

Study Guide – Chapter 2 (Scientific Measurements)/

Chapter 3 (The Metric System)

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Name: _____ Date: _____ Period: _____

1. Write the number of significant figures in each of the following *measurements*.

- a. 2.708 b. 16.3050 c. 50.007 d. 3000010 e. 0.00045
- f. 507.7800 g. 6.380×10^9 h. 4.678×10^{22} i. 789.006 j. 0.00000875
- k. 3322.008 l. 56.000 m. 0.01010100 n. 1,000,100 o. 12.00009

2. Express the following numbers in standard exponential form (scientific notation) with the indicated number of significant digits.

- a. 1,000 (2 sig. figs.) b. 43,927 (3 sig. figs.) c. 0.000298 (2 sig. figs.)
- d. 0.000098765 (5 sig. figs.) e. 20.00007 (7 sig. figs.) f. 27,793,350.00 (2 sig. figs.)

3. Convert the following numbers expressed in scientific notation into ordinary decimal numbers. Treat the values as measurements.

- a. 7.23×10^4 b. 8.193×10^2 c. 1.98×10^{-3}
- d. 7.51×10^{-7} e. 5.43×10^0 f. 5.00300×10^{-4}

4. Solve for the indicated variable.

- a. $\frac{2}{3}y + 1 = 13$ (for y) b. $5y - 4 = 3y + 4$ (for y) c. $a = \frac{Gm}{r^2}$ (for r)
- d. $\frac{(2x+3y)}{3} = 4x + 3d$ (for y) e. $PV = nRT$ (for n) f. $\frac{xy}{m} = \frac{(R+t)}{2}$ (for t)

5. Convert the following.

- a. 5.3 cg = _____ mg b. 3.5 dm³ = _____ mL c. 500. mL = _____ L
- d. 22.3 kg = _____ dag e. 2.25 cm³ = _____ dm³ f. 0.00566 μm = _____ nm
- g. 30.0 cm = _____ in h. 0.025 hm = _____ cm i. 0.00452 ms = _____ ds

6. Perform the following conversions in the order given *showing conversion ratios and dimensional analysis*:

Example: Convert 5.3in/s to yds/hr via

in/s → ft/s → yds/s → yds/min → yds/hr

Answer:

$$\frac{5.3 \text{ in}}{s} \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) \left(\frac{1 \text{ yd}}{3 \text{ ft}} \right) \left(\frac{60 \text{ s}}{1 \text{ min}} \right) \left(\frac{60 \text{ min}}{1 \text{ hr}} \right) = 5.3 \times 10^2 \text{ yds/hr}$$

a. Convert 50.23 mi to cm via

mi → ft → in → cm

b. Convert .298ft/s to m/hr via

ft/s → in/s → cm/s → m/s → m/min → m/hr

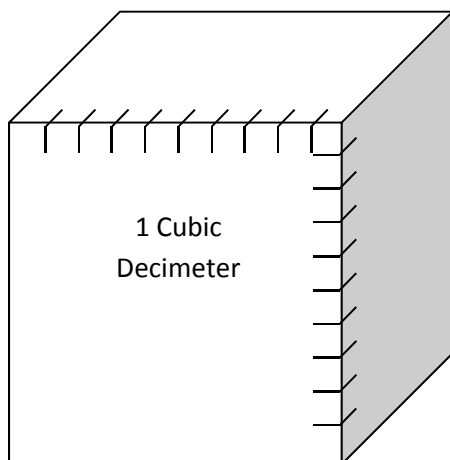
c. Convert $2.44 \times 10^{-3} \text{ kg m/s}^2$ to g cm/s^2 via

$\text{kg m/s}^2 \rightarrow \text{g m/s}^2 \rightarrow \text{g cm/s}^2$

d. Convert $6.490 \times 10^3 \text{ L/min}$ to ft^3/hr via

$\text{L/min} \rightarrow \text{dm}^3/\text{min} \rightarrow \text{cm}^3/\text{min} \rightarrow \text{in}^3/\text{min} \rightarrow \text{ft}^3/\text{min} \rightarrow \text{ft}^3/\text{hr}$

7. The figure below represents a cube with a volume of one cubic decimeter. Given that the mass density of water at exactly 3.98°C is exactly 1 kg/L, answer the following:



a. The length of one side of the cube is

_____ dm = _____ cm

b. The combined area of all the sides of this cube is

_____ dm^2 = _____ m^2

c. The volume of the cube is

_____ L = _____ cm^3

d. The mass of such a volume of water at 3.98°C is

_____ kg = _____ mg

8. Metric Estimates:

Item	Estimate	Actual Value
1. The mass of a nickel in grams.		
2. The volume of a standard can of pop in milliliters.		
3. The distance from Portland, OR to Seattle, WA in km (by Hwy.)		
4. The length of a dollar bill in centimeters.		
6. The mass of a large paper clip in mg.		
7. The surface area of a compact disk (CD) in cubic centimeters (cm ³). (Area = πr^2)		
8. The temperature in Celsius on a 70.0°F day.		
9. The length of an unsharpened wooden (yellow) pencil in millimeters (mm)		
10. Your weight in kilograms.		

