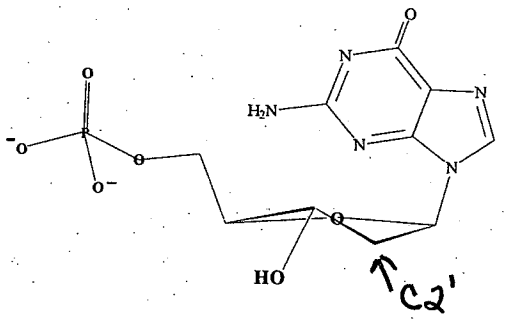
Fall '09 **CH370** Name KEY
Hackert **HW- 2 (20 pts)** UTeID

1. Consider the following nucleotide:
(1)



a) Name the nucleotide dGMP

b) What is the conformation of the nucleoside?
syn

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

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

(1 + 2) a) $^{14}_{6}C \rightarrow \underline{^{14}_{5}B} + {}^{0}_{+1}\beta+$

b) I-131 has a half-life of 8.02 days. If a patient is injected with 4.5 milliCuries on a Monday morning, how many days will it take for the activity to decrease to less than 0.1 milliCuries?

$A = A_0 e^{-kt}$; $k = \frac{\ln 2}{t_{1/2}} = 0.0864 d^{-1}$; $0.1 = 4.5\, e^{-0.0864/d \cdot t}$ $t = 44$ days

$\ln(.1/4.5) = -.0864 \cdot t$

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)
i) % acrylamide: lower % in stacking gel, higher % in running g
ii) buffer pH: pH ~ 6.9 in stacking gel (Gly ~ 0) vs. 8.9 in running g

b) What is the role of each of the following in performing SDS-PAGE?
(1)
i) Dithiothreitol: - reducing agent used to reduce disulfide bonds
ii) N,N'-methylene-bis-acrylamide: - cross-linker for linking linear polyacryla chains

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

b) Now consider protein molecule that is assumed to be spherical with a diameter of 90Å, a density of 1.35 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.
(2)
mass = vol. x $\rho = \frac{4}{3}\pi r^3 \cdot \rho = 5.1 \cdot 10^{-19}$ g
$f = 6\pi\eta \cdot R = 8.48 \cdot 10^{-8}$ g/s
$\frac{v}{V_{max}} = .98 = (1 - e^{-f \cdot t/m})$ $\rightarrow e^{-f \cdot t/m} =$ $t = 2.3 \cdot 10^{-}$

ii) If the diffusion constant for this protein is determined to be 0.185 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.
(2)
$f_{exp} = \frac{k \cdot T}{D} = \frac{R \cdot T}{N^o \cdot D} = \frac{8.314 \cdot 10^7 \frac{g \cdot cm^2}{mol \cdot sec^2 \cdot K}\,(293K)}{(6.02 \cdot 10^{23}/mol)(0.185 \cdot 10^{-6} \frac{cm^2}{sec})}$

$f_{exp} = 2.19 \cdot 10^{-7}$ g/sec

$\frac{f_{exp}}{f_{min}} = \frac{21.9 \cdot 10^{-8}\ g/s}{8.48 \cdot 10^{-8}\ g/}$

