Key 1A

## Chemistry Lab Safety

Where is the safety equipment?

For each of the following lab safety equipment, write where it can be found in your classroom.

1. Fire Blanket
2. Fire Extinguisher
3. Safety Shower
4. Eye Wash Station
5. Fume Hood
6. Chemical Disposal area
7. Broken Glassware Disposal
8. Chemical spill clean up kit
9. Location of goggles
10. Fire Evacuation Route

How should you dress for lab?

| This student is dressed **inappropriately** for laboratory work. | This student is dressed **appropriately** for laboratory work. |
|---|---|
|  |  |

Above are pictures of two students. The student on the left is not dressed for lab, but the student on the right is dressed correctly.

a. Write five inappropriate items of dress for the student on the left.

b. Write five appropriate items of dress for the student on the right.

1

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Density: $D = m/v$ | mass: $v \cdot D = \frac{m}{\cancel{v}}$ $v \cdot D = m$ | volume: $D = \frac{m}{v} \cdot v$ $\frac{v \cdot D}{D} = \frac{m}{D}$ $v = \frac{m}{D}$

Name:

## Density Calculations Worksheet - Honors

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

UNITS OF DENSITY
g/cm³ or g/mL

1) Find the density of a wood block that has a volume of 5.0 cm³ and a mass of 30.5 g.

$D = 30.5g / 5.0cm^3 = \boxed{6.1\ g/cm^3}$

2) Which has the greater mass – 10 cm³ of steel (density = 7.8 g/cm³) or 5 cm³ of mercury (density = 13.6 g/cm³)?

steel 7.8
$m = (10cm^3)($[illegible]$g/cm^3) = 78 g$

mercury
$m = (5cm^3)(13.6 g/cm^3) = 68 g$

3) Calculate the mass of a wooden block that is 4 cm long, 2 cm wide, 6 cm high, and has a density of 0.5 g/cm³ (hint: find the volume of a block first)

$V = (4cm)(2cm)(6cm) = 48cm^3$ $m = (48cm^3)(0.5g/cm^3) = \boxed{24 g}$

4) In the table below are the mass and volume of some mineral samples. Calculate the density of sample B.

| Sample | Mass (g) | Volume (mL) |
|---|---|---|
| A | 19.5 | 6.54 |
| B | 12.4 | 3.1 |
| C | 6.8 | 3.4 |

Density B

$D = \frac{12.4g}{3.1 mL} = \boxed{4.0 g/mL}$

5) What volume would a rock occupy if it had a mass of 31.2 g and a density of 10.4 g/cm³?

$V = m/D = 31.2g / 10.4g/cm^3 = \boxed{3.00\ cm^3}$

6) The density of oak is 0.7 g/cm³, and the density of pine is 0.4 g/cm³. Compare the masses of a 30 cm³ block of each type of wood.

Oak $m = (0.7g/cm^3)(30cm^3) = \boxed{21g}$ Pine $m = (0.4g/cm^3)(30cm^3) = \boxed{12g}$

7) How large a container would you need to hold 195 g of a liquid that has a density of 1.3 g/mL?

$V = m/D = 195g / 1.3g/mL = \boxed{150 mL}$

8) A jeweler suspects that a piece of gold jewelry in his collection is fake. He knows that the density of gold is 19.3 g/cm³. If the volume of the piece of jewelry is 6 cm³, and its mass is 109 g, is the piece fake? Why or why not?

$D = 109g / 6cm^3 = 18.2\ g/cm^3$ → fake b/c density differs

9) A 500 mL glass container filled with milk has a mass of 620 g. The mass of the container is 35 g. What is the density of the milk?

$620g - 35g = 585g$ $D = 585g / 500mL = \boxed{1.17 g/mL}$

10) Substances A and B have the same volume, but the mass of B is twice as great as the mass of A. How do the densities of the two substances compare?

$D = \frac{m}{v}$ if the volume is the same and mass of B is greater than the density will be greater as well

11) 28.5 g of iron shot is added to a graduated cylinder containing 45.50 mL of water. The water level rises to the 49.10 mL mark. From this information, calculate the density of iron.

$49.10 mL - 45.50 mL = 3.60 mL$ $D = 28.5g / 3.60mL = \boxed{7.92 g/mL}$

12) Calculate the density of a metal that has a mass of 36.457 g and a volume of 13.5 cm³. Identify the metal.

