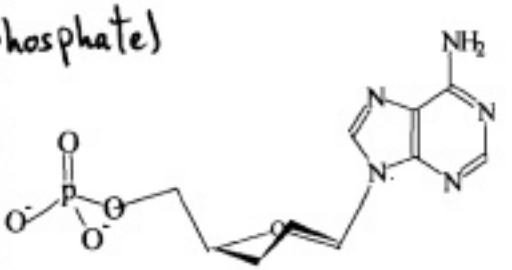
**Spring '07** **CH370 / 387D** Name KEY
**Hackert** **HW- 2 (40 pts)** UTeID _____

1. Consider the following nucleotide:
(3)

a) Name the nucleotide AMP (Adenosine mono phosphate)

b) What is the conformation of the nucleoside?
anti

c) What is the sugar pucker illustrated?
C2'endo / C3'exo



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

(2 + 3) a) $^{14}C \rightarrow {}^{14}_{7}N + \beta^-$

b) I-131 has a half-life of 8.02 days. If a patient is injected with 2 milliCuries on Tuesday at class time, how much radioactivity is left after 3 weeks?

$A = A_0 e^{-kt}$ ; $k = \frac{\ln 2}{t_{1/2}}$ ; $A = A_0 e^{-(0.0864/d)(21d)}$ = 0.326 milliCuries

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

(2)
i) pH → Forces proteins to carry current; large V. gradient
ii) % gel → lower % in stacking gel

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

(2)
i) N,N'-methylene-bis-acrylamide: Cross linker
ii) Dithiothreitol: Reduce disulfides

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.

(3)
$v = \frac{F}{f}(1 - e^{-ft/m}) \longrightarrow v = F/f$ as $t \rightarrow \infty$

b) Now consider protein particle that is assumed to be spherical with a diameter of 80Å, a density of 1.3 g/cm$^3$ and a v-bar of 0.73 cm$^3$/g.
i) Calculate the time in seconds for such a particle to reach 98% of its maximal velocity after being subjected to the force F.

(3)
$\left.\begin{array}{l} v/v_{max} = 0.98 \doteq (1 - e^{-ft/m}) \\ \text{mass} = 3.49 \times 10^{-19}\,g \\ f_{min} = 7.5 \times 10^{-8}\,g/s \end{array}\right\} \Rightarrow t = 1.8 \times 10^{-11}\,sec$

ii) If the diffusion constant for this protein is determined to be 0.258 x 10$^{-6}$ cm$^2$/s with T = 20° C, and η = 0.01 (g/cm-s), calculate the frictional coefficient ratio ($f/f_{min}$) for this protein and comment on whether our assumption that this is a spherical protein molecule was correct or not.

