Science 9

Chapter 9: Circuits are designed to control the transfer of electrical energy.
Chapter 9.1 (page 306) – Series and Parallel Circuits

1. In a ___________ circuit, there is only ___________ path for current to travel. The current is the ___________ in each part of a series circuit. Each ___________ in a series circuit uses a ___________ of the same source voltage. When a resistor is placed in series with other resistors, the total resistance of the circuit ___________. In a ___________ circuit, there is more than one ___________ for current to travel. The voltage across each resistor in a parallel circuit is the ___________. Current entering a parallel circuit must ___________ among possible paths. When you connect resistors in parallel, the total resistance ___________.

2. **Series circuit**: Circuit 1 (page 307)  
   a) Draw each circuit

   b) Example of series circuit (figure 9.1)  

   c) Define Series Circuit (use glossary)  

   d) Explain how a series circuit is different from a parallel circuit.

3. **Parallel circuit**: Circuit 2 (page 307)  
   a) Example of a parallel circuit (figure 9.2)  

   b) Define Parallel Circuit (use glossary)

4. Change in ___________ but ___________ remains the same (page 309 – figures 9.5 & 9.6) for each load.

5. f) When resistors are in series, the total resistance ___________. (page 310)  

   Change in ___________ but ___________ remains the same (page 312 – figures 9.9 & 9.10) for each load.

   When resistors are in parallel, the total resistance ___________. (page 313)  

   Total marks this page: /
3. Read page 309 and answer the following questions:
   a) What happens to the voltage across each load in a series circuit?

   ____________________________________________________________________

   b) Explain why current in a series circuit is the same no matter where you measure it.

   ____________________________________________________________________

4. Read page 312 and answer the following question:
   a) How does the drop in voltage across a load differ in a parallel circuit than in a series circuit?

   ____________________________________________________________________

   b) Fill in the blank: In a ____________ circuit, the current is the same throughout the circuit. This is because there is only ____________ path for the electrons to travel. In a ____________ circuit, the current ____________ into different ____________ that eventually rejoin. A pathway with _________ resistance will be able to have ____________ electrons travel on it and therefore will have a ____________ current than a pathway with more resistance.

   c) Define Junction point: ____________________________________________________________________

   d) Copy figures 9.9 and 9.10 into the space below. Show each junction point with a black dot.

   ____________________________________________________________________

   e) Fill in the blanks: Loads of different ____________ that are connected in ____________ will have different ____________. The total current entering a junction point must ____________ the ____________ of the current leaving the junction point.

   ____________________________________________________________________

   Total marks this page: 11
5. Formulas for circuits:

For a **series** circuit: Total voltage \( V_T = V_1 + V_2 + V_3 \)

For a **parallel** circuit: Total current \( l_T = l_1 + l_2 + l_3 \)

Answer the following questions: **SHOW ALL 4 STEPS**

a) If a series circuit has 3 resistors, each one with a 2 volt voltage drop, what is the total voltage of the circuit?

b) A series circuit has three loads. There is a voltage drop of 5 volts, 9 volts, and 10 volts. What is the total voltage of the circuit?

c) A 120 volt circuit has 10 equal lights all in series. What is the voltage drop across each light in the circuit?

d) Calculate the missing voltage of the circuit below.

![Circuit Diagram](image)

12 V

3 V

4 V

? V

e) A parallel circuit has 3 loads. Each load has a current of .5 amps going through it. What is the total amperage of the circuit?

f) Three loads in parallel have a current of .3 A, .5 A, and .7 A. What is the total current of the circuit?
g) A parallel circuit has 5 equal loads, with a total current of 4 A being drawn. What is the current going through any one load?

h) Calculate the missing current.

6. Do Reading Check on page 310. Do numbers 1, 3, 4, 5

1. 
2. 
3. 
4. 
5.

7. Do Reading Check on page 313. Do numbers 1, 2, 3, 6

1. 
2. 
3. 
4. 
5. 
6. 

8. Do Checking Concepts on page 319. Do number 1, 2, 5

1. 
2. 
3. 
4. 
5. 

