

Knowledge check

Subject area: Organic chemistry

Level: 14–16 years (Higher)

Topic: Burning hydrocarbons

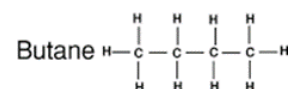
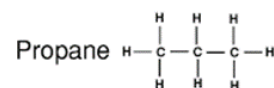
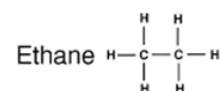
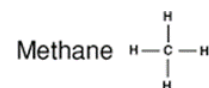
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1. Here are the first four members of the alkane homologous series.

John and Josie make some statements about these alkanes.

State which statements are true, and which are false.

Write 'T' or 'F' into the box.

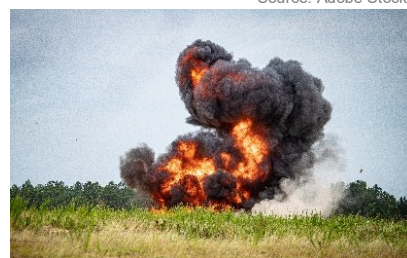


- a) The alkanes are hydrocarbons.
- b) In this homologous series, it is always true that the molecular formula of one alkane differs from the next alkane by a CH_3 unit.
- c) The alkanes in this series are called straight chain hydrocarbons.
- d) The formula of the alkane having 24 hydrogen atoms is $\text{C}_{12}\text{H}_{24}$.
- e) When an alkane burns, water is always formed.
- f) It is always true that when an alkane burns, more heat energy is given out on forming new product chemical bonds than is required to break reactant bonds.
- g) When methane burns, 882 kJ of heat energy is produced per mole. If 1.00 g of methane burns, 14.1 kJ of heat energy is released. [RAM data: C = 12, H = 1]

2. This shows what happens when rubber tyres are set on fire.

a) What type of combustion is taking place?

Give a reason.



b) State two environmental problems with this type of combustion.

3. Some car and lorry engines produce a pollutant called nitrogen dioxide.

a) Name the two gases that react together to make nitrogen dioxide.

b) State the name of the substance that contains these two gases before the engine is used.

c) Describe how nitrogen dioxide is formed inside an engine.

- d) **Sulfur is an impurity in fossil fuels. When this substance burns, it can produce a gas that can be very harmful to the environment.**

Explain why this gas is harmful.

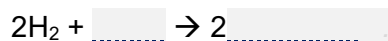
Write a chemical equation to help you explain your answer.

4. **Petrol may produce a lot of pollution when it burns.**

Hydrogen is seen as a better fuel to use as it does not make any pollution.

- a) **Give the names of two pollutants produced from burning petrol.**

- b) **Complete the symbol equation to show what happens when hydrogen burns in air:**



- c) **Use your answer to part b) to explain why hydrogen does not make any pollution when it burns.**

- d) When a hydrocarbon burns in a limited or short-supply of oxygen, a toxic gas may form.

Draw straight lines from the statements on the left to the correct answer on the right.

Statement	Answer
The name of the gas?	Carbon monoxide
	Carbon dioxide
The chemical formula of the gas?	CO
	CO ₂
The type of combustion taking place?	Complete
	Incomplete

- e) Explain why the gas in part d) is toxic.

5. State which of these equations show complete and incomplete combustions.

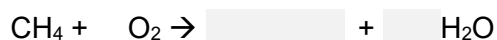
Draw a straight line from the chemical equation to the correct type of combustion.

Chemical equation	Type of combustion
$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	Complete combustion
$C_4H_8 + 4O_2 \rightarrow 4CO + 4H_2O$	
$2C_{10}H_{22} + 11O_2 \rightarrow 20C + 22H_2O$	Incomplete combustion
$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$	

6. This question is about writing chemical equations for combustion reactions.

Complete the equations.
Make sure that each equation is balanced.

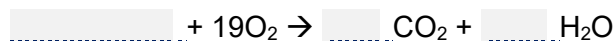
a) The complete combustion of methane.



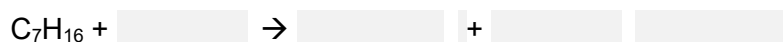
b) The incomplete combustion of ethane.



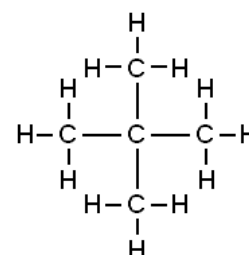
c) The complete combustion of hexane.



d) The incomplete combustion of heptane.

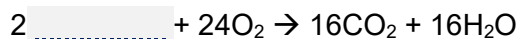


e) The complete combustion of the molecule shown.



7. Steph and Nikita set us a puzzle.

They write down the combustion equation below.



a) What is the formula of the missing straight chain hydrocarbon?

b) State if the missing hydrocarbon is an alkane. Give a reason.