

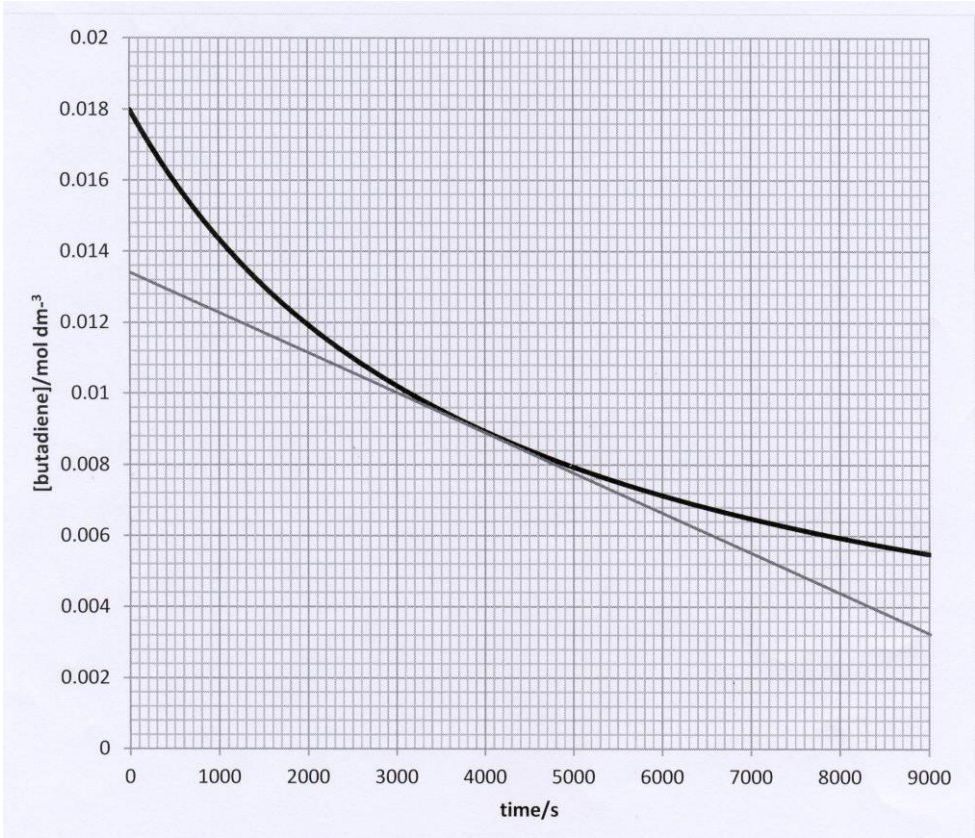
A-level Chemistry

Paper 2 (7405/2): Organic and Physical Chemistry
Mark scheme

7405
Specimen paper

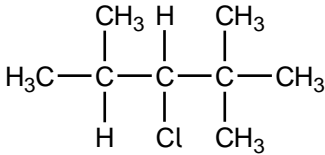
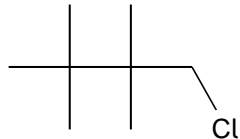
Version 0.1

Question	Marking guidance	Mark	Comments
01.1	2	1	
01.2	1	1	
01.3	$k = \frac{7.2 \times 10^{-4}}{(1.9 \times 10^{-2})^2 \times (3.5 \times 10^{-2})}$	1	Mark is for insertion of numbers into a correctly rearranged rate equ $k =$ etc If upside down, can score units mark only
	= 57.0	1	Allow consequential marking on incorrect transcription
	$\text{mol}^{-2} \text{dm}^6 \text{s}^{-1}$	1	Any order If k calculation wrong, allow units consequential to their k
01.4	$3.99 \times 10^{-3} \quad (\text{mol dm}^{-3} \text{s}^{-1})$ OR Their $k \times 7.00 \times 10^{-5}$	1	
01.5	Reaction occurs when molecules have $E \geq E_a$	1	
	Doubling [E] doubles the number with this E	1	
	Raising T by 10 °C causes <u>many</u> more to have this E	1	

Question	Marking guidance	Mark	Comments
02.1	<p>Gradient drawn on graph</p> 	1	

02.2	$= (0.0134 - 0.0032)/(9000 - 0)$	1	Allow use of any correct gradient
	$= 1.13 \times 10^{-6}$	1	Allow $1.10\text{--}1.16 \times 10^{-6}$
02.3	Initial rate is 4 times rate at concentration = $0.0090 \text{ mol dm}^{-3}$	1	
	Doubling concentration increases rate by 4 times	1	
	Second order with respect to butadiene	1	

