

Name: _____ Date: _____ Period: _____

Graded problems are worth 2 points each. This assignment is graded out of **24** points.

- 1) **Graded.** What happens to the current in a circuit if the voltage remains the same, but the power increases? (For instance, if you replace a 60 W bulb with a 100 W bulb.)?
 - a. The current increases
 - b. The current decreases
 - c. The current stays the same
 - d. Not enough information.

- 2) **Graded.** At home, your mother replaces a “normal” 100 W bulb in the living room with a 26 W high-efficiency bulb to save money. Which of the following is TRUE?
 - I. The flow of current decreases
 - II. The power consumed by the circuit is decreases
 - III. The voltage in the circuit decreases
 - a. I only
 - b. II only
 - c. III only
 - d. I and II
 - e. I and III

- 3) Which of the following methods will reduce the amount of energy consumed **the most**?
 - a. Reduce the power rating of the device and reduce the usage time of the device
 - b. Reduce the power rating of the device and increase the usage time of the device
 - c. Increase the power rating of the device and reduce the usage time of the device
 - d. Increase the power rating of the device and increase the usage time of the device
 - e. All the above will reduce the amount of energy the same amount.

- 4) Most washing machines in the USA are plugged into 220 V power sources. How much current does one such 750 W washing machine consume?

- 5) **Graded.** A microwave oven, plugged into a 120 V power source, consumes 1300 W of power. How much current does the microwave oven draw?
- 6) A small bulb draws 0.75 A of current when hooked up to a 1.5 V battery. How much power does it consume?
- 7) **Graded.** A cooling fan inside a computer draws 1.5 A of current. The power supply it is hooked up to is a 10 V power supply. How much power does the fan consume?
- 8) Your electric bill for the month of May is \$73.45. If the cost of electricity is $\frac{\$0.32}{kWh}$, how much energy did your house consume in May?
- 9) **Graded.** City Hall's electric bill for the month of April is \$3,493.35. If the cost of electricity for public buildings is $\frac{\$0.22}{kWh}$ (they get a discount), how much energy (in kilowatt-hours) did City Hall consume in April?

A hair dryer manufactured in the USA (120 V) is designed to draw 10 A of current in order to work. If it draws more than 13 A of current, it will break (possibly catch fire). The cost of electricity is $\frac{\$0.31}{kWh}$. Use this information for 10) through 14).

10) How much power does the typical USA-made hair dryer consume?

11) If you plug a USA-made hair dryer into a 200 V outlet (the voltage in some parts of Asia and Africa), will it break?

12) How much energy, in kilowatt-hours, does the hair dryer consume if it is used for 0.25 hours?

13) How much money does it cost to run the hair dryer for 0.33 hours?

14) How much money does it cost to run the hair dryer for 12 minutes?

- 15) (*For setup info, see previous page.*) Assuming that the power consumption of the hair dryer never changes, How much would it cost to run a typical USA-made hair dryer for 15 minutes if the outlet voltage were 90 V instead?

A hair dryer manufactured in France (220 V) is designed to draw 8 A of current in order to work. If it draws more than 12 A of current, it will break (possibly catch fire). The cost of electricity in France is equivalent to $\frac{\$0.28}{kWh}$. Use this information for 16) through 22).

- 16) **Graded.** How much power does the typical French hair dryer consume?

- 17) **Graded.** If you use a French hair dryer in the USA (120 V), will it break?

- 18) **Graded.** What is the range of voltages that the French hair dryer can operate in? (*The power that you figured out in 16) does not change.* Give both minimum and maximum values)

- 19) **Graded.** How much energy does the hair dryer consume if it is used for 0.15 hours?

20) **Graded.** How much energy does the hair dryer consume if it is used for 25 minutes?

21) **Graded.** How much does it cost (in dollars) to run the hair dryer (in France) for 0.20 hours?

22) **Graded.** How much does it cost (in dollars) to run the hair dryer (in France) for 8 minutes?

Selected Answers

3) Which of the following methods will reduce the amount of energy consumed **the most**?

a. Reduce the power rating of the device and reduce the usage time of the device

4) Most washing machines in the USA are plugged into 220 V power sources. How much current does one such 750 W washing machine consume?

$$I = \frac{P}{V} = \frac{750 \text{ W}}{220 \text{ V}} = 3.41 \text{ A}$$

6) A small bulb draws 0.75 A of current when hooked up to a 1.5 V battery. How much power does it consume?

$$P = I \times V$$

$$P = 0.75 \text{ A} \times 1.5 \text{ V} = 1.125 \text{ W}$$

8) Your electric bill for the month of May is \$73.45. If the cost of electricity is $\frac{\$0.32}{\text{kWh}}$, how much energy did your house consume in May?

