PHYSICS CIRCUITS STUDY GUIDE

Name: Key

Equations

$$\Delta V = IR \qquad R_{eg} = R_1 + R_2 + \cdots + R_n \qquad \frac{1}{R_{eg}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

Things you should be able to do / know / understand!

- ☐ Use Ohm's Law to calculate potential difference across a resistor, current through a resistor, or the value of a resistor.
- ☐ Use power and its different "flavors" to solve problems
  - o Knowing which equation of power to use when solving conceptual problems.
- ☐ Identify the type of circuit (series/parallel)
- ☐ Find total resistance in a circuit (series and parallel)
- ☐ Know the properties of a series and parallel circuit
- ☐ Use the properties of a series and parallel circuit to solve for unknown quantities
- ☐ Know how to use a voltmeter and ammeter to measure voltage and current respectively in a circuit

Problems

1. For each term, write a brief definition, write its variable and the unit that it is measured in.

Term	Variable	Measuring Unit	Definition
Current	I	Amps, A	flow of electricity (electrons)
Voltage	V	Volts, V	Potential Energy of circuits
Resistance	R	Ohms, Ω	Uses electricity, slows the flow

2. What is the equation for Ohm's Law? What is the relationship between voltage, current, and resistance?

$V = IR$ If... V↑ then I↑ ; I↑ then R↓
V↑ then R↑

3. If 0.2 A of current is drawn by a lamp when a voltage of 12 V is used, what is the resistance?

$\frac{12V}{0.2A} = \frac{0.2AR}{0.2A}$ $R = 60\,\Omega$

4. What is the resistance of an electric frying pan that draws 12 A when connected to a 120 V circuit?

$\frac{120V}{12A} = \frac{12AR}{12A}$ $R = 10\,\Omega$

5. At a resistance of 100,000 Ω, what will be the current in your body if you touch the terminals of a 12-volt battery?

$\frac{12V}{100{,}000\,\Omega} = \frac{I(100{,}000\,\Omega)}{100{,}000\,\Omega}$ $I = 1.2 \times 10^{-4}$ Amps

Circuit Basics –

6. What is the schematic symbol for a battery?

7. What is the schematic symbol for a resistor or a lightbulb?

V = 0.1 (10)

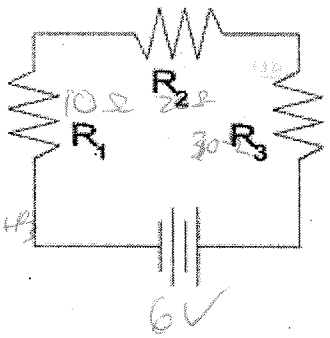
8. Fill out the table for the circuit diagramed at the right.

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

V=IR → 1 ; V=IR → 2 ; V=IR → 3 ; V=IR → Battery

6V = I 60Ω

$R_{tot} = R_1 + R_2 + R_3$



Which of the lightbulb would be the brightest?

Bulb 3 → highest Voltage and same currents

(6) = I (10)

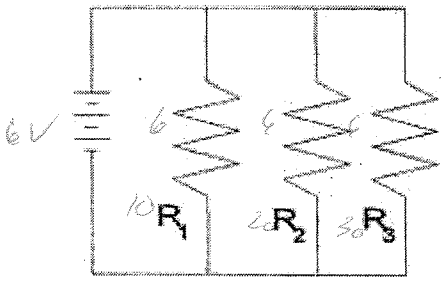
9. Fill out the table for the circuit diagramed at the right.

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

V=IR → 1 ; V=IR → 2 ; V=IR → 3 ; V=IR → Battery

$I_{tot} = I_1 + I_2 + I_3$

6 = 1.1 R



Which of the lightbulb would be the brightest?

Bulb 1 - Same Voltage, higher current

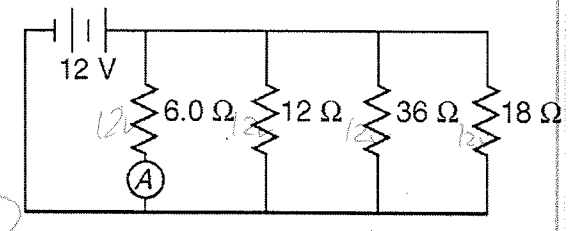
Questions 10 and 11 refer to the following:
The diagram to the right represents an electric circuit consisting of four resistors and a 12-volt battery.

10. What is the equivalent resistance of the circuit shown?

(total)

$\frac{1}{R_{tot}} = \frac{1}{6} + \frac{1}{12} + \frac{1}{36} + \frac{1}{18} = \frac{1}{3}$

$R_{tot} = 3\Omega$



11. What is the current measured by ammeter *A* shown in the diagram?

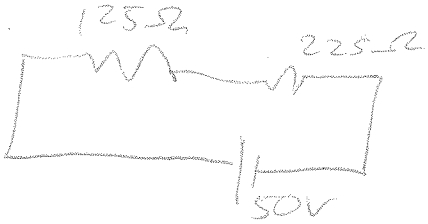
V = IR

$\frac{12}{6} = \frac{I(6)}{6}$

I = 2 Amps

12. A circuit with a 50.0-V battery consists of a series combination of two lamps with resistances of 125 Ω and 225 Ω.

a. Draw the circuit and calculate all values.



b. What is the total resistance of the circuit?

350Ω

125 + 225 = 350

c. What is the current in the circuit?

