Chemistry

General course

Marking key for the Externally set task

Sample 2016

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# Chemistry

## Externally set task – marking key

1. Crude oil is a mixture of a very large number of hydrocarbons and not all of them are suitable to be used as fuels. Fractional distillation uses the differences in boiling points to separate the mixture into fractions. The group of alkanes, or fraction, that has between five and twelve carbon atoms
(C5 – C12­), is the fraction used in petrol.

 **(13 marks)**

The table below gives some of the boiling point values for the straight chain alkanes in the C5 – C12­ fraction.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of carbon atoms | 6 | 7 | 8 | 9 | 11 | 12 |
| Approximateboiling point ºC | 70 | Missing data | 125 | 150 | 200 | Missing data |

1. On the grid provided below, plot a line graph of the number carbon atoms against their boiling points.



|  |  |
| --- | --- |
| **Description** | **Marks** |
| Independent variable on horizontal axis  | 1 |
| Dependent variable on vertical axis | 1 |
| Axis labelled with units | 1 |
| Appropriate scale | 1 |
| Title | 1 |
| Line graph between C6 and C11 | 1 |
| **Total** | **6** |

1. Using the graph, determine the boiling point of the straight chain alkane that has 7 carbon atoms.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Boiling point C7 is 99 – 101°C | 1 |
| **Total** | **1** |

1. Draw the structural formula for and name the straight chain hydrocarbon that has 7 carbon atoms in its structure.

|  |  |
| --- | --- |
| **Description** | **Marks** |
|  | 1 |
| heptane | 1 |
| **Total** | **2** |

1. Extrapolate the graph and predict the boiling point of the straight chain alkane that has 12 carbon atoms.
Boiling point C12 \_\_\_\_\_\_\_\_\_ °C

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Dotted line between C11 and C12 | 1 |
| Boiling point C12 is 215 – 217°C | 1 |
| **Total** | **2** |

1. Explain why the hydrocarbons methane and butane cannot be collected in the fractionating column.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Both are gases at room temperature | 1 |
| Temperature at top of fractionating column is above their boiling points | 1 |
| **Total** | **2** |

2(a) Octane (C8H18­) can undergo thermal cracking forming hexane and ethene.

Complete the equation by drawing the structural formulas of the two products produced in the cracking process.



hexane

ethene

+

→

octane

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Hexane | 1 |
| Ethene | 1 |
| **Total** | **2** |

(b) Nonane C9H20 is a colourless liquid and, when it undergoes thermal cracking, forms molecules of ethene and a straight chain alkane. Using the partial equation below, draw the structural formula for and name the straight chain hydrocarbon that is produced.



nonane

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Ethene | 1 |
| Alkane has 7 carbons - heptane | 1 |
|  | 1 |
| **Total** | **3** |

3(a) In Australia, ethanol is made from sugar cane waste, or from the starch by-product from flour production, so that there is no conflict with food production.
The three equations in the bioethanol fuel cycle are given below.

 Photosynthesis
6 CO2 + 6 H2O + sunshine → C6H12O6 + 6 O2 (1)

 Fermentation
C6H12O6 → 2 C2H5OH + 2CO2 + heat (2)

 Combustion
C2H5OH + 3 O2 → 2 CO2 + 3H2O + heat (3)

 Use the three equations to explain why bioethanol can be considered to be CO2 neutral.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Carbon is captured in photosynthesis | 1 |
| Carbon is release in the fermentation and combustion processes | 1 |
| The amount of carbon released in these processes equals the amount of carbon captured | 1 |
| **Total** | **3** |

(b) The original diesel engine invented by Rudolf Diesel was designed to use peanut and other vegetable oil as its fuel. The use of these oils was phased out as cheaper petroleum-based diesel fuel became widely available. Today there is a move back to producing a sustainable alternative to petroleum based diesel fuel known as biodiesel. An increasing number of commercial organisations (mining companies and transport companies) are trialling biodiesel blends.

(i) Name **two (2)** common sources of the raw materials used in the trans esterification process used to produce biodiesel.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any two of the following – the list is not exhaustive |  |
| Vegetable oils like canola, animal fat (tallow) or used cooking oil |  |
| **Total** | **2** |

(ii) A blend of biodiesel B20 is available in Perth. Describe **two (2)** advantages of using blended diesel, like B20, over using conventional petroleum-based diesel fuel.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Less greenhouse gas emissions | 2 |
| Uses renewable resources in its production |
| Increase biodegradability |
| **Total** | **2** |

(iii) Some people make biodiesel at home on a small scale. Explain the attraction of producing your own biodiesel.

|  |  |
| --- | --- |
| **Description (any two of the following)** | **Marks** |
| Raw materials are cheap | 2 |
| Process is relatively simple |
| Process can be safely carried out on a small scale |
| **Total** | **2** |

(c) Many of the oils that could be used in the production are used in the preparation of food.

(i) Explain why, in many cases, these oils are used to form emulsions before they can be used in foodstuff.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The oils are not water soluble and will not remain mixed and the mixture will separate into a layers | 1 |
| **Total** | **1** |

(ii) With the aid of a simple labelled diagram, draw an oil water emulsion.

|  |  |
| --- | --- |
| **Description** | **Marks** |
|  oil water water oil |
| Emulsions can either be water/ oil or oil/water |  |
| Labelled diagram showing both components | 1 |
| Outer layer dispersed. Substance thinner | 1 |
| **Total** | **2** |