessed by the object

**Question 16:**

aa. Which one of the following is true of the gravitational potential?

a. It depends on both the mass of and the height of the object.

b. It depends solely upon the location of the object within the gravitational field.

**Question 17:**

aa. Electric potential of an object is the \_\_\_\_\_.

a. amount of electrical potential energy per kilogram of mass

b. amount of electrical potential energy per coulomb of charge

c. distance that an object is located from another object

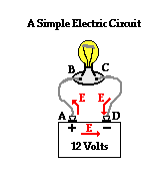
d. amount of electric potential energy and height possessed by the object

**Question 18:**

aa. Which one of the following is true of the electric potential?

a. It depends solely upon the location of the object within the electric field.

b. It depends on both the charge of an object and its distance from the source.

**Questions 19-22:**

The electric field (E) direction is indicated by arrows on the diagram at the right. Identify the following statements as being either **TRUE** or **FALSE**.

aa. A positive test charge would gain energy as it moves through the battery from location D to location A.

a. True b. False

aa. The + terminal of the battery is the highest energy location within the electric circuit.

a. True b. False

aa. A positive test charge that moves through the wires from location A to location D is moving against the electric field.

a. True b. False

aa. It would require work to move a positive test charge through the wires from Location A to Location D.

a. True b. False

**Question 23:**

aa. Another name for electric potential difference is \_\_\_\_\_.

a. electricity b. electric potential energy c. current

d. voltage e. electrical power

**Question 24:**

aa. Which one of the following is **not** a role of the battery in an electric circuit?

a. supplies energy to the circuit

b. to provide the charge that move through the circuit

c. establishes a difference in electric potential across the external circuit

d. pumps charge from – to + terminal of the battery

**Question 25:**

aa. Fill in the blanks:

Electrical energy is \_\_\_\_\_\_\_\_\_\_\_\_ (gained, lost) by the charge as it moves through the battery – also known as the \_\_\_\_\_\_\_\_\_\_\_\_ (internal, external) circuit. Electrical energy is \_\_\_\_\_\_\_\_\_\_\_\_ (gained, lost) by the charge as it moves through the wires, bulbs and other devices – also known as the \_\_\_\_\_\_\_\_\_\_\_\_ (internal, external) circuit.

**Question 26:**

aa. Dry cells and batteries are rated with a *voltage*. What does a 12-volt battery do?

a. It does 12 watts of power.

b. It does a total of 12 joules of work.

c. It does 12 joules of work every 1 second.

d. It does 12 joules of work on every 1 coulomb.

e. It does a total of 12 Joules of work over its entire lifetime.

ab. Nonsense! A 12-Volt battery is not worth much and couldn't do any of these.

**Question 27:**

aa. If an electrical circuit were analogous to a water circuit at a water park, then the voltage would be comparable to \_\_\_\_\_.

a. the rate at which water flows through the circuit

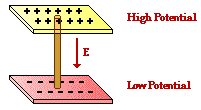
b. the distance which water flows through the circuit

c. the speed at which water flows through the circuit

d. the water pressure between the top and bottom of the circuit

e. the hindrance caused by obstacles in the path of the moving water

**Question 28:**

aa. Suppose that a positively-charged metal plate is connected to a negatively-charged metal plate by a conducting wire. Positive charge will naturally flow through the wire from the positive plate to the negative plate. Is this an example of an electric circuit? Why or why not?

a. No. Because the charge must move in a loop back up to the + plate.

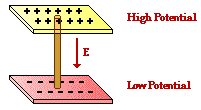
b. Yes. Because charges are moving from high potential to low potential.

c. Yes. Because the pathway through which the charges move is a conducting pathway.

d. No. Because there is the same amount of opposite charges on the two plates, thus neutralizing each other.

e. No. Because there is an electric field existing between the two plates.

**Question 29:**

aa. Which of the following occurs as charge flows from the top conducting plate to the bottom plate? Select all that apply.

a. The charge flow eventually ceases.

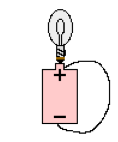
b. The electric field between the two plates decreases.

c. Charges move in a complete loop back to their original location.

d. The difference in electric potential between the two plates decreases to zero.

e. Charges flow in a complete conducting loop.

f. The difference in electric potential between the two plates remains high.



**Question 30:**

aa. Which statement explains why the light bulb does not light in the diagram at the right?

a. The light bulb must not be making complete contact with the cell.

b. The wire should extend from the positive terminal to the ribbed side of the bulb.

c. The cell is likely old and no longer working.

d. Charge flows through the wire but not through the light bulb filament.

e. Nonsense! The light bulb would light in this situation.

**Question 31:**

aa. Which two items listed below are the minimum requirements for an electric circuit to exist? Select two.

a. An energy supply capable of pumping charge from low to high electric potential.

b. A loop of wire.

c. A continuous conducting pathway between the positive and negative terminals.

d. Some sort of source of charge like a battery.

e. A light bulb or other device that transforms electrical energy to other forms.

**Question 32:**

aa. Suppose that you turn on the desk lamp this evening and the light bulb does not light. What is the likely reason for why you must do your physics homework in the dark?

a. My family has evidently failed to pay the monthly electric bill and power has been shut off to my home.

b. The light bulb has run out of charge and current can no longer exist.

c. The light bulb has run out of chemicals and the reaction that makes the bulb light can no longer take place.

d. The filament of the bulb has somehow become unattached, thus breaking the circuit.

e. When it comes to physics, I always feel like I’m in the dark.

**Question 33:**

aa. Which one of the following is NOT a role of the electrochemical cell within an electric circuit?

a. establishes a difference in electric potential across the external circuit

b. supplies energy to the circuit

c. to provide the charge that move through the circuit

d. pumps charge from negative to positive terminal of the battery

**Question 34:**

aa. Fill in the blanks:

All electrical circuits have an energy input location and an energy output location. The energy input location is the \_\_\_\_\_\_\_\_\_\_\_\_\_ and the energy output location is mostly the \_\_\_\_\_\_\_\_\_\_\_\_.

Choose from: cell, wire, conducting pathway, electrons in the atom, light bulb or other device

**Question 35:**

aa. Fill in the blanks:

If an electric circuit were compared to the roller coaster circuit at the amusement park, then …

a. … the battery would be analogous to the \_\_\_\_\_\_.

b. … the positive terminal of the battery would be analogous to the \_\_\_\_\_\_.

c. ... charge would be analogous to the \_\_\_\_\_\_.

Choose from: the loading station; roller coaster cars; the motor of the lift hill; the top of the lift hill; the length of the track.

**Questions 36-42:**

Identify the following statements as being either TRUE or FALSE.

aa. Current refers to the amount of charge that passes a point on the circuit.

a. True b. False

aa. Currents within an electric circuit are typically small within a wire because the carriers of charge are not very densely packed.

a. True b. False

aa. Currents within an electric circuit are typically large because charge moves at high speed – a fraction (1/10-th to 1/100-th) of the speed of light.

a. True b. False

aa. Physicists define the direction of the electric current based upon a man-made convention and not upon any observable evidence.

a. True b. False

aa. Electrons with in an electric circuit move through the wires of a circuit from the – to the + terminal

a. True b. False

aa. The rate at which charge flows is greatest where it exits the battery and noticeably when it returns back to the battery.

a. True b. False

aa. It is possible for electrons to flow in one direction in a circuit and the current to be in the opposite direction.

a. True b. False

**Question 43:**

aa. When you flip the light switch in your bedroom to ON, the lights turn on immediately. Learned students of physics interpret this finding to be evidence for the fact that \_\_\_\_\_.

a. Light travels from the switch to the light bulb … at the speed of light.

b. Charge moves from the switch to the light bulb at nearly the speed of light.

c. Charge in the light filament begins moving immediately in order to light it.

d. There was light already in the light bulb; flipping the switch activates it.

**Question 44:**

aa. A current of 5 amperes indicates that \_\_\_\_\_.

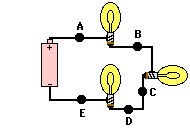
a. there are 5 coulombs of charge passing by any point on the circuit every 1 second

b. every 5 seconds, a coulomb of charge will pass by any point on the circuit

c. it takes 5 seconds for a coulomb of charge to make its way around the entire circuit

d. it takes 1 second for 5 coulombs of charge to makes its way around the entire circuit.

**Questions 45-46:**

Consider the diagram at the right in answering the next two questions:

aa. Current within the external circuit moves from \_\_\_\_\_.

a. from both terminals out into the circuit to the nearest bulb, only to meet up somewhere between points B and C.

b. the positive terminal to A to B to C to D to E and back to the negative terminal

c. the negative terminal to E to D to C to B to A and back to the positive terminal

aa. At what location within this circuit is the current the greatest?

a. At location A.

b. At location E

c. It’s difficult to tell with so little information.

d. Somewhere between location B and C.

e. Nonsense! It is the same at all locations.

