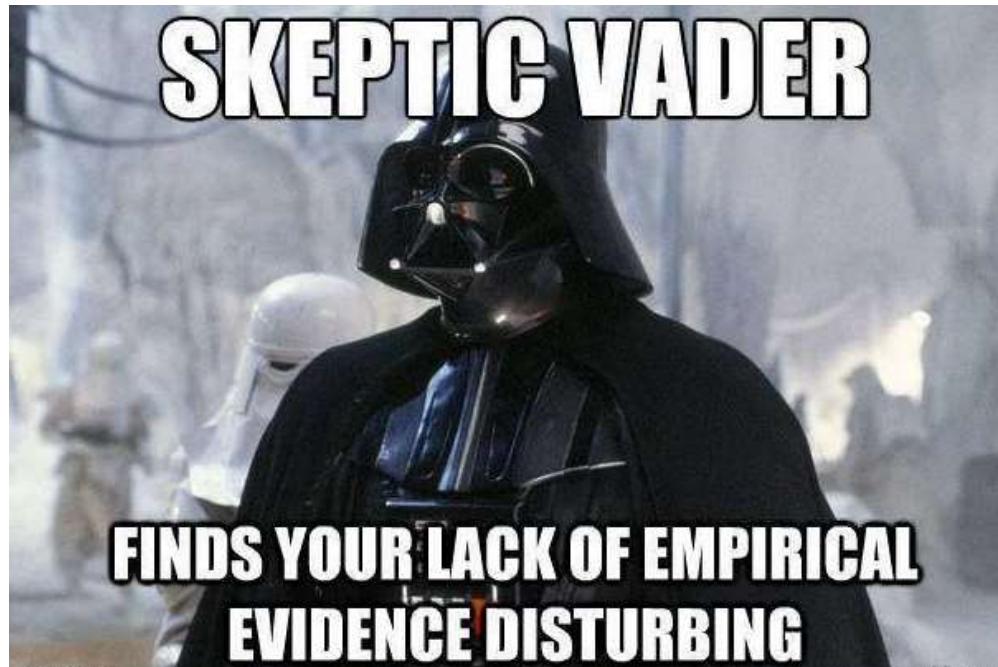


Monday, August 26, 2019

**Welcome to Investigative Science
with Mr. Fireng**



1. Get out your stampsheet
2. Get out your homework
3. Write tomorrow's homework in agenda
4. START WORKING QUIETLY

Investigative Science



Learning goal: Properly apply all steps in the scientific method when problem solving.

Learning goal: Properly apply all steps in the scientific method when problem solving.

Learning scale:

1	2	3	4
Name the steps	Name the steps and follow directions in an investigation	Can design and conduct an investigation leading to a conclusion	Design and carry out an investigation leading to a valid and rational conclusion

Student's self-evaluation: Complete at home or at the end of class, use the **4-3-2-1** Learning scale (two to three sentences).



- 4**
Design, complete, valid conclusion
- 3**
Design & complete
- 2**
Know steps, follow directions
- 1**
Know the steps

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

What is Dimensional Analysis with combination units?

4 steps of multi-step dimensional analysis

1.

2.

3.

4.

EXAMPLE:

Summary

Dimensional Analysis with combination units

Write all Cues!!



4

Design, complete, valid conclusion

3

Design & complete

2

Know steps, follow directions

1

Know the steps

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Multi-step Dimensional Analysis

Dimensional Analysis where you will have to perform multiple conversions.

Example: How old are you in seconds?

Multi-steps..

Years -> Months -> Days -> Hours -> Seconds!!!

4

Evaluate based on A&P

3

Distinguish A&P in data

2

Importance of A&P

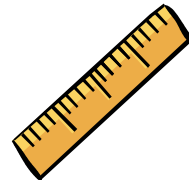
1

Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 10 feet?

Step 1: Read the problem and find out what unit you are in, and what unit you want to get to. This time leave space in between. Write what you have below it. Put a 1 below it and a “X”.

What units you have →

Feet →

What units you want

Centimeters

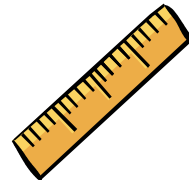
$$\frac{10 \text{ feet}}{1} \times$$

4	Evaluate based on A&P
3	Distinguish A&P in data
2	Importance of A&P
1	Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Multi-step Dimensional Analysis

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What units you have →

Feet →

What units you want

Centimeters

$\frac{10 \text{ feet}}{1}$

X

4	Evaluate based on A&P
3	Distinguish A&P in data
2	Importance of A&P
1	Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

*1 inch = 2.54 centimeters

1 foot = 12 inches

1 pound = 454 grams

*1 liter = 1.06 quarts

1 yard = 3 feet

1 hour = 60 minutes

*1 calorie = 4.18 joules

1 mile = 5,280 feet

1 minute = 60 seconds

*1 ampere = 1,000 milliamperes

1 mile = 1,760 yards

1 gallon = 4 quarts

1 pound = 16 ounces

1 quart = 2 pints

$^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32$

$^{\circ}\text{C} = \frac{\text{F} - 32}{1.8}$

$\text{K} = ^{\circ}\text{C} + 273$

Review

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 10 feet?

