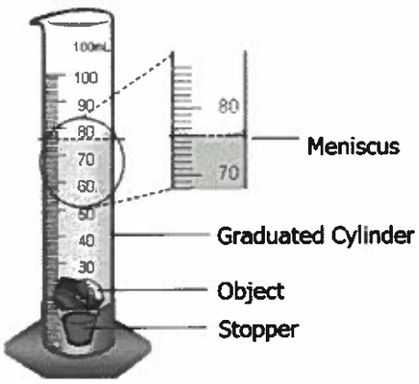
Activity: **Density of an Irregular Object** **Name:** _____

Due: Friday. Sept. 13th all groups

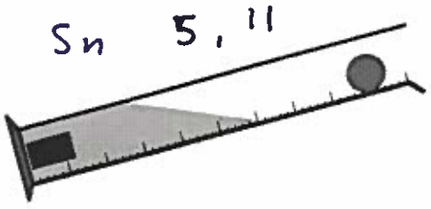
Purpose: To find the density of an object using the water displacement method, and use that data to help identify the substance of the object.

Materials: small irregular object
balance, graduated cylinder
rubber stopper.

Diagram:



Al 1, 7, 12 Mg 2, 8, 13
Fe 3, 9
Pb 4, 10, 14
Cu 6, 15
Sn 5, 11



Slide the object into the cylinder.

±0.5 1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 1
±0.1 6, 15

What to do?

1. Find the mass of the object.
2. Find the volume of the object using the graduated cylinder.
3. Record your data including the uncertainty of the equipment.
4. Calculate the density & identify the metal using the posted list.

Data: Station # 13

Description of metal (Colour(s), size, shape)

colour: light silver, dark grey discolouration, long rectangular prism very light (mass)

Mass (*m*) of the object: (19.9 ± 0.1) g (1)

Initial volume(V_i) of water: (84.0 ± 0.5) mL

Final apparent volume (V_f): (95.3 ± 0.5) mL

Depends on the graduated cylinder used!

Density Calculations:

Volume

$\Delta V = V_f - V_i$

$\Delta V = (V_f - V_i)_{mL} \pm (\delta V_f + \delta V_i)\,mL$

$= (95.3 - 84.0)_{mL} \pm (0.5 + 0.5)\,mL$ (1)

$\Delta V = (11.3 \pm 1.0)\,mL$

$P = \frac{m}{\Delta V}$

$= \frac{19.9}{11.3}$ (1)

$P = 1.761062\ g/mL$

$\delta P = \left(\frac{\delta m}{m} + \frac{\delta \Delta V}{\Delta V}\right) P$

$= \left(\frac{0.1}{19.9} + \frac{1.0}{11.3}\right) 1.761062$

$= 0.164696$

$\delta P = 0.2$ (1)

Final answer $(1.8 \pm 0.2)\ g/mL$

Metal magnesium

Practicing using numbers with uncertainties. You must show your formulas and work for full marks.

Use the following numbers with uncertainties to do the following operations.

$A = 38.75 \pm 0.08$ $B = 548.25 \pm 0.02$ $C = 82.85 \pm 0.01$ $D = 115.71 \pm 0.05$

1. A+B-C $(A+B-C) \pm (\delta A + \delta B + \delta C)$

$= (38.75 + 548.25 - 82.85) \pm (0.08 + 0.02 + 0.01)$

$= 504.15 \pm 0.11$

$A+B-C = 504.2 \pm 0.1$

504.2 ± 0.1

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2. $\frac{AB}{C} = \frac{(38.75)(548.25)}{82.85}$

$= 256.424$

$\delta\frac{AB}{C} = \left(\frac{\delta A}{A} + \frac{\delta B}{B} + \frac{\delta C}{C}\right)\frac{AB}{C}$

$= \left(\frac{0.08}{38.75} + \frac{0.02}{548.25} + \frac{0.01}{82.85}\right) 256.424$

$= 0.569695$

$\delta\frac{AB}{C} = 0.6$

256.4 ± 0.6

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3. $\frac{D-B}{C-A}$

$(D-B) \pm (\delta D + \delta B) = (115.71 - 548.25) \pm (0.05 + 0.02)$

$= -432.54 \pm 0.07$

$(C-A) \pm (\delta C + \delta A) = (82.85 - 38.75) \pm (0.01 + 0.08)$

$= 44.10 \pm 0.09$

$\frac{D-B}{C-A} = \frac{-432.54}{44.10} = -9.80816$

$\delta\left(\frac{D-B}{C-A}\right) = \left(\frac{\delta(D-B)}{D-B} + \frac{\delta(C-A)}{C-A}\right)\frac{D-B}{C-A}$

$= \left(\frac{0.07}{|-432.54|} + \frac{0.09}{44.10}\right) 9.80816$

$\delta\left(\frac{D-B}{C-A}\right) = 0.021604$

-9.81 ± 0.02

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4. $\frac{B+D}{A^2}$

$B+D \pm (\delta B + \delta D) = (548.25 + 115.71) \pm (0.02 + 0.05) = 663.96 \pm 0.07$

$\frac{B+D}{A^2} = \frac{B+D}{A \cdot A} = \frac{663.96}{(38.75)(38.75)} = 0.442179$ (1501.56)

$\delta\left(\frac{B+D}{A^2}\right) = \left(\frac{\delta(B+D)}{B+D} + \frac{\delta A}{A} + \frac{\delta A}{A}\right)\frac{B+D}{A^2}$

$= \left(\frac{0.07}{663.96} + \frac{0.08}{38.75} + \frac{0.08}{38.75}\right) 0.442179$

0.442 ± 0.002

$(4.42 \pm 0.02) \times 10^{-1}$