Holy Cross High School
Summer Chemistry Packet
Chemistry CP

This packet is designed to help you prepare for your upcoming chemistry course by:

- reviewing science and math skills you already have
- helping you think about the types of topics that will be covered this year
- encouraging your excitement for the upcoming year!!

The packet is split into multiple parts that include background information, an example problem and practice problems. You are to complete each part and show your work in the space provided. Your answers must be neat, organized, and easy to read. Anything that is illegible will not be graded. Please include units for your final answers when appropriate to receive full credit.

It is expected that you work on the packet throughout the summer and **not at last minute**. Information is provided in the packet, but any information that you are unfamiliar with may be sought from other sources such as books, reliable websites or **YouTube videos**.

The completed packet will be due on the **first day of class**. Make sure to show all your work. This packet will count as a **lab, quiz, and homework grade** for the first marking term. **Late packets will lose 15 points and not accepted after one class period late.**

If the packet is lost during the summer it can be purchased at Holy Cross or found on the school website in the summer reading section (please note this is **not edline**). If you need to purchase the packet from the school please call the office at 203-757-9248 for more information.

Part 2: The Scientific Method

The scientific method is a systematic process of problem solving. According to Wilbraham, et al (2012), the steps include “making observations, proposing and testing hypotheses, and developing theories”. To understand how to use the scientific method you need to understand and define the following terms:

- Problem
- Hypothesis
- Independent Variable
- Dependent Variable
- Materials
- Procedure
- Data
- Conclusion

A. Using the background information you have identify the independent and the dependent variables.

1. Problem: What is the relationship between SPF strength and sunburn?
Hypothesis: If a person uses a higher numbered SPF, then they will become less sunburned.
IV_____ DV_____

2. Problem: What is the relationship between frequency of brushing teeth and cavities?
Hypothesis: If a person brushes his teeth more, then they will have less cavities.
IV_____ DV_____

3. Problem: What is the effect of instant messaging on students' grades.
Hypothesis: If student spend more time using IM, then their GPA will be less.
IV_____ DV_____

B. After many observations, you notice that your bicycle tires (and/or basketball) always look flatter on colder days or during the winter, than they do on warmer days or during the summer. You decide to use the scientific method.

1. What is the problem or question confronting you?

Background information: what happens to the bounce of a basketball when you leave it outside in the winter?

2. What hypothesis would you develop?

3. How would you perform such an experiment to test your hypothesis? (Hint: you would probably use a smaller object.)

4. How would you record your data?

5. How would you analyze your data?

6. What would you include in your conclusion?

7. Should you repeat your experiment after it works correctly the first time? Explain.

Part II: The Mathematics of Chemistry

Even though chemistry is a science you will use basic math concepts throughout the year as a useful tool. Complete the following sections in the space provided. You **MUST** show all of your work and you may use a calculator to determine your final answers.

How to Show Your Work
When showing your work, you're describing a narrative, giving a step by step recipe for solving a problem. Even if you know how to solve the problem in your head to show your work you must express that on paper. It is a way of explaining your thought process and a systematic way of describing your work. Often times, poorly shown work could result in a loss of credit if it is difficult for the person grading your work to understand what you are trying to do. Make sure to show your work in a neat and logical manner.

Example:
How many inches are in 7.25 feet?

Step 1 - Analyze: Identify what is known and unknown, plan how you will solve the problem.
(Known) length = 7.25 feet
(Known) 12 inches = 1 foot
(Unknown) ? inches = 7.25 feet

Step 2 - Calculate:

$\frac{12 \text{ inches}}{1 \text{ foot}} = \frac{X \text{ inches}}{7.25 \text{ feet}}$ *cross multiply

(1 foot)X = (12 inches) (7.25 feet) * you may abbreviate your units (1 ft)X = (12 in)(7.25 ft)

$X = \frac{(12 \text{ inches})(7.25 \text{ feet})}{1 \text{ foot}}$ *feet/foot units cancel out

X = 87 inches

Step 3 - Evaluate: Is the answer reasonable? Does the answer make sense? Would you expect the answer to be a larger or bigger number than the known information? This step is where you will check your work.