Step 2: Find the “conversion factor **S”, that will get you to the units you want. Write in the missing units.**

Feet → inches → *Centimeters*

$$\frac{10 \text{ feet}}{1} \times$$

Evaluate based on A&P
3
Distinguish A&P in data
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Importance of A&P
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Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

*1 inch = 2.54 centimeters
*1 liter = 1.06 quarts
*1 calorie = 4.18 joules
*1 atmosphere = 101.3 kilopascals

1 foot = 12 inches

1 yard = 3 feet

1 mile = 5,280 feet

1 mile = 1,760 yards

1 pound = 16 ounces

1 pound = 454 grams

1 hour = 60 minutes

1 minute = 60 seconds

1 gallon = 4 quarts

1 quart = 2 pints



Review

$$^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = \frac{\text{F} - 32}{1.8}$$

$$\text{K} = ^{\circ}\text{C} + 273$$

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

Feet → inches → *Centimeters*

$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{12 \text{ inches}}{\cancel{1 \text{ foot}}}$$

Evaluate based on A&P
3
Distinguish A&P in data
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Importance of A&P
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Review

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Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

Feet → inches → *Centimeters*

$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{\cancel{12 \text{ inches}}}{\cancel{1 \text{ foot}}} \times \frac{2.54 \text{ cm}}{\cancel{1 \text{ inches}}}$$

Evaluate based on A&P

3

Distinguish A&P in data

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Importance of A&P

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Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

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$^{\circ}\text{C} = \frac{\text{F} - 32}{1.8}$

$\text{K} = ^{\circ}\text{C} + 273$

Review

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 4: Cancel the units and solve the problem!

Feet → inches → *Centimeters*

$$10 \times 12 \div 1 \times 2.54 \div 1 = 270 \text{ cm}$$

$$\frac{10 \cancel{\text{feet}}}{1} \times \frac{12 \cancel{\text{inches}}}{1 \cancel{\text{foot}}} \times \frac{2.54 \text{ cm}}{1 \cancel{\text{inches}}} = 270 \text{ cm}$$

Evaluate based on A&P

3

Distinguish A&P in data

2

Importance of A&P

1

Define A&P

Learning goal: make accurate and precise measurements using proper significant figures when collecting and organizing data.

*1 atm = 101.3 kilopascals
1 mile = 1,760 yards
1 gallon = 4 quarts
1 pound = 16 ounces
1 quart = 2 pints

$$^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32 \qquad ^{\circ}\text{C} = \frac{^{\circ}\text{F} - 32}{1.8} \qquad \text{K} = ^{\circ}\text{C} + 273$$

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 4: Cancel the units and solve the problem!

Feet → inches → *Centimeters*

$$10 \times 12 \div 1 \times 2.25 \div 1 = 270 \text{ cm}$$

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Evaluate based on A&P
3
Distinguish A&P in data
2
Importance of A&P
1
Define A&P

Problem set up:

$$\frac{5 \text{ frumious Bandersnatches}}{1} \times \frac{1 \text{ tulgey wood}}{1 \text{ frumious Bandersnatches}} \times \frac{20 \text{ tumtum trees}}{1 \text{ tulgey wood}} \times \frac{2 \text{ Jubjub birds}}{200 \text{ tumtum trees}} \times \frac{1 \text{ slithy tove}}{5 \text{ Jubjub birds}} \times \frac{2 \text{ borogoves}}{5 \text{ slithy toves}} \times \frac{200 \text{ mome raths}}{1 \text{ borogove}} \times \frac{1 \text{ Jabberwock}}{2 \text{ mome raths}}$$

Cancellation of Units (Color coded for cancelling units)

$$\frac{5 \text{ frumious Bandersnatches}}{1} \times \frac{1 \text{ tulgey wood}}{1 \text{ frumious Bandersnatches}} \times \frac{20 \text{ tumtum trees}}{1 \text{ tulgey wood}} \times \frac{2 \text{ Jubjub birds}}{200 \text{ tumtum trees}} \times \frac{1 \text{ slithy tove}}{5 \text{ Jubjub birds}} \times \frac{2 \text{ borogoves}}{5 \text{ slithy toves}} \times \frac{200 \text{ mome raths}}{1 \text{ borogove}} \times \frac{1 \text{ Jabberwock}}{2 \text{ mome raths}}$$

The units all cancel until all you are left with are Jabberwocks! Now just do the math and you end up with 8 Jabberwocks!

