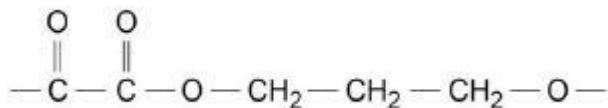


## Mark schemes

## Q1.

(a)



**M1** ester link including C–O–C  
*ignore brackets and 'n'*  
*allow* (CH<sub>2</sub>)<sub>3</sub>  
 –O– at either end but **not** both

1

**M2** rest of structure including trailing bonds  
*not* M2 if more than one repeating unit  
*allow* for one mark –OCCOOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>– as long as trailing bonds included

1

(b) polyesters: C=O/C–O **OR** polar bonds / chain **AND**  
 polyalkenes: (only) C–C **OR** non-polar bonds / chain  
*not* just 'polyesters are polar'  
*not* M1 if C=C mentioned

1

(polyesters) susceptible to nucleophilic attack / can be hydrolysed

1

(c) **M1** amount of Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub> =  $\frac{0.162}{134.0} = 0.00121$  mol  
 $M1 \times \frac{2}{5}$

1

**M2** stoichiometry  $\left(\frac{2}{5}\right)$  (4.84 x 10<sup>-4</sup>)

1

**M3** scaling (÷10)

$$= 0.00121 \times \frac{2}{5} \div 10 = 4.84 \times 10^{-5} \text{ mol}$$

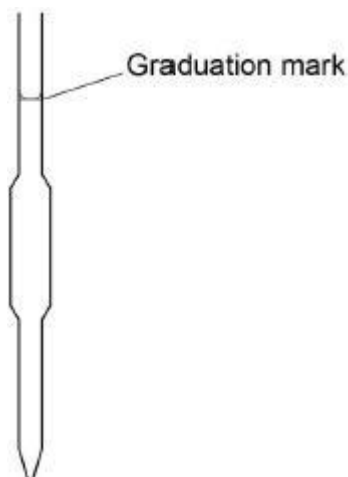
*M2 ÷ 10 (conc/40)*  
*M3 x 1000*  
 23.85

1

**M4** concentration of MnO<sub>4</sub><sup>-</sup> =  $\frac{4.84 \times 10^{-5}}{\frac{23.85}{1000}} = 0.00203$  mol dm<sup>-3</sup>  
*Min 2 sig figs*

1

(d)



Meniscus curved with the bottom of the curve on the horizontal line

1

(e) (burette) fill below/at eye level

**ignore** make sure tap closed / funnel / gloves

1

(solution) wear gloves

**allow** wash/rinse hands after any spillage **not** fume cupboard

**ignore** lab coat / stir carefully

1

(f) colourless to pink/pale purple

**not** just purple

**not** 'clear' for 'colourless'

1

(g) remove funnel

1

ensure jet is filled / no (air) bubbles

**allow** open tap to fill space below tap

1

(h)

This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.

<b>Level 3</b> <b>5-6</b> <b>marks</b>	<p>All stages are covered and each stage is generally correct and virtually complete.</p> <p>Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3</p> <p>Covers at least 2 point for stage 1, 1 for stage 2 and 2 for stage 3.</p> <p>If given equation must show correct stoichiometry for</p>
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Q4.

A

*poly(alkene)*

[1]

Q5.

A

[1]

Q6.

A

[1]

Q7.

(a) 4 peaks

1

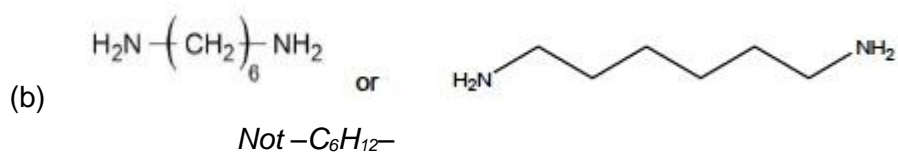
Triplet

1

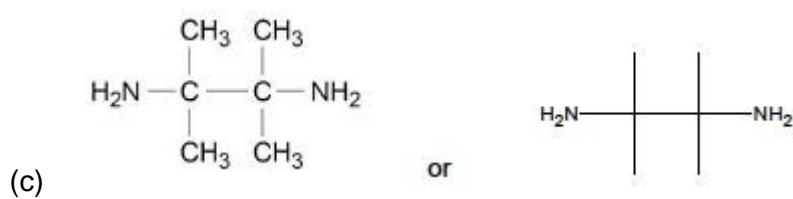
Two H on adjacent C

*M3 dependent on correct M2*

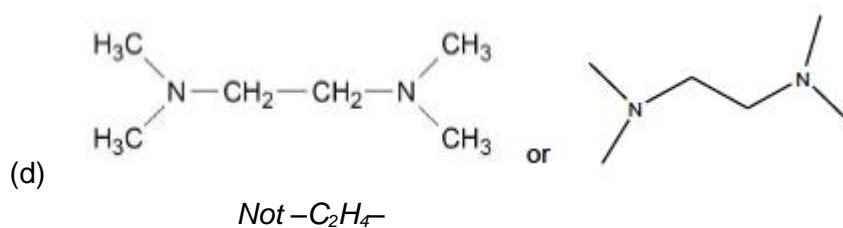
1



1



1



1

[6]

Q8.

C

[1]

Q9.

B

[1]

Q10.

