Conceptual Questions

1. Three lightbulbs are connected in series. One of the bulbs burns out. What happens to the other two?
They go dark.
2. How would the answer to the previous question be different if the bulbs were connected in parallel?
They stay lit.
3. What are the units for charge, energy, work, voltage (2 choices), current, resistance, and power (2 choices)?
symbol [unit]
$q[C]$, $U[J]$, $W[J]$, $V[V]$, $V[\frac{J}{C}]$, $I[A]$, $R[\Omega]$, $P[W]$
$P[\frac{J}{s}]$
4. Which circuit is more deadly, one with a high voltage and low current or one with a low voltage and high current?
Low voltage, high current
5. Connecting resistors in series will increase or decrease the total equivalent resistance of the circuit?
Increase
6. Connecting resistors in parallel will increase or decrease the total equivalent resistance of the circuit?
Decrease
7. How do you convert from a "mili" to base unit and vice versa? How do you convert from "kilo" to base unit and vice versa?
base → kilo (÷1000) base → mili (x1000)
kilo → base (x1000) mili → base (÷1000)
8. When resistors are connected in series they have the same ~~resistance~~ current.
9. When resistors are connected in parallel they have the same voltage.

Electricity Study Guide

10. What happens when a charged object is brought near i) and insulator ii) a conductor?

i) atoms become polarized, but electrons stay by their protons

ii) electrons move away from their protons in response to the charged object

11. What happens when two charged conductors touch?

electrons flow from one conductor to the other until the charge on each conductor is equal.

12. Which types of particles carry charge through an electric circuit (electrons, protons, or neutrons)?

electrons.

Computations

1. How much resistance is in circuit with a 9V battery and a current of 65mA?

$V = 9V$ $\quad I = 0.065A$

$V = IR$

$9V = (0.065A)R$

$R = \frac{9V}{0.065A} = 138.46\Omega$

2. How much current will a 60W lightbulb draw from a 110V outlet? How much resistance is in the lightbulb, assuming it obeys Ohm's Law?

$P = 60W$ $\quad V = 110V$

$P = IV$

$60W = I(110V)$

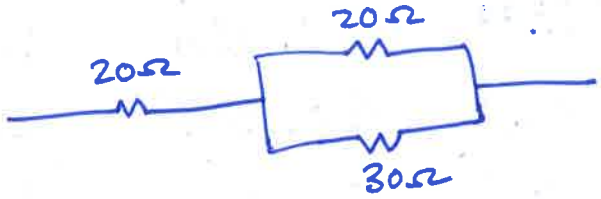
$I = \frac{60W}{110V} = 0.545A$

$V = IR$

$110V = (0.545A)R$

$R = 201.83\Omega$

3. What is the equivalent resistance of a 20Ω resistor connected in series with the parallel combination of a 20Ω resistor and a 30Ω resistor? 32Ω



$20\Omega \parallel 30\Omega = \frac{1}{\left(\frac{1}{20\Omega} + \frac{1}{30\Omega}\right)} = 12\Omega$

Electricity Study Guide

4. How many electrons pass through a point in a circuit every second if the current is 2A?

$I = \frac{q}{\Delta t}$

$2A = \frac{q}{1s}$ → $q = 2C$ (total charge)

electron charge $= 1.602 \times 10^{-19}$ C

electrons $= \frac{2C}{1.602 \times 10^{-19} C} = 1.25 \times 10^{19}$

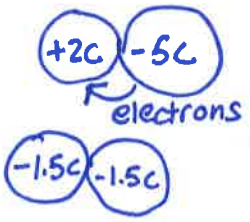
5. At what rate does a 12V battery transfer energy into a circuit with an equivalent resistance of 12kΩ?

$V = 12V$

$R = 12{,}000\ \Omega$

$P = \frac{V^2}{R} = \frac{(12V)^2}{12{,}000\ \Omega} = 0.012\ W$ or $\frac{J}{s}$

6. A conductor has a positive charge of +2C. It touches another conductor with a charge of -5C. After they touch, they are separated. What is the charge on each conductor?



Total Charge: $2C + (-5C) = -3C$

must be evenly distributed

$-3C/2 = -1.5\ C$ each

7. If the cost per kilowatt hour is $0.25, then how much money will it cost to run a 400W device for 3 hours a day for a whole month?

$P = 0.400\ kW$

$\Delta t = (3\ \frac{hrs}{day})(30\ days) = 90\ hrs$

30 days

$U = P\Delta t$

$U = (0.400\ kW)(90\ hrs)$

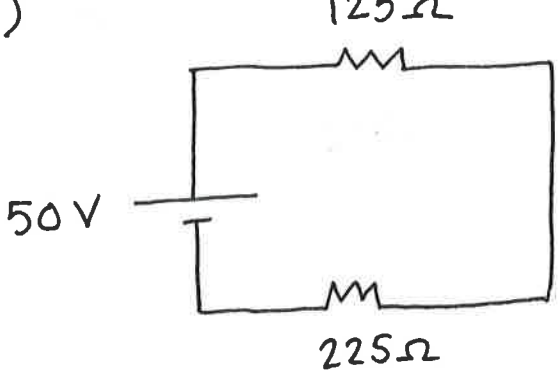
$U = 36\ kW \cdot hrs$

$cost = (36\ kW\cdot hrs)(\$.25\ /\ kW\cdot hr)$

$cost = \$9.00$

Circuit Analysis – Find all unknown voltages, currents, and resistors.