In this case since we started with feet and we are going to a smaller unit, inches, we would expect the answer to be a larger number than the initial 7.25 feet. Therefore, this answer does make sense.

*You do NOT have to actually show your evaluation step!

A. Metric System

The metric system is used in the sciences and is based off of the *Le Systeme International d'Unites* (SI). These units set standards for how measurements may be taken. This way information can be easily shared between different parts of the world, without needing to know conversion factors! The metric system is based off of the unit 10, which makes it easier than the English system to convert between units.

Some important metric units that you will use in chemistry this coming year are:

grams: used to measure the mass of an object
liters: used to measure volume of an object
meters: used to measure length of an object

You will also use the following prefixes to attach to the above units to express smaller or larger numbers.

milli- 1000x smaller than the unit it proceeds
centi- 100x smaller than the unit it proceeds
kilo- 1000x larger than the unit it proceeds

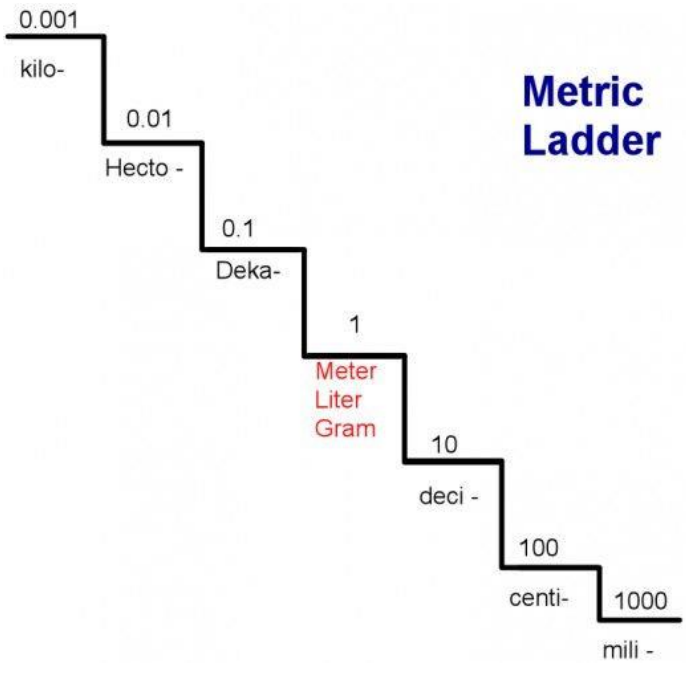
For example:

100 centimeters = 1 meter **1000 meters = 1 kilometer**
100 centigrams = 1 gram
100 centiliters = 1 liter

Conversion between the different units within the metric system is accomplished by using a mathematical formula:
Convert 152 meters to centimeters.

$$152 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} = 15{,}200 \text{ cm}$$

The fraction (100 cm/1 m) is an equivalency that features the unit you are converting from as the denominator - and your target unit as the numerator.



You can remember the order of the prefixes by the following learning trick:

King
Hector
Died
By - Base
Drinking
Chocolate
Milk

Complete the following:

1. _____ millimeters = 1 meter

2. _____ liters = 1 kiloliter

3. 1 gram = _____ milligrams

4. 1 kilogram = _____ grams

5. If you had to measure the amount of juice in a container which metric unit would you use?

6. If you wanted to measure the length of your textbook which metric unit would you use?

7. Convert 3 meters into centimeters.

8. Convert 10 kilometers into meters.

9. Convert 15,050 milligrams into grams.

10. Convert 3,264 milliliters into liters.

11. Convert 9,674,430 grams into kilograms.

12. Convert 3.25 kilograms into milligrams.

13. Convert 6,700 millimeters into kilometers.

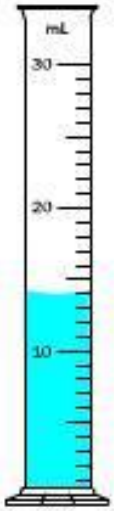
14. Convert 35 mm into cm.

