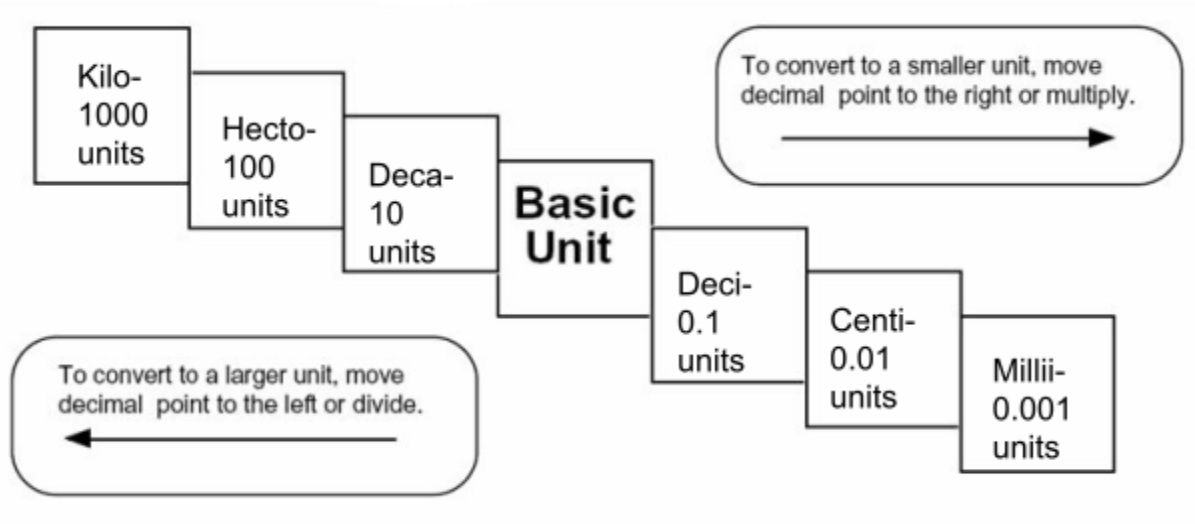
**Fill in the boxes in the stair step diagram.**

Grade on Concept Check:_____/5




1. 5 L = **5,000mL**
2. 16 cm = **160 mm**
3. 104 km = **104,000m**
4. 198 g = **0.198 kg**
5. 2500 m = **2.5 km**
6. 480 cm = **4.8 m**
7. 75 mL =**0.075 L**
8. 65 g =**65,000 mg**
9. 5.6 kg = **5,600 g**
10. 6.3 cm =**0.063 m**

**Compare using <, >, or =.**

1. 63 cm **<** 6 m
2. 5 g **>** 508 mg
3. 1,500 mL **=** 1.5 L
4. 536 cm **=** 53.6 dm
5. 43 mg **<** 5 g
6. 3.6m **>** 36cm

**Put the following numbers in scientific notation.**

1. 2,345 = **$2.345 \times 10^{0}$**
2. 0.0000707 = **$7.07 \times 10^{5}$**
3. 0.004050 = **$4.050 \times 10^{3}$**
4. 33,800 = **$3.38 \times 10^{4}$**

**Put the following numbers into expanded notation.**

1. $9.4 \times 10^{6}$ = **9,400,000**
2. $435.4 \times 10^{-5}$ = **0.00435**
3. $3.10 \times 10^{-3}$ = **0.00310**
4. $1.500 \times 10^{2}$ = **150**

**Complete the following dimensional analysis problems. Please show all work and record your answers with proper units.**

1. The highway department wants to plant trees along the highway from Colorado Springs to Denver. They plan to plant 18 trees per mile along this 97 mile strip of highway. How many trees are needed?

**1,746 trees**

2. It has been determined that an average high school student uses 13,000 yards of pencil lead during their time in school. What is this distance in km? (1 yard = 3 feet and 1 in = 2.54 cm)