$D = 36.457g / 13.5cm^3 = \boxed{2.70\ g/cm^3}$

aluminum

2

→ Other common equipment:
- balance
- hot plate
- test tube

* - not responsible for

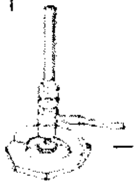
## LABORATORY EQUIPMENT

Name ______________

List of the lab equipment below

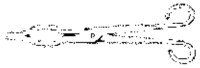
watch glass → evaporate liquid, hold solids, cover beaker, heating small substances

evaporating dish → to evaporate off excess liquid



bunsen burner

evaporating dish



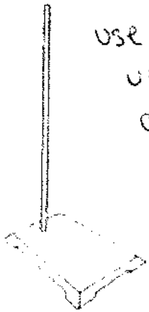
tongs

* wire gauze

buret

* crucible

graduated cylinder

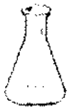


ring stand

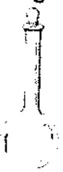
wire gauze → use to hold up beaker on top of ring attached to ring stand (usually when heating above bunsen burners)

beaker

* pipestem triangle



erlenmeyer flask



volumetric flask

test tube holder

watch glass

7

pipestem triangle → used to hold a crucible above a bunsen burner

Crucible → used to hold substances that are to be heated to high temperatures

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# Significant Digits and Measurement

What digits are significant when recording a measurement?

## Why?

Scientists do a lot of measuring. When scientists use an instrument (such as a ruler, graduated cylinder, spectrophotometer or balance) to measure something, it is important to take full advantage of the instrument. However, they can't cheat and record a better measurement than the instrument is capable of. There is an understanding among scientists of the proper way to record valid measurements from any instrument. When you are the scientist, you must record data in this way. When you are reading other scientists' work, you must assume they recorded their data in this way.

## Model 1 – Ruler A

| | |
|---|---|
| Susan | 3 cm |
| Maya | 2 cm |
| Jonah | 2.5 cm |
| Tony | 3.00 cm |
| Emily | 3¼ cm |
| Dionne | 3.33 cm |

1. What distances can you be certain of on the ruler in Model 1?

0cm and 10 cm

2. Six students used the ruler in Model 1 to measure the length of a metal strip. Their measurements are shown at the right. Were all of the students able to agree on a single value (1, 2, 3…) for any digit (ones place, tenths place, etc.) in the measurement? If yes, which value and digit did they agree on?

the ~~[illegible]~~ tens place

3. The ruler in Model 1 is not very useful, but a measurement can be estimated. Discuss in your group how each student might have divided up the ruler "by eye" in order to get the measurement that he or she recorded.

probably divided it in half

8

## Model 2 – Ruler B

| | |
|---|---|
| Sean | 3.2 cm |
| Maya | 3.1 cm |
| Jonah | 3.3 cm |
| Mark | 3 cm |
| Emily | 3.25 cm |
| Devon | 3.20 cm |

4. The students in class used the ruler shown in Model 2. What digits can you be certain of on this ruler?

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

5. Were the students able to agree on a common value (the 3 in 3.2) for any digit (ones place, tenths place, etc.) in their measurements using the ruler in Model 2? If yes, what value in what digit did they agree on?

ones place

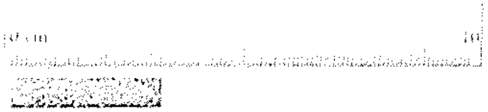
6. What feature of the ruler in Model 2 made it possible for the students to agree on a value in that digit?

more tick marks

7. There will always be uncertainty in any measurement. This causes variation in measurements even if people are using the same instrument. Compare the variation in the measurements made by the six students using the rulers in Models 1 and 2. Which ruler resulted in greater variation? Explain why that ruler caused more variation.

ruler one had more variation because the instrument was less precise

## Model 3 – Ruler C



| | |
|---|---|
| Sean | 3.21 |
| Maya | 3.20 cm |
| Jonah | 3.22 cm |
| Mark | 3.2 cm |
| Emily | 3.215 cm |
| Devon | 3.205 cm |

8. The students changed to a ruler with more marks shown in Model 3.

a. Were the students able to agree on a single value for any of the digits in their measurements using the new ruler? If so, what value did they agree on in which digits?

ones and tenths place

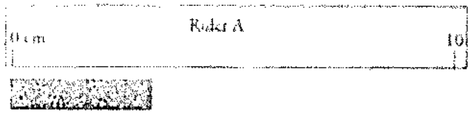
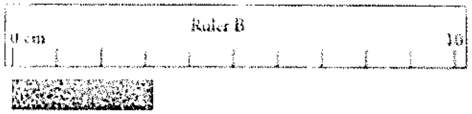
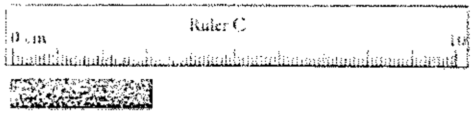
b. What feature of the ruler in Model 3 made it possible for the students to agree on the values in those digits?

the addition of more tick marks

## Read This!

When humans use measuring instruments, variation is expected. Everyone will estimate differently between marks on the instrument. On the other hand, digits that are certain (based on marks on the instrument) should not vary from person to person.