B. Measurement

In chemistry you will be using different instruments to take measurements, such as a graduated cylinder and a metric ruler. Practice measuring the following items.

Read each graduated cylinder and write the amount. Be sure to include **mL** in your answer.

a.



14 mL

b.

_____

c.

_____

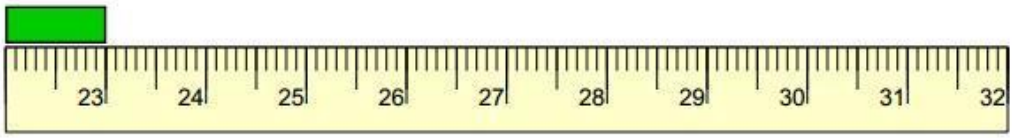
d.

_____

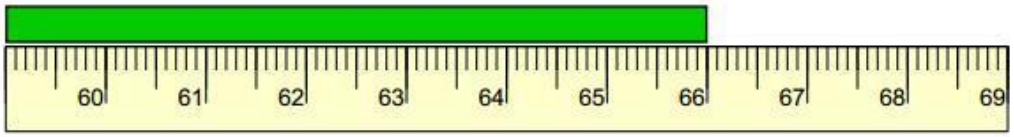
Reading a Metric Ruler

Look at the green line

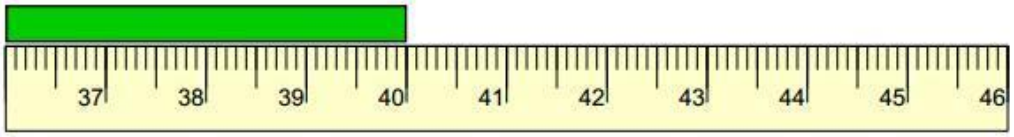
How many Centimeters ?



