Fall 2002 (Przybycien) **42-101 Intro to BME** **NAME: _____**

EXAM #1

Part I: Short Answer Questions (48 pts)

Short written answer/short calculation questions – I'll be looking for key words, diagrams and/or calculations that backup your answers in this section. *No more than two or three sentences in answer to each question please.*

1. (6 pts) A correlation for male body density, ρ, in g/cm3 is given by the equation:

$$\rho = 0.0277W^{-0.3}H^{0.725} + 0.75$$

   where W is mass in kg and H is height in cm. What must the units of the constants 0.0277 and 0.75 be?

2. (6 pts) What is meant by the "oil drop model" of globular proteins?

3. (6 pts) Why are phospholipids well-suited for forming cell membranes?

4. (6 pts) What is "The Central Dogma"?

5. (6 pts) Suppose you ate a synthetic gelatin made up of poly(D-glycine), i.e. a polymer made up of monomers of D-glycine connected by peptide bonds. What would happen and why?

6. (6 pts) I.V. Leeg, a non-CMU biomedical engineer, performs a growth rate study with a bacterial species and a series of increasing substrate concentrations and obtains the following data:

S (g/L)	μ (hr^{-1})
57	1.37
103	1.38
199	1.35
411	1.38

   Iggy is confused by his data. Can you explain this behavior? If the Monod growth model were to be used to describe the growth of this bacterium, could you say anything about the magnitude of the Monod constant K_s?

7. (6 pts) A microorganism growing aerobically on glucose exhibits the growth stoichiometry below:

$$C_6H_{12}O_6 + 1.473O_2 + 0.782NH_3 \rightarrow 0.909C_{4.4}H_{7.3}N_{0.86}O_{1.2} + 3.854H_2O + 2CO_2$$

   What is the respiratory coefficient for this organism growing under these conditions?

8. (6 pts) Compare the function of a promoter with that of the Shine-Delgarno box.

Fall 2002 (Przybycien) **42-101 Intro to BME** **NAME: _____**
EXAM #1

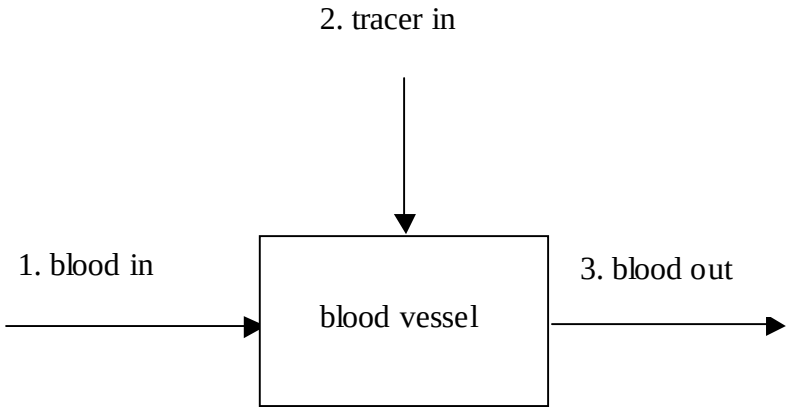
Part II: Detailed Questions (52 points)

1. (26 pts) Consider the microorganismic growth stoichiometry below:

$$C_6H_{12}O_6 + 1.473O_2 + 0.782NH_3 \rightarrow 0.909C_{4.4}H_{7.3}N_{0.86}O_{1.2} + 3.854H_2O + 2CO_2$$

Cells and glucose are added to a solution such that biomass is present at 1.48 g dry cells/L and glucose is present at 95 g/L. At this glucose concentration, the cells have a specific growth rate of 1.63 hr^{-1}. How long, in hours, will it take the cells to consume 5.0% of the glucose given the stoichiometry above?

2. (26 pts) A radioactive tracer experiment is performed in order to measure the flow rate of blood in a blood vessel (stream 3). The concentration of the tracer in the inlet and outlet blood streams is determined via autoradiography. A schematic of the experiment is given below.



Four different experiments were performed:

expt	tracer in flow rate (mL/min)	tracer in tracer conc (ppm)	blood in tracer conc (ppm)	blood out tracer conc (ppm)
1	1.73	4007	345	732
2	1.67	3999	472	847
3	1.69	4013	507	875
4	1.60	4002	523	900

For this set of experiments, determine the average blood flow rate, in mL/min, with 95% confidence limits for stream 3.

Student's t-Table

Degrees of		Confidence	
Freedom	90%	95%	99%
1	6.314	12.706	63.657
2	2.92	4.303	9.925
3	2.353	3.182	5.841
4	2.132	2.776	4.604
5	2.015	2.571	4.032
6	1.943	2.447	3.707
7	1.895	2.365	3.499
8	1.86	2.306	3.355
9	1.833	2.262	3.25
10	1.812	2.228	3.169
11	1.796	2.201	3.106
12	1.782	2.179	3.055
13	1.771	2.16	3.012
14	1.761	2.145	2.977
15	1.753	2.131	2.947
16	1.746	2.12	2.921
17	1.74	2.11	2.898
18	1.734	2.101	2.878
19	1.729	2.093	2.861
20	1.725	2.086	2.845
30	1.697	2.042	2.75
40	1.684	2.021	2.704