

Mass and Volume

Reading a Graduated Cylinder

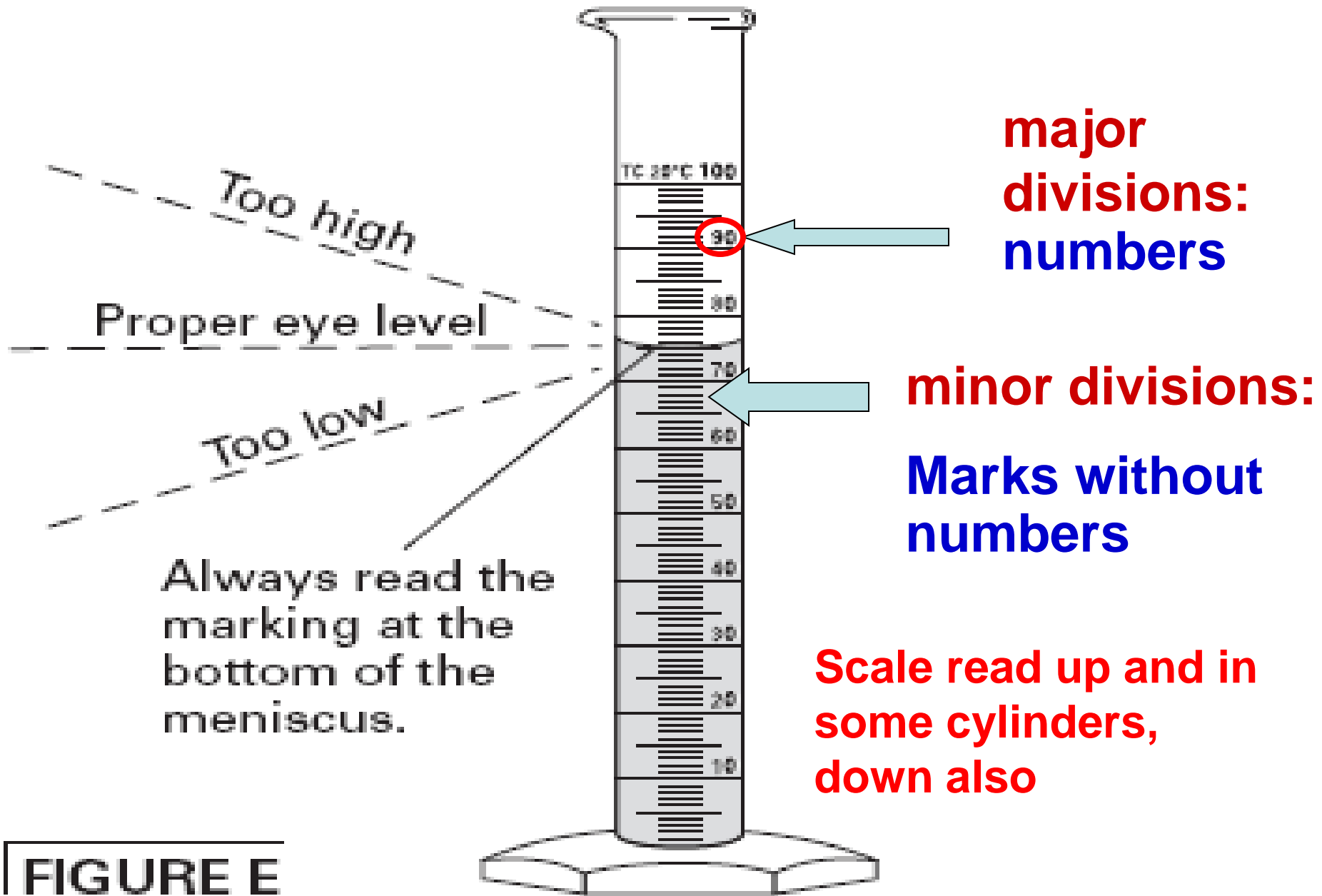
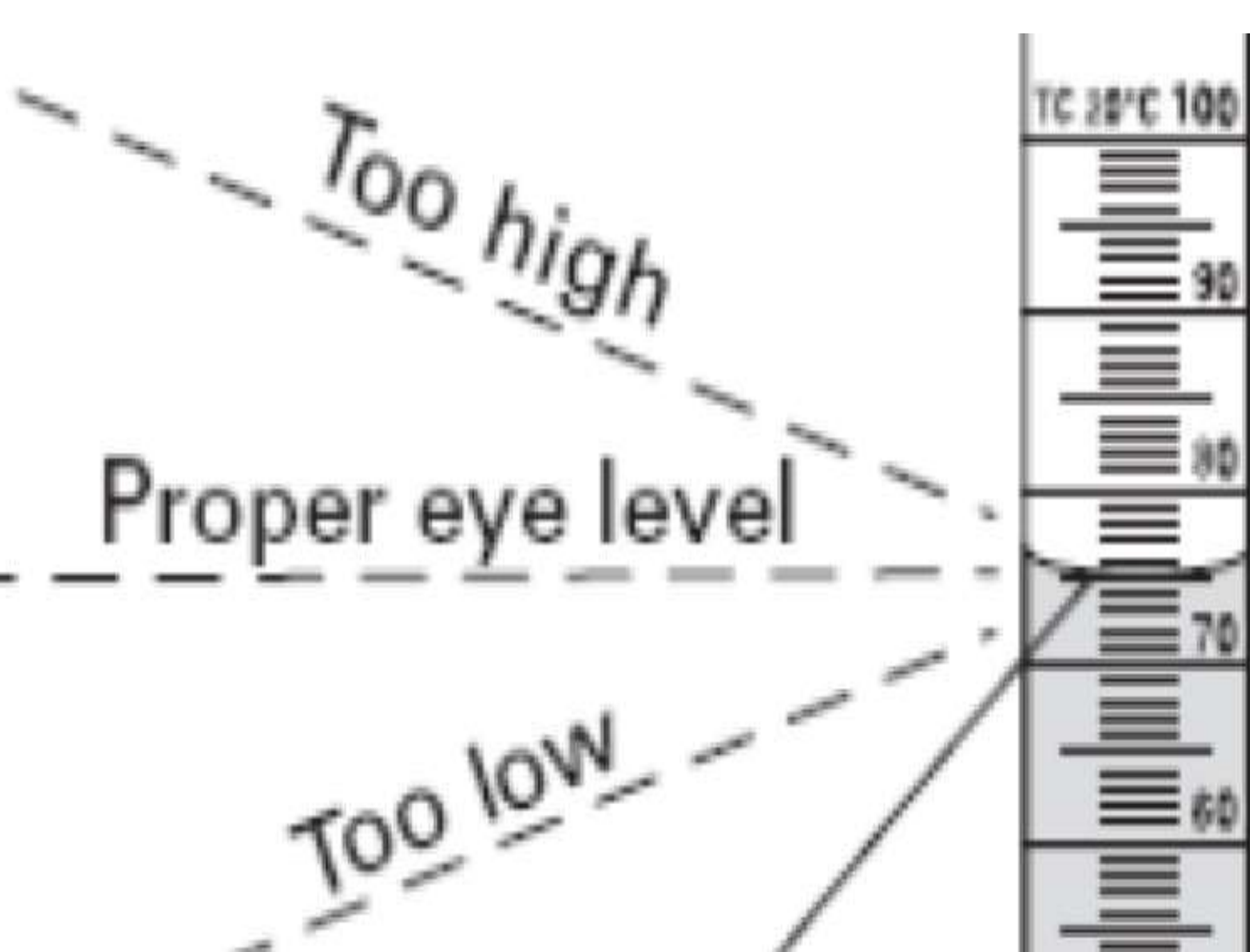
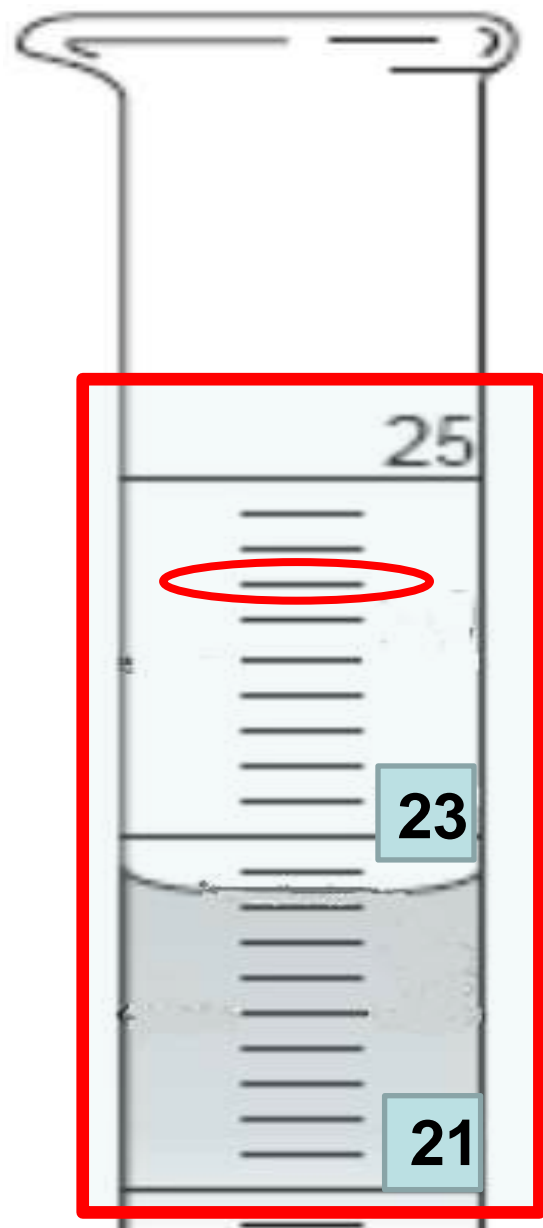