_____

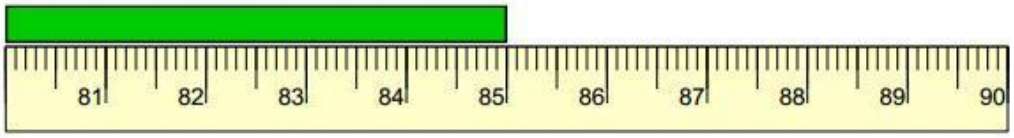


_____

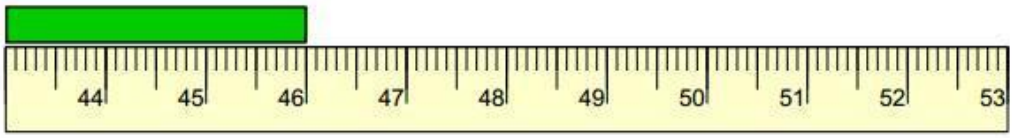


_____

Reading a Metric Ruler

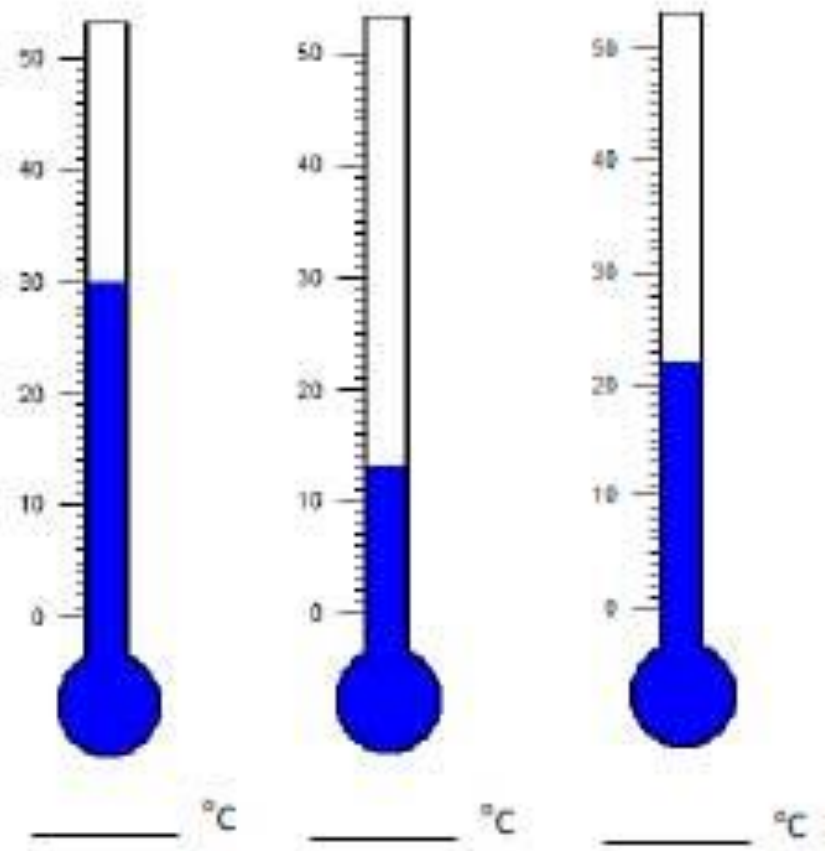


_____



_____

Write the temperature shown on each thermometer:



C. Basic Calculations

In this section you will test your ability to perform basic calculations and use units in your answers.

Example:

(34 cm) (2 cm) (5.5 cm) = 374cm^3

$$\frac{(10\text{ kg})\ (2\text{ m})}{3.7\text{ s}} = 5.4\ (\text{kgm})/\text{s}$$

Complete the following:

1. $\frac{(53\text{ g})}{(4\text{ L})}$

2. 39 N x 9.4 m

3. (2 mL) (0.5 mL) (32 mL)

4. $\frac{(4.08\text{ g})}{(0.32\text{ g})}$

5. $\frac{1.57\ L}{2.0\ L}$

6. $\frac{(35\ m)\ (2\ m)}{25\ s}$

7. 5.5 cm x 2 cm x 10 cm

8. $\frac{35\ miles}{0.5\ hours}$

9. $\frac{35\ g}{0.25\ L}$

10. (56 m)(2 m)

D. Solve for a Variable

Many time in chemistry you will use an equation to find an unknown quantity (unknown variable) by using quantities that you are familiar with. The key is to remember to isolate your variable (x) by performing the same mathematical calculation on both sides.

Example:

$2x - 15 = 8$

$+15 \quad +15$

$\frac{2x}{2} = \frac{8 + 15}{2}$

$x = \frac{23}{2}$

$x = 11.5$

Complete the following:

Solve the following problems, for x, in the space provided. You **MUST** show all of your work, you may use a calculator to determine your final answers and you may have letters included in your final answers.

1. $4x = 2+9$

2. $8x + 3 = 10$

3. $H = WQx$

4. $7x - 4 = 2x + 3$

E. Density

Example:

To calculate density of an object you divide mass (in grams) by the volume (in milliliters). The answer would then have the units of g/mL.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \qquad D = \frac{M}{V}$$

Common units for density are: **g/L, g/cm^3**

Complete the following:

1. Calculate the density of an object with a mass of 35.0 grams and a volume of 3.55 cm3.

2. Water has a density of 1.0 g/L. What volume of water has mass of 250 g?

3. A block of aluminum occupies a volume of 0.015 L and has a mass of 40.5 g. What is it's density?

4. Mercury metal is poured into a graduated cylinder that holds exactly 0.0225 liters. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

5. What is the mass of ethanol that exactly fills a 200.0 mL container? The density of ethanol is 0.789 g/mL.

6. What volume of silver metal will weigh exactly 2500 grams? The density of silver is 10.5 g/cm^3.

7. A block of aluminum occupies a volume of 15.0 mL and weighs 40.5 g. What is its density?

8. Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

9. What is the mass of the ethanol that exactly fills a 200.0 mL container?
The density of ethanol is 0.789 g/mL.

10. A rectangular block of copper metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper? (hint: find the volume of a block first)

F. Significant Figures

Significant Figures are used to show which numbers in a measurement are exact and which ones are measured. If you look at a number like 1,000 m you do not know if this person measured exactly 1,000. m or if they measured 999.9 m and rounded off. Significant figures are important to show how far you are measuring a value.

