

M1.C

[1]

M2. (a) 5 (1)

1

(b) 2:2:2:3:3 (1)

any order but not multiples

1

(c) 
$$\begin{array}{c} \text{CH}_3 - \text{C} - (\text{R}) \\ \parallel \\ \text{O} \end{array} \quad (1)$$

1

(d)  $\text{CH}_3\text{CH}_2$  or  $\text{C}_2\text{H}_5$  or ethyl (1)

$\delta 4.13$  (quartet) :  $\text{CH}_2$  peak split by  $\text{CH}_3$  / next to  $\text{CH}_3$  (1)

$\delta 1.26$  (triplet) :  $\text{CH}_3$  peak split by  $\text{CH}_2$  / next to  $\text{CH}_2$  (1)

3

(e)  $\text{CH}_2\text{CH}_2$  (1)

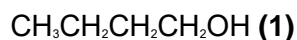
1

(f) 
$$\begin{array}{c} \text{CH}_3 - \overset{(\text{CO})}{\underset{\parallel}{\text{C}}} - \text{CH}_2\text{CH}_2 - \overset{(\text{CO})}{\underset{\parallel}{\text{C}}} - \text{OCH}_2\text{CH}_3 \\ \text{O} \qquad \qquad \qquad \text{O} \end{array} \quad (2)$$
  
allow (1) for  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{OCOCH}_2\text{CH}_3$   
or  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{COCH}_2\text{CH}_3$   
Must be  $\text{C}_7\text{H}_{12}\text{O}_3$

2

[9]

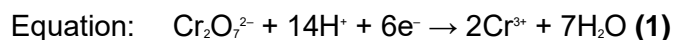
**M3.** (a)  $K_2Cr_2O_7/H_2SO_4$  reduced by



oxidised to  $CH_3(CH_2)_2CHO$  (1)  
and  $CH_3(CH_2)_2COOH$  (1)



oxidised to  $CH_3(CH_2)_2COOH$  (1)

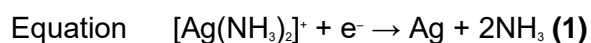


*Note: Deduct one if all three compounds given as reducing agents.*

6

(b) Tollens' reduced by  
 $CH_3CH_2CH_2CHO$  (1)

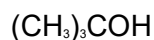
oxidised to  $CH_3(CH_2)_2COOH$  (1)



3

(c)  $CH_3CH_2CH_2CH_2OH$  (1)

Product  $CH_3CH_2CH_2CH_2OOCCH_3$  (1)



Product  $(CH_3)_3COOCCH_3$  (1)

4

(d)  $CH_3CH_2CH_2OH$  has five peaks (1)

$(CH_3)_3COH$  has two peaks (1)

2

[15]

**M4.D**

- M5.** (a) Pentan-2-one 1
- (b) (i) 1680 – 1750 (cm<sup>-1</sup>) 1
- (ii) 3230 – 3550 or 1000 – 1300 (cm<sup>-1</sup>) 1
- (iii) 4 1

(c)

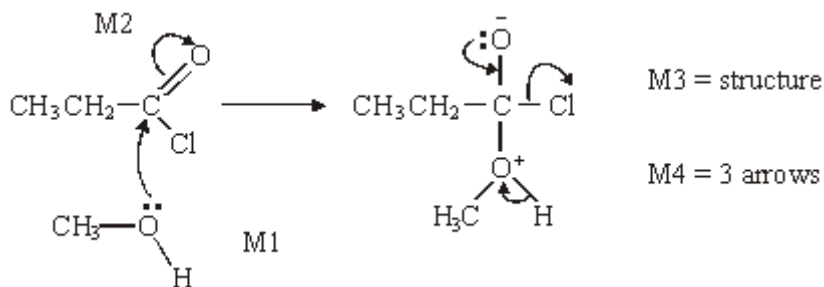
Reagent	K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> /H <sup>+</sup>	KMnO <sub>4</sub> /H <sup>+</sup>	Na	CH <sub>3</sub> COOH/ H <sub>2</sub> SO <sub>4</sub>	1
with <b>C</b>	no reaction	no reaction	no reaction	no reaction	1
with <b>D</b>	goes green	goes colourless	effervescence	smell	1

