MiSP Weather Data Worksheet #2

Name ______________________________ Date_____________

Temperature, Pressure, Density – What happens as you go up? (L 3)

Introduction

Our planet is surrounded by a sea of air. It is separated into layers. This worksheet is focused on the troposphere, the lowest layer and the part of the atmosphere where weather occurs.

Problem

What happens to air pressure, temperature, and air density as altitude increases from sea level (0') to 16,000'?

Procedures

1. Review the data below from http://www.engineeringtoolbox.com/air-altitude-temperature-d_461.html Note:

- *1 ft (foot) = 0.3048 m*
- *1 in mercury (Hg) = 3,376.8 N/m² (Pa)= 0.49 lb/in² (psi) = 12.8 in water*
- *T(°C) = 5/9[T(°F) - 32]*
- *Density is listed as a percent of the density of air at sea level*

2. Graph the data on the third page for altitude (feet) and temperature (°F), pressure (inches Hg), and density (%). All will be on the same graph.

- Label the X axis with altitude (thousand feet)
- Label the Y axis with temperature (°F), pressure (inches Hg), and density (%)
- Use the same number line for all three measurements on the Y axis. Number the y axis from 0 to 120. Use an appropriate scale.
- Plot the three sets of data points with three different color pencils
- Connect the data points

Altitude *(thousand feet)*	Pressure *(in. Hg)*	Temp. *(F)*	Density *(%)*
sea level 0	29.92	59.0	100
2	27.82	51.9	94.3
4	25.84	44.7	88.8
6	23.98	37.6	83.6
8	22.22	30.5	78.6
10	20.57	23.3	73.8
12	19.02	16.2	69.3
14	17.57	9.1	65.0
16	16.21	1.9	60.9

Discussion

1a. What happens to each of the following as altitude increases?

Temperature ____

Air pressure ____

Density ____

1b. Explain why each of the changes you listed in 1a happens (You may need help from textbook materials, other resources, or your teacher):

-Temperature (this one is a special challenge – doesn't warm air rise?)

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-Air pressure ____

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-Density ____

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2. Use the graph to find the following measurements at 11 thousand feet:

Temperature ____

Air pressure ____

Density ____

3. Compare the changes in pressure, temperature, and density with increasing altitude by calculating the unit rates of change (slopes).

Pressure Unit Rate of Change = $\frac{\Delta \text{ pressure (in.Hg)}}{\Delta \text{ altitude (thousand feet)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ pressure (in.Hg) Δ y	Δ altitude (thousand feet) Δ x	Unit Rate of Change (slope) Δ y/Δ x

Temperature Unit Rate of Change = $\frac{\Delta \text{temperatute (°F)}}{\Delta \text{ altitude (thousand feet)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δtemperatute (°F) Δ y	Δ altitude (thousand feet) Δ x	Unit Rate of Change (slope) Δ y/Δ x

Density Unit Rate of Change = $\frac{\Delta \text{density (\%)}}{\Delta \text{ altitude (thousand feet)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δdensity (%) Δy	Δ altitude (thousand feet) Δx	Unit Rate of Change (slope) Δ y/Δ x

4. All the unit rates of change (slopes) are negative (-). Why are they negative?

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5a. Look at the graph. Which line has the steepest angle downward?

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5b. Look at the three unit rates of change (slopes). How can you tell which line has the steepest angle downward by comparing the unit rates of change (slopes)?

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6. What is the y-intercept for the altitude – pressure line? Use the equation for a line to calculate the y-intercept. Use the pressure data and the unit rate of change for pressure that you calculated in #3 above . The equation for a line is

$y = mx + b$
where m is the unit rate of change (slope) and
b is the y-intercept

Y Intercept
m =   Ordered pair (x, y) = (___ , ___)   y = mx +b   Solve for b:

7. Write an equation for the altitude – pressure line based on the unit rate of change and the y intercept that you calculated above. Remember that the equation for a line is **y = mx + b** and m is the unit rate of change (slope) and b is the y intercept.

Equation

8. Use the formula above to calculate the atmospheric pressure at an altitude of 4,150 feet (use 4.150 thousand feet in the formula). Show work.
x = 4.150 thousand feet

y = ____________________