9. Perform the Following Temperature Conversions.

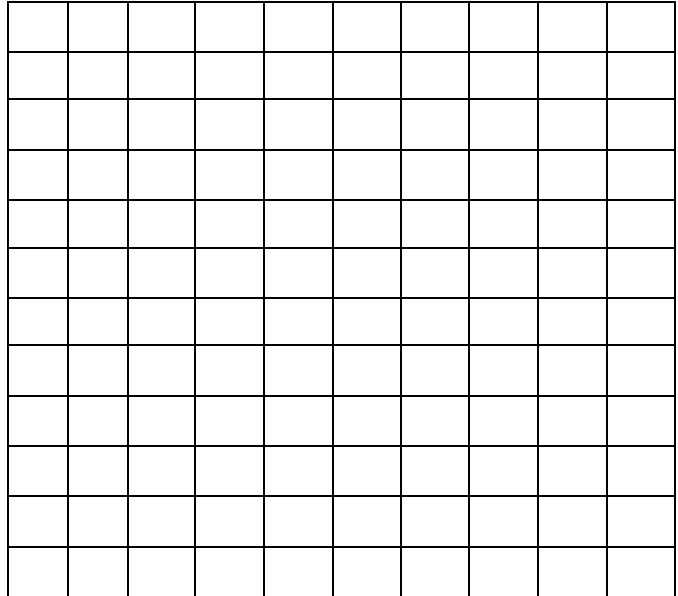
- a. The temperature in Phoenix, AZ often reaches 110.°F. What is this temperature in °C?
- b. Nitrogen boils at 77.36K. What is this temperature in °C?
- c. A 1.00 g piece of copper metal initially at 20.0°C has a specific heat of 0.385 J/g°C (meaning that a gram of copper will rise in temperature by 1.00°C for every 0.385 J of energy it absorbs.) If the 1.00 g of copper absorbs 35.0 J of energy, what is its final temperature in °C; in °F?

10. Do the following calculations using measured values to the correct number of significant digits. Include units.

- a. 2.44 cm - 2.2 cm + 12.0055 cm b. 2.44 cm x 2.2 cm x 12.0055 cm c. 2.2×10^2 nm + 3.422×10^1 nm
- d. $(5.2 \text{ g} + 4.33 \text{ g} + 12.500 \text{ g}) / (2.63 \text{ cm} \times 1.00 \text{ cm} \times 1.5 \text{ cm})$ e. $(2.602 \times 10^5 \text{ cm}^2)(5.33 \times 10^{-3} \text{ cm}) / (8.423 \times 10^6 \text{ cm})$

11. Below is an experimental data set that was used to determine the mass of several sample volumes of the element Aluminum (Al). Plot the data with the volume on the abscissa (x-axis) and the mass on the ordinate (y-axis). Use as much of the graph area as possible. Draw a "best line" through the data then use the slope of the line to determine the density of aluminum. Be sure to label your axes and put a title on your graph.

Aluminum (Al)	
Volume (cm ³)	Mass (g)
2.0	5.1
3.5	9.9
5.0	13.9
7.5	18.2
8.5	22.5



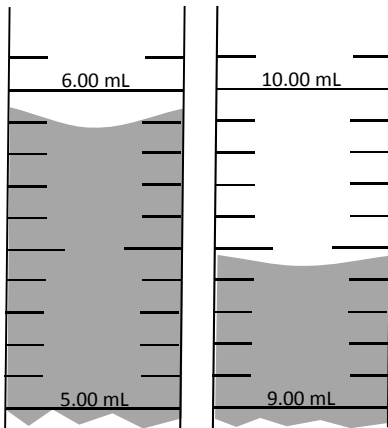
Calculated density of aluminum:

_____ g/cm³

Based on your calculated density, determine the mass (in g) of a piece of aluminum with dimensions of 1.0 cm x 1.2 cm x 2.2 cm

Mass = _____ g

12. The section of graduated cylinder on the left displays a volume of water prior to the insertion of a sample of an irregular piece of shiny metal thought to be silver. The cylinder on the right displays the volume after insertion of the sample. If the mass of the sample is 37.355g, determine the density of the sample and whether or not it is likely to be silver (Density_{silver} = 10.5 g/cm³)



Density of object: _____ g/mL

Is it likely to be silver? Explain.

Challenge Problem: A penny is 19.05 mm in diameter and 1.22 mm thick*. It is currently composed of 97.5% zinc and 2.5% copper (by mass). Copper has a density of 8.960 g/cm³ and zinc has a density of 7.133 g/cm³. ($V_{\text{cylinder}} = \pi r^2 h$) (*The actual published value is 1.55 mm, but this seems to be the maximum thickness, not the average based on calculations.)

a. What is the average mass (in grams) of one of these pennies?

b. From 1962 until 1982, the penny's composition was 95.0% copper and 5.0% zinc. Calculate the percent change in mass between the two types of pennies.