A quick and easy rule to count the number of significant figures in a number is the Pacific-Atlantic rule. This rule is determined by the decimal. If the decimal is **Present** you start counting your number of significant figures on the **Pacific side, or the left side of your number.** If the decimal is **Absent** then you start counting the numbers on the **Atlantic side, or right side of your number.** What counts as significant is every number after the first non-zero number.

Example: 1,000 would have 1 significant figure because my decimal is absent so I start counting on the right, the first 3 zeros are said to be insignificant because they would be taken away by scientific notation (more on that later).

0.000908 would have 3 significant figures because my decimal is present so I start counting on the left. The first 4 zeros are insignificant and I start counting what is significant from my 9 onward.

0.0040 would have 2 significant figures because my decimal is present so I start counting on the left. The first 3 zeros are insignificant and I start counting what is significant from my 4 onward, this includes the last zero.

Complete the following:

1) 31,000,000 has _____ significant figures

2) 102.3 has _____ significant figures

3) 40,000.0 has _____ significant figures

4) 500 has _____ significant figures

5) 104,000 has _____ significant figures

6) 5.000 has _____ significant figures

7) 231,509 has _____ significant figures

8) 980 has _____ significant figures

9) 807. has _____ significant figures

10) 222,000,200 has _____ significant figures

11) Round 14,720 to three significant figures: _____

12) Round 0.000005478 to three significant figures: _____

13) Round 500,947 to two significant figures: _____

14) Round 0.0033333333 to one significant figures: _____

15) Round 108.00478 to three significant figures: _____

G. Scientific Notation and Standard Form

Scientific notation is used often in chemistry to represent really small or really large numbers. Using scientific notation you can represent a number written out in standard form using a product of two numbers: a coefficient and 10 raised to a power. The power (exponent) represents the number of places the decimal point has to be shifted to give the number in standard form. A positive exponent indicates that the decimal point would be shifted to the right, while a negative exponent indicates that the decimal would be shifted to the left. The coefficient must be a number greater than or equal to one and less than ten. The exponent may be a positive or negative whole number.

Example:

506,000 seconds = 5.06×10^{5} seconds

4.3×10^{-4} m = 0.00043 m

2.7×10^{4} = 24,000

0.0023 L = 2.3×10^{-3} L

Complete the following:

Standard Notation	Scientific Notation
120,000 m	
	2.2×10^{-7} s
0.000075 cm	
340,000,000 mL	
	9.1×10^{10}

Convert the following numbers into scientific notation:

1. 3,400 _____

2. 0.000023 _____

3. 101,000 _____

4. 0.010 _____

5. 45.01 _____

6. 1,000,000 _____

7. 0.00671 _____

8. 4.50 _____

Convert the following numbers into standard notation:

9. 2.30×10^{4} _____

10. 1.76×10^{-3} _____

11. 1.901×10^{-7} _____

12. 8.65×10^{-1} _____

13. 9.11×10^{3} _____

14. 5.40×10^{1} _____

15. 1.76×10^{0} _____

16. 7.4×10^{-5} _____

G. Percent

Every percent has three parts: the percent, the part, and the whole. To solve any percent problem you must identify the given variables in the word problem.

$$\text{Percent (\%)} = \frac{\text{Part}}{\text{Whole}} \times 100$$

Guidelines to solve percent word problems:

- Make sure you understand the question that is asked.
- Sort out the information to make a basic percent problem, such as “30% of what is 17”?
- You may have to add or subtract some of the numbers to get the part or whole.
- The whole will always be the original number, price, or total amount.

