Self Assessment

1. The fractional concentration of gases in the atmosphere do not change with changes in altitude.
   a. True
   b. False

2. List the normal values for each of the following:
   a. PaO_2: **80 to 100 mmHg**
   b. $PaCO_2$: **35 to 45 mm Hg**
   c. PvO_2: **40 mm Hg**
   d. $PvCO_2$: **46 mm Hg**
   e. PAO_2: **100 to 105 mm Hg**
   f. $PACO_2$: **40 mm Hg**

3. List the anatomic barriers that Oxygen and Carbon Dioxide must traverse between the alveoli and the capillary blood.

   a. **Surfactant layer**
   b. **Alveolar Type I Epithelium**
   c. **Alveolar Basement membrane**
   d. **Interstitial Space**
   e. **Capillary Basement membrane**
   f. **Capillary Endothelium**
   g. **Plasma in Capillary**
   h. **Erythrocyte Membrane**
   i. **Intracellular (erythrocyte) fluid**

4. What is the thickness of the A-C membrane? **0.36 to 2.5 μ**

5. What is the normal pulmonary capillary transit time? **0.75 seconds**

6. How long does it take for diffusion to occur across the A-C membrane? **0.25 seconds**

7. What is the driving pressure for oxygen and carbon dioxide across the membrane?
   a. Oxygen **60 torr (100-40) ($PAO_2 - PaO_2$)**
   b. Carbon Dioxide **6 torr (46-40) ($PACO_2 - PaCO_2$)**

8. Name three laws that deal with gas diffusion.
   a. **FICK**
   b. **HENRY**
   c. **GRAHAM**

9. Describe Fick's Law of Diffusion.

   Volume of gas Diffused $\propto \dfrac{Area \times (P_1 - P_2) \times DiffusionConstant}{Thickness}$

10. What is the solubility coefficient for oxygen? **0.0244 mL/mm Hg/ mL H_2O**

11. What is the solubility coefficient for CO2? **0.592 mL/mm Hg/ mL H_2O**

Module C

1. What is the normal P_{BARO} at sea level?

   760 mm Hg $\mathbf{760 mmHg \times \frac{1.36 cmH_2O}{mmHg} = 1034 cmH_2O}$

2. List the fractional concentrations of the four major gases that comprise the atmosphere.

Gas	Fractional Concentration
A. **Nitrogen (N_2)**	**78.08% or 0.78**
B. Oxygen **(O_2)**	**20.95% or .21**
C. Argon **(Ar)**	**0.93% or .009**
D. Carbon Dioxide **(CO_2)**	**.03% or .0003**

3. Calculate the Partial Pressure of each gas in the atmosphere at a PB of 760 mm Hg.

   A. P_{N_2} = **760 x .78 = 592.8 mm Hg**

   B. P_{O_2} = **760 x .78 = 159.6 mm Hg**

   C. P_{Ar} = **760 x .009 = 68 mm Hg**

   D. P_{CO_2} = **760 x .0003 = .23 mm Hg**

4. As we inspire air into the lung, the air becomes fully saturated by the time the gas reaches the carina. This means that the air now contains all the water it can hold. We can say that:

   a. The air is **100**% saturated.
   b. The air hold **43.8** mg/L of water.
   c. The water vapor pressure (P_{H_20}) is **47** mm Hg.

5. Calculate the partial pressure of the inspired gas at normal P_B of 760 mm Hg.

   a. P_iN_2 = **(760-47) x .78 = (713)(.78) = 556.1 mm Hg**

   b. P_iO_2 = **(760-47) x .21 = (713)(.21) = 149.73 mm Hg**

   c. P_iAr = **(760-47) x .009 = (713)(.009) = 6.42 mm Hg**

   d. P_iCO_2 = **(760-47) x .0003 = (713)(.0003) = .21 mm Hg**

6. Dalton's Law states that the total pressure of a gas mixture is equal to the sum of the individual partial pressures of the gases. Calculate the pressure of gas B.

