

**WKS-Honors**  
**Unit Conversions**  
**Using Factor Label Method**

Name Answer Key  
 Date \_\_\_\_\_  
 Period \_\_\_\_\_

**Directions:** Answer the following questions. All calculations must be done using the factor label method (even if you prefer a different method). Show all work. Every number written must have units. Write answers with the correct number of significant digits.

- 1) You are in France at a nice restaurant. Wanting to try a French delicacy, you contemplate ordering an escargot appetizer, but you are worried that it will be too expensive. The price for the appetizer is 12.00 euros. What is the price of the appetizer in US dollars? (Show work)

*1 US dollar = 0.8884 euros as of Sept. 26, 2016*

$$? \$ = \cancel{12.00 \text{ euros}} \times \frac{\cancel{\$1}}{0.8884 \cancel{\text{ euros}}} = \cancel{\$13.507} = \boxed{\$13.51}$$

- 2) A bottle contains 25 fluid ounces. How many cups is this?

*128 fluid ounces = 1 gallon 1 gallon = 4 quarts 1 quart = 2 pints 1 pint = 2 cups*

$$? \text{ cups} = \cancel{25 \text{ fl. oz.}} \times \frac{\cancel{1 \text{ gal}}}{\cancel{128 \text{ fl. oz.}}} \times \frac{\cancel{4 \text{ qt}}}{\cancel{1 \text{ gal}}} \times \frac{\cancel{2 \text{ pt}}}{\cancel{1 \text{ qt}}} \times \frac{\cancel{2 \text{ cups}}}{\cancel{1 \text{ pt}}} = \cancel{3.125 \text{ cups}} = \boxed{3.1 \text{ cups}}$$

- 3) Cesium atoms are the largest of the naturally occurring elements. They have a diameter of  $5.30 \times 10^{-10}$  m. Express the diameter of a cesium atom in nanometers, nm.

$$? \text{ nm} = \cancel{5.30 \times 10^{-10} \text{ m}} \times \frac{\cancel{1 \text{ nm}}}{\cancel{1 \times 10^{-9} \text{ m}}} = \boxed{5.30 \times 10^{-1} \text{ nm} = 0.530 \text{ nm}}$$

- 4)  $15 \mu\text{L} = ? \text{ L}$

$$? \text{ L} = \cancel{15 \mu\text{L}} \times \frac{\cancel{1 \times 10^{-6} \text{ L}}}{\cancel{1 \mu\text{L}}} = \boxed{1.5 \times 10^{-5} \text{ L}}$$

- 5) The mass of the sun is  $1.989 \times 10^{30}$  kg. Express this mass in Tg.

$$? \text{ Tg} = \underbrace{\cancel{1.989 \times 10^{30} \text{ kg}}}_{1.989 \times 10^{33} \text{ g}} \times \frac{\cancel{1 \times 10^3 \text{ g}}}{\cancel{1 \text{ kg}}} \times \frac{\cancel{1 \text{ Tg}}}{\cancel{1 \times 10^{12} \text{ g}}} = \boxed{1.989 \times 10^{21} \text{ Tg}}$$

- 6)  $1.5$  karat diamond = ? mg (*1 karat = 0.200 g*)

$$? \text{ mg} = \underbrace{\cancel{1.5 \text{ karat}}}_{0.300 \text{ g}} \times \frac{\cancel{0.200 \text{ g}}}{\cancel{1 \text{ karat}}} \times \frac{\cancel{1 \text{ mg}}}{\cancel{1 \times 10^{-3} \text{ g}}} = \cancel{300 \text{ mg}} = \boxed{3.0 \times 10^2 \text{ mg}}$$

- 7)  $582 \text{ cm}^3 = ? \text{ L}$

$$? \text{ L} = \cancel{582 \text{ cm}^3} \times \frac{\cancel{1 \text{ mL}}}{\cancel{1 \text{ cm}^3}} \times \frac{\cancel{1 \times 10^{-3} \text{ L}}}{\cancel{1 \text{ mL}}} = \boxed{0.582 \text{ L}}$$

- 8) How many minutes will it take you to travel 25 km if you are driving at a speed of 85 km/hr.

$$? \text{ min} = \cancel{25 \text{ km}} \times \frac{\cancel{1 \text{ hr}}}{\cancel{85 \text{ km}}} \times \frac{\cancel{60 \text{ min}}}{\cancel{1 \text{ hr}}} = \cancel{17.64} \Rightarrow \boxed{18 \text{ min}}$$