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

What is dimensional Analysis with Combination Units?

- **Dimensional Analysis can also be used for combination units for example $\frac{\text{mi}}{\text{hr}}$ to $\frac{\text{m}}{\text{s}}$.
Need to convert BOTH units.**

- Write the fraction in a “clean” manner:
 km/h becomes $\frac{\text{km}}{\text{h}}$

4

Evaluate based on A&P

3

Distinguish A&P in data

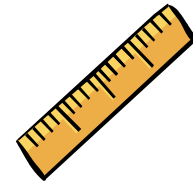
2

Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 1: Read the problem and find out what unit you are in at the top and bottom, and what unit you want to get to.

$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$

$\frac{5 \text{ miles}}{1 \text{ hour}} \times$

Like a two step because you need to convert both top and bottom

4

Evaluate based on A&P

3

Distinguish A&P in data

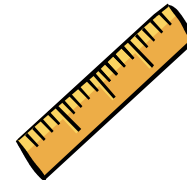
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Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 2: Find the “conversion factors”, that will get you to the units you want. Write in the missing units.

$$\begin{array}{ccc} \frac{\text{miles}}{\text{hour}} & \rightarrow & \frac{\text{Km}}{\text{sec}} \\ \hline \frac{1.609 \text{ km}}{1 \text{ mile}} & & \frac{1 \text{ hour}}{3600 \text{ sec}} \end{array}$$

Like a two step because you need to convert both top and bottom

4

Evaluate based on A&P

3

Distinguish A&P in data

2

Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 2: Find the “conversion factors”, that will get you to the units you want. Write in the missing units.

$$\begin{array}{ccc} \frac{\text{miles}}{\text{hour}} & \rightarrow & \frac{\text{Km}}{\text{sec}} \\ \frac{1.609 \text{ km}}{1 \text{ mile}} & & \frac{1 \text{ hour}}{3600 \text{ sec}} \end{array}$$

Diagram illustrating conversion factors for dimensional analysis. A blue arrow points from the 'miles' unit in the top-left fraction to the 'Km' unit in the top-right fraction. Another blue arrow points from the 'hour' unit in the top-left fraction to the 'sec' unit in the bottom-right fraction. The bottom-left fraction is $\frac{1.609 \text{ km}}{1 \text{ mile}}$ and the bottom-right fraction is $\frac{1 \text{ hour}}{3600 \text{ sec}}$.

Put the unit you want to get rid of on the top or bottom

4

Evaluate based on A&P

3

Distinguish A&P in data

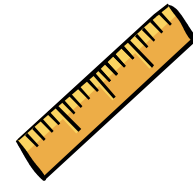
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Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with miles Combination Units hour

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

$$\frac{\cancel{5 \text{ miles}}}{\cancel{1 \text{ hour}}} \times \frac{1.609 \text{ km}}{\cancel{1 \text{ mile}}} \times \frac{\cancel{1 \text{ hour}}}{3600 \text{ sec}} = \frac{\text{Km}}{\text{Sec}}$$

4

Evaluate based on A&P

3

Distinguish A&P in data

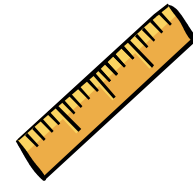
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Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with miles hour Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 4: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

multiply the top $5 \times 1.6 = 8$;

multiply the bottom $1 \times 1 \times 3600 = 3600$,

$$\frac{\cancel{5 \text{ miles}}}{\cancel{1 \text{ hour}}} \times \frac{1.609 \text{ km}}{\cancel{1 \text{ mile}}} \times \frac{\cancel{1 \text{ hour}}}{3600 \text{ sec}} = \frac{8 \text{ km}}{3600 \text{ sec}}$$

4

Evaluate based on A&P

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Distinguish A&P in data

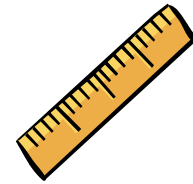
2

Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with $\frac{\text{miles}}{\text{hour}}$ Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 4: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

(multiply the top 5 x 1.6=8;

multiply the bottom 1 x 1 x 3600 = 3600,

Divide.. Top/bottom = .002

$$\frac{\cancel{5 \text{ miles}}}{\cancel{1 \text{ hour}}} \times \frac{1.609 \text{ km}}{\cancel{1 \text{ mile}}} \times \frac{\cancel{1 \text{ hour}}}{3600 \text{ sec}} = \frac{.002 \text{ km}}{\text{sec}}$$

