1. Imagine two chambers containing air at different pressures. The chambers are connected by a hose with a valve. When the valve is suddenly opened air flows *through* the hose from the chamber with _____ pressure into the chamber with _____ _____, until the pressures become _____.

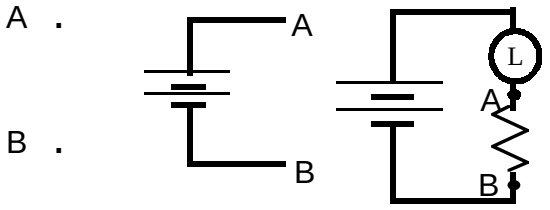
2. Suppose two chunks of metal contain electrons at different pressures, so the electrons are more crowded in one chunk than in the other.
   a. If the two pieces of metal are connected by a wire, that pressure difference will cause electrons to flow *through* the _____ from the region of _____ pressure into the region of _____ pressure.
   b. What special name did we give to *electron flow* in #5 on page 78? _____ (It's a single noun.) -Has that definition been copied onto RS IX? ___
   c. We must conclude (from 2a and 2b) that an electron pressure difference *between* the terminals of a device can cause _____s to flow _____ the device. (noun, preposition) *Use #1 & 2a!*
   d. Page 82 describes a familiar type of "electron pump" that can create an electron pressure difference by pushing electrons out one end while pulling them in the other end. It's called a "_____".

3. Because electrons repel each other, squeezing them closer together requires work. Consequently they are capable of *doing* work whenever they are allowed to spring back apart. Compressing electrons, like compressing air, causes potential energy to be stored. There must be a simple relationship between the potential _____ of a bunch of electrons and the *pressure* of that bunch.

4. Here are two *beginner's definitions* to save on RS IX: (We shall have to improve them later.)
   a. "**Potential difference**" or "**voltage**" is ***electron pressure difference.*** (See p. 79R & 83R.)
   b. Removing one word from the left side of an equation requires us to remove the same word from the right side: #4a implies that "**potential**" must be a measure of _____ _____.

5. According to the clue ***italicized*** in #4, a "voltmeter" must be a device for measuring the _____ between electron pressures at any ___ points in a circuit. *Please try not to contradict #4.*
   a. At how many points must a voltmeter be connected to a circuit for such a comparison? ____
   b. Do you expect electrons to pass easily through a voltmeter, as in #1? _____
   c. Do you expect a voltmeter to "resist" electron flow, as in #2 on page 83R? _____
   d. In terms of "resistance" to electron flow, should a voltmeter be similar to an ammeter? ____ -Should a voltmeter's resistance be *different* from an ammeter's, so that it does *not* equalize the pressures between its terminals? ____ -Does 5d contradict 5b or 5c? _____

6. In circuit diagrams a voltmeter is represented by a circle with a "V" in it, with two wires called "leads" attached. Please draw a voltmeter into *each* of these three diagrams to show how it could measure the pressure difference between points "A" and "B". (Clue: According to 5a, one of the voltmeter leads must be connected to point "B" in each diagram, and the other lead must be connected to ___.)



7. In the third diagram above the voltmeter measures the potential difference between the terminals of a _____. In other words, it measures the "voltage ***across****"* that device. Is the voltmeter connected in *series* with the resistor in that diagram? __ -Is the voltmeter connected in *parallel* with the resistor? __

8. **VOLTMETER CONNECTION RULE:** To measure the potential difference between the terminals of a device you must always connect one terminal of the voltmeter to one terminal of the device and you must connect the _____ terminal of the voltmeter to the other _____ of the _____. Does this rule agree with 6 & 7 above? ____ This connection rule has been saved in # __ on RS ___.

9. There is also a connection rule for *ammeters* in # ___ on RS IX. *Don't be vague.*
   a. Is the voltmeter connection rule the same? ___ -Do 6c and 7 above agree with this answer? ___
   b. There is also a "sign rule" for *ammeters* in # ___ on RS IX. Could a similar rule possibly be appropriate for voltmeters? ____ *If not, please explain.*

1. Copy the beginner's definition of "voltage" from RS IX: _____ _____ _____

2. Suppose a tire has a hole in it:
   a. Is the tire then hard, or is it soft? _____
   b. Is the air pressure inside the tire equal to zero, or equal to the atmospheric pressure? _____
   c. If we measured the pressure in that tire with a pressure gauge, what reading would we get? ____
   d. Apparently a tire pressure gauge actually measures the _____ between the pressure inside the tire and the pressure outside. (sum, difference, product)
   e. A voltmeter measures pressure _____s too.

3. Do you want to let all of the air out of your tire every time you check its pressure? _____
   -Is a tire pressure gauge supposed to allow air to pass through it freely when it is in use?____
   -Should it "resist" that flow? _____ -Is a voltmeter supposed to allow electrons to flow through it freely?___ -Should a voltmeter resist electron flow?___
   -Do these answers contradict each other? __

4. Draw a vacuum cleaner like the one on page 78 with an air hose connecting its intake to its exhaust. This time give the hose *two* narrow sections, instead of one. Make one of those "constrictions" narrower than the other, so it's harder to blow air through it.
   a. Draw arrows on your diagram to indicate the direction of the air flow in the hose.
   b. Draw three pressure gauges attached to the air hose. Connect gauge "A" at the point where the air enters the first constriction. Put gauge "B" between the two constrictions, and put gauge "C" where air emerges from the second constriction.
   c. Air flows from regions with _____ pressure into regions with _____ pressure. Does 4a agree? ___
   d. The readings on these gauges are 2, 7, and 10 psi. Use 4a & 4c to figure out which pressure reading goes with which gauge. Write correct readings beside the gauges in your sketch. (See page 78R.)
   e. The pressure difference between A and B is _____ ____. Between B and C it is _____ ____.
   f. Which constriction (AB or BC) seems to be the hardest to blow through? In other words, which has the greater "***resistance***"? ____ -Does this contradict 4d? ____
   g. How can the pressure difference between the two ends of the vacuum cleaner be calculated from the two pressure differences mentioned in 4e? _____ *Answer with a verb.*
   h. In this example the two constrictions are connected so that every atom of air passing through one must also go through the other. Is this a "series" connection, or is it "parallel"? _____

5. The rate at which charge flows out of a device *depends* on the rate at which charge flows in.
   a. How are those rates related? _____ (On RS IX this is called the "_____ Conservation Law".)
   b. What single word on RS IX means "the rate at which charge flows"? _____
   c. Circle the words below that could be used in place of the word "device" in #5 above, and *cross out* the words which would NOT make any sense there:

resistor	resistance	branch point	battery	current
light-bulb	ampere	wire	voltage	circuit

6. A "circuit component" is a *part* of a circuit. A "passive" component is one which does *not* cause electrons to flow. Copy the names of the five "passive" components that you circled in 5c:

7. Two conditions are necessary for an electron pressure difference to exist between two terminals of a passive component: First, there must be a _____ through the component. Second, the component must have the property mentioned on this page called "_____".

8. To find out if a passive component has resistance, we must cause charge to _____ through it and measure the _____ difference between its _____s with a _____meter. We say that the component's resistance is "great" if the _____ _____ is great and the _____ is small.