Total marks this page: 15
9. Do Understanding Key Ideas on page 319. Do numbers 7, 8

7) Resistor 1 voltage = ______
   Resistor 1 current = ______  Explain why: ______________________________________
   Calculate the resistance of resistor 1  [Show work]

   Resistor 2 voltage = ______  Explain why: ______________________________________
   Resistor 2 current = ______  Explain why: ______________________________________
   Calculate the resistance of resistor 2  [Show work]

8) Resistor 1 voltage = ______
   Resistor 1 current = ______
   Calculate the resistance of resistor 1  [Show work]

   Resistor 2 voltage = ______  Explain why: ______________________________________
   Resistor 2 current = ______  Explain why: ______________________________________
   Calculate the resistance of resistor 2  [Show work]

10. In the space below draw a series circuit and a parallel circuit. Use 3 resistors for each, a battery and a switch.

    series  \                      \  Parallel

Total marks this page: 18
Section 9.2: The Power of Electricity (page 320)

1. Electrical ____________ is the ____________ at which electric potential energy is being ____________. One ____________ (____) of electric potential energy transformed in one ____________ is one ____________ (____) of power. Electrical power can be calculated by multiplying ____________ and ____________ (__________)_. The amount of electrical energy used by a device is its power consumption multiplied by the length of ____________ the device is turned on (__________). Since the joule is a very small amount of electrical energy, the ____________ (_____) is used for devices that consume larger amounts of electricity.

2. Define the following terms (include information on name of person) – pages 322 and 323:
   a) Power: _______________________________________________________________
   
   b) Joule: _______________________________________________________________
   
   c) Watt: _______________________________________________________________
   
   d) Electrical power: ____________________________________________________
   
   e) Power rating: ________________________________________________________

3. When doing any questions involving formulas, always complete the question using this 4 step method:
   
   Step 1: Write the correct formula arrangement down
   Step 2: Substitute known values for variables
   Step 3: Solve and include units
   Step 4: Write a sentence answering the question.

Each question will be worth 2 marks: You get ½ a mark per step.
Do Practice Problems (page 323) 1, 2, and 3 in the space below. Show all 4 steps!

1) 

2) 

3) 

4) A car fan draws 5 A and uses 60 W of power to operate. What is the voltage?

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4. Energy is the amount of power used over time. Energy is normally measured in joules (J). A joule is one watt of power used over one second of time. The problem with the joule is that it is a very small unit. So we use a different unit of energy called the kilowatt hour (kWh).

Power (P) should be in measured in watts and time (t) should be measured in seconds when calculating Energy in watts. When calculating Energy in kilowatt hours (kWh) power should be in kilowatts and time should be in hours.

\[
E = Pt = \frac{E}{P} \quad P = \frac{E}{t}
\]

1 kWh = 1 kilowatt x 1 hour = 1000 watts x 3600 seconds
So 1 kWh = 3,600,000 joules. Multiply by 3.6 million to convert kWh to joules, divide by 3.6 million for the reverse.

---

Do Practice Problems (page 324) 1, 2, and 3 in the space below. Show all 4 steps!

1) 

2) 

3) 

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Total marks this page: 8
5. Do the following problems. Show all 4 steps.

<table>
<thead>
<tr>
<th>a) An electric frying pan uses 1200 watts of power. How much energy is used in half an hour (calculate both joules and kWh).</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) John's stereo has two 5 watt speakers. How much energy does he use in 2 hours?</td>
</tr>
<tr>
<td>c) A 100 watt bulb is left on for a week. How much energy is used? (kWh)?</td>
</tr>
<tr>
<td>d) A 3 amp circuit runs on 120 volts for 5 minutes. Calculate the energy used.</td>
</tr>
<tr>
<td>e) 14400 joules of energy are used by a 60 watt bulb. How long was it on for? Calculate time in minutes.</td>
</tr>
<tr>
<td>f) An electric motor uses 2 kWh of energy. It runs for exactly one day. What is the power rating of the motor (answer in watts)? Give 1 decimal place.</td>
</tr>
<tr>
<td>g) A 5Ω resistor has a .5 A current running through it for 10 seconds. How much energy does it consume? (hint – do three separate calculations)</td>
</tr>
<tr>
<td>h) A fridge's motor is only on 10% of the time. If it is rated at 600 watts, how much energy does it use over a week? Answer in kWh.</td>
</tr>
</tbody>
</table>

Total marks this page: 1
6. How much power does your home electrical equipment use? Find 5 electrical devices at home (for example: hair dryer, toaster, battery charger, monitor, kettle, light) and record their power use / and or current use in the table below. Assume that it uses **120 volts to operate**. Calculate missing values. Complete the table. Two have been done for you. Show all your work in the table as illustrated.

