

**Multiple Choice Answers**

Q17: A

Q19: C

**Multiple Choice Answers**

Q18: C

**Multiple Choice Answers**

Q19: A

Q20: B

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4(a) | <b>M1</b> energy level of products below energy level of reactants<br><b>M2</b> label of $\text{SO}_2(\text{g}) + 4\text{HF}(\text{g})$ on product line<br><b>M3</b> upward arrow labelled $E_a$ from energy level of reactants to the highest point of the curve<br><b>M4</b> one downward arrow labelled $\Delta H$<br>AND<br>energy change starting from energy level of reactants and finishing at energy level of products |
| 4(b) | <b>M1</b> $= (4 \times \text{S-F}) + (4 \times \text{O-H}) = (4 \times 330) + (4 \times 460) = 3160$<br><b>M2</b> bond energy of products $- 3160 = -54$<br>$= 3160 - (-54) = 3214$<br><b>M3</b> $(2 \times \text{S=O}) + (4 \times \text{H-F}) = 3214$ therefore $2 \times \text{S=O} = 3214 - (4 \times 570) = 934$<br><b>M4</b> $\text{S=O} = \text{M3} \div 2 = 934 \div 2 = 467$                                           |
| 4(c) | increased temperature:<br><b>M1</b> (position of) equilibrium moves to left hand side<br><b>M2</b> reaction is exothermic<br>increased pressure:<br><b>M3</b> (position of) equilibrium moves to left hand side<br><b>M4</b> less (gaseous) moles on left hand side<br><b>M5</b> no change / catalyst does not affect position of equilibrium                                                                                   |
| 4(d) | <b>M1</b> kinetic energy of particles decreases<br><b>M2</b> frequency of collisions between particles decreases<br><b>M3</b> lower percentage/proportion/fraction of collisions / particles have energy greater than / equal to activation energy                                                                                                                                                                              |

**Multiple Choice Answers**

Q16: B

**Multiple Choice Answers**

Q16: D

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |               |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|
| 5(a)         | <p><b>M1</b> concentration is no longer changing</p> <p><b>M2</b> rates of forward reaction and of the reverse reaction are equal</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |               |
| 5(b)(i)      | <p><b>M1</b> rate decreases</p> <p><b>M2</b> yield of methanol decreases</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |               |
| 5(b)(ii)     | <table border="1"> <tr> <td>no change(1)</td> <td>increases (1)</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | no change(1) | increases (1) |
| no change(1) | increases (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |               |
| 5(b)(iii)    | exothermic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |               |
| 5(b)(iv)     | <p><b>M1</b> copper</p> <p><b>M2</b> transition element</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |               |
| 5(c)(i)      | <p><b>any 2 from:</b></p> <ul style="list-style-type: none"> <li>• same or <b>similar</b> chemical properties or reactions</li> <li>• (same) general formula</li> <li>• (consecutive members) differ by CH<sub>2</sub></li> <li>• same functional group</li> <li>• physical properties <b>OR</b><br/> example of a physical property<br/> e.g. melting point /<br/> boiling point /<br/> volatility<br/> vary in predictable manner <b>or</b> show trends <b>or</b> gradually change</li> </ul>                                                                                                                                                                                                  |              |               |
| 5(c)(ii)     | C <sub>5</sub> H <sub>12</sub> O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |               |
| 5(d)(i)      | <p><b>M1</b> displayed formula of ester linkage, i.e.</p> $\text{H or C} - \overset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{O} - \text{C}$ <p><b>M2</b> completely correct displayed formula of methyl ethanoate or ethyl methanoate i.e.</p> $\begin{array}{c} \text{H} & & \text{O} & & \text{H} \\   & &    & &   \\ \text{H} - \text{C} - & \text{C} & - \text{O} - & \text{C} & - \text{H} \\   & & & &   \\ \text{H} & & & & \text{H} \end{array}$ <p><b>OR</b></p> $\begin{array}{c} & \text{O} & & \text{H} & \text{H} \\ &    & &   &   \\ \text{H} - & \text{C} & - \text{O} - & \text{C} & - \text{C} & - \text{H} \\ & & &   &   \\ & & & \text{H} & \text{H} \end{array}$ |              |               |
| 5(d)(ii)     | <p><b>M1</b> butan-1-ol</p> <p><b>M2</b> ethanoic acid</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |               |

|      |                                                                                                                                                 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 5(e) | <b>M1</b> C 64.87 / 12<br>H 13.51 / 1<br>O 21.62 / 16<br><br><b>OR</b><br><br>5.41 13.51 1.35<br><br><b>M2</b> C <sub>4</sub> H <sub>10</sub> O |
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**Multiple Choice Answers**

Q20: D