Plan for today

- Sig fig Check In ✓
- Sig fig Rules for Calculations ✓
- Density Lab Examples ← Rounding Rules ✓

Significant Figures Check In

Measurements:		Significant Figures
210.02 cm (Bound)		5
0.0069 L (Placeholders)	6.9×10^{-3} L	2
2.7300×10^{6} sec (Trailing)		5
390 m (placeholder)	3.9×10^{2} m	2
2100. ft (Bound)	2.100×10^{3} ft	4

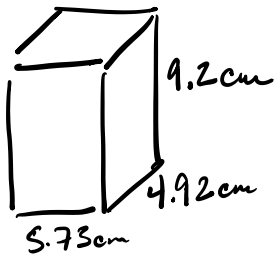
12 in = 1 ft 2.54 cm = 1 in	Definitions	Exact ⇒ Exempt from Sig figs ⇒ Infinite Sig figs
13 apples 250 Cars	Counted	Exact

Two types of Calculations $\pm$, $\times \div$, logs ← later

Idea is that the result of a calculation should have the same degree of uncertainty as the piece of data with the least certainty.

multiplication / Division

Volume = $l \times w \times h$



Smallest = largest uncertainty = least Certain

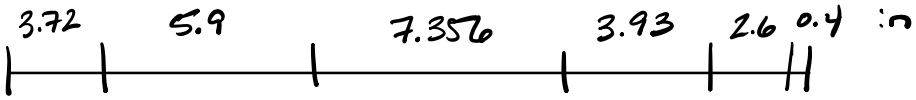
2 SF 3 SF 3 SF

Volume = $9.2\,cm \times 4.92\,cm \times 5.73\,cm$

= $259.36272\,cm^3$ (2 SF)

= $260\,cm^3$ 2 Sig figs

Addition & Subtraction



Total length ?

3 2 4 3 2 1

$3.72 + 5.9 + 7.356 + 3.93 + 2.6 + 0.4 = 23.906$

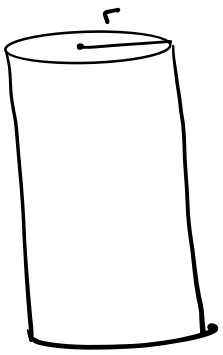
	3.72	$\pm$ 0.01
	5.9	$\pm$ 0.1
	7.356	$\pm$ 0.001
	3.93	$\pm$ 0.01
	2.6	$\pm$ 0.1
+	0.4	$\pm$ 0.1
	23.906	$\pm$ 0.1

uncertainty in each value

Larger $\pm$ = less certain value

3 SF !

= 23.9 in



Area of Circle $= \pi r^2$

Volume of Cylinder $= h \times A$

$= h\pi r^2$

$r = 3.62\text{ cm}$

$h = 0.73\text{cm} + 0.2\text{cm} + 1.1\text{ cm}$

3 SF
3.14

2 SF

3 SF

$$\text{Volume} = h\pi r^2 = (0.73\text{cm} + 0.2\text{cm} + 1.1\text{cm})\pi(3.62\text{cm})^2$$

$$\begin{array}{r} 0.73\text{ cm} \\ 0.2\text{ cm} \\ 1.1\text{ cm} \\ \hline 2.03\text{ cm} \end{array}$$

$h = 2.0\text{ cm}$ 2 SF

Hold Rounding but track Sig Figs

2 SF 3 SF 3 SF

$$V = (2.03\text{ cm})(3.14)(3.62\text{ cm})^2$$

$$= 83.530\,066\,48\text{ cm}^3$$

$$= \boxed{84\text{ cm}^3}$$

Rounding

Round each of the following to 3 SF

493.76 cm = 494 cm ✓

Round even

192.5 cm = 192 cm ↓

773.5 cm = 77.4 cm ↑

0.00092106 cm = 0.000921 cm

⇒ 299760 cm = 300,000 cm = 3.00×10^5 cm

0
1
2
3
4
5
6
7
8
9

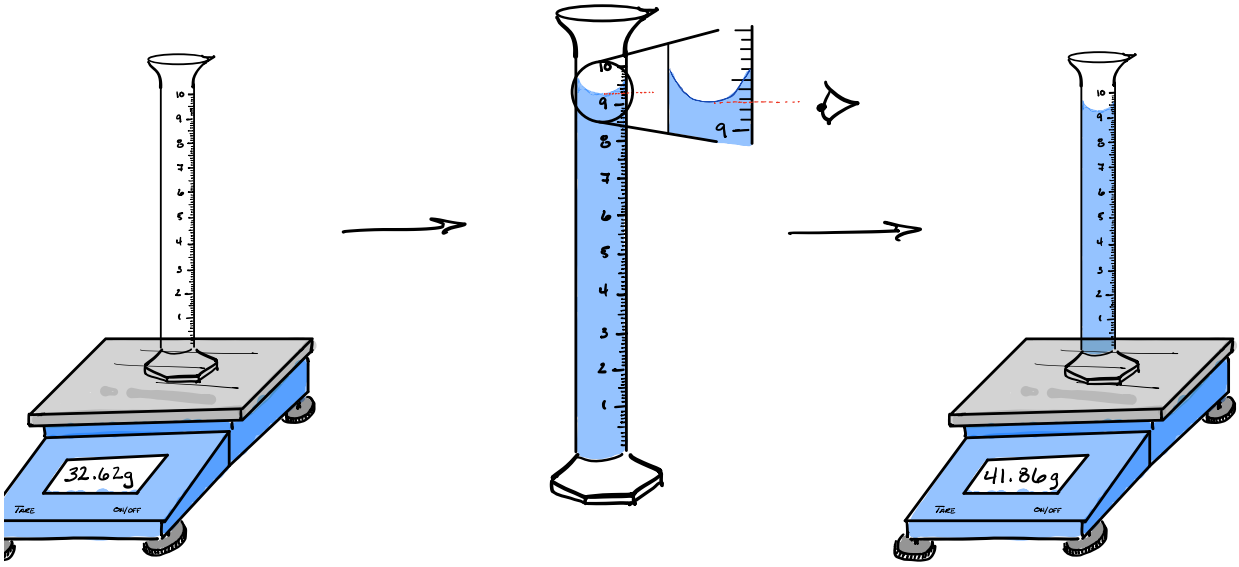
Round even = statistically even Rounding

