

|           |                                                                                                                                                                                                                                                         |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1(a)(i)   | 24 protons    28 neutrons    24 electrons                                                                                                                                                                                                               |
| 1(a)(ii)  | ( <sup>54</sup> Cr has two) more neutrons (than <sup>52</sup> Cr)                                                                                                                                                                                       |
| 1(a)(iii) | (relative) abundance (of each isotope)                                                                                                                                                                                                                  |
| 1(a)(iv)  | The fourth isotope has any value of RIM less than 51.996                                                                                                                                                                                                |
| 1(b)(i)   | 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup> 3s <sup>2</sup> 3p <sup>6</sup> (3d <sup>5</sup> 4s <sup>1</sup> )                                                                                                                                      |
| 1(b)(ii)  | 6                                                                                                                                                                                                                                                       |
| 1(c)(i)   | Cr / Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> <b>AND</b> it gains electrons                                                                                                                                                                         |
| 1(c)(ii)  | (+) <sup>4</sup>                                                                                                                                                                                                                                        |
| 1(c)(iii) | <i>Due to an issue with question 1(c)(iii), the question has been removed from the question paper.</i>                                                                                                                                                  |
| 1(c)(iv)  | <b>M1</b> CO <sub>2</sub> has only instantaneous / temporary dipole–induced dipole forces<br><b>AND</b> methanal has permanent dipole–permanent dipole (and id-id) forces<br><br><b>M2</b> IMF's in methanal are stronger than IMF's in CO <sub>2</sub> |
| 1(d)(i)   | rate of forward and backward (reaction) are the same / equal<br><b>OR</b> concentrations of reactants and products are constant                                                                                                                         |
| 1(d)(ii)  | closed system                                                                                                                                                                                                                                           |
| 1(d)(iii) | <b>M1</b> (mixture becomes more) orange<br><br><b>M2</b> forward reaction is endothermic<br><br><b>M3</b> (mixture becomes more) orange<br><br><b>M4</b> equilibrium moves (forwards/right) to compensate for extra acid / H <sup>+</sup>               |
| 1(e)      | <b>M1</b> hydrolysis<br><br><b>M2</b> CrF <sub>4</sub> + 2H <sub>2</sub> O → CrO <sub>2</sub> + 4HF                                                                                                                                                     |