

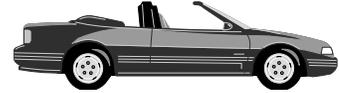
Name \_\_\_\_\_ Section \_\_\_\_\_

## 1103 Period 1: Intro to the World of Energy

### 1.1 What Are Ratios? How Are They Used?

- 1) **Ratios used to solve problems:** Your instructor will introduce the concepts of ratios and "per." Use this information to answer the questions in this section. Show your mathematical steps and the units of the quantities.

- a) A sports car uses 0.8 gallons of gas to travel 21 miles. How many miles per gallon does it get?



- b) How many gallons of gas does this sports car require to travel 243 miles?

- 2) **Ratios used to convert units:** Next we illustrate how ratios are used to convert units.

- a) Using the blue balances on your table, place washers in the center of one balance pan and plastic chips in the center of the other pan.

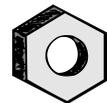
How many chips are required to balance one washer? \_\_\_\_\_

Write the number of chips per washer as a ratio. \_\_\_\_\_



Washer

- b) Using the balance, find how many chips are required to balance one metal nut. Write the number of chips per nut as a ratio. \_\_\_\_\_



Nut

- c) **Without using the balance,** calculate how many nuts there are per washer. Show the steps in your calculation, including units and how they cancel. \_\_\_\_\_

- d) Use the balance to check your answer to part c. How many nuts balance one washer? \_\_\_\_\_

- e) Use ratios to convert 10 miles/1 gallon of gas into kilometers/liter. Show the steps in the calculation, including units and how they cancel. (Hint: 1 mile = 1.609 kilometers and 1 gallon = 3.785 liters.)

- f) Group Discussion Question: List some common ratios. Why are ratios useful?

## 1.2 How are Ratios Used to Calculate Efficiency?

3) **Ratios used to find efficiency:** Your instructor will the efficiency of energy processes.

a) Connect one hand-cranked generator to a second hand-cranked generator. Turn the crank of the first generator **slowly** 10 full revolutions.

1) How many revolutions did the crank of the second generator turn?  
\_\_\_\_\_

2) Calculate the efficiency of the system of two generators when the first generator crank is turned slowly.

3) Turn the first generator's crank **rapidly** 10 full revolutions. How many revolutions did the crank of the second generator turn? \_\_\_\_\_

4) Calculate the efficiency when the first generator crank is turned rapidly.

5) Does the efficiency depend on the speed of the cranking? \_\_\_\_\_

Is it possible to turn the first generator crank 10 revolutions so rapidly that the second crank also turns 10 revolutions? \_\_\_\_\_ Why or why not?

b) Watch the demonstration of an exercise bicycle connected to light bulbs. The energy used to pedal the bicycle and to light the bulbs is measured in units of joules.

1) Each lit bulb requires 50 joules of energy per second. What is the total energy per second required to light all of the bulbs in this demonstration?  
\_\_\_\_\_

2) If the person pedaling the bicycle expends 1,300 joules of energy per second, what is the efficiency of the bicycle and light system when all the bulbs are lit?

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**1.3 How Do Exponents and Scientific Notation Simplify Calculations?**

**4) Exponents:** Your instructor will discuss the meaning of exponents. Use this information to calculate base 2 or base 10 raised to an exponential power.

a) Bill says that  $2^2 \times 2^3 = 2^{2 \times 3}$ . Denise says that  $2^2 \times 2^3 = 2^{2+3}$ . To decide whose method is correct, answer the questions below.

1) How much is  $2^2$ ? \_\_\_\_\_  $2^3$ ? \_\_\_\_\_  $2^2 \times 2^3$ ? \_\_\_\_\_

2) How much is  $2^{2 \times 3}$ ? \_\_\_\_\_

3) How much is  $2^{2+3}$ ? \_\_\_\_\_

4) Based on your calculations, which method is correct? State the rule for multiplying numbers with exponents.