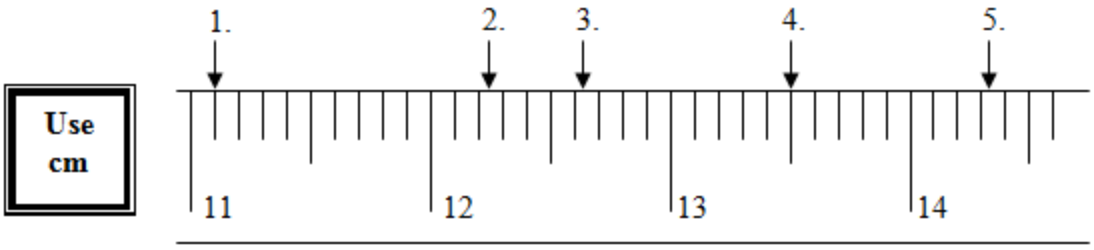
**11.8 km**

3. How many kilometers will light travel in 65.84 days? (speed of light = $3.00 \times 10^{8}$ m/s)

**$1.7 \times 10^{12}$ km**

**For the instruments shown below, record the correct reading.**

Grade on Concept Check:_____/5




1. **11.10 cm** 2. **12.23 cm** 3. **12.62 cm** 4. **13.50 cm** 5. **14.33 cm**

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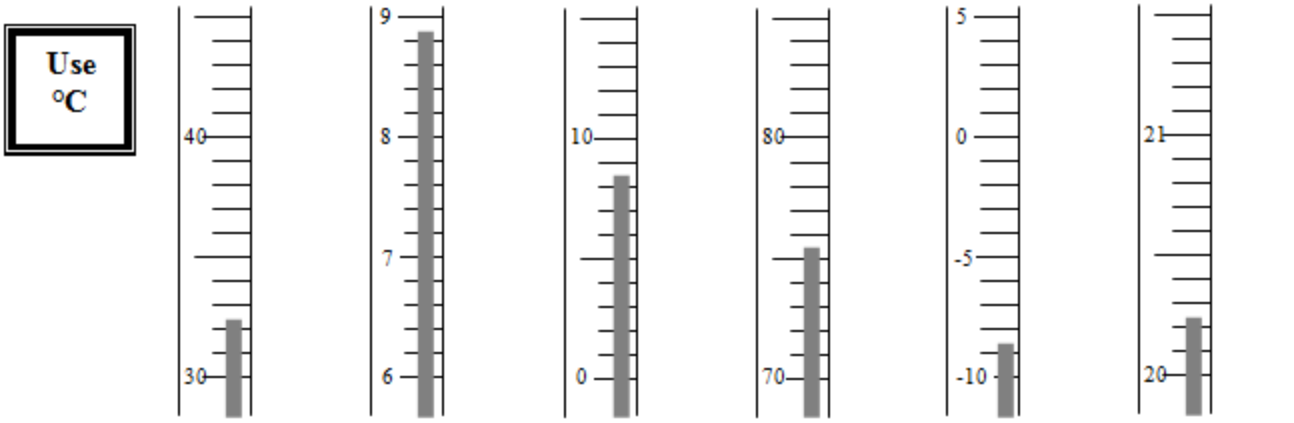


1. **32.3**°C 2. **8.9**°C 3. **8.4**°C 4. **75.4**°C 5. -**8.9**°C 6. **20.23**°C

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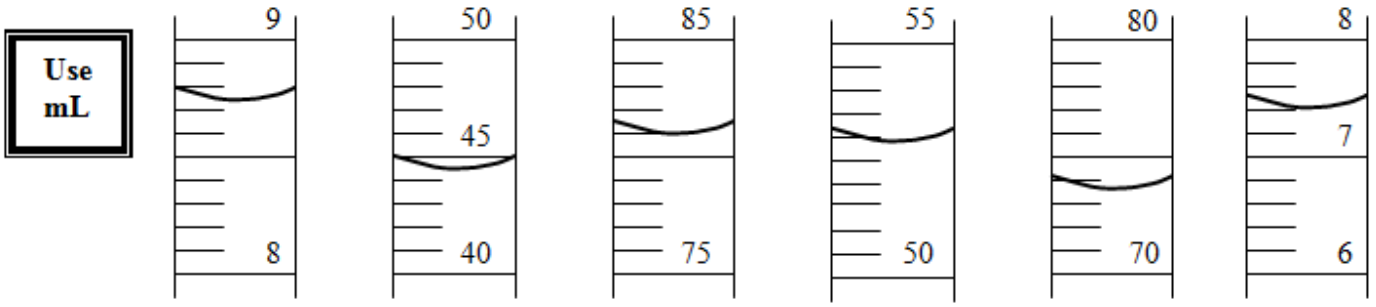