**Question 47:**

aa Technically speaking, batteries are NOT rechargeable. What is the logical reasoning behind such a claim?

a. Eventually, re-chargeable batteries can no longer be re-charged; there is a limit on the number of times that one can re-charge them.

b. Charge cannot be created nor destroyed, only transferred; thus, recharging a battery simply involves transferring charge from a re-charger or outlet to the battery.

c. Like most manufacturers, battery companies exaggerate the abilities of their products; rechargeable batteries can have some charge returned, but not all of it.

d. Batteries are not sources of charge nor do they provide charge; thus they cannot ever lose their charge and they have no need to be re-charged.

**Question 48:**

aa. The unit of measurement for electric current is the \_\_\_\_\_.

a. ohm b. volt c. watt

d. joule e. ampere ab. coulomb

**Question 49:**

aa. Current has a direction associated with it. The conventional direction used for electric current is the direction that \_\_\_\_\_ would flow in an electric circuit.

a. electrons b. positive charge c. negative charge

**Question 50:**

aa. A current is said to exist whenever \_\_\_\_\_.

a. a wire is charged b. a battery is present

c. electric charges are unbalanced d. electric charges move in a loop

**Question 51:**

aa. The **mobile charge carriers** in the metal wires of a household circuit are \_\_\_\_\_.

a. + charges b. + electrons     c. - electrons

**Question 52:**

aa. The drift velocity of mobile charge carriers in electric circuits is \_\_\_\_.

a. very slow; slower than a snail

b. very fast; less than but very close to the speed of light

c. slow; slower than Michael Jackson runs the 220-meters

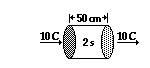
d. fast; faster than the fastest car but nowhere near the speed of light

**Question 53:**

aa. When you turn on the room lights, they light immediately. This is best explained by the fact that \_\_\_\_.

a. electrons present everywhere in the circuit move instantly.

b. electrons move very fast from the switch to the light bulb filament.



**Question 54:**

aa. The diagram at the right depicts a conducting wire. Two cross-sectional areas are located 50. cm apart. Every 2.0 seconds, 10 C of charge flow through each of these areas. The current in this wire is \_\_\_\_ A.

a. 0.10 b. 0.25 c. 0.50

d. 1.0 e. 5.0 ab. 10

ac. 20 ad. 40 ae. none of these

**Question 55:**

aa. Choose the best means of completing the following sentence:

When the current in a typical circuit (DC) is large, it is because ...

a. ... the mobile charge carriers are moving very fast.

b. ... a large number of mobile charge carriers are moving forward per second.

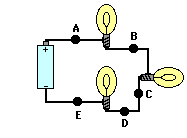
**Question 56:**

aa. The two factors that affect the rate of charge flow through a circuit are \_\_\_\_.

a. voltage and resistance b. voltage and energy

c. energy and resistance d. voltage and power

**Questions 57-58:**

Consider the circuit at the right consisting of a cell and three light bulbs.

aa. The direction of conventional current in this circuit is \_\_\_\_\_.

a. from E to D to C to B to A

b. from A to B to C to D to E

c. one way for electrons and the opposite way for protons

d. ... nonsense! The direction of the current is arbitrary. It can be any direction you wish.

aa. **TRUE**  or **FALSE**:

The current at point E is considerably less than the current at point A since charge is being *used up* in the light bulbs.

a. True b. False

**Question 59:**

aa. Two of the following words and phrases mean the same thing. Select the two.

a. Voltage b. Energy c. Wattage

d. Drift Speed e. Electric Potential Difference

**Question 60:**

aa. Which one of the following is true about the electrical circuit in your flashlight?

a. The charge becomes used up as it passes through the light bulb.

b. Charge moves around the circuit at a fraction of the speed of light.

c. The batteries supply the charge (electrons) that move through the wires.

d. The batteries supply the charge (protons) that move through the wires.

e. The battery supplies energy that raises charge from low to high voltage.

ab.... nonsense! None of these are true.

**Question 61:**

aa. Electrons within the external circuit move in the \_\_\_\_\_ direction as the direction of the conventional current.

a. same b. opposite

c. ... nonsense! It depends on how the battery is oriented.

**Question 62:**

aa. Which one of the following is a common cause of household electrical fires?

a. So many appliances are on that the resistance of the circuit becomes very high and overheats.

b. The current becomes too low that appliances have to make their own heat to operate properly.

c. The voltage becomes very high and sparks begin to fly from the electrical devices.

d. The current becomes too high, wires then become hot, their insulation melts and a fire is started.

**Question 63:**

aa. Many older homes use **fuses** to protect a circuit from overheating. How does a fuse protect a household circuit from overheating?

a. A fuse contains a high-resistance metal that prevents overheating by keeping the current low.

b. A fuse contains a heat absorbing metal that absorbs heat from the circuit in order to cool it down.

c. A fuse contains a piece of metal that burns up and opens the circuit when the current becomes too high.

d. A fuse contains a metal that vibrates with a high pitch when large currents flow through it. This warns occupants to evacuate.

**Question 64:**

aa. The appliances in your kitchen (refrigerator, toaster, dishwasher, garbage disposal, electric blender, etc.) are wired in a \_\_\_\_\_.

a. parallel circuit b. series circuit

**Question 65:**

aa. If the unit of current were the *run* and the unit of voltage were the *punt*, then the unit of resistance would be the \_\_\_\_\_.

a. punt / run b. run • punt c. field goal d. punt2 / run

e. run / punt ab. bogie ac. run2 / punt

**Question 66:**

aa. For a constant resistance, a quadrupling of the voltage drop across an electrical device will cause the current through it to be \_\_\_\_.

a. unchanged

b. four times as much

c. one-fourth as much

d. ... nonsense! There would be no way to make such a prediction.

**Questions 67-71:**

Identify the following statements regarding the journey of an electron as being either **TRUE** or **FALSE**.

aa. An electron typically travels along a long, slow, zig-zag path.

a. True b. False

aa. An electron will lose a little energy as it passes through a wire.

a. True b. False

aa. Wires in an electric circuit can warm up due to the collision of mobile electrons with the atoms of the wire.

a. True b. False

aa. Whatever energy that a charge has at the positive terminal of the battery is entirely lost by the time the charge returns to the negative terminal of the battery.

a. True b. False

aa. The *load* of an electric circuit is the electrochemical cell that provides the circuit with energy.

a. True b. False

**Question 72:**

aa. What is the cause of resistance within an electrical wire?

a. Collisions of mobile electrons with atoms

b. The insulating material that surrounds the wire

c. Frictional forces and air drag

d. A weak electric field within the wire

**Question 73:**

aa. The three factors that affect the resistance of an electrical wire are \_\_\_\_\_. Select three variables.

a. the current that exists in the wire b. the time of day

c. the electrical potential difference across the wire d. the length of the wire

e. the thickness or width of the wire f. the wiring material

**Question 74:**

aa. The equation that relates the resistance to the variables that affect it is shown at the right. According to the equation, the resistance (**R**) is greatest for a \_\_\_\_\_. Choose two.

a. a long wire b. a wire with a wide cross-sectional area

c. a short wire d. a wire with a narrow cross-sectional area

**Question 75:**

aa. The *funny-looking Greek letter* in the resistance equation (known as “rho” and looking a bit like a p) represents the \_\_\_\_\_.

a. the temperature of the material b. the density of the material

c. conductivity of the wire d. resistivity of the material

**Question 76:**

aa. According to the resistance equation, a doubling of the length of a wire would lead to \_\_\_\_\_.

a. no change in the resistance of the wire b. a quadrupling of the resistance of the wire

c. a doubling of the resistance of the wire d. a halving of the resistance of the wire

**Question 77:**

aa**.** According to the resistance equation, a doubling of the cross-sectional area of a wire would lead to \_\_\_\_\_.

a. a halving of the resistance of the wire b. no change in the resistance of the wire

c. a doubling of the resistance of the wire d. a quadrupling of the resistance of the wire

**Question 78:**

aa. The unit of electrical resistance is the \_\_\_\_.

a. ampere b. hindrants c. volt

d. rho e. ohm

**Question 79:**

aa. Which of the following will cause the current through an electrical circuit to decrease? Choose all that apply.

a. decrease the voltage b. increase the resistance

c. increase the voltage d. decrease the resistance

**Questions 80-83:**

Complete the following sentences by filling in the blanks.

