# Head in the clouds: a better model

Air pressure decreases as we move above sea level. If we assume that temperature decreases linearly with altitude, the function $P(h)$ (pressure in kilopascals at altitude $h$ meters) is given by

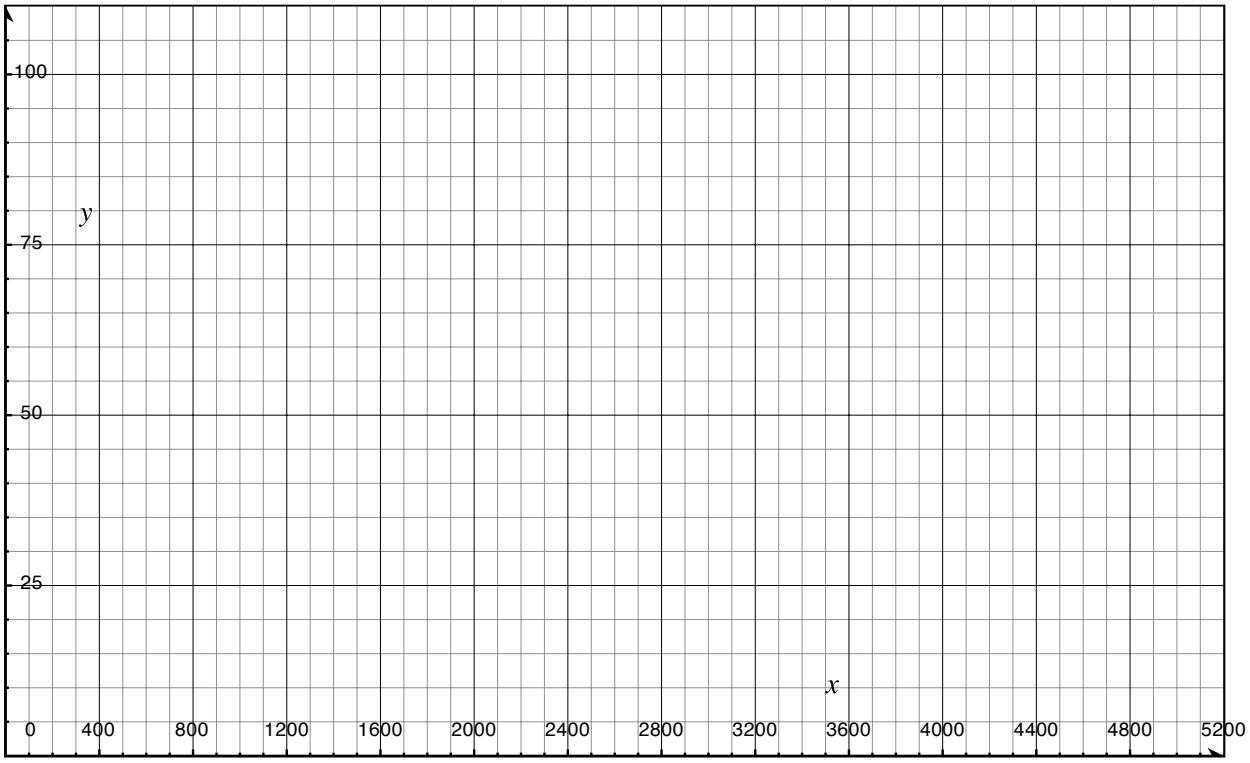
$$P(h) = \frac{1}{10}\left(\frac{44331.514 - h}{11880.516}\right)^{1/0.1902632}.$$

1. Fill in the blank: The function $P(h)$ is the composition of a linear function and a _____ function. How can you tell?

2. Fill in the following table using the altitudes given:

| city | San Francisco CA, U.S. | New York NY, U.S. | Minneapolis MN, U.S. | Antananarivo Madagascar | Lake Titicaca Peru | Wenquan China |
|---|---|---|---|---|---|---|
| elevation (m) | 11 | 125 | 264 | 1275 | 3860 | 5019 |
| pressure (kPa) | | | | | | |

3. Use your table above to graph the pressure against altitude.



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4. Identify intervals on which the pressure is increasing or decreasing with respect to altitude. Does this make sense with your physical intuition about the weight of the atmosphere pressing down on you? Does this make sense considering the equation for pressure?

5. Would a linear approximation tangent to the curve at $h = 0$ underestimate or overestimate the atmospheric pressure in Lake Titicaca? Why?

6. Consider the family of lines tangent to the curve for $P(h)$ at different points along the curve. As $h$ increases, does the slope of a line tangent to $P(h)$ at the point $(h, P(h))$ increase or decrease?

7. Will pressure $P(h)$ ever equal zero? What would it mean for atmospheric pressure to be zero? What would that mean for how much oxygen we'd breathe in with each breath?