Fall '11 **CH370** Name KEY
Hackert **HW- 2 (20 pts)** UTeID _____

1. You have visited your doctor about a "lump" on your back. She runs a genomics marker test using a DNA microarray to compare "normal" cells vs. "lump" cells. After 24 hours exposure, mRNA is harvested, cDNA prepared using red-dye markers for the "normal" cell sample and green-dye markers for "your lump" cells. Any gene product that shows **no difference** in expression between the two cell lines would be indicated by a yellow colored spot.

(1)

2. Balance the following radioactive decay equation by filling in the blank with the missing item.

(1) a) $^{201}_{74}W \rightarrow {}^{201}_{73}Ta + {}^{0}_{+1}\beta^{+}$

(1) b) A radioisotope has a **rate constant** of **0.037 / yr**. Calculate the **half-life** of the radioisotope.

Half-life = 18.7 yr

$$\tau_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{0.037/yr} = 18.7\,yr$$

(1) c) How many **years** will it take for a sample of this radioisotope rated at 20 microCuries to undergo radioactive decay to the point where it loses 98% of its current activity ? 106 **years.**

$$A = A_0 e^{-kt};\ 0.4 = 20\,e^{-kt} \Rightarrow \ln\frac{20}{.4} = kt \text{ or } t = \frac{\ln 50}{k} = 106\,yr$$

3. SDS gels are greatly improved in resolution by running a "stacking" gel and a "resolving" or "running" gel.
a) **Name two key property differences** between the "stacking" gel and the "resolving" gel that contribute to the improved resolution of running DISC PAGE.

(1) a) pH - lower pH in stacking gel (Gly ~ 0 charge)

b) % gel - lower % acrylamide in stacking gel

What is the role of each of the following in performing SDS-PAGE?

(1) a) pH - vary pH so glycine in buffer goes from ~0 charge to ⊖ charge in running gel.

b) Coomassie Blue: - general stain for proteins

4. The equation of motion for a small, spherical particle of mass (m) and frictional coefficient (f) that is initially at rest, and then acted on by a constant force (F) at time t = 0 is F –fv = ma.
(From calculus recall that F - fv = m(dv/dt) solves to v = (F/f) [1 - exp(-ft/m)].)
a) Show that such a particle will initially accelerate but over time will approach a "maximal" velocity.

(1) $v = \frac{F}{f}(1 - e^{-f\cdot t/m})$; as $t \rightarrow \infty$, $e^{-f\cdot t/m} \rightarrow 0 \Rightarrow v_\infty = \frac{F}{f}$

(2) b) The diffusion constant for a protein is determined to be 0.258 x 10^{-6} cm^2/s at with T = 20° C, and η = 0.01 (g/cm-s). It has a diameter of 80Å, a density of 1.3 g/cm^3 and a v-bar of 0.73 cm^3/g protein. Calculate the frictional coefficient ratio (f/f_{min}) for this protein and comment on the expected shape of the molecule (spherical or not).

$$f_0 = 6\pi\eta_\cdot R_0 = 6(3.1416)\frac{0.01\ g}{cm\cdot s}\cdot(40\cdot10^{-8}\,cm) = 7.5\cdot10^{-8}\ g/s$$

$$f_{exp} = \frac{R\cdot T}{N_A\cdot D} = \frac{(8.314\cdot10^7\ \frac{g\cdot cm^2}{mol\cdot s\cdot K})(293K)}{6.02\cdot10^{23}/mol\,(0.258\cdot10^{-6}\ cm^2/s)} = 1.57\cdot10^{-7}\ g/s;\quad \frac{f}{f_0} = \frac{15.7\cdot10^{-8}}{7.5\cdot10^{-8}} = 2.1$$

Not so spherical

5. What is typically measured by dynamic light scattering (LS)? D → f → R_h

(2) What wavelengths are normally employed in making circular dichroism (CD) spectra?