Example:

70% of 30 is 21

70 is the percent
21 is the part
30 is the whole

If there are 10 girls in your chemistry class that contains 24 students, what percent of the class is female?

$$\frac{10}{24} \times 100 = 41.67\%$$

Percent Error:
In chemistry you will need to calculate the percent error during lab experiments. The percent error is how far away you are from the accepted value (or the text book value) of a measurement. For example the accepted value for water freezing is $0^{o}C$. In any lab experiment you will calculate a measured value. The formula for percent error is as follows:

$$\% \text{ error} = \frac{\left| \text{Accepted} - \text{Measured} \right|}{\text{Accepted}} \times 100$$

Accepted = Value from references
Measured = Value from your experiment
Brackets mean you need the absolute value
(ie, no negative numbers)

Complete the following:
Round your final answers to the nearest hundredth.

1. A baseball pitcher won 75% of the games he pitched. If he pitched 43 ballgames, how many games did he win?

2. Tom, a plumber, worked 7.5 months of the year. What percent of the year did he work?

3. There are 28 students in a class. Fifteen of the students are female. What percent would be male?

4. Julie took her chemistry class and had 42 correct answers and 10 incorrect answers. What was the percentage of correct answers?

5. A student earned an 82% on a test that had 50 problems. How many problems did the student answer correctly?

6. A metal bar weighs 8.35 ounces. 73% of the bar is silver. How many ounces of silver are in the bar?

7. Joan purchased a car for 63% of the original price of $35,000. How much did she pay for the car?

8. Bill earns $125,000 a year and 28% is taken out for taxes. How much did he pay in taxes?

9. The Holy Cross Baseball team played 12 games and won 7 of them. What percent of games did they lose?

10. If there are 150 cookies and 25% are chocolate chip, how many chocolate chip cookies are there?

11. I have 8 bags of sweets. My brother eats 50% of them. How many do I have left?

12. 1 large pizza costs $10.95. If I buy 3 of them I get 25% off the total bill. How much should I pay?

13. A carpenter needs to cut a plank of wood that is 3.75m long into 5 equal pieces. What percentage of the plank is each piece?

14. Mr. Usher is 190cm tall and his sister Sarah is 10% shorter. How tall is Sarah?

15. The weather forecaster says that it is 200° C in London but only 75% as hot in New York. How hot is it in New York?

16. Calculate the percent error of the mass of a baseball where the accepted value is 125g and the measured value is 127.6g.

17. Calculate the percent error of the mass of an iPhone where the accepted value is 138g and the measured value is 150g.

18. Calculate the percent error of the mass of a textbook where the accepted value is 500g and the measured value is 503.5g.

19. Calculate the percent error of the mass of a purse where the accepted value is 474g and the measured value is 400g.

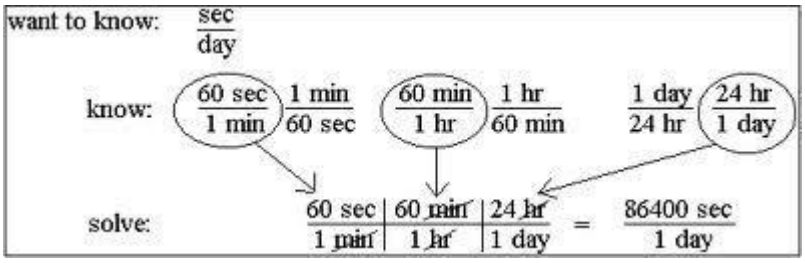
H. Conversions

Examples:

How many feet are in 10 meters? (The conversion factor is 3.28 feet = 1 meter)

$$\frac{10 \text{ meters}}{} \times \frac{3.28 \text{ feet}}{1 \text{ meter}} = 32.8 \text{ feet}$$

How many seconds are in 1 day?



