

Chemistry flashcard



**ASSIGN
BUSTER**

The diagram below represents the industrial fractional distillation of crude oil. (i) Identify fraction A. (ii) What property of the fractions allows them to be separated in the column? (2) (b) A gas oil fraction from the distillation of crude oil contains hydrocarbons in the C₁₅ to C₂₅ range.

These hydrocarbons can be cracked by strong heating. (i) Write the molecular formula for the alkane with 19 carbon atoms. Name the type of reaction involved in cracking. (ii) Write an equation for one possible cracking reaction of the alkane C₁₉H₄₀ when the products include ethane and propane in the molar ratio 2: 1 and only one other compound.

(4) (Total 6 marks) 2. A compound of carbon, hydrogen and nitrogen contains 61. 0% of carbon and 15. 3% of hydrogen by mass. (i) Calculate the empirical formula of the compound.

(ii) What other piece of data is required to deduce the molecular formula from the empirical formula? (iii) If the molecular formula of the compound is the same as the empirical formula, draw two possible structures of the compound. Total 6 marks) 3. (a) Compound A (M_r = 215.

8) contains 22. 24% carbon, 3. 71% hydrogen and 74. 05% bromine by mass. Show that the molecular formula of A is C₁₀H₁₁Br.

3) (b) There are nine structural isomers of molecular formula C₁₀H₂₂, three of which have branched carbon chains. Give the names and draw the displayed formulae for any two of the branched chain isomers of C₁₀H₂₂. (4) (Total 8 marks) 4. The table below shows the fractions obtained from crude oil.

Name of fraction Number of carbon atoms Use Gases 1-4 bottled fuels for camping Petrol (gasoline) 4-12 fuel for cars Naphtha 7-14 11-15 jet fuel Gas oil (diesel) 15-19 central heating fuel Mineral oil 20-30 lubrication Fuel oil 30-40 Wax 41-50 candles Bitumen over 50 road surfacing

a) Complete the table above by writing in the empty boxes (b) Give one structural formula in each case for the following components of crude oil: (i) the isomer of C₆H₁₄ with the lowest boiling point a saturated compound with molecular formula C₁₀H₂₂ (c) Give a molecular formula for each of the following components of crude oil: (i) the alkaline which, on cracking, forms, as the only products, two moles of ethane and one mole of butane per mole of alkaline. The straight chain alkaline found in the petrol fraction which contains the lowest percentage by mass of hydrogen.

Refer to the table at the start of the question to deduce your answer. (2) (d) Write an equation for the complete combustion of the alkaline which requires 11 moles of oxygen per mole of alkaline for complete combustion. (2) (Total 9 marks) 5.

There are eight structural isomers with the molecular formula C₆H₁₄. Four of these are classed as primary, three as secondary and one as tertiary.

The graphical formula of one of the secondary compounds, isomer A, is shown below. Isomer A (i) Give the name of isomer A. (ii) Explain what is meant by the term structural isomers. (iii) Draw the graphical formula of the tertiary compound with molecular formula C₆H₁₄, isomer B.

(1) Total 5 marks) 6. (a) Central heating fuel is obtained by distillation of crude oil. An alkaline present in central heating fuel contains 16 carbon

atoms per molecule. When a molecule of this alkaline is cracked, propane is formed. (i) Name the crude oil fraction used as central heating fuel. (ii) Write an equation for the cracking of the 16-carbon alkaline to form octane, propane and ethane as the only products commercial use of propane.

Give one important (b) A catalytic converter in the exhaust system of a car contains a ceramic honeycomb covered with a thin coating of the catalyst. When hot gases containing nitrogen monoxide and unburnt octane are passed over the catalyst, they react to form nitrogen, carbon dioxide and water. (i) Explain why the catalyst is coated on a honeycomb. (ii) Write an equation for the reaction of octane with nitrogen monoxide to form nitrogen, carbon dioxide and water. (4) 7.

There are five structural isomers of the molecular formula $C_{10}H_{22}$ which are alkenes.

The graphical formulae of two of these isomers are given. Isomer 1 Isomer 2
Draw the graphical formulae of two of the remaining alkane structural isomers. (Total 2 marks) 8. (a) Petrol engines in cars produce a number of pollutants which can be removed by catalytic converters.

Discuss this statement, indicating what the pollutants are, how they arise and how they are removed as efficiently as possible in a catalytic converter. Write equations for any reactions you discuss. (11) (b) Petrol is obtained, not only by fractional distillation of crude oil, but also by cracking of hydrocarbons from heavy fractions.

State why hydrocarbons from heavy fractions are cracked and explain why these hydrocarbons are less easy to ignite than those in petrol. (4) (Total 15 marks) 9. Ethane and other important hydrocarbons can be produced industrially from decane, $\text{C}_{10}\text{H}_{22}$.

Name the process involved and give the name of the mechanism occurring. Write two equations for reactions in which ethane is formed from decane by this process. Explain the economic importance of the process. (Total 8 marks) 10.