FIGURE E



25 mL Graduated Cylinder

Draw the cylinder



1. Determine the value of each minor mark

$$\frac{25 - 23}{10 \text{ lines}} = 0.2 \text{ mL}$$

2. What is the uncertainty?

Estimation is $\frac{1}{2}$ the minor mark, which is

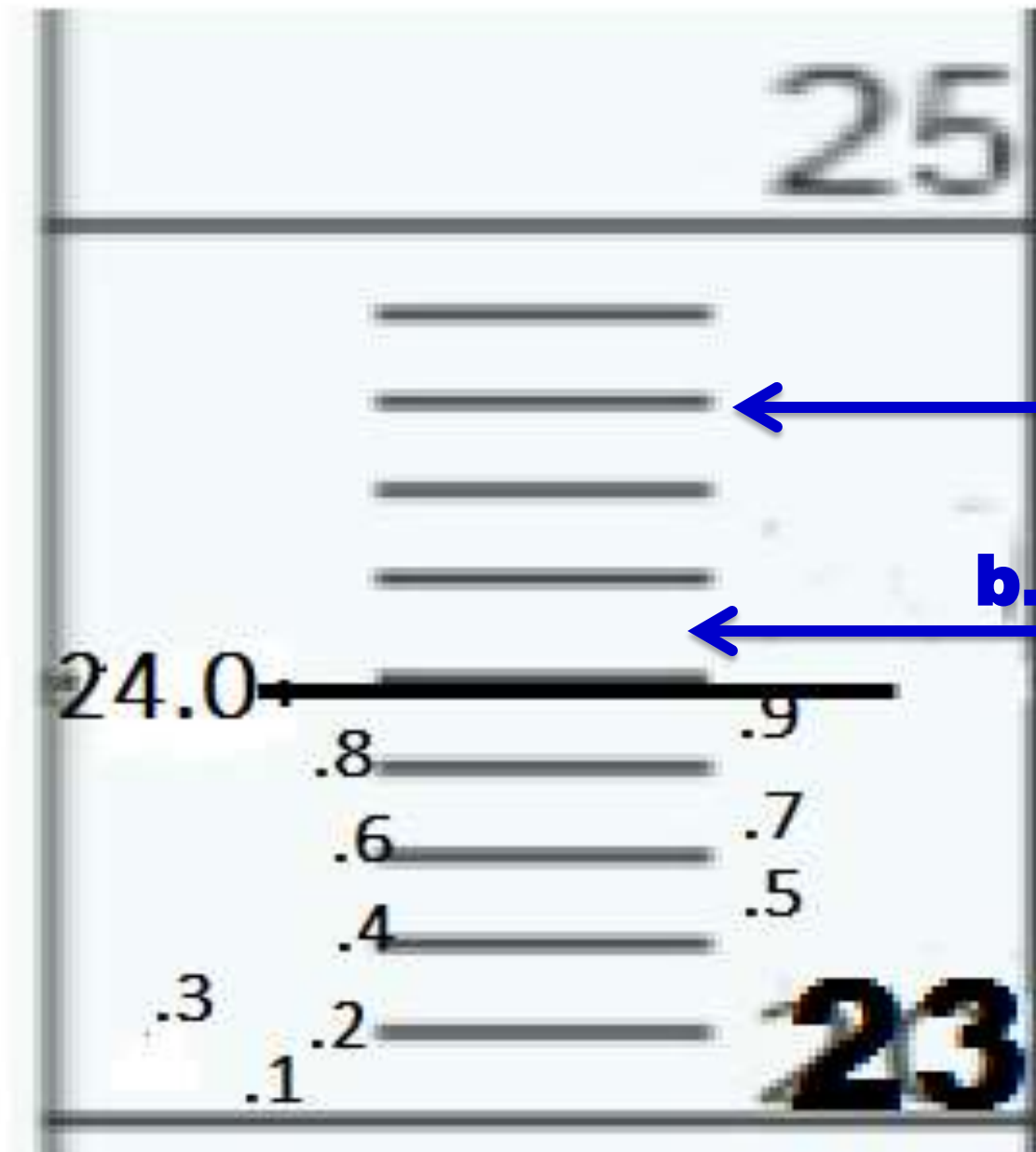
$$\frac{0.2 \text{ mL}}{2} = 0.1 \text{ mL}$$

3. What is the measurement shown in cm^3 ?

4. How many sig figs 3

22.7 cm^3





a.

24.6 mL

24.6 cm³

b.

24.1 mL

24.1 cm³

Report the measurements to three significant figures.



The major marks are _____ mL

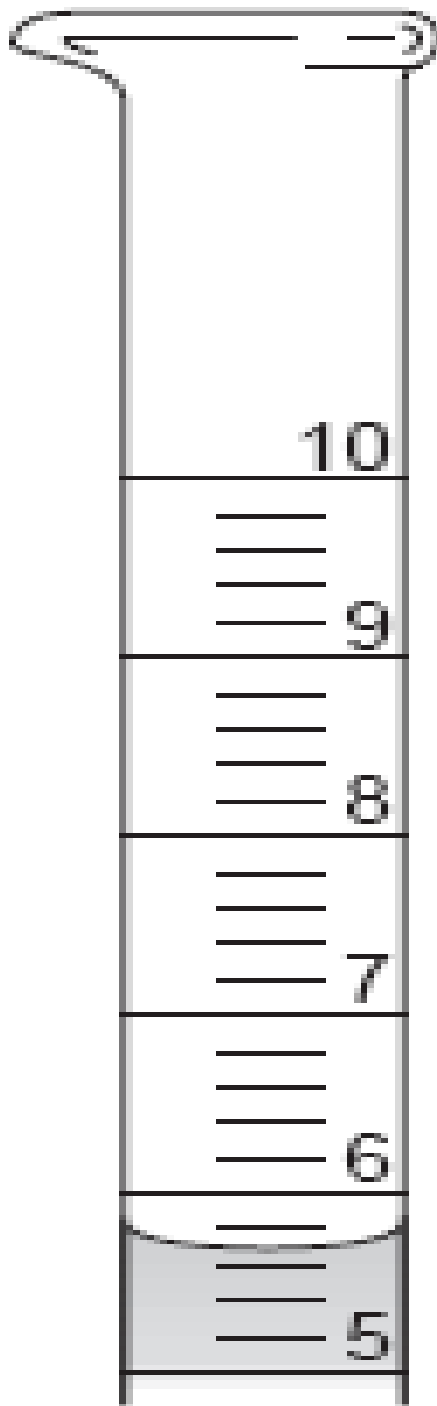
1 mL

The minor marks are _____ mL

0.2 mL

Estimation is $\frac{1}{2}$ the minor mark, which is

0.1 mL



The measurement is

5.7 mL

The uncertainty is

± 0.1 mL

How many significant figures?

two

c.

