Assignment 1 - Blood Gas Calculations Homework Key
BE-374, Spring '06, Dr. C. S. Tritt
Due: 3/27

1. Calculate the amount of oxygen consumed by an organ when 0.35 l/min of blood having a hemoglobin concentration of 14 g/dl enters the organ at 98% saturation and leaves it at 74% saturation. Express your answer in ml (@STP)/min and mM/s. You may neglect changes in the amount of dissolved oxygen.

Note: At 100% saturating 1.00 g of Hb binds 1.34 ml of O_2 and 1 mole of O_2 occupies 22.4 l.

O_2 Balance: In + Gen = Out + Acc → (since Acc is 0) Gen = Out − In

In = (0.35 l/min)(0.98)(1.34 ml/g)(14 g/dl)(10 dl/l) = 64.3 ml/min.

Out = (0.35 l/min)(0.74)(1.34 ml/g)(14 g/dl)(10 dl/l) = 48.6 ml/min.

Gen = 48.6 − 64.3 = − 15.7 ml/min (negative sign indicates consumption)

Gen = − 15.7 ml/min(1 min/60 s)(1 mM/22.4 ml) = − 0.0117 mM/s.

2. Use the Henderson-Hasselbalch equation (not my blood gas programs) to calculate the concentration of bicarbonate (HCO_3^-) in a solution at 37°C with a P_{CO2} of 45 mmHg and a pH of 7.40. Show your work.

The H-H equation is:

$pH = pK + \log([HCO_3^-]/(\alpha \cdot P_{CO2}))$ where pK = 6.1 and α = 0.03 mM/mm Hg.

So, $[HCO_3^-] = \alpha \cdot P_{CO2}\ 10^{(pH - pK)} = (0.03\ mM/mm\ Hg)(45\ mm\ Hg)\ 10^{(7.40 - 6.1)}$

$[HCO_3^-]$ = (1.35 mM)(20.0) = 26.9 mM (or mEq/l).

For the next two problems use my blood gas program to find the patient's base excess and proceed from there.

3. What is the acid-base status of a patient in the following state P_{O2} = 100 mm Hg, P_{CO2} = 28.0 mm Hg, pH = 7.319, Hct = 40.0%, [Hb] = 15.0 g/dl and T = 37.0ºC?

Use my blood gas program to determine the base excess is − 10.0 mEq/l.

Then determine this is acidosis (low pH), caused by a metabolic problem (i.e., the negative base excess) that has been compensated for (as indicated by the abnormally low P_{CO2}). Restating this in the normal order: Compensated metabolic acidosis.

4. What is the acid-base status of a patient in the following state P_{O2} = 100 mm Hg, P_{CO2} = 68.0 mm Hg, pH = 7.250, Hct = 40.0%, [Hb] = 15.0 g/dl and T = 37.0ºC?

Use my blood gas program to determine the base excess is − 0.0 mEq/l.

Then determine this is acidosis (low pH), caused by a respiratory problem (the abnormally high P_{CO2}) that has not been compensated for (as indicated by the normal base excess). Restating this in the normal order: Uncompensated respiratory acidosis.