There are four structural isomers of molecular formula $\text{C}_4\text{H}_9\text{Br}$. The structural formulae of two of these isomers are given below. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ (it) Name isomer 1. (Total 3 marks) 11.

Catalytic cracking and thermal cracking of petroleum fractions produce different types of products, both of which are valuable.

Discuss the catalytic cracking of a petroleum fraction. In your answer you should state the conditions used and the type of mechanism involved. Identify the products formed and state their uses. Give two economic reasons for the catalytic cracking of alkanes. (Total 9 marks) (a) Four members to the homologous series to alkanes are ethane, propane, but-1-ene and pent-1-ene. (i) Give one structural feature of the compounds that makes them members of the homologous series of alkanes.

(1) (ii) State the trend in the boiling points from ethane to pent-1-ene. 1) (iii) Give the name and draw the structural formula of an alkene that is an isomer of but-1-ene and that has a different carbon skeleton. Total 4 marks)

13. (a) Gas oil (diesel), kerosene (paraffin), mineral oil (lubricating oil) and petrol (gasoline) are four of the five fractions obtained by the fractional distillation of crude oil within the temperature range 40-400 °C. Identify the missing fraction and state the order in which the five fractions are removed as the fractionating column is ascended.

Give two reasons why the fractions collect at different levels in the fractionating column. (4) (b) Thermal cracking of large hydrocarbon molecules is used to produce alkenes. State the type of mechanism involved in this process.

Write an equation for the thermal cracking of C₁₀H₂₂ in which ethane and propane are produced in a 3: 2 molar ratio together with one other product.

(3) (c) Write equations, where appropriate, to illustrate your answers to the questions below. (i) Explain why it is desirable that none of the sulfur-containing impurities naturally found in crude oil are present in petroleum fractions.

(ii) The pollutant gas NO is found in the exhaust gases from petrol engines. Explain why NO is formed in petrol engines but is not readily formed when petrol burns in the open air. (iii) The pollutant gas CO is also found in the exhaust gases from petrol engines. Explain how CO and NO are removed from the exhaust gases and why the removal of each of them is desirable.

(10) (Total 17 marks) 14.

A) Gas oil (diesel), kerosene (paraffin), mineral oil (lubricating oil) and petrol

(c) Write equations, where appropriate, to illustrate your answers to the questions Explain why it is desirable that none of the sulfur-containing

impurities naturally found in crude oil are present in petroleum fractions. (it)

The pollutant gas NO is found in the exhaust gases from petrol engines.

Explain why NO is formed in petrol engines but is not readily formed when petrol burns in the open air. (ii) The pollutant gas CO is also found in the exhaust gases from petrol engines.

Explain how CO and NO are removed from the exhaust gases and why the removal of each of them is desirable. (10) 15. (a) Crude oil is separated into fractions by fractional distillation. Outline how different fractions are obtained by this process. (3) (b) The table below gives details of the supply of, and demand for, some crude oil fractions. (1) Use the data given above to explain why catalytic cracking of crude oil fractions is commercially important.

Give the two main types of product obtained by catalytic cracking. (4) c) Name a catalyst used in catalytic cracking. State the type of mechanism involved and outline the industrial conditions used in the process. (4) (Total 11 marks) 16. Many hydrocarbon compounds burn readily in air. (i) Write an equation to show the complete combustion of C₄H₁₀ (ii) One of the gaseous products of the incomplete combustion of methane in gas fires is known to be poisonous.

Identify this product and write an equation for the reaction in which it is formed from methane. (Total 4 marks) 17. The alkanes form an homologous series of hydrocarbons.

The first four straight-chain alkanes are shown below.

Methane CH_4 ethane C_2H_6 propane C_3H_8 butane C_4H_{10} (a) (i)

State what is meant by the term hydrocarbon. (ii) Give the general formula for the alkane. (iii) Give the molecular formula for hexane, the sixth member of the series. (3) (b) Each homologous series has its own general formula.

State two other characteristics of an homologous series. (2) (c) Branched-chain structural isomers are possible for alkanes which have more than three carbon atoms. (i) State what is meant by the term structural isomers. (d) Name the two isomers of hexane shown below.

Give the structures of two other branched-chain isomers of hexane.

A hydrocarbon, W, contains 92. % carbon by mass. The relative molecular mass of W is 78.

(i) Calculate the empirical formula of W. Calculate the molecular formula of

W. 18. (a) Butane, C_4H_{10} , is a hydrocarbon which is used as a fuel. (i)

Explain what is meant by the term hydrocarbon.

(ii) Explain what is meant by the term fuel. (iii) Write an equation for the complete combustion of butane. (iv) Write an equation for the incomplete combustion of butane to produce carbon monoxide and water. (v) Under what conditions would you expect incomplete combustion to occur? (5) (b) Ethane can be cracked in the presence of a catalyst to produce ethene and hydrogen. (i) Write an equation for this reaction. (ii) Give a suitable catalyst for this reaction.

