



Government of **Western Australia**
School Curriculum and Standards Authority



CHEMISTRY

GENERAL COURSE

Marking key for the Externally set task
Sample 2016

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Chemistry

Externally set task – marking key

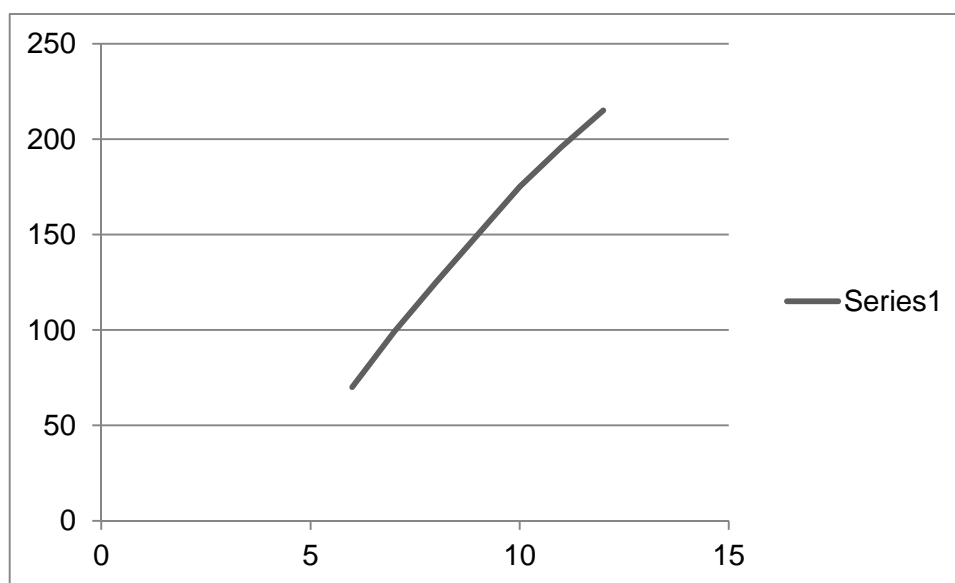
1. Crude oil is a mixture of a very large number of hydrocarbons and not all of them are suitable to be used as fuels. Fractional distillation uses the differences in boiling points to separate the mixture into fractions. The group of alkanes, or fraction, that has between five and twelve carbon atoms ($C_5 - C_{12}$), 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 $C_5 - C_{12}$ fraction.

Number of carbon atoms	6	7	8	9	11	12
Approximate boiling point $^{\circ}C$	70	Missing data	125	150	200	Missing data

- (a) 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 C_6 and C_{11}	1
Total	6

- (b) Using the graph, determine the boiling point of the straight chain alkane that has 7 carbon atoms.

Description	Marks
Boiling point C ₇ is 99 – 101°C	1
Total	1

- (c) Draw the structural formula for and name the straight chain hydrocarbon that has 7 carbon atoms in its structure.

Description	Marks
$ \begin{array}{cccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \\ & & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \end{array} $	1
heptane	1
Total	2

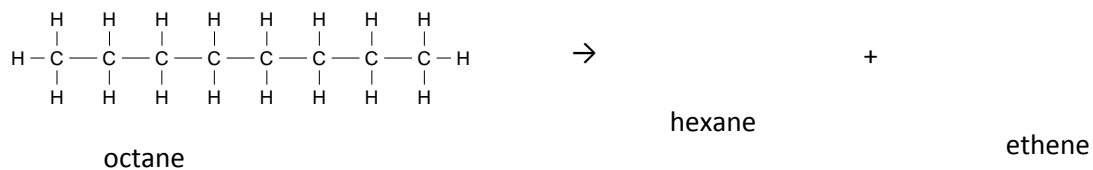
- (d) Extrapolate the graph and predict the boiling point of the straight chain alkane that has 12 carbon atoms.
Boiling point C₁₂ _____ °C

Description	Marks
Dotted line between C ₁₁ and C ₁₂	1
Boiling point C ₁₂ is 215 – 217°C	1
Total	2

- (e) Explain why the hydrocarbons methane and butane cannot be collected in the fractionating column.

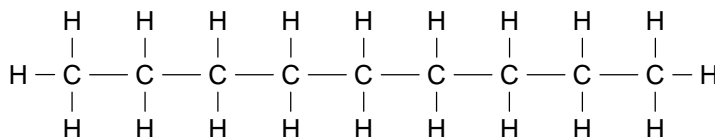
Description	Marks
Both are gases at room temperature	1
Temperature at top of fractionating column is above their boiling points	1
Total	2

- 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.



Description	Marks
$ \begin{array}{cccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ <p>Hexane</p>	1
$ \begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} $ <p>Ethene</p>	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.

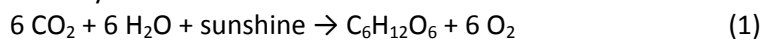


nonane

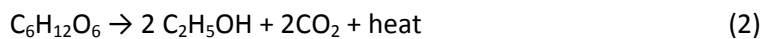
Description	Marks
$ \begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} $ <p>Ethene</p>	1
Alkane has 7 carbons - heptane	1
$ \begin{array}{cccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	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.

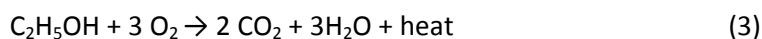
Photosynthesis



Fermentation



Combustion



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