Question	Marking guidance	Mark	Comments
03.1	2,2,4-trimethylpentane	1	
03.2	$\text{C}_8\text{H}_{18} + 12\frac{1}{2}\text{O}_2 \longrightarrow 8\text{CO}_2 + 9\text{H}_2\text{O}$	1	Accept doubled
03.3	5	1	
03.4	$\text{C}_{20}\text{H}_{42} \longrightarrow \text{C}_8\text{H}_{18} + 2\text{C}_3\text{H}_6 + 3\text{C}_2\text{H}_4$	1	
03.5	Mainly alkenes formed	1	
03.6	$\text{Cl}_2 \longrightarrow 2\text{Cl}\cdot$ $\text{C}_8\text{H}_{18} + \text{Cl}\cdot \longrightarrow [\text{C}_8\text{H}_{17}] \cdot + \text{HCl}$ $[\text{C}_8\text{H}_{17}] \cdot + \text{Cl}_2 \longrightarrow \text{C}_8\text{H}_{17}\text{Cl} + \text{Cl}\cdot$ Any termination step to form an organic compound eg $\text{Cl}\cdot + [\text{C}_8\text{H}_{17}] \cdot \longrightarrow \text{C}_8\text{H}_{17}\text{Cl}$ or $2 [\text{C}_8\text{H}_{17}] \cdot \longrightarrow \text{C}_{16}\text{H}_{34}$	1 1 1 1	

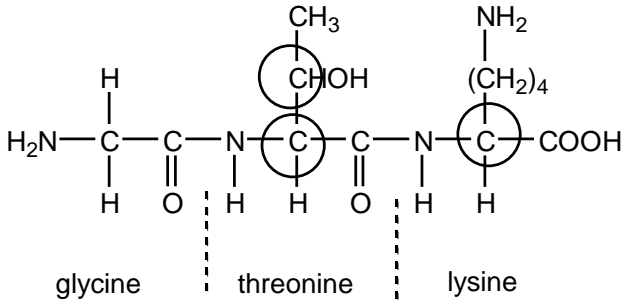
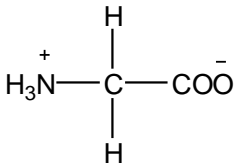
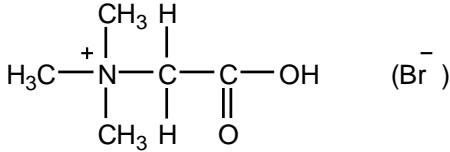
03.7	Ultraviolet or UV	1	
03.8	4 	1 1	
03.9		1	

Question	Marking guidance	Mark	Comments
04.1	3-methylbutan-2-ol	1	
04.2	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{CH}_3 \\ \quad \\ \text{H} \quad \text{O} \end{array}$	1	
04.3	Elimination	1	

04.4	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}=\text{C}-\text{CH}_3 \\ \\ \text{H} \end{array} $	1	
	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{C}=\text{CH}_2 \\ \quad \\ \text{H} \quad \text{H} \end{array} $	1	
04.5	Position	1	
04.6	C B A	1	
	Van der Waals forces in C (are weaker than)	1	
	Dipole-dipole forces in B (which are weaker than)	1	
	Hydrogen bonding in A	1	
04.7	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2\text{CH}_3 \\ \\ \text{OH} \end{array} $	1	

04.8	$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2\text{OH} \\ \\ \text{CH}_3 \end{array}$	1	
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Question	Marking guidance	Mark	Comments
05.1	Secondary	1	
05.2	Hydrogen bonding Very electronegative N Attached H very δ^+ Attracted to lone pair on O	1 1 1 1	

Question	Marking guidance	Mark	Comments
06.1	 <p style="text-align: center;">glycine threonine lysine</p>	1	
06.2		1	
06.3		1	Allow: $(\text{CH}_3)_3\text{N}^+-\text{CH}_2-\text{COOH} \quad (\text{Br}^-)$
06.4	2-amino-3-hydroxybutanoic acid	1	

