2.8 Organic Chemistry: 30-minute Pack

AQA 8462 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student cracks a sample of a long-chain hydrocarbon (decane) using a catalyst and heat, producing useful shorter hydrocarbons, one of which is an alkane and one of which is an alkene.

(a) State the general name for the process that breaks large hydrocarbon molecules into smaller, more useful molecules. **(1)**

(b) Give one safety precaution the student should follow when heating the hydrocarbon sample using a Bunsen burner, and explain why this precaution is needed. **(2)**

(Total for Question 1 is 3 marks)

2 Polymers are long chains of repeating units. Poly(ethene) is made from ethene monomers.

(a) Describe, in simple terms, how many small ethene molecules join together to make poly(ethene). **(2)**

(b) Give one everyday use for poly(ethene). **(1)**

(Total for Question 2 is 3 marks)

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3 Alkenes are a homologous series of unsaturated hydrocarbons.

(a) State the general formula of an alkene. **(1)**

(b) State the type of bond that makes alkenes unsaturated, and explain what 'unsaturated' means in this context. **(2)**

(Total for Question 3 is 3 marks)

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4 A student cracks 71.0 g of decane using a catalyst and heat. The cracking reaction produces octane and ethene in a 1:1 mole ratio: $C_{10}H_{22}$ -> C_8H_{18} + C_2H_4. Mr values: decane $C_{10}H_{22}$ = 142, octane C_8H_{18} = 114. The actual yield of octane obtained is 72% of the maximum possible mass.

(a) Calculate the maximum theoretical mass of octane that could be produced from 71.0 g of decane (before yield). **(2)**

(b) Using the 72% yield, calculate the actual mass of octane produced. **(2)**

(Total for Question 4 is 4 marks)

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5 Hydrocarbons can be separated by fractional distillation. A student distils a mixture and collects two fractions. Fraction A boils at about 40°C and Fraction B boils at about 180°C.

(a) Suggest which fraction (A or B) contains smaller hydrocarbon molecules and explain your reasoning. **(2)**

(b) Give one industrial product that would be expected to have a boiling point near 180°C and be found in the heavier fractions. **(2)**

(Total for Question 5 is 4 marks)

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6 Name the homologous series that contains compounds with the general formula C_nH_{2n+2} and give one chemical property common to members of this series.

(a) Name the homologous series with general formula C_nH_{2n+2}. **(1)**

(Total for Question 6 is 1 mark)

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7 Describe what is meant by a 'functional group' in organic chemistry and give one example relevant to alcohols.

(a) Define functional group. **(1)**

(b) Give one example of a functional group and name the homologous series it identifies. **(1)**

(Total for Question 7 is 2 marks)

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8 Bromine water is used as a chemical test to distinguish between alkanes and alkenes.

(a) State what you would observe when bromine water is added to and shaken with an alkane, such as hexane. **(1)**

(b) State what you would observe when bromine water is added to and shaken with an alkene, such as hexene. **(1)**

(c) Explain, in terms of bonding, why alkenes decolourise bromine water but alkanes do not. **(2)**

(Total for Question 8 is 4 marks)

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Mark scheme · 2.8 Organic Chemistry: 30-minute Pack

Question 1

(a) cracking cao **B1**

(a) Answer: Cracking.

(b) states a valid precaution such as wear eye protection, keep the flame away from the flammable hydrocarbon sample and vapour, or work in a well-ventilated area/fume cupboard **M1**

(b) gives a reason linked to the precaution: e.g. hydrocarbons and their vapours are flammable and could ignite, or fumes could be harmful if inhaled, oe **A1**

(b) Answer: Keep the flame away from the flammable hydrocarbon sample and work in a well-ventilated area, because hydrocarbon vapours are flammable and could ignite or be harmful if inhaled.

Question 2

(a) states that many ethene monomers join together in a repeating chain (polymerisation) **M1**

(a) refers to the breaking of the double bond and joining of carbon atoms to make a long chain, oe **A1**

(a) Answer: Many ethene monomers join together by opening their C=C double bonds and linking the carbon atoms into a long repeating chain.

(b) e.g. plastic bags, plastic bottles, packaging, containers, oe **B1**

(b) Answer: Plastic bags or packaging.

Question 3

(a) C_nH_{2n} **B1**

(a) Answer: C_nH_{2n}

(b) a carbon-carbon double bond (C=C) **B1**

(b) unsaturated means the molecule does not contain the maximum possible number of hydrogen atoms/contains at least one C=C double bond (oe) **B1**

(b) Answer: Alkenes contain a C=C double bond; unsaturated means they do not have the maximum number of hydrogens possible for that number of carbons.

Question 4

(a) calculates moles of decane: 71.0 / 142 = 0.500 moles **M1**

(a) correct theoretical mass: mass = moles x Mr = 0.500 x 114 = 57.0 g cao **A1**

(a) Answer: 57.0 g

(b) applies yield: actual mass = 57.0 x 0.72 **M1**

(b) 41.0 g cao **A1**

(b) Answer: 41.0 g

Question 5

(a) identifies Fraction A as smaller molecules **M1**

(a) reason relates lower boiling point to smaller molecules having weaker intermolecular forces/less surface area, oe **A1**

(a) Answer: Fraction A contains smaller hydrocarbon molecules, because its lower boiling point indicates weaker intermolecular forces associated with smaller molecules.

(b) kerosene or diesel fuel as an example located in heavier fractions **B1**

(b) accept naming kerosene or diesel as a single example cao **B1**

(b) Answer: Diesel fuel (a heavy fraction).

Question 6

(a) alkanes cao **B1**

(a) Answer: Alkanes

Question 7

(a) a group of atoms in a molecule responsible for the characteristic chemical reactions of that molecule/homologous series, oe **B1**

(a) Answer: A functional group is a group of atoms responsible for the characteristic reactions of a molecule or homologous series.

(b) -OH (hydroxyl group) identifies the alcohols, oe (accept -COOH for carboxylic acids, or C=C for alkenes) **B1**

(b) Answer: The -OH (hydroxyl) group identifies the alcohols.

Question 8

(a) no colour change / bromine water stays orange(-brown) **B1**

(a) Answer: No colour change (stays orange-brown).

(b) bromine water is decolourised / turns from orange(-brown) to colourless **B1**

(b) Answer: The bromine water turns from orange-brown to colourless.

(c) alkenes contain a C=C double bond, which can undergo an addition reaction with bromine (oe) **M1**

(c) alkanes are saturated (contain only single C-C and C-H bonds) and have no double bond available to react, so no reaction occurs (oe) **A1**

(c) Answer: Alkenes have a reactive C=C double bond that reacts with bromine by addition; alkanes are saturated with no double bond, so they do not react.

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