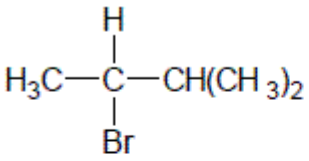
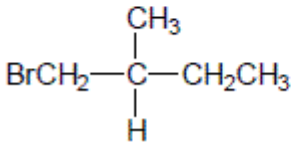
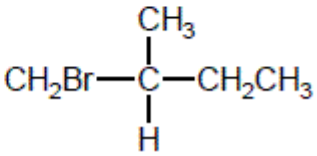
1

(a) (i)



must be **branched** and chiral

or  or 

not allow C_3H_7

allow C_2H_5 bonded to C either way round

1

(ii) elimination

allow base – elimination

but penalise any other qualification

1

(iii) Z-pent-2-ene or cis-pent-2-ene (allow Z-2-pentene or cis-2-pentene) either Z or cis is necessary

with or without brackets around Z

with or without hyphens

1

(b) (i) C

1

(ii) A

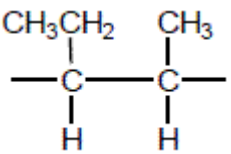
1

(iii) B

1

(iv) D

1

(c) 

allow C_2H_5 bonded via C or H

must have both trailing bonds

ignore brackets or n

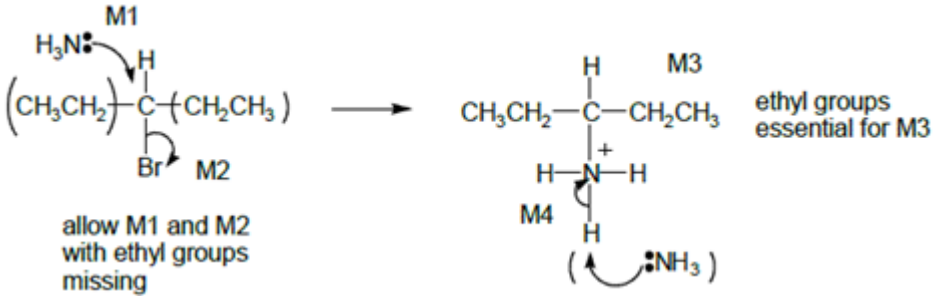
1

addition or radical or step or chain growth

QOL not additional

1

(d) (i)



Allow SN1, i.e M2 first then attack of NH_3 on carbocation.

Allow C_2H_5 in M3 bonded either way

Allow with or without NH_3 to remove H^+ in M4, but lose mark if Br^- used.

ignore δ+ or δ– unless wrong

+ on central C instead of δ + loses M2

4

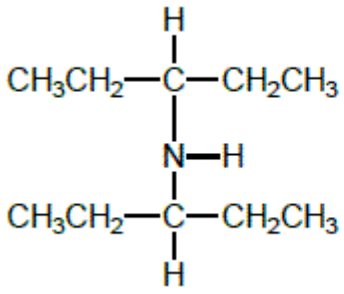
(ii) <u>excess</u> NH_3

ignore reflux

allow conc ammonia in sealed tube

1

(iii)

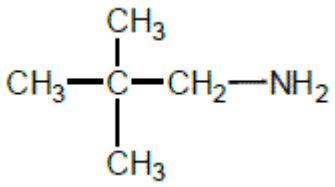


NOT $-C_5H_{11}$

Allow C_2H_5 bonded either way

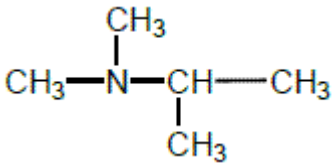
1

(e) (i)



1

(ii)



NOT $(C_2H_5)_2NCH_3$ which is tertiary with 3 peaks but its spectrum has no doublet.