aa. A rotary light dimmer switch involves the use of a **potentiometer**. The dimmer switch regulates the current in the light bulb by \_\_\_\_\_.

a. changing the voltage of the circuit

b. changing the length of wire in the circuit

c. channeling the current to a different light bulb

aa. A long length of wire will result in a \_\_\_\_\_ resistance …

a. small b. large

aa. (Continued from the previous question.) … and \_\_\_\_\_ the overall current of the circuit.

a. increase b. decrease c. not change

aa. (Continued from the previous question.) … This would cause the lights to be \_\_\_\_\_.

a. dim b. bright

**Question 84:**

aa. The resistance of a metal wire will vary \_\_\_\_ with temperature. It is greatest at \_\_\_\_\_\_ temperatures.

a. directly, higher b. directly, lower

c. inversely, higher d. inversely, lower

**Question 85:**

aa. Compared to a 3-V battery, a 12-V battery will produce \_\_\_\_ the current.

a. two times b. four times c. one-half d. one-fourth

e. the same amount

**Question 86:**

aa. The standard metric unit of electrical resistance is the \_\_\_\_.

a. Ohm b. Amp c. Volt d. Watt e. Joule

**Question 87:**

aa. The cause of resistance to the flow of charge within an electrical wire is \_\_\_\_\_.

a. mobile charge carriers collide with atoms of the resistor

b. charge is consumed or used up as it flows through the wire

c. the electric field which causes charge flow diminishes with distance

d. mobile charge carriers have mass (possess inertia) which resists their motion

**Question 88:**

aa. The resistance to charge flow will be greatest in \_\_\_\_\_.

a. longer wires b. shorter wires c. ... nonsense! It is unaffected by length.

**Question 89:**

aa. The resistance to charge flow will be greatest in \_\_\_\_\_.

a. wider wires b. thinner wires c. ... nonsense! It is unaffected by width.

**Question 90:**

aa. The intrinsic property of a material that depends upon the material's electronic structure and temperature is \_\_\_\_\_.

a. resistivity b. resistance

c. ionization energy d. electron affinity

**Question 91:**

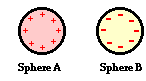
aa. Power is defined as \_\_\_\_\_.

a. the rate at which work is done b. the force used to do the work

c. the time it takes to to do the work d. the amount of work which is done

e. the distance over which work is done

**Question 92:**

aa. If the two spheres shown at the right are connected by a wire, there will be a flow of charge between the two spheres. The flow of charge eventually stops. In order for the flow of charge between spheres A and B to be continuous, it is necessary that \_\_\_\_\_.

a. sphere B be a much, much bigger object

b. sphere B leak charge to some third object

c. a charge pump move positive charge from sphere B to sphere A

**Question 93:**

aa. Light bulbs are rated with a *wattage*. What does a 60-watt light bulb do when plugged into a 110-volt household outlet?

a. It will produce 60 joules of light energy over its entire lifetime.

b. It can withstand a 60-Newton bump without the filament breaking.

c. It will be guaranteed to last for 60 months before running out of charge.

d. It does 60 Joules of work on each coulomb of charge which passes through it.

e. It transforms 60 joules of electrical energy each second into other forms of energy.

**Question 94:**

aa. A certain electrical circuit contains a battery, wires and a light bulb. If electrical potential energy is gained by charges at the battery, then charges lose electrical potential energy \_\_\_\_.

a. in the bulb only

b. in the wires only

c. equally in the wires and the bulb

d. mostly in the wires but a little in the bulb

e. mostly in the bulb but a little in the wires

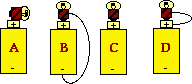
**Question 95:**

aa. Two different light bulbs are plugged into two different household circuits. Each bulb is in a 110-volt circuit. Bulb A is noticeably dimmer than bulb B. This is evidence that the current is greatest is bulb \_\_\_\_\_.

a. A b. B

**Question 96:**

aa. A student is given a wire, battery and light bulb in order to complete a physics lab. The student is directed to arrange the battery, wire and bulb in such a manner as to light the bulb. Which of the arrangements below will result in a lit bulb? Select all that apply.



**Question 97:**

aa. Which one of the following statements is true concerning the situation represented at the right?

a. The bulb will light because one side of the bulb is connected to a high potential.

b. The bulb will not light because only one side of it is connected to the battery.

c. The bulb will not light because both sides of it are connected to the same electric potential.

d. The bulb will light because it is being placed on the wrong side of the battery.

e. ... nonsense! This bulb will light.

**Question 98:**

aa. Which two statements below best describe the two essential requirements in order for charge to flow through an electric circuit? Select two.

a. There must be a light bulb in the circuit.

b. There must source of charge such as a battery.

c. There must be some source of energy such as a battery.

d. There must be a closed conducting loop between the terminals of the energy source.

**Question 99:**

aa. An example of a charge pump is a \_\_\_\_\_. Select all that apply.

a. motor b. dry cell c. light bulb or other appliance

d. solar cell e. wall switch or other switch

**Question 100:**

aa. The role of the cells in a calculator is to \_\_\_\_\_. Select all that apply.

a. increase the electric potential of the charge

b. supply energy to pump the charge between the terminals

c. provide the protons which move through the wires of the circuit

d. provide the electrons which move through the wires of the circuit

e. maintain an electric potential difference across the two ends of a circuit

**Question 101:**

aa. If the electrical circuit in your mp3 player were analogous to a water circuit at a water park, then the battery would be comparable to \_\_\_\_\_.

a. the pipes through which water flows

b. the distance which water flows through the circuit

c. the obstacles which stand in the path of the moving water

d. the people which slide from the elevated positions to the ground

e. the pump which moves water from the ground to the elevated positions

**Question 102:**

aa. The resistance of an electrical device refers to \_\_\_\_ through the device.

a. the rate at which charge moves

b. the amount of charge which moves

c. the speed at which charge moves

d. the amount of hindrance to the flow of charge

e. the energy possessed by a charge when moving

**Question 103:**

aa. Which of the following will cause the current in an electrical circuit to decrease? Select all that apply.

a. decrease the resistance b. decrease the voltage

c. increase the voltage d. increase the resistance

**Question 104:**

aa. For a constant voltage drop across an electrical device, a quadrupling of the resistance of the device will cause the current through it to be \_\_\_\_.

a. unchanged b. one-fourth as much c. four times as much

d. ... nonsense! There would be no way to make such a prediction.

**Question 105:**

aa. For a constant resistance, a quadrupling of the voltage drop across an electrical device will cause the current through it to be \_\_\_\_.

a. unchanged b. one-fourth as much c. four times as much

d. ... nonsense! There would be no way to make such a prediction.

**Question 106:**

aa. The resistance of a wire is relatively \_\_\_\_\_.

a. large b. small

**Question 107:**

aa. **Fill in the blanks:**

Work is done on the charge at the location of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (wires, load, cell, light bulb, resistor) in order to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (increase, decrease, maintain a constant value for) the electrical potential energy of the charge. The electrical potential energy of the charge is then\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (lost, gained, turned inside-out, transformed to other non-electrical forms) (chose the best completion phrase) as the charge travels through the external circuit.

**Question 108:**

aa. The rate at which work is done upon the charge is known as \_\_\_\_\_\_.

a. kinetic energy b.power c. potential energy

d. resistance e. impedance f. current

**Question 109:**

aa. A 60-watt light bulb is a light bulb that \_\_\_\_.

a. produces 60 J of energy for every 1 Coulomb of charge that passes through it.

b. contains 60 J of energy

c. produces 60 J of energy for every 1 amp of current that passes through it.

d. can produce 60 J of energy over the course of its lifetime

e. produces 60 J of light energy every second

**Question 110:**

aa. Your family’s electrical utility bill lists electricity usage in kilowatt•hours. This is a unit of \_\_\_\_\_.

a. energy b. current c. criminal activity

d. power e. electric potential

**Questions 111-113:**

Combining the power equation with the Ohm’s law equation (∆V = I•R) leads to three versions of the same equation – labeled …

**Equation A**: P = I2•R

**Equation B**: P = ∆V2/R

**Equation C**: P = I•∆V

For each question below, identify which of the three equations must be used to most simply (i.e., least number of steps) solve for the unknown.

aa. What is the power delivered to a 2.5-ohm resistor across which the electric potential difference is 7.5 V? This problem can most simply be solved by using Equation \_\_\_\_\_.

a. A b. B c. C

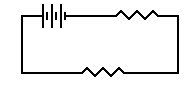
aa. Determine the power of a 6.0-ohm light bulb in which the power is 10.0 A. This problem can most simply be solved by using Equation \_\_\_\_\_.

a. A b. B c. C

aa. A power saw draws a maximum current of 15 A when started up on a 110-volt circuit. This problem can most simply be solved by using Equation \_\_\_\_\_.

a. A b. B c. C

**Question 114:**

aa. Analyze the schematic diagram for the circuit shown at the right. Identify the circuit elements that are present in this circuit. Select all that apply.

