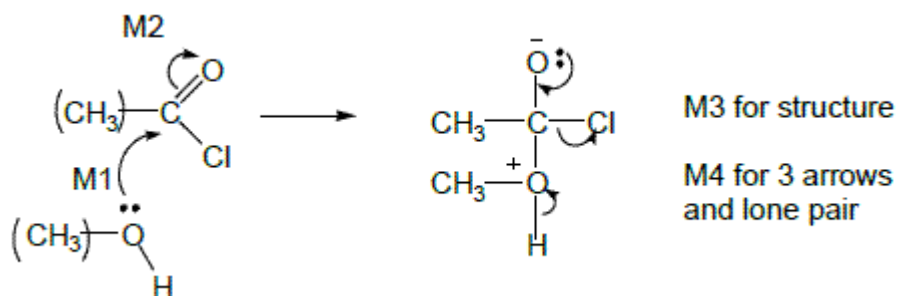


- M1.** (a) **M1** $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
not $\text{C}_3\text{H}_7\text{COOH}$ 1
- M2** $\text{CH}_3\text{CH}_2\text{OH}$ or $\text{C}_2\text{H}_5\text{OH}$ 1
- M3** $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$
allow $\text{C}_3\text{H}_7\text{COOC}_2\text{H}_5$
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** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
not $\text{C}_4\text{H}_9\text{OH}$ 1
- M2** $(\text{CH}_3\text{CO})_2\text{O}$ 1
- M3** $\rightarrow \text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 + \text{CH}_3\text{COOH}$
allow $\text{CH}_3\text{COOC}_4\text{H}_9$
penalise M3 for wrong products and unbalanced equation 1

(c) (nucleophilic) addition-elimination



not acylation alone

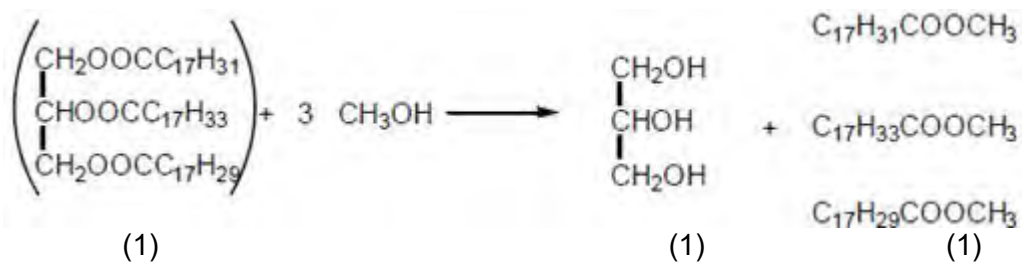
M2 not allowed indep of M1 but allow M1 for correct attack on C^+

$+\text{C}=\text{O}$ loses M2

only allow M4 after correct or v close M3

ignore Cl^- removing H^+

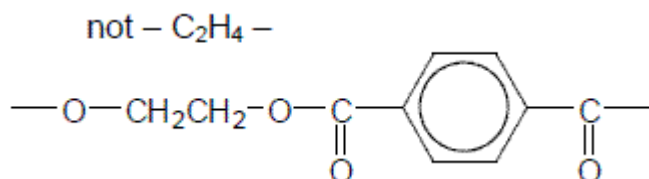
(d)



ignore errors in initial triester
First mark for 3CH₃OH
Third mark for all three esters

3

(e)



2

Adv reduces landfill
 saves raw materials
 lower cost for recycling than making from scratch
 reduces CO₂ 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]

M2. (a) (i) W 3

1

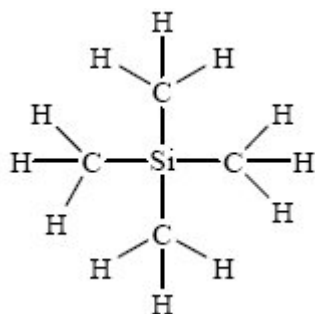
X 4

1

Y 2

1

(ii)



displayed formula shows ALL bonds

1

(b) (i) NO_2^+

*allow + anywhere
can score in equation*

1



1

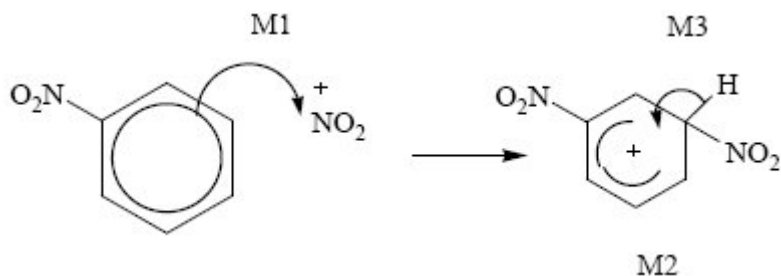
OR



or use two equations via H_2NO_3^+

(ii) electrophilic substitution
Not Friedel Crafts

1



Allow Kekule structures

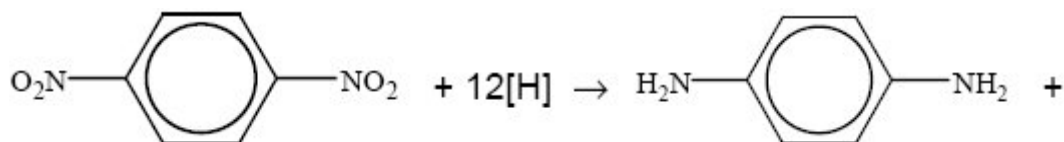
+ must be on N of $^+\text{NO}_2$ (which must be correct)
 both NO_2 must be correctly positioned and bonded to gain M2
M1 arrow from circle or within it to N or to + on N
horseshoe must not extend beyond C2 to C6 but can be smaller
 + not too close to C1
M3 arrow into hexagon unless Kekule
allow M3 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 $\text{Na}/\text{C}_2\text{H}_5\text{OH}$
not conc H_2SO_4 or any HNO_3

1

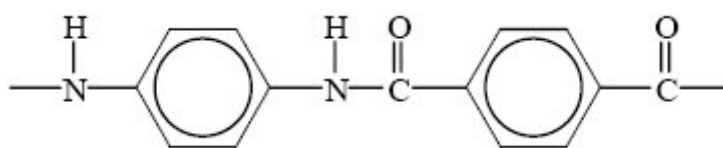


$4\text{H}_2\text{O}$
 Or 6H_2

allow $\text{C}_6\text{H}_4(\text{NO}_2)_2$ etc ,
allow NO_2-NH_2-
i.e. be lenient on structures, the mark is for balancing equ

1

(ii)



allow $-\text{CONH}$
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 biodegradable but polyalkenes not
allow Kevlar is more biodegradable

1

M2 Kevlar has polar 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 non polar/has non-polar bonds
*comment on structure of polyalkenes but not just strong
bonds*

1

[18]