06.5	$\begin{array}{c} \text{NH}_3^+ \\ \\ (\text{CH}_2)_4 \\ \\ \text{H}_3\text{N}^+ - \text{C} - \text{COOH} \\ \\ \text{H} \end{array}$	1	
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Question	Marking guidance	Mark	Comments
07.1	$\begin{array}{cc} \text{H} & \text{CH}_3 \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{CH}_3 & \text{Cl} \end{array}$ <p>Addition</p>	<p>1</p> <p>1</p>	
07.2	$\begin{array}{cc} \text{H} & \text{H} \\ & \\ \text{HO}-\text{C} & - & \text{C}-\text{OH} \\ & \\ \text{CH}_3 & \text{CH}_3 \end{array}$ $\begin{array}{ccccccc} & \text{O} & \text{CH}_3 & \text{H} & \text{O} & & \\ & & & & & & \\ \text{HO}-\text{C} & - & \text{C} & - & \text{C} & - & \text{C}-\text{OH} \\ & & & & & & \\ & & \text{CH}_3 & \text{H} & & & \end{array} \quad \text{OR} \quad \begin{array}{ccccccc} & \text{O} & \text{CH}_3 & \text{H} & \text{O} & & \\ & & & & & & \\ \text{Cl}-\text{C} & - & \text{C} & - & \text{C} & - & \text{C}-\text{Cl} \\ & & & & & & \\ & & \text{CH}_3 & \text{H} & & & \end{array}$	<p>1</p> <p>1</p>	
07.3	<p>Q is biodegradable</p> <p>Polar C=O group or δ^+ C in Q (but not in P)</p> <p>Can be attacked by nucleophiles</p>	<p>1</p> <p>1</p> <p>1</p>	

Question	Marking guidance	Mark	Comments
08.1	2-deoxyribose	1	
08.2	Cytosine - which forms hydrogen bonds Top N–H bonds to lone pair on O of guanine Lone pair on N bonds to H–N of guanine Lone pair on O bonds to lower H–N on guanine	1 1 1 1	If adenine stated, allow 1 mark only for response including hydrogen bonding Allow all 4 marks for a correct diagram showing the hydrogen bonding
08.3	Pt forms a (covalent) link between the two strands of DNA The strands are unable to separate DNA is prevented from replicating	1 1 1	

09.2	Dissolve sample in hot solvent / water	1	
	Minimum volume of solvent	1	
	Allow to cool	1	
	Filter off crystals	1	
	Take melting point	1	
	Compare melting point with data value to confirm purity	1	
09.3	M_r product = 135.0	1	
	Expected mass = $5.05 \times \frac{135.0}{93.0} = 7.33 \text{ g}$	1	
	Percentage yield = $\frac{4.82}{7.33} \times 100 = 65.8(\%)$	1	
09.4	Conc HNO_3	1	
	Conc H_2SO_4	1	
09.5	Electrophilic substitution	1	
09.6	Hydrolysis	1	
09.7	Sn/HCl	1	

Question	Marking guidance	Mark	Comments
10	IR		
	M1 absorption at 3360 cm^{-1} shows OH alcohol	1	
	NMR		
	M2 4 peaks indicates 4 different environments of hydrogen	1	
	M3 Integration ratio 4 1 3 6	1	
	M4 Quartet (integ 4) + triplet (integ 6) = CH_2CH_3	1	
	M5 Two equivalent CH_2CH_3	1	
	M6 Singlet (integ 1) = OH	1	
	M7 Singlet (integ 3) = CH_3	1	
	M8 $\begin{array}{c} \text{CH}_2\text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{OH} \\ \\ \text{CH}_2\text{CH}_3 \end{array}$	1	Correct structure without explanation scores maximum of 4 marks

Question	Marking guidance	Mark	Comments
11.1	HCN	1	
11.2	$\text{CH}_3\text{CH}_2\text{COCH}_3 + \text{HCN} \longrightarrow \text{CH}_3\text{CH}_2\text{C}(\text{OH})(\text{CN})\text{CH}_3$	1	
11.3	Planar C=O Equal chance of nucleophilic attack from both sides Inactive racemic mixture (racemate) formed	1 1 1	Allow independent of 11.1 and 11.2
11.4	HBr OR HCl OR H_2SO_4	1	Allow HI
11.5		4	Allow consequential marking on acid in 11.4
11.6	Major product exists as a pair of enantiomers Third isomer is 1-bromobutane (minor product) Obtained via primary carbocation	1 1 1	