Key

Problem Solving: Conversions and Factor Labeling

1. A small bottle contains 45.5 g of calcium chloride. What is the mass of calcium chloride in milligrams?

45,500 mg

2. A metallurgist is going to make an experimental alloy that requires adding 325 g of bismuth to 2.500 kg of molten lead. What is the total mass of the mixture in kilograms?

0.325 kg
+ 2.500
2.825 kg

3. How many milliliters of water will it take to fill a 2 L bottle that already contains 1.87 L of water?

2 L
− 1.87 L
0.13 L

130 mL

$0.13\,L \times \frac{1000\,mL}{L}$

4. A piece of copper wire is 150 cm long. How long is the wire in millimeters? How many 50 mm segments of wire can be cut from the length?

$150\,cm \times \frac{10\,mm}{1\,cm} = 1500\,mm \times \frac{1\,segment}{50\,mm} = 30\ segments$

5. The greatest distance between Earth and the sun during Earth's revolution is 152 million kilometers. What is this distance in megameters?

$152{,}000{,}000\,km \times \frac{1\,Mm}{1000\,km} = 152{,}000\,Mm$

6. The ladle at an iron foundry can hold 8500 kg of molten iron. 646 metric tons of iron are needed to make rails. How many ladlefuls of iron will it take to make 646 metric tons of iron? (1 metric ton = 1000 kg)

$$646 \text{ metric tons} \times \frac{1000 \text{ kg}}{1 \text{ metric ton}} \times \frac{1 \text{ ladle}}{8500 \text{ kg}} = 76 \text{ ladles}$$

7. A balloon contains 0.5 m^3 of neon gas. What is the volume of gas in cubic centimeters?

$$0.5 \text{ m}^3 \times \frac{(100)^3 \text{ cm}^3}{1 \text{ m}^3} = 500000 \text{ cm}^3$$

8. How many palisade cells from plant leaves would fit in a volume of 1.0 cm^3 of cells if the average volume of a palisade cell is 0.0147 mm^3?

$$1.0 \text{ cm}^3 \times \frac{(10)^3 \text{ mm}^3}{1 \text{ cm}^3} \times \frac{1 \text{ cell}}{0.0147 \text{ mm}^3} = 68027 \text{ cells}$$

68000 cells

9. What is the speed of a car in meters per second when it is moving at 1.00 $\times 10^2$ km/h?

$$\frac{1.00 \times 10^2 \text{ km}}{\text{hr}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = 27.8 \text{ m/s}$$

10. A heater gives off heat at a rate of 330 kJ/min. What is the rate of heat output in kilocalories per hour? (1 cal = 4.184 J)

4700 kcal/hr

$$\frac{330 \text{ kJ}}{\text{min}} \times \frac{1000 \text{ J}}{1 \text{ kJ}} \times \frac{1 \text{ cal}}{4.184 \text{ J}} \times \frac{1 \text{ Kcal}}{1000 \text{ cal}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 4732.3 \text{ kcal/hr}$$

11. The instructions on a package of fertilizer tell you to apply it at the rate of 62 g/m^2. How much fertilizer in kilograms would you need to apply to 1.0 ha? (1 ha = 10,000 m^2)

$$1.0 \text{ ha} \times \frac{10000 \text{ m}^2}{1 \text{ ha}} \times \frac{62 \text{ g}}{1 \text{ m}^2} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 620 \text{ kg}$$

12. A water tank leaks water at the rate of 3.9 mL/h. If the tank is not repaired. what volume of water in liters will it leak in a year? Make sure you show your setup for solving this.

$$1\ yr \times \frac{365 days}{1\ yr} \times \frac{24\ hrs}{1\ day} \times \frac{3.9\ mL}{1\ hr} \times \frac{1\ L}{1000 mL} = 34\ L = 30\ L$$

13. A nurse plans to give flu injections of 50 µL each from a bottle containing 2.0 mL of vaccine. How many doses are in the bottle?

$$2.0 mL \times \frac{1000 \mu L}{1 mL} \times \frac{dose}{50 \mu L} = 40\ doses$$

14. The average density of living matter on Earth's land areas is 0.10 g/cm^2. What mass of living matter in kilograms would occupy an area of 0.125 ha? (1 ha = 10,000 m^2)

$$0.125 ha \times \frac{10{,}000 m^2}{1 ha} \times \frac{(100)^2 cm^2}{1 m^2} \times \frac{0.10 g}{1 cm^2} \times \frac{1 kg}{1000 g} = 1250\ kg$$

15. An automobile uses 0.05 mL of oil for each kilometer it is driven. How much oil in liters is consumed if the automobile is driven 20,000 km?

$$20{,}000 km \times \frac{0.05 mL}{1 Km} \times \frac{1 L}{1000 mL} = 1\ L$$

16. How many microliters are there in a volume of 370 mm^3 of cobra venom?

$$370\ mm^3 \times \frac{1 mL}{10^3\ mm^3} \times \frac{1000 \mu L}{1 mL} = 370 \mu L$$

17. A baker uses 1.5 tsp of vanilla extract in each cake. How much vanilla extract in liters should the baker order to make 800 cakes? (1 tsp = 5 mL)

$$800\ cakes \times \frac{1.5 tsp}{1\ cake} \times \frac{5 mL}{1 tsp} \times \frac{1 L}{1000 mL} = 6\ L$$

18. A person drinks eight glasses of water each day, and each glass contains 300 mL. How many liters of water will that person consume in a year? What is the mass of this volume of water in kilograms? (Assume one year has 365 days and the density of water is 1.00 kg/L)

$$1\text{ yr} \times \frac{365\text{ days}}{1\text{ yr}} \times \frac{8\text{ glasses}}{\text{day}} \times \frac{300\text{ mL}}{1\text{ glass}} \times \frac{1\text{ L}}{1000\text{ mL}} = 876\text{ L}$$

$$876\text{ L} \times \frac{1\text{ L}}{1\text{ kg}} = 876\text{ kg}$$

19. At the equator Earth rotates with a velocity of about 465 m/s.
    a. What is this velocity in kilometers per hour?
    b. What is this velocity in kilometers per day?

$$\frac{465\text{ m}}{\text{s}} \times \frac{\text{km}}{1000\text{ m}} \times \frac{3600\text{ s}}{1\text{ hr}} = 1674\text{ km/hr} \times \frac{24\text{ hr}}{\text{day}} = 40176\text{ km/day}$$

1670 km/hr

40200 km/day

20. A chemistry teacher needs to determine what quantity of sodium hydroxide to order. If each student will use 130 g and there are 60 students, how many kilograms of sodium hydroxide should the teacher order?

$$160\text{ students} \times \frac{130\text{ g}}{\text{student}} \times \frac{\text{kg}}{1000\text{ g}} = 7.8\text{ kg}$$

21. The teacher in question 20 also needs to order plastic tubing. If each of the 60 students needs 750 mm of tubing, what length of tubing in meters should the teacher order?

$$60\text{ students} \times \frac{750\text{ mm}}{\text{student}} \times \frac{1\text{ m}}{1000\text{ mm}} = 45\text{ m}$$