***Hydrocarbons: The Effect of Chain Length on Physical Properties***

***Task:***

Analyze a chart and graph showing the relationship between the length of the hydrocarbon chain and its physical properties.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **# of Carbons** | **Name** | **Structure** | **Formula** | **Boiling Point (°C)** | **Melting Point (°C)** |
| 1 | methane | CH3-H | CH4 | -164 | -182 |
| 2 | ethane | CH3- CH3 | C2H6 | -89 | -183 |
| 3 | propane | CH3-CH2- CH3 | C3H8 | -42 | -190 |
| 4 | butane | CH3- CH2-CH2- CH3 | C4H10 | 0 | -138 |
| 5 | pentane | CH3-(CH2)3- CH3 | C5H12 | 36 | -130 |
| 6 | hexane | CH3-(CH2)4- CH3 | C6H14 | 69 | -95 |
| 7 | heptane | CH3-(CH2)5- CH3 | C7H16 | 98 | -91 |
| 8 | octane | CH3-(CH2)6- CH3 | C8H18 | 126 | -57 |
| 9 | nonane | CH3-(CH2)7- CH3 | C9H20 | 151 | -51 |
| 10 | decane | CH3-(CH2)8- CH3 | C10H22 | 174 | -30 |

Use the data table and the graph to answer the questions.

1. What is the relationship between the number of carbon atoms and the boiling point?
2. Explain the relationship between the number of carbon atoms and the melting point.
3. Look at the graph- Does boiling or melting point show a faster rate of change? Use the shapes and slopes of the lines (rise/run) to explain your answer. (You may estimate the change in temperature as the number of carbon atoms changes).
4. Convert the boiling points of the hydrocarbons from degrees Celsius to degrees Fahrenheit. The formula is °F = (9/5 x °C) + 32

|  |  |  |
| --- | --- | --- |
|  | **Boiling Point (°C)** | **Boiling Point (°F)** |
| methane | -164 |  |
| ethane | -89 |  |
| propane | -42 |  |
| butane | 0 |  |
| pentane | 36 |  |
| hexane | 69 |  |
| heptane | 98 |  |
| octane | 126 |  |
| nonane | 151 |  |
| decane | 174 |  |

1. At room temperature (72**°**F**)-**  Which of these hydrocarbons would exist as gases? Liquids? Solids?
2. Give the structural and molecular formulas for each hydrocarbon.

|  |  |  |  |
| --- | --- | --- | --- |
| **Hydrocarbon** | **Molecular Formula**  | **Structural Formula** | **Boiling Point (°C)** |
| pentane |  |  | 36 |
| 2-methyl butane |  |  | 28 |
| 2,2-dimethyl propane |  |  | 9 |

Use the chart above to answer these:

1. How many carbons does each of these three compounds have?

Pentane-

2-methyl butane-

2,2-dimethyl propane-

1. How many branches does each of these three compounds have?

Pentane-

2-methyl butane-

2,2-dimethyl propane-

1. What is the relationship between the number of carbon branches and the boiling point of the hydrocarbons?