

15 Electrical Circuits

Name _____

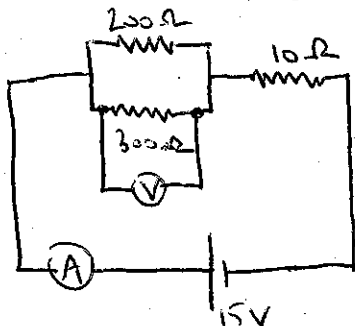
Key

Worksheet C: COMBINATION CIRCUITS, POWER IN CIRCUITS, CAPACITORS

AP Physics B

1. A $200\ \Omega$ and a $300\ \Omega$ resistor are connected in parallel. This parallel arrangement is connected in series with a $10.0\ \Omega$ resistor. The total potential difference per unit charge in this circuit is $15.0\ \text{V}$, which is supplied by an arrangement of six $5.00\ \text{V}$ dry cells.

- a. Draw a diagram of the circuit, including how the six $5.00\ \text{V}$ cells could be arranged to provide $15.0\ \text{V}$. Include in your diagram an ammeter that would measure total current (see part d below) and a voltmeter that could measure the voltage across a parallel resistor (see part f below).



- b. What is the effective resistance of the parallel portion of the circuit?

$$\frac{1}{R} = \frac{1}{200} + \frac{1}{300}$$

$$R = 120\ \Omega$$

- c. What is the effective resistance of the entire circuit?

$$R = 120 + 10 = 130\ \Omega$$

- d. What is the total current in the entire circuit?

$$I = \frac{V}{R} = \frac{15\ \text{V}}{130\ \Omega} = 0.1154\ \text{A}$$

- e. What is the voltage drop across the $10.0\ \Omega$ resistor?

$$V = IR = (0.1154)(10) = 1.154\ \text{V}$$

- f. What is the voltage drop across the parallel portion of the circuit?

$$V = 15\ \text{V} - 1.2\ \text{V} = 13.846\ \text{V}$$

- g. What is the current through the $200\ \Omega$ resistor?

$$I = \frac{V}{R} = \frac{13.8\ \text{V}}{200\ \Omega} = 0.0692\ \text{A}$$

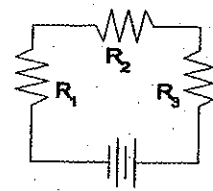
- h. What is the current through the $300\ \Omega$ resistor?

The correct answer is $0.0462\ \text{A}$.

$$I = \frac{V}{R} = \frac{13.8}{300} = 0.0462\ \text{A}$$

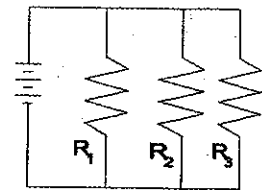
2. Fill out the table for the circuit diagramed at right. USE PROPER SIG FIGS

Circuit Position	Voltage (V)	Current (A)	Resistance (Ω)
1	1	0.1	10.0
2	2	0.1	20.0
3	3	0.1	30.0
Total	6.00	0.1	60



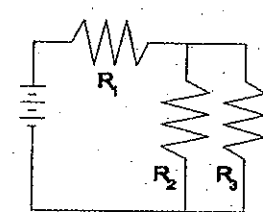
3. Fill out the table for the circuit diagramed at right. USE PROPER SIG FIGS

Circuit Position	Voltage (V)	Current (A)	Resistance (Ω)
1	6	0.6	10.0
2	6	0.3	20.0
3	6	0.2	30.0
Total	6.00	1.1	5.45



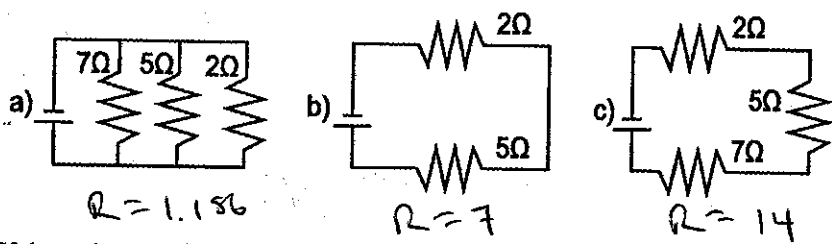
4. Fill out the table for the circuit diagramed at right. USE PROPER SIG FIGS

Circuit Position	Voltage (V)	Current (A)	Resistance (Ω)
1	2.7	0.27	10.0
2	3.3	0.16	20.0
3	3.3	0.11	30.0
Total	6.00	0.27	22



A

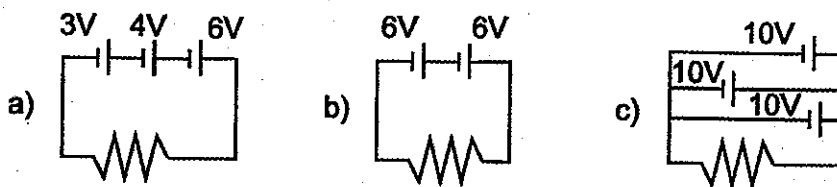
5. If the cells are identical, which circuit would draw the most current from the cell?



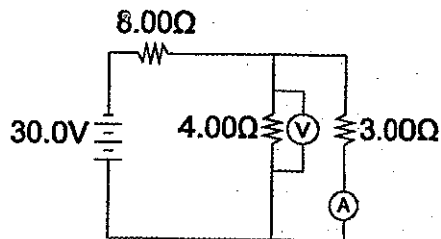
lowest R
draws largest I

X

If the resistors are identical, which circuit would have the lowest overall change in electrical potential energy per unit charge?



7. Use the diagram of the complex circuit to answer the following questions. You may use a table to guide your work, but you must show all relevant equations and calculations in the spaces below.



- a) What is the effective resistance of the parallel part of the circuit?

$$\frac{1}{R} = \frac{1}{3} + \frac{1}{4} \quad R = 1.714 \Omega$$

- b) What is the total resistance of the entire circuit?

$$R = 8 + 1.714 = 9.714 \Omega$$

- c) What is the reading on the voltmeter? (You may use a table to guide your approach, but you must separately show all equations and calculations.)

$$I = \frac{V}{R}$$

$$= \frac{30}{9.714}$$

$$V_s = IR$$

$$= (3.09)(8)$$

$$V_s = 24.71 V$$

$$V_p = 30 - 24.71 = \boxed{5.29 V}$$

$$I = 3.09 A$$

- d) What is the reading on the ammeter?
The correct answer is 1.76 A.

$$I = \frac{V}{R} = \frac{5.29}{3} = 1.76 A$$

POWER IN CIRCUITS:

8. Fluffy's shock collar (she meows too much) delivers a current of 0.0600 A and runs on a 9.00 V battery.

- a) What is the power of the collar circuit in watts?

$$P = IV$$

$$= (0.06)(9) = 0.54 W$$

- b) Over a three month period the collar is in operation for a total of 600 seconds. How many joules of electrical energy were consumed during that period of time? SHOW THE EQUATION

$$E = P \cdot t$$

$$= (0.54)(600) = 324 J$$

- c) A typical 9.00 V battery might cost \$2.40 and provide 19,250 J of energy. What is the cost of running the shock collar as described in parts a and b?

$$\frac{324}{19250} \times \$2.40 = \$0.04$$