$\frac{50}{350} = \frac{I\,350}{350}$

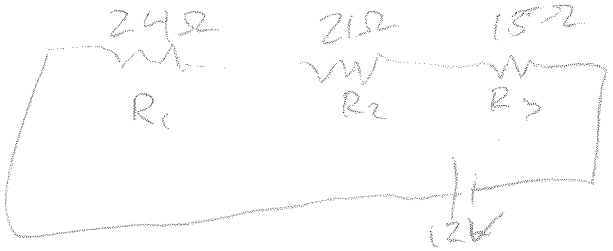
I = 0.14 amps

d. What is the voltage across the 125-Ω lamp?

V = IR

(0.14)(125) = 17.5V

13. A circuit with a 12-V battery consists of a series combination of three resistances are 15 Ω, 21 Ω, and 24 Ω, respectively.
    a. Draw the circuit and calculate all values.



	V	I	R
R_1	4.8V	0.2A	24 Ω
R_2	4.2V	0.2A	21 Ω
R_3	3V	0.2A	15 Ω
Tot	12V	0.2A	60Ω

12 = I 60

    b. What is the total resistance of the circuit?

24 + 21 + 15 = 60Ω

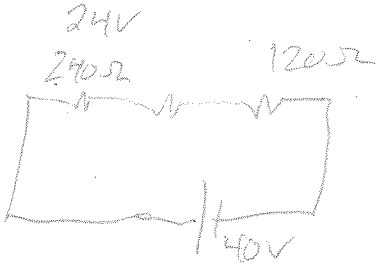
    c. What is the magnitude of the circuit current?

12 = I 60 I = 0.2A

    d. If the resistors were lightbulbs, which would be the brightest? Which would be the dimmest?

R_1 = Brightest (biggest V) R_3 = Dimmest (lowest V)

14. A circuit with a 40-V battery consists of a series combination of three resistances R_1, R_2, and R_3. R_1 is 240 Ω, and R_3 is 120 Ω. The voltage across R_1 is 24 V.
    a. Draw the circuit and calculate all values.



	V	I	R
R_1	24V	0.1V	240Ω
R_2	4V	0.1V	40Ω
R_3	12V	0.1V	120Ω
tot	40V	0.1V	400Ω

    b. Find the current in the circuit.

24 = I 240

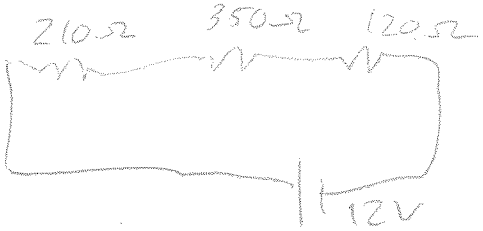
    c. Find the equivalent resistance of the circuit.

400 − 120 − 240 = 40Ω

    d. Find the resistance of R_2.

40 = 0.1 R

15. The load across a 12-V battery consists of a series combination of three resistances R_1, R_2, and R_3. R_1 is 210 Ω, R_2 is 350 Ω, and R_3 is 120 Ω.
    a. Draw the circuit and calculate all values.



	V	I	R
R_1	3.57V	0.017A	210Ω
R_2	5.97	0.017	350Ω
R_3	2.11V	0.017	120Ω
tot	12V	0.017A	680Ω

    b. What is the equivalent resistance of the circuit?

210 + 350 + 120 = 680

    c. What is the current in the circuit?

12 = I 680

    d. What is the voltage across R_3?

V = (0.017)(120)

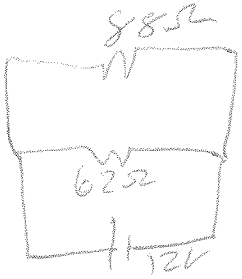
16. 18. Two resistances, one 12 Ω and the other 18 Ω, are connected in parallel. What is the equivalent resistance of the parallel combination?

$\frac{1}{12} + \frac{1}{18} = \frac{1}{R_{tot}} = \frac{5}{36}$ *flip $R_{tot} = 36/5\ \Omega$

17. Three resistances of 12 Ω each are connected in parallel. What is the equivalent resistance?

$\frac{1}{12} + \frac{1}{12} + \frac{1}{12} = \frac{1}{R_{tot}} = \frac{3}{12}$ $R_{tot} = \frac{12}{3} = 4\ \Omega$

18. Two resistances, one 62 Ω and the other 88 Ω, are connected in parallel. The resistors are then connected to a 12-V battery.
    a. Draw the circuit and calculate all values.



	V	I	R
R_1	12V	0.193A	62Ω
R_2	12V	0.136A	88Ω
tot	12V	0.329A	36.475Ω

    b. What is the equivalent resistance of the parallel combination?

$1/62 + 1/88 = 1/R_{tot}$ *flip

    c. What is the current through the 62 Ω resistor?

$12 = I(62) = 0.193\ A$

    d. What is the current through the 88 Ω resistor?

$12 = I(88) = 0.136A$

19. A 35-Ω, 55-Ω, and 85-Ω resistor are connected in parallel. The resistors are then connected to a 35-V battery.
    a. Draw the circuit and calculate all values.

	V	I	R
R_1	35V	1A	35Ω
R_2	35V	0.63A	55Ω
R_3	35V	0.41A	85Ω
Tot	35V	2.04A	17.15Ω

    b. What is the equivalent resistance of the parallel combination?

$1/35 + 1/55 + 1/85 = 1/R_{tot}$ *flip

    c. What is the current through the 35-Ω resistor?

$35 = I\ 35$

    d. What is the current through the 55-Ω resistor?

$35 = I\ 55$

    e. What is the current through the 85-Ω resistor?

$35 = I\ 85$

    f. If the resistors were lightbulbs, which would be the brightest? Which would be the dimmest?

35Ω = brightest (higher current)

85Ω = Dimmest (lowest current)