

| Question | Answers | Extra information | Mark | AO /  Spec Ref |
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| **01** | increasing solution temperature  more collisions every second **and** more collisions with enough energy to break bonds  adding a catalyst  more collisions with enough energy to break bonds  increasing gas pressure  more collisions every second | If more than three lines are drawn, deduct one mark for each incorrect line. | 1  1  1 | AO1  C6.1.2  WS1.2 |
| **02.1** | at least **five** points plotted correctly  all points correct  smooth curve avoiding anomalous point | ±half a small square | 1  1  1 | 2 × AO2  1 × AO3  C6.1.2  MS4a, 4c |
| **02.2** | Any **one** from:   * clock started too late * clock stopped too soon * sodium thiosulfate solution too concentrated * sodium thiosulfate solution warmer | Accept any other sensible suggestions. Must be an error that leads to an anomalous point that is too low | 1 | AO2  C6.1.2  WS3.7 |
| **02.3** | rate increases **or** time taken decreases as concentration increases  particles closer together **or** more particles in a given volume  particles collide more frequently | do not accept more **successful** collisions | 1  1  1 | AO2  C6.1.3  WS1.2 |
| **03** | **Level 3 (**5–6 marks)**:** Detailed and coherent practical method described with most apparatus named **and** both evidences for reversibility. | | 6 | AO1  C6.2.2 |
| **Level 2 (**3–4 marks)**:** Some description of practical method **or** named apparatus **and** one evidence for reversibility. | |
| **Level 1 (**1–2 marks)**:** Brief description of method **or** named apparatus **or** one evidence for reversibility. | |
| **Level 0 (0 marks):** No relevant content. | |

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|  | **Indicative content:**  Apparatus   * Bunsen burner * test tube or crucible * pipette or dropper * other valid apparatus.   Method   * heat until colour change * allow to cool * add water dropwise.   Evidence   * crystals become blue again * heat evolved.   Other creditworthy ideas   * word equation with reversible arrow * endothermic in forwards direction * exothermic in backwards direction. | |  |  |
| **04.1** | gas syringe **or** inverted measuring cylinder over water  correctly named | must be water present in trough if measuring cylinder used | 1  1 | AO2  C6.1.2  AT1 |
| **04.2** | When *t* = 0 **OR** at the beginning  the graph is steepest | accept largest gradient | 1  1 | AO3  C6.1.1  MS4d, 4e |
| **04.3** | steeper curve  same final volume (80 cm3) |  | 1  1 | AO2  C6.1.2  MS5c |
| **04.4** | acid **or** marble used up **or** fully reacted | reaction has stopped is insufficient | 1 | AO2  C6.1.2 |
| **05.1** | reversible (reaction) |  | 1 | AO1  C6.2.1 |
| **05.2** | more sulfur trioxide  fewer molecules **or** moles on product side | ignore references to rate | 1  1 | AO2  C6.2.7 |
| **05.3** | less sulfur trioxide  forward reaction is exothermic | ignore references to rate | 1  1 | AO2  C6.2.6 |
| **05.4** | lower activation energy  alternative reaction pathway | ignore surface area | 1  1 | AO1  C6.1.4 |