

Worksheet 12.2

Organic reaction pathways

NAME:

CLASS:

INTRODUCTION

This worksheet looks at two organic reaction pathways, and allows you to apply your knowledge of organic reactions to solve for 'unknown' compounds in these pathways.

No.	Question	Answer
1	<p>The reaction pathway shown below leads to the production of organic compound G, propyl ethanoate. Complete the diagram by drawing structural formulas for compounds A to G, and writing the systematic name for each compound in the boxes provided.</p> <p>The diagram shows a reaction pathway starting with compound A. A downward arrow from A is labeled with H₂O and H⁺(aq). This leads to box B. From B, a rightward arrow is labeled 'strong oxidant' and leads to box C. From C, a rightward arrow is labeled 'H⁺(aq)' and leads to box G, which is labeled 'propyl ethanoate'. From box D, an upward arrow is labeled with Cl₂ and UV, leading to box E. From E, a rightward arrow is labeled 'OH⁻(aq)' and leads to box F. From box F, a rightward arrow is labeled 'H⁺(aq)' and leads to box G. Boxes A, B, C, D, E, and F are empty for the student to complete.</p>	
2	Describe a chemical test that could be used to distinguish between compounds A and D.	
3	Describe a chemical test that could be used to distinguish between compounds C and G.	

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No.	Question	Answer
4	Which compound, B or F, would be expected to have the higher boiling point? Explain your choice.	

Organic compounds H and I have the same molecular formula, C_4H_8 . Compound H is reacted with $HCl(g)$ and a suitable catalyst. Two organic products, compounds J and K, are isolated. Compound J undergoes reaction with $OH^-(aq)$ to produce compound L. Compound L is oxidised to produce compound M. Compound M undergoes reaction with $Na_2CO_3(aq)$ to produce $CO_2(g)$. Compound I also reacts with $HCl(g)$ and a suitable catalyst to produce a single organic product, compound K. In another reaction, compound I undergoes addition polymerisation to form organic compound N.

No.	Question	Answer
5	What is the general name given to compounds H and I?	
6	What does the reaction of compound M with $Na_2CO_3(aq)$ suggest about compound L?	
7	Complete the diagram below by drawing structural formulas for compounds H to N, and writing the systematic name for each compound in the boxes provided.	

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graph TD
    H[H] -- "HCl/catalyst" --> J[J]
    H -- "HCl/catalyst" --> K[K]
    I[I] -- "HCl/catalyst" --> K
    I -- "high temperature and pressure" --> N[N]
    J -- "OH-(aq)" --> L[L]
    L -- "oxidant" --> M[M]
    
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Worksheet 12.2: Solutions

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No.	Answer
1	Compound A: ethene, CH_2CH_2 Compound B: ethanol, $\text{CH}_3\text{CH}_2\text{OH}$ Compound C: ethanoic acid, CH_3COOH Compound D: propane, $\text{CH}_3\text{CH}_2\text{CH}_3$ Compound E: 1-chloropropane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ Compound F: propan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ Compound G: propyl ethanoate, $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$
2	Test with bromine solution. Compound A (unsaturated) will decolourise bromine, while D (saturated) will not.
3	C is acidic and will produce a solution with pH less than 7. G is neither acidic nor basic; its solution will be neutral.
4	B and F belong to the primary alkanol homologous series. F is larger than B and so will have larger dispersion forces between molecules, leading to a higher boiling point.
5	Isomers
6	Compound L is an acid (i.e. contains an acidic functional group).
7	Compound H: but-1-ene, $\text{CH}_2\text{CHCH}_2\text{CH}_3$ Compound I: but-2-ene, $\text{CH}_3\text{CHCHCH}_3$ Compound J: 1-chlorobutane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ Compound K: 2-chlorobutane, $\text{CH}_3\text{CH}(\text{Cl})\text{CH}_2\text{CH}_3$ Compound L: butan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ Compound M: butanoic acid, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ Compound N: polybut-2-ene, $\dots-\text{CHCH}_3\text{CHCH}_3\text{CHCH}_3\text{CHCH}_3-\dots$

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