A Level AQA Chemistry

Chapter 7 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	zero		1	3.1.9.1 AO1
01.2	$4.3\times10^{-3} = k \times 0.38^2$		1	3.1.9.1 AO2 MS0.0, 2.4
	$k = 4.3\times10^{-3} / 0.38^2$			
	$k = 0.0297(7)$	Allow answers rounded to 0.030	1	
	$\text{mol}^{-1}\,\text{dm}^3\,\text{s}^{-1}$		1	
01.3	$T = 298\,\text{K}$	Allow e.c.f. for ans. from **01.2** If $k = 3.3 \times 10^{-3}$ is used then $E_a = 63.2\ \text{kJ mol}^{-1}$	1	3.1.9.1 AO2 Ms3.3, 3.4
	$\text{In } 0.02977 = \frac{-E_a}{(8.31 \times 298)} + 19.8$		1	
	$E_a = 57735\ \text{J mol}^{-1}$		1	
	$E_a = 57.7\ \text{kJ mol}^{-1}$	Must be positive. Allow answer that rounds to 57700	1	
01.4	Mechanism 1		1	3.1.9.2 AO3
	Because Y is not in the rate equation/ Y is zero order / it is second order wrt X and 2 X moleules are required in the same/first step		1	
02.1	Second order		1	3.1.9.1 AO2
02.2	First order		1	3.1.9.1 AO2

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OXFORD Revise

Question	Answers	Extra information	Mark	AO Spec reference
02.3	rate = k [A] [B]^2 $2.50 \times 10^{-3} = k \times 0.5 \times 1^2$ $2.5\times10^{-3}/ 0.5 = 5.00\times10^{-3}$ $mol^{-2}\,dm^6\,s^{-1}$	Allow any row of data from table	1 1 1 1	3.1.9.1 AO2 MS0.0,2.2
03.1	First		1	3.1.9.1 AO2
03.2	First		1	3.1.9.1 AO2
03.3	Zero		1	3.1.9.1 AO2
03.4	rate = k [X][Y] $3.75\times10^{-3} = k\ (5\times10^{-4} \times 2\times10^{-3})$ $3.75\times10^{-3} / 1\times10^{-6} = k = 3750$ $mol^{-1}\,dm^3\,s^{-1}$	Allow any row of data from table	1 1 1 1	3.1.9.1 AO2 MS0.0,2.2

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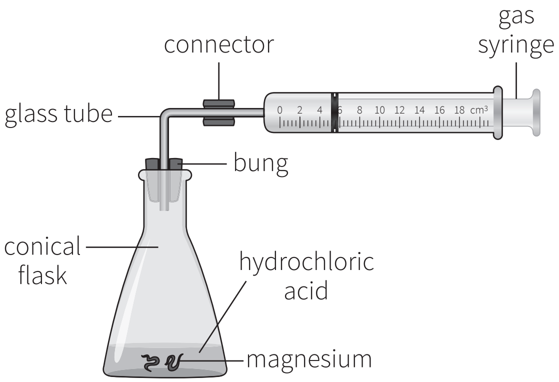
Question	Answers	Extra information	Mark	AO Spec reference
03.5	$K_c = \frac{[D]\,[E]}{[X]\,[Y]^2\,[Z]}$ Moles at equilibrium: $X = 0.90$ $Y = 0.80$ $Z = 0.20$ $D = 0.60$ $E = 0.60$ $K_c = \frac{0.60 \times 0.60}{0.90 \times 0.80^2 \times 0.20}$ = 3.125 $mol^{-2}\,dm^6$		1 1 1 1 1	3.1.6.2 AO2 Ms2.2,2.3
03.6	K_c will be smaller Equilibrium will shift left /towards endothermic So denominator will be larger / numerator bigger		1 1 1	3.1.6.1 AO3
04.1	Appropriate tangent drawn Appropriate gradient calculated	Should touch the curve at 50 s and be at least 4 cm long	1 1	3.1.9.2 Ms3.3,3.4 AO3

