



Cracking: knowledge check

- 1.1 The table compares the supply of crude oil fractions from fractional distillation and the demand.

Fraction	Percentage supplied from crude oil (%)	Percentage demand (%)
gases	3	6
petrol	10	27
kerosene	11	19
bitumen	12	4
diesel	15	23
fuel oil	49	21

Use the data in the table to answer the questions.

- (a) For which four fractions is the demand higher than supply?

- (b) For which two fractions is supply higher than demand?

- 1.2 Decide whether each of the statements is true or false and write your answer in the box provided.

For each statement you think is false, write out the correct version.

[Hint: Remind yourself about the functional groups of alkenes and alkanes and the differences between them.]



- (a) The process of cracking is used to break larger hydrocarbon molecules into smaller ones. True False
- (b) Smaller hydrocarbon molecules are generally less useful than larger hydrocarbon molecules. True False
- (c) Saturated hydrocarbons contain at least one double covalent bond between carbon atoms. True False
- (d) Alkenes are saturated compounds. True False
- (e) Alkane molecules only contain single covalent bonds between carbon atoms. True False
- (f) Alkanes and alkenes are part of the same homologous series. True False

1.3 Choose from the words provided to complete the gaps in the sentences.

petrochemical demand alkanes
diesel fuels alkenes polymers

The process of cracking is used to help match the supply of crude oil fractions with their _____.

The smaller, saturated _____ produced in cracking are used as _____ such as petrol, kerosene and _____.

The unsaturated _____ produced are used in the petrochemical industry to make other products including medicines, dyes and _____.



1.4 Use some of the words provided to complete the sentences describing the two types of cracking. Not all of the words will be used.

steam ionic catalyst slow down
covalent speed up smaller larger
800°C 550°C water

During the process of cracking some of the _____ bonds in the molecules are broken to produce _____ alkanes and alkenes.

Catalytic cracking involves heating the hydrocarbons to a temperature of _____ to vaporise them. The vapours are passed over a _____ of zeolite to _____ the reaction.

Steam cracking involves heating the hydrocarbons to a temperature of _____ to vaporise them.

The vaporised hydrocarbons are mixed with _____ and cracking occurs.



Cracking: test myself

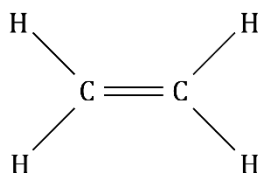
2.1 What type of reaction is cracking?

[Hint: Think about the conditions needed to break the covalent bonds.]

2.2 State the general molecular formula of an alkene.

[Hint: Remember, alkenes are hydrocarbons and that a general molecular formula can be used to represent any member of the same homologous series.]