The major marks are _____ mL

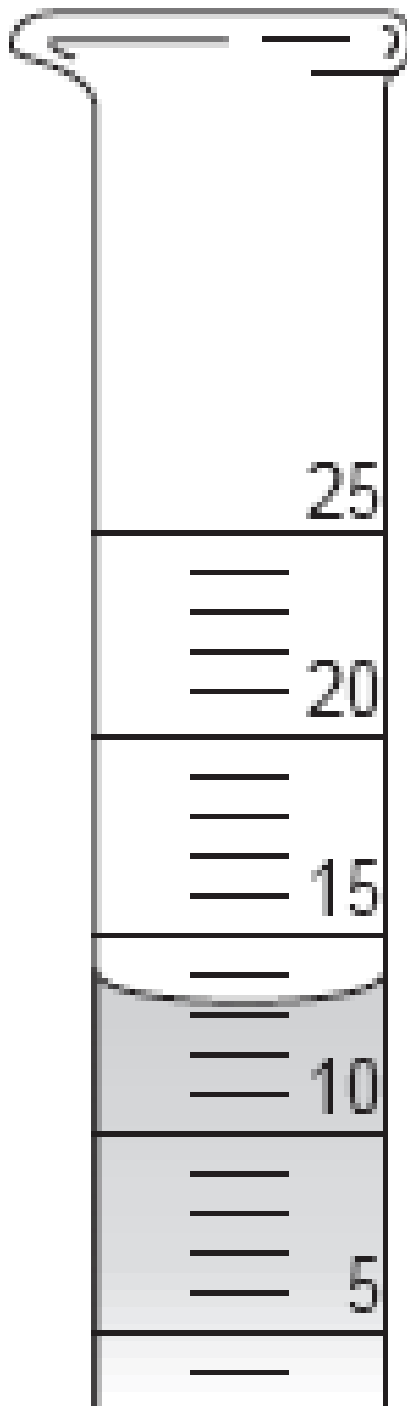
5 mL

The minor marks are _____ mL

1 mL

Estimation is $\frac{1}{2}$ the minor mark, which is

0.5 mL



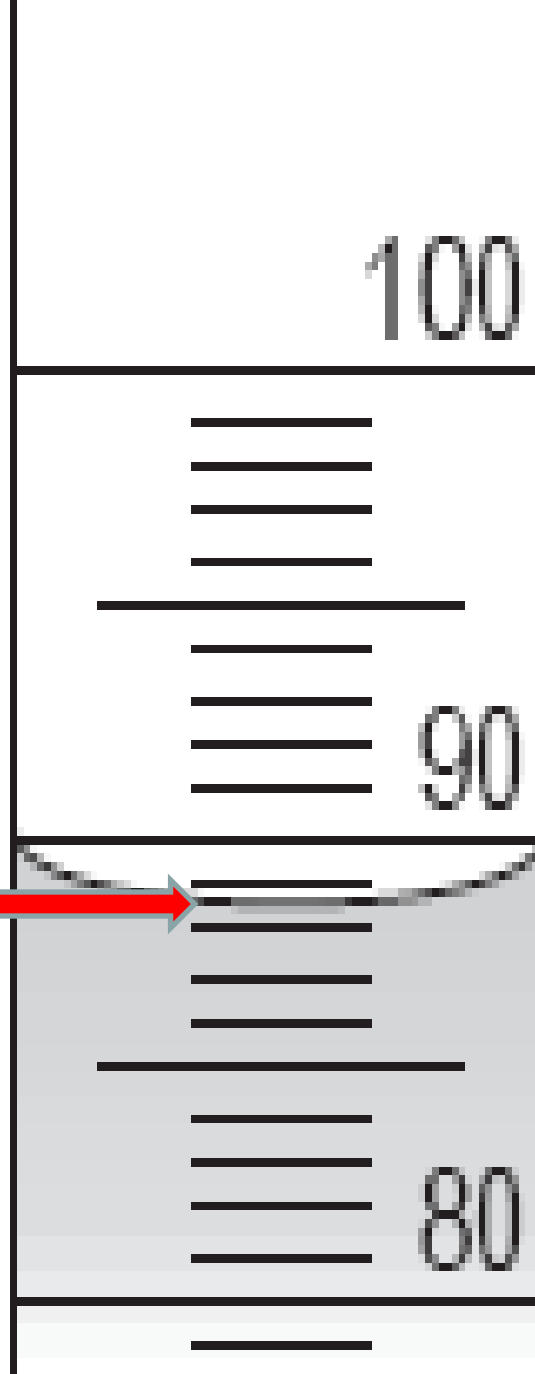
The measurement is

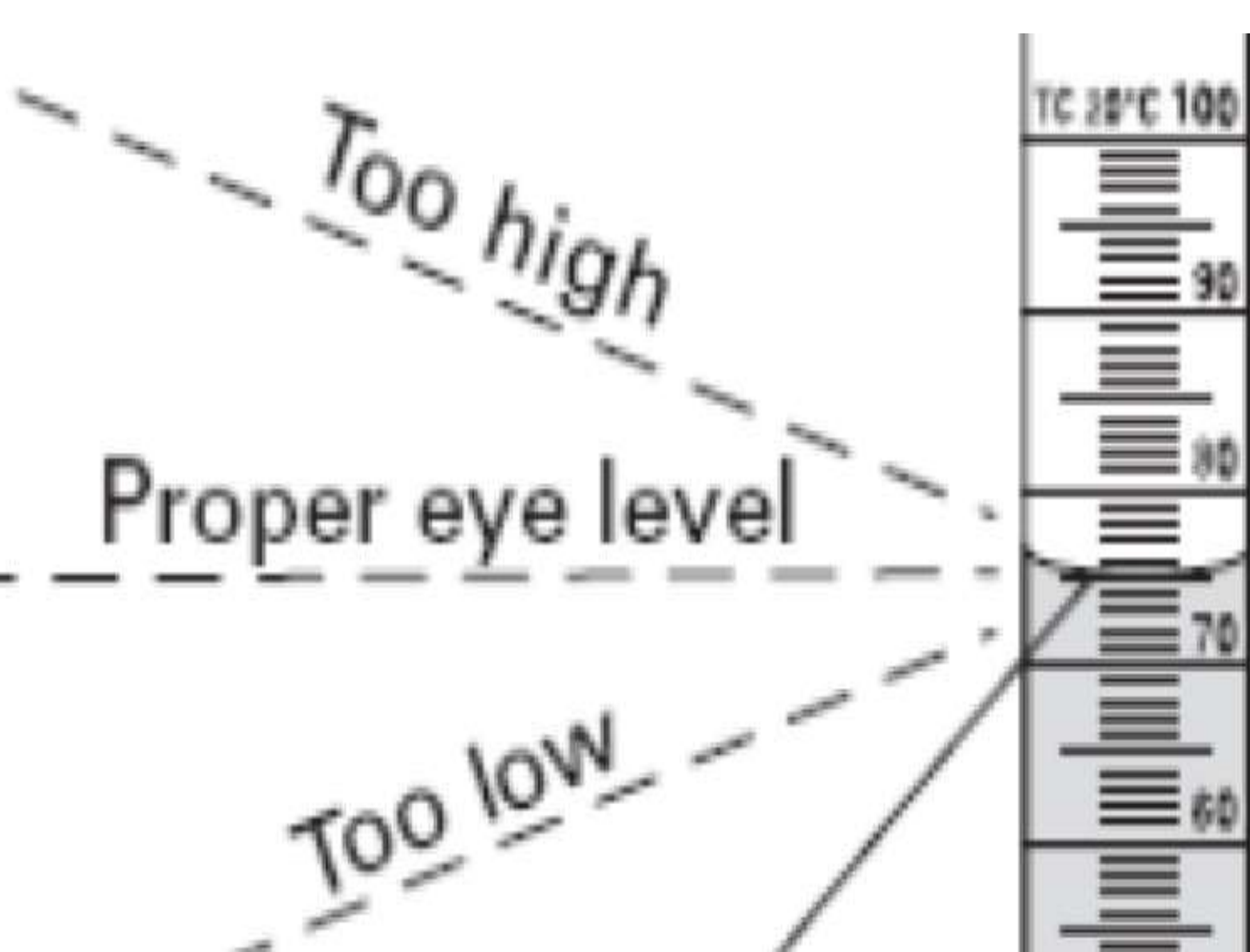
13.0 mL

How many significant figures?

three

**READ FROM
THE BOTTOM
OF THE
MENISCUS**





Preparing the Samples

1ST Sample

5.50

2nd Sample

8.30

3rd Sample

11.0

- DISH HAS A MASS OF: 2.22 g
- 1st sample: 5.50g (metal) + 2.22 g (for the dish) = 7.72 g
- set the scale for 7.72 g
- **But when you try to weigh the sample, you can't get 7.72, it either comes out to heavy or to light.**
- **It weighs either 7.68g or 8.22 g**
- **Always use the lesser mass!! (7.68 g)**
- **You need to record the mass of the metal in the data table.**
- **The mass of the metal is $7.68\text{g} - 2.22\text{g} = \underline{5.46\text{ g}}$**

Sample	Mass of Sample, (g)
red or gold 1	5.46
red or gold 2	
red or gold 3	

	a	b	c	d	e
Sample	Mass of Sample, (g)	Initial Volume, (mL)	Final Volume, (mL)	Volume of sample, (mL) (c -b)	$\frac{\text{mass}}{\text{volume}}$ (a ÷ d)
red or gold 1	5.46	5.00	6.00	1.00	
red or gold 2	8.20	6.00	6.80	0.800	
red or gold 3	11.1	6.80	8.10	1.30	
				AVERAGE	
Silver 1	8.20	14.0	15.0	1.00	
silver 2	11.1	15.0	15.8	0.800	

Silver 1	8.20	14.0	15.0	1.00	
silver 2	11.1	15.0	15.8	0.800	
silver 3	12.1	15.8	17.1	1.30	