Question	Answers	Extra information	Mark	AO Spec reference
04.2	Appropriate diagram of gas syringe or burette over water and conical flask Similar to:  Correct labels of equipment	Check all connections are complete and no tubes are cut off by pen lines Ignore clamp stand Ignore timer/ measuring cylinder, etc. Allow equivalent diagram for collecting gas over water	1 1	3.1.5.4 AO3
04.3	1.9/24.3 = 0.078 Moles of $HCl = 2 \times 0.100 = 0.200$ moles Evidence of ratio/balanced equation Moles of $H_2 = 0.078$		1 1 1	3.1.2.5 MS0.1,0.2 AO2
04.4	Moles of HCl left = 0.200 – (2 × 0.078) = 0.044 $[H^+] = 0.044/0.1 = 0.44$ pH = −log(0.44) = 0.36	Allow e.c.f. from **04.3** 1.36 scores 3 marks Must be 2 d.p.	1 1 1 1	3.1.12.2 MS0.4, MS2.5 AO2

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>05.1</td><td>
<table>
<tr><th>Expt.</th><th>Volume of KI (aq) / cm^3</th><th>log$_{10}$ (volume of KI (aq))</th><th>Time / s</th><th>log$_{10}\left(\frac{1}{t}\right)$</th></tr>
<tr><td>1</td><td>10</td><td>1.00</td><td>142</td><td>−2.15</td></tr>
<tr><td>2</td><td>16</td><td>1.20</td><td>92</td><td>−1.96</td></tr>
<tr><td>3</td><td>20</td><td>1.30</td><td>64</td><td>−1.81</td></tr>
<tr><td>4</td><td>30</td><td>1.48</td><td>50</td><td>−1.70</td></tr>
<tr><td>5</td><td>40</td><td>1.60</td><td>40</td><td>−1.60</td></tr>
<tr><td>6</td><td>50</td><td>1.70</td><td>28</td><td>−1.44</td></tr>
</table>
Log (1 / time) on the y-axis + log (vol) on x-axis
Sensible scales
Plots points correctly ± one square
Line of best fit correctly drawn</td><td></td><td>2
1
1
1
1</td><td>3.1.9.2
AO3
MS 3.1</td></tr>
<tr><td>05.2</td><td>Reads appropriate points from graph showing working or triangle
Gradient = 0.96 +/− 0.02
Answer to 2 d.p.
First order reaction</td><td>Allow points from data table</td><td>1
1
1
1</td><td>3.1.9.2
AO3
MS 3.1</td></tr>
<tr><td>05.3</td><td>Colorimeter / UV-visible spectrometer / light sensor to monitor colour change
Eliminates human error in timing / more accurate time of colour change</td><td>Ignore disappearing cross methods</td><td>1
1</td><td>3.1.9.2
AO3</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>06.1</td><td>Substance that increases the rate of reaction by providing an alternative route
Which are not used up in the reaction</td><td></td><td>1
1</td><td>3.1.5.5</td></tr>
<tr><td>06.2</td><td>Propanone = first
Iodine = zero
hydrogen ions = first</td><td></td><td>1
1
1</td><td>3.1.9.1</td></tr>
<tr><td>06.3</td><td>rate = $k\,[CH_3COCH_3]\,[H^+]$
$1.60\times10^{-2} = k \times 0.30 \times 0.15$
$1.60\times10^{-2}/\ 0.045 = 0.356$
$mol^{-1}\,dm^3\,s^{-1}$</td><td>Allow any row of data
Allow any answer that rounds to 0.036</td><td>1
1
1
1</td><td>3.1.9.1
AO2
MS0.0, 2.2</td></tr>
<tr><td>06.4</td><td>
<table>
<tr><th>Temperature T/K</th><th>1/T /K^{-1}</th><th>Rate constant, k</th><th>ln k</th></tr>
<tr><td>293</td><td>3.413×10^{-3}</td><td>0.0030</td><td>−5.81</td></tr>
<tr><td>313</td><td>3.195×10^{-3}</td><td>0.0216</td><td>−3.84</td></tr>
<tr><td>333</td><td>3.003×10^{-3}</td><td>0.122</td><td>−2.10</td></tr>
<tr><td>353</td><td>2.883×10^{-3}</td><td>0.567</td><td>−0.57</td></tr>
</table>
lnk on the y-axis + 1/T on x-axis
Sensible scales
Plots points correctly ± one square
Line of best fit correctly drawn</td><td>Should take up at least half the grid</td><td>2
1
1
1
1</td><td>3.1.9.2
AO3
MS 3.1</td></tr>
</table>