## Model 4 – Valid Measurements

| | Valid Measurements | Invalid Measurements |
|---|---|---|
|  | 3 cm<br>2 cm | 2.5 cm<br>3.00 cm<br>3½ cm<br>3.33 cm |
|  | 3.2 cm<br>3.1 cm<br>3.3 cm | 3 cm<br>3.25 cm<br>3.20 cm |
|  | 3.21 cm<br>3.22 cm<br>3.20 cm | 3.2 cm<br>3.215 cm<br>3.205 cm |

9. The measurements taken in Models 1–3 have been combined in Model 4. The measurements that follow the rules of measurement agreed upon by scientists are in the "Valid Measurements" column. Those that do not follow the rules are in the "Invalid Measurements" column. For each valid measurement shown in Model 4, draw a square around the certain digits (if any) and circle the digits that were estimated (if any).

10. Based on the examples in Model 4, circle the best phrase to complete each sentence below.

a. In a valid measurement, you record (zero, [✓ one], two) estimated digit(s).

b. In a valid measurement, the estimated digit is the (first digit, second to last digit, [✓ last digit]) in the measurement.

c. In a valid measurement, ~~the estimated digit~~ corresponds to (the largest marks, the smallest marks, [✓ one tenth of the smallest marks]) on the instrument

11. [illegible]

he only has a certain digit, not an estimated one

12. Using Ruler B from Model 2, Dionne recorded a measurement of 3.20 cm, which was invalid. But when Maya made the same measurement using Ruler C, it was considered valid. Explain why the zero was acceptable when using Ruler C, but not when using Ruler B.

Donne has two estimated digits, which is not allowed, and Maya only has one estimated digit

13. A student recorded the length of a test tube as 5.0 cm. Which ruler in Model 1 was the student using? Explain.

ruler B because 5 is the certain digit and 0 is the estimated digit

14. In Model 1, Ricky recorded his measurement 3.19 cm using Ruler C. His classmates thought he was wrong because his second digit was not "2." However, Ricky's recorded measurement is perfectly valid. Explain.

because he has all the certain digits, as well as one estimated digit

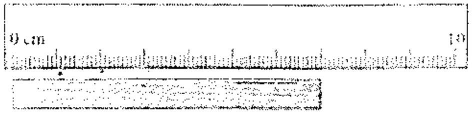
## Read This!

When a measurement is recorded properly, all of the digits that are read directly (certain) and one estimated (uncertain) digit are called **significant digits.** The number of allowable significant digits is determined by the marks or graduations of the instrument. Sometimes a "0" is the estimated digit and must be recorded.

15. Record the length of the wooden splint to the proper number of significant digits.

7 0 cm

16. Record the length of the wooden splint to the proper number of significant digits.



7.00 cm

## Extension Questions

17. When using an electronic device, such as an electronic balance, the measurement displayed on the screen is assumed to have one estimated digit included. In fact, you'll often see the estimated digit changing rapidly, because there is fluctuation in the estimate. Explain why it is important to record the zero in the measurement shown to the right.

Because it shows that both the 1 and 2 are certain digits

18. Consider a 1000-mL graduated cylinder with marks every 100 mL.

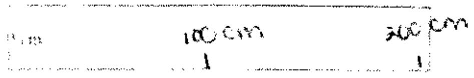
   a. A student records the volume of liquid in the cylinder as 750 mL. Is this a correct measurement? Explain.

   yes because the hundreds place is certain so the tens place is estimated.

   b. Are all of the digits in the described measurement of 750 mL significant? Explain.

   Only the 7 and 5. The zero is not significant b/c it is passed the allowed # of estimated digits

19. A student properly records the length of a block as 120 cm. Draw the markings on the ruler that was used to measure the block.



