

Name \_\_\_\_\_ Section \_\_\_\_\_

## Activity 1: Introduction to Physics 104

### 1.1 Review of Ratio Reasoning and Efficiency

Your instructor will review ratios and the efficiency of energy processes.

1) **Efficiency of light bulbs** Compare the relative efficiencies of an incandescent bulb and a compact fluorescent bulb.

a) Using a wattmeter, measure the power required by an incandescent bulb. \_\_\_\_\_

b) Measure the power required by a compact fluorescent bulb. \_\_\_\_\_

c) Measurements have shown that each of these bulbs produce 6 watts of visible light. Calculate the efficiency of the incandescent bulb.

d) Calculate the efficiency of the compact fluorescent bulb.

e) How do the efficiencies of the bulbs compare?

f) Group Discussion Question: Why is the compact fluorescent bulb so much more efficient than the incandescent bulb?

### 2) Generating electricity with the exercise bicycle

a) If five 50-watt bulbs are lit, how many kilowatts of electricity are generated?

b) If you ride the bicycle and generate this much electricity for 8 hours, how many kilowatt hours of electricity have you generated?

c) If you sold the electricity you generated for \$0.10/kWh, how much money would you receive for it?

## 1.2 Linear and Exponential Growth Rates and Exponential Decay

Your instructor will discuss linear and exponential growth and exponential decay.

### 3) Illustrating exponential decay

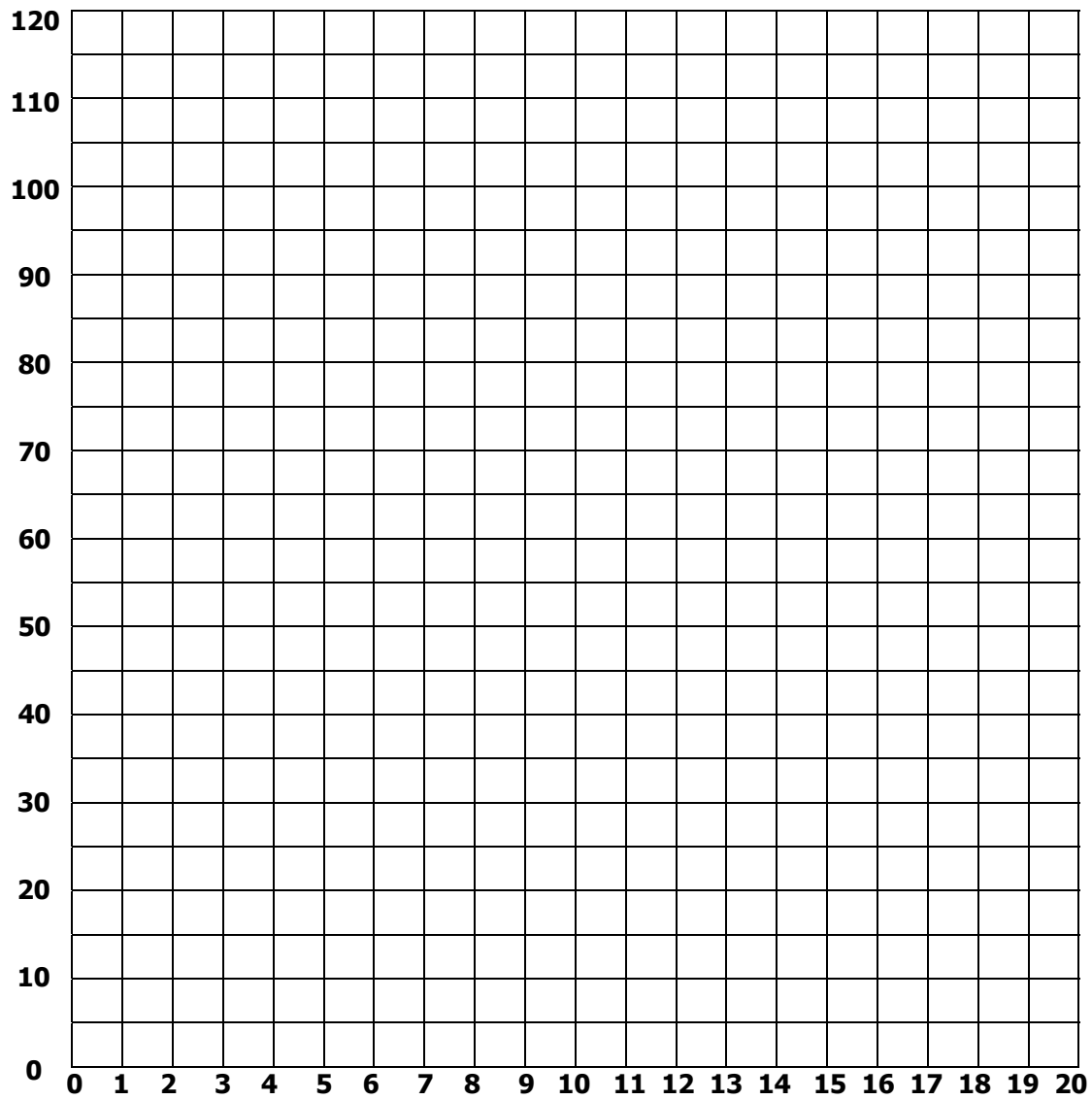
Roll the 20 dice in the plastic cup onto your table and remove any dice that land with a "1" showing. Repeat for 20 throws, each time removing any dice showing a "1." After each roll, record below the number of dice left after you remove the dice showing a "1." When each table has completed 20 throws, we will combine the data for all groups.