10 mL cylinder: start with 5 mL of water

25 mL cylinder: start with no more than 14 mL of water

Reading a Graduated Cylinder

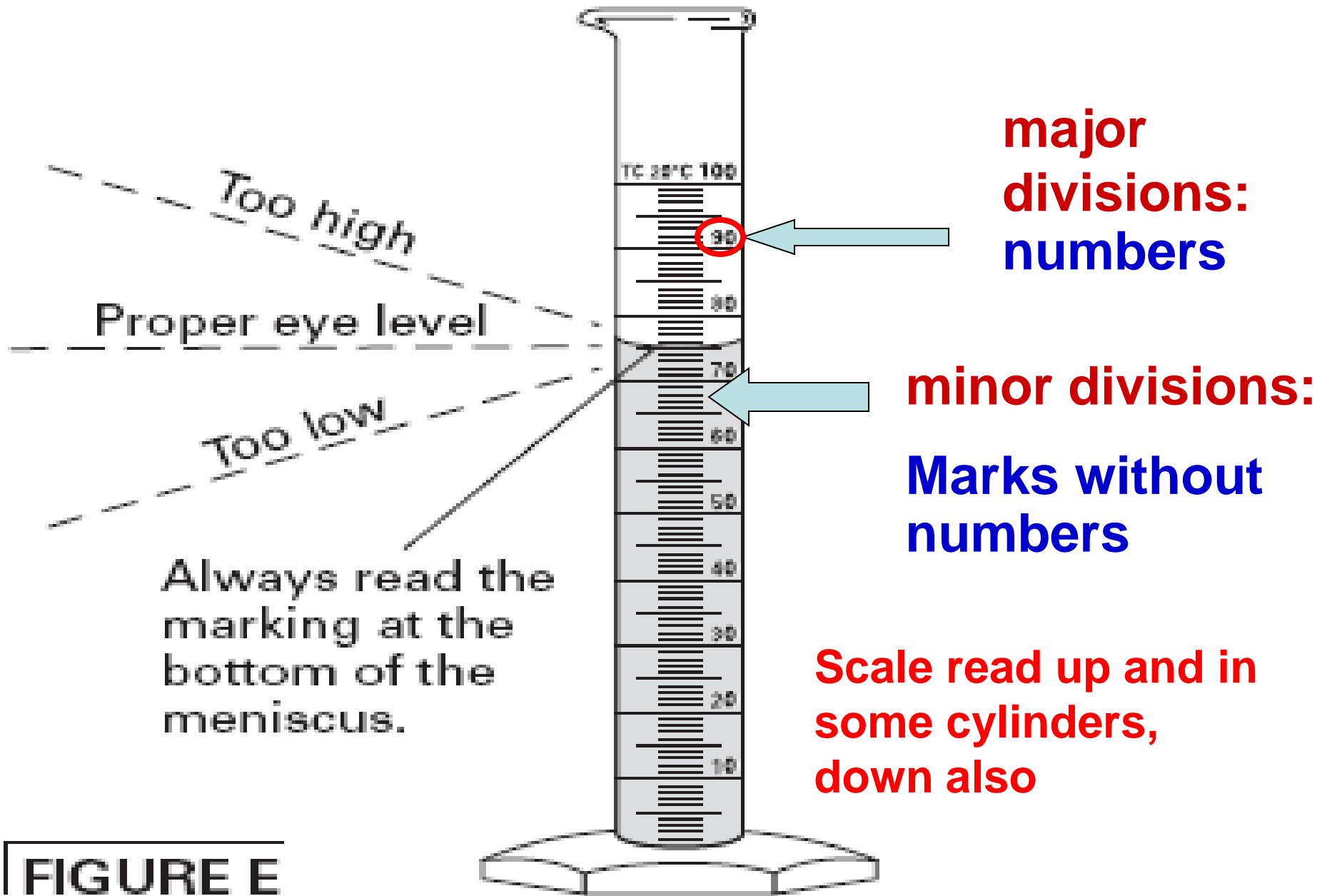
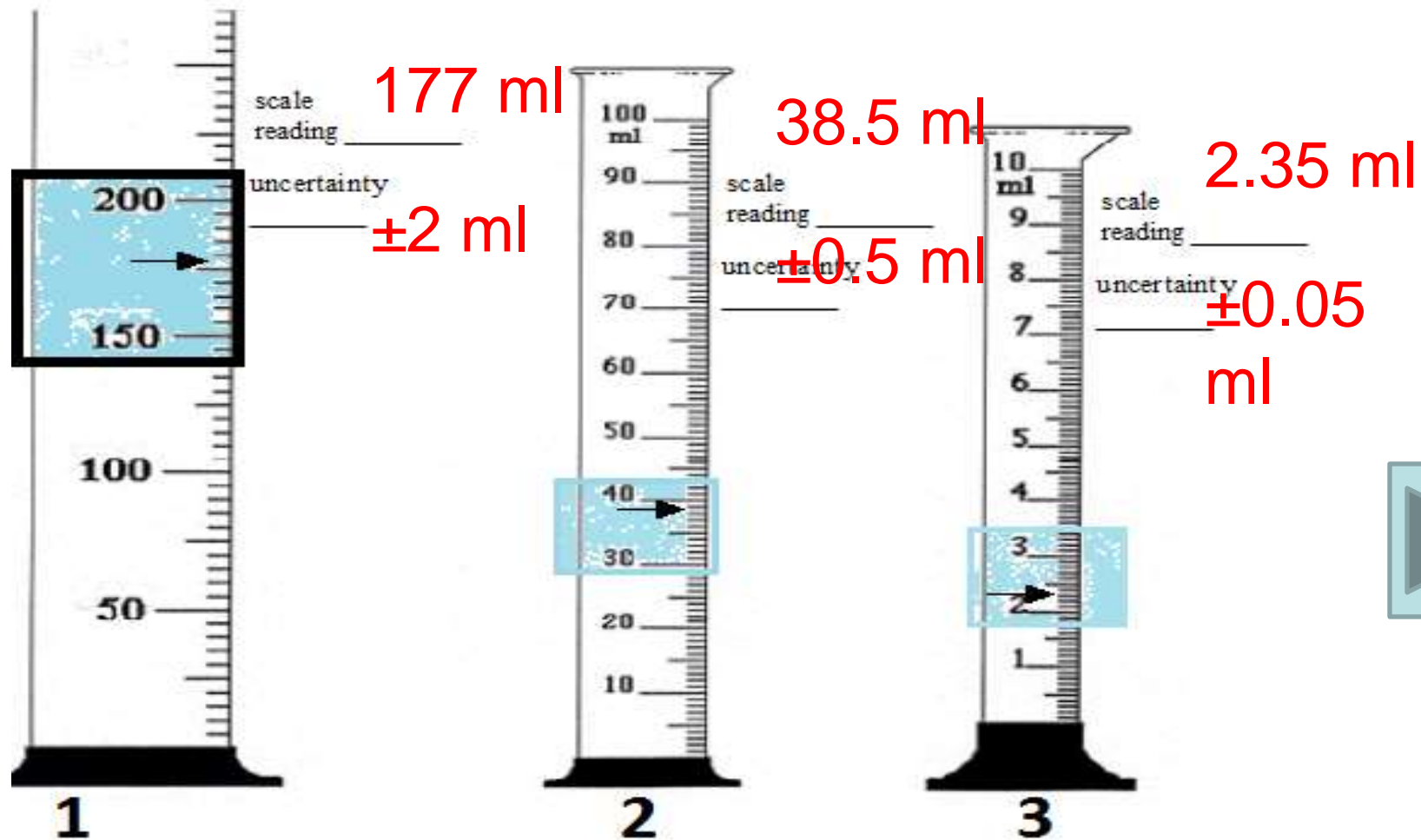
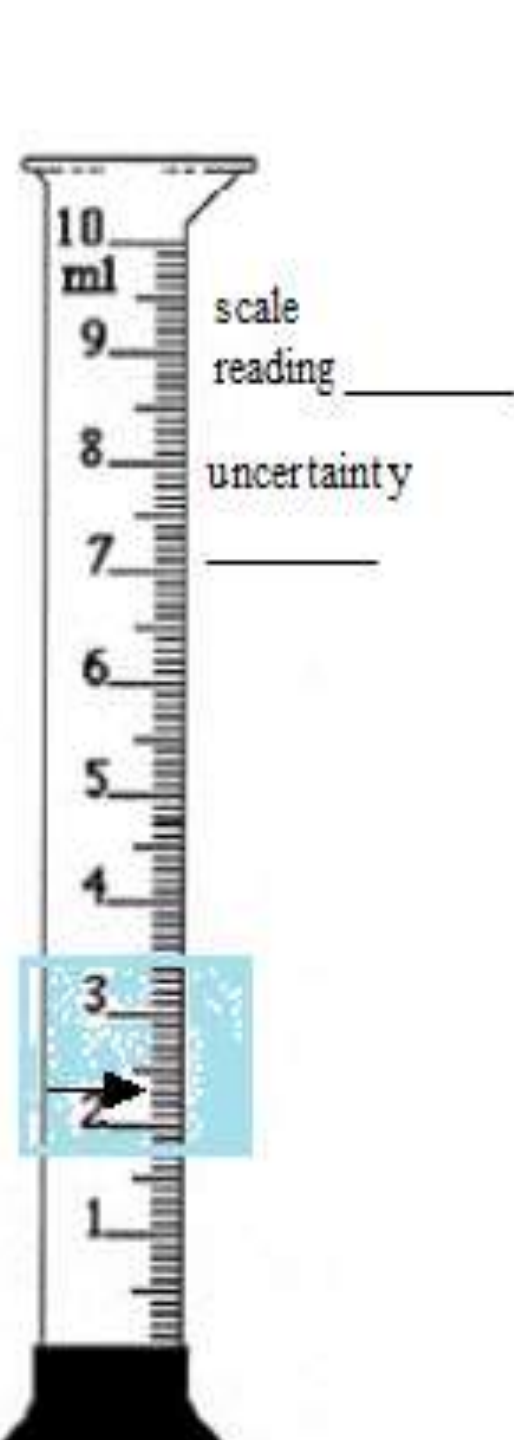
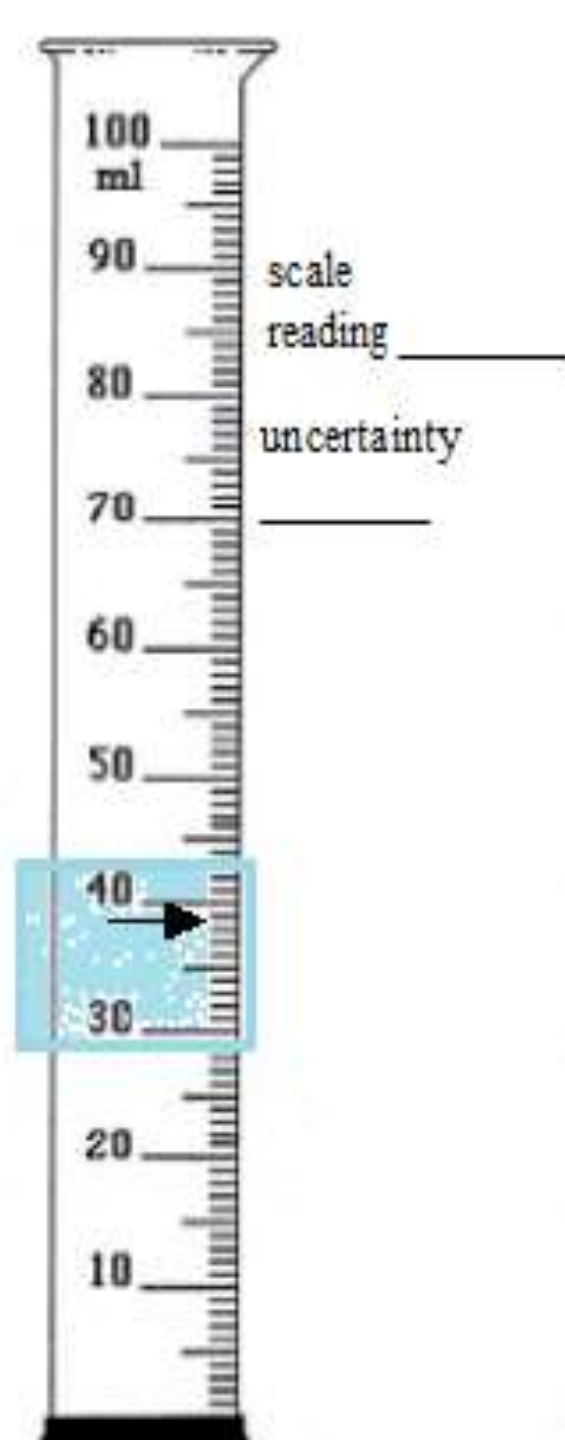
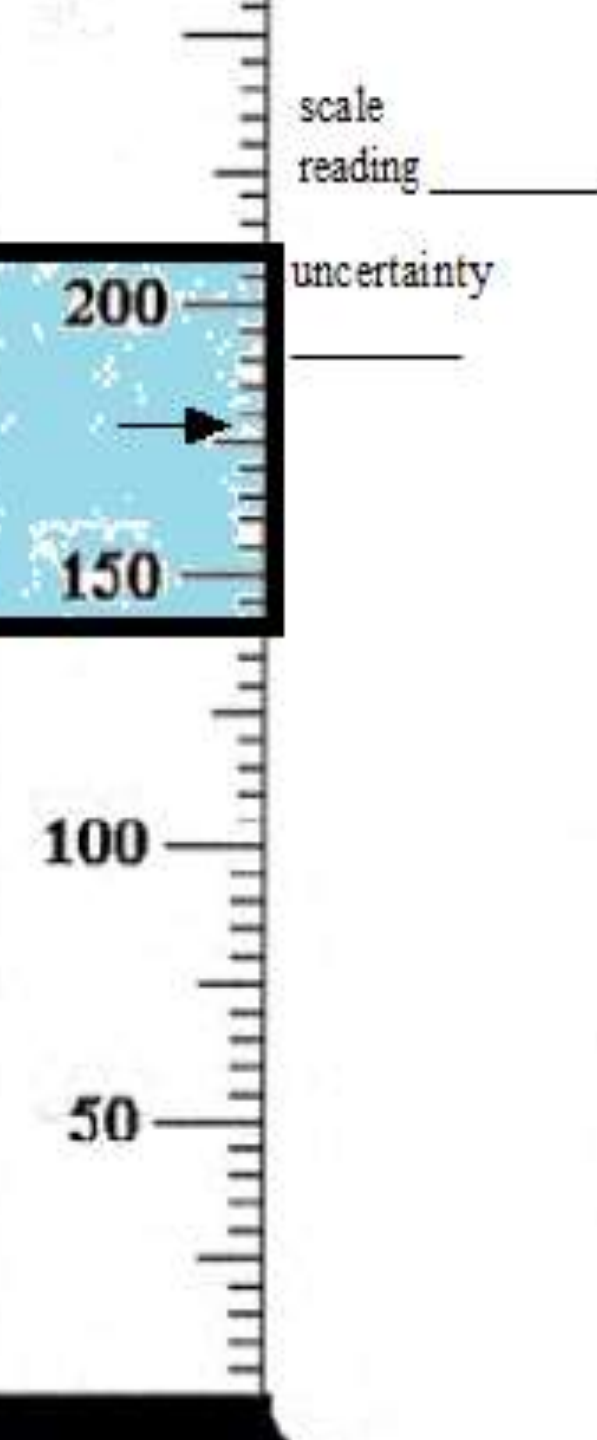


FIGURE E

Draw the blue section of the graduated cylinders:





Reading a Graduated Cylinder

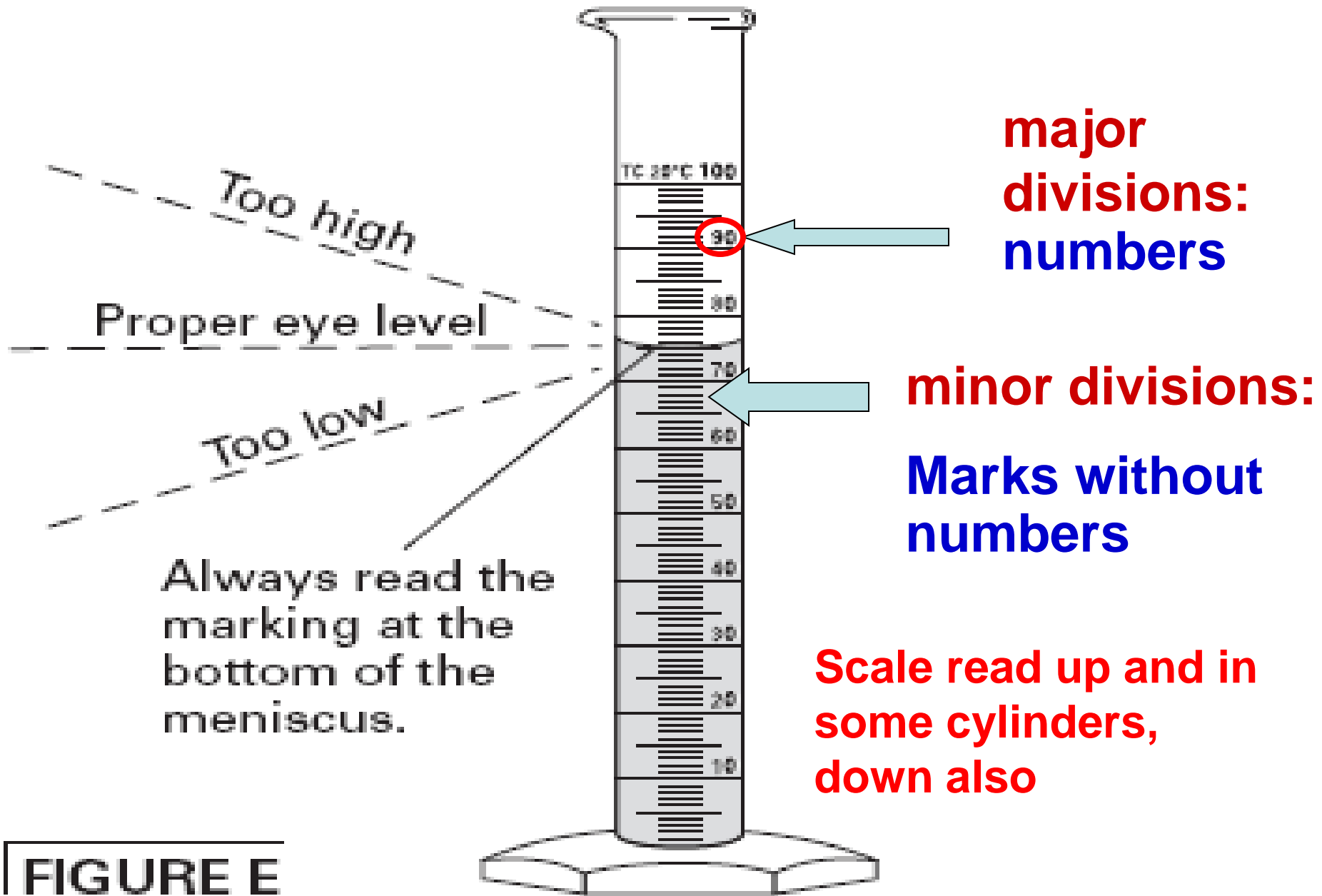
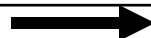


