

## SAMPLE MATH PROBLEMS FOR CELL BIOLOGY

page 23

David B. Fankhauser, PhD

18 September 1995, 20 Sept. '96, 5 Sept '97, 19Sept04

The following are examples of the type of math calculations you will need to perform during the course. Be certain you can work them prior to the experiment to which they relate. Similar problems will be on quizzes and/or tests following the pertinent experiment.

- 1) The median for a given quiz is 37. If median for a sophomore course taught by Fankhauser is equivalent to an 85%, what score would be equivalent to 100%? If you got a 33, what would be your percent grade on that quiz?
- 2) 0.2 mL of milk was added to 4.8 mL water. What is the dilution factor? What is the concentration factor?
- 3) How would you prepare 100 mL of 100 mM  $\text{PO}_4$  buffer using a stock solution of 1 M  $\text{PO}_4$  buffer?
- 4) How would you make up 150 mL of a 5% boric acid solution (to be used on eyes in the event that NaOH solution were splashed into them)?
- 5) How many  $\mu\text{g}/\text{mL}$  of protein are there in a 1% solution of protein?
- 6) What percent protein is the stock solution of 1 mg/mL BSA solution?

These problems relate to the microbiuret determination of protein:

- 7) When standardizing microbiuret reagent, 1 mg/mL BSA was used: 0.1 mL gave an  $A_{325}$  of 0.149, 0.2 mL gave an  $A_{325}$  of 0.280. What is the conversion factor you would use to convert O.D. units to mg protein?
- 8) a: Saliva was diluted 1:10. 0.2 mL of this was assayed with microbiuret reagent with a conversion factor of 0.606 mg protein/OD unit. It yielded an  $A_{325}$  of 0.089. How many mg protein/mL saliva?  
b: Milk was diluted 1:5, 0.1 mL of the dilution was assayed in microbiuret reagent which had a conversion factor of 0.561 mg protein/OD unit:  $A_{325} = 0.121$ . What % protein is the milk?
- 9) A lactase tablet was crushed and dissolved in 100 mL buffer.
  - a) The solution was diluted 0.2 mL into 0.8 mL buffer. What is the dilution factor?
  - b) 100  $\lambda$  of the dilution was assayed by microbiuret (conv. fact = 0.699), yielding an  $A_{325}$  of 0.186. How many mg protein in the tablet?

Answers:

1: 100% = 43.5, 33 = 75.8, 2: D.F. = 25x, conc. factor = 0.04, 3: 90 mL of water + 10 mL buffer.  
4: 7.5 g boric acid, dissolve and q.s. to 150 mL, 5: 10  
8a: 2.70 mg/mL, 8b: 3.39 mg/mL, 9a: 5x, 9b: 650 mg/tablet

1.1%, 7: 0.699 mg protein/OD unit.

What is the protein content per 100 mL in egg? Show your work.

1)

You dissolved a lactase tablet in 100 mL, dilute it 1 to 10, and used 10  $\mu$ L in a lactase assay. By how much would you multiply this aliquot's activity to equal the total in the tablet?

1. The microbiuret standardization was performed as in class, read against water, and the following data collected:

tube	mg/mL prot.std	mL water	mL MB	$A_{310}$
1	0.0	2.0	1.0	0.110
2	0.2	1.8	1.0	0.170
3	0.4	1.6	1.0	0.227
4	0.6	1.4	1.0	0.274
5	1.0	1.0	1.0	0.402
6	1.4	0.66	1.0	0.522
7	2.0	0.0	1.0	0.700

The identical protocol was used to determine the protein content in saliva. 1.3 mL was collected, and a 1:10 dilution prepared. The microbiuret assay was used as indicated in the following table:

tube	mL $10^{-1}$ saliva	mL water	mL MB	$A_{310}$
1	0.1	1.9	1.0	0.150
2	0.1	1.9	1.0	0.165
3	1.0	1.0	1.0	0.551
4	1.0	1.0	1.0	0.523

Graph the standardization curve on the graph paper.

Determine the conversion factor:

conversion factor: \_\_\_\_\_

Calculate the mg/mL protein in saliva in the original:  
(Show work)

% protein in saliva : \_\_\_\_\_

2. A study was performed to determine the nature of an inhibitor of lactase, using ONPG as the substrate. The product is measured at 450 nm. The following data were collected:

g/tube	inhibitor			lactase tube mg/tube	ONPG units $A_{450}$	"X" m
1	0.2	0.05	0.0	0.042		
2	0.2	0.10	0.0	0.074		
3	0.2	0.15	0.0	0.098		
4	0.2	0.30	0.0	0.143		
5	0.2	0.05	0.1	0.029		
6	0.2	0.10	0.1	0.051		
7	0.2	0.15	0.1	0.067		
8	0.2	0.30	0.1	0.098		

Do the initial calculations (show and explain your work) on this sheet, then construct a Lineweaver-Burk plot on the graph paper provided.

What kind of inhibitor is X? \_\_\_\_\_

What is the  $V_{max}$  for the enzyme? \_\_\_\_\_

1. Conversion factor is 0.669 mg/O.D. unit