(3)
$f = \frac{kT}{D} = 1.57 \times 10^{-7}\,g/sec$

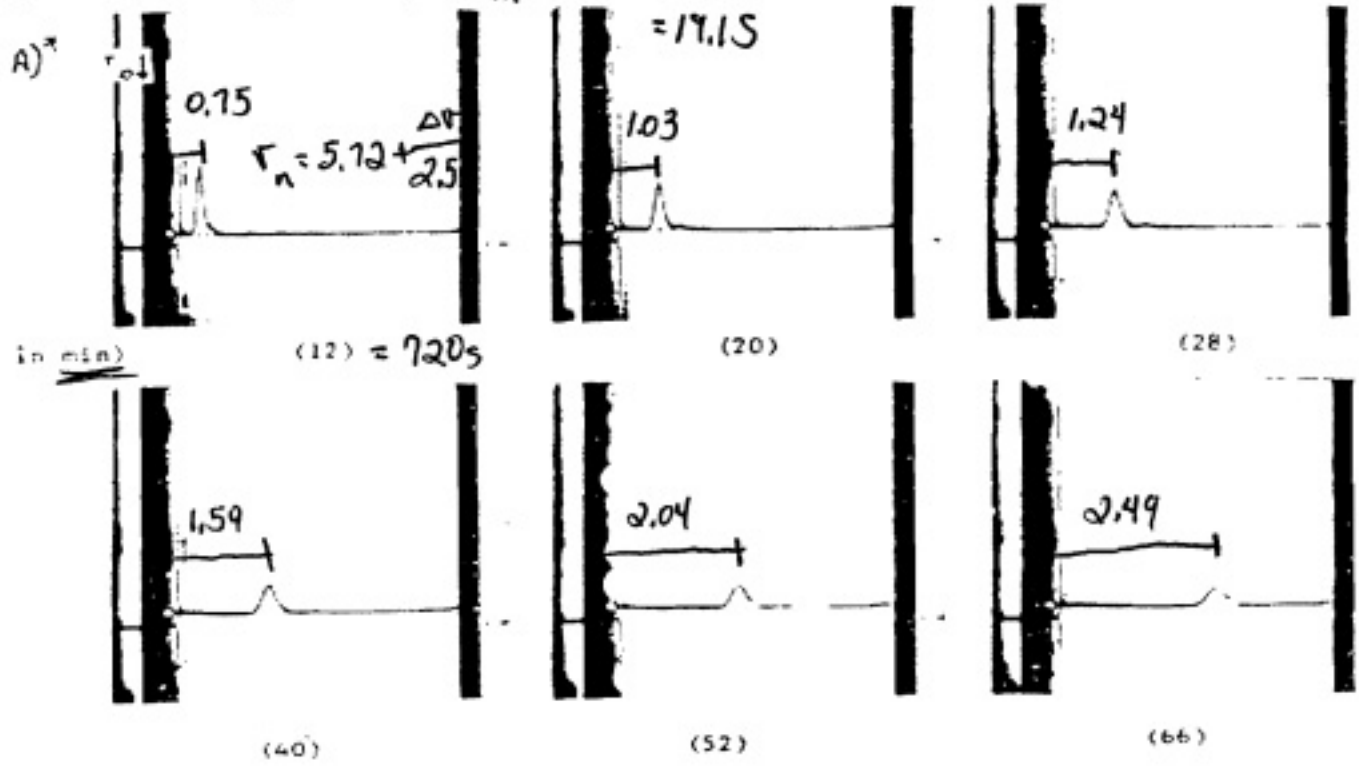
"Frictional Coeff. Ratio" = $f/f_{min} = 2.09$

Since ratio is larger than 1.0-1.3, not very spherical → not correct assumption

5. 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 $\eta$ = 0.01 (g/cm-s) for both experiments.

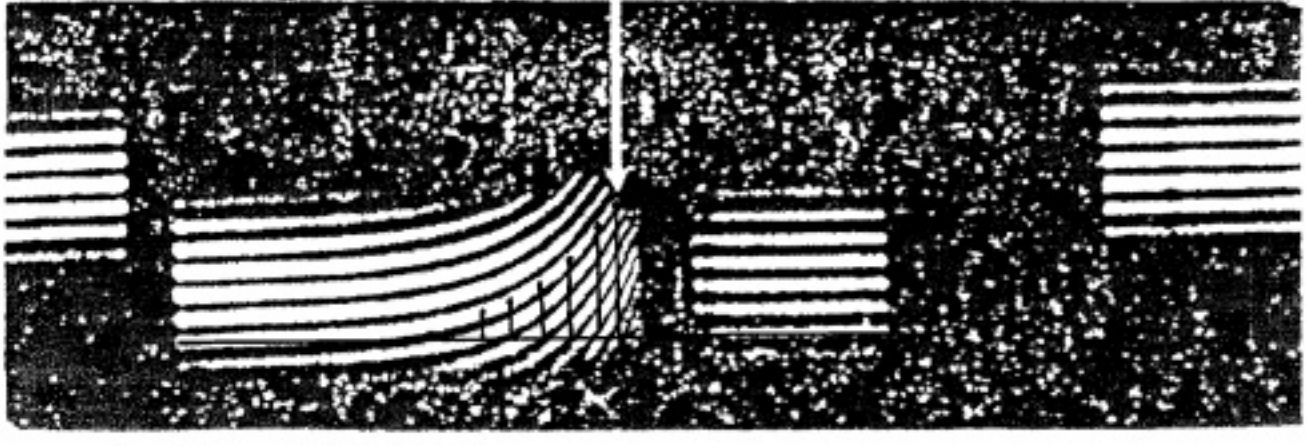
A) Sed. Vel. : $\omega$ = 40,000 rpm, magnification factor (2.5X), $r_o$ = 5.72 cm. (times are given in minutes).