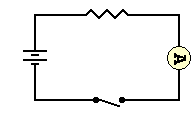
a. lamp b. switch

c. resistor d. ammeter

e. voltmeter f. capacitor

g. single cell h. potentiometer

i. 2-cell battery j. 3-cell battery

**Question 115:**

aa. Analyze the schematic diagram for the circuit shown at the right. Identify the circuit elements that are present in this circuit. Select all that apply.

a. lamp b. switch

c. resistor d. ammeter

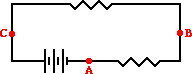
e. voltmeter f. capacitor

g. single cell h. potentiometer

i. 2-cell battery j. 3-cell battery

**Question 116:**

aa. Analyze the schematic diagram for the circuit shown below.

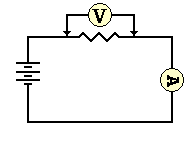


Observe that three points are labeled in the diagram. The direction of the conventional current in this circuit is from \_\_\_\_\_.

a. A to B to C b. C to B to A

c. ... nonsense! It is impossible to predict unless we know what type of charge is flowing.

**Questions 117-118:**

Analyze the schematic diagram for the circuit shown at the right.

aa. The voltmeter in this circuit is arranged \_\_\_\_\_\_\_ with the resistor.

a. in series b. in parallel

aa. The ammeter in this circuit is arranged \_\_\_\_\_ with the resistor

a. in series b. in parallel

**Question 119:**

aa. The resistance of a wire depends upon its length. Longer wires have \_\_\_\_\_ resistance than shorter wires.

a. more b. less

**Question 120:**

aa. The resistance of a wire depends upon its cross-sectional area. A wider wire has a greater cross-sectional area and \_\_\_\_\_ resistance than narrower wires.

a. more b. less

**Question 121:**

aa. The resistance of a wire depends upon its temperature. Hotter wires have \_\_\_\_\_ resistance than colder wires.

a. more b. less

**Question 122:**

aa. The resistance of a wire will increase if it is \_\_\_\_. Select all that apply.

a. made longer b. made wider (diameter increased)

c. connected to a higher voltage battery d. put in a circuit with a lower current

**Question 123:**

aa. The resistance of an electrical device in a circuit can be determined by measuring the current in the device and the voltage drop across the device. The resistance is then calculated as the \_\_\_\_\_.

a. voltage drop divided by the current

b. current divided by the voltage drop

c. the current multiplied by the voltage drop

d. the voltage drop squared divided by the current

e. the current squared multiplied by the voltage drop

**Question 124:**

aa. The unit that is used to express the resistance of an object is the \_\_\_\_.

a. ampere b. ohm c. joule d. volt e. watt

**Question 125:**

aa. The unit **ohm** is equivalent to a \_\_\_\_\_.

a. ampere2/volt b. volt/ampere

c. ampere/volt d. volt2/ampere

e. volt•ampere

**Question 126:**

aa. If the unit of current were the *putt* and the unit of voltage were the *drive*, then the unit of resistance would be the \_\_\_\_\_.

a. drive2 / putt b. putt • drive c. touchdown

d. putt / drive e. putt2 / drive ab. fumble

ac. drive / putt

**Question 127:**

aa. What finding did scientist Georg Simon Ohm make? The finding later came to be known as *Ohm's law*.

a. The resistance of a conducting device changes as the current through it changes.

b. The resistance of a conducting device is much bigger than the resistance of a wire.

c. The resistance of a conducting device can be represented by a color-coding scheme.

d. The resistance of a conducting device increases when there is more voltage impressed across it.

e. The resistance of a conducting device does not vary with changes in the voltage impressed across it.

**Question 128:**

aa. **TRUE** or **FALSE**:

All conducting devices used in electrical circuits follow Ohm's law.

a. True b. False

**Question 129:**

aa. **TRUE** or **FALSE**:

A television set and floor lamp are wired together in the same circuit of your home. The current in the television will decrease when the floor lamp is turned on.

a. True b. False

**Question 130:**

aa. **TRUE** or **FALSE**:

A kiloWatt•hour is a unit of power.

a. True b. False

**Question 131:**

aa. **TRUE** or **FALSE**:

Three light bulbs are connected in series. The filament of one of the light bulbs burns out. The remaining two light bulbs will still be lit; yet, their brightness will be noticeably less.

a. True b. False

**Question 132:**

aa. **TRUE** or **FALSE**:

A battery is sometimes referred to as "charge pump." Its energy is used to pump charge from the + terminal of the battery through the external circuit and back to the - terminal of the battery.

a. True b. False

**Question 133:**

aa. **TRUE** or **FALSE**:

Suppose that four resistors are connected to a battery *in series*. There are two + charges, labeled A and B, in the circuit. You can be assured that charge A and charge B would follow the same exact path through the circuit.

a. True b. False

**Question 134:**

aa. **TRUE** or **FALSE**:

If resistors are connected in parallel, then the current will be the same through each resistor.

a. True b. False

**Question 135:**

aa. In Mechanics (the study of motion), **power** is the rate at which work is done upon an object. In electricity, power has a slightly different *twist*. Which statement best defines power in electrical terms? Power is ...

a. the rate at which the battery produces electrons

b. the amount of electrons which the battery produces

c. the amount of energy used up by a light bulb or other device

d. the rate at which electrical energy is converted to other forms of energy

e. the speed at which charge moves from the positive to the negative terminal

**Question 136:**

aa. You pay your electric bill according to the number of kilowatt•hours used. A kilowatt•hour is a unit of \_\_\_\_.

a. power b. energy c. current

d. resistance e. potential difference

**Question 137:**

aa. Electrical companies like Commonwealth Edison meet the electrical needs of our homes. They do this by \_\_\_\_\_\_.

a. sending large quantities of electrons to our homes on a daily basis

b. transmitting electricity over the internet to our homes electrical supply boxes

c. supplying the circuit breakers that are often found in the basements and closets of homes

d. providing the energy necessary to maintain an electric potential difference across the circuits

**Question 138:**

aa. A monthly electric bill is a charge for the \_\_\_\_\_.

a. amount of energy used in our homes

b. electrical power which our homes use

c. number of electrons consumed in our homes

d. length of electrical wire which our homes used

**Questions 139-142:**

Electrical devices in circuits convert electrical energy to other forms of energy. Demonstrate your understanding of this by completing the following statements:

aa. A light bulb is intended to convert electrical energy to \_\_\_\_\_\_\_.

a. light energy b. solar energy c. sound energy

d. thermal energy e. mechanical energy

aa. An iron converts electrical energy to \_\_\_\_\_\_\_.

a. light energy b. solar energy c. sound energy

d. thermal energy e. mechanical energy

aa. A motor converts electrical energy to \_\_\_\_\_\_\_.

a. light energy b. solar energy c. sound energy

d. thermal energy e. mechanical energy

aa. A toaster (like those found in the kitchen) converts electrical energy to \_\_\_\_\_\_\_.

a. light energy b. solar energy c. sound energy

d. thermal energy e. mechanical energy

**Question 143:**

aa. There are many mathematical expressions for power. Identify which expressions below are expressions for electrical power. Select all that apply.

a. ∆V2/R b. I·R2 c. I·∆V

d. ∆E/t e. I2·R

**Question 144:**

aa. Which of the following diagrams represents resistors connected in series? Select all that apply.



**Question 145:**

aa. The voltage drops across each individual resistor in a series circuit is \_\_\_\_\_.

a. the same fore each resistor

b. greatest for the resistor with the greatest current

c. greatest for the resistor with the greatest resistance

d. greatest for the resistor with the smallest current

e. greatest for the resistor with the smallest resistance

**Question 146:**

aa. The sum of the voltage drops of the individual resistors is \_\_\_\_\_\_ the voltage of the source.

a. less than b. greater than c. equal to

**Questions 147-148:**

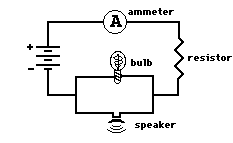
aa. As more resistors are added in series, the overall resistance \_\_\_\_, …

a. increases b. decreases c. remains the same

aa. (Continuing from previous question.) … and current in each resistor \_\_\_\_.

a. increases b. decreases c. remains the same

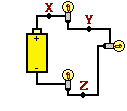
**Question 149:**

aa. Consider the pictorial representation of the circuit shown at the right. Which two devices are connected in series to each other? Select two answers.

a. bulb b. resistor

c. speaker d. ammeter

**Question 150:**

aa. Three identical light bulbs are connected to a battery as shown at the right. Which one of the following statements is true?