1. **8.72 mL** 2. **44.5 mL** 3. **81.0 mL** 4. **52.8 mL** 5. **73.6 mL** 6. **7.4mL**

Which set of measurements below show the greatest degree of precision? Which is the least precise?

a. 15.12 g, 15.60 g, 15.92 g b. 15.9 g, 16.2 g 16.0 g c. 15 g, 16 g, 17 g

If the accepted mass is 15.5 g, which set of measurements above is the most accurate? Which is the least accurate? Explain why. **A, because the average would be closest to the actual value.**

**Significant Figures (Sig. Figs.)**

Grade on Concept Check:_____/5

1. All non-zero digits are significant
2. If there is a decimal point in the number, start with the left side of the number and move to the right. Begin counting with the first non-zero digit and count all remaining digits.
3. If there is **NOT** a decimal point in the number, start with the right side of the number and move to the left. Begin counting with the first non-zero digit and count all remaining digits.
4. All exact numbers have an infinite number of significant digits.
5. All digits written in scientific notation (except the $x10^{exp}$) are significant.

**Determine the number of significant figures in the following number**

1. 0.030 cm = **2**
2. 0.03 cm = **1**
3. 605 g = **3**
4. 505 .0 kg = **4**
5. 7,000 mL = **1**
6. 7,000. mL = **4**
7. 5,091.00 m = **6**
8. 0.000003 kg = **1**

**Round the following numbers to four sig figs**

1. 7.98369 = **7.984**
2. 32.348 = **32.35**
3. 0.83455 = **0.8346**
4. 101.009 = **101.0 g**
5. 353.55 = **353.6**
6. 40,555 = **40,560**
7. 92.856 = **92.86**
8. 113,697 = **113,700**

Why are significant figures important when taking data in chemistry class?

**Significant figures allow you to hold on to the precision of the instruments that you are using.**

**The accuracy of a measurement are shown with significant figures.**

Why are significant figures NOT important when solving problems in math class?

**Math mostly uses exact numbers which do not have significant figures.**

Using two different instruments, I measured the length of my arm to be 62 cm and 62.00 cm. Explain the difference between these two measurements.

**The tool used to measure the 62.00 cm was more precise, having divisions denoting the tenth place. The tool used to measure the 62cm only had divisions ever tens place and therefore was much less precise.**

**Sig Fig Math**

Grade on Concept Check:_____/5

**Rule for determining significant figures when adding or subtracting**

The result has the same number of *DECIMAL PLACES* as the least precise measurement used in the calculation.

Example: 4.77 + 1.0 + 234.0 + 12.0111 = 251.8

**Rule for determining significant figures when multiplying or dividing**

The result has the same number of significant figures as the measurement with the *FEWEST* number of significant figures.

Example: 3.22 x 0.094 = 0.30

Solve the following equations and write the answer with the correct number of sig figs in expanded form. **Then**, write the number using scientific notation.

| | Calculated answer | Ans with correct SF | Ans in Sci. NotatioN |
|---|---|---|---|
| 8.01 + 4.7 + 56 = | **68.71** | **69** | **$6.9 \times 10^{1}$** |
| 567.18 – 40.9 = | **526.28** | **526.3** | **$5.263 \times 10^{2}$** |
| 78.000 + 4.900 + 24.1 = | **107** | **107.0** | **$1.070 \times 10^{2}$** |
| (7,020.1 – 3509) + 300.22 = | **3,811.32** | **3,811** | **$3.811 \times 10^{3}$** |
| (34.788 – 20.9) + (9.11 + 13) = | **35.998** | **36** | **$3.6 \times 10^{1}$** |
| 7.11 x 0.87 = | **6.1857** | **6.2** | **$6.2 \times 10^{0}$** |
| 12.0 x 0.0500 x 430= | **258** | **260** | **$2.60 \times 10^{2}$** |
| 95,050 x 0.409 = | **38,875.45** | **38,900** | **$3.89 \times 10^{4}$** |
| 78.00 / 9.00 = | **8.6666667** | **8.67** | **$8.67 \times 10^{0}$** |
| 110.0 / 55.0 = | **2** | **2.00** | **$2.00 \times 10^{0}$** |
| (732.3 x 9,609.4) / 0.0020 = | **3518481810** | **3500000000** | **$3.5 \times 10^{9}$** |
| 45 / (909 x 10) = | **0.004959495** | **0.005** | **$5 \times 10^{-3}$** |
| (10.0 + 4.11 + 0.012) / 84.9 = | **0.1663368669** | **0.166** | **$1.66 \times 10^{-1}$** |
| (9,125.8 – 6.61) / ($4.80 \times 10^{4}$) = | **0.189983125** | **0.190** | **$1.90 \times 10^{-1}$** |

