Scientific Notation:

Express the following numbers in scientific notation:

a) 543

Ans. 5.43×10^{2}

b) 20,000,000

Ans. $2. \times 10^{7}$

c) 12,000.0

Ans. 1.20000×10^{4}

d) 0.0000230

Ans. 2.30×10^{-5}

e) 0.0012

Ans. 1.2×10^{-3}

Significant Figures:

Determine the number of significant figures for each of the following measurements:

a) 2.303 meters

Ans. 4

b) 5.50 seconds

Ans. 3

c) 0.024 liters

Ans. 2 (leading zeroes are not significant)

d) 24.3 kilograms

Ans. 3

e) 115.20 centimeters

Ans. 5

f) 100 miles/hour

Ans. 1 (This is a tricky one! As a measurement, the lack of a decimal point indicates that the trailing zeroes are not significant, they are only place holders.)

Significant Figures (Part 2): Doing math with measured quantities

Perform the following and express your answers using the appropriate number of significant figures:

a) 22.5 liters + 0.023 liters = 22.5 liters

b) 110 apples – 25 apples = 85 apples (As counted entities, the apples are absolute)

c) 110 meters – 25 meters = 90 meters or 9. x 10^1 meters (As measured quantities, with no decimal points specified, the trailing zero is not significant. Therefore, the final answer is only known to the nearest 10 meters… Sneaky I am :)

d) $\left(\frac{12.003\ grams}{mole}\right)\times 2.5\text{ moles}$ = 30. grams

e) 50.45 cm^3/ 0.02 cm^2 = 3. x 10^3 cm

f) $2.5\text{ moles}\times\left(\frac{6.022x10^{23}\text{ atoms}}{mole}\right)$ = 1.5 x 10^{24} atoms

Unit Conversion:

Convert the following quantities and express your answers using the appropriate number of significant figures:
Using the textbook as a guide, convert the following quantities:

a) 2.3 kilograms = _2.3 x 10^3__ grams

b) 5.50 liters = __5.50 x 10^3__ milliliters (mL)

c) 2.4 mL = __2.4 x 10^{-3}__ L

d) 24.3 calories = __102. (or 1.02 x 10^2)__ joules (1 cal = 4.184 J)

e) 115.2 quarts = __109.0 (or 1.090 x 10^2)__ liters (1 L = 1.057 qt)

f) 1013. kg/m^3 = _1.013_ g/mL (1 mL = 1 cm^3)

g) 100.0 mL/hr = __0.02778 (or 2.778 x 10^{-2})__ cm^3/s (1 hr = 60 min = 3600 s)

Unit Conversion within the Metric System:

Mass: The most common form of hydrogen atom has a mass of 1.67×10^{-27} kg. Express the mass of this hydrogen atom in the following units (use scientific notation):

a) nanograms (ng)

Ans. 1.67×10^{-15} ng

b) micrograms (μg)

Ans. 1.67×10^{-18} μg

c) milligrams (mg)

Ans. 1.67×10^{-21} mg

d) grams (g)

Ans. 1.67×10^{-24} g

Length: A single carbon atom has a diameter of approximately 2.0 angstroms. The angstrom unit is related to the meter by the following: 1 angstrom = 10^{-10} m. Express the diameter of a carbon atom in the following units (use scientific notation):

a) nanometers (nm)

Ans. 0.20 (or 2.0×10^{-1}) nm

b) micrometers (μm)

Ans. 2.0×10^{-4} μm

c) millimeters (mm)

Ans. 2.0×10^{-7} mm

d) kilometers (km)

Ans. 2.0×10^{-13} km

e) How many carbons would you need to stack side-by-side to make a 1.0 inch long carbon atom chain?

Ans. 1 in = 25.4 mm → # carbon atoms = $\dfrac{25.4\,mm}{\left(2.0\times10^{-7}\,\dfrac{\text{mm}}{\text{atom}}\right)}$ = 1.3×10^{8} atoms

Temperature:

1) Convert the following temperature readings from °F to °C:

i) 15 °F = -9.4 °C

ii) 70.0 °F = 21.1 °C

iii) 425 °F = 218. °C

2) Convert the following temperature readings from °C to °F:

i) 4. °C = 39. °F

ii) 37.0 °C = 98.6 °F

iii) −100. °C = -148. °F

3) Convert the temperatures in (2) to K

i) 4. °C = 277. K

ii) 37. °C = 310. K

iii) −100. °C = 173. K

Density:

1) Determine the density for the following substances:

i) 10.0 g of water (at 4 °C) with a volume of 10.0 cm^3: D = 1.00 g/cm^3

ii) 10.0 g of ice with a volume of 10.9 cm^3: D = 0.917 g/cm^3

iii) 10.0 g of aluminum with a volume of 3.7 cm^3: D = 2.70 g/cm^3

iv) 10.0 g of gold with a volume of 0.52 cm^3: D = 19.2 g/cm^3

2) Using the density values above, determine the amount of mass (grams) in 30.0 cm^3 of the following substances:

i) Water (at 4 °C): m = 30.0 g

ii) Ice: m = 27.5 g

iii) Aluminum: m = 81.0 g

iv) Gold: m = 576. g

3) How much space do 50.0 grams of the following substances occupy?

v) Water (at 4 °C): V = 50.0 cm^3

vi) Ice: V = 54.5 cm^3

vii) Aluminum: V = 18.5 cm^3

viii) Gold: V = 2.60 cm^3

A Practical Application:

An ailing patient in a hospital requires a certain drug to be administered at a rate of 40.0 cm^3 per hour. The intravenous (IV) drug delivery system that will deliver the medication controls the drug delivery by measuring drip rate. Using this system, 30 drops are equal to 1.0 cm^3 of medication.

a) What drip rate (drops per hour) is required to maintain a drug delivery of 40.0 cm^3 per hour?

Ans. 1.2 x 10^3 drops/hr

Note: *even though you are attempting to administer the medication at a rate of 40.0 cm^3/hr (3 significant figures), the lack of precision of the drip system itself will only allow a reliable drip rate of 40. cm^3/hr (only 2 significant figures).*

b) What is the drip rate in drops per second?

Ans. 0.33 drops/s

c) How many drops would you expect to count in 10.0 seconds?

Ans. 3 drops (Note: drops are a counting quantity!)