3.5 Organic chemistry 2005 Answers

QUESTION ONE: ORGANIC REACTIONS

a **i** Reagent 1: KOH in ethanol/alcohol
Reagent 2: NaOH(aq) / NaOH/KOH / KOH (aq)/H_2O with OH^- – *not H_2O*
Reagent 3: $SOCl_2$ / PCl_3 / PCl_5 – *not HCl)*

A = TWO correct.

ii Compound X (Minor product): $CH_3CH_2CH_2Br$ or full structure
Name of minor product: 1-bromopropane

CH_3CH_2COCl is propanoyl chloride

Compound Y: $CH_3CH_2COOCH_2CH_3$ **OR** Full structure
Name: ethyl propanoate

A = EITHER: Correct structure and name for compound X or Y OR Both structures X and Y correct OR Correct name for propanoyl chloride and correct name or structure for either compound X or Y OR Correct name for both compounds X and Y.
M = Understanding of reaction sequence demonstrated through FOUR answers correct.

b **i** Elimination: The molecule HCl (a Cl atom and an H atom) is removed and a double bond is created.

ii Substitution: Br^- /Br; is removed and replaced with an OH^-/OH group.

iii Oxidation: Oxygen is added **OR** hydrogen is removed **OR** electrons are lost **OR** the number of bonds to oxygen is increased **OR** the oxidation number of carbon increases ($Cr_2O_7^{2-}$ is an oxidising agent, $Cr_2O_7^{2-}$ is reduced to Cr3+ so the alcohol is oxidised).

A =TWO correct types of reaction.
M =Two types of reaction correct AND each of these two linked with a valid explanation.

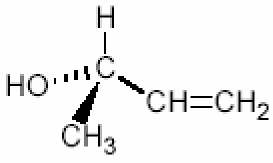
c If the major product (2-bromopropane) remains in the flask when reagent 2 (NaOH(aq)) is added, a substitution reaction would cause the formation of the 2° alcohol propan-2-ol ($CH_3CH(OH)CH_3$) as well as propan-1-ol) This would in turn be oxidised by the dichromate to the ketone, propanone (CH_3COCH_3).

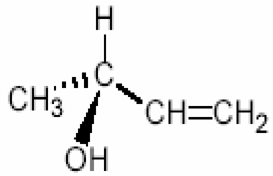
No further reaction with reagent 3 or ethanol will occur, so the final mixture would contain a lot of propanone and a smaller amount of the ester. (If all of the alcohol was not completely oxidised to the ketone, an ester with the ester group attached at the 2nd C atom might form with the propanoic acid and 2-chloropropane might result from excess propan-2-ol reacting with reagent 3.)

A = Either The major product is identified by name /structural formula/ description of Br on the second or middle carbon atom OR the nature of the major product is implied by the identification of the subsequent secondary alcohol.
M = Either Answer recognises that there are TWO possible substitution products with OH– i.e. a 1^0 and a 2^0 alcohol or the named products propan-1-ol and propan-2-ol.
E = Answer clearly indicates that oxidation would produce a ketone (propanone) CH_3COCH^3 (as the final product from propan-2-ol).

QUESTION TWO: ISOMERS

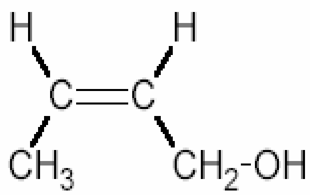
a Enantiomers of compound A:



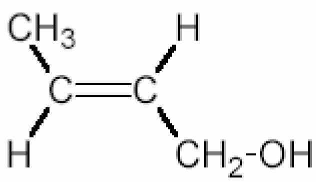


A = One isomer drawn correctly with 3D arrangement of groups around chiral OR The isomers are exact mirror images of a 3D structure that has a minor error in the formula or an error in the way the groups are connected to the chiral C atom.
M = Both isomers with correct formulae are drawn as Enantiomers showing 3-dimensionalarrangement around chiral C.

b Compound B (cis)



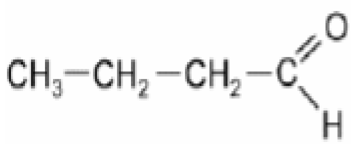
Compound C (trans)



