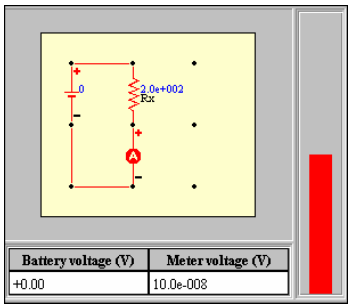
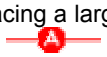
Worksheet for Exploration 30.5: Voltmeters

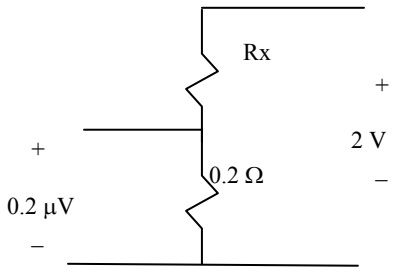


A voltmeter measures the voltage across a circuit element and therefore is put in parallel with that element. We can construct a voltmeter by placing a large resistor in series with the galvanometer, which is indicated by  (an ammeter symbol) in the circuit because a galvanometer and an ammeter are essentially the same (see Exploration 30.4). In this example the galvanometer shows a full-scale indication at a current of 1 μA and the internal resistance of the galvanometer is 0.2 Ω.

a. What voltage across the galvanometer produces a full-scale reading?

If we want to measure battery voltages of up to 2 V, we'd want the galvanometer needle to give a full-scale indication at this voltage. This means that 0.2 μV must drop across the galvanometer (with a current of 1 μA) while 1.9999998 V must drop across the series resistor. Restart.

b. Calculate the value of the series resistor required to produce a full scale reading when the input voltage is 2 V. Test to see if you get the appropriate reading for a range of battery voltages. (Use the *set values* button.) Specifically, check that, for a battery voltage of 1 V, you get a half-scale reading on the indicator bar.



c. What would the ideal value of internal resistance for a voltmeter be and why?