1. **(1 pt) mathbioLibrary/setABiocLabs/Lab121_G2_breathing.pg**

Because of the accuracy of WebWork, you should use 5 or 6 significant figures on all problems.

If c_n represents the concentration of the inert gas argon (Ar) in the lungs, then a mathematical model for breathing is given by the discrete dynamical model:

$$c_{n+1} = (1-q)c_n + q\gamma,$$

where q is the fraction of the lung volume exchanged with each breath and $\gamma = 0.0093$ (fraction of Ar in dry air) is the concentration of Ar in the atmosphere. Normal breathing usually exchanges a volume of air, known as the tidal volume, V_i. The space remaining in the lung after exhaling from a normal breath is known as the functional residual volume, V_r. The fraction of air exchanged $q = V_i/(V_i + V_r)$.

a. Assume that a normal subject breathes an enriched mixture of air that contains 10 percent Ar, so that $c_0 = 0.1$ (fraction of Ar in dry air). Suppose that the tidal volume is measured at $V_i = 540$ ml for this subject, while another measurement gives the functional residual volume, $V_r = 2300$ ml. Determine the fraction of the lung volume q exchanged for this subject.

$q =$ _____

Find the concentration of Ar in the first, third, fifth, and tenth breaths

$c_1 =$ _____

$c_3 =$ _____

$c_5 =$ _____

$c_{10} =$ _____

What is the equilibrium concentration, c_e, of Ar in this subject?

$c_e =$ _____

Determine how many breaths are required until the concentration of Ar drops below 0.01.

Number of Breaths = _____

b. In your Lab Report, create a graph showing the concentration of Ar in the first 10 breaths.

c. A patient with emphysema is given the same mixture of Ar (so again $c_0 = 0.1$ (fraction of Ar in dry air). The tidal volume for this patient is measured at $V_i = 205$ ml. The concentration of Ar in the first breath in found to contain 0.0907 (fraction of Ar in dry air) for this patient or $c_1 = 0.0907$. Find the fraction of the lung volume exchanged q and the functional residual volume, V_r.

$q =$ _____

$V_r =$ _____

Find the concentration of Ar in the second, third, fifth, and tenth breaths for this subject

$c_2 =$ _____

$c_3 =$ _____

$c_5 =$ _____

$c_{10} =$ _____

What is the equilibrium concentration, c_e, of Ar in this subject?

$c_e =$ _____

Determine how many breaths are required until the concentration of Ar drops below 0.01.

Number of Breaths = _____

d. In your Lab Report, create a graph showing the concentration of Ar in the first 10 breaths of this subject with emphysema. Write a brief paragraph discussing the differences between the breathing of a normal subject and a patient with emphysema based on the results above.