FIGURE E

Mass and Volume

	a	b	c	d	e.
	Mass of Sample, (g)	Initial Volume, (mL)	Final Volume, (mL)	Volume of sample, (mL) (c -b)	<u>mass</u> volume (a ÷ d)
Sample					
red or gold 1					
red or gold 2					
red or gold 3					
				AVERAGE:	
Silver 1					



Continued on the same page!!!!

Silver 1					
silver 2					
silver 3					
			→	AVERAGE:	

New Page

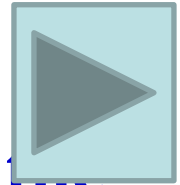
	a	b	c	d	e.
	Mass of Sample, Grams	Initial Volume, mL	Final Volume, mL	Volume of sample, mL (c - b)	<u>mass</u> Volume (a ÷ d)
Sample					
Silver 1					
silver 2					
silver 3					
			→	AVERAGE:	

Bell Work, Tuesday, 4/09/13

1. On a graduated cylinder what are major divisions and what are minor divisions

Major divisions are marks with number.

Minor divisions are marks without numbers.



2. What is the equation of a straight line? Define the variables.

$$**y = mx + b**$$

y = the y value

x = the x value

m = the slope $\left(\frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} \right)$

b = the y intercept

Reading a Graduated Cylinder

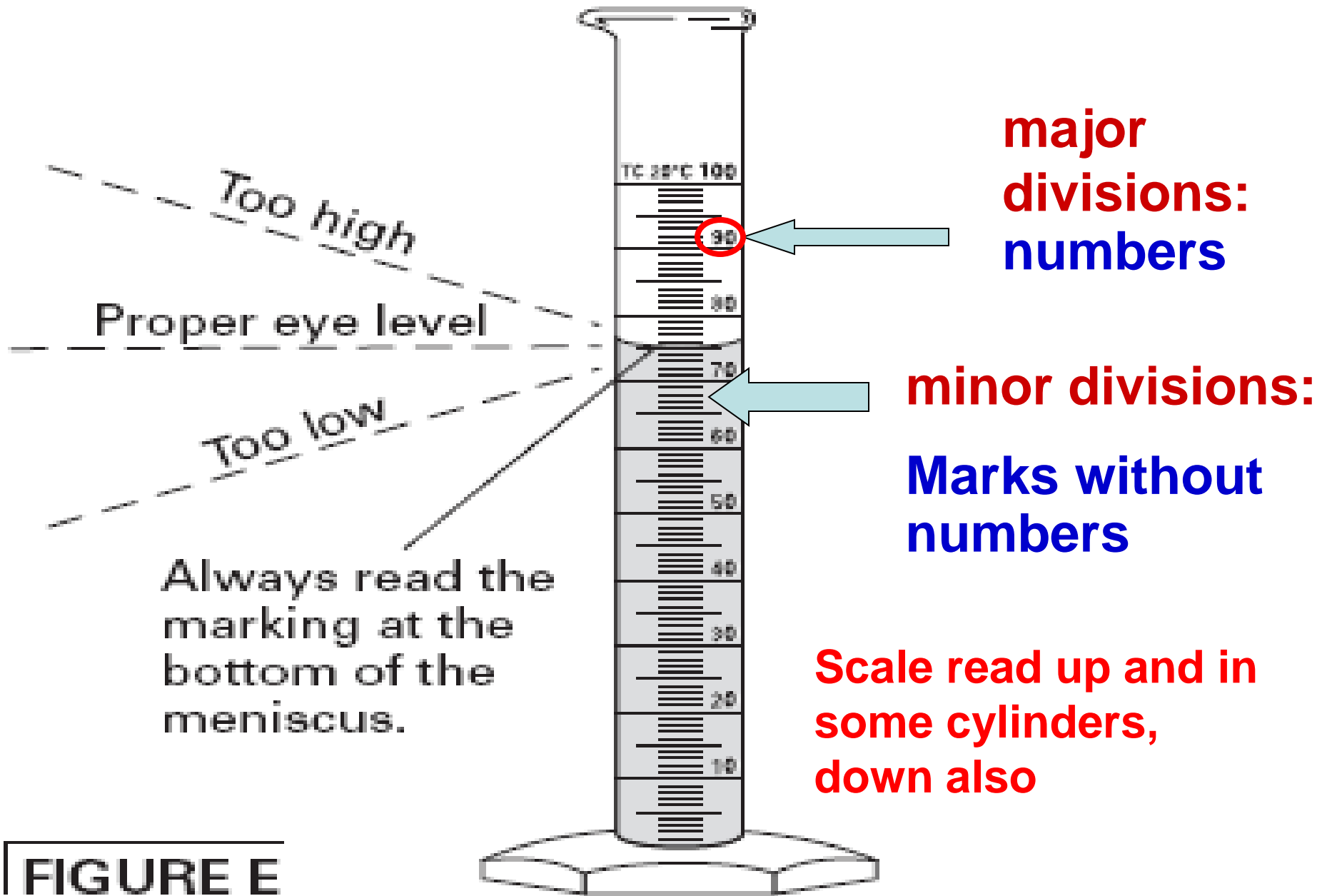


FIGURE E

The major marks are _____ mL

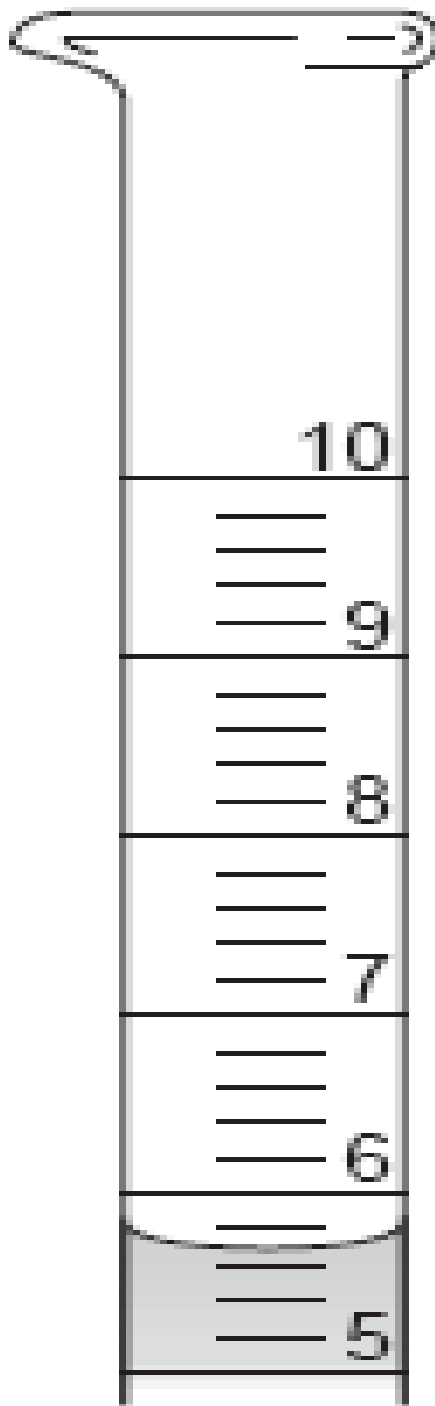
1 mL

The minor marks are _____ mL

0.2 mL

Estimation is $\frac{1}{2}$ the minor mark, which is

0.1 mL



The measurement is

5.7 mL

The uncertainty is

± 0.1 mL

How many significant figures?

two

c.

The major marks are _____ mL

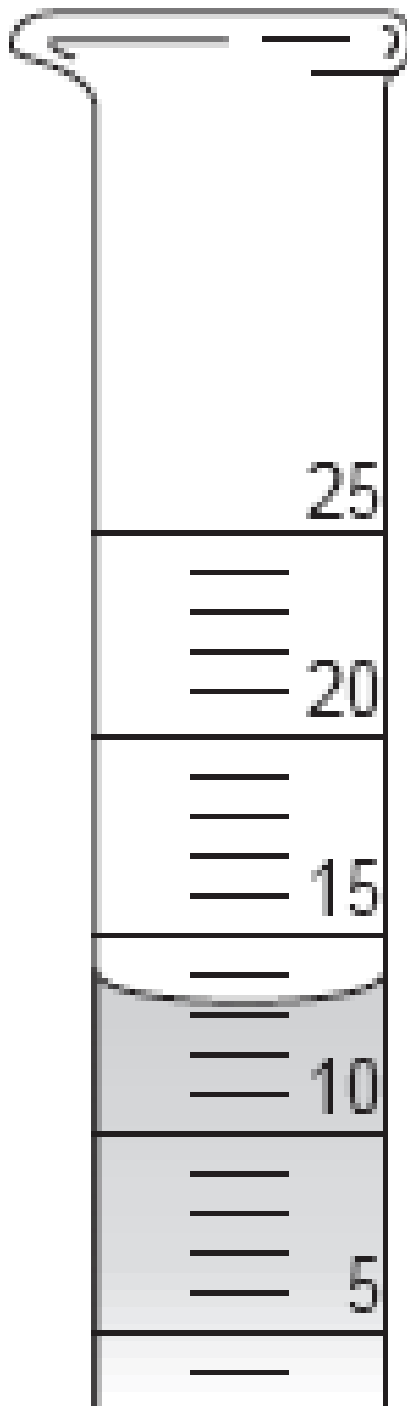
5 mL

The minor marks are _____ mL

1 mL

Estimation is $\frac{1}{2}$ the minor mark, which is

0.5 mL



The measurement is

13.0 mL

The uncertainty is

± 0.5 mL

Reported as 13.0 ± 0.5 mL

How many significant figures?

