Mark schemes

Q1.

(a)

1

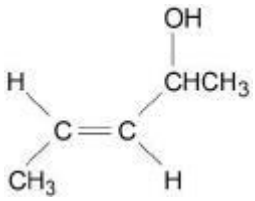
(b) Use Plane polarised light

M1

<u>rotates</u> (the plane of) in opposite directions

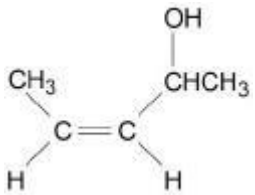
M2

(c)



Must be E isomer

M1

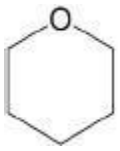


Must be Z isomer

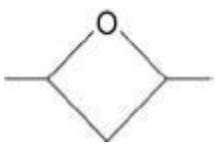
Allow 1 mark out of 2 for 2 correct structures but shown in the wrong boxes

M2

(d)



M1



M2

[7]

Q2.

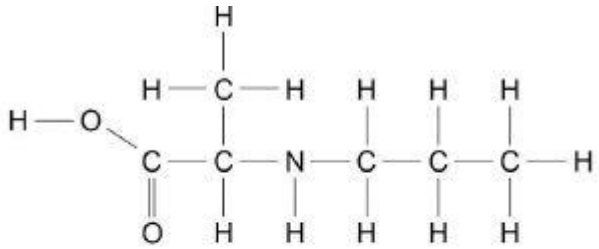
(a) One circled C atom only – The C attached to CH_3/C=O/ H and NH

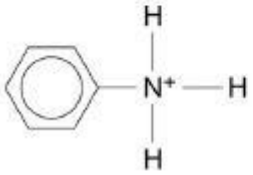
1

(b) Two ticks only for amine and amide

1

(c)

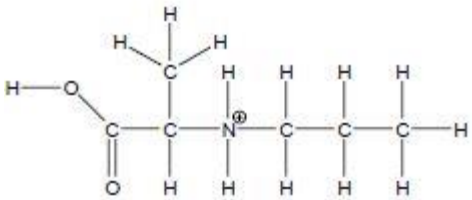




M1 *for choosing the correct bond to hydrolyse*

M2 *and* ***M3*** *for the correct structures of the products*

Allow protonated amino acid for M2



Allow $C_6H_5NH_3^+$ *or + outside a square bracket*

3

(d) **M1** Enzyme has an <u>active site</u>

1

M2

The G-Enantiomer / Enzyme has the correct stereo chemistry / stereospecific

Or

The G-Enantiomer / Enzyme has the complementary shape

For M2 allow opposite argument for F-Enantiomer

1

[7]

Q3.

(a) 2-hydroxyhexanenitrile

1

(b) (Plane) polarised light

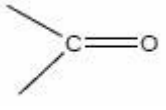
1

Enantiomers would rotate light in opposite directions

not different alone

1

(c) planar carbonyl group or

planar 

Not planar molecule,
not planar bond, not planar C=O

1

Attack from either side

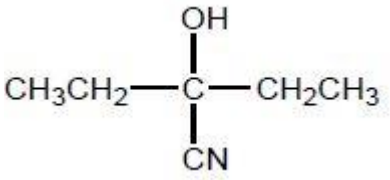
1

With equal probability

OR produces equal amounts (of the two isomers/enantiomers)

1

(d)



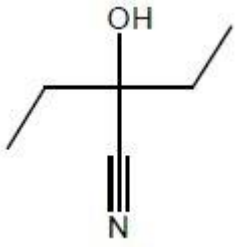
Does not contain a chiral centre

OR does not contain C attached to 4 different groups

OR contains two identical/ethyl groups

OR symmetrical (product)

Allow C_2H_5 or skeletal



M2 dependent on correct M1 (No structure = 0)
If pentan-3-one drawn then allow symmetrical ketone for M2

[8]

Q4.

D

[1]

Q5.

D

[1]

Q6.

