Unit Conversion:

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

a) 2.3 kg = __$2.3\text{x}10^{3}$__ g

b) 5.50 L = ___$5.50\text{x}10^{3}$__ mL

c) 2.4 cm = __$2.4\text{x}10^{-2}$__ m

d) 24.3 cal = __102.__ J (1 cal = 4.184 J)

e) 115.2 qt = __109.0__ L (1 L = 1.057 qt)

f) 1013. kg/m^3 = ___1.013__ g/mL (1 mL = 1 cm^3)

g) 100.0 mL/hr = ___$3.63\text{x}10^{5}$__ cm^3/s (1 hr = 60 min = 3600 s)

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.

i) What is the SI unit for length? Ans. The meter (m)

ii) How is the SI unit for length defined?

Ans. 1 meter is the length light travels in vacuum in 1/299792458 seconds

iii) Express the diameter of a carbon atom in the following units (use scientific notation):

a) nanometers (nm) Ans. 0.20 nm

b) micrometers (μm) Ans. $2.0\text{x}10^{-4}$ μm

c) millimeters (mm) Ans. $2.0\text{x}10^{-7}$ mm

d) kilometers (km) Ans. $2.0\text{x}10^{-13}$ km

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

Ans. $1.3\text{x}10^{8}$ C atoms

Time:

The period of revolution of the "dwarf" planet Pluto is 248 years (y). According to the textbook, the year unit is related to the day (d) by the following: 1 yr = 365.25 d.

i) What is the SI unit for time? Ans. The second (s)

ii) How is the SI unit for time defined?

Ans. 1 second is the time interval taken by 9,192,631,770 oscillations of light emitted by a ^{133}Cs atom.

iii) Express the revolution period of Pluto in the following units (use scientific notation):

a) seconds (s) Ans. 7.20×10^{9} s

b) microseconds (μs) Ans. 7.20×10^{15} μs

c) milliseconds (ms) Ans. 7.20×10^{12} ms

d) nanoseconds (ns) Ans. 7.20×10^{18} ns

Mass:

The most common isotope of hydrogen atom, consisting of a single proton and an electron, has an accepted mass of 1.0078 atomic mass units. The atomic mass unit is related to the gram (g) by the following: 1 u = 1.6605×10^{-24} g.

i) What is the SI unit for mass? Ans. The kilogram (kg)

ii) How is the SI unit for mass defined?

iii) Express the mass of this hydrogen isotope in the following units (use scientific notation):

a) nanograms (ng) Ans. 7.20×10^{-15} ng

b) micrograms (μg) Ans. 7.20×10^{-18} μg

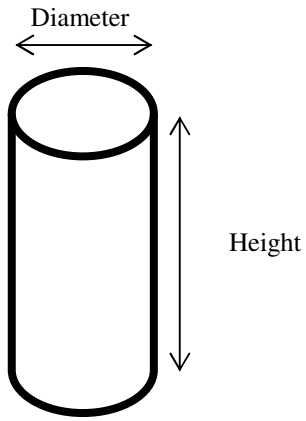
c) milligrams (mg) Ans. 7.20×10^{-21} mg

d) kilograms (kg) Ans. 7.20×10^{-27} kg

Errors in Measurement:

An engineer performs a series of measurements to determine the volume of a cylinder. The measurements are as follows:

Trial	Height (cm)	Diameter (cm)
1	1.20	0.625
2	1.22	0.615
3	1.23	0.628
4	1.22	0.619
5	1.21	0.600



i) Calculate the average height of the cylinder.

Ans. H=1.22 cm

ii) Calculate the average radius of the cylinder.

Ans. r=0.309 cm

iii) Calculate % Range for the height and radius measurements.

Ans. $\%\ Range_H = 2.45\%$ and $\%\ Range_r = 4.05\%$

iv) Express the height (H) and radius (r) values as: **Avg. Value +/- Uncertainty**. *Note: the uncertainty is one half the Range value.*

H_{avg} +/- dH: ____1.22 ± 0.02 cm____

r_{avg} +/- dr: __0.309 ± 0.013 cm ____

v) Calculate the average volume of the cylinder.

Ans. $V_{avg} = 0.367\ cm^3$

iv) Estimate the uncertainty of these measurements by taking the derivative of the volume equation then inserting the average and uncertainty values for both height and radius.

Ans. $dV = d(\pi r^2 H) = 2\pi r H dr + \pi r^2 dH = 0.031\ cm^3 + 0.006\ cm^3 = 0.037\ cm^3$

→ **V_{avg} +/- dV:** ____0.367 ± 0.037 cm^3____