



CHEMISTRY

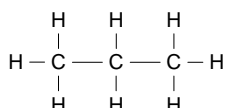
GENERAL COURSE

Externally set task

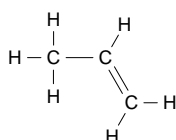
Sample 2016

Note: This Externally set task sample is based on the following content from Unit 3 of the General Year 12 syllabus.

- represent data in meaningful and useful ways; organize and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and inconsistencies in data; and use evidence to make and justify conclusions
- crude oil is a mixture of a very large number of compounds
- the substances in crude oil can be separated using fractional distillation
- crude oil is made up of hydrocarbons; hydrocarbons consist of only hydrogen and carbon atoms
- most of the hydrocarbons found in crude oil are called alkanes; alkanes are hydrocarbons that contain only single carbon to carbon bonds and are described as saturated
- alkanes can be named using IUPAC conventions (C_1 - C_8 , straight chain only)
- alkanes can be represented using structural formula (C_1 - C_8 , straight chain only) for example, propane (C_3H_8)



- substances separated from the fractional distillation of crude oil can be broken down (cracked) to make smaller hydrocarbons, such as alkenes
- alkenes are hydrocarbons that contain at least one carbon to carbon double bond and are described as unsaturated
- alkenes can be named using IUPAC conventions (C_2 - C_3 only)
- alkenes can be represented using structural formulae (one double bond), for example, propene (C_3H_6)



- vegetable oils can be used to make biofuels
- ethanol can be used as a biofuel
- oils are insoluble in water; oils can be used to produce emulsions, for example, in food and cosmetics

In future years, this information will be provided late in Term 3 of the year prior to the conduct of the Externally set task. This will enable teachers to tailor their teaching and learning program to ensure that the content is delivered prior to the students undertaking the task in Term 2 of Year 12.

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Chemistry

Externally set task

Working time for the task: 60 minutes

Total marks: 30 marks

Weighting: 15% of the school mark

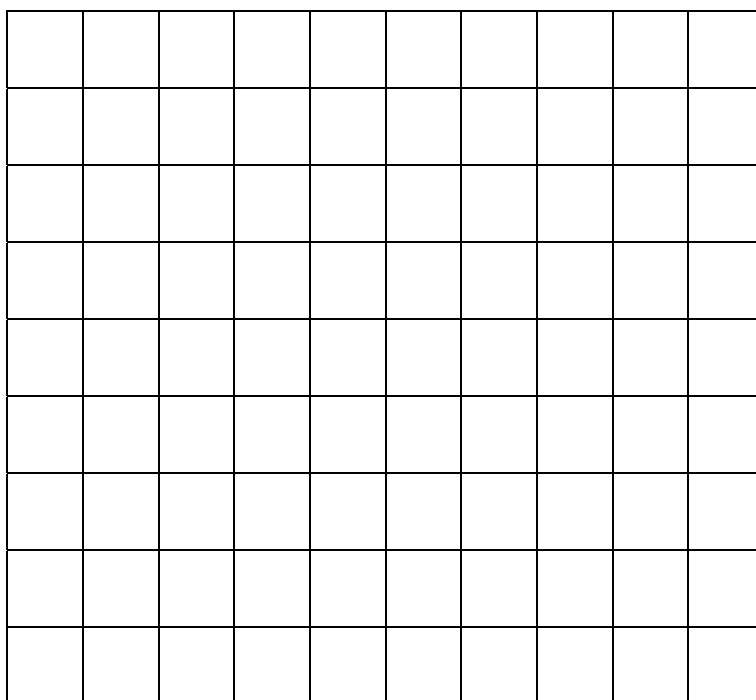
1. Crude oil is a mixture of a very large number of hydrocarbons and not all of them are suitable to be used as fuels. Fractional distillation uses the differences in boiling points to separate the mixture into fractions. The group of alkanes, or fraction, that has between five and twelve carbon atoms ($C_5 - C_{12}$), 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. **(6 marks)**



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

(1 mark)

Boiling point C₇ _____ °C

- (c) Draw the structural formula for and name the straight chain hydrocarbon that has seven carbon atoms in its structure. (2 marks)

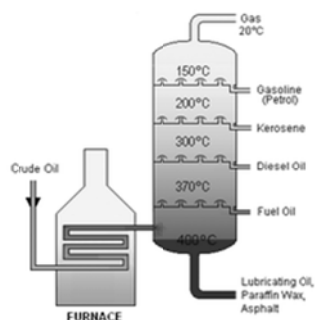
- (d) Extrapolate the graph and predict the boiling point of the straight chain alkane that has 12 carbon atoms. (2 marks)

Boiling point C₁₂ _____ °C

- (e) Explain why the hydrocarbons methane and butane cannot be collected in the fractionating column. (2 marks)

2. The fractionating column separates the mixture into fractions that have different uses depending on their properties, such as viscosity or flammability.

(5 marks)



The percentage of the fractions used for petroleum does not match the demand for this product. In order to boost the amount of petroleum from crude oil, a process called cracking is used to break longer chain alkanes into a mixture of smaller more useful hydrocarbons.

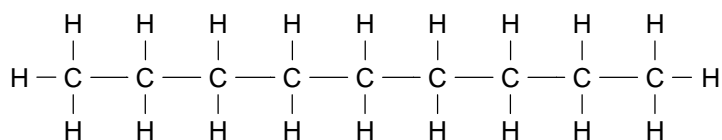
- (a) Octane (C_8H_{18}) can undergo thermal cracking forming hexane and ethene. Complete the equation by drawing the structural formulas of the two products produced in the cracking process.

(2 marks)



- (b) Nonane C_9H_{20} 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.

(3 marks)



nonane

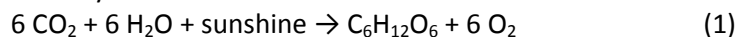
ethene

+

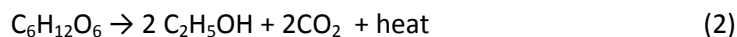
3. In Australia, ethanol is made from sugar cane waste, or from the starch by-product of flour production, so that there is no conflict with food production.

The three equations in the bioethanol fuel cycle are given below.

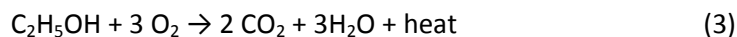
Photosynthesis



Fermentation



Combustion



(12 marks)

- (a) Use the three equations to explain why bioethanol can be considered to be CO₂ neutral.

(3 marks)

- (b) The original diesel engine, invented by Rudolf Diesel in 1893, 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. (2 marks)

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

- (iii) Some people make biodiesel at home on a small scale. Explain the attraction of producing your own biodiesel. (2 marks)

- (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. (1 mark)

- (ii) With the aid of a simple labelled diagram, draw an oil water emulsion. (2 marks)