# Significant Figures Worksheet

1. [illegible] the following measured values.

| | | | | | |
|---|---|---|---|---|---|
| [illegible] | 5 | 1.008 | 4 | 700000 | 1 |
| [illegible] | 6 | [illegible] | 3 | 350 620 | 6 |
| [illegible] | 4 | 14.600 | 5 | 1.0000 | 5 |
| [illegible] | 3 | 0.0001 | 1 | 320001 | 6 |

2. Calculate the answers to the appropriate number of significant figures.

```
  32.567        216.24          658.0
 135.0          238.278          23.5478
+  1.2567     +  98.3        + 1345.29
 169.0          552.3          2026.8
```

3. Calculate the answers to the appropriate number of significant figures.

a) 23.7 x 3.8 = 90.

b) 45.76 x 0.25 = 1.2

c) [illegible] = 0.81

d) 6.47 x 64.5 = 417

e) 43.678 x 64.1 = $2.80\times10^{3}$

f) 1.678 / 0.42 = 4.0

g) 28.367 / 3.74 = 7.58

h) 4278 / 1.006 = 4252

4. (12.[illegible] - 11.[illegible]) / [illegible]

0.47 / 36.1 = 0.012

*hint*
first find lowest # decimal points for subtraction, then least # sig figs for division

5. Calculate the density of an object that has a mass of 23.0 g and the volume is found by water displacement. The water level starts at 5.05 mL and after the object is put in, has a water level of 11.3 mL.

volume : 11.3 mL - 5.05 mL = 6.3 mL

mass 23.0 g

$D = \frac{m}{V} = \frac{23.0\,g}{6.3\,mL} = 3.7\,g/mL$

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Name ______________

Date ____________ Period ______

## Metric System Conversions

Convert:

1) 7.58 mg to g $7.58\,mg \cdot \frac{1\,g}{1\times10^{3}\,mg} = 7.58\times10^{-3}\,g$

2) 1.9 km to m $1.9\,km \cdot \frac{1\times10^{3}\,m}{1\,km} = 1.9\times10^{3}\,m$

3) 733 mL to hL $733\,mL \cdot \frac{1\,L}{1\times10^{3}\,mL} \cdot \frac{1\,hL}{1\times10^{2}\,L} = 7.33\times10^{-3}\,hL$

4) 4.00 s to cs $4.00\,s \cdot \frac{1\times10^{2}\,cs}{1\,s} = 4.00\times10^{2}\,cs$

5) 0.388 dag to dg $0.388\,dag \cdot \frac{1\times10^{1}\,g}{1\,dag} \cdot \frac{1\times10^{1}\,dg}{1\,g} = 3.88\times10^{1}\,dg$

6) 89.7 mm to dam $89.7\,mm \cdot \frac{1\,m}{1\times10^{3}\,mm} \cdot \frac{1\,dam}{1\times10^{1}\,m} = 8.97\times10^{-3}\,dam$

7) 0.444 cL to mL $0.444\,cL \cdot \frac{1\,L}{1\times10^{2}\,cL} \cdot \frac{1\times10^{3}\,mL}{1\,L} = 4.44\,mL$

8) 4.0 kg to dg $4.0\,kg \cdot \frac{1\times10^{3}\,g}{1\,kg} \cdot \frac{1\times10^{1}\,dg}{1\,g} = 4.0\times10^{4}\,dg$

9) 314 cm to km $314\,cm \cdot \frac{1\,m}{1\times10^{2}\,cm} \cdot \frac{1\,km}{1\times10^{3}\,m} = 3.14\times10^{-3}\,km$

10) 293 das to ms $243\,das \cdot \frac{1\times10^{1}\,s}{1\,das} \cdot \frac{1\times10^{3}\,ms}{1\,s} = 2.93\times10^{6}\,ms$

11) 0.0849 kL to mL $0.0849\,kL \cdot \frac{1\times10^{3}\,L}{1\,kL} \cdot \frac{1\times10^{3}\,mL}{1\,L} = 8.49\times10^{4}\,mL$

12) 32 dg to hg $32\,dg \cdot \frac{1\,g}{1\times10^{1}\,dg} \cdot \frac{1\,hg}{1\times10^{2}\,g} = 3.2\times10^{-2}\,hg$

13) 2.145 mm to dm $2.145\,mm \cdot \frac{1\,m}{1\times10^{3}\,mm} \cdot \frac{1\times10^{1}\,dm}{1\,m} = 2.145\times10^{-2}\,dm$

14) 1.17 × 10² g to hg $1.17\times10^{2}\,g \cdot \frac{1\,hg}{1\times10^{2}\,g} = 1.17\,hg$

16