three

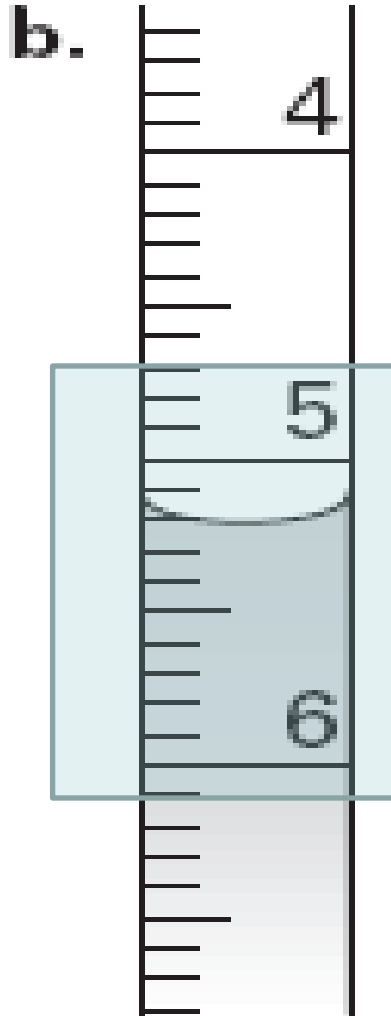
Bell Work, Tuesday, 4/09/13

Draw the cylinder between 5 – 6

3. The major cm^3 marks are _____
 cm^3
1 mL

4. The minor marks are _____
 cm^3
0.1 mL

5. Estimation is $\frac{1}{2}$ the minor mark, which is
0.05 mL



6. The measurement is 5.20 mL

7. The uncertainty is ± 0.05 mL

Reported as 5.20 ± 0.05

How many significant figures?
three

The major marks are _____ mL

1 mL

The minor marks are _____ mL

0.1 mL

Estimation is $\frac{1}{2}$ the minor mark, which is

0.05 mL

b.



The measurement is

5.20 mL

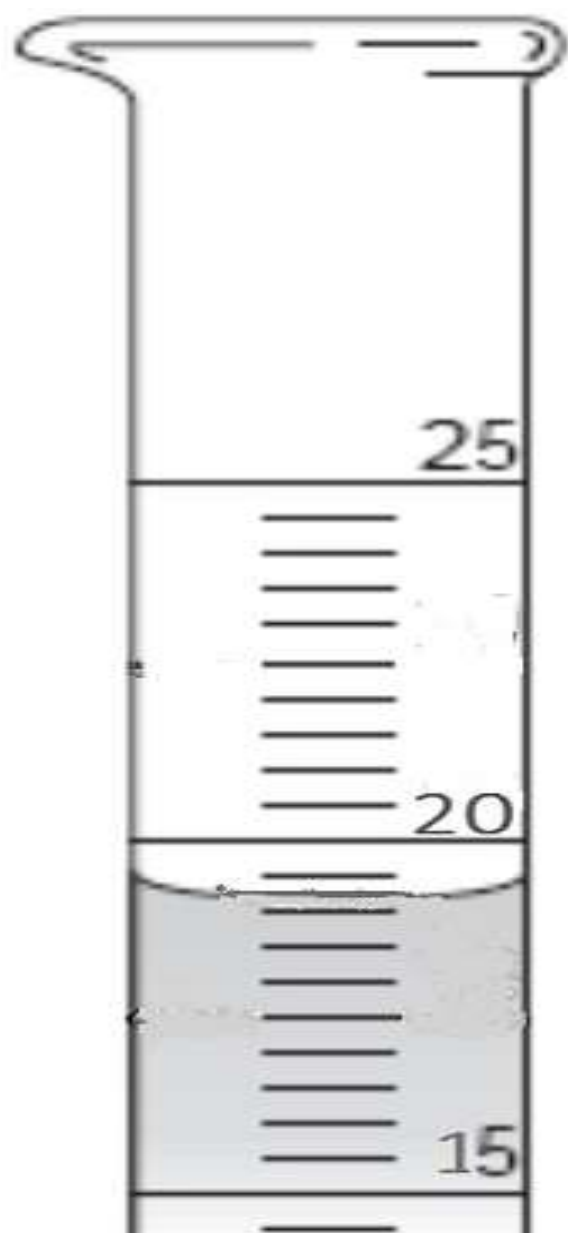
The uncertainty is

± 0.05 mL

Reported as 5.50 ± 0.05

How many significant figures?

three



•

2. What is the equation of a straight line? Define the variables.

$y = mx + b$

y = the y value


x = the x value

m = the slope $\left(\frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x}\right)$

b = the y intercept



Mass and Volume Lab

	a	b	c	d	e.
Sample	Mass of Sample, Grams	Initial Volume, mL	Final Volume, mL	Volume of sample, mL (c - b)	<u>mass</u> Volume (a ÷ d)
red or gold 1					
red or gold 2					
				AVERAGE	
silver 1					
silver 2					
				AVERAGE	

Slope



Write the linear equation (equation of a straight line)

Define the variables:

$$y = mx + b$$

x & y are data points you measured

m = the slope $\left(\frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x}\right)$ b = the y-intercept

Explain this equation: $y = 4.75x + 0.465$

The equation is a linear equation because it has the form of $y = mx + b$.

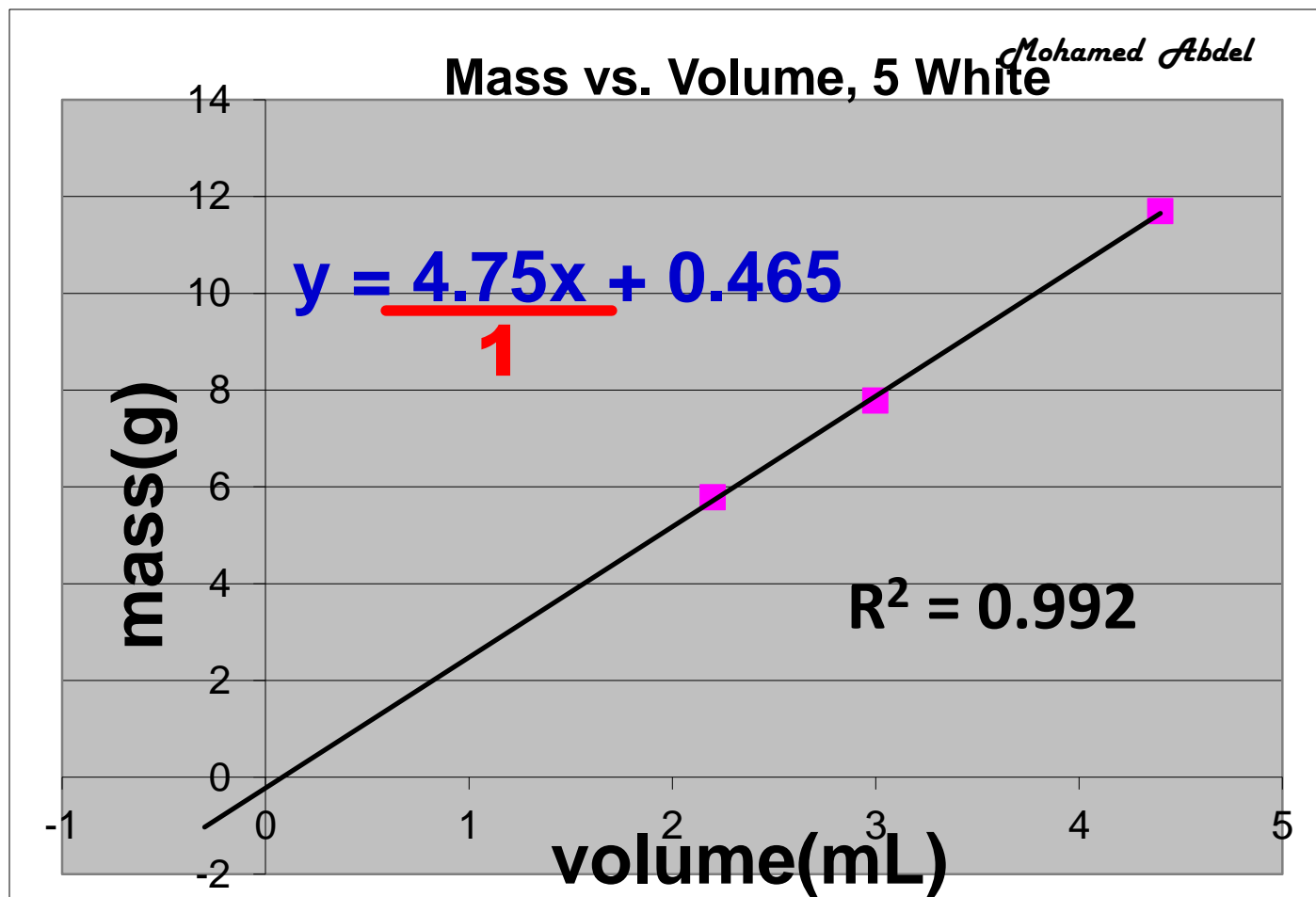
4.75 is the slope (m)