73.5172 → >5 ⇒ Round up = 74

73.5000 exactly 5 ⇒ Round even = 74

72.5000 exactly 5 ⇒ Round even = 72

Density of H_2O



Data

Mass Cylinder = 32.62 g

Volume H_2O = 9.28 mL

Mass Cylinder + H_2O = 41.86 g

Calculations

Mass H_2O - weighing by difference

mass Cylinder & H_2O =	41.86 g
− mass Cylinder =	− 32.62 g
mass H_2O	9.24 g

no Rounding

Density of H_2O

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

solids, liquids: g/mL; gas: g/L

$$\text{Density of water} = \frac{\text{mass (g)}}{\text{volume (mL)}}$$

$$= \frac{9.24\ \text{g}}{9.28\ \text{mL}}$$

3 SF / 3 SF

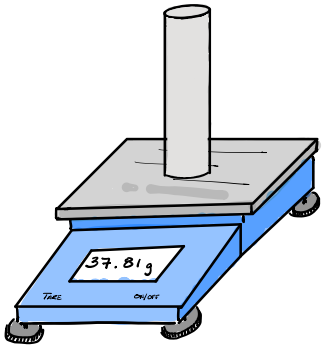
$$= 0.995689655172\ \text{g/mL}$$

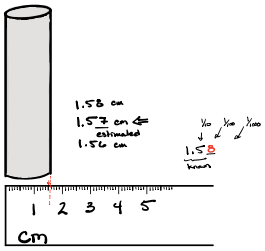
$$= 0.996\ \text{g/mL}$$

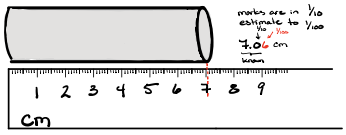
Part C Density of Cylinder by Geometry

Procedure:

1. measure the mass of a cylinder
2. measure the diameter of Cylinder
3. measure the height of Cylinder
4. Calculate density

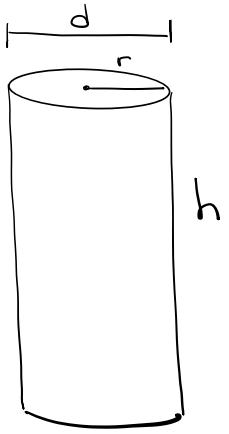






Data

mass Cyl.	37.81 g
diameter Cyl.	1.57 cm
height Cyl.	7.06 cm



Area $= \pi r^2$

radius $= \frac{d}{2}$ ← definition

Area $= \pi\left(\frac{d}{2}\right)^2 = \pi\frac{d^2}{4} = \frac{\pi d^2}{4}$

Volume = Area × height

$= \frac{\pi d^2}{4} \cdot h = \boxed{\frac{\pi d^2 h}{4}}$

3 SF 3 SF 3 SF

$$\text{Volume} = \frac{(3.14)(1.57\text{ cm})^2(7.06\text{ cm})}{4}$$ ← definition

3 SF

$$= 13.660\,722\,29\ \text{cm}^3$$

4 SF

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{37.81\text{ g}}{13.660\,722\,29\ \text{cm}^3}$$

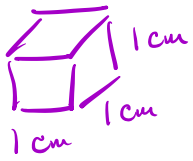
3 SF

$$= 2.767\,892\,2793\ \text{g/cm}^3$$

Density of Cylinder $= 2.77\ \text{g/cm}^3$

Liquids g/mL vs. Solids g/cm³

$1\ cm^3 = 1\ mL = 1\ cc$ Cubic Centimeter



Thickness of Metal foil

$$\text{Volume} = l \times w \times t$$

$$\text{mass} = m$$

$$\text{density} = \frac{\text{mass}}{l \times w \times t}$$

$2.704\ g/cm^3$

only 1 unknown
Solve for that unknown

$$t \times d = \frac{m}{l \times w \times t} \times t$$

$$\frac{1}{d} \times dt = \frac{m}{l \times w} \times \frac{1}{d}$$

$$t = \frac{m}{l \times w \times d}$$