1 **(a) (i)**

aqueous solution	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead (II) nitrate		✓	✓	✗
magnesium nitrate	✗		✗	✗
zinc nitrate	✗	✓		✗
silver(I) nitrate	✓	✓	✓	

each horizontal line correct (1) [3]

(ii) Zn (1)

An arrow **from** Zn **to** Zn^{2+} (1) [2]

(iii) $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$ (1) [1]

(b) correct direction from zinc to lead (1) [1]

(ii) metals react by **losing electrons** (1)

the more reactive metal / zinc will lose electrons more readily (making the electrode negatively charged). (1) [2]

(iii) manganese **and** zinc are more reactive than lead (and / or copper) (1)

lead is more reactive than copper (1) [2]

(iv) the **polarity** of a Mn / Zn (cell)
or the **voltages** of Zn / Pb **and** Mn / Pb (cells) (1) [1]

[Total: 12]

2 **(a) (i)** measure melting point **NOT** just heating [1]
pure sample would melt at 135 °C [1]
OR impure would melt lower than 135 °C

(ii) $C_3H_4O_4$ [1]

(iii) $C_2H_4O_2$ **OR** CH_3COOH [1]
ethanoic **OR** acetic acid [1]
both marks are independent of each other

(iv) ester **NOT** organic, covalent [1]

(b) (i) malonic is a weaker acid/less dissociated
OR sulfuric acid is a stronger acid/more dissociated [1]
NOT sulfuric acid is a strong acid

(ii) add piece of suitable metal, e.g. Mg **ALLOW** A*l*, Ca **NOT** K, Na, Cu [1]

sulfuric acid reacts fast**er OR** malonic reacts slow**er** [1]

OR
as above add a piece of $CaCO_3$, if soluble carbonate then [1] only

OR measure electrical conductivity [1]
sulfuric acid is the bett**er** conductor
OR malonic acid poor**er** conductor [1]
NOT sulfuric acid is a good conductor

(c) (i) sodium malonate **and** water [1]

(ii) $CuSO_4$
H_2O [2]

(iii) $CH_2(COO)_2Mg$
H_2 [2]

(iv) K_2SO_4
CO_2 **and** H_2O **NOT** H_2CO_3 [2]

[Total: 16]

3 **(a** because they have more than one oxidation state or valency / form ions with different charges [1]

there are two iron oxides (iron(III) oxide and iron(II) oxide) / iron forms Fe^{2+} and Fe^{3+} compounds / iron forms iron(II) and iron(III) compounds [1]

(b) (i) to remove the precipitate / remove the silver(I) chromate(VI) / remove the residue [1]

(ii) to remove soluble impurities / remove named soluble salt e.g. potassium nitrate / remove reactants [1]

(iii) to dry solid / to remove water [1]

(c) (i) need one mole of potassium chromate(VI) for two moles of silver(I) nitrate / correct references to mole ratio [1]

(ii) mass of $AgNO_3$ needed is $170 \times 0.2 \times 0.1 = 3.4g$ [2]
NOTE: if answer given is 34 they have omitted 0.1
ALLOW: (1) ecf

(iii) number of moles of $AgNO_3$ used = $0.02 \times 0.2 = 0.004$ [1]

number of moles of Ag_2CrO_4 formed = 0.002 [1]

mass of one mole of Ag_2CrO_4 = 332g

mass of Ag_2CrO_4 formed = 0.664g [1]
NOTE: use ecf when appropriate

[Total: 11]

4 **(a** nitric acid; [1]
sodium hydroxide / carbonate / hydrogen carbonate; [1]

copper(II) oxide / hydroxide / carbonate; [1]

any named soluble chloride; [1]
accept: *hydrochloric acid* / *hydrogen chloride*
silver(I) nitrate / ethanoate / sulfate; [1]
must be soluble silver salt **not** *silver oxide* / *carbonate*

zinc(II) sulfate [1]

(b) (i) $Ag^+(aq) + Cl\ (aq) \rightarrow AgCl(s)$
equation correct state symbols missing [1]

(ii) $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + CO_2 + H_2O$ [2
correct formula for zinc sulfate = 1

[Total: 10]

5 **(a (i)** A C D B [1]

(ii) speed (or rate) increases as <u>concentration</u> increases / time decreases as <u>concentration</u> increases; [1]
rate or speed or time depends on (concentration) of H^+ or hydrogen ions; [1]
B is slow because propanoic acid is weak or doesn't dissociate or weakly ionises;
or
B is slow because HCl **and** H_2SO_4 are stronger or ionise or dissociate more than propanoic; [1]
D slow<u>er</u> than C because C is more concentrated than D / ORA; [1]
A is fast because H^+ concentration high (**note:** this would also score second mark if not already awarded) / H_2SO_4 is diprotic or dibasic or $2H^+$; [1]
time is inversely proportional to rate / owtte / ORA; [1]
max [5]

(b) change 1:
increase temperature / heat (the mixture); [1]
<u>particles</u>/<u>molecules/ions</u> have more energy or move faster; [1]
more (successful) collisions / more particles with E_a; [1]
change 2:
increase surface area / decrease particle size / use powdered (magnesium) / use smaller pieces / crush the magnesium; [1]
more collisions / more particles exposed to reaction; [1]
or
catalyst; [1]
more (successful) collisions; [1]
lowers E_a; [1]
max [5]

6 **(a)** proton donor; [1]

(b) equal concentrations of both (solutions); [1]
add Universal indicator / determine pH / pH paper; [1]
ethylamine has lower pH / ORA; [1]
or
equal concentration of both (solutions); [1]
measure conductivity of aqueous ethylamine and sodium hydroxide; [1]
ethylamine will have lower conductivity / sodium hydroxide will have higher conductivity; [1]

(c) add strong(er) base / NaOH / KOH; [1]
warm / heat; [1]

(d) (ethylamine forms) hydroxide ions / OH (in water); [1]
hydroxide ions / OH reacts with iron(III) ions / Fe^{3+};
or
iron(III) hydroxide / $Fe(OH)_3$ (forms as a brown precipitate); [1]
note: balanced or unbalanced ionic equation i.e. $Fe^{3+} + (3)OH \rightarrow Fe(OH)_3$ scores both marks