



RECOGNISING ACHIEVEMENT

**Subject: Chains and Rings**

**Code: 2812**

**Session: June**

**Year: 2004**

**Mark Scheme**

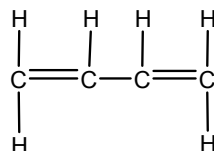
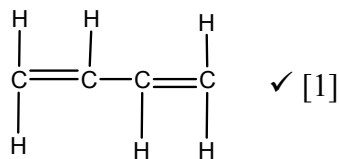
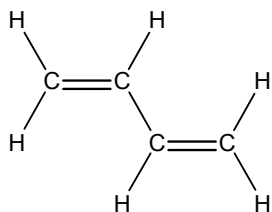
<b>MAXIMUM MARK</b>	<b>60</b>
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## ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.  
You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ( $\frac{1}{2}$ ) should never be used.
3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.
  - x = incorrect response (errors may also be underlined)
  - ^ = omission mark
  - bod = benefit of the doubt (where professional judgement has been used)
  - ecf = error carried forward (in consequential marking)
  - con = contradiction (in cases where candidates contradict themselves in the same response)
  - sf = error in the number of significant figures
4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.
5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.
6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.
8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

- 1 (a)
- (i)  $C_4H_{10}$  ✓ [1]
- (ii)  $C_2H_5O$  ✓ [1]
- (iii) B and E ✓ [1]
- (iv) A and F ✓ [1]
- (b)  $(C_4H_9OH \rightarrow) C_4H_8 + H_2O$  ✓ [1]  
*allow but-1-ene and but-2-ene*

(c) any unambiguous formula:



buta-1,3-diene  
*name ecf to the structure*

✓ [1]

[Total : 7]

2(a)

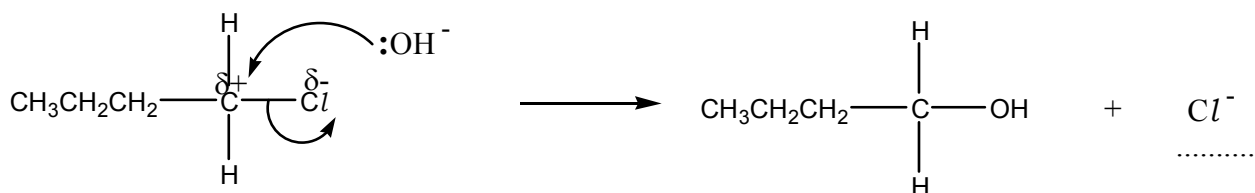
$Cl^-$  must be shown as a product ✓[1]

(at least 1) lone pair of electrons on the O in the  $OH^-$  with curly arrow from the lone pair on the  $OH^-$  to the  $C^{\delta+}$  ✓[1]

dipoles on the  $C-Cl$  bond ✓[1]

curly arrow from  $C-Cl$  bond to the  $Cl^{\delta-}$  ✓[1]

The mechanism below would get all 4 marks.



(b) (i) mark for method/dividing by  $A_R$ / C, 3.15; H, 6.3; Cl, 1.58. ✓[1]

$C_2H_4Cl$  / ratio is 2 : 4 : 1

alternative method:

% of each element  $\times 127 \div A_R$  of that element =

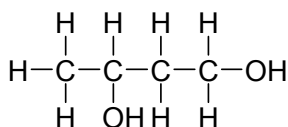
molecular formula, hence deduce empirical formula

(ii)  $C_4H_8Cl_2$

✓[1]

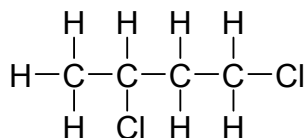
✓[1]

(iii) any unambiguous form of:



✓ [1]

(iv) any unambiguous form of:

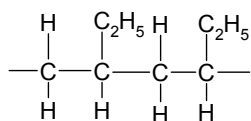


✓ [1]

*ecf to (iii) provided that there are two OH's in (iii)*

- (c) (i) ethanol/ alcohol ✓ [1]
- (ii) elimination/dehydro-halgenation/dehydro-chlorination ✓ [1]
- (iii) any unambiguous form of but-1-ene. ✓ [1]
- (iv)  $C_4H_9Cl + (Na^+)OH^- \rightarrow C_4H_8 + H_2O + (Na^+)Cl^-$  ✓ [1]

(d)



1 mark is available if the backbone consists of 4 C atoms and a reasonable attempt has been made

✓ ✓ [2]

- (e)(i) reagent **J**  $NH_3$  ✓ [1]
- (ii) product **K**  $HBr/NH_4Br$  ✓ [1]
- (iii) ethanol (as solvent)/high temp(heat) + (high) pressure/heat in a sealed tube ✓ [1]

[Total : 18]

3 (a)

Same molecular formula, different structure /displayed formula/  
arrangement of atoms/bonds

✓✓ [2]

(Same formula, different structure/displayed formula/arrangement of atoms

✓ [1])

(b) (i)

3-methylbut-1-ene and 2-methylbut-2-ene  
(any unambiguous structure/formula is acceptable)

✓✓ [2]

