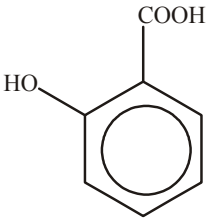
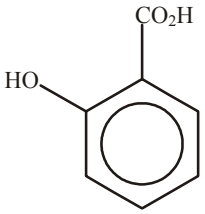
F324: Rings, Polymers and Analysis
4.1.3 Carboxylic Acids and Esters /46

1.

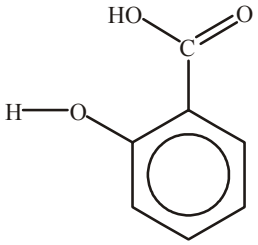


✓

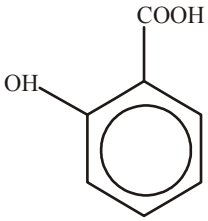
ALLOW



or



DO NOT ALLOW *incorrect bond linkage*



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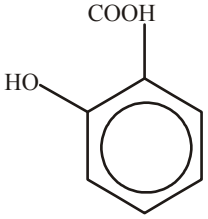

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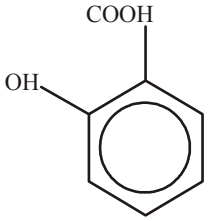


[1]

2. (i) hydrolysis **(1)**

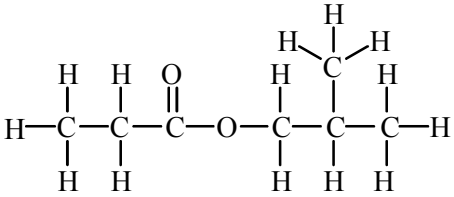
(sorbitan monolaurate is an) ester **(1)**

broken down to form an alcohol and carboxylic acid/salt **(1) AW** / equation to show the reaction 3

(ii) sorbitan monolaurate is made from a renewable resource / not based on crude oil **(1) AW** 1

[4]

3. (a)



propanoate and ester group **(1)** 2-methyl propyl **(1)** 2

(b) propanoic acid **(1)**
(2-)methylpropan-1-ol **(1)**

heat **(1)**
conc. H_2SO_4 **(1)**
(allow ecf from part (a) for the equation)

$CH_3CH_2COOH + CH_3)_2CHCH_2OH \rightarrow CH_3CH_2COOCH_2CH(CH_3)_2 + H_2O$
reactants **(1)** products **(1)** 6

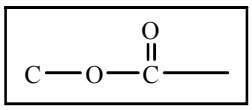
(c) mass spectrum / spectrometry **(1)**

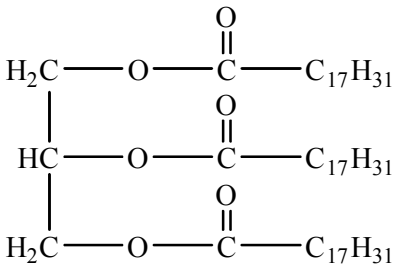
molecular ion peak /
m/e or mass of the peak furthest right **(1) AW** 2

[10]

4. (i)

(1) for a correct ester
(1) for rest





Accept correct skeletal form (even if only for acyl groups)
but must have 17C and two double bonds/one triple bond 2

(ii) 6. Ecf from (i). **(1)** 1

[3]

5. Three of following points: **(1)(1)(1)**

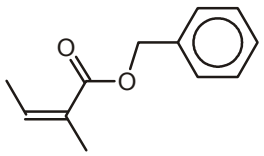
- 1. There is van der Waals (IDID) between triglycerides.
- 2. There is van der Waals between triglycerides and (non-polar) solvent.
- 3.Triglycerides cannot hydrogen bond (to water)(enough).
- Because there are not enough suitable sites/oxygen atoms
  Or long hydrocarbon chains do not hydrogen
  bond/would interfere with hydrogen bonding in water
  AW 3

[3]

6. (a) (i) alkene **(1)**
ester **(1)** 2

allow "C=C double bond"

i.



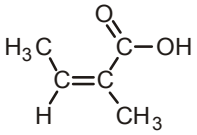
(1) 1

ii. $C_{12}H_{14}O_2$ **(1)** 1

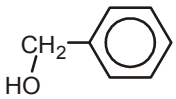
(b) same structural formula/order of bonds,
different spacial arrangement **AW (1)**

description or diagram showing **B** and how it is different from **A (1)** 2

(c)



(1)



(1) 2

(d) (i) peak at 1680-1750 (cm^{-1}) due to C=O **(1)**

peak at 1000-1300 (cm^{-1}) due to C-O / **(1)** 2

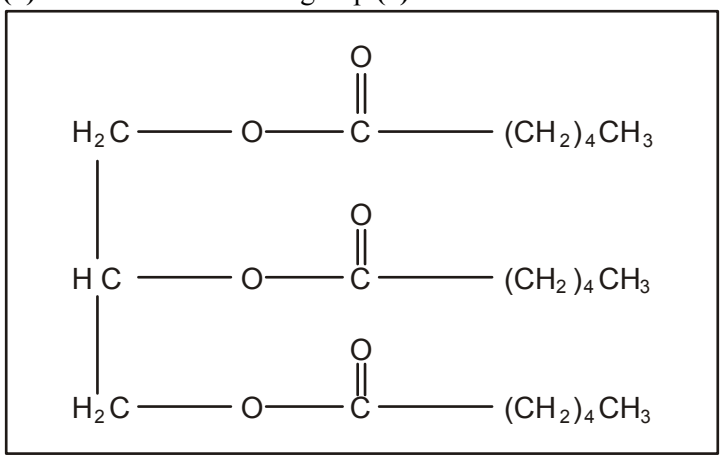
(ii) 2500-3300 / 3230-3550 (cm^{-1}) **(1)**

O-H /carboxylic acid/alcohol is **not** present in **A (1)**

allow 1 mark for ~500-1500 (cm^{-1}) which is a unique fingerprint region etc 2

[12]

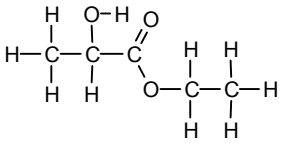
7. **(1)** for correct functional group **(1)** for the rest



C_5H_{11} acceptable 2

[2]

8. (i)



(1) 1

(ii) any sensible change in flavour linked to the presence of the ester or loss of the acid **(1)** – e.g.
'more fruity due to the ester'
'less sour as acids get used up' 1

[2]

9. (i) flavouring / fruity smell etc 1
NOT *perfume or sweetener*

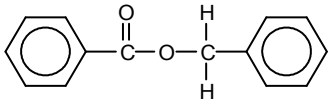
(ii) conc H_2SO_4 **(1)**
reflux/ distil **(1)** 2

(iii) $CH_3COOH + C_9H_{15}CH_2OH \rightarrow CH_3COOCH_2C_9H_{15} + H_2O$ 3
(1) **(1)** **(1)**
allow $C_2H_4O_2$ *and* $C_{12}H_{20}O_2$
but ***NOT*** *wrong structures*
allow ecf on the wrong acid

[6]

10. (i) H^+ /acid / named strong acid eg H_2SO_4 / HC*l* 1

(ii)



displayed ester group **(1)**
rest of the ester **(1)** 2

[3]