Complete the following:

Useful Information

Conversions

1 hour = 3600 seconds
1 meter = 3.28 feet
1 kg = 2.2 lbs
1 m/s = 2.2 miles/hour
1 mile = 5280 feet
1 km = 0.62 miles
1 lb = 0.45 kg
1 foot = 12 inches
1 yard = 3 feet
1 light second = 300,000,000 meters
1 quart = 0.946 liters
1 inch = 2.54 cm = 25.4 mm

1. How many dozen donuts are there in 244 doughnuts?

2. How many seconds are there in 1 year? (365 days = 1 year)

3. How many quarters are in $50?

4. How many dollars would 75 quarters be?

5. How many months are in 200,500 seconds?

6. How many inches are in 6 feet?

7. How many quarts are in 7 gallons? (1 gallon = 4 quarts)

8. How many pounds would 750 ounces be? (16 ounces = 1 pound)

9. Convert $100 into dimes.

10. 565,900 seconds into days

11. 17 years into minutes

12. 43 miles into feet

13. 165 pounds into kilograms

14. 100 yards into meters

15. 22,647 inches into miles

Part III: Graphing

A. Refer to the graphs on the next page to answer the following questions.

1. Why do you think the graph *Elements in the Earth's Crust* a pie chart and not a bar graph or line graph?

2. What percentage of the Earth's crust do silicon AND oxygen make up? _____

3. Referring the graph *Mechanical Efficiency of Machines and Humans:*

a. Which machine has the highest efficiency? _____

b. What is the mechanical efficiency of a pulley system? _____

c. Which machine has the least efficiency? _____

4. What is missing from the graph *Average Maximum Daily Temperatures* that makes it incomplete and misleading? Explain your answer.

5. Refer to the data table called *Speed of Sound:*

a. What kind of graph would best represent the data? _____

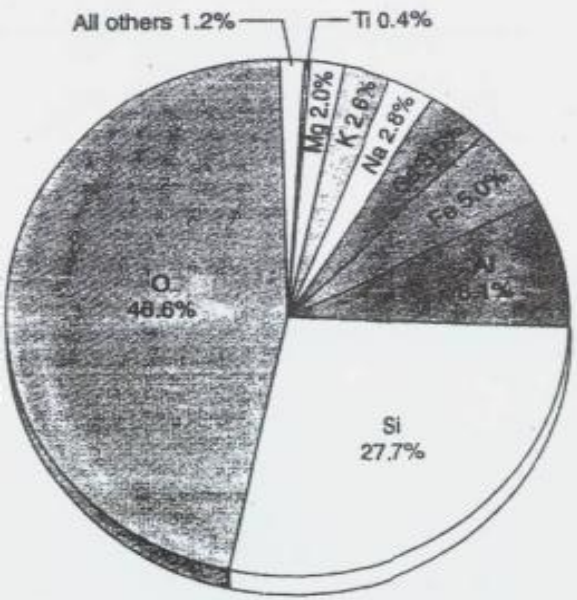
b. What would you label your x-axis? _____

c. What would you label your y-axis? _____

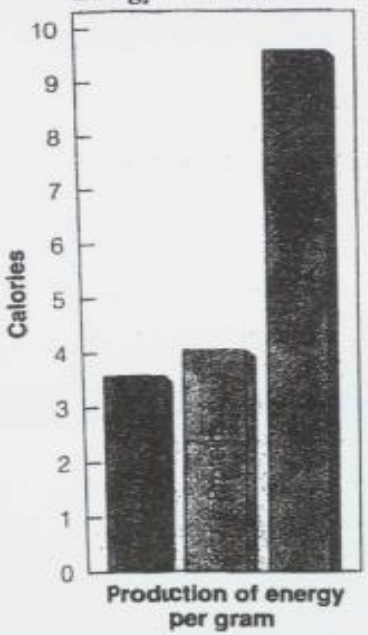
d. What scale (numbers) would you use to label your y-axis? _____

e. Construct a graph in the space below to represent the data.

