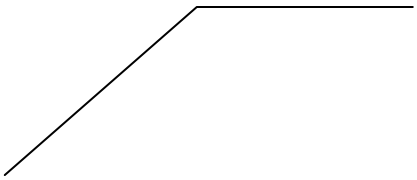
1 **(a (i)** Named soluble zinc salt **[1]**
corresponding sodium salt **[1]**
If hydroxide **or** oxide then 0/2

(ii) Correct equation **[2]**
not balanced **[1]** only

(iii) Correct equation **[2]**

(b) $Fe^{3+} + 3OH^- = Fe(OH)_3$ **[1]**

(ii) Max at $8cm^3$ **[1]**
Same shape of graph



Just the above shape, the height of the precipitate and the volume of sodium hydroxide are irrelevant **[1]**

(iii) Maximum then height of precipitate decreases **[1]**
or graph slopes down to x axis **or** comes to zero

hydroxide dissolves in excess **or** it is amphoteric **[1]**

TOTAL = [11]

2 dilute
filter
saturated
cool
blue
sulphate **[6]**

TOTAL = 6

Question	Answer	Marks
3(a)	(sulfur-containing) fossil fuels;	**1**
(b)	**M1** vanadium pentoxide / vanadium(V) oxide / V_2O_5 (catalyst); **M2** 1–5 atmospheres (units required); **M3** 450 °C (units required); **M4** $2SO_2 + O_2 \rightarrow 2SO_3$; **M5** equilibrium / reversible reaction;	**5** 1 1 1 1 1
(c)	$_2S_2O_7$;	**1**
(d)(i)	3 correct (2 marks) 2 correct (1 mark) bubbles / effervescence / fizzing; dissolves / disappears / *forms* a solution; blue (solution);	**2**
(d)(ii)	carbon dioxide and water and copper(II) sulfate;	**1**
(e)(i)	c	**1**
(e)(ii)	dehyd	**1**

4(a)(i)	to Zn^{2+} ; because electron loss;	**2**	**A** because oxidation number has increased for M2
(a)(ii)	$^{+}$ or 'hydrogen ion(s)'; it accepts electrons or takes electrons (from zinc atoms);	**2**	**R** H_2 or 'hydrogen' **A** because it is reduced or because it decreases in oxidation number **A** it causes zinc to lose electrons
(b)(i)	zinc displaces copper or zinc more reactive than copper; $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$ **OR** $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$;	**2**	**A** copper less reactive than zinc **I** zinc reacts with copper ions or with Cu^{2+} or with copper chloride **I** zinc reacts with copper **I** Cu^{2+} ions are reduced **A** multiples **I** state symbols
(b)(ii)	steeper (line) or higher gradient; (means an) increased rate; but the same (final) volume;	**3**	 **A** less time to complete the reaction / same amount of gas in less time / faster reaction / more gas in the same time period **A** same volume of hydrogen produced **A** 'amount' for volume **A** no extra gas is made

4(c)	M1 less steep (line) or lower gradient; M2 (because of) decreased rate; M3 ethanoic is a weak(er) acid; M4 only partially ionised or dissociated **OR** lower concentration of hydrogen ions;	**4**	**A** alternative phrases e.g. 'shallower' **A** more time to complete the reaction **A** same amount of gas in more time **A** slower rate or slower reaction ORA **A** not fully dissociated or ionised **A** ionises less (than HCl) **I** less hydrogen ions
(d)	M1 moles of HCl = 0.1 (mol); M2 moles of Zn = 0.05 (mol); mass of zinc = 3.25 g;	**3**	 **A** ECF for M1 × ½ **A** ECF for M2 × 65 Unit required for M3

5 **(a** any **three** from:
(it would have) more than one or variable valency / oxidation state / oxidation number (1)

(metal / element / titanium / it has a) high density (1)

coloured compounds / ions / solutions (1)

form complex (ions) (1)

(element/compound act as) catalyst (1) [3]

(b) ScF_3 (1)

correct charges on **both** ions (1)

8 electrons around (each) fluoride (1) [3]

(c) name or formula of strong acid and alkali (1)

reacts with or neutralises both acid and base or alkali (then amphoteric) (1)

it dissolves / soluble in both(acid and alkali) or form solutions in both (1) [3]

[Total: 9]