26. Reaction kinetics

26.2 Homogeneous and heterogeneous catalysts

Paper 4

Marking Scheme

Q1.

(b)	**M1** equation 1: $2Fe^{2+} + S_2O_8^{2-} \rightarrow 2Fe^{3+} + 2SO_4^{2-}$ **M2** equation 2: $2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$	**2**

Q2.

(b)(i)	Any **two** from: • variable oxidation state • vacant / empty / unfilled d orbitals [1] • can form dative bonds / can accept electrons	**1**
(b)(ii)	Iron **AND** iron is solid, reactants are gases **OR** catalyst and reactants are in different phases / states [1]	**1**
(b)(iii)	Two for one mark, three for two marks: • adsorption of reactants by Pt • bonds of reactants weaken [1] • desorption of products [1]	**2**
(b)(iv)	$NO_2 + SO_2 \rightarrow NO + SO_3$ **AND** $2NO + O_2 \rightarrow 2NO_2$ [1]	**1**

Q3.

(a)(i)	palladium, platinum and rhodium / Pt, Pd, Rh	**1**
(a)(ii)	a catalyst in a different state / phase to the reactants / substrate	**1**

Q4.

(d)	iron(III) chloride / $FeCl^3$ AND same state / phase as reactants / H_2O_2 [1]	**1**

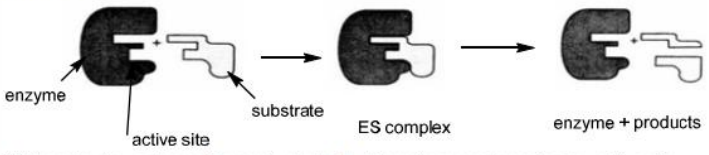
Q5.

(c)(i)	the catalyst and the reactants are in a different state / phase	**1**
(c)(ii)	**M1** adsorption of reactants to the surface of the catalyst **M2** bonds in the reactants weaken (lowering the activation energy) **M3** reaction occurs and the products are desorbed	**3**

Q6.

(a)(i)	(homogeneous is in the) same phase / state as reactants **AND (**heterogeneous is in a) different phase / state to reactants	**1**
(a)(ii)	1 $S_2O_8^{2-} + 2Fe^{2+} \rightarrow 2Fe^{3+} + 2SO_4^{2-}$ [1] 2 $2I^- + 2Fe^{3+} \rightarrow 2Fe^{2+} + I_2$ [1]	**2**
(a)(iii)	reactants are **both anions / negatively charged** **AND** so they **repel** each other **OWTTE**	**1**

Q7.

(c)	diagrams  M1 (can be in words or diagram) substrate shape is complementary to active site M2 (can be in words or diagram) the substrate bind / bonds / fits into the active site M3 (can be in words or diagram) products are released M4 (words) lower E_A / bonds weakened (in substrate) Any three points	**3**

Q8.

(h)	provides an alternative route of lower activation energy / E_a **or** to lower E_a and more molecules with $E \geqslant E_a$	**1**