9) 197 grams of gold contain  $6.02 \times 10^{23}$  atoms of gold. How many gold atoms are in 4.00 g of gold?

$$? \text{ atoms Au} = \frac{4.00 \text{ g Au}}{197 \text{ g Au}} \times \frac{6.02 \times 10^{23} \text{ atoms Au}}{197 \text{ g Au}} = 1.2223 \times 10^{22} \text{ atoms Au} = 1.22 \times 10^{22} \text{ atoms Au}$$

10) What is the volume in mL of a 4.5 g slug of zinc? Density = 7.14 g/mL

Do not use  $D = M/V$ . Instead, start with the 4.5g and use the density as the conversion factor.

$$? \text{ mL} = 4.5 \text{ g} \times \frac{1 \text{ mL}}{7.14 \text{ g}} = 0.6303 \text{ mL} = 0.63 \text{ mL}$$

11) Suppose right now it costs \$2.50 for a gallon of gasoline in the US. In Germany, the prices of gasoline are listed in euros per liter. Suppose the price of gasoline was exactly the same in Germany as it is right now in the US. How would this US price be listed in Germany?

(In other words, express \$2.50/gallon in euro/liter.)

1 US dollar = 0.7253 euros      1 gallon = 3.77 Liters

$$? \frac{\text{euros}}{\text{L}} = \frac{\$2.50}{1 \text{ gal}} \times \frac{0.7253 \text{ euros}}{\$1} \times \frac{1 \text{ gal}}{3.77 \text{ L}} = 0.48097 \text{ euros/L} = 0.481 \text{ euros/L}$$

1.81325 euros/gal

12) A heater gives off heat at a rate of 330.0 kJ/min. What is the rate of heat output in kcal/hr?

(1 cal = 4.184 J)

$$? \frac{\text{kcal}}{\text{hr}} = \frac{330.0 \text{ kJ}}{1 \text{ min}} \times \frac{1 \times 10^3 \text{ J}}{1 \text{ kJ}} \times \frac{1 \text{ cal}}{4.184 \text{ J}} \times \frac{1 \text{ kcal}}{1 \times 10^3 \text{ cal}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 4732.31 \text{ kcal/hr} = 4732 \text{ kcal/hr}$$

3.3300 × 10<sup>5</sup> J/min      78.872 kcal/min

13) Express 3.5 m<sup>2</sup> in nm<sup>2</sup>.

$$? \text{ nm}^2 = 3.5 \text{ m}^2 \times \left( \frac{1 \text{ nm}}{1 \times 10^{-9} \text{ m}} \right)^2 = 3.5 \times 10^{18} \text{ nm}^2$$

1 nm<sup>2</sup> = 1 × 10<sup>-18</sup> m<sup>2</sup>

14) At standard conditions the density of helium is  $1.786 \times 10^{-4}$  g/cm<sup>3</sup>. What is its density in kg/m<sup>3</sup>?

$$? \frac{\text{kg}}{\text{m}^3} = \frac{1.786 \times 10^{-4} \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1 \times 10^3 \text{ g}} \times \left( \frac{1 \text{ cm}}{1 \times 10^{-2} \text{ m}} \right)^3 = 0.1786 \text{ kg/m}^3$$

1.786 × 10<sup>-7</sup> kg/cm<sup>3</sup>      1 cm<sup>3</sup> = 1 × 10<sup>-6</sup> m<sup>3</sup>

15) Vanillin, a flavoring used in ice cream, is the substance whose aroma the human nose detects in the smallest amount. The smallest amount of vanillin that can be detected is  $2.0 \times 10^{-11}$  grams per liter of air. If the current price of 50 g of vanillin is \$112, determine the cost to supply enough vanillin so that its aroma could be detected in a large aircraft hangar with a volume of  $5.0 \times 10^7$  ft<sup>3</sup>.

Helpful info: 1 inch = 2.54 cm

This problem needs two conversion factors: volume to mass and mass to cost

$$? \$ = 5.0 \times 10^7 \text{ ft}^3 \times \left( \frac{12 \text{ in}}{1 \text{ ft}} \right)^3 \times \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right)^3 \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{1 \times 10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{2.0 \times 10^{-11} \text{ g}}{\text{L}} \times \frac{\$112}{50 \text{ g}} = \$0.06343 = \$0.063 \text{ (6.3¢)}$$

1728 in<sup>3</sup> = 1 ft<sup>3</sup>      16.39 cm<sup>3</sup> = 1 in<sup>3</sup>

First convert volume from ft<sup>3</sup> to L: 1.415 × 10<sup>9</sup> L