(a) Z-2-methylpent-2-en (-1-) oic acid*Ignore missing hyphens or extra commas, spaces, hyphens*

1

(b)  $C_6H_{10}O_2 + 7\frac{1}{2} O_2 \rightarrow 6CO_2 + 5H_2O$ *Allow multiple*

M1

Volume of  $CO_2$  formed =  $180 \text{ cm}^3$ *If incorrect volume: 155 gives 125mg / 335 gives 270mg could score M1, M3, M4 – max 3**If incorrect volume from AE then penalise M2 and mark on**(Final answer is  $0.806 \times$  their volume)*

M2

$$\text{Mol carbon dioxide} = pV/RT = \frac{105000 \times (180 \times 10^{-6})}{8.31 \times 298}$$

$$= 7.632 \times 10^{-3}$$

*If unit error in p, V or T lose M3 and M5**If incorrect rearrangement lose M3 and M5**If both errors seen then no further marks*

M3

$$\text{Mol P, } C_6H_{10}O_2 \text{ used} = 7.632 \times 10^{-3} / 6 = 1.272 \times 10^{-3}$$

*M3 divided by 6 If wrong no further marks*

M4

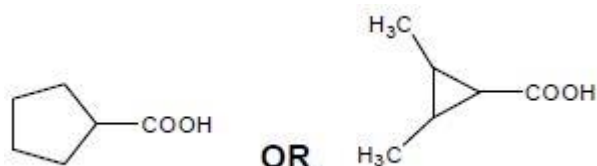
$$\text{Mass P used} = 1.272 \times 10^{-3} \times 114(.0) \text{ g}$$

$$= 145 \text{ mg}$$

*Mark for answer (allow ans to 2 sf)***Check chemical equation before awarding final mark**

M5

(c)



Mark independently  
Apply the list principle

M1

Fig 4: IR OH (acid) peak ( $2500-3000\text{cm}^{-1}$ ) present  
Ignore  $\text{C}=\text{O}$  signal at  $1750\text{ cm}^{-1}$

M2

Fig 5:  $^{13}\text{C}$  NMR 4 peaks so 4 (non-equivalent) environments  
Or Peak at 160-185 (show  $\text{C}=\text{O}$ ) in (esters or) acids  
Or Peak at 40-50 (show  $\text{R}-\text{CO}-\underline{\text{C}}\text{H}$ ) presence of carbonyl

M3

**Both M2 & M3 can be awarded on the spectra**

Allow correct Fig 4 answers in Fig 5 and converse

(d) **R** has 4 C next to  $\text{C}=\text{O}$  **S** has 2 C next to  $\text{C}=\text{O}$   
M1 for structural point

M1

in range  $\delta = 20-50$

**R** has two peaks and **S** only one peak in this range  
Or **R** has more peaks (allowed if no numbers given)

M2 for resulting peak in spectra

M2

**OR**

**S** has a  $-\text{C}(\text{H}_2)-\text{C}(\text{H}_3)$  **R** does not

M1

**S** has one peak in range  $\delta = 5-40$  **R** does not  
/ lowest peak for **S** is lower than lowest for **R**

M2

(Both have) three peaks

M3

(e) **R** Both singlets

M1

**S** has triplet and a quartet

M2

**OR**

**R**  $\text{CH}_3$ /peak at 2.1-2.6 is a singlet

M1

**S**  $\text{CH}_3$ /peak at 0.7-1.2 is a triplet

M2

OR

R CH<sub>2</sub>/peak at 2.1-2.6 is a singlet

M1

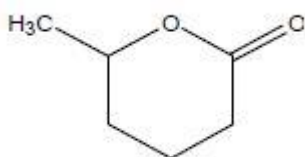
S CH<sub>2</sub>/peak at 2.1-2.6 is a quartet

M2

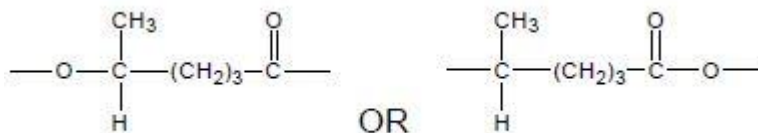
(Both have) two peaks

M3

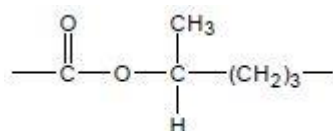
(f)



1

*Must have trailing bonds**Ignore brackets and n*

1



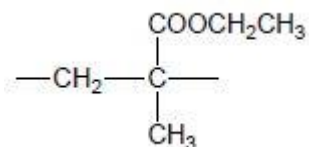
OR

condensation

*Ignore esterification*

1

(g)

*Must have trailing bonds**Ignore brackets and n*

M1

Strong / non-polar C-C bonds (in the chain)

M2

cannot be attacked by nucleophiles / acids / cannot be hydrolysed.

M3

OR

Only polar ester group

M2

Can be attacked by nucleophiles / acids / can be hydrolysed

M3

*M3 dependent on correct or close M2*

*Allow 1 mark for in (polar) ester link in side chain/not in main chain therefore polymer chain not broken*

[21]

Q11.

C

[1]

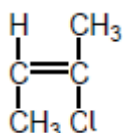
Q12.

C

[1]

Q13.

(a)

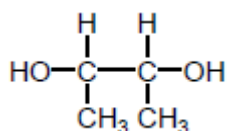


1

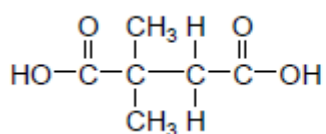
Addition

1

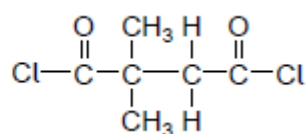
(b)



1



OR



1

(c) Q is biodegradable

1



Polar C=O group or  $\delta^+$  C in **Q** (but not in **P**)

1

Therefore, can be attacked by nucleophiles (leading to breakdown)

1

**[7]**