

Question	Answer	Marks	AO Element	Notes	Guidance
1	(substance which) speeds up a reaction / substance which increases the rate of reaction	1			
2	line starts from 0 cm ³ AND initial gradient less steep (1) final volume levels off between 24–30 cm ³ (1)	2			
3	any value between and including 37 (cm ³) to 38 (cm ³)	1			
4	the reaction is complete / the reaction has finished	1			
5	(substance which) speeds up a reaction / increases the rate of reaction	1			
6	variable oxidation states	1			
7	(a substance which) increases the rate of a reaction (1) without being used up (at the end) / remains unchanged / unaffected / without changing mass (1)	2			
8(a)	decreases (rate) / slower (rate)	1			

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8(b)	decreases (rate)/ slower (rate)	1			
8(c)	increases (rate)/ faster (rate)	1			
9(a)	220 (cm ³)	1			
9(b)	49 (min)	1			
9(c)	goes faster / increases (rate)	1			
10	D - 2 and 4	1			
11	A	1			
12(a)	allow: 420–440 (s)	1			
12(b)	0.175 g	1			
12(c)	increases / gets faster	1			
	decreases / gets slower	1			
	decreases / gets slower	1			
13(a)	decreases	1			
	then remains constant	1			

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13(b)	0.28 (mol / dm ³)	1			
13(c)	allow: values between 44–46 (hours)	1			
13(d)	curve steeper at start	1			
	curve levels out at same level and before 45 hrs	1			
14(a)	(concentration) decreases	1			
	then remains constant	1		allow: levels out	
14(b)	3.8 (hr) / 3 hr 48 min	1			
14(c)	9 (hr)	1		allow: 8.8–9.2 (hr)	
14(d)	steeper graph line from same starting point	1			
	levels off lower than 0.10 mol / dm ³	1			
14(e)	increase the temperature / increase concentration of sodium hydroxide	1		allow: add a catalyst	

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15(a)	water / natural gas / hydrocarbons	1											
15(b)	<table border="1"> <tr> <td>effect on the rate of the reverse reaction</td> <td>effect on the equilibrium yield of CH₃OH(g)</td> </tr> <tr> <td>M1 increases</td> <td></td> </tr> <tr> <td></td> <td>M3 decreases</td> </tr> <tr> <td>M2 decreases</td> <td>M4 decreases</td> </tr> </table>	effect on the rate of the reverse reaction	effect on the equilibrium yield of CH ₃ OH(g)	M1 increases			M3 decreases	M2 decreases	M4 decreases	4			
effect on the rate of the reverse reaction	effect on the equilibrium yield of CH ₃ OH(g)												
M1 increases													
	M3 decreases												
M2 decreases	M4 decreases												
16(a)	at the start / beginning	1											
16(b)	new line is steeper than printed line and starts at origin (1) new line reaches same final volume as printed line (1)	2											
17	new line steeper than printed line and starts at origin (1) new line reaches same final volume as printed line (1)	2											

Question	Answer	Marks	AO Element	Notes	Guidance
18(a)	faster and more particles per unit volume / dm ³ / cm ³ (1) more collisions per second / unit time or greater collision rate (1)	2			
18(b)	reaction faster and (particles) have more energy or (particles) move faster (1) more collisions per second or greater collision rate (1) more (of the) particles / collisions have energy greater than the activation energy or more particles / collisions have sufficient energy to react or greater percentage / proportion / fraction of collisions are successful (1)	3			

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19	particles have more kinetic energy (1) particles move faster (1) more collisions per unit time (1) more of the particles have energy greater than or equal to activation energy / more of the collisions have energy greater than or equal to activation energy (1) OR more of the particles have sufficient energy to react / more of the collisions have sufficient energy to react OR a greater percentage or greater proportion or greater fraction of collisions are successful (1)	4			
20	rate decreases / reaction gets slower (1) concentration of acid decreases (1) fewer collisions per unit time (1)	3			
[Total: 57]					