Total Pressure 500 mm Hg
Gas A 40 mm Hg
Gas C 50 mm Hg
Gas D 200 mm Hg
Gas E 10 mm Hg

Pressure of Gas B would be: **P_B = 500-(40+50+200+10) = 200 mm Hg**

7. Calculate the pressure of gas C.

Total Pressure 640 mm Hg
Gas A 38 mm Hg
Gas B 69 mm Hg
Gas D 150 mm Hg
Gas E 300 mm Hg

Pressure of Gas C would be: **P_C = 640 – (38+69+150+300) = 83 mm Hg**

8. Calculate the Alveolar Air Equation (P_AO_2)
   a. Given a P_B of 760 mm Hg, $PaCO_2$ 40 mm Hg, FIO2 50%

   P_AO_2 = **[(P_B-47)(FiO_2)-($PaCO_2$ x 1.25)=[(760-47).50]-(40 x 1.25) = [(713)(.5)]-50 = 356.5-50 = 306.5 mm Hg**

   b. Given a P_B of 740 mm Hg, $PaCO_2$ 50 mm Hg, FIO2 40%

   P_AO_2 = **[(P_B-47)(FiO_2)-($PaCO_2$ x 1.25)=[(740-47).40]-(50 x 1.25) = [(693)(.4)]-62.5 = 346.5-62.5 = 284 mm Hg**

   c. Given a P_B of 700 mm Hg, $PaCO_2$ 30, FIO2 60%

   P_AO_2 = **[(P_B-47)(FiO_2)-($PaCO_2$ x 1.25)=[(7)0-47).60]-(30 x 1.25) = [(653)(.6)]-37.5 = 391.8-37.5 = 354.3 mm Hg**

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9. As you rise above sea level the barometric pressure will
   a. increase
   b. decrease
   c. stay the same

10. As you rise above sea level, the fractional concentration of the individual gases will
    a. increase
    b. decrease
    c. stay the same

11. Fractional concentrations of gases are expressed as
    a. pressure
    b. volume
    c. %

12. By the time gas reaches the level of the carina at (37° C) the
    a. relative humidity (%) = **100%**
    b. absolute humidity = **43.8 mg/L**
    c. partial pressure = **47 mm Hg**

13. 1 atmosphere of pressure is equal to **760** mm Hg or **1034** cm H_20.

14. At a barometric pressure of 750 mm Hg and P_{H_20} of 25.2 mm Hg, calculate the following:
    a. P_{O_2} **$(P_{Baro}-P_{H_2O}) \times F_{iO_2} = (750-25.2) \times .21 = 724.8 \times .21 = 152.2$ mm Hg**
    b. P_{N_2} **$(P_{Baro}-P_{H_2O}) \times F_{iN_2} = (750-25.2) \times .78 = 724.8 \times .78 = 565.3$ mm Hg**

15. At a barometric pressure of 680 mm Hg and a P_{H_20} of 35.7 mm Hg, calculate the following:
    a. P_{O_2} **$(P_{Baro}-P_{H_2O}) \times F_{iO_2} = (680-35.7) \times .21 = 644.3 \times .21 = 135.3$ mm Hg**
    b. P_{CO_2} **$(P_{Baro}-P_{H_2O}) \times F_{iCO_2} = (680.35.7) \times .0003 = 644.3 \times .0003 =$ .19 mm Hg**

16. At a barometric pressure of 730 mm Hg (dry gas), calculate the
    a. P_{O_2} **$P_{Baro} \times F_{iO_2} = (730)(.21) = 153.3$ mm Hg**
    b. Par **$P_{Baro} \times F_{iAr} = (730)(.009) = 6.57$ mm Hg**

17. In the hospital, how much oxygen can be administered to a patient? **100%**

18. Who's law states that in a gas mixture, each gas will exert its own individual partial pressure? **Dalton's**