

Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Mark Schemes

Q1.

(a)

This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.	
Level 3 5-6 marks	All stages are covered and the description of each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 and stage 3.
Level 2 3-4 marks	All stages are covered but the description of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer is mainly coherent and shows progression from stage 1 to stage 2 and/or stage 3.
Level 1 1-2 marks	Two stages are covered but the description of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes isolated statements and these are presented in a logical order.
Level 0	0 marks Insufficient correct chemistry to gain a mark.

Stage 1

1a Heterogeneous means in a different phase/state from reactants

1b Catalyst speeds up reaction and is left unchanged **OR** lowers the activation energy for the reaction

Stage 2

2a Hydrogen and nitrogen/reactants adsorb onto the surface/ active sites of the iron

2b Bonds weaken/reaction takes place

2c Products desorb/leave from the surface (of the iron)

Stage 3

3a Large surface area (of iron) by using powder or small pellets or support medium/mesh

3b Catalyst poisoned / sulfur poisons or binds to the catalyst

3c Active sites blocked

Ignore references to temperature and pressure

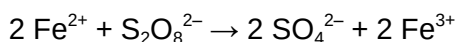
6

- (b) Two negative ions repel

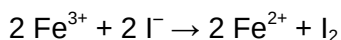
1

So activation energy is high

1



1



Ignore any state symbols given

Allow multiples for both equations

Allow equations in either order

1

- (c) (Zn ions) have only one oxidation state

Or

Zn^{2+} is the only ion

Allow doesn't have variable oxidation state

Allow cannot be oxidised to Zn^{3+}

Ignore has a full d shell

1

- (d) M1 Amount of Fe = $0.998 \div 55.8 = 0.0179$ mol

1

M2 Amount of HCl = 0.0300 mol

1

M3 HCl is the limiting reagent

1

M4 Amount of H_2 produced = 0.0150 mol

$M4 = M2 \div 2$

1

M5 T = 303 K P = 100 000 Pa

1

M6 $V \left(= \frac{0.0150 \times 8.31 \times 303}{100\,000} \right) = 3.78 \times 10^{-4} \text{ (m}^3\text{)}$

$M6 \quad V \left(= \frac{M4 \times 8.31 \times 303}{100\,000} \right) \text{ (m}^3\text{)}$

1

- (e) FeCO_3 or iron(II) carbonate

1

Green

Allow white

1

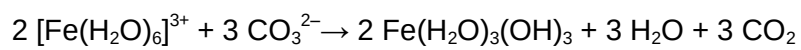
- (f) $\text{Fe}(\text{H}_2\text{O})_3(\text{OH})_3$

Ignore square brackets if added

1

brown

1



Accept multiples

1

- (g) M1 Fe^{3+} is smaller (than Fe^{2+}) **OR** Fe^{3+} has a greater charge **OR** Fe^{3+} has a greater charge density **OR** Fe^{3+} has a greater charge to size ratio

Penalise $\text{Fe}(\text{H}_2\text{O})_6^{3+}$ ions once in M1 or M2

1

M2 Fe^{3+} ions are more polarising **OR** Fe^{3+} ions polarise water molecules more

1

M3 So more O-H bonds (in the water ligands) break **OR** more H^+ ions released **OR** weaken O-H bonds in ligands more (in the Fe^{3+} solution)

Do not allow Fe^{3+} releases 3H^+ ions

1

[25]