

| Question | Answers | Extra information | Mark | AO / Spec Ref |
| --- | --- | --- | --- | --- |
| **01** | increasing solution temperature  more collisions every second **and** more collisions with enough energy to break bondsadding a catalyst  more collisions with enough energy to break bondsincreasing gas pressure  more collisions every second | If more than three lines are drawn, deduct one mark for each incorrect line. | 111 | AO1C6.1.2WS1.2 |
| **02.1** | at least **five** points plotted correctlyall points correctsmooth curve avoiding anomalous point | ±half a small square | 111 | 2 × AO21 × AO3C6.1.2MS4a, 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 | AO2C6.1.2WS3.7 |
| **02.3** | rate increases **or** time taken decreases as concentration increasesparticles closer together **or** more particles in a given volumeparticles collide more frequently | do not accept more **successful** collisions | 111 | AO2C6.1.3WS1.2 |
| **03** | **Level 3 (**5–6 marks)**:** Detailed and coherent practical method described with most apparatus named **and** both evidences for reversibility. | 6 | AO1C6.2.2 |
| **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. |

| Question | Answers | Extra information | Mark | AO / Spec Ref |
| --- | --- | --- | --- | --- |
|  | **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 watercorrectly named | must be water present in trough if measuring cylinder used | 11 | AO2C6.1.2AT1 |
| **04.2** | When *t* = 0 **OR** at the beginningthe graph is steepest | accept largest gradient | 11 | AO3C6.1.1MS4d, 4e |
| **04.3** | steeper curvesame final volume (80 cm3) |  | 11 | AO2C6.1.2MS5c |
| **04.4** | acid **or** marble used up **or** fully reacted | reaction has stopped is insufficient | 1 | AO2C6.1.2 |
| **05.1** | reversible (reaction) |  | 1 | AO1C6.2.1 |
| **05.2** | more sulfur trioxidefewer molecules **or** moles on product side | ignore references to rate | 11 | AO2C6.2.7 |
| **05.3** | less sulfur trioxideforward reaction is exothermic | ignore references to rate | 11 | AO2C6.2.6 |
| **05.4** | lower activation energyalternative reaction pathway | ignore surface area | 11 | AO1C6.1.4 |