1

[17]

2

(a) **M1** $CH_3CH_2CH_2COOH$

not C_3H_7COOH

1

M2 CH_3CH_2OH or C_2H_5OH

1

M3 $CH_3CH_2CH_2COOCH_2CH_3 + H_2O$

allow $C_3H_7COOC_2H_5$

penalise M3 for wrong products and unbalanced equation

1

M4 H_2SO_4 or HCl or H_3PO_4 conc or dil or neither

not HNO_3

1

(b) **M1** $CH_3CH_2CH_2CH_2OH$

1

not C_4H_9OH

M2 $(CH_3CO)_2O$

1

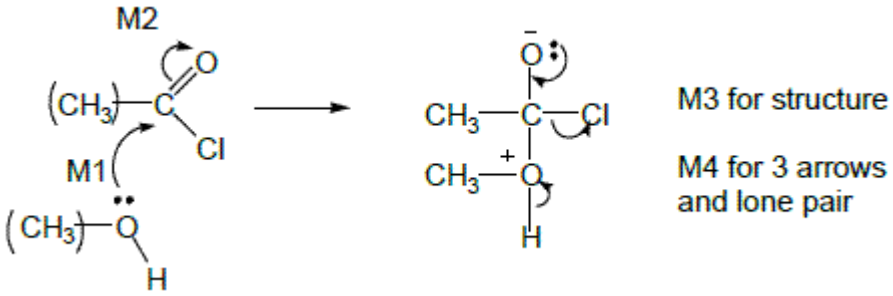
M3 $\rightarrow CH_3COOCH_2CH_2CH_2CH_3 + CH_3COOH$

allow $CH_3COOC_4H_9$

penalise M3 for wrong products and unbalanced equation

1

(c) (nucleophilic) addition-elimination



not acylation alone

M2 not allowed indep of M1 but allow M1 for correct attack on C+

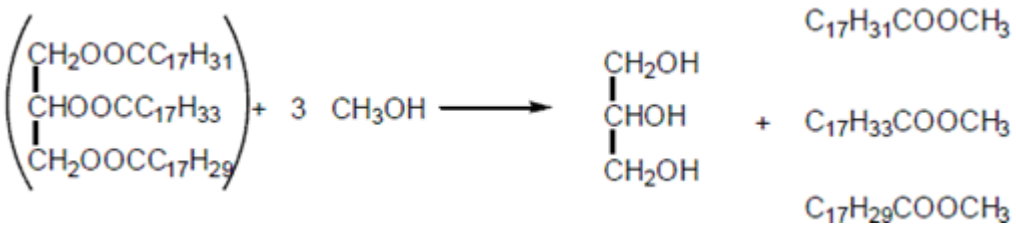
+C=O loses M2

only allow M4 after correct or v close M3

ignore Cl^- removing H^+

5

(d)



(1) (1) (1)

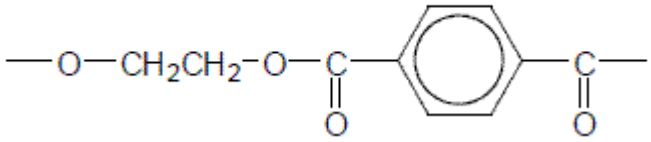
ignore errors in initial triester

First mark for $3CH_3OH$

Third mark for all three esters

3

(e) not – C_2H_4 –



First mark for correct ester link second mark for the rest including trailing bonds

If ester link wrong, lose second mark also

2

Adv reduces landfill
saves raw materials
lower cost for recycling than making from scratch
reduces CO_2 emissions by not being incinerated

not allow cost without qualification
ignore energy uses

1

Disad difficulty/cost of collecting/sorting/processing
product not suitable for original purpose, easily contaminated

not allow cost without qualification
ignore energy uses

1

[19]