*(penalise incomplete reagent e.g. K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> or Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>/H<sup>+</sup> then mark on)*

(d)

Reagent	Tollens	Fehlings or Benedicts	1
with <b>E</b>	silver (mirror)	red ppt or goes red <i>(not red solution)</i>	1

- M6.** X is methyl propanoate



1

M1 for arrow and lone pair,

4

M2 for arrow  
addition-elimination

1

Spectrum 2

*if thinks Spectrum 1 = X can only score for structure of Y*

1

Y is  $\text{CH}_3\text{COOCH}_2\text{CH}_3$

1

The two marks for explanation are awarded for discussing one or more of the four peaks (not those for the  $\text{CH}_3$  of the ethyl groups) for stated  $\delta$  values the integration or the splitting should be related to the structure: e.g. structure of **X** shows that at  $\delta$  3.7 – 4.1 **(1)** spectrum of **X** should have integration 3 / singlet **(1)**

or

at  $\delta$  2.1 – 2.6 **(1)** spectrum of **X** should have integration 2 / quartet **(1)**

Spectrum 2 has these

[OR Spectrum 1 has

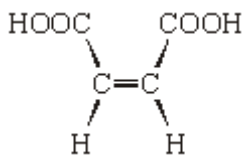
at 3.7 – 4.1 **(1)** quartet / integration 2 **(1)** so not **X**

at 2.1 – 2.6 **(1)** singlet / integration 3 **(1)** so not **X**]

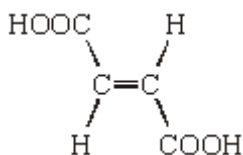
2

[10]

M7. (a)



1



1

*NB The bonds shown in the structure must be correct*

Isomerism: E-Z isomerism

*If written answer is correct, ignore incorrect labelling of structures.*

*If no written answer, allow correctly labelled structures.*

1

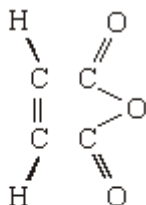
Both COOH groups must be on the same side/ close together/ cis

1

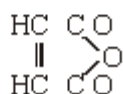
No rotation about C=C axis

1

Structure

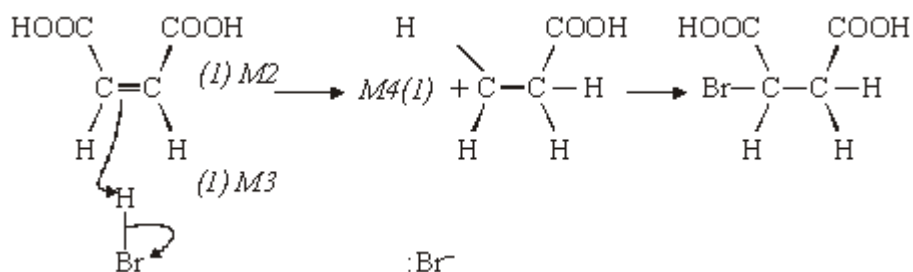


Allow



1

(b)  $\text{Br}_2 / \text{HBr} / \text{H}_2\text{SO}_4 / \text{H}^+ / \text{Br}^+ / \text{NO}_2^+$  (Mark M1)



*NB If electrophile  $\text{H}^+ / \text{Br}^+ / \text{NO}_2^+$  allow M1, M2 and M4*

*If the acid is incorrect, M2 and M3 can still be scored  
Allow M4 consequentially if repeat error from part (a)*

4

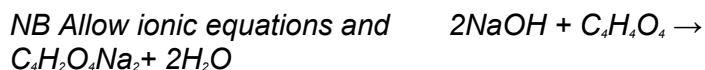


Both H replaced

1

Balanced for atoms and charges

1



*Allow one if structure incorrect but molecular formula correct*

*Allow one for a correct equation showing one H replaced*

(d) *M1* Two peaks

1

*M2* No splitting or singlets

1

*M3* (Two) non-equivalent protons or two proton environments

1

*M4* No adjacent protons

1

*M5* Same area under the two peaks or same relative intensity

1

*NB Doublet could score M1 and M3 or M5 (Max 2)*

*More than two peaks CE = 0*

*Apply the "list principle" to incorrect answers if more than 3 given*

Max 3

[15]