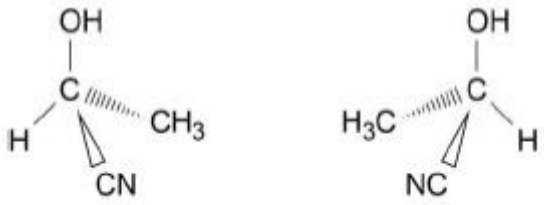
(a) 3

1

(b) Chain.

1

(c)



One 3D enantiomer.

1

Second enantiomer correctly drawn as 3D mirror image of first.

1

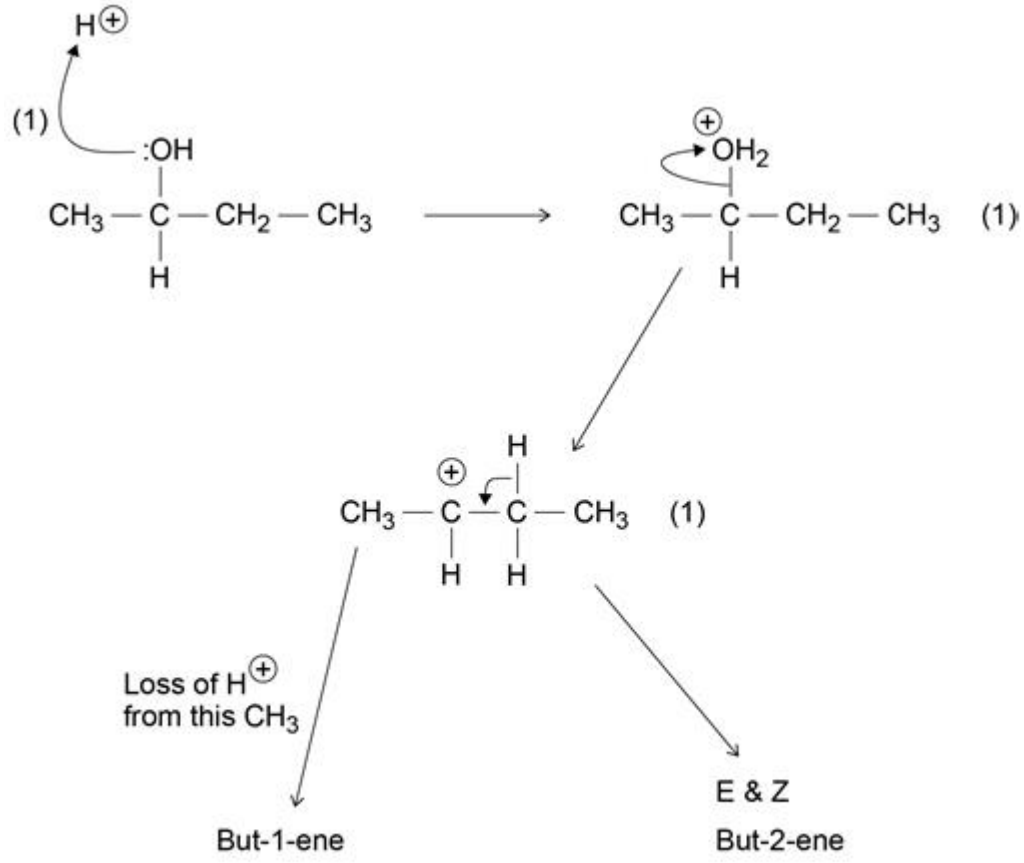
(d) Plane-polarised light.

1

Rotated in opposite directions.

1

(e) Elimination



Extended response question

M1

Mechanism (3 marks)

M2 arrow from lone pair on O to H^+

M3 1st intermediate **and** arrow from C–O^+H_2 bond to O (with loss of H_2O)

M4 2nd intermediate (carbocation) **and** arrow from C–H bond to C–C (with loss of H^+) to form C=C

M3 and M4 can be scored in one step (see alternative mechanism below).

If carbocation incorrect then answer cannot score maximum marks.

