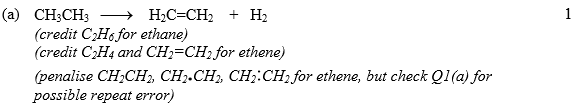
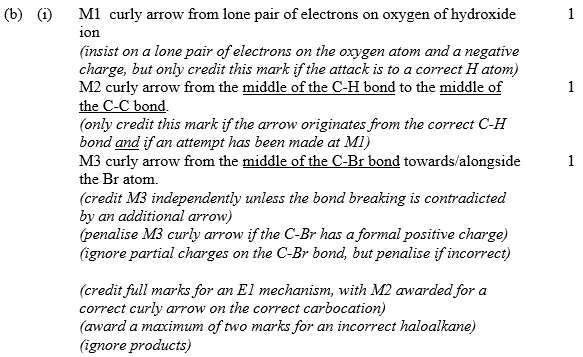
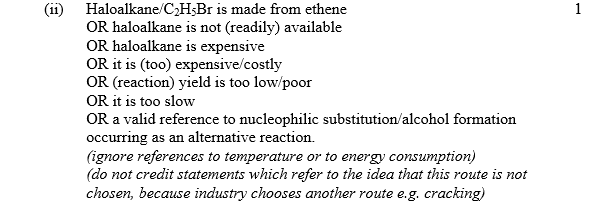
A-LEVEL PAPER 2 PP3 MS

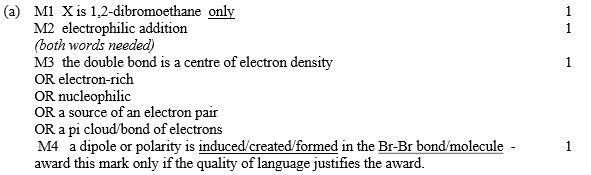
**1.**

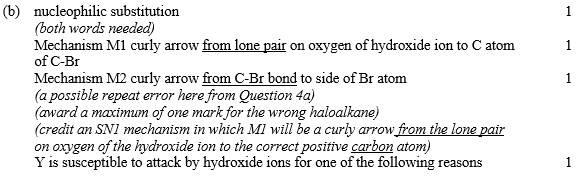




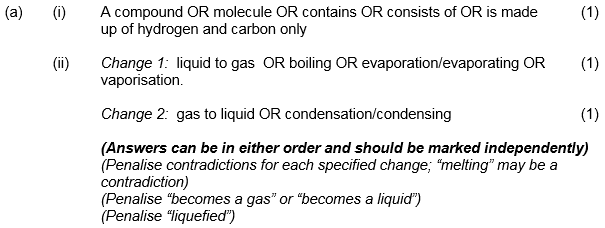
 **[5]**

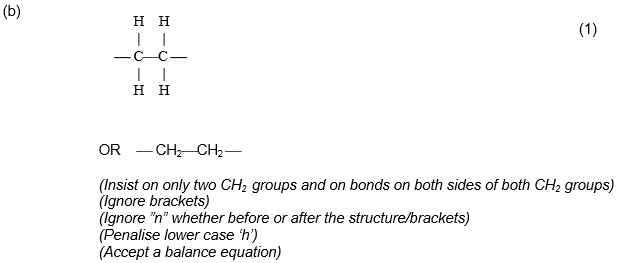
**2.**

****

** [8]**

**3.**

****

**[4]**

**4.** (a)   (i)      2 or two or second or [E]2

**1**

(ii)     1 or one or first or [F]1 or [F]

**1**

(b)    (i)      *k* = 

*mark is for insertion of numbers into a correctly rearranged rate equ , k = etc.  
AE (−1) for copying numbers wrongly or swapping two numbers.*

**1**

= 22.9 (Allow 22.9 − 24 after correct rounding)

**1**

mol−2dm+6 s&8722;1

*Any order.*

**1**

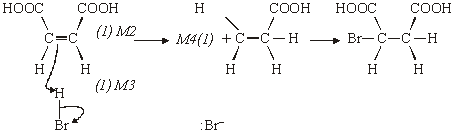
(ii)     6.8(2) × 10−3 (mol dm&8722;3s−1)  
***OR*** if their k is wrong, award the mark consequentially  
a quick check can be achieved by using  
their answer = 2.9768 × 10−4 Allow 2.9 − 3.1 × 10−4 for the mark  
    their *k*

