

Mark schemes

1

(a) Electrophilic substitution

Both words needed

Ignore minor misspellings

1

(b) (i) Sn / HCl

OR H₂ / Ni **OR** H₂ / Pt **OR** Fe / HCl **OR** Zn / HCl **OR** SnCl₂ / HCl

Ignore conc or dil with HCl,

Allow (dil) H₂SO₄ but not conc H₂SO₄

Not allow HNO₃ or H⁺

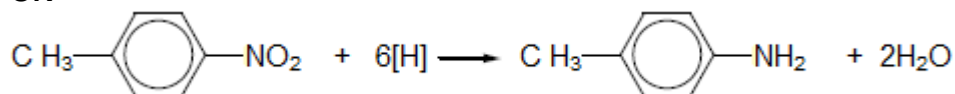
Ignore NaOH after Sn / HCl

Ignore catalyst

1

(ii) CH₃C₆H₄NO₂ + 6[H] → CH₃C₆H₄NH₂ + 2H₂O

OR



Allow molecular formulae as structures given

$$\text{C}_7\text{H}_7\text{NO}_2 + 6[\text{H}] \rightarrow \text{C}_7\text{H}_9\text{N} + 2\text{H}_2\text{O}$$

Qu states use [H], so penalised 3H₂

1

(iii) making dyes

OR making quaternary ammonium salts

OR making (cationic) surfactants

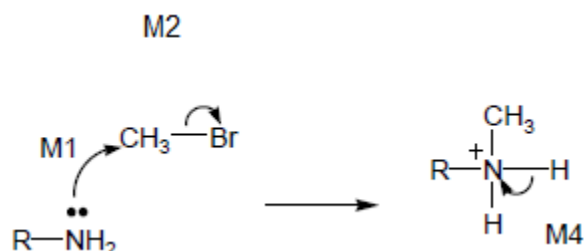
OR making hair conditioner

OR making fabric softener

OR making detergents

1

(c)



NO Mark for name of mechanism

Allow SN1

M1 for lone pair on N and arrow to C or mid point of space between N and C

M2 for arrow from bond to Br

M3 for structure of protonated secondary amine

M4 for arrow from bond to N or + on N

For M4: ignore RNH₂ or NH₃ removing H⁺ but penalise Br⁻

4

(d) lone or electron pair on N

If no mention of lone pair CE = 0

If lone pair mentioned but not on N then lose M1 and mark on

M1

1

in **J** spread / delocalised into ring (or not delocalised in **K**)

Ignore negative inductive effect of benzene

Allow interacts with π cloud for M2

M2

1

less available (for protonation or donation in **J**)

M3

OR

in **K** there is a positive inductive effect / electron releasing)

M2

more available (for protonation or donation in **K**)

M3

1

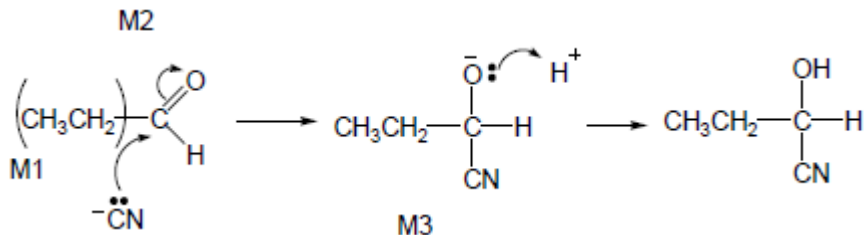
[11]

2

(a) Nucleophilic addition

1

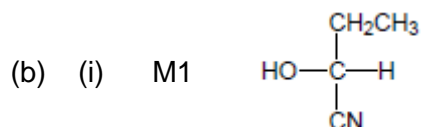
M4 for lp, arrow and H+



Allow C₂H₅- for CH₃CH₂-

- M1 and M4 include lone pair and curly arrow.
- Allow: CN⁻ but arrow must start at lone pair on C.
- M2 not allowed independent of M1, but allow M1 for correct attack on C⁺.
- + rather than δ⁺ on C=O loses M2.
- Penalise incorrect partial charges.
- M3 is for correct structure including minus sign but lone pair is part of M4.
- Penalise extra curly arrows in M4.

4



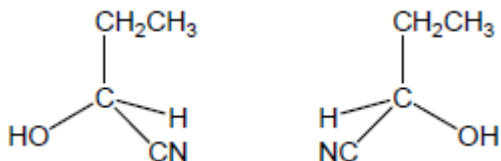
M1 for correct structure of product of part (a).

Allow C₂H₅- for CH₃CH₂-.

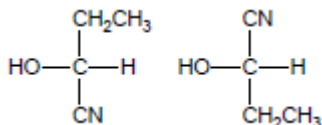
Penalise wrongly bonded, OH or CN or CH₂CH₃ once only in clip.

1

M2

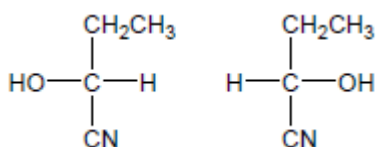


M2 cannot be gained by simply swapping two or more groups with no attempt to show a mirror image., e.g. do not allow M2 for



because these do not show the enantiomers as mirror images.

Students must show an attempt at mirror images, eg allow

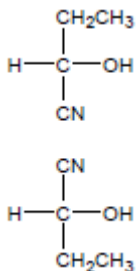


ie vertical groups same and horizontal swapped as if there was a mirror between them

No mirror need be shown

Do not penalize wedge bond when wedge comes into contact with both C & N

However these two could score M2 if placed as below as if with a "mirror" horizontally between them.



1

- (ii) M1 (Plane) polarized light
M2 *only scores following correct M1*

1

M2 Rotated in opposite directions (equally) (only allow if M1 correct or close)

Not just in different directions but allow one rotates light to the left and one to the right.

