|  |
| --- |
| **Exhibit 3-1** MATCH a structure below to each of the following descriptions and place the letter corresponding to the structure in the blank. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. \_\_\_\_\_ is an amino aldehyde.   |  |  | | --- | --- | | *ANSWER:* | B | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2. \_\_\_\_\_ is an aromatic ketone.   |  |  | | --- | --- | | *ANSWER:* | E | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 3. \_\_\_\_\_ is a tertiary chloride.   |  |  | | --- | --- | | *ANSWER:* | C | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 4. \_\_\_\_\_ is a cyclic alkane with two cis methyl groups.   |  |  | | --- | --- | | *ANSWER:* | C | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 5. Circle and name each functional group in the following structure.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| **Exhibit 3-2** Label the indicated atoms in the structure below as 1°, 2°, 3°, or 4°. |

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| --- | --- | --- | --- | --- |
| 6. Refer to Exhibit 3-2. The atom at **A** is \_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | 4° | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7. Refer to Exhibit 3-2. The atom at **B** is \_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | 3° | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 8. Refer to Exhibit 3-2. The atom at **C** is \_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | 3° | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 9. Refer to Exhibit 3-2. The atom at **D** is \_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | 1° | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- | --- | --- |
| **Exhibit 3-3** Label the following pairs of compounds as:   |  |  | | --- | --- | | a. | identical | | b. | constitutional isomers | | c. | neither |   Place the letter of the correct answer in the blank. |

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| 10. \_\_\_\_\_   |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 11. \_\_\_\_\_   |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 12. \_\_\_\_\_   |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | |

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| **IUPAC Naming Instructions**: Provide proper IUPAC names. |

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| --- | --- | --- | --- | --- |
| 13. Name:  (CH3)2CHCH2CH2CH(CH2CH3)CH2C(CH3)3   |  |  | | --- | --- | | *ANSWER:* | 4-ethyl-2,2,7-trimethyloctane | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 14. Name:   |  |  | | --- | --- | | *ANSWER:* | 7-bromo-3-ethyl-2,2,5,5-tetramethyloctane or 2-bromo-6-*tert*-butyl-4,4-dimethyloctane | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15. Name:   |  |  | | --- | --- | | *ANSWER:* | 5-isopropyl-3-methyloctane | | *POINTS:* | 1 | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 16. Name:   |  |  | | --- | --- | | *ANSWER:* | 5-ethyl-3,4-dimethyloctane | | *POINTS:* | 1 | |

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| **Drawing Instructions**: Draw skeletal structures corresponding to each of the given names. |

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| 17. Draw: 6-ethyl-4-isopropyldecane   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 18. Draw: 2-fluoro-3-methylpentane   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 19. Draw: 4-(2,2-dibromoethyl)-3,5-dichloroheptane   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| --- |
| **Exhibit 3-4** Experiments have shown that for 1,2-dichloroethane, ClCH2CH2Cl, in carbon tetrachloride solution at 25 °C, 70% of the molecules are in the *anti* and 30% are in the *gauche* conformation. |

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| 20. Refer to Exhibit 3-4. Draw a Newman projection of the *anti* conformation of 1,2-dichloroethane.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 21. Refer to Exhibit 3-4. Draw a Newman projection of the *gauche* conformation of 1,2-dichloroethane. Explain why the majority of the molecules are not in the *gauche* conformation.   |  |  | | --- | --- | | *ANSWER:* | The *gauche* conformation is a higher energy state than the *anti* conformation due to the torsional strain caused by the close proximity of the two chlorine atoms. | | *POINTS:* | 1 | |

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| **Exhibit 3-5** Cipro® (Ciprofloxacin) is a synthetic broad spectrum antibacterial agent. It was most recently in the news as the antibiotic of choice for the treatment of anthrax. The structure of Cipro® is shown below. |

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| --- | --- | --- | --- | --- |
| 22. Refer to Exhibit 3-5. ***Circle*** the functional groups in the Cipro® representation above.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| **Exhibit 3-6** Predict the hybridization of the indicated atoms in Cipro®. |

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| 23. Refer to Exhibit 3-6. The hybridization of this nitrogen atom (**A**) is \_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | *sp*3 | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 24. Refer to Exhibit 3-6. The hybridization of this carbon atom (**B**) is \_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | *sp*2 | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 25. Refer to Exhibit 3-6. The hybridization of this carbon atom (**C**) is \_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | *sp*3 | | *POINTS:* | 1 | |

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| 26. Put a ***box*** around the **most polar** bond in Cipro® based on electronegativity values.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| 27. Name the following hydrocarbon.   |  |  | | --- | --- | | *ANSWER:* | 2,3-dimethylbutane | | *POINTS:* | 1 | |

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| Sight along the C2-C3 bond of 2-methylbutane. |

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| 28. How many eclipsed conformations can be drawn?   |  |  | | --- | --- | | *ANSWER:* | 3 | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 29. Draw the staggered conformations.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| 30. Arrange the following conformation from lowest to highest energy.   |  |  | | --- | --- | | *ANSWER:* |  | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 31. Explain your energy order from lowest to highest.   |  |  | | --- | --- | | *ANSWER:* | The lowest energy conformation of those shown is the one staggered conformation. Of the two eclipsed conformations given, the one in which there is one eclipsed interaction (energy cost: 11 kJ/mol) and one eclipsed interaction (energy cost: 6.0 kJ/mol) and one eclipsed interaction(energy cost: 4 kJ/mol, for a total energy cost of 11 kJ/mol + 6 kJ/mol + 4 kJ/mol = 21 kJ/mol) will be higher than the one in which there are three eclipsed interactions (energy cost: 6.0 kJ/mol x 3 = 18 kJ/mol). | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- |
| 32. Draw at least four isomers with molecular formula given below.  C4H10O   |  |  | | --- | --- | | *ANSWER:* | There are seven total isomers, four alcohols and three ethers. | | *POINTS:* | 1 | |

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| 33. Which of the following functional groups if bonded to a three-carbon chain would have the largest δ– charge?   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | a. | alcohol | b. | ether | |  | c. | phosphate | d. | sulfide |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 34. Which of the following functional groups contains a carbonyl group?   |  |  |  | | --- | --- | --- | |  | a. | ketone | |  | b. | ester | |  | c. | carboxylic acid | |  | d. | amide | |  | e. | All contain a carbonyl group. |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 35. How many isomeric chloroalkanes have the molecular formula shown below?  C4H9Cl   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | a. | 2 | b. | 3 | |  | c. | 4 | d. | 5 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 36. If the following alkyl group were attached to a cyclohexane ring,  the group would be named as:   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | a. | butyl | b. | isobutyl | |  | c. | *sec*-butyl | d. | *tert*-butyl |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 37. Which of the following alkanes would have the highest boiling point?   |  |  |  | | --- | --- | --- | |  | a. | heptane | |  | b. | 2-methylhexane | |  | c. | 2,3,-dimethylpentane | |  | d. | 2,2,3-trimethylbutane | |  | e. | All have the same molar mass and would have about the same boiling point. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | |