1. The torch used to start the modern Olympic Games uses a mixture of propane and butane.

When propane and butane burn in air, they produce heat energy, and a flame.

1. Propane and butane are chemical compounds.

Name the two elements that make these compounds.

Source: Envato Elements

Answer: Hydrogen and carbon.

1. State the name of the compounds that contain the elements in part a).

*Answer*: Hydrocarbons.

1. To which homologous series do propane and butane belong?

Answer: The alkanes.

1. Below are the incomplete molecular structures for propane and butane.

Complete these structures.



Butane

Propane

1. Using your answers to part d), explain what is meant by the word ‘saturated’.

Answer: Hydrocarbons containing carbon single bonds only.

1. When propane and butane burn in air, the same two products are made in each case.

State the names of the products formed.

Answer: Carbon dioxide and water.

1. Complete the word equation to show what happens when these gases burn in air:

Propane + oxygen 🡪 carbon dioxide + water

Butane + oxygen 🡪 carbon dioxide + water

1. The chemical formula for propane is C3H8.

Complete the symbol equation below to show propane burning in air.

C3H8 + 5O2 🡪 3CO2 + 4H2O

The ratio in which propane and butane are mixed together as a fuel in the torch (by volume) is 2 : 1.

1. What fraction of the fuel is butane?

Answer: $\frac{1 }{3}$

1. An Olympic torch contains 37.8 cm3 of fuel.

Calculate the volume of butane in the fuel.

Show your working.

Answer: $\frac{1 }{3}$ x 37.8 = 12.6 cm3

1. The image to the right shows a car called the ‘Bio-Bug’.

Source: GENeco

You can find out more at [www.geneco.uk.com/Case\_study\_Bio\_bug/](https://www.geneco.uk.com/Case_study_Bio_bug/).

Solid human waste decomposes to make a gas that powers the car.

This gas is a hydrocarbon containing only one carbon atom.

The gas is the first member of the alkane homologous series.

Source: Wessex Water

1. What is the name of the gas?

Answer: Methane.

1. State the chemical formula for the gas.

Answer: CH4

1. Explain how the gas powers the car.

Answer: Methane burns in oxygen (from the air) to form heat energy. The car’s engine converts most of that heat energy to kinetic energy, powering the car.

1. Complete the symbol equation to show the gas burning in air.

Methane + oxygen 🡪 carbon dioxide + water

1. Suggest why this car is considered to be more environmentally friendly, or ‘greener’, than a car that runs on petrol or diesel.

Answer: Petrol and diesel come from crude oil and this is a finite resource. However, methane (in this case) comes from human waste and is therefore renewable. The energy costs will be lower in the latter case.

1. When 16.0 g of methane burns, 890 kJ of heat energy is produced.

Calculate how much heat energy is produced when 1.00 kg of methane burns.

Give your answer in MJ and to 3 significant figures.

Show your working.

Answer: Unit conversion: 1.00 kg = 1000 g.

1.00 g of methane produces $\frac{890}{16}$ kJ = 55.625 kJ.

1000 g of methane produces 55.625 kJ × 1000 = 55,625 kJ or 55.6 MJ (to 3 significant figures).