Chemistry

Higher level

Paper 2

Practice paper

Topic: Organic Chemistry

Chemistry

Higher level

Paper 2

Specimen paper

2 hours 15 minutes

Instructions to candidates

- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [80 marks].

1. Consider the lengthy reaction pathway converting propene into essentially pure propanoic acid.

(a) State the reagents and conditions strictly necessary to convert propene to propan-1-ol, taking care to achieve anti-Markovnikov or standard addition requirements. **[3]**

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(b) Specify the detailed oxidation setup required to fully convert propan-1-ol to propanoic acid without stopping at the intermediate aldehyde. **[2]**

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2. Lactic acid (2-hydroxypropanoic acid) exists as a pair of enantiomers.

(a) Describe the specific physical technique used to differentiate between the two pure enantiomeric forms of lactic acid. **[2]**

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3. Primary halogenoalkanes react with nucleophiles generally via an S_N2 mechanism.

(a) Explain the notation "S_N2" using proper kinetic terminology. **[2]**

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(b) Draw the mechanism for the reaction between hydroxide ions and bromoethane, showing the use of curly arrows and representing the transition state. **[4]**

4. Heating 2-bromopropane with sodium hydroxide can produce either propan-2-ol or propene, depending strictly on the solvent environment.

(a) Identify the solvent condition that heavily favors the formation of propene over propan-2-ol. **[1]**

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5. The addition of hydrogen bromide to but-1-ene yields two structural isomers.

(a) Identify the major product and utilize carbocation stability to mathematically/theoretically justify why it is formed in greater yield. **[3]**

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6. Benzene reacts with a mixture of concentrated nitric acid and concentrated sulfuric acid to form nitrobenzene.

(a) Formulate the chemical equation demonstrating how the strong acid mixture generates the nitronium ion (NO_2^+) electrophile. **[2]**

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7. A ketone with the formula C_4H_8O produces a mass spectrum with significant peaks at m/z = 43 and m/z = 72.

(a) Identify the specific fragments responsible for these two peaks and state the structural naming of the ketone. **[3]**

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8. Infrared (IR) Spectroscopy depends on the stretching and bending of bonds.

(a) Explain why diatomic oxygen (O_2) does not absorb IR radiation, while entirely different gases like carbon dioxide (CO_2) do. **[2]**

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9. Condensation polymers generate small molecule byproducts during synthesis.

(a) Deduce the structure of the smallest repeat linkage connecting an amine monomer with a dicarboxylic acid monomer. **[2]**

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10. Solvent choice exerts immense influence on SN mechanisms.

(a) Explain theoretically why polar aprotic solvents (like propanone or DMSO) accelerate S_N2 reactions relative to polar protic solvents (like water or ethanol). **[2]**

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