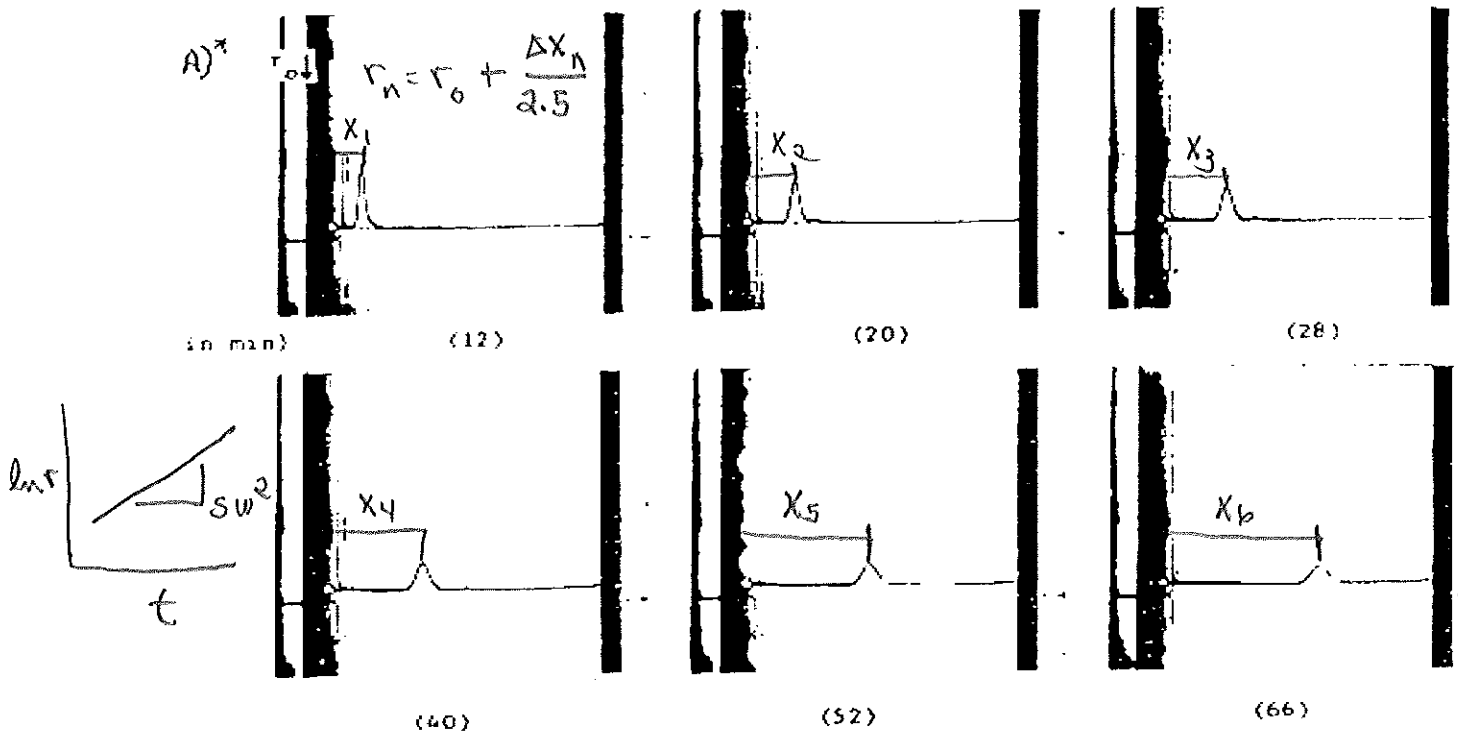
180 - 240 nm

6. Determine the sedimentation coefficient (s) and molecular weight (M) for the sample that gave the following data when subjected to: A) a sedimentation velocity run using Schlieren optics, and B) a sedimentation equilibrium run using interference optics.

Note: the figures below have been magnified to allow you to make measurements from the figures. The "r" can be determined from the reference points (r_o) and the magnification factors. Assume T = 20° C, density of buffer = 0.9978 g/mL, and v-bar = 0.737 cm^3/g for the protein, and η = 0.01 (g/cm-s) for both experiments.

A) Sed. Vel. : ω = 40,000 rpm, magnification factor (2.5X), r_o = 5.72 cm. (times are given in minutes).

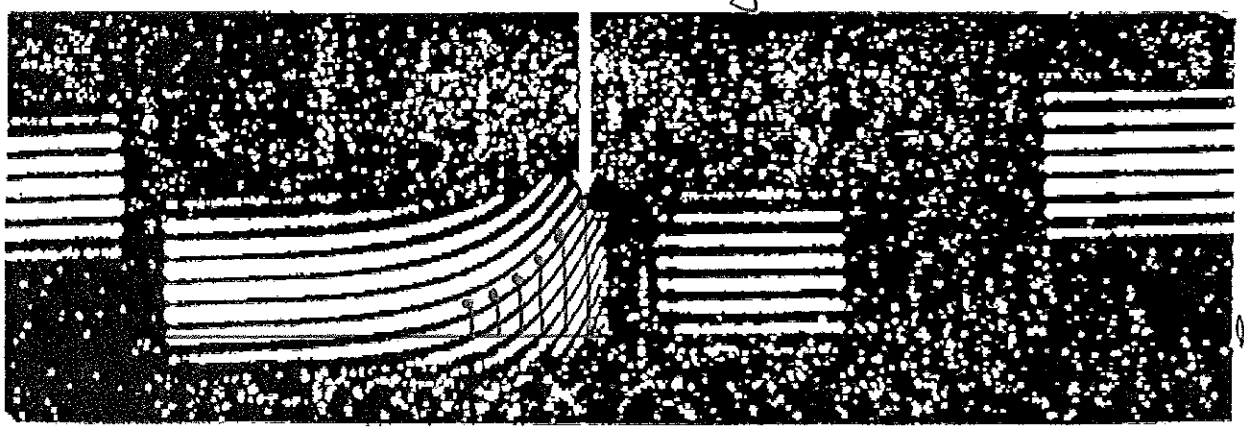
(4) Report "s" in proper units [s = $19 \cdot 10^{-13}$ sec = 19 S] (Show work and attach plot).



B) Sed Equilibrium: ω = 5200 rpm, magnification factor (25X), r_o = 6.75 cm. Calculate M in g/mol (4pts) and

(5) also estimate the concentration of the protein at the position with the white arrow (1 pt). Assume the cell path length to be 12.00 mm, λ = 546 nm, and (dn/dc = 0.186 $(g/cm^3)^{-1}$.

[M = ~ $1.0 \cdot 10^6$ g/mol ; [ ] arrow = ~ 1.4 mg/mL] (Show work and attach plot).



I hereby declare that I did this assignment independently:

$$\text{slope} = \frac{M(1-\bar{v}\rho)\omega^2}{RT(K)} \leftarrow \frac{1}{sec^2}$$

$$\frac{1}{cm^2}$$

$8.314 \cdot 10^7 \frac{g \cdot cm^2}{s^2 \cdot mol \cdot K}$