0.465 is where the line crosses the y axis (the y-intercept) (b)

y is a y coordinate on the line,

X is a x coordinate on the line,

Silver	
x, volume	y, mass
2.2	5.78
3	7.78
4.4	11.69
5% max y=	0.5845

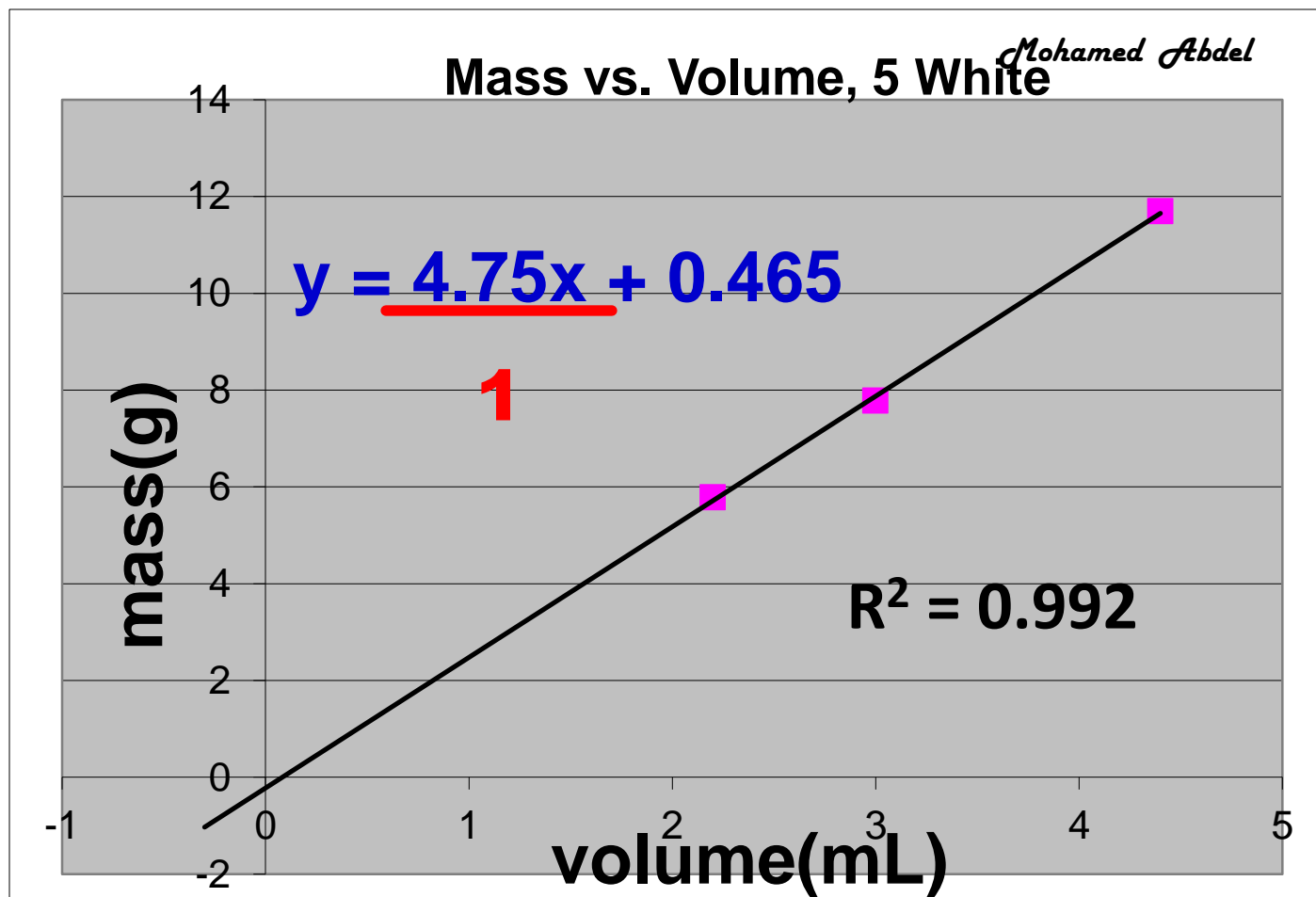


For a piece of silver metal, what does a slope of 4.75 mean?

What does the y-intercept of 0.465 mean?

Is the y-intercept on this graph negligible?

Silver	
x, volume	y, mass
2.2	5.78
3	7.78
4.4	11.69
5% max y=	0.5845

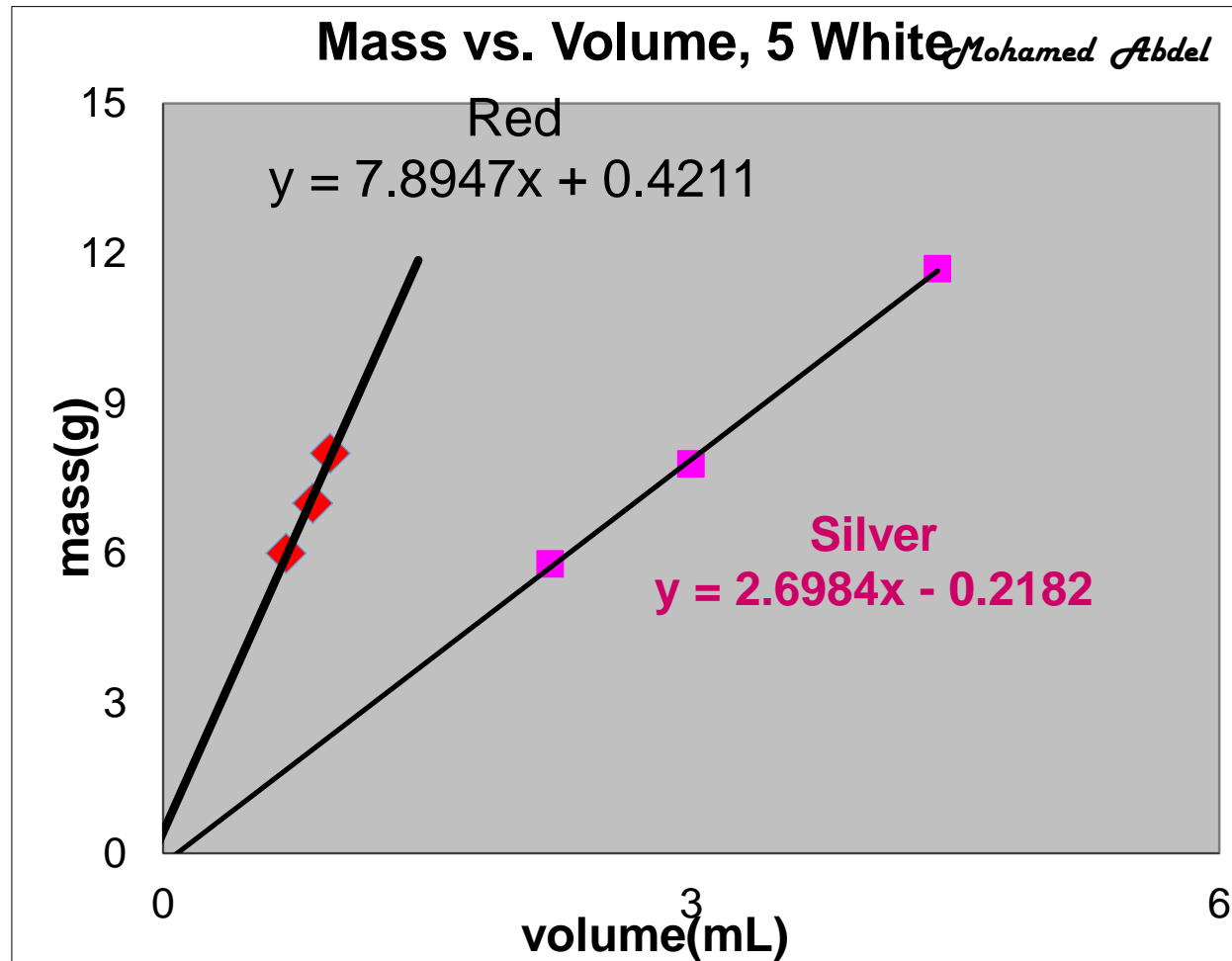


For a piece of silver metal, what does a slope of 4.75 mean?

What does the y-intercept of 0.465 mean?

Is the y-intercept on this graph negligible?

Red Metal	
x, volume	y, mass
0.7	6.00
0.85	7.00
0.95	8.00
Silver	
x, volume	y, mass
2.2	5.78
3	7.78
4.4	11.69



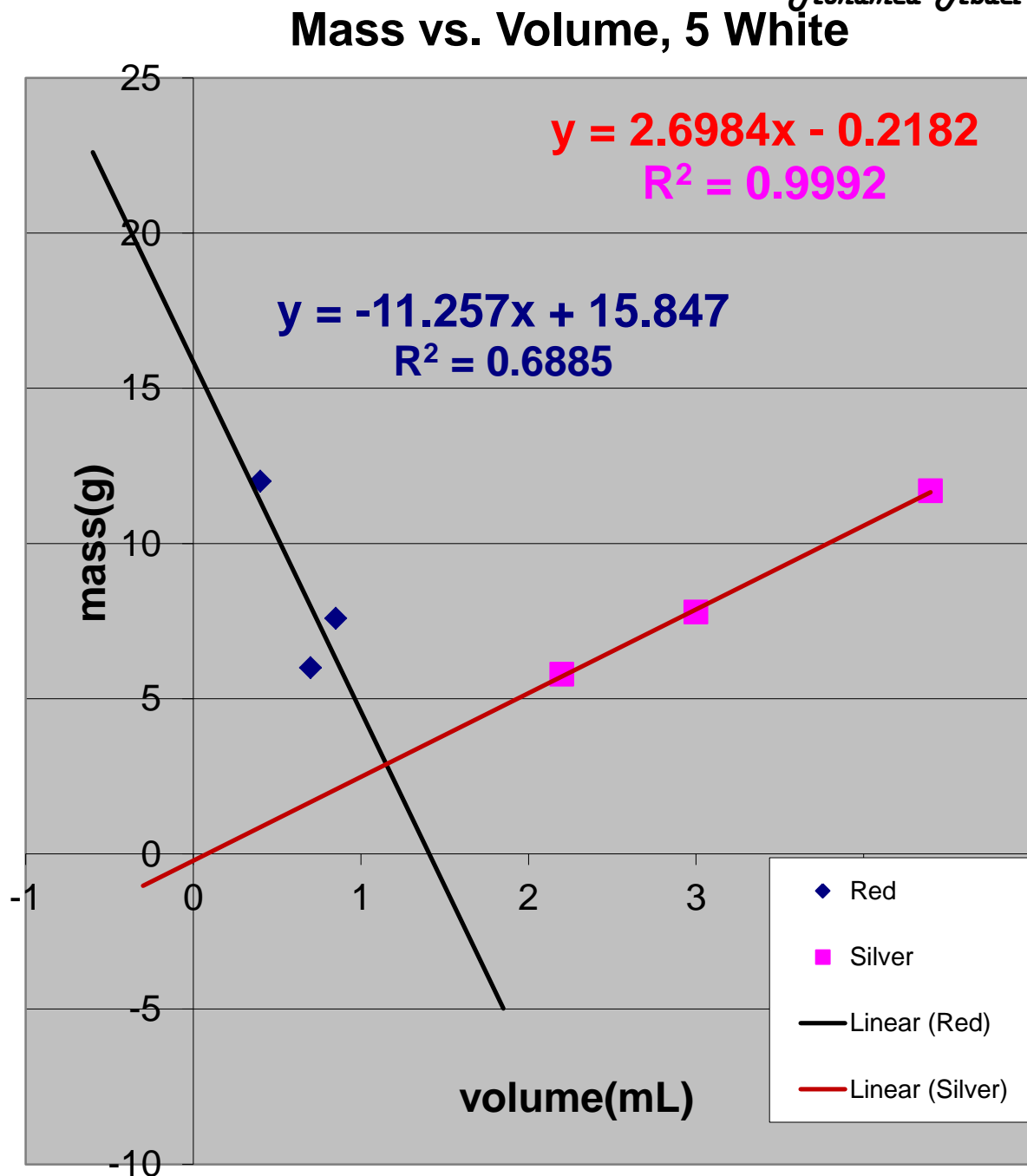
Write your data as shown.

Sketch & label your graph as shown

Write the linear equations as shown.

Determine if your y-intercept is negligible.