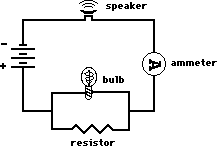
a. The bulb between X and Y will be the brightest.

b. The bulb between Y and Z will be the brightest.

c. The bulb between Z and the battery will be the brightest.

d. All three bulbs will have the same brightness.

**Question 151:**

aa. Consider the pictorial representation of the circuit shown at the right. Which two devices are connected in series with each other? Select two answers.

a. bulb b. resistor

c. speaker d. ammeter

**Question 152:**

aa. A series circuit consists of several electrical devices. The current in each of the devices is the same. Which statement below best explains why this is true?

a. Charge cannot be destroyed, so the rate is the same at the beginning and the end of the circuit.

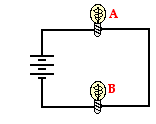
b. Each device transforms the charge from negative to positive, but the amount stays the same.

c. Each device transforms the charge from positive to negative, but the amount stays the same.

d. Each device in the circuit consumes the charge but the charge moves faster. The charge and the time decrease but the current stays constant.

e. Nonsense! Charge gets used up in each electrical device. It is not the same at all locations.

**Question 153:**

aa. Light bulbs A and B are connected in series to a 9-volt energy source. The voltage drop across light bulb A is 3 volts. What is the voltage drop across light bulb B?

a. 3 Volts b. 6 Volts

c. 9 Volts d. 12 Volts

e. None of these are correct.

**Questions 154-155:**

aa. As the number of resistors in a parallel circuit increases, the equivalent resistance of the circuit \_\_\_\_\_\_

a. increases b. decreases c. stays the same

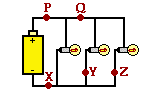
aa. (Continued from the previous question.) … and the current in each resistor\_\_\_\_\_.

a. increases b. decreases c. stays the same

**Question 156:**

aa. Which of the following diagrams represents resistors connected in parallel? Select all that apply.





**Questions 157-159:**

Three identical light bulbs are connected to a battery as shown at the right. P, Q, X, Y and Z represent locations along the circuit.

aa. At which location will the current be the same as at Y?

a. P b. Q

c. X d. Z

aa. At which location will the current be the same as at X?

a. P b. Q

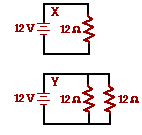
c. Y d. Z

aa. At which location will the current be twice that at Z?

a. P b. Q

c. X d. Y

**Question 160:**

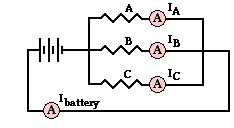
aa. A 12-V battery and a 12-ohm resistor are connected as shown in circuit X at the right. Two 12-ohm resistors are connected as shown in circuit Y. The current in the battery in circuit X is \_\_\_\_ that in the battery in circuit Y.

a. one-third b. one-half c. two-thirds

d. the same a e. 1.5 times ab. twice

ac. three times ad. four times

**Questions 161-163:**

Consider resistors A, B and C in the parallel circuit below. The resistances of the three resistors are:

RA = 17.5 

RB = 13.4 

RC = 24.3 

aa. The resistor that will have the greatest current is \_\_\_\_\_\_.

a. A b. B c. C

d. ... nonsense!. The current is the same for each branch.

aa. The branch with the greatest voltage drop will be the branch with resistor \_\_\_\_\_.

a. A b. B c. C

d. ... nonsense!. The voltage drop is the same for each branch.

aa. Which statement below would represent the mathematical relationship between currents?

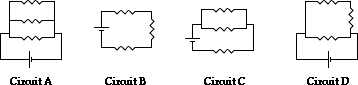
a. IA = IB = IC < IBattery b. IA + IB+ IC > IBattery

c. IA + IB+ IC = IBattery d. IA = IB = IC = IBattery

e. 1/IA + 1/IB+ 1/IC = 1/IBattery

**Question 164:**

aa. Combination circuits are circuits which contains devices wired using both parallel and series connections. Which two of the circuit schematics below - A, B, C or D - represents a combination circuit? Select two.



**Questions 165-166:**

aa. In order for an ammeter to measure the current at a location in a circuit, it is important that the ammeter have a \_\_\_\_\_ resistance.

a. low b. high

aa. (Continued from the previous question.) … If the resistance of the ammeter is too \_\_\_\_\_, then the current in the circuit would be altered by the ammeter.

a. low b. high

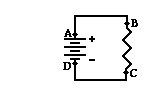
**Questions 167-168:**

aa. In order for a voltmeter to measure the voltage drop between two points on a circuit, it is important that the voltmeter have a \_\_\_\_\_ resistance.

a. low b. high

aa. (Continued from the previous question.) … If the resistance of the voltmeter is too \_\_\_\_\_, then the voltage drop between the two points on the circuit would be altered by the voltmeter.

a. low b. high



**Questions 169-173:**

The diagram at the right depicts an electric circuit in a car. The rear defroster is connected to the 12-Volt car battery. Several points are labeled along the circuit. Use this diagram in answering the next several questions.

aa. Charge flowing through this circuit possesses 0 J of potential energy at point \_\_\_.

a. A b. B

c. C d. D

aa. The overall effect of this circuit is to convert \_\_\_\_\_ energy into \_\_\_\_\_ energy.

a. chemical, thermal b. electrical, chemical

c. thermal, electrical d. chemical, mechanical

aa. The potential energy of the charge at point A is \_\_\_\_\_ the potential energy at B.

a. less than b. greater than c. approximately equal to

aa. The + charge gains potential energy as it moves between points \_\_\_\_\_ and \_\_\_\_\_.

a. A and B b. B and C c. C and D d. D and A

e. none of these

aa. The + charge loses potential energy as it moves between points \_\_\_\_\_ and \_\_\_\_\_.

a. A and B b. B and C c. C and D d. D and A

e. none of these

**Question 174:**

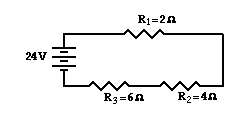
aa. The current established in a 240-Watt speaker when plugged into a 120-V wall outlet is \_\_\_\_\_.

a. 0.5 Amps b. 0.5 Ohms c. 2.0 Amps d. 2.0 Ohms

e. None of these

**Questions 175-178:**

Consider the diagram at the right in answering the next several questions. The diagram depicts a 24 V battery and three resistors connected in series. The resistors are labeled 1, 2, and 3.



aa. The current will be greatest for the \_\_\_\_ Ω resistor.

a. 2 b. 4 c. 6

d. ... nonsense! The current is the same for each.

aa. The voltage drop will be greatest across the \_\_\_\_ Ω resistor.

a. 2 b. 4 c. 6

d. ... nonsense! The voltage drop is the same for each.

aa. The equivalent resistance for this circuit is \_\_\_\_ Ω.

a. 4 b. 12 c. 48

d. none of these

aa. The voltage drop across the 2 Ω, 4 Ω and 6 Ω resistors are \_\_\_ V, \_\_\_ V, and \_\_\_ V respectively.

a. 4, 8, 12 b. 6, 4, 2 c. 2, 4, 6 d. 8, 8, 8

e. 24, 24, 24 ab. 12, 8, 4 ac. None of these are correct.

**Question 179:**

aa. A circuit in which all charge follows a single pathway is a \_\_\_\_ circuit; a circuit in which charge follows multiple pathways is a \_\_\_\_ circuit.

a. parallel, series b. series, parallel

**Question 180:**

aa. A 2-Ω and a 4-Ω resistor are connected in a parallel circuit. The electric potential difference (i.e., voltage drop) across the 4-Ω resistor will be \_\_\_\_\_ the electric potential difference across the 2-Ω resistor.

a. the same size as b. two times less than

c. two-times more than

**Question 181:**

aa. A 2-Ω and a 4-Ω resistor are connected in a parallel circuit. The current through the 4-Ω resistor will be \_\_\_ the current through the 2-Ω resistor.

a. the same size \_\_as b. two times less than

c. two-times more than

**Question 182:**

aa. Two 6-Ω resistors connected in parallel will have an equivalent resistance of \_\_\_\_ Ω.

a. 0.333 b. 2.0 c. 3.0 d. 6.0

e. 12.0 ab. none of these

**Question 183:**

aa. Three 6-Ω resistors connected in parallel will have an equivalent resistance of \_\_\_\_ Ω.

a. 0.5 b. 2.0 c. 3.0 d. 6.0

e. 18.0 ab. none of these

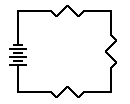
**Question 184:**

aa. Four resistors are connected in a parallel circuit. Three of the resistance values are known - 3 Ω, 4 Ω and 6 Ω. The overall or equivalent resistance of the four resistors must be \_\_\_\_ Ω. (Choose the one answer which is most informative.)

a. greater than 3 b. greater than 6 c. greater than 13

d. less than 13 e. less than 3 ab. ... it is impossible to tell.