5) Apply the rule you found for the base 2 to calculations using the base 10 raised to an exponential power.

How much is  $10^3 \times 10^6$ ? \_\_\_\_\_

b) Sarah says that  $10^6 / 10^2 = 10^{6/2}$ . Jason says that  $10^6 / 10^2 = 10^{6-2}$ . Based on your answer to question 4, predict the rule for dividing numbers with exponents. Then check your rule by using it to answer the questions below.

1) How much is  $10^6$ ? \_\_\_\_\_  $10^2$ ? \_\_\_\_\_  $10^6 / 10^2$ ? \_\_\_\_\_

2) How much is  $10^{6/2}$ ? \_\_\_\_\_

3) How much is  $10^{6-2}$ ? \_\_\_\_\_

4) State the rule for dividing numbers with exponents.

**5) Scientific notation:** Your instructor will discuss scientific notation.

Scientific notation usually means writing one digit to the left of the decimal times the base 10 raised to an exponential power. For example, in scientific notation  $13,300 = 1.33 \times 10^4$

Write each of the quantities below in scientific notation, as an integer, and in words. First find the answer **without** using a calculator. Then check your answer with a calculator.

Ex:  $(2 \times 10^2) \times (7 \times 10^4) = (2 \times 7) \times 10^{2+4} = 14 \times 10^6 = 1.4 \times 10^7 = 14,000,000 = 14 \text{ million}$

a)  $(5 \times 10^1) \times (3 \times 10^2) =$

b)  $(7 \times 10^3) \times (1 \times 10^{-3}) =$

c)  $(6 \times 10^3) / (2 \times 10^5) =$

d)  $(9 \times 10^6) / (3 \times 10^{-3}) =$

**6) Energy content of fuels:** Your instructor will discuss the energy content of some common fuels. Use this information, along with ratios and scientific notation, to make the comparisons below.

a) How many kilograms of wood are needed to produce the same amount of energy as 1 kg of coal?

b) An electric generating plant burns coal to produce electricity. If burning 1 kg of coal produces  $1.1 \times 10^7$  joules of energy, what is the efficiency of burning coal to produce electricity?

c) Group Discussion Question: Of the fuels listed in Table 1.3, which fuel contains the most energy per kilogram? How does the energy content of this fuel compare to the energy content of the fossil fuels – coal, natural gas, and crude oil?

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**Period 1 Exercises: Intro to the World of Energy**

Write answers to the questions below. Show your mathematical steps and the units of the quantities. This sheet with your answers should be turned in at the beginning of Period 2.

**1. Using ratios to solve problems:**

A hybrid car uses 3.9 gallons to gas to travel 157 miles. How many miles per gallon does this car get?

Answer: \_\_\_\_\_

**2. Using ratios to convert units:**

A truck travels at 43 miles/hour. How many meters/second is this?  
(Hint: 1 mile = 1,609 meters)

Answer: \_\_\_\_\_

**3. Using scientific notation to solve problems:**

Write each of the quantities below in scientific notation, as an integer, and in words. First find the answer **without** using a calculator. Then check your answer with a calculator.

Ex:  $(2 \times 10^2) \times (7 \times 10^4) = (2 \times 7) \times 10^{2+4} = 14 \times 10^6 = 1.4 \times 10^7 = 14,000,000 = 14 \text{ million}$

a)  $10^{10} / 10^4 =$

b)  $(8 \times 10^6) / (2 \times 10^{-3}) =$

**4. Using ratios to make comparisons:**

Natural gas can be obtained from shale rock by the process of fracking, in which a water and sand mixture is pumped into shale layers to fracture the shale and release any natural gas. This natural gas can be burned in generating plants to produce electricity. How many kilograms of coal are needed to produce the same amount of energy as 1 kg of natural gas? (1 kg of coal =  $2.4 \times 10^7$  joules and 1 kg of natural gas =  $5.5 \times 10^7$  joules.)

Answer: \_\_\_\_\_