This problem lends itself very well to using proportions, since you know how much money it costs for one kilowatt-hour.

$$\frac{\$0.32}{1 \text{ kWh}} = \frac{\$73.45}{x}$$

$$x \times \$0.32 = (\$73.45 \times 1 \text{ kWh}) = \$73.45 \text{ kWh}$$

$$x = \frac{\$73.45 \text{ kWh}}{\$0.32} = 229.53 \text{ kWh}$$

A hair dryer manufactured in the USA (120 V) is designed to draw 10 A of current in order to work. If it draws more than 13 A of current, it will break (possibly catch fire). The cost of electricity is $\frac{\$0.31}{\text{kWh}}$. Use this information for 10) through 0.

10) How much power does the typical USA-made hair dryer consume?

$$P = IV = 10 \text{ A} \times 120 \text{ V} = 1200 \text{ W}$$

11) If you plug a USA-made hair dryer into a 200 V outlet (the voltage in some parts of Asia and Africa), will it break?

We need to find out how much current is drawn by the hair dryer if we use 200 V:

$$I = \frac{P}{V} = \frac{1200 \text{ W}}{200 \text{ V}} = 6 \text{ A}$$

No, the hair dryer will not break. However, the hair dryer will also not work, since the current that is drawn is below the minimum amperage necessary to make it work!

12) How much energy, in kilowatt-hours, does the hair dryer consume if it is used for 0.25 hours?

$$1200 \text{ W} = 1.2 \text{ kW}$$

$$1.2 \text{ kW} \times 0.25 \text{ h} = 0.6 \text{ kWh}$$

13) How much money does it cost to run the hair dryer for 0.33 hours?

First, find the energy consumed in the time given: $1.2 \text{ kW} \times 0.33 \text{ h} = 3.64 \text{ kWh}$

Next, use proportions to calculate the cost:

$$\begin{aligned} \frac{\$0.31}{\text{kWh}} &= \frac{\$x}{3.64 \text{ kWh}} \\ (\$0.31)(3.64 \text{ kWh}) &= (\$x)(1 \text{ kWh}) \\ \$1.13 \text{ kWh} &= (\$x)(1 \text{ kWh}) \\ \frac{\$1.13 \text{ kWh}}{1 \text{ kWh}} &= \$x = \$1.13 \end{aligned}$$

14) How much money does it cost to run the hair dryer for 12 minutes?

Use the same basic idea as in the previous question. However, we need to do the extra step of converting 12 minutes into hours.

$$\begin{aligned} \frac{60 \text{ minutes}}{1 \text{ hour}} &= \frac{12 \text{ minutes}}{x \text{ hours}} \\ x &= \frac{12}{60} = 0.2 \text{ hours} \end{aligned}$$

Now, use plug this time into the formulas we used above.

$$1.2 \text{ kW} \times 0.2 \text{ h} = 0.24 \text{ kWh}$$

$$\begin{aligned} \frac{\$0.31}{1 \text{ kWh}} &= \frac{\$x}{0.24 \text{ kWh}} \\ x &= \$0.07 \end{aligned}$$

15) Assuming that the power consumption of the hair dryer never changes, How much would it cost to run a typical USA-made hair dryer for 15 minutes if the outlet voltage were 90 V instead?

Convert the time: 15 minutes = 0.25 hours.

Since the power does not change, we still have 1.2 kW of power consumed for 0.25 hours. So, we do the same thing we did in the previous questions.

$$1.2 \text{ kW} \times 0.25 \text{ h} = 0.3 \text{ kWh}$$

$$\frac{\$0.31}{1 \text{ kWh}} = \frac{\$x}{0.3 \text{ kWh}}$$

$$x = \$0.09$$

However, there's a trick to this question. Let's examine the current that is drawn by the hair dryer if the voltage is 90 V:

$$I = \frac{P}{V} = \frac{1200 \text{ W}}{90 \text{ V}} = 13.3 \text{ A}$$

This current is greater than the 13 A limit of the hair dryer, and would cause the hair dryer to break. So, it would be impossible to run the hair dryer for 15 minutes!