2.3 This is the displayed structural formula of ethene.

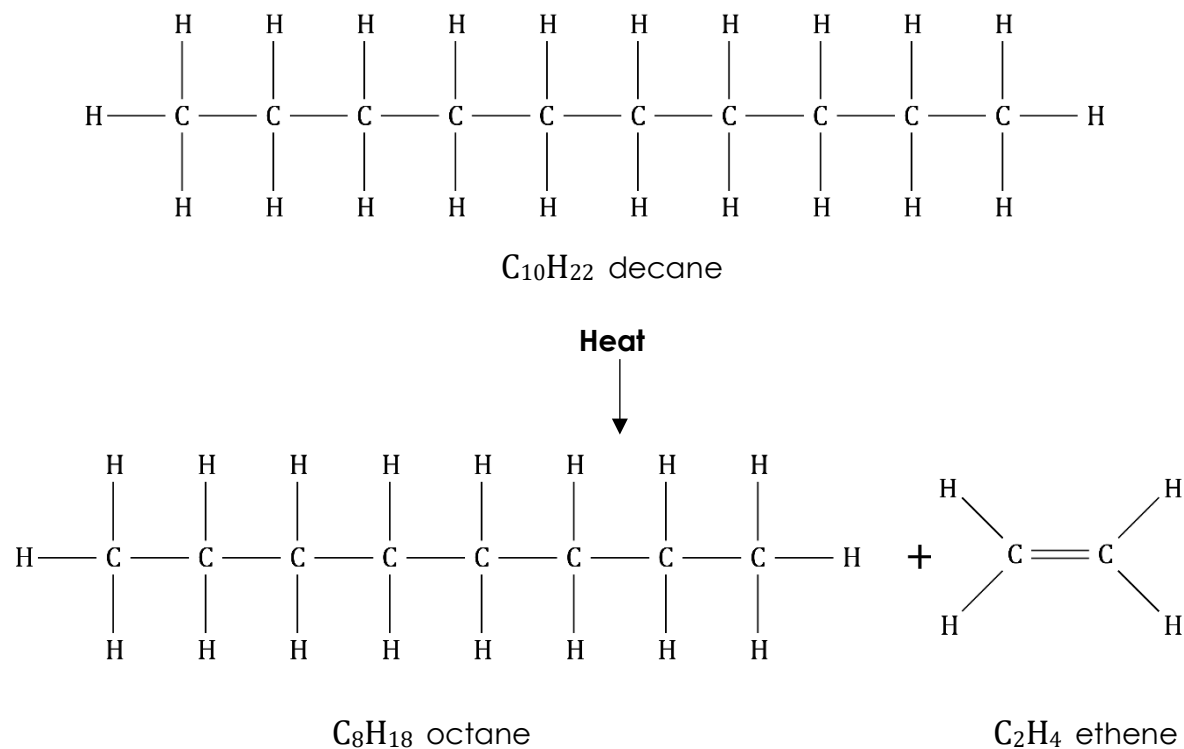


How many pairs of electrons are shared in the double covalent bond?

[Hint: Think about how many electrons each carbon atom has in its outer shell to use to form covalent bonds.]



2.4 This equation represents the cracking of decane, $C_{10}H_{22}$.



Identify which of the two products is unsaturated?

2.5 Complete the equation representing the cracking of undecane, $C_{11}H_{24}$, to produce nonane, C_9H_{20} and an unsaturated compound.



2.6 The cracking of dodecane, $C_{12}H_{26}$, produces one molecule of propene, one molecule of ethene and a third alkane product.



State the molecular formula of the alkane product formed.



- 2.7** The cracking of the alkane $C_{16}H_{34}$ produces an alkane with 12 carbon atoms in each molecule and a second unsaturated product.

Complete the equation for the reaction.

[Hint: Think about the general molecular formula of the alkanes and the meaning of the term 'unsaturated'.]



- 2.8** Suggest two reasons why catalytic cracking is usually preferred to steam cracking.

[Hint: Think about the conditions needed for the two processes.]

Reason 1: _____

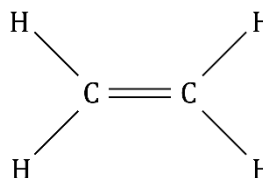
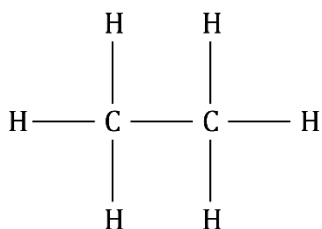
Reason 2: _____



Cracking: feeling confident?

3.1 Ethane or ethene? Complete the table comparing ethane and ethene.

The displayed structural formulas are provided to help you.



Compound	Homologous series	Molecular formula	Displayed structural formula	Number of single covalent bonds	Number of double covalent bonds
ethane					
ethene					

3.2 Alkanes that contain between 10 and 16 carbon atoms are the feedstock for steam cracking.

By varying the temperature at which cracking is carried out, chemists can control the chain length of the alkanes and alkenes produced.

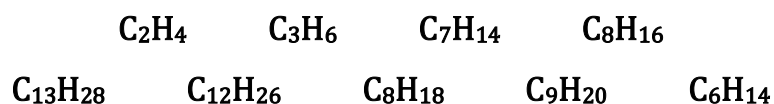
The table provides information about the alkanes and alkenes produced at two different temperatures during steam cracking.



Temperature	Point at which the carbon chain breaks	Alkanes produced	Alkenes produced
higher temperature	near the end of the alkane chain	higher proportion of longer alkanes containing 10 to 14 carbons	higher proportion of smaller alkenes, ethene and propene
lower temperature	near the middle of the alkane chain	higher proportion of medium-sized alkanes such as C_8H_{18}	higher proportion of larger alkenes, such as C_8H_{16}

Use the information provided in the table to write an equation representing the cracking of $C_{14}H_{30}$ at each of the two temperatures.

[Hint: You can use the information in the table to decide on the products formed in each process, but the equations must be balanced.]



(a) Higher temperature



(b) Lower temperature





Cracking: what do I understand?

Think about your answers and confidence level for each mini-topic. Decide whether you understand it well, are unsure or need more help. Tick the appropriate column.

Mini-topic	I understand this well	I think I understand this	I need more help
I can compare the supply and demand of fractions produced from the fractional distillation of crude oil.			
I can describe the reasons for cracking.			
I can describe the production of smaller alkane molecules and alkene molecules from cracking.			
I can write equations to represent cracking.			
I can compare catalytic and steam cracking.			
Feeling confident? topics	I understand this well	I think I understand this	I need more help
I can describe the difference between ethane and ethene.			
I can predict products formed during steam cracking.			