**Question 185:**

aa. Identify the direction of conventional current in the diagram at the right. The current in this circuit will \_\_\_\_\_.

a. be in a clockwise direction

b. be in a counter-clockwise direction

c. be in both a clockwise and counter-clockwise direction

d. … nonsense! There is no way to draw such a conclusion without knowing the + and - terminals

**Question 186:**

aa. How will a circuit diagram with two cells be different than a circuit diagram with three cells?

a. There will be three lines instead of four lines.

b. There will be two pairs of long-short bars instead of three pairs.

c. There will be two zig-zag lines instead of three zig-zag lines.

d. The three-cell circuit will have long, medium and short bars instead of just long and short bars.

**Questions 187-192:**

Two or more devices (such as light bulbs) can be wired together in a circuit – either *in series* or *in parallel*. Use your understanding to identify whether the following statements apply to parallel circuits, parallel circuits, both types of circuits or neither type of circuit.

aa. Any single charge that passes through one light bulb will also pass through the other light bulbs.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

aa. There are multiple pathways by which charge can pass between the terminals of the battery.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

aa. As the number of resistors increases, the overall current in the circuit also increases.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

aa. Is characterized by the presence of nodes or branching points.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

aa. When a bulb is removed from a socket, the other bulbs still light.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

aa. Adding more resistors results in more overall resistance.

This statement applies to

a. Series circuits. b. Parallel circuits.

c. Both types of circuits. d. Neither type of circuits.

**Questions 193-194:**

aa.Suppose that three resistors with R values of 12 Ω, 11 Ω, and 22 Ω are connected in series to a 12-volt energy source. In which resistor will the current be the greatest?

a. In the 12-Ω resistor. b. In the 11-Ω resistor. c. In the 22-Ω resistor.

d. … nonsense! The current is the same in each resistor.

e. … nonsense! It depends on the order in which they are placed.

aa. Which statement best explains the answer above?

a. The current is always greatest in the resistor with the greatest resistance.

b. The current decreases as the resistance increases.

c. The *middlemost* resistance value optimizes current flow by maintaining balance.

d. Charges march together around the circuit with no exit or entrance ramps.

e. The current is greatest in the resistor that is closest to the + terminal of the power source.

**Question 195:**

aa. Which statement below describes the relationship between the voltage gained in the battery and the voltage drops (∆V) in the individual resistors of a series circuit?

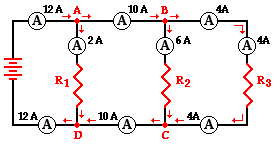
a. The voltage gained in the battery is equal to the ∆V for each resistor.

b. The voltage gained in the battery is equal to the sum of the ∆V for all resistors.

c. The voltage gained in the battery is equal to the average of the ∆V for all resistors.

**Questions 196-197:**

aa. Analyze the circuit diagram below.



This diagram demonstrates that \_\_\_\_\_. Select all that apply.

a. The total current in the wire(s) approaching a node equals the total current in the wire(s) attached on the other side of the node.

b. The current within an individual branch is equal to the current outside the branches.

c. Current is created and destroyed within an electric circuit.

d. Current is lost within an electric circuit.

e. The current is the same within the individual branches of a parallel circuit.

aa. Consider the same diagram. The fact that the current in resistor **R1** is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (equal to, greater than, smaller than) the current in the other resistors…

aa. (Continued from the previous sentence.) … is an indication that \_\_\_\_\_.

a. the total current is equal to the sum of the branch currents

b. resistor R1 has the greatest resistance

c. all resistors have the same resistance

d. resistor R1 has the smallest resistance

**Question 198:**

aa. Three resistors with resistance values of 1 Ω, 2 Ω, and 3 Ω are connected in parallel to a 12-volt battery. The voltage drops across the three resistors (in order of their listing) is \_\_\_\_\_.

a. 12 V, 12 V, and 12 V b. 12 V, 6 V, and 4 V

c. 12 V, 24 V, and 36 V d. 1 V, 2 V, and 3 V

e. … nonsense! This is impossible to predict without knowledge of the current.

**Question 199:**

aa. Which one of the following statements is true of the voltage drops in a parallel circuit?

a. The voltage drops of the individual resistors sums up to the voltage gained in the battery.

b. The average of the voltage drops of the individual resistors is equal to the voltage gained in the battery.

c. The voltage drops of the individual resistors is equal to the voltage gained in the battery.

**Calculations and Long Answer Questions:**

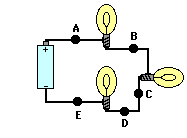
**Question 200:**

aa. A battery does 12 Joules of work for every 6.0 C of charge that it encounters during a 4.0-second time period. What is the voltage of the battery?

**Question 201:**

aa. Your home uses a 9-volt battery (the rectangular variety with two terminals on top) in its smoke detectors. If 3 coulombs of charge pass through the battery from one terminal to the other over the course of time, then this charge will experience a change in energy of \_\_\_\_\_\_\_ joules. (Enter a number in the blank.)

**Questions 202-207:**

For the next six questions, consider the circuit at the right consisting of a cell and three light bulbs.

aa. The direction of conventional current in this circuit is \_\_\_\_\_.

a. from E to D to C to B to A

b. from A to B to C to D to E

c. one way for electrons and the opposite way for protons

d. ... nonsense! The direction of the current is arbitrary. It can be any direction you wish.

aa. When a charge of 14.0 C flows past any point along a circuit in 2 seconds, the current is \_\_\_\_\_ A.

aa. If 9.0 C of charge flow past point A in 10 seconds, then the current is \_\_\_\_\_ A.

aa. If the current at point D is 2.6 A, then \_\_\_\_\_\_\_ C of charge flow past point D in 10.0 seconds.

aa. If 12 C of charge flow past point A in 3 seconds, then 8 C of charge will flow past point E in \_\_\_\_\_\_\_ seconds.

aa. **TRUE** or **FALSE**:

The current at point E is considerably less than the current at point A since charge is being *used up* in the light bulbs.

a. True b. False

**Question 208:**

aa. A 60-ohm light bulb is installed in a chandelier that is on a circuit with a dimmer switch. At a certain setting, it generates light at a rate of 20 Watts. If the current is …

a. … doubled, then the power will be \_\_\_\_\_\_\_\_\_\_\_\_\_ Watts.

b. … halved, then the power will be \_\_\_\_\_\_\_\_\_\_\_\_\_ Watts.

c. … tripled, then the power will be \_\_\_\_\_\_\_\_\_\_\_\_\_ Watts.

**Question 209:**

aa. How much electrical energy is used by a 1500-Watt hair dryer during a 5-minute time period?

**Question 210:**

aa. If 2.23 x 1020 electrons flow past a given cross section of the wire in 16.0 minutes, what is the current (in milliAmps) in the wire?

**Question 211:**

aa. A current of 68.1 mA exists in a household wire. What quantity of charge (in Coulombs) flows past a given cross section of the wire in a time of 29.0 minutes?

**Question 212:**

aa. Suppose an older color television draws about 1.81 Amps when connected to a 110-Volt source. What is the effective resistance (in ohms) of the TV set?

**Question 213:**

aa. The tungsten filament of a small light bulb is 3.25 cm long. The resistivity of tungsten is 5.6x10-8 Ω•m. The bulb resistance is 0.0586 ohm. What is the diameter of the filament wire?

**Question 214:**

aa. A space heater plugged into a 110-V source delivers 1500 J/s to a room. What is the current in the circuit?

**Question 215:**

aa. Your 60-Watt light bulb is plugged into a 120-Volt household outlet and left on for 24 hours. The utility company charges you $0.12 per kiloWatt•hr. Determine the cost of such a mistake (in dollars).

**Question 216:**

aa. Use the P = I•∆V equation to determine the …

a. … power of a 12-volt circuit that has a current of 2.0 Amps. Power = \_\_\_\_\_\_\_\_ Watt

b. … current in a 60-watt lamp bulb connected to a 120-volt circuit. Current = \_\_\_\_\_\_\_\_ Amp

c. … voltage drop across a 0.50-watt LED in which the current is 0.10 ampere. ∆V = \_\_\_\_\_\_\_\_ Volt

**Question 217:**

aa. A circuit is wired with a power supply, a resistor and an ammeter (for measuring current). The ammeter reads a current of 24 mA (milliAmps). Determine the new current (in milliAmps) if the voltage of the power supply was ...

a. … decreased by a factor of 3 and the R was held constant. I = \_\_\_\_\_\_\_ mA

b. … decreased by a factor of 3 and the R was increased by a factor of 2. I = \_\_\_\_\_\_\_ mA

c. … increased by a factor of 2 and the R was increased by a factor of 3. I =\_\_\_\_\_\_\_ mA

**Question 218:**

aa. A power supply is used to operate a series circuit consisting of a 7.84-ohm and a 3.33-ohm resistor. The current in the circuit is found to be 0.349 A. What is the voltage setting of the power supply?

