| Question | Answers | Extra information | Mark | AO / Spec ref. |
| --- | --- | --- | --- | --- |
| **01** | Increasing solution temperature  more collisions every second **and** more collisions with enough energy to break bonds.Adding a catalyst  more collisions every second with enough energy to break bonds.Increasing gas pressure  more collisions every second. | If more than three lines are drawn, deduct **1** mark for each incorrect line. | 111 | AO1C6.1.2WS1.2 |
| **02.1** | At least **five** points plotted correctly;all points correct;smooth 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 | AO3C6.1.2WS3.7 |
| **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/ more collisions in a given time. | Do not accept more collisions or more successful collisions. | 111 | AO2C6.1.3WS1.2 |
| **03** | **Level 3:** Detailed and coherent practical method described with most apparatus named **and** both evidences for reversibility. | 5–6 | AO1C6.2.2 |
| **Level 2:** Some description of practical method **or** named apparatus **and** one piece of evidence for reversibility. | 3–4 |
| **Level 1:** Brief description of method **or** named apparatus **or** one piece of evidence for reversibility. | 1–2 |
| **Level 0:** No relevant content. | 0 |
|  | **Indicative content:**Apparatus:* Bunsen burner
* test tube or crucible
* pipette or dropper
* any other valid apparatus.

Method:* heat until colour change
* allow to cool
* add water (dropwise).

Evidence:* white powder becomes blue again when water is added
* and energy evolved/test tube gets hot

Other creditworthy ideas:* word equation with reversible arrow:

 endothermichydrated copper sulfate ⇌ anhydrous copper sulfate + water(blue) exothermic (white)* endothermic in forwards direction
* exothermic in backwards direction.

This indicative content is not exhaustive, other creditworthy responses should be awarded marks as appropriate. |  |
| **04.1** | Gas syringe **or** inverted measuring cylinder over water;correctly named. | Must be water present in trough if measuring cylinder used. | 11 | AO2C6.1.2AT1 |
| **04.2** | when *t* = 0–20s  |  | 1 | AO3C6.1.1MS4e |
| **04.3** | 2.25cm3/s | Allow error carried forward from **04.2**;allow **1** mark for evidence of 44 to 46 divided by 20. | 11 | AO2C6.1.1MS3c, 4a |
| **04.4** | steeper curvesame final volume (80 cm3) |  | 11 | AO2C6.1.2MS4e |
| **05.1** | reversible (reaction) |  | 1 | AO1C6.2.1 |
| **05.2** | More sulfur trioxide;fewer molecules **or** moles (of gas) on product side so equilibrium shifts right to lower the pressure. | Ignore references to rate. | 11 | AO2C6.2.7 |
| **05.3** | Less sulfur trioxide;forward reaction is exothermic so equilibrium shifts left to lower the temperature. | Ignore references to rate. | 11 | AO2C6.2.6 |
| **05.4** | Lower activation energy/alternative reaction pathway;resulting in higher proportion of molecules with enough energy to react. | Ignore surface area. | 11 | AO1C6.1.3C6.1.4 |