## Online Textbook Questions

**Section 1.2 Phases and Classification of Matter**

Grade on Concept Check:_____/5

1. Draw Figure 9 in the space provided. In your diagram add an example for each of the 4 types of matter.(Heterogeneous Mixture,Homogeneous Mixture, Element and Compound)

   **See figure 9 in the reading.**

2. How does a heterogeneous mixture differ from a homogeneous mixture? How are they similar?

   **Both types of mixtures have undefined ratios of "ingredients". In heterogeneous mixtures you Can see the components of the mixture with the naked eye. A homogeneous mixture look the same throughout.**

3. How does an element differ from a compound? How are they similar?

   **Both elements and compounds are pure substances with chemical formulas. Compounds have 2 or more elements chemically bonded in a fixed ratio.**

4. Put an "x" in the box that best describes the types of matter below:

| Material | Heterogenous Mixture | Homogeneous Mixture | Element | Compound |
|---|---|---|---|---|
| Diamond (pure carbon) | | | x | |
| Fizzy Soda | x | | | |
| Water ($H_2O$) | | | | x |
| Salt Water | | x | | |
| Windex Glass Cleaner | | x | | |
| Mint Chip Ice Cream | x | | | |

**Section 1.3 Physical and Chemical Properties**

5. List at least 5 physical properties.
   **-density** **-boiling point** **-freezing point**
   **-specific heat** **-hardness** **-electrical conductivity**

6. Does the "Hazard Diamond" that appears on chemical labels describe chemical properties, physical properties, or both? Give examples to defend your answer.

   **The hazard diamond provides information about toxicity, flammability, and reactivity of a chemical. These are all chemical properites.**

7. Put an "x" in the box that best describes the types of changes below:

| **Change** | **Physical** | **Chemical** |
|---|---|---|
| Burning gasoline | | **x** |
| Melting Silver | **x** | |
| Shredding Cheese | **x** | |
| Grass growing | **x** | |

BONUS: Create a mnemonic device that can be used to remember the difference between intensive and extensive properties.

[Online Textbook Questions]

Grade on Concept Check:_____/5

**Section 2.1 Early Ideas in Atomic Theory**

1. In the following drawing, the green spheres represent atoms of a certain element. The purple spheres represent atoms of another element. If the spheres of different elements touch, they are part of a single unit of a compound. The following chemical change represented by these spheres may violate one of the ideas of Dalton's atomic theory. Which one?


2. Samples of compound X, Y, and Z are analyzed, with results shown here.

| Compound | Description | Mass of Carbon | Mass of Hydrogen |
|---|---|---|---|
| X | clear, colorless, liquid with strong odor | 1.776 g | 0.148 g |
| Y | clear, colorless, liquid with strong odor | 1.974 g | 0.329 g |
| Z | clear, colorless, liquid with strong odor | 7.812 g | 0.651 g |

Do these data provide example(s) of the law of definite proportions, the law of multiple proportions, neither, or both? What do these data tell you about compounds X, Y, and Z?

**Section 2.2 Evolution of the Atomic Theory**

3. The existence of isotopes violates one of the original ideas of Dalton's atomic theory. Which one?

4. Compare and contrast protons, neutrons, and electrons.

5. Who was JJ Thompson? Is his model of the atom still valid today? Why or why not?

6. Who performed the gold foil experiment? How did the results of this experiment shape our understanding of the interior of an atom?

**Section 2.3 Atomic Structure and Symbolism (*Read until the Atomic Mass Topic*)**

7. Describe inner structure of an atom.

8. What is an ion? How are cations and anions similar? Different?

9. What is an isotope? In what way are isotopes of a given element always different? In what way(s) are they always the same?