Red Metal	
x, volume	y, mass
0.85	7.59
0.4	12
0.7	6
Silver	
3	7.78
4.4	11.69
2.2	5.78
x, volume	y, mass
0.7	6
0.85	7.59
0.4	12
Silver	
2.2	5.78
3	7.78
4.4	11.69



What is bigger, the pillow or the battery?



What is heavier, the pillow or the battery



What is heavier, a ten pound puppy or a ten pound battery



What is bigger, the pillow or the battery?

What is heavier, the pillow or battery?

How can the battery have less volume than the pillow but have more mass?

There are more particles in the battery and/ or the particles of the battery are heavier than the pillow.



The battery is more dense than the pillow.



Density is the amount of mass that 1 mL of cm³ contains.

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

- **Mass is the amount of particles that make up a particular sample of matter.**
- **Density is the mass of stuff that occupies one unit of volume.**

Examples: 1 g of water occupies 1 cm³

The density is 1 g per cm³ and is written

$$1 \frac{\text{g}}{\text{cm}^3} \quad \text{or} \quad 1 \text{ g/cm}^3$$

What is heavier, a ten pound puppy or a ten pound battery?



Characteristic Properties

- **Properties that are unique to the identity of the substance can be used to i.d. a substance:**
- **Density – amount of mass per unit volume**
- **Boiling Point – temp that the stuff boils**
- **Melting/ Freezing Point- temp that the stuff melts/ freezes**
Type equation here.
- Electrical conductivity- amount electricity conducted
- Heat conductivity- amount heat conducted
- Reflection or absorption of light – amount of light reflected or refracted
- Absorption/ emission of light - amount of light absorbed or emitted
- ----More-----

Mean Deviation, Standard Deviation

- **Absolute Deviation** = $x - \bar{x}$
- density – average density

Tells you how much your data value are off from the average value to identify outliers.

Mean Deviation

The average of the absolute deviations.

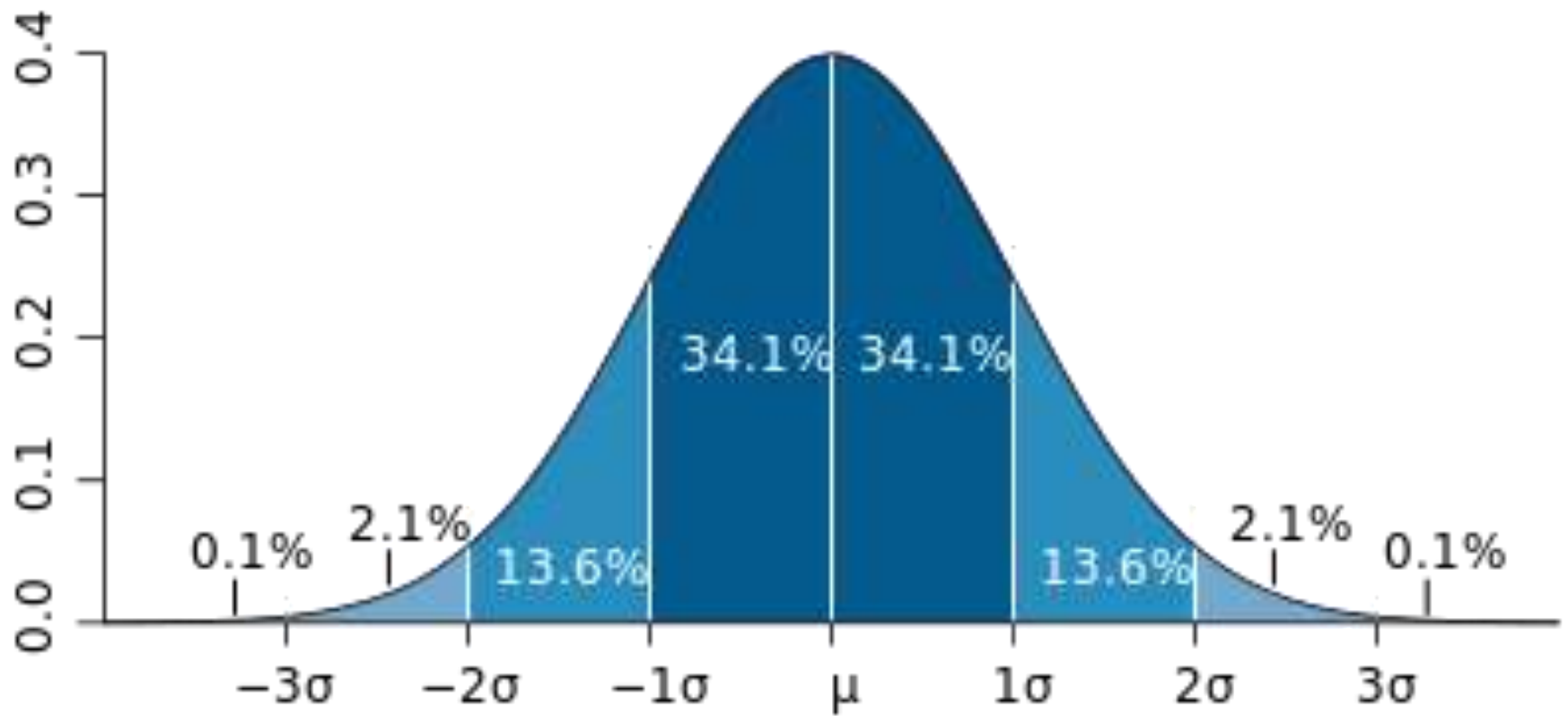
- **Standard Deviation**

tells you how much randomness (should be small compared to your data

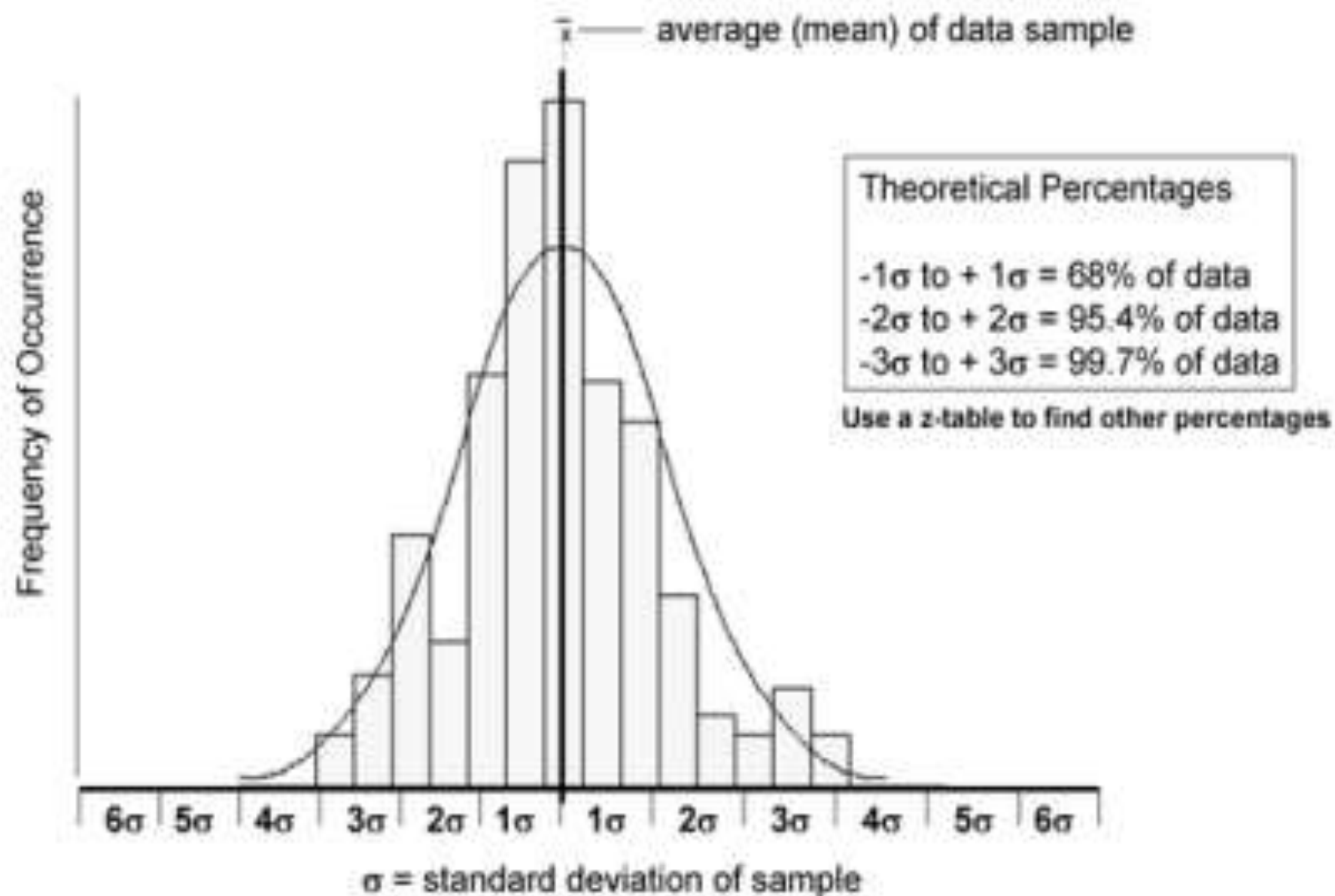
$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2},$$

Use Excel

Normal curve



Normal Distribution Curve, Fit to a Histogram



Percent experimental error calculation

➤ From your data table, your average density for the gold metal is 6.8 grams/ mL.

➤ You believe the metal is brass.

➤ The true density of brass is 8.39 g/ml or 8.4 g/ml

$$\% \text{ experimental error} = \frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100$$

$$\% \text{ experimental error} = \frac{|8.4 - 6.8|}{8.4} \times 100 = 19\%$$

3. Consider your results accurate if the percent error is equal or less than 10%

4. Were your result accurate?

Use this calculation to determine % range

Example:

- Value 1 = 8.1g/cm³,
- value 2 = 8.3g/cm³,
- value 3 = 12.6 g/cm³

$$\% \text{ range} = \frac{\text{highest value} - \text{lowest value}}{\text{lowest value}} \times 100$$

$$\% \text{ range} = \frac{12.6 - 8.1}{8.1} \times 100 = 55.5\%$$

5. Consider your values precise if the range is less than or equal to 10%.

	a	e	f	g
Sample	Mass of Sample, (g)	<i>mass</i>	Deviation e – class average	% Deviation $\frac{f}{\text{class avg}} \times 100$
		<i>volume</i>		
		(a ÷ d)		
		Density		
1		1.55	1.32	46%
2		2.49	0.380	13%
3		2.75	0.120	4%
	Avg	2.26	0.480	21%

1.32	45.99
0.38	13.24
0.12	4.18
0.61	21.14

% error Silver
 $(2.7 - 2.87) / 2.7 \times 100 = 6.3\%$

	% error silver	6.30%
8.6	gold	2.4%
8.83	red	1.5%

Sample 1: Deviation = $|1.55 - 2.87| = 1.32$

Sample 1: % Deviation = $\frac{1.32}{2.87} \times 100 = 46\%$