MiSP Weather Data Worksheet #2 L3

Name _____ Date _____

TEMPERATURE, PRESSURE, DENSITY — WHAT HAPPENS AS YOU GO UP?

Introduction:

Our planet is surrounded by a sea of air that is separated into layers. This worksheet is focused on the troposphere, which is the lowest layer of air 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:

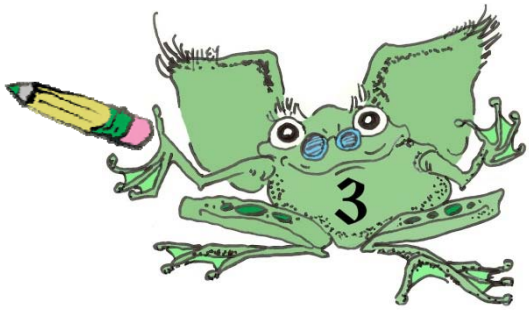
Review the data below from http://www.engineeringtoolbox.com/air-altitude-temperature-d_461.html. Note:

- *1 ft (foot) = 0.3048 m*
- *1 in (inch) mercury (Hg) = 3,376.8 N/m^2 (Pa)= 0.49 lb/in^2 (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.*

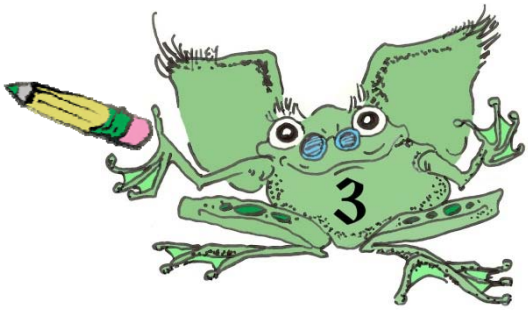
Graph the data:

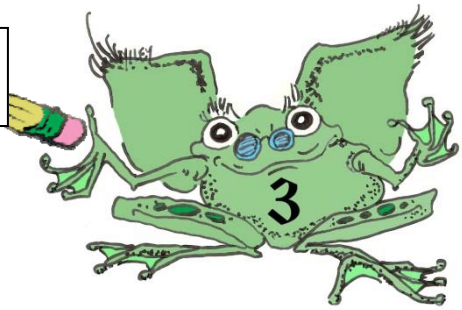
Graph the data on the third page for altitude (feet) and temperature (°F), pressure (inches Hg), and density (%). All will be on the same graph.

- 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

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Discussion Questions:

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?)

_____

_____

_____

-Air pressure:_____

_____

_____

_____

-Density: _____

_____

_____

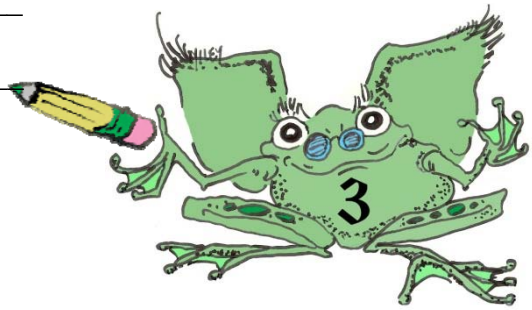
_____

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

Temperature _____

Air pressure _____

Density _____



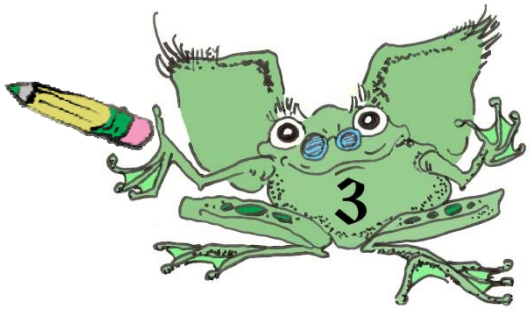
3. Compare the changes in pressure, temperature, and density with increasing altitude by calculating the unit rates of change (slopes).

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) Δy	Δ Altitude (thousand feet) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

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

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Temperature (^{o}F) Δy	Δ Altitude (thousand feet) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$



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)	$\frac{\Delta \text{ Density (\%)}}{\Delta y}$	Δ Altitude (thousand feet) Δx	**Unit Rate of Change (slope)** $\Delta y / \Delta x$

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

_____

_____

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

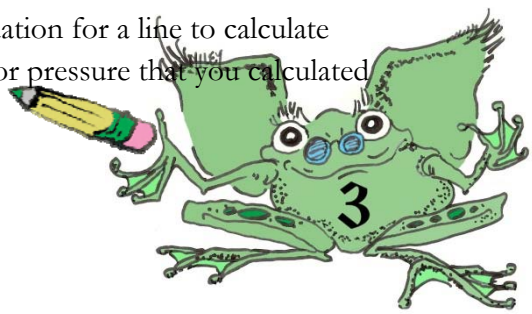
_____

5b. Look at the three unit rates of change (slopes). How does comparing the unit rates of change (slopes) enable you to determine which line has the steepest angle downward?

_____

_____

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 $\boldsymbol{y = mx + b}$ 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 your work.

x = 4.150 thousand feet y = _____