Lecture 9)

1) 2.8% of protein move from the ER to the Golgi per minute. Therefore, in the 1st minute, 2.8% moves to the Golgi. In the second minute, ~2.8% moves to the Golgi again, but as it does, the original 2.8% moves from the Golgi to the plasma membrane. This continues until 10% gets to the plasma membrane.

Time	% in ER	% in Golgi	% in PM
0	100%	0%	0%
1 min	97.2%	2.8%	0%
2 min	~94.4%	~2.8%	2.8%
3 min	~91.6%	~2.8	~5.6%
4 min	~88.8%	~2.8%	~8.4%
5 min	~86%	~2.8%	~11.2%

If you divide the 10% at the plasma membrane by 2.8 %, you get a more exact figure of 3.6 minutes, plus the first minute, when protein is only moving from the ER to the Golgi (since there is no protein in the Golgi), is 4.6 minutes.

* Dr Sheetz and I disagree on this answer, as I believe that the protein stays in the Golgi for a longer time, as opposed to being shipped directly to the membrane. Hopefully there will be more to follow on this topic.*

2) There are 2 ways to solve this problem.

Method A) using the equation Dr. Sheetz gave in class.

X2/X1=e^-Kt, where K is the exit constant, and t is the time in minutes.

Therefore, 96/100=.96, and t is one minute. Taking the ln of both sides gives you:

ln.96=-K*1min, giving you a K of .0408. Take this value of K and plug it back into the equation, this time solving for 20% remaing (80% has been endocytosed).

Ln .20=-.0408*time, gives you 39.45 minutes.

Method B) If you did not know how to use the equation above, you could do this problem reiteratively using your calculator. 100 * 96% (how much remains)=96.

96 * 96%=92.12

92.12*96%=88.47 and so on. If you counted the number of times that you performed this operation to get down to 20.0 you should get either 39 or 40 minutes as your answer.

Lecture 10)

Answers to this problem will probably vary since you actually have to count the number of the dots in the pictures. Your number will probably vary due to things such as the quality of your printout, how sharp your eyes are, how you determine exactly what is peri-nuclear, how lazy you are, etc. What is important is that you take the %'s that you get and you carry those #s through the rest of the problem.

p.s. Several people have complained how this is fairly subjective and even ridiculous to have to count the dots in order to get our data, but this is how it actually is in the real world for us research scientists. ~Tim~

1)a) In normal cells, I counted ~36 perinuclear dots, and 14 dots that were elsewhere, giving me 36/50 total = 72%
b) In the dynein inhibited cells, I counted ~13 perinuclear, and 55 non perinuclear, giving me 13/68 total or about 20%
c) I counted ~3/5 green dots also being red dots (the yellow in these picts means that the red and green are overlapping, and that both are there).
d) 4/11 by my count, or 36% have DNA in them
e) using the answers from above.
If 20% of (d) can infect a cell, how many virons are needed to infect a cell?
(d) is 36% of (a)
(a) is 72% the total # of virons needed.

*we know that 1 copy of the viron getting into the nucleus and infecting the genome is all that is necessary for a cell to be permanently infected with the HIV. Therefore, we can back calculate for the total number of virons needed to infect one cell.

$X * 72\% * 36\% * 20\% = 1$ this gives us 19.2 virons, but since we don't have .2 virons, we assume we need 20 virons to infect a normal cell.
Repeat this calculation for the Dynein inhibited cells

$X * 20\% * 36\% * 20\% = 1$, which will give us ~virons necessary to infect a dynein inhibited cell.

2) Macrophages clear 10% out of blood
~5% of virons in bloodstream bind to target cells.
The mathematical logic is similar to question 1 above.
Y = # of virons in the blood stream necessary to infect a cell, X from above is the # of virons needed a cell.

$Y * 90\% * 5\% = X$.

When we plug in the Xs from above, we get 444 virons to infect a normal cell, and 1,556 virons for the dynein inhibited cells.

Lecture 13)
Kd is a multiplicative term in this example. The quick and dirty way to solve this is:
Kd1 * kd2 = kd for both together. Therefore, you can get .1mM * XmM=.03mM, and X would be = .3

Slightly more elegantly, you can convert these two kds to energy terms, where they are KT ln kd. Since the entropy terms stay the same, we can rearrange this so that we get:

KT ln .1 + KT ln ? = KT ln .03 $\rightarrow$ KT is a constant that cancels out, leaving us with
ln.1 + ln ? =ln .03, take each side e^, and we get .1 * ? = .03, where ?=.3