TOPIC: LAW OF PARTIAL PRESSURE

Partial Pressure

- Movement of gases (O_2 and CO_2) depends on _____ gradients.
  - *Recall*: molecules move down a gradient — _____ process.
  - For diffusion of gas molecules, we care about partial _____; NOT _____.
- **Dalton's Law of Partial Pressure:** in a mixture, total pressure = _____ of individual pressures.

$$P_{TOTAL} = P_{GAS\ A} + P_{GAS\ B} + \ldots$$

	Atmospheric Pressure = 760 mm Hg	
Gas	**Concentration (%)**	**Partial Pressure**
Nitrogen	78.08	
Oxygen	20.95	
Argon	0.93	
Carbon Dioxide	0.04	
Total	100	

EXAMPLE

The following gas mixtures are contained in two chambers separated by a permeable membrane. For each gas listed, draw an arrow in the direction you would expect the molecules to move by diffusion.

	Gas A			Gas B	
Gas	**Concentration (%)**	**Partial Pressure (mm Hg)**	**Direction of Difussion**	**Concentration (%)**	**Partial Pressure (mm Hg)**
Nitrogen	60	300		40	400
Hydrogen	20	100		10	100
Helium	15	75		5	50
Oxygen	5	25		45	450
Total	100	500		100	1000

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PRACTICE

Gas A and Gas B are both mixtures separated by a permeable membrane. Gas A contains 40% nitrogen at a partial pressure of 300 mm Hg. Gas B contains 80% nitrogen at partial pressure of 200 mm Hg. Given this information, in which direction do you expect to see a net movement of nitrogen and why?

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a) From Gas A to Gas B because the total pressure of Gas A is greater than Gas B.

b) From Gas B to Gas A because Gas B has a higher concentration of nitrogen than Gas A.

c) From Gas B to Gas A because 80% of 200 mm Hg > 40% of 300 mm Hg.

d) From Gas A to Gas B because the partial pressure of nitrogen in Gas A is greater than in Gas B.

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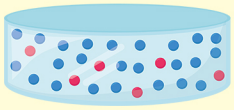
Pressures: Dalton's and Henry's Laws

◆ ___ laws explain the movement of molecules by respiration:

Dalton divides the pressure; ***Henry*** hydrates it.

1. **Dalton's Law:** partial _____ of a gas is equal to its percent composition multiplied by the total pressure.

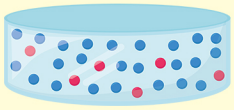
Pressure 760 mm Hg



P_{O_2} = 21% x 760 mm Hg =

P_{O_2} = _____ mm Hg

Pressure 500 mm Hg



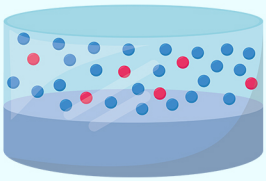
P_{O_2} = 21% x 500 mm Hg =

P_{O_2} = _____ mm Hg

2. **Henry's Law:** the amount of a gas that _____ in a liquid is proportional to the _____ pressure.
(Specific values depend on solubility and _____).

Pressure 760 mm Hg

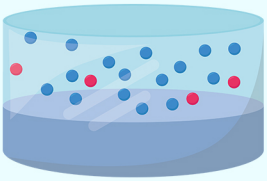
$\%O_2$ = _____ P_{O_2} =_____



_____ dissolves

Pressure 500 mm Hg

$\%O_2$ = _____ P_{O_2} = _____



_____ dissolves

EXAMPLE

When climbers summit Mt. Everest, they often use an oxygen mask to increase the amount of O_2 that they inspire with each breath. The table below gives the concentration of O_2 and the atmospheric pressure under three conditions. Use the table to calculate the P_{O_2} under each condition. Then, answer the questions below.

	Sea Level	Everest with supplemental O_2	Everest without supplemental O_2
Concentration of oxygen	20.9%	50%	20.9%
Total atmospheric pressure	760 mm Hg	235 mm Hg	235 mm Hg
Partial pressure of oxygen			

a) Using the information from the table, under which two scenarios would you expect the amount of oxygen dissolved in the blood to be the most similar.

_____ _____

b) What law allowed you to calculate the partial pressures? _____

c) What law allowed you to predict how much oxygen would dissolve in the blood? _____

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PRACTICE

Air in the alveoli is approximately 5.2% CO_2. Given that information along with the total air pressure in the alveoli, which law would allow you to calculate the partial pressure of CO_2?

a) Henry's Law.
b) Dalton's Law.
c) Purkinje's Law.
d) Boyle's Law.

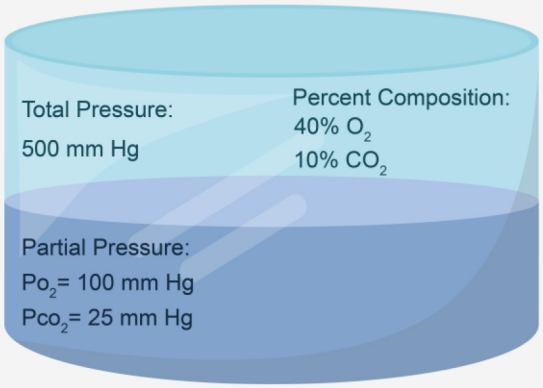
PRACTICE

How is Henry's law related to the amount of gas that can be exchanged in the alveoli?

a) Henry's law states that the small volume of the alveoli will cause an increase the total pressure, allowing gases to be more easily dissolved by the blood.
b) Henry's law allows us to predict the relative amount of a gas that will dissolve in the blood when given its partial pressure.
c) Henry's law states that molecules will always move towards an area of lower pressure.
d) Henry's law states that, in a mixture, the total pressure can be divided into the partial pressures of each gas; this determines how much of each gas will be absorbed by the blood.

PRACTICE

Gas A is 40% oxygen and 10% CO_2. It has a total pressure of 500 mm Hg. Gas A is in contact with a with a liquid containing oxygen at a partial pressure of 100 mmHg and CO_2 at a partial pressure of 25 mm Hg. In which direction will O_2 and CO_2 diffuse in this situation?



a) Oxygen will dissolve into the liquid, while CO_2 will move from the liquid into the gas.
b) CO_2 will dissolve into the liquid, while O_2 will move from the liquid into the gas.
c) Both O_2 and CO_2 will move from the gas into the liquid.
d) Both O_2 and CO_2 will move from the liquid into the gas.