Roll	Dice Left Your table	Dice Left All tables		Roll	Dice Left Your table	Dice Left All tables
<b>1</b>				<b>11</b>		
<b>2</b>				<b>12</b>		
<b>3</b>				<b>13</b>		
<b>4</b>				<b>14</b>		
<b>5</b>				<b>15</b>		
<b>6</b>				<b>16</b>		
<b>7</b>				<b>17</b>		
<b>8</b>				<b>18</b>		
<b>9</b>				<b>19</b>		
<b>10</b>				<b>20</b>		

- a) Using the totals for all groups, plot the number of dice left versus the number of rolls of the dice on the grid on the next page.

What type of change does this graph line represent? \_\_\_\_\_

- b) What is the halving time in terms of the number of rolls? \_\_\_\_\_



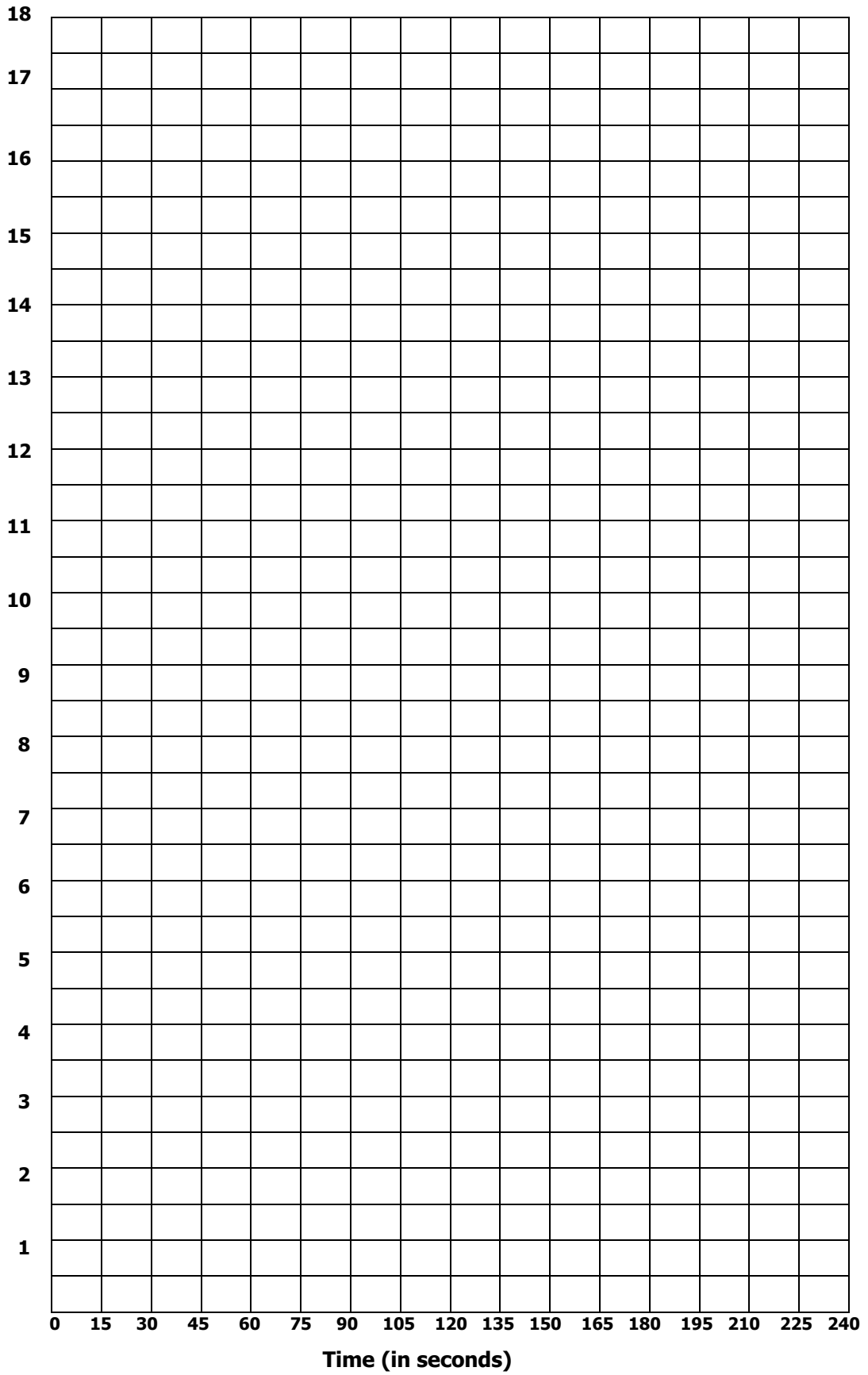
**Exponential decay of a capacitor**

Your instructor will explain how to measure the rate of discharge of a capacitor.

