# 6.1 Introduction to organic chemistry



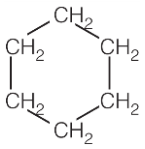
## Pages 169–170 Exam practice questions

**1 a)** For 1 mark each, any two of:

- ability to catenate/form long chains and rings
- the unreactive nature of C–C and C–H bonds
- ability to form four bonds
- ability to form C–C, C=C and C≡C bonds
- ability to form isomers. [2]

**b) i)** Compounds with the same molecular formula [1] but a different structural formula. [1]

**ii)** $C_nH_{2n+2}$ [1] Allow any alkane from $C_6$ to $C_{10}$, e.g. $C_6H_{14}$, $C_{10}H_{22}$. [1]

**c)**  [1]

$C_nH_{2n}$ [1]

**2 a)** The empirical formula of X is $C_5H_{10}O$ [1] and its molecular formula is also $C_5H_{10}O$. [1]

The skeletal formula of X is  [1]

A functional group is a group of atoms [1] which gives an organic compound its characteristic properties. [1] The functional groups in X are the alkene group [1] (accept carbon–carbon double bond) and the alcohol group [1] (also allow alkyl).

**b) i)** Pentan-1-ol [1]

**ii)** $CH_3CH_2CH{=}CHCH_2OH(g) + H_2(g) \rightarrow CH_3(CH_2)_3CH_2OH(g)$ [2]

**iii)** Pentan-2-ol and pentan-3-ol [2]

**iv)** $CH_3OCH_2CH_2CH_2CH_3$ or $CH_3CH_2OCH_2CH_2CH_3$ [1]

**3 a) i)** A compound containing carbon and hydrogen only. [1]

**ii)** $C_{12}H_{26}$ [1]

**iii)** $C_6H_{13}$ [1]

**b) i)** Highly reactive atom or group of atoms [1] with an unpaired electron. [1]

**ii)** $Cl{-}Cl \rightarrow Cl\bullet + \bullet Cl$ [1]

**iii)** Homolytic [1]

**iv)** 5 [1]

**v)** $CH_3(CH_2)_8CH_2Cl$ [1] 1-chlorodecane [1] (or 2-, 3-, 4- and 5-chlorodecane)

**4 a)** Elimination [1] **b)** Substitution [1]

**c)** Addition [1] **d)** Oxidation [1]

**e)** Substitution, hydrolysis [1] **f)** Polymerisation, addition [1]

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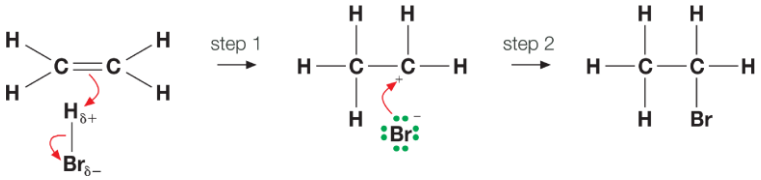
## Answers to Exam practice questions

**5 a) i)** An electrophile is a reactive molecule or ion that seeks out and reacts with electrons in molecules. [1]

Examples include, $H^+$ ions, $H^{\delta+}$ atoms in molecules such as H–Br [1]

**ii)**



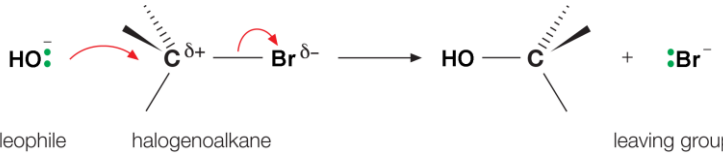

(3)

The H−Br bond is polar [1] with the hydrogen atom at the δ+ end of the dipole. [1]

**b) i)** A nucleophile is a molecule or ion with a lone pair of electrons which seeks out and forms new bonds with δ+ atoms in molecules. [1]