(iii) State one reason why cracking is important. 19. Four isomers with the formula C_4H_{10} are given below. Isomer Name $CH_3CH_2CH_2CH_3$ butane-1-ol 2-methylpropan-2-ol (i) Complete the naming of the isomers in the table above. (ii) Name the type of isomerism shown by these four isomers. (Total 3 marks) 20.

(a) Crude oil is composed mainly of alkanes, which are saturated hydrocarbons. (i) State what is meant by the term hydrocarbon. (ii) State what is meant by the term saturated, as applied to a hydrocarbon. (2) b) Crude oil can be separated into the fractions listed in the table below.

Name of fraction	Number of carbon atoms
ALP (liquefied petroleum gas)	4-?
Mineral oil (lubricating oil)	20 - 30

(i) Name the process used to obtain these fractions from crude oil.

Complete the table by naming the missing fraction. (c) Some of the naphtha fraction is thermally cracked to produce more useful products. (i) Give the molecular formula of an alkane with ten carbon atoms. (ii) Write an equation to illustrate the thermal cracking of one molecule of tetrahedral, C_4H_{10} , in which the products are ethane and propane, in the ratio of 2: 1, and one other product. (iii) Name the mechanism involved in thermal cracking.

21. The burning of fossil fuels can produce atmospheric pollutants. A) The combustion of petrol in an internal combustion engine can lead to the formation of carbon monoxide, CO, and nitrogen monoxide, NO. (i) Write an equation for the incomplete combustion of octane, C_8H_{18} , to produce CO

and water only. (it) State one essential condition for the formation of NO in an engine.

Write an equation for the reaction in which NO is formed. (3) (b) All new petrol-engines cars must be fitted with a catalytic converter. (i) Name one of the metals used as a catalyst in a catalytic converter. (it) Write an equation to show how CO and NO react with each other in a catalytic converter. (2) (c) State why sulfur dioxide gas is sometimes found in the exhaust gases of petrol- engines cars.

Give one adverse effect of sulfur dioxide on the environment. (2) (Total 7 marks) 22. (a) (i) Name the process used to separate petroleum into fractions. (it) Give the molecular formula for an alkaline with nine carbon atoms. (iii) Write an equation for the complete combustion of the alkaline CLC IHA (v) Write an equation for the incomplete combustion of CLC 1 H₂O to produce carbon and water only. (4) (b) Alkenes can be produced by cracking the naphtha fraction obtained from petroleum.

(i) Write an equation for the thermal cracking of one molecule of C₁₀H₂₀ to give one molecule of propane and one molecule of an alkene only. (it) Draw the structure of the chain isomer of but-1-ene. (c) The alkane and the alkenes are examples of homologous series of compounds. One feature of an homologous series is the gradual change in physical properties as the relative molecular mass increases. State two other general features of an homologous series of compounds. 2) 23.

Petroleum is separated into fractions by fractional distillation. The petrol fraction (C₄ to C₁₂) is burned in internal combustion engines and the naphtha

fraction (CA to CA) is cracked. (a) Petroleum is separated into fractions when it is heated and the vapor mixture is passed into a fractionating column. (i) Explain what is meant by the term fraction as applied to fractional distillation. (ii) State a property of the molecules in petroleum which allows the mixture to be separated into fractions.

(iii) Describe the temperature gradient in the column. (b) The fractions from petroleum contain alkaline hydrocarbons. (i) Write an equation for the incomplete combustion of the alkaline hydrocarbon to produce carbon monoxide and water only. One isomer of the hydrocarbon is Draw the structure of this isomer.

(2) (c) State one economic reason for the cracking of petroleum fractions. (1)

(d) (i) Give the type of reactive intermediate formed during catalytic cracking. (ii) Identify a catalyst used in catalytic cracking. (e) (i) Give the type of reactive intermediate formed during thermal cracking.

State how this reactive intermediate is formed. (ii) Identify the different type of hydrocarbon produced in a high percentage by the thermal cracking of alkaline.

(3) 24. The fractions obtained from petroleum contain saturated hydrocarbons that belong to the homologous series of alkanes. (a) Any homologous series can be represented by a general formula. (i) State two other characteristics of homologous series. (ii) Name the process which is used to obtain the fractions from petroleum.

(iii) State what is meant by the term saturated, as applied to hydrocarbons.

(4) (b) Ethane has the molecular formula C_2H_6 (i) State what is meant by

the term molecular formula. It) Give the molecular formula of the alkaline which contains 14 carbon atoms. III) Write an equation for the incomplete combustion of decane, $C_{10}H_{22}$, to produce carbon and water only. (3)

(c) When petrol is burned in an internal combustion engine, some nitrogen monoxide, NO , is formed.

This pollutant is removed from the exhaust gases by means of a reaction in a catalytic converter. (I) Write an equation for the reaction between nitrogen and oxygen to form nitrogen monoxide. (ii) Identify a catalyst used in a catalytic converter. (iii) Write an equation to show how nitrogen monoxide is removed from the exhaust gases as they pass through a catalytic converter. (3) (Total 10 marks)