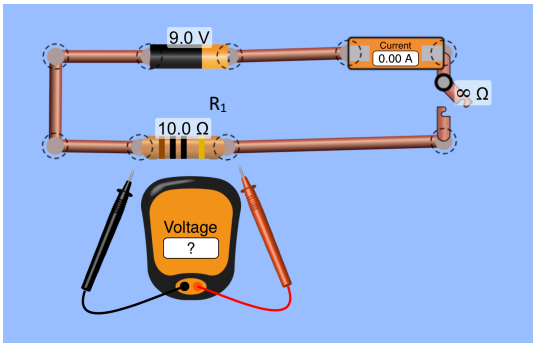
Electric power (in watts) is the *rate* at which *energy flows* in a circuit. As current flows in a circuit, it carries electric energy with it – if we take the time for this into consideration we can say – an electric current delivers power to the circuit. Power $\mathbf{P = I.V = V^2 /R = I^2. R}$

A current I from a battery of voltage V delivers power I.V to the circuit in which it flows. As the current flows through a resistor R, some energy is consumed by the resistor or I^2. R is the power dissipated in the resistor. Or another way to say this is -- as current flows through a device of resistance R and with a voltage drop v across it, power v^2/R is consumed by the device.

Power transferred to a resistor is usually converted to heat. In a light bulb it is eventually converted to light energy. So, the brightness of a bulb is a measure of the power delivered to it by the circuit current.

1. Build the circuit shown with a 9V battery. Connect the ammeter to read the battery current.



a. The battery current I = _____A.

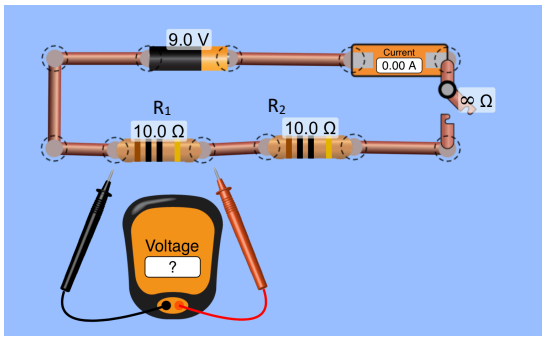
b. The power delivered by the battery is I.V = _____watts.

c. Measure the voltage across the resistor R_1, v = _____v.

d. The power dissipated in the resistor is v^2/R_1 = _____watts.

Q1. Compare the power in 1b and 1d. What does this tell you?

2. Add a second 10Ω resistor to the circuit as shown.



a. The battery current I = _____A.

b. The power delivered by the battery is I.V = _____watts.

c. Measure the voltage across the resistor R_1, v_1 = _____v.

d. The power dissipated in the **resistor R_1** is v_1^2/R_1 = _____watts.

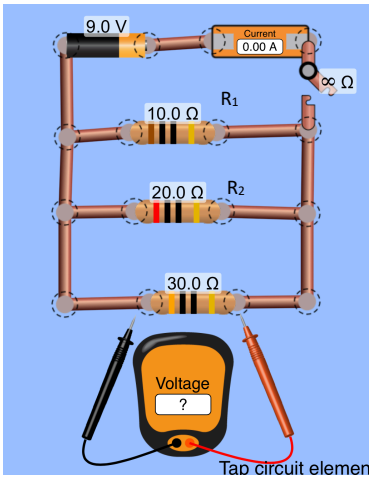
e. Measure the voltage across the resistor R_2, v_2 = _____v.

f. The power dissipated in the **resistor R_2** is v_2^2/R_2 = _____watts.

Q2. Add the power in 2d. and 2f. and compare it with 2b. What does this tell you?

Q3. Compare 1d and 2d. If more and more resistors are added in series to the circuit, how does the power dissipated in resistor R_1 change?

3. Build the circuit shown with resistors in parallel.



a. The battery current I = _____A.

b. The power delivered by the battery is
I.V = _____watts.

c. Measure the voltage across the resistors and calculate the power dissipated in each of them:

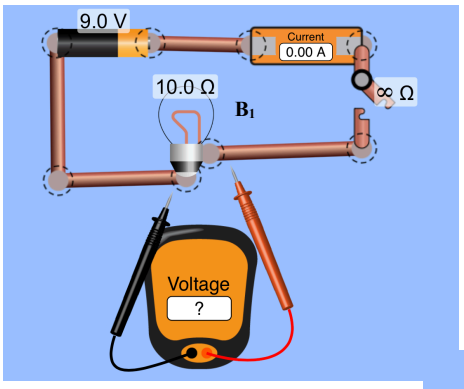
	Voltage	Power = v^2/R
R_1		
R_2		
R_3		

d. Add the power in the 3 resistors in the table and compare to 3b.

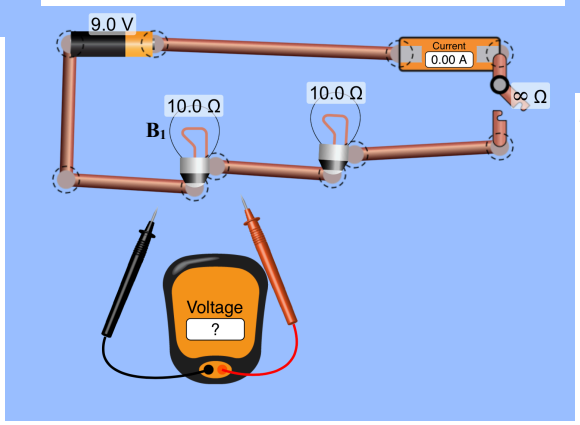
4. Compare the power dissipated in R_1 in the three different circuits (1d, 2d, 3c). What can you conclude?

	power = v_1^2 / R_1
simple	
series	
parallel	

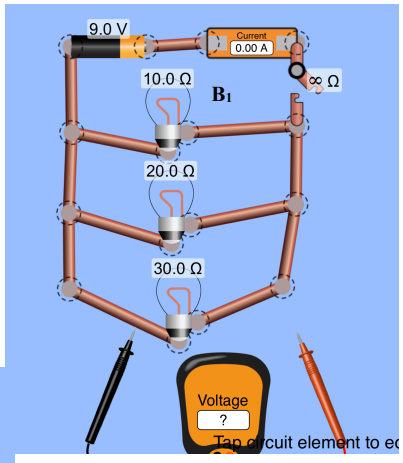
5. Bulb **B_1** is connected in three different circuits. Build the circuits and compare the **brightness** of this bulb in the three circuits. In which one will **B_1** be the brightest and in which will it be the dimmest? Explain. *(Tap on the bulb to change resistance.)*



simple circuit 1



series circuit 1



Parallel circuit 1

Q4. Five **identical** bulbs are connected together either in series or parallel. Rank the brightness of the bulbs in the table, from the brightest one to dimmest one. Put an '=' sign between any two that share the same brightness.

brightest				*dimmest*