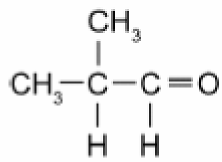
A = A correct structure is drawn for ONE compound, i.e. it contains a 1° alcohol group and an alkene group and is capable of *cis-trans* isomers OR Cis and trans isomers are shown but the OH is not 1°OR The *cis- trans* relationship is correct but there is a minor error in the formula of the 1st compound.
M = BOTH *cis-* and *trans-* isomers with correct formulae and the OH in the 1^0 position, are correctly drawn in the correct box.

c i **OR**

Compound D is **butanal**



methylpropanal



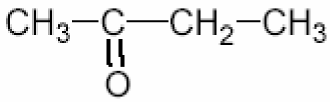
A = EITHER the name OR structural formula correct.

ii Tollens' – a silver mirror forms (silver or black particles precipitate)
Benedict's – a change from the blue solution to a green **OR** yellow **OR** orange **OR** orange-red **OR** red: colour precipitate.

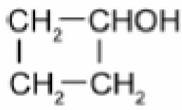
A = At least ONE of the observations correctly described.

d

Compound E is



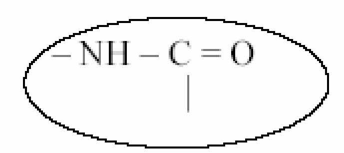
Compound F is



A = ONE structure drawn is correct and in either box. (E could also be a cyclic ether).
M = EITHER Compound F, the cyclic alcohol is in correct box OR TWO structures correct BUT NOT in the correct box.
E = Valid structure for BOTH compounds and in the correct box.

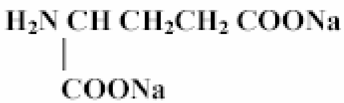
QUESTION THREE: POLYMERS

a i



A = At least one amide (peptide) link is circled.

ii Under alkaline conditions products would be:



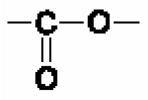
$H_2N\ CH(CH_2SH)COONa$

$H_2N\ CH_2COONa$

The above structures could have −COO^- instead of −COONa

Under acidic conditions the NH_2 group would be protonated (to NH_3^+) in each case and −COOH would be present instead of −COO^- or −COONa.

A = ONE correct hydrolysis product drawn with either −COO^- or −COONa or −COOH group.
M = EITHER Structures of TWO products of the alkaline hydrolysis (with −COONa, or −COO^-) *(not COOH)* OR for the acid hydrolysis the answer discusses the protonation of the NH_2 (to NH_3^+) and the presence of −COOH rather than −COONa (or −COO^-).
E = Correct structures of TWO products of the alkaline hydrolysis with −COONa or −COO^- *(not −COOH)* AND for the acid hydrolysis discusses the protonation of the −NH_2 (to −NH_3^+) and the presence of −COOH rather than −COONa (or −COO^-).

b • A polymer is a long chain molecule formed where many molecules or units (i.e. monomers) link together.
• Polyester chains are formed by condensation with the loss of H_2O or HCl at each ester linkage.
• Polyesters contain ester linkages. 

• A single monomer must be a hydroxyl alkanoic acid or hydroxy alkanoyl chloride
e.g. $HO(CH_2)_4COOH$ / HO-R-COOH **OR** $HO(CH_2)_4COCl$ / HO-R-COCl

• Two different monomers can be a diol and a dioic acid **OR** a diol and a dioyl chloride / **OR** two different hydroxy alkanoic acids **OR** two different hydroxy alkanoyl chlorides
e.g. $HOOC(CH_2)_nCOOH + HO(CH_2)_mOH$
$ClOC(CH_2)_nCOCl + HO(CH_2)_mOH$
$HOOC(CH_2)_nOH + HOOC(CH_2)_mOH$
$ClOC(CH_2)_n OH + ClOC(CH_2)_mOH$

A = Description includes any TWO of the bullet points.
M = Explanation shows understanding of the need for the monomers to be "double ended" AND general or specific structures are described or drawn for a single monomer / two different monomers that could be used to form a polyester.
E = Full discussion showing understanding of terms used in the given statement
Appropriate structures (general or specific) are drawn for monomers that could be used to form a polyester AND • two different monomers and the repeating unit of the polyester formed from them.

Judgement Statement

Chemistry: Describe aspects of organic chemistry (90698)

Achievement

SEVEN questions answered correctly.

Minimum of 6 × A

Achievement with Merit

EIGHT questions answered correctly, including at least FIVE at Merit level.

Minimum of 5 × M + 3 × A

Achievement with Excellence

NINE questions answered correctly, including at least FIVE at Merit level and at least TWO at Excellence level.

Minimum of 2 × E + 4 × M + 3 × A