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Question	Answers	Extra information	Mark	AO Spec reference
06.5	Shows triangle or uses figure from graph		1	3.1.9.2 AO3 MS3.3, 3.4, 3.5
	Gradient = −5690 ± 200		1	
	$-E_a/R = -5690$			
	$E_a = -5690 \times 8.31 = 47283\ \text{J mol}^{-1}$		1	
	$E_a = 47\ \text{kJ mol}^{-1}$	Allow 2 or 3 s.f.	1	
07.1	$SO_3 = 3.0$		1	3.1.10 AO2
	$O_2 = 0.5$		1	
07.2	$K_p = \frac{P^2SO_3}{P^2SO_2 \times P^2O_2}$		1	3.1.10 AO2 MS2.2, 2.3
	Mole fractions $SO_2 = 0.8/4.3 = 0.186$ $O_2 = 0.5/4.3 = 0.116$ $SO_3 = 3.0/4.3 = 0.698$		1	
	Partial pressures $SO_2 = 0.186 \times 210 = 39.06$ $O_2 = 0.116 \times 210 = 24.36$ $SO_3 = 0.698 \times 210 = 146.58$		1	
	$K_p = \frac{146.58^2}{39.06^2 \times 24.36} = 0.578$		1	
	kPa^{-1}		1	

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Question	Answers	Extra information	Mark	AO Spec reference
07.3	The position of equilibrium would shift left/towards reactants As there are less moles To oppose the change	Allow 'due to le Chatelier's principle'	1 1 1	3.1.10 AO3
07.4	K_p would increase Equilibrium would shift right/ towards exothermic To oppose the change	Allow 'due to le Chatelier's principle'	1 1 1	3.1.10 AO3
07.5	1/0.578 = 1.73 kPa	allow error carried forward Must be 3 s.f. answer and unit scores 2 marks independent of approach taken	1 1	3.1.10 AO2
08.1	Moles in 2.70 g sulfuryl chloride = $\frac{2.7}{135}$ = 0.02 Moles in 0.64 g sulfuryl chloride = $\frac{0.67}{135}$ = 0.005 Moles at equilibrium SO_2Cl_2 = 0.015 mol SO_2 = 0.005mol Cl_2= 0.005 mol		1 1 1	3.1.10 AO2

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Question	Answers	Extra information	Mark	AO Spec reference
08.2	$K_p = \frac{PSO_2 \times PO_2}{P^2SO_3}$ Mole fraction $SO_2Cl_2 = \frac{0.015}{0.025} = 0.6$ $SO_2 = \frac{0.005}{0.025} = 0.2$ $Cl_2 = \frac{0.005}{0.025} = 0.2$ Partial pressure = $SO_2Cl_2 = 0.6 \times 125 = 75$ $SO_2 = 0.2 \times 125 = 25$ $Cl_2 = 0.2 \times 125 = 25$ $K_p = \frac{25 \times 25}{75} = 8.33$ kPa		1 1 1 1 1	3.1.10 AO2 MS2.2, 2.3
08.3	Tetrahedral shape drawn With double bonds to oxygen Bond angle 104 – 109.5	Either draw with wedge and dotted lines or named	1 1 1	3.1.3.5 AO1

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Skills box answers:

1. To prevent mass loss due to spitting. The cotton wool is fitted loosely so that CO_2 gas can still escape.
   $2HCl(aq) + CaCO_3(s) \rightarrow H_2O(l) + CO_2(g) + CaCl_2(aq)$
2. At max mass, $[HCl] = 2.00\ mol\ dm^{-3}$ (this is the initial amount)
   Change in mass (Δm) = mass of lost CO_2
   mol(CO_2) = $\Delta m/44.0$
   $2 \times$ mol(CO_2) = mol(HCl) = $2 \times \Delta m/44.0$
   $\therefore$ [HCl] = mol(HCl)/volume = $(2 \times \Delta m)/(44.0 \times 16.0 \times 10^3) = 2.84 \times \Delta m$
3. Measure the half-life of the reaction. If it is constant, then the reaction is first order with respect to HCl.