3 (a) (i) **W** 3

1

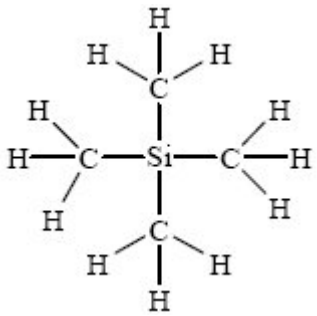
X 4

1

Y 2

1

(ii)



displayed formula shows ALL bonds

1

(b) (i) NO_2^+

allow + anywhere
can score in equation

1

$HNO_3 + 2H_2SO_4 \rightarrow NO_2^+ + 2HSO_4^- + H_3O^+$

1

OR

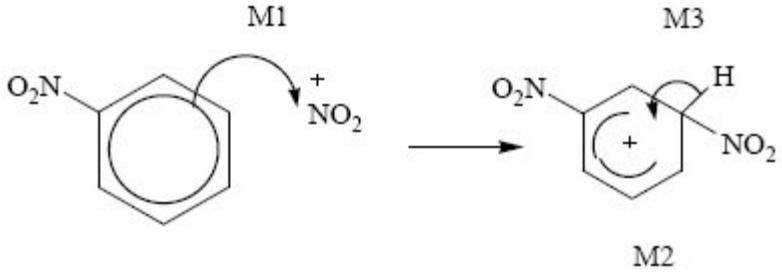
$HNO_3 + H_2SO_4 \rightarrow NO_2^+ + HSO_4^- + H_2O$

or use two equations via $H_2NO_3^+$

(ii) electrophilic substitution

Not Friedel Crafts

1



Allow Kekule structures

+ must be on N of $^+NO_2$ (which must be correct)

both NO_2 must be correctly positioned and bonded to gain M2

M1 arrow from circle or within it to N or to + on N
horseshoe must not extend beyond C2 to C6 but can be smaller
+ not too close to C1
M3 arrow into hexagon unless Kekule
allow M3 arrow independent of M2 structure
ignore base removing H in M3

3

(c) (i) H_2/Ni or H_2/Pt or Sn/HCl or Fe/HCl (conc or dil or neither)

allow dil H_2SO_4

ignore mention of NaOH

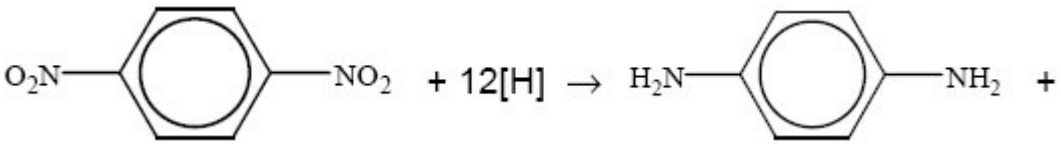
Not $NaBH_4$

Not $LiAlH_4$

Not Na/C_2H_5OH

not conc H_2SO_4 or any HNO_3

1



$4H_2O$

Or $6H_2$

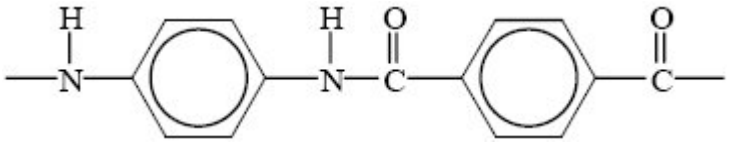
allow $C_6H_4(NO_2)_2$ etc ,

allow NO_2– NH_2–

i.e. be lenient on structures, the mark is for balancing equ

1

(ii)



allow –CONH

ignore $[\ ]_n$ as in polymer

1st mark for correct peptide link

2nd mark for the rest correct including trailing bonds

2

(iii) **M1** Kevlar is <u>biodegradeable</u> but polyalkenes not

allow Kevlar is <u>more</u> biodegradeable

1

M2 Kevlar has <u>polar</u> bonds/is a (poly) amide/has peptide link

comment on structure of Kevlar

1

M3 can be hydrolysed/attacked by nucleophiles/acids/ bases/enzymes

1

M4 polyalkenes <u>non polar</u>/has <u>non-polar</u> bonds

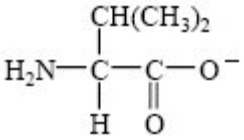
comment on structure of polyalkenes but not just strong bonds

1

[18]

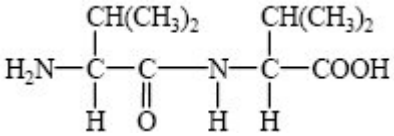
4

(a) (i)



1

(ii)



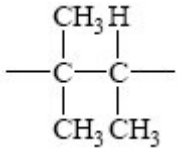
1

(iii) hydrogen bonding (do not allow H-bonding) QWC

do not penalise any error twice.

