InkChemistry

QUESTION WORKBOOK

Planning a synthetic route

Organic synthesis · Unit C22

AQA 3.3.14 · OCR A 4.2.3, 6.2.4, 6.2.5

21 questions · 76 marks

PRINT EDITION

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SECTION A · Short, 1 to 2 marks

A1 PSR-Q8

Explain why acidified potassium dichromate(VI) gives propanal from propan-1-ol if the product is distilled, but propanoic acid if the mixture is heated under reflux. [2]

SECTION B · Standard, 3 to 5 marks

B1 PSR-Q15

Evaluate two routes to butylamine, $CH_3CH_2CH_2CH_2NH_2$: route A, one step from 1-bromobutane with excess ethanolic ammonia in a sealed tube; route B, two steps from 1-bromopropane through butanenitrile. [5]

B2 PSR-Q1

State the reagents and conditions for each step when 1-bromobutane is converted into pentylamine, $CH_3(CH_2)_4NH_2$, in two steps through pentanenitrile, and name the type of reaction in each step. [4]

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B3 PSR-Q4 Outline a two-step synthesis of phenylamine from benzene, giving the reagents and conditions for each step and naming the intermediate. [4]

B4 PSR-Q12 Suggest a two-step synthesis of 1-phenylethanol, $C_6H_5CH(OH)CH_3$, from benzene, and suggest why the product does not rotate plane-polarised light. [4]

B5 PSR-Q13 Suggest a two-step synthesis of 2-hydroxypropanenitrile, $CH_3CH(OH)CN$, from ethanol, with reagents and conditions, and suggest one hazard of the second step. [4]

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B6 PSR-Q16 Identify the reagents and conditions for making methyl propanoate from propanoic acid, and from propanoyl chloride, and identify one advantage and one disadvantage of the second method. [4]

B7 PSR-Q18 Suggest a two-step synthesis of propyl propanoate, $CH_3CH_2COOCH_2CH_2CH_3$, in which propan-1-ol is the only organic starting material. [4]

B8 PSR-Q20 Outline how bromoethane is converted into propanoic acid using a Grignard reagent, and explain why water must be excluded. [4]

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B9 PSR-Q21 Suggest how a Grignard reagent could be used to make 2-methylpropan-2-ol, $(CH_3)_3COH$, naming the halogenoalkane and the carbonyl compound, giving the conditions, and writing an equation for the formation of the Grignard reagent. [4]

B10 PSR-Q23 Justify the order of the steps in the route from ethene to 2-hydroxypropanenitrile, $CH_3CH(OH)CN$: ethene to ethanol with steam, ethanol to ethanal with acidified potassium dichromate(VI) and distillation, then ethanal to the hydroxynitrile with potassium cyanide followed by dilute acid. [4]

B11 PSR-Q2 Give the reagents and conditions needed to convert propan-1-ol into propanal, propan-1-ol into propanoic acid, and propan-2-ol into propanone. [3]

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B12 PSR-Q3 Explain why sodium tetrahydridoborate rather than $LiAlH_4$ is used to reduce butanone to butan-2-ol in a school laboratory, giving the conditions for the reduction. [3]

B13 PSR-Q6 Explain, by comparing carbon skeletons, why a synthesis of butylamine, $CH_3CH_2CH_2CH_2NH_2$, from 1-bromopropane needs a nitrile step, while a synthesis of propylamine from 1-bromopropane does not. [3]

B14 PSR-Q7 Explain why propylamine made from 1-bromopropane and ammonia is impure, and why the route through propanenitrile avoids the problem. [3]

B15 PSR-Q11 Suggest a two-step synthesis of propanone from propene, giving the reagents and conditions and naming the intermediate. [3]

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B16 PSR-Q14 Compare the reactions of 2-bromopropane with potassium hydroxide dissolved in water and with potassium hydroxide dissolved in ethanol. [3]

B17 PSR-Q17 Explain why chemists aim to design processes that do not need a solvent. [3]

B18 PSR-Q19 Suggest a two-step synthesis of butanoic acid from 1-bromopropane that passes through a nitrile, giving the reagents and conditions for each step. [3]

B19 PSR-Q22 Explain why the carbon bonded to magnesium in ethylmagnesium bromide acts as a nucleophile, and why with methanal it gives a primary alcohol but with propanal a secondary alcohol. [3]

SECTION C · Long, 6 marks or more

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C1 PSR-Q5 Outline a three-step synthesis of 2-methylpropan-1-amine, $(CH_3)_2CHCH_2NH_2$, from propene. For each step give the reagents and conditions and name the product, and explain why the route gives a branched chain. [6]

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