**Question 219:**

aa. A power supply is used to operate a parallel circuit consisting of a 7.84-ohm and a 3.33-ohm resistor. The current in the circuit is found to be 0.349 A. What is the voltage setting of the power supply?

**Question 220:**

aa. Three resistors rated at 3.84 Ω, 4.41 Ω, and 12.27 Ω are connected in series to a 12.0-volt car battery.

a. Calculate the equivalent resistance (in Ohms).

b. Calculate the current (in Amperes) in the 3.84-ohm resistor?

c. Calculate the current (in Amperes) in the 4.41-ohm resistor?

**Question 221:**

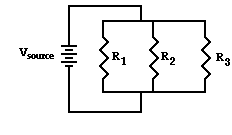
aa. Three resistors rated at 3.84 Ω, 4.41 Ω, and 12.27 Ω are connected in parallel to a 12.0-volt car battery.

a. Calculate the equivalent resistance (in Ohms).

b. Calculate the current (in Amperes) in the 3.84-ohm resistor?

c. Calculate the current (in Amperes) in the 4.41-ohm resistor?

**Question 222:**

aa. Determine the missing values below. Use the given information below and the mathematical ideas from the reading.

**GIVEN**:

R1 = 31.7 Ω

R2 = 16.5 Ω

R3 = 23.4 Ω

Vsource = 110 volt

I1 = \_\_\_\_\_\_\_\_\_\_\_\_ A

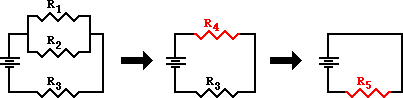
∆V1 = \_\_\_\_\_\_\_\_\_\_\_\_ V

I2 = \_\_\_\_\_\_\_\_\_\_\_\_ A I3 = \_\_\_\_\_\_\_\_\_\_\_\_ A

∆V2 = \_\_\_\_\_\_\_\_\_\_\_\_ V ∆V3 = \_\_\_\_\_\_\_\_\_\_\_\_ V

**Question 223:**

aa. Consider the diagram of a combination circuit below on the left. In the middle, the resistors in the two parallel branches have been replaced by a single resistor (R4) with an equivalent resistance to the overall branch resistors. On the right, all three resistors have been replaced by a single resistor (R5) with an equivalent resistance as all three original resistors.



Suppose that you know that:

R1 = 24.7 

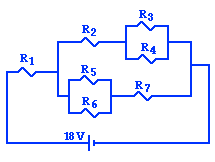
R2 = 24.7 

R3 = 12.7 

What must **R4** and **R5** be in order for the two circuits to have the same equivalent resistance?

R4 = \_\_\_\_\_\_\_\_\_\_ Ω R5 = \_\_\_\_\_\_\_\_\_\_ Ω

**Question 224:**

aa. Find the equivalent resistance (in Ohms) of the circuit shown at the right.

R1 = 4.17 ohm

R2 = 3.85 ohm

R3 = 7.99 ohm

R4 = 7.09 ohm

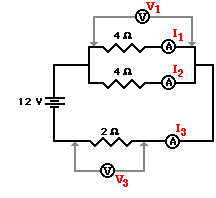
R5 = 2.11 ohm

R6= 8.99 ohm

R7 = 8.06 ohm.

**Question 225:**

aa. The circuit below is a combination circuit.



The resistors that are arranged in parallel have the same resistance value. Determine the equivalent resistance (for the combination of three resistors), the voltmeter readings and the ammeter readings at the indicated locations.

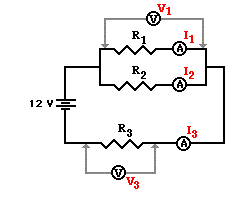
Req = \_\_\_\_\_\_\_\_\_\_\_\_ Ω V1 = \_\_\_\_\_\_\_\_\_\_\_\_ V

V3 = \_\_\_\_\_\_\_\_\_\_\_\_ V I1 = \_\_\_\_\_\_\_\_\_\_\_\_ A

I2 = \_\_\_\_\_\_\_\_\_\_\_\_ A I3 = \_\_\_\_\_\_\_\_\_\_\_\_ A

**Question 226:**

aa. The circuit below is a combination circuit.



The resistance values are

R1 = 4.21 Ω R2 = 4.21 Ω R3 = 2.64 Ω

Determine the equivalent resistance (for the combination of three resistors), the voltmeter readings and the ammeter readings at the indicated locations.

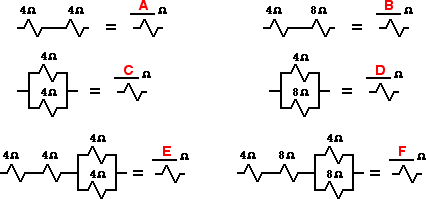
Req = \_\_\_\_\_\_\_\_\_\_\_\_ Ω V1 = \_\_\_\_\_\_\_\_\_\_\_\_ V

V3 = \_\_\_\_\_\_\_\_\_\_\_\_ V I1 = \_\_\_\_\_\_\_\_\_\_\_\_ A

I2 = \_\_\_\_\_\_\_\_\_\_\_\_ A I3 = \_\_\_\_\_\_\_\_\_\_\_\_ A

**Question 227:**

aa. The following diagrams depict a collection of resistors.



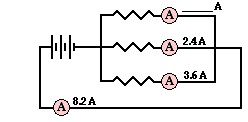
For each case, determine the equivalent resistance.

A: Req = \_\_\_\_\_\_\_\_\_\_ Ω B: Req = \_\_\_\_\_\_\_\_\_\_ Ω

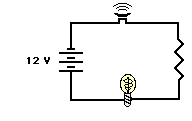
C: Req = \_\_\_\_\_\_\_\_\_\_ Ω D: Req = \_\_\_\_\_\_\_\_\_\_ Ω

E: Req = \_\_\_\_\_\_\_\_\_\_ Ω F: Req = \_\_\_\_\_\_\_\_\_\_ Ω

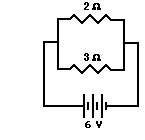
**Question 228:**

aa. A parallel circuit is constructed with three different branches. An ammeter is placed in each of the branches to measure the *branch currents*. An ammeter is also placed outside the circuit to measure the current in the voltage source. Determine the missing ammeter reading.

**Question 229:**

aa. A speaker and a light bulb are connected in series to a 12.0-volt battery. The voltage drop across the light bulb is 3.9 volts. What is the voltage drop across the speaker?

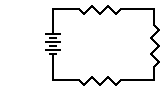
**Question 230:**

aa. A 2-Ω and a 3-Ω resistor are placed in parallel with each other and connected to a 6 volt battery. What is the voltage drop across each resistor?

Voltge drop across 2-Ω resistor = \_\_\_\_\_\_\_\_\_\_ V

Voltge drop across 3-Ω resistor = \_\_\_\_\_\_\_\_\_\_ V

**Question 231:**

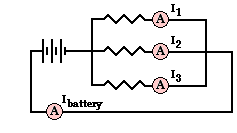
aa. Three resistors are connected in series to a battery. Their resistances are 2.0 Ω, 6.0 Ω and 8.0 Ω. The current in the circuit is 2.0 A.

a. The voltage drop across the 2.0-Ω resistor is \_\_\_\_\_\_\_\_\_\_ V.

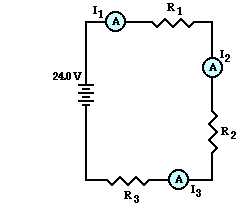
b. The voltage drop across the 6.0-Ω resistor is \_\_\_\_\_\_\_\_\_\_ V.

c. The voltage drop across the 8.0-Ω resistor is \_\_\_\_\_\_\_\_\_\_ V.

**Question 232:**

aa. A parallel circuit is constructed with three different branches. An ammeter is placed in each of the branches to measure the *branch currents*. An ammeter is also placed outside the circuit to measure the current in the voltage source. If I1 = 2.4 A, I2 = 4.4 A, and I3 = 3.7 A, then what is the current in the battery (Ibattery)?