<table>
<thead>
<tr>
<th>Electrical Device</th>
<th>Current (use A not mA)</th>
<th>Power</th>
<th>Energy for 1 hour of use (specify unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan</td>
<td>.6 A <em>(given on fan label)</em></td>
<td>( P = VI = 120 \times .6 = 72 \text{ watts} )</td>
<td>( E = Pt = 72 \times 3600 = 259200 \text{ J} )</td>
</tr>
<tr>
<td>60 watt light bulb</td>
<td>( I = \frac{P}{V} = \frac{60}{120} = .5 \text{ A} )</td>
<td>60 watts <em>(given on the light bulb)</em></td>
<td>( E = Pt = .060 \text{ kW} \times 1 = .060 \text{ kWh} )</td>
</tr>
</tbody>
</table>

7. Read Paying for Electricity on page 325. Answer the following questions:

   a) How does the power company tell how much energy you use at home? 

   b) What units do the energy meters measure in? 

   c) How much does the science book say energy costs per kilowatt hour? 

   d) **OPTIONAL** Ask permission to look at your house's BChydro bill. Find out what rate you are being charged (Step 1 _________  Step 2 _________)  Total kWh: _________

   Total amount paid for that: _________ Average price per kWh: _________

Total marks this page: _____
8. Use the formula to the left to answer the questions below. Use $.07 / kWh as the cost of energy. **Show all 4 steps.**

   a) Mary used 1420 kWh of energy one month. How much did she pay for her electric bill?

   b) A 100 watt bulb is left on for a week. How much money was spent to light the bulb? (hint: calculate Energy first).


<table>
<thead>
<tr>
<th>Appliance</th>
<th>Power (W) (convert to kW)</th>
<th>Time of use each day (h)</th>
<th>Energy (kWh)</th>
<th>Cost (cents) assume 7¢/kWh</th>
<th>Cost (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: Cell phone charger</td>
<td>50 w (given) =50 ÷ 1000 = .05 kW</td>
<td>4.5 hours</td>
<td>E = Pt = .05 x 4.5 = .225 kWh</td>
<td>cost = Ex$/kWh = .225 x 7 = 1.6 7¢</td>
<td>= 1.6 ÷ 100 = $.02</td>
</tr>
</tbody>
</table>
10. Do the following problems. Show all 4 steps. - Assume $.07 / kWh

a) A 1500 watt kettle takes 10 minutes to boil water. How much does it cost to run the kettle?

c) A fridge costs $2.80 to operate a month. If the fridge uses 500 w to operate, how many hours per month is it using electricity?

e) A set of Christmas lights has 24 light bulbs in series, each bulb has 100 ohms of resistance. The chain of lights is on for 31 days in a row. What is the cost of operating them? (hint – assume 120 volts, first determine circuit resistance, then current. Then calculate power then energy, finally calculating cost. -- pay attention to units --)

b) A compact fluorescent bulb uses 15 watts of energy instead of the 60 watts an incandescent bulb uses. How much does it cost to operate it 20 hours per month? How much money was saved?

d) Gary uses a 1000 watt hair dryer every day for 6 minutes. How much does that cost him each year?

11. Make notes on Electrical Surges (page 326). You should have at least 4 facts.
12. Do Reading Check on page 326. Do numbers 1 and 2.  
   Full Sentences.
   
   1.
   
   2.

13. Do Checking Concepts on page 329. Do numbers 1, 2, 3, 4, 5, 6  
   Full Sentences.
   
   1.
   
   2.
   
   3.
   
   4.
   
   5.
   
   6.

14. Do Understanding Key Ideas (page 331). Do numbers 19, 20, 21, 22. Use the back of this page if you need more room.  
   Show all work.

   19.

   20.

   21.

   22.

Total marks this page: / 21