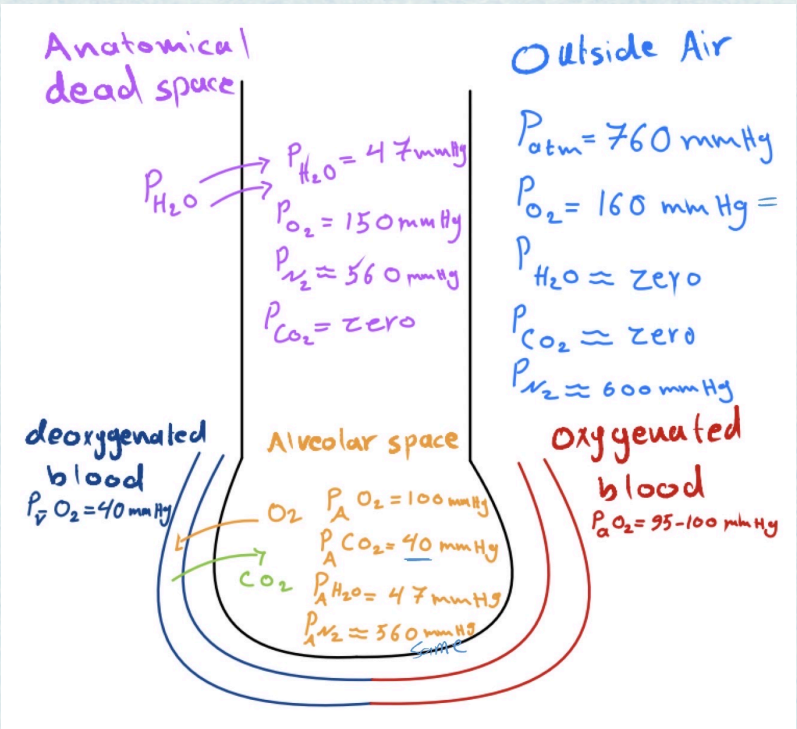
بسم الله الرحمن الرحيم

Outside air :

- PH = 7.4 Note : the renal system also plays an imp role in PH regulation.
- P_{atm} = 760 mmHg
- PO_2 = 21%*P_{atm}
- O_2 = 21% of P_{atm} = 160 mmHg
- N_2 = 79% of P_{atm} = 600
- CO_2 = 0.3% , so it is neglected or zero
- Partial pressure of water vapor (P_{H2O}) in the atmosphere = around zero

In Alveoli :

- Arterial partial Oxygen pressure (P_aO_2) = 100mmHg
- P_aCO_2 = 40 mmHg
- P_aN_2 = 560 mmHg
- p_aH_2O = 47 mmHg



- In normal person and normal condition Cardiac Output = 5 L/min
- so oxygen availability to the tissues it determined by this amount of blood
- Oxygen consumption = 250 ml/min, Oxygen consumption is the amount of oxygen that lows from the alveoli into the vasculature per unit time.
- Flow = DF/R [$Ohm's\ Law$] , (DF: $Driving\ Force$, R: $Resistance$)
- We can replace resistance with permeability.

Oxygen Flow = DeltaPO2 * K , (K: permeability)

- Regarding permeability itself, it depends on both membrane and gas factors, summarized in the following equation : K= (A/dx) * $(S/\sqrt{MW})$, while (A: $surface\ area$; dx: $thickness$ S: $Gas\ solubility$; MW: $Gas\ molecular\ weight$)
- Heart Rate in normal person = 75 bpm (In 0.25-0.3 seconds).

As the heart rate increases, the duration of cardiac cycle decreases.

- Total Body Water = 60% * Body Weight = 42L in a 70-kg person
- At rest, normal person inhales about 500 ml and exhales the same volume per one breath (Tidal volume)
- During inspiration, the inhaled fresh air (PO2= 150, PCO2= 0, PH2O= 47 [mmHg]) is in total about 500 ml (tidal volume).

- $$P\bar{E}O2 = \frac{350\ ml * 100\ mmHg + 150\ ml * 150\ mmHg}{500\ ml} \approx 116\ mmHg$$

$$P\bar{E}CO2 = \frac{350\ ml * 40\ mmHg + 150\ ml * 0\ mmHg}{500\ ml} \approx 28\ mmHg$$

The subscript "E-bar" means "mixed expired", which relates to expired air composition.

- P = force / Area.

Boyle's law states that the pressure and volume of gas are inversely proportional at constant T

$$P_1V_1 = P_2V_2 = \text{constant}$$

- Flow = (P_{atm} - $P_{alveolar}$) / $R_{airways}$ ..[DF =$P_{alveolr}$ - P_{atm} for expiration].
- Respiratory minute ventilation (RMV) =Tidal volume (V_T) * Respiratory rate (RR)
- RMV = 0.5 L * 12 breathes/min = 6L
- Cardiac Output (Q)= Stroke Volume * Heart rate =5 L/min
- R = $8\eta l / \pi r4$ (directly measured) || $R \propto \frac{1}{A^2}$ [Recall that $R \propto \frac{1}{r^4}$ and that $A \propto r^2$]
- R = DF/Flow = 1mmHg /6L perm minute → ***too small*** indirectly

in the respiratory tract it resides. Remember that $\boldsymbol{Velocity}\left(\frac{d}{t}\right) = \frac{\boldsymbol{Flow}\left(\frac{d^3}{t}\right)}{\boldsymbol{Area}\,(d^2)}$.

- Inspiratory Capacity (IC) = VT + IRV.
- Functional Residual Capacity (FRC) = ERV + RV
- Vital Capacity(VC) =IRV+VT+ERV (all volumes except RV)
- Total Lung Capacity (TLC) = VC + RV (all 4 volumes)
- FRC = V1 ($C_1/C_2 - 1$), where c is concentration of helium

- PDSV = ADSV + AWV ,, PDSV can be equal to or higher than ADSV , BUT NOT LOWER THAN ADSV (cause normally ADSV = Zero)

- (PDSV) = TV x ($P_aCO_2 - P_ECO_2 / P_aCO_2$)

PDSV :Physiological Dead Space Volume\\VT: Tidal Volume

PaCO2: Arterial CO2 Partial Pressure

PECO2: Mixed Expired Air CO2 Partial Pressure

When PDSV = 150 ,, Means no alveolar waste volume (AWV) ,,, IN Pathological conditions where there is an AWV , PECO2 will be decreased.

- P=2T/r Laplace's law,T: surface tension, r:alveolar radius
- Net Filtration Pressure (NFP) = $(Pc + \Pi i)$ – $(Pi + \Pi c)$
- Permeability(K) = (A/dx) * $(S/\sqrt{MW})$ → $K \propto A/dx$
- $\dot{Q}$A= 5L/min
- $\dot{V}$A = 350 ml/breath * 12breath/min = 4.2 L/min

The dot on V and Q indicate that the quantity is a volume per unit time (low).

- $\dot{V}$ Base > $\dot{V}$Apex
- $\dot{Q}$ Base > $\dot{Q}$Apex

{لَا يُكَلِّفُ اللَّهُ نَفْسًا إِلَّا وُسْعَهَا}.

Done By Nour Aldulaimi