SELF-ASSESMENT - RSPT 2350: MODULE A

1. Circle below, those values that represent a true "blood gas"

   A. Base excess
   B. Bicarbonate
   C. Carbon dioxide
   D. Carbon monoxide
   E. Glucose
   F. Helium
   G. Hemoglobin
   H. Krypton
   I. Nitrogen
   J. Oxygen
   K. pH

2. What is the maximum value attainable by adding the values obtained for SaO_2, %COHb and %MetHb from a single blood gas? **100%**

Location	PB	PO_2 (Dry Gas)	PiO_2
Mt. Everest	253 mm Hg	53 mm Hg	43 mm Hg
Andes Mountains	380 mm Hg	80 mm Hg	70 mm Hg
Denver Colorado	640 mm Hg	134 mm Hg	125 mm Hg
New Orleans (Sea Level)	760 mm Hg	160 mm Hg	150 mm Hg
Leadville Colorado	520 mm Hg	3. **109.2**	**4.** **99.3**

5. What is the average airway pressure of a:

   A. Denver resident? **640 mm Hg**

   B. New Orleans resident? **760 mm Hg**

   C. Climber in the Andes? **380 mm Hg**

   D. Climber on the summit of Mt. Everest? **253 m Hg**

   E. Subject breathing air in a hyperbaric chamber at 2 atmospheres? **1520 mm Hg**

6. What is the dry air PO_2 in Leadville, Colorado (altitude of 10,200 feet).
   520 mm Hg x .21 = 109.2 mm Hg

7. What is the PiO_2 in Leadville?
   (520 mm Hg – 47 mm Hg) x .21 = 99.3 mm Hg

8. Calculate the PO_2 (dry gas) at 3 miles above sea level.
   PO_2=3 x 120 = 360 mm Hg drop. (760 mm Hg – 360 mm Hg) x .21 = 400 x .21 = 84 mm Hg

9. What is the total pressure of all gases in the lungs under the following conditions:

   A. P_{Baro}: 760 mm Hg, normal body temperature (37° C)
   P_{total} = **760 mm Hg – 47 mm Hg = 713 mm Hg**

   B. P_{Baro}: 253 mm Hg, normal body temperature (37◦ C)
   P_{total} = **253 mm Hg – 47 mm Hg = 206 mm Hg**

   C. P_{Baro}: 760 mm Hg, body temperature 39° C?
   P_{total} = **760 mm Hg – 52 mm Hg = 708 mm Hg**

10. A patient has the following ABG results: pH: 7.43, $PaCO_2$: 27 mm Hg, PaO_2: 80 mm Hg, $HCO3^-$: 15 mEq/L, FiO_2: .60.

   A. How would you assess the oxygenation status of this patient? **Corrected hypoxemia, probably due to a shunt. Note compensatory hyperventilation. The reduced bicarbonate and normal pH imply that this is not an acute situation.**

11. In general terms, what are the physiologic consequences during an airplane trip from the East Coast to California for someone who:
   A. Is healthy with PaO_2 95 mm Hg? **The PaO_2 will decrease slightly, but a mild hyperventilation will return the value to normal.**

   B. Has severe COPD with a PaO_2 of 58 mm Hg? **The patient may experience significant respiratory difficulty during the flight and will need supplemental oxygen for the flight.**

12. You take a hot air balloon ride from sea level to an altitude of 4000 feet. At this altitude, will the following values be higher, lower or the same as they are at sea level?

   A. FiO_2 **Same**

   B. P_{Baro} **Lower**

   C. PaO_2 **Lower**

   D. Water vapor pressure in your lungs? **Same**

   E. Your average airway pressure **Lower**

   F. The sum of all the individual partial pressures in your alveoli? **Lower**

13. **Write the following formulas and use the formulas to help solve the rest of this exercise**

   A. $PaCO_2 = \frac{CO_2 \text{ Production x } .863}{\bar{c}_E}$

   B. PAO_2 = **$[(PBaro - 47) \times FiO_2] - (PaCO_2/0.8)$**

   C. CaO_2 = **$(Hb \times 1.34 \times SaO_2) + (PaO_2 \times 0.003)$**

D. Henderson-Hasselbalch Equation: **$pH = pK + \log \frac{HCO_3^-}{PaCO_2 \times 0.03}$**

E. What is the normal pK for the HCO_3^-/H_2CO_3 buffer system? **20:1**

14. **$PaCO_2$ Equation**

A. If CO_2 production stays the same and alveolar ventilation increases, $PaCO_2$ will
   i. Rise
   ii. Fall
   iii. Stay the same

B. If alveolar ventilation stays the same and CO_2 production increases, $PaCO_2$ will
   i. Rise
   ii. Fall
   iii. Stay the same

C. A woman running on a treadmill doubles her f, HR, level of CO_2 production, $\dot{c}_E$, and $\dot{c}_A$. If her baseline $PaCO_2$ is 40 mm Hg, her $PaCO_2$ during exercise is
   i. 20 mm Hg
   ii. 30 mm Hg
   iii. 40 mm Hg
   iv. Impossible to determine from information provided.