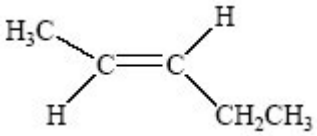
1

(b) (i)



1

(ii)

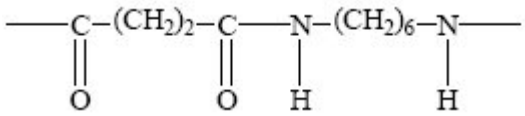


1

(iii) Isomer must be saturated or must not contain a double bond

1

(c)



2

(d) (i) heat/reflux with aqu NaOH

1

poly(alkene) is inert/ no reaction

1

polyamide is hydrolysed (or undergoes hydrolysis) to form acid salt and alcohol QWC

1

(ii) e.g combustion

1

heat energy produced

1

toxic gases produced

1

[14]

5 (a) (i) $CH_3CH=CHCH_3$

1

Addition or radical (**QoL**)

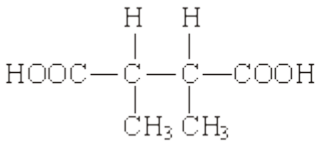
1

(ii) $CH_3CH(OH)CH(OH)CH_3$ or with no brackets

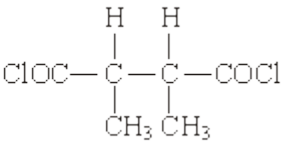
1

butan(e)–2,3–diol or 2,3–butan(e)diol

1



allow



1

2,3–dimethylbutan(e)dioic acid 2,3–dimethylbutan(e)dioyl chloride

ignore –1,4–

1

condensation (**QoL**)

1

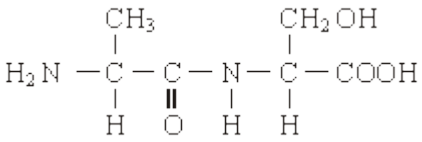
(iii) NaOH or HCl etc or Na_2CO_3

Allow conc sulphuric/nitric

***NOT** water nor acidified water nor weak acids*

1

(b) Structure 1



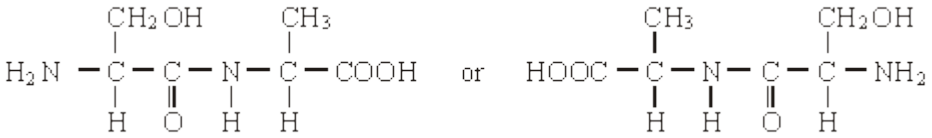
Allow –CONH– and –COHN–

Allow zwitterions

NOT polypeptides/repeating units

1

Structure 2 either of



1

(c) (i) $CH_3CH_2CH_2Br$

allow –Cl, –I

1

(ii) CH_3CH_2CN

1

(iii) (nucleophilic) substitution or from $CH_3CH_2CH_2Br$

if reduction written here, no further marks

1

further substitution/reaction occurs or other products are formed

Allow reduction forms only one product

1

one of

$(CH_3CH_2CH_2)_2NH$

$(CH_3CH_2CH_2)_3N$

$(CH_3CH_2CH_2)_4N^+ Br^-$

Allow salts including NH_4Br

Allow HBr

1

[15]

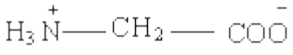
6 (a) polyamide or nylon (2,4)

(allow nylon without numbers but if numbers are present they must be correct)

1

condensation

1

(b) 

1

(c) ionic bonding in aminoethanoic acid

(can only score if includes that aminoethanoic is ionic)

1

stronger attractions than Hydrogen bonding in hydroxyethanoic acid

(e.g. stronger Hydrogen bonding in aminoethanoic acid scores 0)

(mention of electrostatic forces between molecules scores 0)

1

[5]