*Allow 6.8 × 10−3 to 6.9 × 10−3Ignore units.*

**1**

**[6]**

**5.**      (a)     Br2 / HBr / H2SO4 / H+ / Br+ / NO2+ (*Mark M1*)



*NB If electrophile H+ / Br+ / NO2+ 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**

(b)     *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**

**[7]**

**6.** (a)    Hydrogen bond(ing)

*Allow H bonding.*

*Penalise mention of any other type of bond.*

**1**

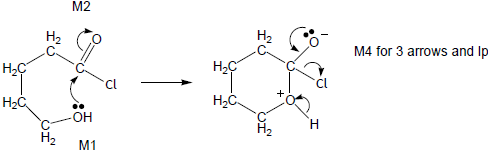
**[1]**

**7.** (a)     (i)      (nucleophilic) addition-elimination

*Not electrophilic addition-elimination*

*Ignore esterification*

**1**

****M3 for structure

*•        If wrong nucleophile used or O–H broken in first step, can          only score M2.*

*•        M2 not allowed independent of M1, but allow M1 for correct          attack on C+*

*•        + rather than δ+ on C=O loses M2.*

*•        If Cl lost with C=O breaking lose M2.*

*•        M3 for correct structure with charges but lone pair on O is          part of M4.*

*•        Only allow M4 after correct / very close M3.*

*•        Ignore HCl shown as a product.*

**4**

*a*    20-50 (ppm)    or single value or range entirely within this range

*If values not specified as a or b then assume first is a.*

**1**

*b*    50-90 (ppm)    or single value or range entirely within this range

**1**

(ii)       


*Must have trailing bonds, but ignore n.*

**1**

**OR**     –OCH2CH2CH2CH2CO–    **OR**     –CH2CH2CH2CH2COO–

*Allow  
*

*but not     - C4H8−*

*one unit only*

*Condensation*

***1***

*(b)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | *Tollens’* | *Fehling’s / Benedicts* | *Acidified potassium dichromate* |

*Penalise wrong formula for Tollens or missing acid with potassium dichromate but mark on.*

***1***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | ***J*** | *No reaction / no (visible) change / no silver mirror* | *No reaction / no (visible) change / stays blue / no red ppt* | *No reaction / no (visible) change / stays orange / does not turn green* |

*Ignore ‘clear’, ‘nothing’.*

*Penalise wrong starting colour for dichromate.*

***1***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | ***K*** | *Silver mirror / grey ppt* | *Red ppt  (allow brick red or red-orange)* | *(orange) turns green* |

***1***

***J****Two (peaks)*

*Allow trough, peak, spike.*

***1***

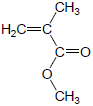
***K****Four (peaks)*

*Ignore details of splitting.*

*If values not specified as J or K then assume first is J.*

***1***

*(c)     If all the structures are unlabelled, assume that the first drawn ester is L, the second ester is M; the first drawn acid is N, the second P. The cyclic compound should be obvious.*

***L****ester  
                   ****OR****H2C=C(CH3)COOCH3*

***All C5H8O2 L to P must have C=C****.*

*Allow CH3−.*

*Allow -CO2CH3 etc.*

*Allow CH2C(CH3)COOCH3.*

***1***

***M****ester  
              
        CH3CH=CHCOOCH3    CH3CH=CHOOCCH3    CH3CH=C(CH3)OOCH  
   
          
   
                        CH3CH=CHCH2OOCH         CH3CH2CH=CHOOCH*

*Allow either E–Z isomer.*

*Allow CH3− or C2H5− but not CH2CH3−.*

*Allow CH3CHCHCOOCH3 etc.*

***1***

***N****acid  
            *

*(CH3)2C=CHCOOH       H2C=C(CH3)CH2COOH       H2C=C(COOH)CH2CH3*

*Allow CH3− or C2H5− but not CH2CH3−.*

*Allow −CO2H.*

*Not cyclic isomers.*

*Not the optically active isomer.*

**

*Allow (CH3)2CCHCOOH etc.*

***1***

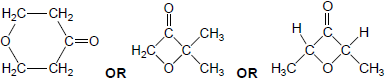
***P****acid  
            *

*Allow −CO2H.*

*CH3CH(COOH)CH=CH2*

*Allow    CH3CH(CO2H)CHCH2 or  
      CH3CH(CO2H)C2H3.*

***1***

***Q*****

*Not cyclic esters.*

***1***

***[19]***

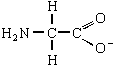
***8.****(a)     2-amino(e) propanoic acid* ***(1)***