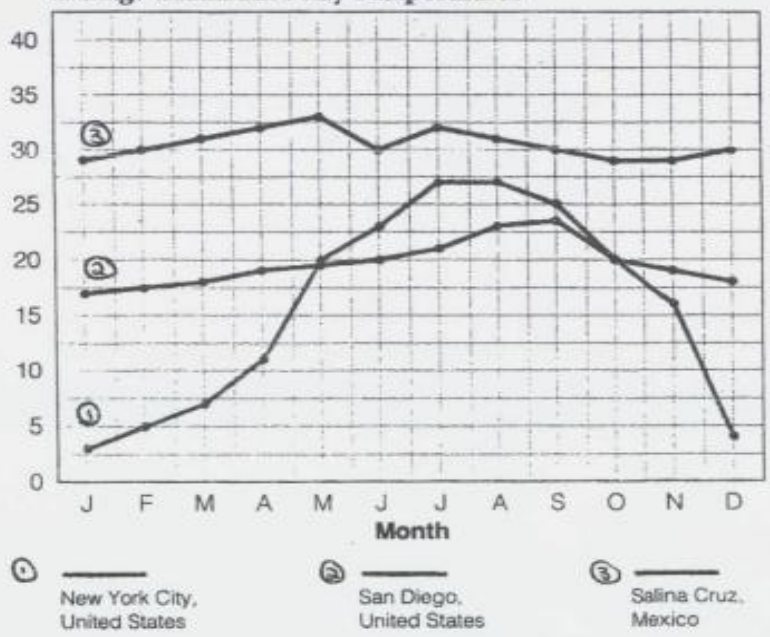
Elements in the Earth's Crust (in percent)



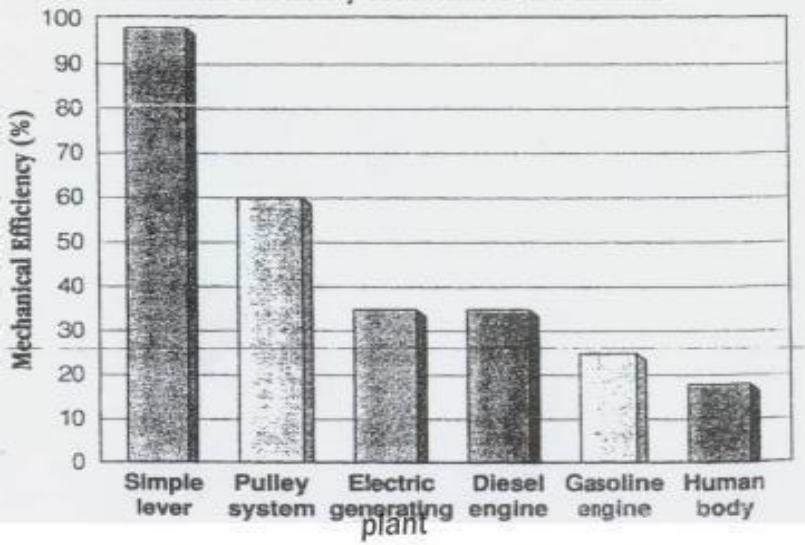
Energy Production



Average Maximum Daily Temperatures



Mechanical Efficiency of Machines and Humans



Speed of Sound

Material	Speed of Sound (m/s)
Air (0°C)	331
Helium (0°C)	965
Ethyl alcohol (25°C)	1207
Water (25°C)	1498
Copper	3800
Tempered glass	5170

B. Chris and Nick are studying heat. They are posed with a problem. They wonder whether the color of a container will affect how much heat that color will retain. Chris said, "If I put hot water in a dark can and a light can, then they will cool down at the same rate." Nick said, "If I put hot water in a dark can and a light can, then the dark can will cool down faster." They designed and cooperatively conducted an experiment using light colored and dark colored soup cans.

Their data table is below:

Time (Minutes)	**Light Can Temp ^{0}C**	**Dark Can Temp ^{0}C**
Start	100	100
5	90	70
10	70	50
20	50	30
30	40	25
40	30	22
50	25	21
60	20	20
70	20	20

Answer in complete sentences where applicable.

1. Graph this data in a double line graph.

2. Compare the two lines on your graph: How was the cooling the same?

3. Compare the two line on your graph: How was the cooling different?

4. Write Nick's conclusion in 4-5 sentences.

5. Write Chris's conclusion in 4-5 sentences