Examples include water molecules, hydroxide ions, cyanide ions, ammonia molecules. [1]

**ii)**




[3]

The C–Br bond is polar [1] with the carbon atom at the δ+ end of the dipole. [1]

**6 a)** Homolytic bond breaking is favoured with non-polar reactant [1] either in the gas phase or in non-polar solvents. [1]

Absorption of UV light can bring about homolytic fission. [1]

Heterolytic bond breaking is favoured if the organic reactant has polar bonds [1] and the reagents are ionic or highly polar. [1]

This type of bond breaking is also favoured by polar solvents. [1]

**b)** Reagents with a similar classification tend to react in similar ways with compounds of a particular type. [1]

The characteristic reactions of functional groups can be related to the types of reagents with which they react. [1]

This helps to explain and predict the reactions which are likely to take place. [1]

This makes it possible to select reagents for particular purposes. [1]

**7 a)** Number of moles of carbon dioxide in 408 $cm^3$ = $\frac{408}{24\,000}$ = 0.0170 mol [1]

Mass of carbon in this amount of carbon dioxide = 0.0170 × 12.0 = 0.204 g [1]

Mass of hydrogen in 0.308 g water = 0.308 × $\frac{2.0}{18.0}$ = 0.0342 g [1]

Mass of oxygen in original compound = (0.292 – 0.204 – 0.0342) g = 0.0538 g [1]

Ratio of masses C : H : O = 0.204 : 0.0342 : 0.0538

Ratio of moles $C : H : O = \frac{0.204}{12.0} : \frac{0.0342}{1.0} : \frac{0.0538}{16.0}$ [1]

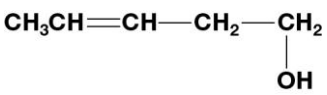
$= 0.017 : 0.0342 : 0.00336$

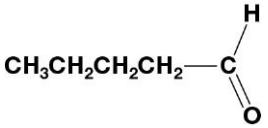
$= 5 : 10 : 1$

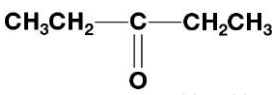
Empirical formula $= C_5H_{10}O$ [1]

**b)** If the compound were a (saturated) alcohol it would have 12 hydrogens. [1]

If cyclic, could be a cyclic ether such as  [1]

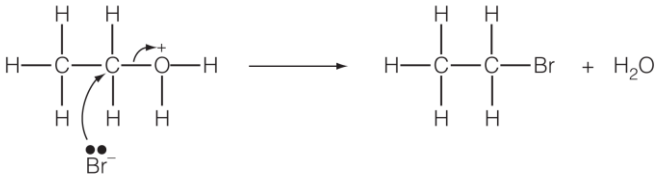
If unsaturated, could be an enol such as  [1]

Or an aldehyde such as  [1]

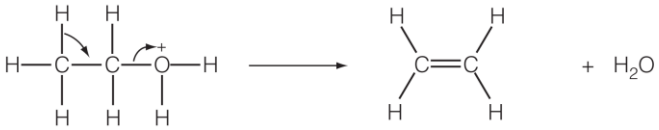
Or a ketone such as  [1]

**8 a)** 

[1] for arrow, [1] for structure of ion

**b)** 

[1] × 2 for arrows

**c)** 

[1] × 2 for arrows

**d)** The nucleophile is ethanol itself. [1] There is a lone pair of electrons on the oxygen atom of the −OH group. So this oxygen attacks the carbon atom of the $C–OH_2^+$ in an ethanol molecule that has gained a hydrogen ion from the acid. [1]

**e) i)** $(CH_3)_3COH$ [1]

**ii)** Physical: ethoxyethane has lower boiling temperature [1] because no hydrogen bonding occurs between molecules *Or* using IR, ethoxyethane has no O–H alcohols peak. [1]

Chemical: alcohol reacts with Na [1] to give effervescence; ethoxyethane does not. [1]