***1***

*(b)     (i)      molecules with same structure / structural formula* ***(1)****but with bonds* ***(atoms or groups)*** *arranged differently in  
space (3D)* ***(1)***

*(ii)     Plane polarised light* ***(1)****Rotated (equally) in opposite directions* ***(1)***

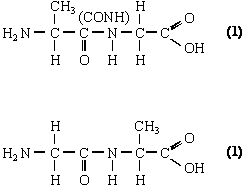
***4***

*(c)     ****(1)***

*allow H2NCH2COO–*

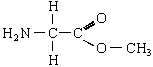
*Penalise NH2‑ and OH‑ once per paper  
but CH3– is allowed*

***1***

*(d)     *

*Not anhydrides; not repeating units*

***2***

*(e)     ****(1)***

*or H2NCH2COOCH3*

***1***

***[9]***

***9.*** *(a)     (i)      CDCl3 or CD2Cl2 or C6D6 or CCl4*

*Not D2O Allow CD3Cl*

***1***

*(ii)     4* ***or four***

***1***

*(iii)    Triplet or 3 or three*

***1***

*(iv)    1,4-dichloro-2,2-dimethylbutane*

*Do not penalise different or missing punctuation or extra spaces.*

*Spelling must be exact and order of letters and numbers as here.*

***1***

*(b)     (i)      3 or three*

***1***

*(ii)     190-220 (cm−1)*

*Allow a single number within the range.*

***OR*** *a smaller range entirely within this range.*

***1***

*(iii)    hexan****e****-2,5-dione*

*Do not penalise different or missing punctuation or extra spaces.*

*Spelling must be exact and order of letters and numbers as here.*

*NB so must have middle e*

***1***

***[7]***

***10.*** *Step 1*

*HBr*

*In any step, if wrong reagent or extra wrong reagent, can only score mechanism mark,but if AlCl3 added in Step 3, lose M7 but can score M8 & M9*

*M1*

***1***

**

*M2*

***1***

*electrophilic addition*

*If 1-bromobutane structure given for M2 then 1-aminobutane structure for M5, penalise M2 and M5 but mark M8 consequentially*

*M3*

***1***

*Step 2*

*NH3*

*M4*

***1***

**

*If 1-bromobutane structure given for M2 then 2-aminobutane structure for M5, penalise M2, M5 and M8*

*M5*

***1***

*nucleophilic substitution*

*If 2-bromobutane structure given for M2 then 1-aminobutane structure, penalise M5 and M8*

*M6*

***1***

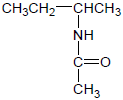
*Step 3*

*CH3COCl or (CH3CO)2O*

*Allow C2H5 for CH3CH2*

*M7*

***1***

**

*M8*

***1***

*(nucleophilic) addition-elimination*

*Not allow (electrophilic) addition-elimination*

*M9*

***1***

***[9]***

***11.****(a)* ***X*** *(O–H) (alcohols)*

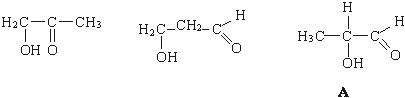
*penalise acid or missing “alcohol”*

***1***

***Y*** *C=O*

*allow carbonyl*

***1***

******

*NOT acid*

***4***

*(b)*

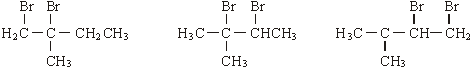
**

*Allow conseq dibromocompounds following incorrect unbranched alkenes*

*NOT allow dibromocompound consequent on a duplicate alkene*

*NOT allow monobromocompounds if HBr added*

***3***

******

***3***

*6:3:1 either next to correct structure or to none*

***1***

*Allow a mark for identifying correct dibromocompound with three peaks  
even if integration ratio is wrong*

***1***

*if 6:3:1 missing or wrong, no marks for splitting*

*Only award a mark for splitting if it is clear which integration number it  
refers to*

*6 singlet or drawn*

***1***

*3 doublet or drawn*

***1***

*1 quartet/quadruplet or drawn*

***1***

***(max 10 marks)***

***[16]***

|  |  |  |
| --- | --- | --- |
| **4.** |  | |
|  |  | |
|  |  | |
|  |  | |
|  | (d) |  |
|  | (e) | **[14]** |