(8) Report "s" in proper units [ s = 19.1 x $10^{-13}$ sec ] (Show work and attach plot).




B) Sed Equilibrium: $\omega$ = 5200 rpm, magnification factor (25X), $r_o$ = 6.75 cm. Calculate M in g/mol (8pts) and also estimate the concentration of the protein at the position with the white arrow (2 pts). Assume the cell path length to be 12.00 mm, $\lambda$ = 546 nm, and (dn/dc = 0.186 $(g/cm^3)^{-1}$.

[ M = 1.01 x $10^6$ g/mol ; [ ]$_{arrow}$ = 1.44 mg/$cm^3$ ] (Show work and attach plot).



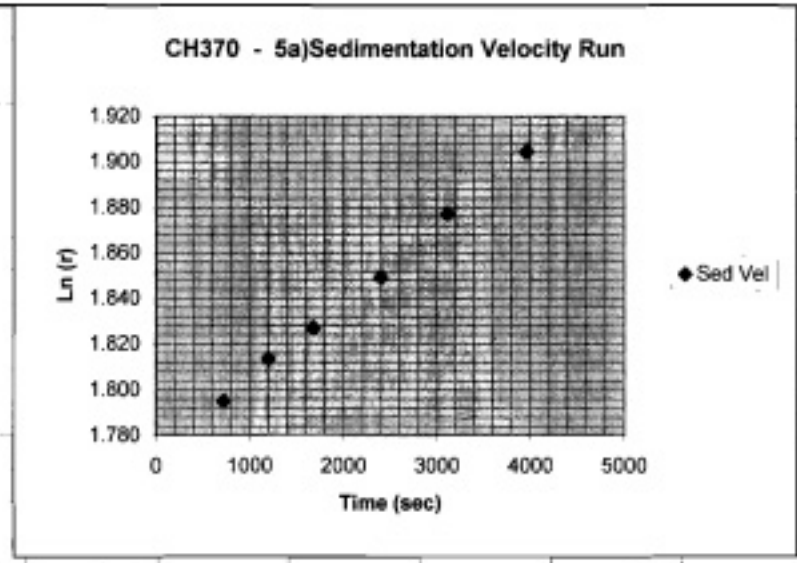

$$C \approx \Delta C = \frac{\Delta J \cdot \lambda}{a \cdot K} = 1.44\ mg/cm^3 \text{ at arrow}$$

$$r_n = 6.75 + \frac{\Delta r_n}{25.0}$$

**5a) Sedimentation Velcoity Run**

| R meas | Radius | ln R | time (min) | time (sec) |
|---|---|---|---|---|
| 0.75 | 6.020 | 1.795 | 12 | 720 |
| 1.03 | 6.132 | 1.814 | 20 | 1200 |
| 1.24 | 6.216 | 1.827 | 28 | 1680 |
| 1.59 | 6.356 | 1.849 | 40 | 2400 |
| 2.04 | 6.536 | 1.877 | 52 | 3120 |
| 2.49 | 6.716 | 1.904 | 66 | 3960 |

T = 293K omega = 40,000 rpm = 4189 / sec
slope = "s"omega**2 = 3.35 x 10(-5) /sec
**sed coeff = 1.91 x 10(-12) sec = 19.1S**




**5b) Sedimentation Equilibrium Run**

| R meas | Radius | R**2 | Displacement | Fringe shift | Conc. | Ln [ ] |
|---|---|---|---|---|---|---|
| 4.00 | 6.910 | 47.75 | 0.32 | 1.05 | 0.26 | -1.36 |
| 4.40 | 6.926 | 47.97 | 0.49 | 1.60 | 0.39 | -0.94 |
| 4.80 | 6.942 | 48.19 | 0.78 | 2.55 | 0.62 | -0.47 |
| 5.20 | 6.958 | 48.41 | 1.08 | 3.53 | 0.86 | -0.15 |
| 5.60 | 6.974 | 48.64 | 1.52 | 4.97 | 1.22 | 0.19 |
| 5.80 | 6.982 | 48.75 | 1.80 | 5.88 | **1.44** | 0.36 |

1.53 cm / 5 "fringes"
= 0.306 cm / fringe

T = 293K omega = 5200 rpm = 545 / sec
slope = Mw***2(1 - vbar rho)/2RT = 1.62 / cm**2
**M = 1.01 x 10(+6)**