In context

Subject area: Organic chemistry | **Level: 14–16 years (Higher)**

Topic: Hydrocarbons | **Source: rsc.li/34Fv93j**

1. The methane rocket

A mixture of methane and oxygen in the proportion of 1 : 2 (by volume) can be exploded in a plastic bottle.

This experiment can be watched at https://youtu.be/xDlGSkTbh2A.

In this experiment, methane reacts violently with oxygen to form two products.

Source: Royal Society of Chemistry

a) Name the two products made in this reaction?

b) Complete the symbol equation for the reaction:

CH_4 + ____ → ____ + ____

c) Using your answer to part b), explain why the proportion of methane to oxygen must be 1 : 2.

d) The bottle has a volume of 2.00 dm^3.

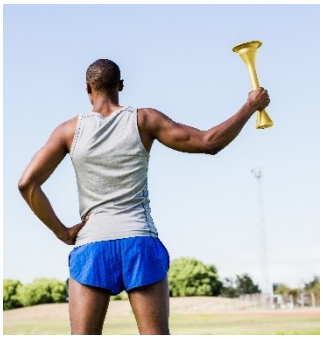
Calculate the volume of methane and oxygen in the bottle, in cm^3. Show your working. Give your answers to 4 significant figures.

e) Explain why the bottle moves when the gases are ignited.

f) Methane is a saturated hydrocarbon.

Explain what 'saturated' means.

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



Source: Envato Elements

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

a) Propane and butane are chemical compounds.

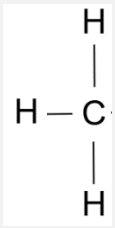
Name the two elements that make these compounds.

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

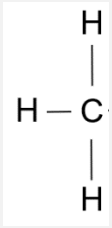
c) To which homologous series do propane and butane belong?

d) Below are the incomplete molecular structures for propane and butane.

Complete these structures.



Propane



Butane

e) Using your answers to part d), explain what is meant when these substances are described as 'saturated'.

f) Complete the symbol equations to show what happens when these gases burn in air:

Propane: $C_3H_8 + 5$ ____ → ____ + ____

Butane: C_4H_{10} + ____ → ____ + ____

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

g) What fraction of the fuel is butane?

h) An Olympic torch contains 37.8 cm^3 of fuel.

Calculate the volume of butane in the fuel.
Show your working.

i) In a different Olympic torch, the same fuel was used as in the previous torch.

The volume of propane in the mixture was 9.80 cm^3.
Calculate the volume of the fuel.
Show your working.