10. Write the symbol for each of the following ions:
    a. the ion with a 1+ charge, atomic number 55, and mass number 133

    b. the ion with 54 electrons, 53 protons, and 74 neutrons

11. The following are properties of isotopes of two elements that are essential in our diet. Determine the number of protons, neutrons and electrons in each and name them.
    a. atomic number 26, mass number 58, charge of 2+

    b. atomic number 53, mass number 127, charge of 1–

**Subatomic Particles**

Grade on Concept Check:_____/5

1. Complete the following table to describe properties of subatomic particles.

| Subatomic particle | Relative mass | Relative Charge | Location in atom |
|---|---|---|---|
| Proton | **1** | **+1** | **nucleus** |
| Neutron | **1** | **neutral** | **nucleus** |
| Electron | **0** | **-1** | **Outside the nucleus** |

2. In the space provided, show the relationships and equations needed to calculate the following:

- Nuclear Symbol (show what the top and bottom number represent) =
- Atomic Number = **# of protons**
- Mass Number = **# of protons + neutrons**
- Protons = **mass # - neutrons**
- Neutrons = **mass #- protons**
- Electrons = **Look at charge. More electrons than protons = -charge. Fewer electron than protons =+charge**
- Atomic Charge= **See above**
- Nuclear Charge = **Same at # of protons**

3. Complete the following table using the relationships and equations above.

| Element name | Nuclear symbol | Atomic # | Mass # | # of protons | # of electrons | # of neutrons | Atomic Charge | Nuclear Charge (charge of nucleus |
|---|---|---|---|---|---|---|---|---|
| Calcium | $^{41}Ca^{2+}$ | 20 | 41 | 20 | 18 | 21 | 2+ | +20 |
| Iron | $^{54}Fe$ | 26 | 54 | 26 | 26 | 28 | 0 | +26 |
| Cobalt | | 27 | 58 | 27 | 25 | 31 | 2+ | +27 |
| Argon | $^{39}Ar$ | 18 | 39 | 18 | 18 | 21 | 0 | +18 |
| Nitrogen | | 7 | 14 | 7 | 10 | 7 | 3- | +7 |
| Sodium | | 11 | 24 | 11 | 10 | 13 | +1 | +11 |
| Chlorine | $^{36}Cl^{1-}$ | 17 | 19 | 17 | 18 | 19 | -1 | +17 |
| Zinc | | 30 | 65 | 30 | 28 | 35 | 2+ | +30 |
| Helium | | 2 | 4 | 2 | 2 | 2 | 0 | +2 |

**Conversions Using the Mole**

Grade on Concept Check:_____/5

Using knowledge of the mole and conversions by dimensional analysis complete the following problems. **Show conversion factors and all your work for each problem. Express each answer with the correct units and sigfigs.**

**1 mole (mol) = 6.02 x $10^{23}$ particles**

1. How many moles are present in 2.45 x $10^{23}$ molecules of $CH_4$?

   **0.407 moles of $CH_4$**

2. How many moles are present in 34.5 grams of copper? (for Cu: 63.5 grams = 1 mole)

   **0.543 moles of Cu**

3. What is the mass of 0.250 moles of uranium? (for U: 238.1 grams = 1 mole)

   **0.250 moles x $\frac{238.1 \text{ grams}}{1 \text{ mole}}$ = 59.5 g of U**

4. How many atoms of helium (He) are in 8.45 x $10^{-3}$ moles of helium?

   **5.09 x $10^{21}$ atoms of He**

5. How many molecules are there in 450. grams of ammonia, $NH_3$? ($NH_3$: 17.0 grams = 1 mole).

   **1.59 x $10^{25}$ molecules of $NH_4$**

6. What is the mass of 2.38 x $10^{24}$ atoms of silver? (Ag: 107.9 grams = 1 mole)

   **$238x10^{24}$atoms x $\frac{1 \text{ mole}}{6.02x10^{23}}$ x $\frac{107.9 \text{ grams}}{1 \text{mole}}$ = 427 g of Ag**

7. What is the mass of 9.46 x $10^{25}$ molecules of hydrogen, $H_2$? ($H_2$: 2.02 grams = 1 mole)

   **317 g of $H_2$**

8. How many molecules of carbon dioxide, $CO_2$, are present if you have 654.8 grams of $CO_2$? ($CO_2$: 44.01 grams = 1 mole)

   **8.96 x $10^{24}$ molecules of $CO_2$**

9. How many moles of lead are present if 6.71 x $10^{37}$ atoms are lead are in your paint?

**$1.11 \times 10^{14}$ moles of lead**

**What's In An Average?**

Grade on Concept Check:_____/5

**Answer the following questions and show your work if a calculation is required.**

1. How are isotopes of the same elements alike? Different?

   Isotopes are alike because they have the same number of neutrons, they are different because they have different numbers of neutrons.

