MDCM 601 2025 Exam 1 Key
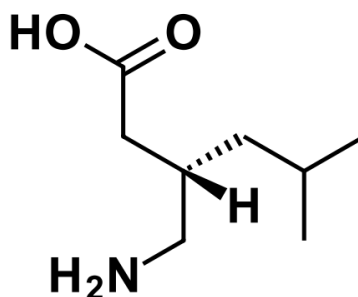
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Use the bond-line structure of pregabalin (Lyrica) to answer the following questions:

Problem 1. Determine the molecular weight of pregabalin from the bond-line structure.
Answer: 159 g mol^{-1}

Problem 2. Determine the stereodescriptor (R/S configuration) for the stereocenter in pregabalin.
Answer: $\boldsymbol{S}$

Problem 3. How many hydrogen-bond donors are there?
Answer: **2**

Problem 4. How many hydrogen-bond acceptors are there?
Answer: **3**

Problem 5. Two pK_a values for pregabalin are $pK_{a1} = 4.2$; $pK_{a2} = 10.6$. Predominantly, what is the overall charge of the molecule at:

1. pH $= 3$? Answer: $\boldsymbol{+1}$

2. pH $= 7$? Answer: **0**

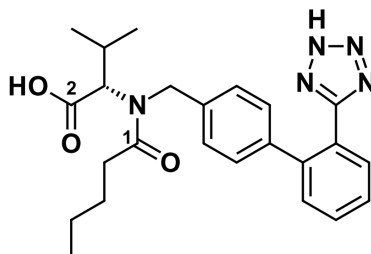3. pH $= 11$? Answer: **-1**

Problem 6. What is the orbital hybridization of 7 out of 8 carbons?
Answer: $\mathbf{sp^3}$

Problem 7. How many aromatic carbons are there?
Answer: **0**

Use the bond-line structure of valsartan (Diovan) to answer the following questions:

Problem 8. Determine the stereodescriptor (R/S configuration) for the stereocenter in valsartan.
Answer: **S**

Problem 9. How many aromatic carbons are there?
Answer: **13**

Problem 10. pK_a value of valsartan is 4.73. Calculate the percentage of neutral valsartan (i.e. charge $= 0$) at pH $= 5.33$.
Answer: **20%**

Problem 11. Prepare the acetate buffer that maintains the pH at 5.33 by mixing acetic acid and sodium acetate. pK_a for acetic acid is 4.75. What should be the ratio of concentrations of sodium acetate and acetic acid?
Answer: **3.8**

Problem 12. What is the functional group for the carbon labeled '1'?
Answer: **amide**

Problem 13. What is the functional group for the carbon labeled '2'?
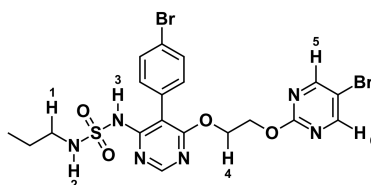Answer:
textbfcarboxylic acid

Problem 14. Determine pH at which 50% of valsartan will be deprotonated.
Answer: **4.73**

Problem 15. In saliva, pH $= 6.8$, would valsartan be predominantly neutral or charged?
Answer: **Charged**

Use the bond-line structure of macitentan (Opsumit) to answer the following questions:

Problem 16. Out of six numbered hydrogens, which one is the most acidic?
Answer: **3**

Problem 17. In one word what is the reason for its acidity?
Answer: **resonance**

Problem 18. pK_a of macitentan is 6.2. Calculate the Gibbs free energy(in $kJ\,mol^{-1}$ for this deprotonation (in the absence of any external bases) at T = 298 K (R = 8.314 $J\,mol^{-1}\,K^{-1}$. (Use 3 significant figures in your answer.)
Answer: **35.4** $kJ\,mol^{-1}$

Problem 19. pK_a of the conjugate acid of triethylamine is 10.75. Will triethylamine be able to deprotonate macitentan?
Answer: **Yes, weaker acid obtained.**

Problem 20. How many ether functional groups are there in the molecule?
Answer: **2**

Problem 21. What is the name of the aliphatic group on sulfamide nitrogen?
Answer: **n-propyl**