1. This question is about how trends in properties of the fractions from crude oil change with the chain length of the molecule.
	1. Complete the table by writing the words: ‘decrease’, ‘increase’ or ‘stays the same’ into the right-hand column.

|  |  |
| --- | --- |
| **Property** | **Trend in property as carbon chain length increases** |
| Boiling point | Answer: Increases. |
| Viscosity | Answer: Increases. |
| Flammability | Answer: Decreases. |

* 1. Place these fractions from crude oil in order of their boiling point.

diesel kerosene petroleum gas petrol bitumen

Write your answers below.

|  |  |
| --- | --- |
| **Name of fraction** | Increasing boiling point |
| Answer: Petroleum gas. |
| Answer: Petrol. |
| Answer: Kerosene. |
| Answer: *Diesel.* |
| Answer: Bitumen. |

1. A sample of petrol (gasoline) was analysed by a chemist.

She recorded a mass of petrol of 5.20 g.

The analysis found a substance called decane in the petrol.

The percentage of decane in the petrol sample was 4.8%, by mass.

Source: Envato Elements

Decane is an alkane containing ten carbon atoms in its molecule.

* 1. Which two elements are present in alkanes?

Answer: Hydrogen and carbon.

* 1. What is the general formula for an alkane?

Answer: CnH(2n+2)

* 1. Use your answer to part b) to work out the molecular formula for decane.

Answer: C10H22

* 1. Draw the structure of a decane molecule.



* 1. Explain why a decane molecule is described as ‘saturated’.

Answer: It contains carbon single bonds only.

* 1. Calculate the mass of decane in the petrol sample.

Give your answer to 3 significant figures.

Show your working.

Answer: The mass of decane = $\frac{4.8}{100}$ × 5.2 = 0.2496 g.

 And to 3 significant figures, this would be 0.250 g.

* 1. What mass of petrol would contain exactly 10.0 g of decane?

Give your answer to 1 decimal place.

Show your working.

Answer: The percentage by mass of decane in the petrol is 4.8%.

 So $\frac{4.8}{100}$ × mass of petrol = 10.0 g.

 So the mass of petrol = 10.0 × $\frac{100}{4.8}$ = 208.3… g.

 And this is 208.3 g to 1 decimal place.

1. Crude oil is a complex mixture of hydrocarbons, many of which are alkanes.

The boiling points of the first six members of the alkane homologous series are shown in the table below.

|  |  |
| --- | --- |
| **Number of carbon atoms in alkane** | **Boiling point in °C** |
| 1 | –162 |
| 2 | –89 |
| 3 | –42 |
| 4 | –0.5 |
| 5 | 36 |
| 6 | 69 |

* 1. Plot the number of carbon atoms on the horizontal axis and the boiling point on the vertical axis on the graph below.
	2. Draw a best fit line through these points.

Answer: See graph for answer.

* 1. Describe how the boiling point changes from two carbon atoms to six carbon atoms.

Answer: Almost linearly.

* 1. Use your graph to determine the boiling point of the alkane with seven carbon atoms.

Answer: c.a. 100 °C.

* 1. Which of the hydrocarbons are gases at room temperature, 20°C?

Answer: The first four members are gases.

* 1. Dane and Debbie have a discussion about the best graph to draw to show the data in the table.

Dane suggests that a line is a good idea, but Debbie suggests a bar chart would be better.

State who you think is correct. Give a reason.

Answer: A continuous line shows the trend in data clearly, and it can be used for extrapolating to another point, for example. However, this data is discontinuous or discrete, so a bar chart should be drawn. It is important to realise that each method has its advantages and disadvantages although a bar chart is the more acceptable representative form for displaying discrete data. Clearly, values between, for example, one and two carbon atoms have no meaning, so a line is drawn to show the trend in values.