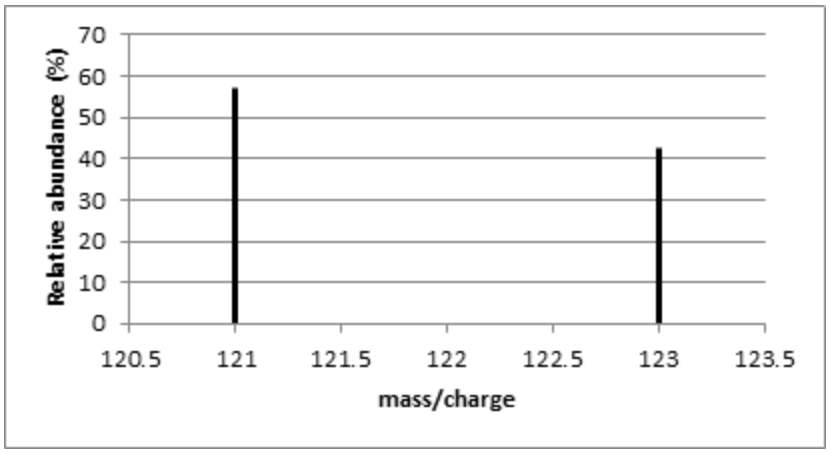
2. The following data was obtained using a mass spectrometer. The atomic mass of Cl-35 is 34.968 and the atomic mass of Cl-37 is 36.956. Cl-35 has an abundance of 75.53% and Cl-37 has an abundance of 24.47%. Calculate the average atomic mass of chlorine.

   **35.45**

3. Uranium is used in nuclear reactors and is a rare element on earth. Uranium has three common isotopes. If the abundance of 234U is 0.01%, the abundance of 235U is 0.71%, and the abundance of 238U is 99.28%, what is the average atomic mass of uranium?

   **237.98**

4. The data from the analysis of an elemental sample using a mass spectrometer is shown below.



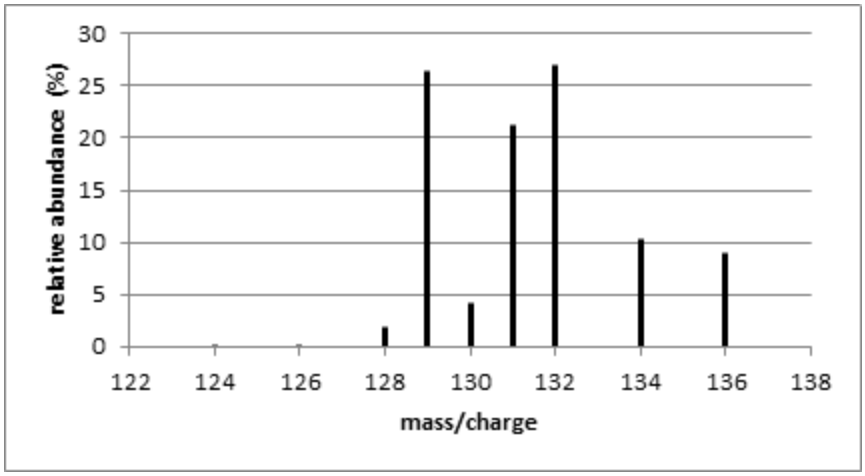

   a. Using the data provided calculate the average atomic mass of the element being tested.

      **121.84**

   b. Using the periodic table, determine the most logical identity of the unknown element.