4

Evaluate based on A&P

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Importance of A&P

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Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with $\frac{\text{miles}}{\text{hour}}$ Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 1: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

Re=write “un=clean if you want..”

$$\frac{5 \cancel{\text{ miles}}}{1 \cancel{\text{ hour}}} \times \frac{1.609 \text{ km}}{1 \cancel{\text{ mile}}} \times \frac{1 \cancel{\text{ hour}}}{3600 \text{ sec}} = .002 \frac{\text{ km}}{\text{ sec}}$$

- 4 Evaluate based on A&P
- 3 Distinguish A&P in data
- 2 Importance of A&P
- 1 Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 1: Process is the same as two step! Write the fraction in a “clean” manner:

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

$$\frac{5 \text{ miles}}{1 \text{ hour}} \times$$

Like a two step because you need to convert both top and bottom

- 4 Evaluate based on A&P
- 3 Distinguish A&P in data
- 2 Importance of A&P
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Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 2: Find the “conversion factors”, that will get you to the units you want. Write in the missing units.

$$\begin{array}{ccc} \frac{\text{miles}}{\text{hour}} & \rightarrow & \frac{\text{Km}}{\text{sec}} \\ \frac{1.609 \text{ km}}{1 \text{ mile}} & & \frac{1 \text{ hour}}{3600 \text{ sec}} \end{array}$$

Like a two step because you need to convert both top and bottom

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Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 2: Find the “conversion factors”, that will get you to the units you want. Write in the missing units.

$$\begin{array}{ccc} \text{miles} & \rightarrow & \text{Km} \\ \text{hour} & & \text{sec} \\ \hline 1.609 \text{ km} & & 1 \text{ hour} \\ \hline 1 \text{ mile} & & 3600 \text{ sec} \end{array}$$

Diagram illustrating conversion factors for dimensional analysis. A blue arrow points from the fraction $\frac{1.609 \text{ km}}{1 \text{ mile}}$ to the word "miles" in the numerator of the target unit $\frac{\text{miles}}{\text{hour}}$. Another blue arrow points from the fraction $\frac{1 \text{ hour}}{3600 \text{ sec}}$ to the word "hour" in the denominator of the target unit $\frac{\text{miles}}{\text{hour}}$.

Put the unit you want to get rid of on the top or bottom

- 4 Evaluate based on A&P
- 3 Distinguish A&P in data
- 2 Importance of A&P
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Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$

$$\frac{5 \cancel{\text{ miles}}}{1 \cancel{\text{ hour}}} \times \frac{1.609 \text{ km}}{1 \cancel{\text{ mile}}} \times \frac{1 \cancel{\text{ hour}}}{3600 \text{ sec}} = \frac{\text{km}}{\text{sec}}$$

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Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 1: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

multiply the top $5 \times 1.6 = 8$;

multiply the bottom $1 \times 1 \times 3600 = 3600$,

$$\frac{5 \cancel{\text{ miles}}}{1 \cancel{\text{ hour}}} \times \frac{1.609 \text{ km}}{1 \cancel{\text{ mile}}} \times \frac{1 \cancel{\text{ hour}}}{3600 \text{ sec}} = \frac{8 \text{ km}}{3600 \text{ sec}}$$

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Dimensional Analysis with Combination Units

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Step 1: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

(multiply the top 5 x 1.6=8;

multiply the bottom 1 x 1 x 3600 = 3600,

Divide.. Top/bottom = .002

Re=write

“un=clean if you want..

$$\frac{\cancel{5} \text{ miles}}{\cancel{1} \text{ hour}} \times \frac{1.609 \text{ km}}{\cancel{1} \text{ mile}} \times \frac{\cancel{1} \text{ hour}}{3600 \text{ sec}} = \frac{.002 \text{ km}}{\text{sec}}$$

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Evaluate based on A&P

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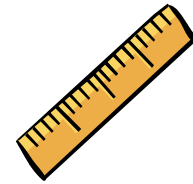
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Importance of A&P

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Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Dimensional Analysis with miles hour

Combination Units

Example Problem: How many kilometers/sec are in 5 miles/hour

Step 1: Do the math!

$$\frac{\text{miles}}{\text{hour}} \rightarrow \frac{\text{Km}}{\text{sec}}$$

Re=write “un=clean if you want..

$$\frac{\cancel{5 \text{ miles}}}{\cancel{1 \text{ hour}}} \times \frac{1.609 \text{ km}}{\cancel{1 \text{ mile}}} \times \frac{\cancel{1 \text{ hour}}}{3600 \text{ sec}} = .002 \frac{\text{km}}{\text{sec}}$$

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