$= 2.58$

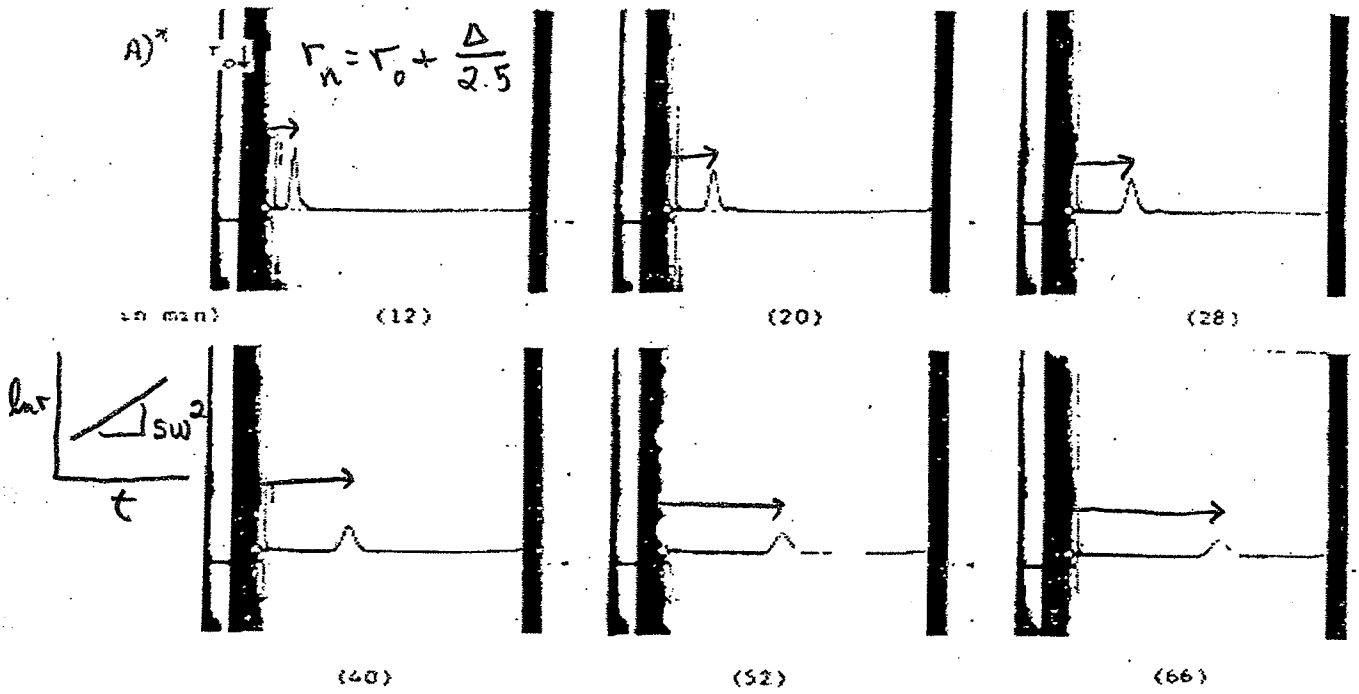
→ not spherical

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 η = 0.01 (g/cm-s) for both experiments.

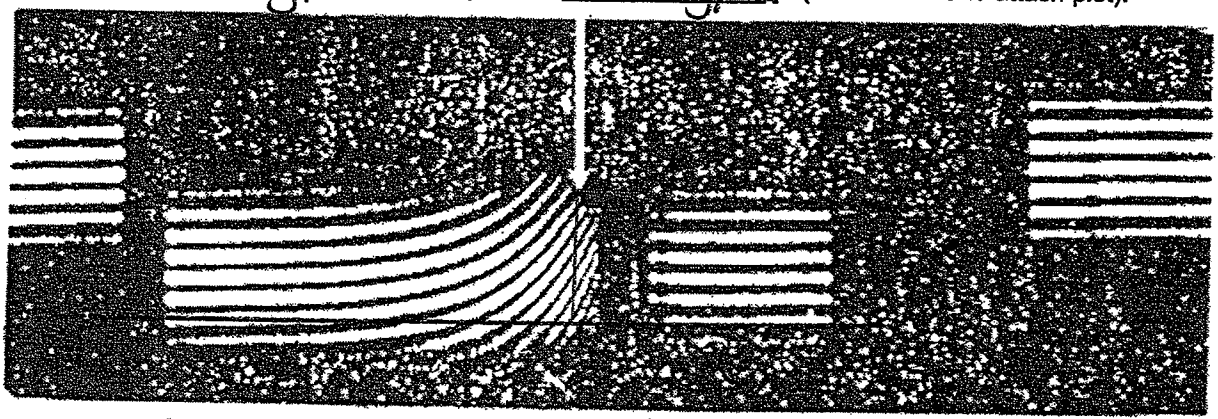
A) Sed. Vel. : ω = 40,000 rpm, magnification factor (2.5X), r_o = 5.72 cm. (times are given in minutes).

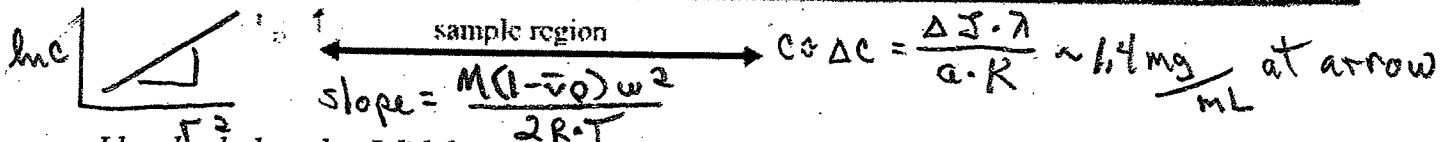
(4) Report "s" in proper units [s = $19 \cdot 10^{-13}$ s or 19 S] (Show work and attach plot).



B) Sed Equilibrium: ω = 5200 rpm, magnification factor (25X), r_o = 6.75 cm. Calculate M in g/mol (4pts) and also estimate the concentration of the protein at the position with the white arrow (1 pts). 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: _____