      **Sb - Antimony**

5. The data from the analysis of an elemental sample using a mass spectrometer is shown below.



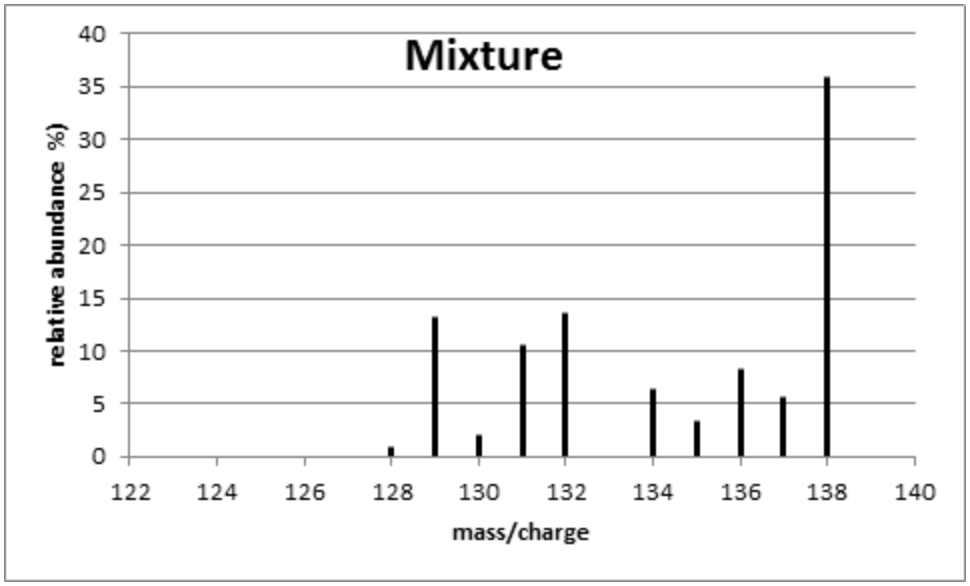

   a. Using the data provided calculate the average atomic mass of the element being tested.

      **131.48**

   b. Using the periodic table, determine the most logical identity of the unknown element.

      **Xe- Xenon**

6. A mixture of including one of the elements from the questions above was analyzed with a mass spectrometer. Based on the mass spectrum below, which element is absent from the mixture? How do you know?



**Weird Question?**

7. Manganese is composed of two stable isotopes: Mn-54 and Mn-57. Use the periodic table and predict which of these isotopes is more abundant? Explain your prediction.

**54 because 54.938 is closer to 54 than 57**

8. Why is the mass in amu of a carbon atom reported as 12.011 in the periodic table of the elements?

**Carbon has several isotopes. The most common isotope of carbon is C-12, so the average is close to 12.**

**Radioactivity and Nuclear Reactions**

Grade on Concept Check:_____/5

Complete the table below:

| Particle | Symbol | | Mass | Charge | Relative Energy |
|---|---|---|---|---|---|
| a. Alpha | $^{4}_{2}He$ | $^{4}_{2}\alpha$ | 1 | +1 | low |
| b. Beta | $^{0}_{-1}e$ | $^{0}_{-1}\beta$ | 0 | -1 | middle |
| c. Gamma | $^{0}_{0}\gamma$ | | 0 | 0 | high |
| d. Proton | P | | 1 | +1 | |
| e. Neutron | N | | 1 | 0 | |

**Fill in the missing pieces of the following nuclear reactions**

$^{238}_{92}U \rightarrow \alpha + {}^{234}_{90}Th$

$^{234}_{90}Th \rightarrow \beta + {}^{234}_{91}Pa$

$^{234}_{91}Pa \rightarrow {}^{234}_{92}U + \beta$

$^{230}_{90}Th \rightarrow {}^{226}_{88}Ra + {}^{4}_{2}He$

$^{214}_{82}Pb \rightarrow \beta + {}^{214}_{83}Bi$

$^{210}_{82}Pb \rightarrow \beta + {}^{210}_{83}Bi$

$^{210}_{83}Bi \rightarrow {}^{210}_{84}Po + \beta$

$^{210}_{84}Po \rightarrow \alpha + {}^{206}_{82}Pb$

**Half-Life Worksheet**

Grade on Concept Check:_____/5

1. Iodine-131 has a half-life of 8 days.
    a. Determine the mass of I-131 left after 32 days if the original sample contains 200 g of the isotope.

**12.5 g**

    b. Another 200 g sample is tested after a decay period and 50 g of I-131 is present. How long is the decay period?

**16 days**

2. Fluorine-21 has a half-life of approximately 5 seconds. What fraction of the original nuclei would remain after 1 minute?

**$2.44 \times 10^{-4}$**

3. If 20.0 g of a radioactive isotope are present at 1:00 PM and 5.0 g remain at 2:00PM, what is the half-life of the isotope?

