

Trigonometric Model of Respiration (that means "breathing")

Velocity is a quantity which tells you the speed and direction which something is moving. One direction is assigned to be negative and the other direction to be positive. If the velocity of something is zero then it is not moving.

Suppose a person has just exhaled and is at the point where there is no more air coming out of their lungs. At this point the velocity of the air is zero. They then begin to inhale, the speed of the air intake increases and then slows down as they reach the point where the lungs are full of air. The velocity is now zero (during the inhalation the velocity is considered to be positive). As they begin to exhale, the speed of the air increases and then slows down until they reach the point where there is no more air flowing out. The velocity is back at zero again and one cycle of respiration has been completed (during the exhalation the velocity is considered to be negative).

The **frequency** of an oscillation is the number of cycles that occur in one unit of time. It is the reciprocal of the period. (The period (P) is the number of units of time in one oscillation). $f = \frac{1}{P}$

Suppose the equation $v = 0.85 \sin\left(\frac{\pi}{3} t\right)$

gives the velocity of air during the respiratory cycle, where t is in seconds and v is liters/second.

- How long does it take for the person to complete one breath?
- What is the frequency of this function?
- How many breaths does the person take in one minute?
- At what times during the breathing process is the rate of air flow the greatest?
- Sketch the breathing cycle below for two breaths. Label the axes appropriately.

