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| 1. Consider the Newman projection. Give the systematic (IUPAC) name of this alkane.   |  |  | | --- | --- | | *ANSWER:* | This tests your ability to “decode” a Newman projection. Always remember that the “circle” represents only one carbon of a bond; there is a second carbon obscured behind it that you can’t see—the one with the three bonds to the periphery. Hopefully you drew a structure before you constructed the name:  ​  ​  The name then follows: 2,3-dimethylpentane.  ​ | |

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| 2. Select all Newman projections that are valid Newman projections for stable conformations of butane. (“Stable” means located at any energy minimum in a plot of energy vs. dihedral angle.)  ​   |  |  | | --- | --- | | *ANSWER:* | A, B, and D. Projection B is a projection of the C1—C2 bond, whereas the other correct projections are projections of the C2—C3 bond. Projection C is not butane, and projection E is not a stable conformation of butane. Although the gauche conformation D is less stable than the anti conformation A, it lies at an energy minimum and certainly exists.  ​ | |

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| 3. Consider the compound:  The largest substituent group mentioned (cited) explicitly in the name of this compound is   |  |  |  | | --- | --- | --- | |  | a. | *tert-*butyl. | |  | b. | methyl. | |  | c. | ethyl. | |  | d. | propyl. | |  | e. | octyl. | |  | f. | some other group. |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 4. Which **one**of the Newman projections is correct for the projected bond indicated by the arrow in 2,2,4-trimethylpentane?  ​  ​   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 5. Consider the following alkane, shown in a skeletal structure. What is the IUPAC name of this compound?  ​   |  |  | | --- | --- | | *ANSWER:* | The IUPAC name is 3-ethyl-3-methylpentane. | |

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| 6. Consider the alkane, shown in a skeletal structure. Which of the Newman projections depicts one of the staggered conformations of this compound about the projected bond (arrow) when viewed with the carbon marked with a \* in the front?  ​   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  | |  | d. |  |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 7. Name the alkane using an IUPAC systematic name.   |  |  | | --- | --- | | *ANSWER:* | The correct name is 3-ethylhexane. | |

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| 8. Provide an IUPAC systematic name for this compound.  ​   |  |  | | --- | --- | | *ANSWER:* | The IUPAC name is 2,2,5-trimethylhexane. | |

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| 9. Consider the compound. This compound is a constitutional isomer of which unbranched alkane?     |  |  | | --- | --- | | *ANSWER:* | The compound has nine carbons. Therefore, it is a constitutional isomer of nonane. | |

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| 10. Complete a Newman projection of the most stable conformation of this compound about the bond marked with the arrow. The carbon with the asterisk should be in front. You can use group abbreviations for large groups.  ​   |  |  | | --- | --- | | *ANSWER:* | The most stable conformation is the staggered configuration with the two alkyl substituents in the anti position.  ​ | |

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| 11. Which is a correct Newman projection of 3-methylpentane?   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| 12. Which compound has the highest boiling point?   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  | |  | d. |  |  |  |  | | --- | --- | | *ANSWER:* | d | |

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| 13. Consider the IUPAC systematic name of the alkane.  ​  ​  The name of this compound is   |  |  |  | | --- | --- | --- | |  | a. | 5-ethyl-2-methyl-3-propylheptane. | |  | b. | 3-ethyl-5-isopropylnonane. | |  | c. | 6-ethyl-4-isopropyloctane. | |  | d. | 1,1-diethyl-3-isopropylhexane. | |  | e. | None of the above is a correct name. |  |  |  | | --- | --- | | *ANSWER:* | e | |

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| 14. Complete the Newman projection on the right for the compound on the left, with the projection taken about the C3—C4 bond. The Newman projection should show the **least stable staggered** conformation.     |  |  | | --- | --- | | *ANSWER:* | The three staggered conformations about the C3—C4 bond are:  ​  ​  The conformation B is the least stable (shown in red) since it has two eclipsing interactions with the bulky *tert*-butyl group.  ​ | |

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| 15. Behold the structure of vanillin, which is the main ingredient in vanilla extract.  ​  ​  The functional groups in vanillin are best described as   |  |  |  | | --- | --- | --- | |  | a. | a ketone, a phenol, and an ether. | |  | b. | an alcohol, an aldehyde, and an ether. | |  | c. | a ketone, an alcohol, and an ether. | |  | d. | a phenol, an aldehyde, and an ether. | |  | e. | an aldehyde, a phenol, and an alcohol. |  |  |  | | --- | --- | | *ANSWER:* | d | |

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| 16. Identify the correct name for the compound.  ​  ​   |  |  |  | | --- | --- | --- | |  | a. | 1,1,1,4,4,4-hexamethylbutane | |  | b. | 1,2-di-tert-butylethane | |  | c. | 2,2,5,5-tetramethylhexane | |  | d. | some other name |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 17. Behold the molecule hydroxyproline, drawn in its un-ionized form. Hydroxyproline is an important constituent (in combined form) of collagen. Which correctly describes the functional groups in hydroxyproline?  ​   |  |  |  | | --- | --- | --- | |  | a. | alcohol, amine, carboxylic acid | |  | b. | alcohol, amide, carboxylic acid | |  | c. | amide, amine, carboxylic acid | |  | d. | ester, carboxylic acid, amine | |  | e. | None of these lists all of the functional groups correctly. |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| 18. The α-amino acid tyrosine has the following structure. What is the functional group (circled) in the side-chain of tyrosine?  ​  ​   |  |  | | --- | --- | | *ANSWER:* | The side-chain functional group in tyrosine is a phenol. | |

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| 19. Consider the structure of methyl acetate. Draw an alcohol that is a constitutional isomer. It may contain other functional groups.  ​  ​   |  |  | | --- | --- | | *ANSWER:* | A constitutional isomer has the same molecular formula but different connectivity. The molecular formula for methyl acetate is C3H6O2. Some examples of constitutional isomers containing alcohols are:  ​  ​ | |

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| 20. The compound with the greatest boiling point is   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  | |  | d. |  |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 21. Give the systematic (IUPAC) name of this alkane.  ​   |  |  | | --- | --- | | *ANSWER:* | The alkane should be named 1,2-dimethylcyclopentane. | |

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| 22. Given the structure, classify each of the carbons as primary, secondary, tertiary, or quaternary.  ​   |  |  | | --- | --- | | *ANSWER:* | The primary carbons are labeled (p), the secondary carbons are labeled (s), and the tertiary carbons are labeled (t). There are no quaternary carbons in the molecule.  ​  ​ | |

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| 23. Given the structure, classify each of the hydrogens as primary, secondary, or tertiary.  ​   |  |  | | --- | --- | | *ANSWER:* | The primary hydrogens are labeled (p) and the secondary hydrogens are labeled (s). There are no tertiary hydrogens in this molecule.  ​ | |

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| 24. How many hydrogens are there in a noncyclic alkane containing 10 carbons?   |  |  | | --- | --- | | *ANSWER:* | Noncyclic alkanes have the molecular formula CnH2n+2. If there are 10 carbons, there must be 22 hydrogens. | |

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| 25. Draw the structure of 2-butyl-1,1-dimethylcyclohexane.   |  |  | | --- | --- | | *ANSWER:* | Start by drawing the parent name. Cyclohexane is a six-carbon ring. Number the ring from 1 to 6. Place two methyl substituents on carbon 1 and a butyl substituent on carbon 2.  ​ | |