Not molecules rotate.

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- (c) 2-hydroxybutane(-1-)nitrile

1

- (d) Weak acid / (acid) only slightly / partially dissociated / ionised
Ignore rate of dissociation.

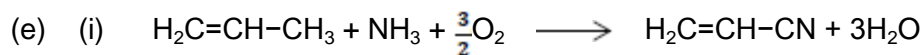
1

[CN⁻] very low

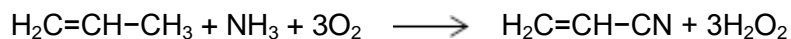
Allow (very) few cyanide ions.

Mark independently.

1



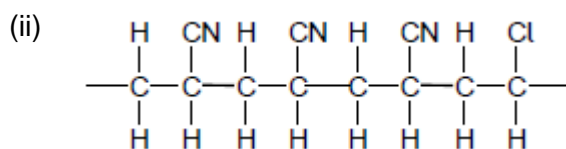
OR



OR doubled.

Allow C₃H₆ and CH₂CHCN or C₃H₃N on this occasion only.

1

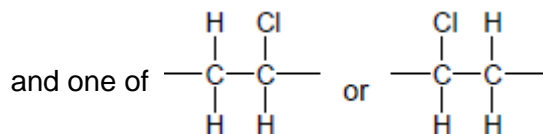
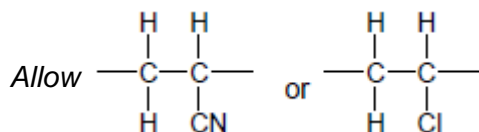
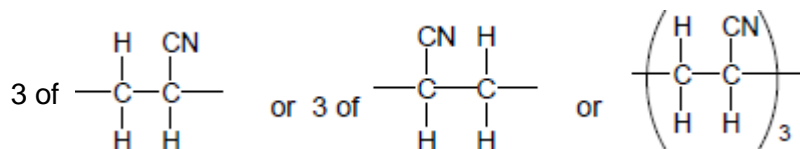


Ignore n.

Must show trailing bonds.

Do not penalise C–NC bond here on this occasion.

Must contain, in any order,



Allow –CH₂CH(CN)CH₂CHCl– etc.

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- (iii) Addition (polymerization)

Allow self-addition.

Do not allow additional.

1

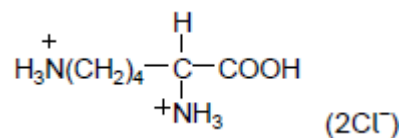
[15]

3

(a) 2,6-diaminohexanoic acid*Ignore additional , or – or spaces.*

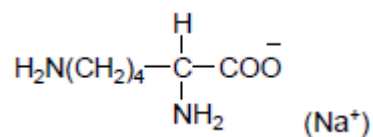
1

(b) (i)

*NB both N must be protonated.**Allow $-\text{NH}_3^+$ allow CO_2H Allow $-\text{H}_3\text{N}$.**Penalise $-\text{C}_4\text{H}_8$ – here.*

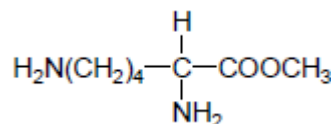
1

(ii)

*Allow CO_2^- .**Allow $-\text{H}_2\text{N}$.**Allow $-\text{COONa}$ but penalise $\text{O}-\text{Na}$ bond shown.*

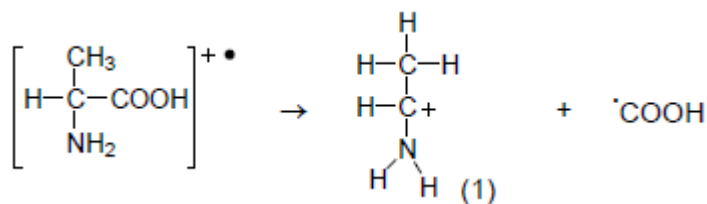
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(iii)

*Allow CO_2CH_3 .**Allow $-\text{NH}_3^+$ or $-\text{H}_2\text{N}$.*

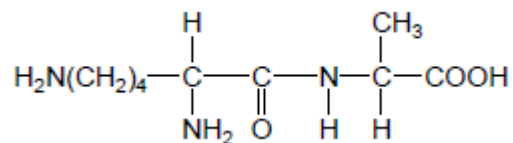
1

(c)

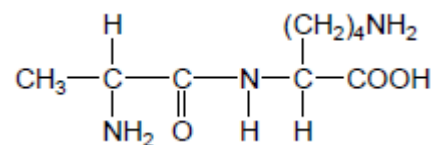
*1 for displayed formula of fragment ion.**1 for molecular ion of alanine AND radical.**Allow molecular ion without brackets and fragment ion in brackets with outside +.**Allow dot anywhere on radical.**Allow $[\text{C}_3\text{H}_7\text{NO}_2]^+$ for molecular ion.*

2

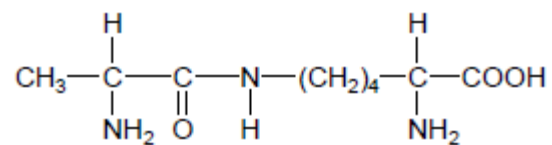
(d)



OR



OR



Dipeptide, not repeating unit /.

Allow CO₂H Allow -H₂N.

Allow -CONH-.

1

(e) M1 In acid lysine has double positive or more positive charge

1

M2 (Lysine ion) has greater affinity / greater attraction / adheres better / sticks better to polar / stationary phase

M2 only scores after a correct M1.

Ignore greater retention time.

1

[9]

C
4

[1]

D
5

[1]

B
6

[1]

A
7

[1]