1)



	Voltage (V)	current (A)	resistance (Ω)
⑤	17.88	③ 0.143 A	125 Ω
⑥	32.18	④ 0.143 A	225 Ω
	50 V	② 0.143 A	① 350 Ω

① series formula for R_{eq}

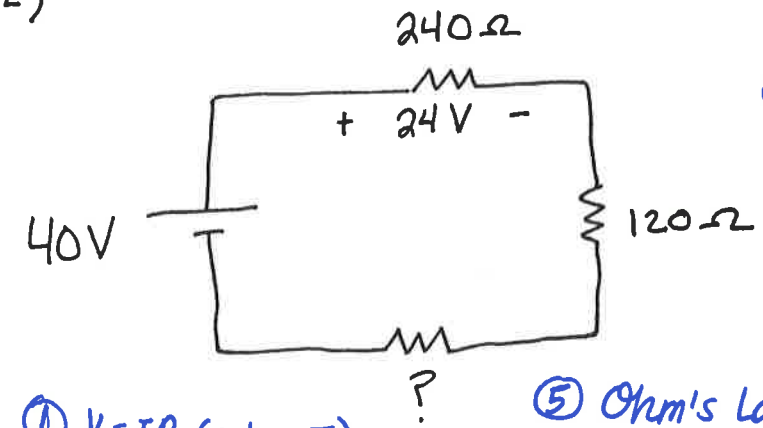
⑤, ⑥ $V = IR$ (solve V)

② $V = IR$ (solve I)

③, ④ series ⇒ same current

d all unknown currents, voltages, and resistances.

2)

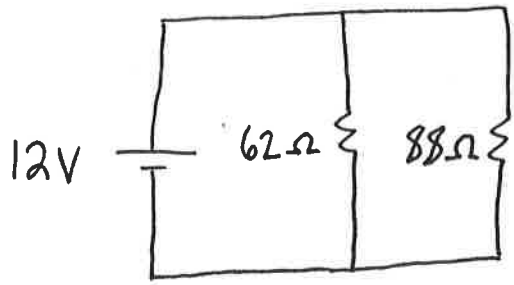


	Voltage (V)	Current (A)	Resistance (Ω)
	24 V	① 0.10A	240 Ω
⑤	12 V	② 0.10 A	120 Ω
⑥	4V	③ 0.10 A	⑦ 40 Ω
	40 V	④ 0.10 A	⑧ 400Ω

① $V = IR$ (solve I) ⑤ Ohm's Law $V = IR$ (solve V) ⑦, ⑧ $V = IR$ (solve R)

②, ③, ④ series ⇒ same I ⑥ 40V − 24V − 12V = 4V

3)

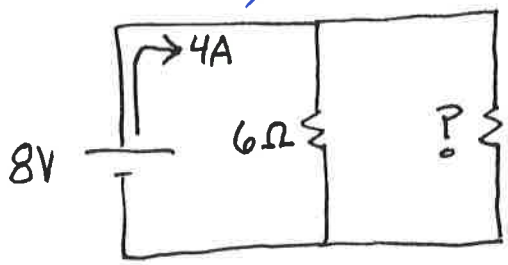


	Voltage (V)	Current (A)	Resistance (Ω)
①	12V	③ 0.194A	62 Ω
②	12V	④ 0.136A	88 Ω
	12 V	⑥ 0.330 A	⑤ 36.37Ω

①, ② parallel ⇒ same Voltage

③, ④ $V = IR$ (solve I) ⑤ R_{eq} (parallel formula) $V = IR$ (solve I)

4)

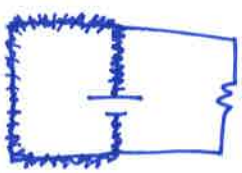
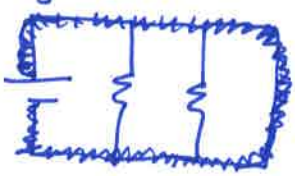
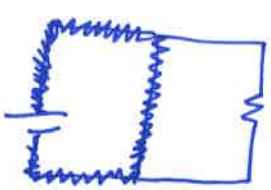


	Voltage (V)	Current (A)	Resistance (Ω)
②	8V	③ 1.333A	6 Ω
①	8V	④ 2.667A	⑤ 3 Ω
	8V	4A	⑥ 2Ω

①, ② parallel ⇒ same V ③ $V = IR$ (solve I) ④ 4A − 1.333A = 2.667A ⑤, ⑥ $V = IR$ (solve R)

5) What is a short circuit? Know how to identify one.

A short circuit contains a path from one side of the battery to the other with no resistance

(paths of no resistance are shown here)