**30 minutes**

4. The half-life of iodine-125 is 60 days. What fraction of iodine-125 nuclides would be left after 360 days?

**1/64 or 0.0156**

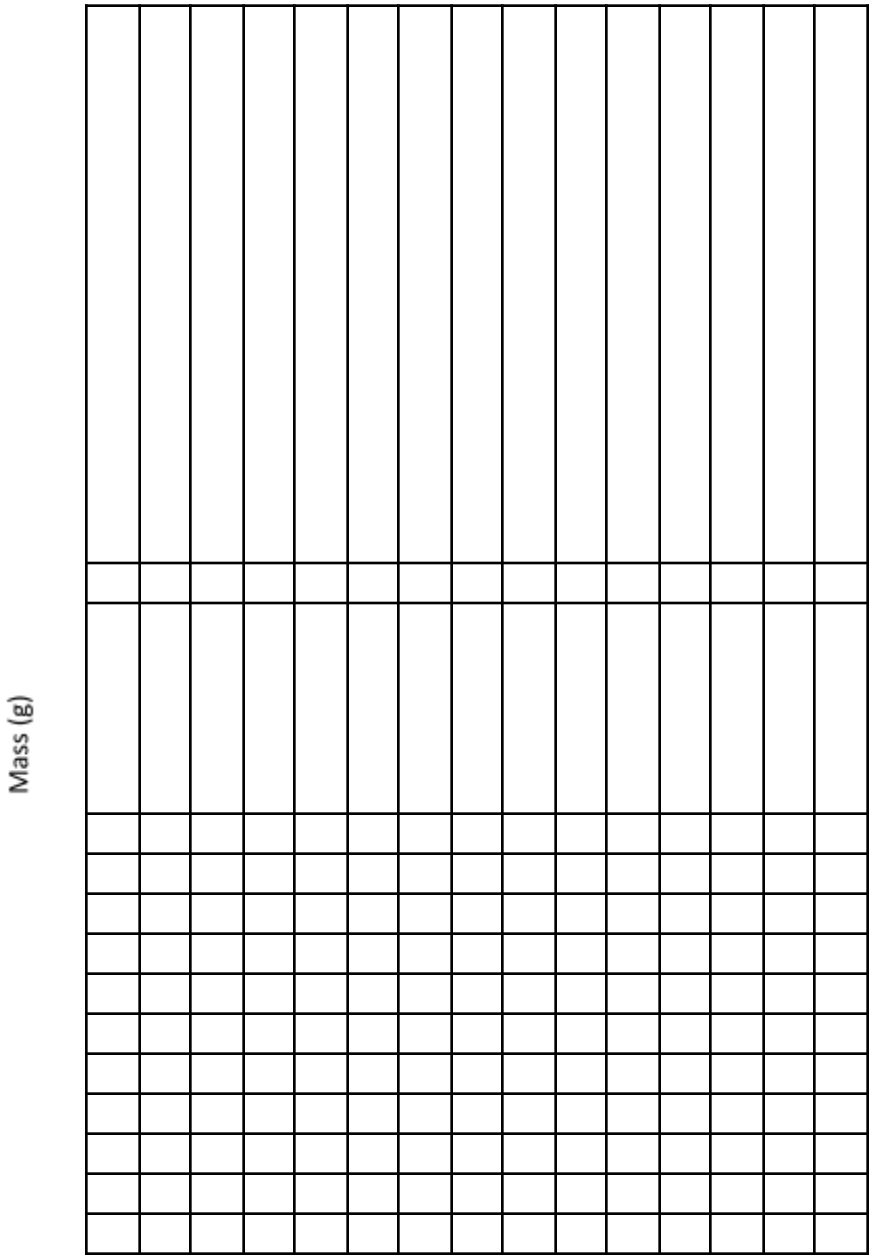
5. A medical institute requests 1 g of bismuth-214, which has a half-life of 20 min. How many grams of bismuth-214 must be prepared if the shipping time is 2 hours?

**64 grams**

6. A sample of strontium-90 has a half-life of 29 years. Complete the following table and graph the decay rate of strontium-90.

| Time (years) | 0 | 29 | 58 | 87 | 116 | 145 |
|---|---|---|---|---|---|---|
| Mass (g) | **130** | **65** | **32.5** | **16.25** | **8.125** | **4.0625** |

Graph the change in mass of strontium-90 as time Increases




- What mass of stron
would remain after
- How old would the
when only 20 g rem
- Describe how the
would change if th
were 60 years.

- What mass of strontium-90 would remain after 100 years?

## About 9 grams

- How old would the sample be when only 20 g remain?

## About 75 years

- Describe how the decay line would change if the half-life were 60 years.

## More stretched out