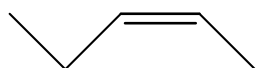
*look for structure that contains either 2 or 3 methyl groups*

(ii)

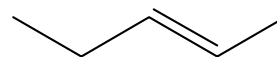
2-methylbut-1-ene/2-methyl-1-butene

✓ [1]

(iii)

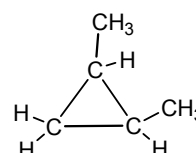
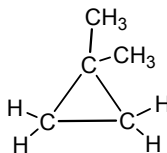
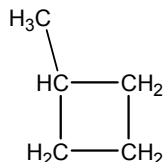


allow

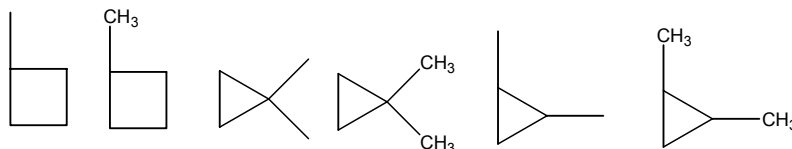


✓ [1]

(c)(i) any two from methylcyclobutane, 1,1-dimethylcyclopropane and 1,2-dimethylcyclopropane



allow hybrid skeletal structures such as

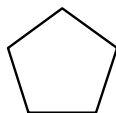


✓✓ [2]

(ii) cyclopentane

✓ [1]

(iii)



✓ [1]

(d)(i)

homolytic

✓ [1]

(ii)

$Cl_2 \rightarrow 2Cl\bullet$  (need  $\bullet$  on the Cl... penalise only once in the 3 equations)

✓ [1]

(iii)

I  $(C_5H_{10}) + Cl\bullet \rightarrow (\bullet C_5H_9) + HCl$

✓ [1]

II  $(\bullet C_5H_9) + Cl_2 \rightarrow C_5H_9Cl + Cl\bullet$

✓ [1]

[Total : 14]

- 4.(a) (i) Alkene/C=C ✓ [1]  
 Alcohol/ROH/hydroxy/hydroxyl/OH (not OH<sup>-</sup> or hydroxide) ✓ [1]
- (ii) One of the C in both C=C is joined to two methyl groups/H atoms/same group ✓ [1]  
*or contrasting argument*
- (b) Observation decolourisation(of Br<sub>2</sub>) – *not clear* ✓ [1]  
 Molecular formula C<sub>10</sub>H<sub>18</sub>OBr<sub>4</sub> ✓✓[2]  
 C<sub>10</sub>H<sub>18</sub>OBr<sub>2</sub> gets 1 mark
- (c) reagent CH<sub>3</sub>COOH ✓ [1]  
 catalyst H<sub>2</sub>SO<sub>4</sub>/H<sup>+</sup>/HCl (aq) or dilute loses the mark ✓ [1]
- (d)(i) C<sub>10</sub>H<sub>18</sub>O + 2[O] → C<sub>10</sub>H<sub>16</sub>O<sub>2</sub> + H<sub>2</sub>O ✓ [2]  
 1 mark for H<sub>2</sub>O and 1 mark for 2[O]
- (ii) The infra-red spectrum was of compound Y  
 because absorption between 1680 – 1750 cm<sup>-1</sup> indicates a C=O ✓ [1]  
 and the absence of a peak between 2500 – 3300 cm<sup>-1</sup> shows the absence of the  
 OH hydrogen bonded in a carboxylic acid ✓ [1]
- Use professional judgement and allow both marks if reference is made correctly to both absorptions.*

[Total : 12]

**5** Variation in boiling points. (max = 4 marks)

As chain length/  $M_r$  increases boiling point increases ✓[1]

due to increased number of electrons/ surface area/ more van der Waals forces /  
intermolecular forces/ more surface interactions ✓[1]

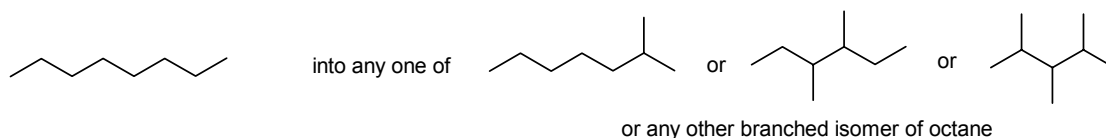
As branching increases boiling point decreases ✓[1]

straight chains can pack closer together/ straight chains have greater surface area/  
more van der Waals (vdW, VDW, vdw) forces /more intermolecular forces/ more surface  
interactions ✓[1]

**Isomerisation** (max = 4 marks)

(produces) branched chain alkanes ✓[1]

equation to illustrate any isomerisation (of octane) ✓[1]



Branched chains are better/more efficient fuels/used as additives ✓[1]

because they are more volatile/easier to ignite/burn more easily/higher octane  
number(rating)/lower boiling points/reduces knocking(pinking) ✓[1]

QWC mark

- use of suitable chemical terms such as van der Waals, intermolecular forces/ intermolecular bonds/volatile/ knocking/ pinking/pre-ignition
- reasonable spelling, punctuation and grammar throughout ✓[1]

[Total : 9]