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1. Show and explain your calculations for the following 3 short problems.

a)Compare the dissociation of NaCl in formamide with its dissociation in methanol. Formamide has a dielectric constant of 110 and a dipole moment of 3.4. Methanol has a dielectric constant of 33 and a dipole moment of 1.7.

b) Calculate the approximate osmotic pressure (in Atm) obtained at room temperature for a 10 g/L solution of a 100 amino acid long protein. R = 0.082 L Atm deg^{-1} M^{-1}

c) Compare the straight line distance between carbons 1 and 3 in a flat 5 member ring with their distance in a flat 6 member ring. Express your results in nm. Use your drawing to explain why a hydrogen atom would not fit inside the 6 member ring.

3 a) 1.5-> $F_f = (kq_1q_2)/(D_f r^2))$ $F_m = (kq_1q_2)/(D_m r^2))$ $F_f / F_m = 33 /110 = 1/3$

1.5-> negative repulsion (q_1q_2) = attraction -> attraction is 3 x better in methanol

thus dissociation, the opposite, will be 3 x better in formamide than in methanol

give 1 if they at least give the formula.

If they understand and just do the ratio without full formula-give full marks

3 b) $\pi = cRT$ 1-> MW= 100 aa x about 100/aa (estimate done in class)= 10,000

accept any reasonable estimating procedure but give only 0.5 if no explanation

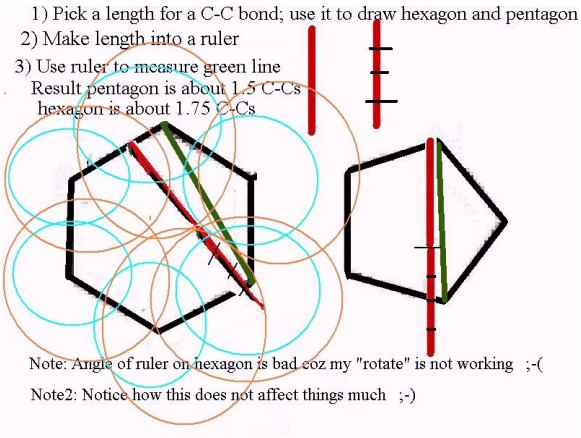
1-> 10 g/L= 10,000 mg/L /10,000mg/mMol = 1 mM

give 0.5 if 1000 fold unit error in above

1-> $\pi = 0.001 \times 0.08 \times (273 +20) = 0.001 \times 0.08 \times 300 = 0.024$ Atm

don't penalize for earlier error. give 0.5 if can't do temperature

4



1 for 1) there should be something saying drawings are to scale (-0.3 if not)

1 for 2) this could be combined with 3) -give full marks if done

1 for 3) 1.75-1.5= 0.25 thus about 1/6 further in hex (17%). Give full marks if they do this.

If they do not compare and just give distances 1.75x0.15=0.26nm 1.5x0.15=0.22 nm give only 0.7

1 for hydrogen (I showed them this in CHIME): they must draw something like the lite blue circles or the orange circles

give 0.5 for a by heart explanation ("CHIME shows that there is no room") that does not use drawing

give an **EXTRA 2 MARK** for those who have learned from this that Van der Waals radius is greater than ½ of a C-C bond!
give an **EXTRA 1 MARK** for those who comment that using the half C-C length as a radius does leave a hole in the middle when CHIME shows that there is none (and don't penalize them for whatever they say about hydrogen) or that lack of hole in pyranose is due chair conformation

Montrez et expliquez vos calculs pour les 3 problèmes suivants.
a) Comparez la dissociation du NaCl en formamide à sa dissociation en méthanol. Le formamide a une constante diélectrique de 110 et un moment dipolaire de 3.4. Le méthanol a une constante diélectrique de 33 et un moment dipolaire de 1.7.
b) Calculez la pression osmotique approximative (en Atm) obtenue à la température ambiante pour une solution de 10 g/L d'une protéine qui a 100 acides aminés. R = 0.082 L Atm deg^{-1} M^{-1}
c) Comparez la distance (en ligne droite) entre les carbones 1 et 3 dans un anneau plat de 5 carbones avec la distance entre les carbones 1 et 3 dans un anneau plat de 6 carbones. Exprimez vos résultats en nanomètres. Employez votre schéma pour expliquer pourquoi un anneau plat de 6 carbones ne pourra pas contenir un atome d'hydrogène au milieu de l'anneau.
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3. A normal size individual has 3 mg of glucose in 10 ml of his blood. Calculate the mM concentration and comment on it. Will the ratio of the anomers in this individual be 1? Why not? Why? How does it compare to the ratio in your blood? Why?
Assume that he has a normal osmotic pressure. What percentage of it would be due to this sugar? Discuss how the osmotic pressure would change if instead of glucose, the sugar was fructose.
This individual needs 300 g of sugar a day to stay alive. How long will he survive using just the sugar in his blood?

0.5 MW = 6 C + 6 O + 12 H ≈ 200
1 3 mg/10ml = 0.3mg/ml = 300ug/ml /200= 1.5umol/ml= 1.5mM;
0.5 normal is 5 mM
0.5 this is 3 **x lower**
1 No because of steric hindrance there is a difference in the ratio seen at equilibrium
0.5 Will be same. K=a/b will not depend on concentration
1 normal OP= 300 mOsM
0.5 1mM glucose= 1 mOsM
1 1.5/300= 0.5%
0.5 no change 1mM fructose also= 1 mOsM
1 Needed 300g/200g/Mol= 1.5Mol= 1,500 mMol /25h/day = 60 mMol/h
1 Have: 5L of blood x 1.5 mM= 7.5 mMol
1 Will survive: 7.5 mMol/60 mMol/h ≈ 0.125 h about 6 min+
Accept a 20% variation
If initial mw is badly wrong, give 0 there and half marks for later calcs that need it, same for OP & 5L

Un individu de taille normale a 3 mg de glucose dans 10 ml de son sang. Calculez la concentration en mM et commentez là-dessus. Le rapport des anomères dans cet individu sera-t-il 1 ? Pourquoi pas ? Pourquoi ? Comment compare-t-il au rapport dans votre sang ? Pourquoi ?
Cette personne a une pression osmotique normale. Quel pourcentage de cette pression sera dû à ce sucre ? Discutez comment la pression osmotique changerait si au lieu du glucose, le sucre était fructose.
Cet individu a besoin de 300 g de sucre par jour pour rester vivant. Combien de temps survivra-t-il en utilisant juste le sucre dans son sang ?
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