**Question 233:**

Three resistors are connected in series to a 24.0-Volt power source. The resistances are:

R1 = 2.03 Ω

R2 = 3.94 Ω

R3 = 4.95 Ω

Three ammeters are placed in the circuit to measure the current. **Ammeter 1** reads a current (I1) of 2.20.

a. What does **ammeter 2** read?

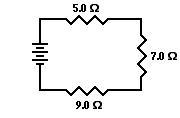
b. What does **ammeter 3** read?

c. What is the voltage drop across **resistor 1**?

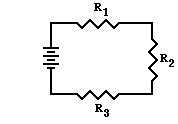
d. What is the voltage drop across **resistor 2**?

e. What is the voltage drop across **resistor 3**?

**Question 234:**

aa. Consider the circuit shown at the right with its three resistors. This resistance of this circuit would be equivalent to the resistance of a circuit with a single resistor of \_\_\_\_\_\_ Ω.

**Question 235:**

aa. Consider the circuit shown at the right with its three resistors.

R1 = 1.68 Ω

R2 = 3.90 Ω

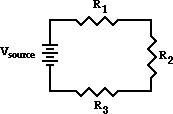
R3 = 2.79 Ω

This resistance of this circuit would be equivalent to the resistance of a circuit with a single resistor of \_\_\_\_\_\_\_\_\_\_ Ω.

**Question 236:**

aa. Consider the circuit at the right. Determine the missing values below.

R1 = 34.2 Ω

R2 = 17.7 Ω

R3 = 23.6 Ω

∆Vsource = 90 volt

I1 = \_\_\_\_\_\_\_\_\_\_ A

∆V1 = \_\_\_\_\_\_\_\_\_\_ V

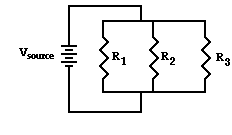
I2 = \_\_\_\_\_\_\_\_\_\_ A

∆V2 = \_\_\_\_\_\_\_\_\_\_ V

I3 = \_\_\_\_\_\_\_\_\_\_ A

∆V3 = \_\_\_\_\_\_\_\_\_\_ V

**Question 237:**

aa. Use the given information to determine the missing values below.

**GIVEN**:

R1 = 34.2 Ω

R2 = 17.7 Ω

R3 = 23.6 Ω

Vsource = 90 volt

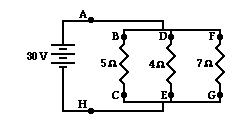
I1 = \_\_\_\_\_\_\_\_\_\_ A

∆V1 = \_\_\_\_\_\_\_\_\_\_ V

I2 = \_\_\_\_\_\_\_\_\_\_ A I3 = \_\_\_\_\_\_\_\_\_\_ A

∆V2 = \_\_\_\_\_\_\_\_\_\_ V ∆V3 = \_\_\_\_\_\_\_\_\_\_ V

**Questions 238-242:**

The diagram at the right shows three resistors connected in parallel to a 30-Volt power supply. Use the diagram to answer the next several questions.

aa. Determine the equivalent resistance of the above circuit.

aa. Determine the overall current in the circuit (as determined at position A or H).

aa. Determine the electric potential difference (i.e. voltage drop) across the 5-Ω resistor (from B to C).

aa. Determine the current through the 5-Ω resistor (from B to C).

aa. Determine the current through the 7-Ω resistor (from B to C).

**Question 243:**

aa. Determine the equivalent resistance of a series circuit with three resistors with R values of 12 Ω, 11 Ω, and 22 Ω.

Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

**Question 244:**

aa. Determine the equivalent resistance of a series circuit with three resistors with R values of 4.6 Ω, 2.5 Ω, and 7.4 Ω.

Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

**Question 245:**

aa. Determine the total resistance of a circuit and the current in a 5.8-volt battery that is used to operate the circuit consisting of a 4.2-Ω, a 3.8-Ω, and a 5.9-Ω resistor connected *in series*.

Rtotal = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω Ibattery = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A

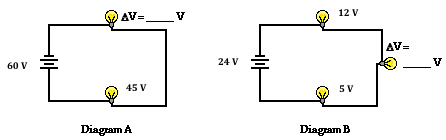
**Question 246:**

aa. A circuit that is powered by a 12-volt source is composed of three *series-connected* resistors with different resistance values: 6.0-Ω, a 8.0-Ω, and a 10.0-Ω Determine the total resistance of the circuit and the current in the 12-volt battery.

Rtotal = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω Ibattery = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A

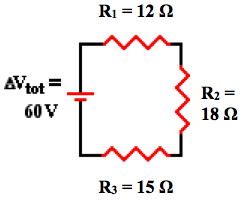
**Question 247:**

aa. Find the missing ∆V value in the two examples below:



**Question 248:**

aa. Analyze the circuit below and fill in the blanks of the table.



|  |  |
| --- | --- |
| Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω | Ibattery = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ A |
| I1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ A | ∆V1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ V |
| I2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ A | ∆V2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ V |
| I3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ A | ∆V3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ V |

**Question 249:**

aa. Use the concept of equivalent resistance to answer the next two questions:

a. Two 24-Ω resistors placed within their own separate branches would result in an equivalent resistance of \_\_\_\_\_\_\_\_ Ω.

b. Three 24-Ω resistors placed within their own separate branches would result in an equivalent resistance of \_\_\_\_\_\_\_\_ Ω.

c. Four 24-Ω resistors placed within their own separate branches would result in an equivalent resistance of \_\_\_\_\_\_\_\_ Ω.

d. These numerical figures indicate that as the number of resistors within parallel branches increases, the overall or equivalent resistors of those branches \_\_\_\_\_.

increases decreases remains the same

**Question 250:**

aa. Use the equivalent resistance formula to determine the equivalent resistance of a parallel circuit with three resistors (5.0 Ω, 7.0 Ω, and 8.0 Ω).

Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

**Question 251:**

aa. Determine the equivalent resistance of a parallel circuit with three resistors having resistance values of …

a. … 5.0 Ω, 7.0 Ω, and 11.0 Ω. Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

b. … 5.0 Ω, 7.0 Ω, and 13.0 Ω. Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

c. … 5.0 Ω, 7.0 Ω, and 6.0 Ω. Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

d. … 5.0 Ω, 7.0 Ω, and 3.0 Ω. Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

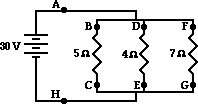
aa. These calculations indicate that the equivalent resistance of a parallel circuit is \_\_\_\_.

a. greater than the resistance of the resistor with the most resistance.

b. less than the resistance of the resistor with the least resistance.

c. … nonsense! Neither of the above conclusions can be made.

**Question 252:**

aa. Conduct a complete mathematical analysis in order to answer the following questions.

a. Determine the equivalent resistance of the above circuit.

Req = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ω

b. Determine the overall or total current in the circuit (as determined at position A or H).

Itot = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A

c. Determine the electric potential difference (i.e. voltage drop) across the 5-Ω resistor (from B to C).

∆VBC = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ V

d. Determine the electric potential difference (i.e. voltage drop) across the 7-Ω resistor (from B to C).

∆VFG = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ V

e. Determine the current in the 5-Ω resistor (from B to C).

IBC = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A

f. Determine the current in the 7-Ω resistor (from F to G).

IFG = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A

**Question 253:**

aa. The concept of electric current is much different than drift speed. Suppose you must explain the difference to a friend. How would you do so using the turtle race analogy. Write a good paragraph:

**Question 254:**

aa. Describe the path of electrons through a typical wire of a circuit. Is the path straight? Mostly straight? What causes the electrons to move as they do?

**Question 255:**

aa. Two students suggest different functions for the battery plays a flashlight.

**Student A**: "The battery supplies the charge which allows the light bulb to light. When the battery no longer works, it is because it has run out of charge."

**Student B**: "The battery pumps the charge around the circuit. The charge itself comes from the conducting elements of the circuit; the battery supplies the energy to pump this charge. When the battery no longer works, it is because the energy-producing chemicals have been consumed."

Which student (A or B) do you agree with? \_\_\_\_\_\_\_\_\_\_ Explain your reasoning.

**Question 256:**

aa. A friend of yours says that "An electric circuit produces energy and as such is an example of a device which fails to follow the law of conservation of energy." Being a physics type, you are constantly evaluating such statements. How would you respond to your friend's statement?

**Question 257:**

aa. Suggest a few reasons why household appliances are connected in parallel circuits. Be thorough and logical in your discussion.

**Question 258:**

aa. The tollway analogy is often used to explain how adding resistors in series and in parallel affects the overall flow rate. Use the analogy to explain how and why adding more resistors in parallel increases the flow rate.

**Question 259:**

aa. In 1-2 sentences, explain what is meant by the term *equivalent resistance*.

**Question 260:**

aa. Humor (or at least an attempt at humor): Identify the following.

A. B. c.