D. A patient with severe emphysema has an FEV_1 of 0.5 L (25% of predicted). His resting $PaCO_2$ is 45 mm Hg. What will happen to his $PaCO_2$ when he exercises if his minute and deadspace ventilation do not increase?
   i. Will increase along with increases in VCO_2
   ii. Will remain unchanged
   iii. Will decrease as a result on exertional hyperventilation.
   iv. Change will depend on oxygen consumption.

15. **Alveolar Air Equation**

A. If PIO_2 stays the same and $PaCO_2$ increases, alveolar PO_2 will
   i. Increase
   ii. Decrease
   iii. Remain the same

B. If $PaCO_2$ stays the same and FiO_2 increases, alveolar PO_2 will
   i. Increase
   ii. Decrease
   iii. Remain the same

C. If both sea level barometric pressure and $PaCO_2$ fall by half, alveolar PO_2 will
   i. Increase
   ii. Decrease
   iii. Remain the same

D. If PAO_2 increases above normal, PaO_2
   i. Increases if the lungs are normal.
   ii. Increases only if the lungs are normal and patient is hyperventilating.
   iii. Always increases.

E. If the PAO_2 decreases, PaO_2
   i. Always decreases.
   ii. Decreases only if the lungs are abnormal.
   iii. Decreases only if the lungs are abnormal and the patient is hypoventilating.

F. If increasing altitude is the only variable that changes, PAO_2 will
   i. Increase
   ii. Decrease
   iii. Remain the same

16. **CaO_2/Oxygen Delivery Equations**

A. List three ways to express normal values for CaO_2:
   i. **Vol%**
   ii. **mL/100 mL blood**
   iii. **mL/dL blood**

B. The dissolved fraction of O_2 contributes how much to the total oxygen carried, in vol%?
0.3 Vol%

C. If normal PaO_2 and oxygen content are, respectively, 100 mm Hg and 20 vol%, approximately what % of oxygen is contributed by the dissolved fraction of O_2?
   i. 1.5%
   ii. 3.0%
   iii. 4.5% $\frac{\mathbf{0.3}\boldsymbol{vol}\mathbf{\%}}{\mathbf{20}\boldsymbol{vol}\mathbf{\%}} = \mathbf{0.15} = \mathbf{1.5\%}$
   iv. 10%
   v. 25%

D. Oxygen Delivery to the tissues will be influenced by 5 factors. Name these 5 factors.
   i. **Hemoglobin (Hb)**
   ii. **Oxygen Saturation (SaO_2)**
   iii. **Dissolved Oxygen (PaO_2)**
   iv. **Stroke Volume (SV)**
   v. **Heart Rate**

17. **Henderson-Hasselbalch Equation**

A. If HCO_3^- and $PaCO_2$ double from their normal baseline values, pH will:
   i. Stay the same
   ii. Double
   iii. Depend of the change in pK

B. If HCO_3^- falls by half and $PaCO_2$ remains the same, pH will
   i. Stay the same
   ii. Increase
   iii. Decrease

C. A pH of 7.40 means

   i. HCO_3^- is normal
   ii. $PaCO_2$ is normal
   iii. The ratio of HCO_3^- to $PaCO_2$ is normal.

D. If $PaCO_2$ increases from 40 to 60 mm Hg, the Henderson-Hasselbalch equation predicts:
   i. pH will fall
   ii. HCO_3^- will fall
   iii. HCO_3^- will rise
   iv. Nothing, since change in a single H-H variable cannot predict change in the other two.

18. If CO_2 production, PiO_2 and HCO_3^- remain constant, then as alveolar ventilation decreases **PAO_2** and **pH** will also decrease.

19. If both PiO_2 and HCO_3^- remain constant, then as $PaCO_2$ decreases, **pH** and **PAO_2** will increase.

20. Changes in which of the following will not affect the PAO_2?
   A. $PaCO_2$
   B. HCO_3^-
   C. Barometric Pressure
   D. SaO_2
   E. Altitude
   F. FiO_2
   G. Hb Content
   H. Patient's Age