

**BCMB/CHEM 8190 ANSWERS  
PROBLEM SET 9**

- 1) Dissociation constant =  $2 \times 10^{-4} \times 5 \times 10^{-6} = 1 \times 10^{-9}$
- 2) The relative rate of build-up of NOEs will be  $300,000/2000$ . A 20% contribution from the free NOE would occur with a free to bound ratio of  $X/(X-1)$  where  $X^2/((1-X)300) = 0.2$ . Assuming the ligand binding constant is relatively high, 20% would be bound at a 30:1 ligand to protein ratio.
- 3) Iron oxide nano particles exert their greatest effect on T2 – making it shorter. You would use a T2 enhanced sequence. T2 filters usually result in loss of signal from regions having the shortest T2 – these regions would appear dark.
- 4)  $1/T1(\text{Mn}) - 1/T1(\text{Mg})$  is proportional to  $1/r^{**6}$  where r is the metal site to proton distance. Using two distances to eliminate the proportionality constant,  $r(\text{A8})^{**6}/R(\text{a9})^{**6} = 1.5/0.167$ . This implies  $r(\text{A8})/r(\text{A9}) = 1.442$ . Since G7 and A9 are on a straight line and see equal effects, the A8-metal vector is perpendicular to the A8-A9 vector. Relating the lengths of the sides of this right triangle we get a metal to A8 distance of 4.81 and a metal to A9 distance of 6.94.
- 5) a)  $dV = 1/(\pi T2^*) + 1/(\pi\tau) = 0.5 + 1/(\pi\tau) = 1.0; \tau = 0.64\text{s}$
- b)  $dV = 1/(\pi T2^*) + (\tau/(8\pi))(w_a-w_b)^{**2} = 0.5 + (\tau/(8\pi))(2\pi*100)^{**2} = 5.0;$
- $\tau = 2.9 \times 10^{**(-4)}\text{s}$