- a) After charging the capacitor, flip the switch to the right to allow the capacitor to discharge through the resistor. At the same time, start the timer. Measure the voltage with a multimeter set to measure DC voltage (  $V_{\text{DC}}$  ) every 15 seconds for four minutes. Record your measurements in the table below.

<b>Time elapsed (Min: Sec)</b>	<b>Voltage (volts)</b>		<b>Time elapsed (Min: Sec)</b>	<b>Voltage (volts)</b>
<b>0:00</b>			<b>2:15</b>	
<b>0:15</b>			<b>2:30</b>	
<b>0:30</b>			<b>2:45</b>	
<b>0:45</b>			<b>3:00</b>	
<b>1:00</b>			<b>3:15</b>	
<b>1:15</b>			<b>3:30</b>	
<b>1:30</b>			<b>3:45</b>	
<b>1:45</b>			<b>4:00</b>	
<b>2:00</b>				

- b) Make a graph on the grid on the next page of the voltages you measured versus time elapsed.



c) Use your graph to find the half-life of the capacitor discharge. \_\_\_\_\_

### 1.3 How Is Electric Current Generated?

#### 5) **Generating an electric current**

- a) Connect the tan coil of wire to the large galvanometer that measures electric current. Move a magnet near and into the wire coil. Describe what happens.
  
- b) Hold the magnet still and move the coil of wire. Describe what happens.
  
- c) What happens if neither the magnet nor the wire is moving?
  
- d) What must happen in a power plant to generate electricity?

#### 6) **Magnetic Force on a Current** Your instructor will review induced current and induced magnetic fields.

- a) Place a wire between the ends of a large C shaped magnet. Briefly touch the ends of the wire to both terminals of a 3 battery tray. What happens to the wire?
  
- b) Change the direction of the current flowing through the wire by switching the leads to the battery. Describe what happens when you touch the end of the wire to the battery.
  
- c) What causes the wire to move?

#### 7) **Induced Current and Magnetic Forces** Your instructor will demonstrate a large solenoid with an iron core, which is connected to a variable current source.

- a) What happens when a solid ring is placed over the solenoid?
  
- b) What happens when a ring with a slit is placed over the solenoid?

**8) Measuring and Calculating Electric Currents**

- a) Plug the incandescent light bulb into the wattmeter. Measure the current through the bulb. \_\_\_\_\_
- b) How many coulombs of charge per second flow through this circuit?
- c) An electron has a charge of  $1.60 \times 10^{-19}$  coulombs. How many electrons per second move through this circuit?

**1.4 Radiant Energy and the Electromagnetic Spectrum****9) Vibrating electric charges**

Your instructor will demonstrate the effect on a radio of electromagnetic radiation produced by vibrating charge.

- a) What happens to the radio broadcast when the radio antenna receives electromagnetic radiation from the spark of the Wimshurst machine?
- b) How did energy from the separated charges on the Wimshurst machine reach the radio?
- c) We have seen that moving electric charge produces an electric current. What type of energy does vibrating electric charge produce?

**10) Examples of electromagnetic radiation** Your instructor will demonstrate the different types of radiant energy (electromagnetic radiation)

- a) **Radio waves** Which devices operate using radio waves?
- b) **Microwaves** Which devices use microwaves?

**c) Infrared radiation**

- 1) Which devices illustrate infrared radiation?
- 2) How do we experience this type of electromagnetic radiation? If you closed your eyes, how could you tell if an incandescent light bulb was lit?

**d) Visible light**

- 1) Your instructor will demonstrate a large bulb. Can a bulb that does not appear to be lit radiate energy? If so, what type of radiant energy?
- 2) Observe the bulb through a diffraction grating as your instructor slowly increases the energy to the bulb.
  - a) What are the major colors of the light do you observe?
  - b) Why is the portion of the spectrum just below the visible spectrum named "infrared"?
  - c) What are the major colors you observe when the energy to the bulb is increased further?
  - d) Why is the portion of the spectrum beyond the visible spectrum named "ultraviolet"?

**e) Ultraviolet light** Which devices illustrate ultraviolet radiation?**f) X-rays** What are some uses of X – ray radiation?**g) Gamma rays** Describe what happens when a Cobalt-60 sample is held near a Geiger counter.