Explanation of formation of 3 alkenes

M5 loss of H^+ from C (in carbocation) adjacent to $^+$C (to which −OH was attached)

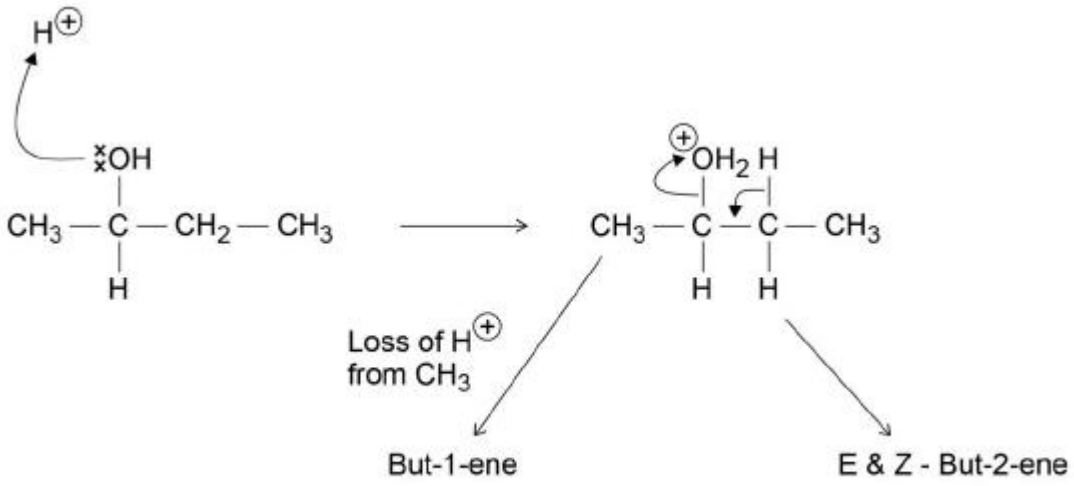
M6 From ^{1}**C**−^{2}C+–^{3}C–^{4}C leads to but-1-ene

M7 From ^{1}C–^{2}C$^+$–**^{3}C**–^{4}C leads to but-2-ene

M8 But-2-ene formed as mixture of *E-Z* isomers

8

Alternative mechanism



[14]

Q7.

D

[1]

Q8.

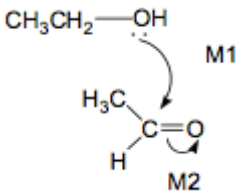
(a) (i) Nucleophilic addition

Any extra loses the mark

Allow minor spelling errors e.g. nucleophyllic

1

(ii)



M1 for arrow from lone pair on oxygen in ethanol to C of C=O (or to space half way between O and C)

M2 for arrow from C=O bond to oxygen in ethanal

Do not allow M2 as first step without nucleophilic attack, but can allow M1 for attack on C+ produced

+ rather than δ+ on C=O loses M2

Ignore any further steps

Mark independently

1

1

(b) (i) Equal mixture of enantiomers/optical isomers
OWTTE

1

(ii) (Non-superimposable) mirror images
Ignore rotates light in opposite directions
Ignore stereoisomers

1

(c) (i) Ethan**al** 0.33

1

Ethan**ol** 4.16
Allow 4.2 for ethanol

1

(ii) $K_c = \dfrac{[acetal][H_2O]}{[CH_3CHO][CH_3CH_2OH]^2}$ or with names

$\dfrac{(0.37/0.31)(0.65/0.31)}{(0.58/0.31)(3.76/0.31)^2}$ **OR** $\dfrac{(0.37)(0.65)}{(0.58)(3.76)^2} \times 0.31$

Ignore slips in acetal structure or formula $C_6H_{14}O_2$
If K_c wrong, allow M4 only for units conseq to their K_c
If volume omitted (gives 2.93×10^{-2}) may only score M1 and M4
If volume used = 310 cm^3 allow M2 then award M3 for 9.08 – 9.23 only and M4 for mol^{-1} cm^3 only
Treat error in converting 310 cm^3 to dm^3 as AE

M1
M2

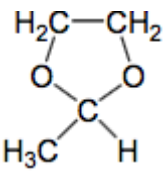
9.1×10^{-3}
Allow range 9.08×10^{-3} – 9.23×10^{-3}

M3

$mol^{-1}dm^3$
Not $moles^{-1}dm^3$

M4

(d)



1

[12]