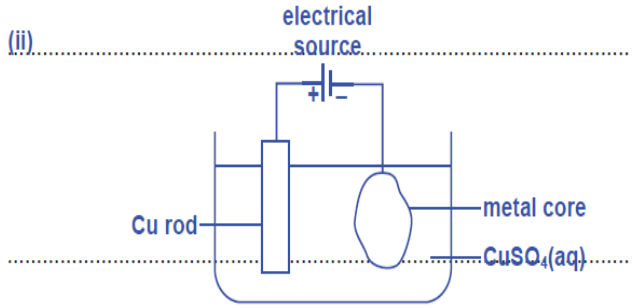
ACJC Qn1b

(i)	$2F_2 + 2H_2O \rightarrow 4HF + O_2$
	Reducing agent as itself is being oxidised. The oxidation number of O increases from −2 in H_2O to 0 in O_2. Or water reduces F_2 to HF as the oxidation number of F decreases from 0 in F_2 to −1 in HF.
(ii)	$CH_3COCl + H_2O \rightarrow CH_3COOH + HCl$
	Nucleophile. The carbon of the acyl chloride functional group is electron deficient and is susceptible to nucleophilic attack by water, which has a lone pair of electrons on its oxygen atom.
(iii)	$H_2PO_4^- + H_2O \rightleftharpoons HPO_4^{2-} + H_3O^+$
	Base. H_2O accepts a proton from $H_2PO_4^-$ to form H_3O^+ and HPO_4^{2-}.
(iv)	$Li + H_2O \rightarrow LiOH + \frac{1}{2} H_2$ Oxidising agent. Water oxidises Li to Li^+ as the oxidation number of Li increases from 0 in Li to +1 in LiOH
(v)	$NO_2^- + H_2O \rightleftharpoons HNO_2 + OH^-$
	Acid. H_2O donates a proton to NO_2^- to form OH^- and HNO_2.

EJC Qn 5b

i. Aqueous copper (II) sulfate

(ii)



iii.Since $E^{\ominus}(Cu^{2+}/Cu)$ is more positive than $E^{\ominus}(_{Fe^{2+}/Fe})$, Fe will be oxidised easily. Fe^{2+} go into the solution as cations and migrate to the cathode. Fe^{2+} ions formed will remain in the electrolyte and not be reduced at the cathode, as they have a lower tendency to be reduced than Cu^{2+} due to less positive $E^{\ominus}$ values.

Since $E^{\ominus}(_{Cu^{2+}/Cu})$ is less positive, Cu is selectively oxidized at anode. Ag will not be oxidised and falls to the bottom of the tank as 'anode sludge'.

(iv) $n_{Cu} = \frac{1.896}{63.5} = 0.02986 \text{ mol}$

Since $Cu^{2+} + 2e^- \rightarrow Cu$, $n_{e^-} = 2n_{Cu} = 2 \times 0.02986 = \underline{\mathbf{0.0597 \text{ mol}}}$

(v) $Q = I \times t = 3.0 \times 32 \times 60 = 5760 \text{ C}$

$F = \frac{Q}{n_{e^-}} = \frac{5760}{0.05972} = 96450 \approx \underline{\mathbf{96500 \text{ C mol}^{-1}}}$

(vi) $L = \frac{F}{\text{electronic charge, } e} = \frac{96450}{1.60 \times 10^{-19}} = \underline{\mathbf{6.03 \times 10^{23} \text{ mol}^{-1}}}$

Viii)if the copper rod contains other metals which can be oxidised to a different oxidation states and involve different electrons to be oxidised. This will affect plating rates and not uniform layer of plating to be formed.

RV Qn 4C

(c) **(i)** $[CH_3COCH_3(aq)]$ remains approximately constant throughout the experiment so rate of reaction is independent of $[CH_3COCH_3(aq)]$.

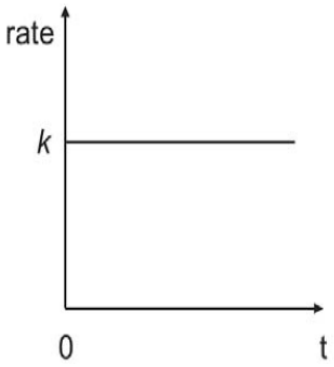
Thus experimental results can be used to determine the order of reaction with respect to $I_2(aq)$ and $H^+(aq)$.

(ii) A straight line/ linear plot is obtained/ graph has a constant (negative) gradient.

Rate of reaction is constant regardless of the concentration of I_2.

Reaction is independent of $[I_2]$ and reaction is zero order with respect to I_2.

(iii)



(iv) Rate of expt 1 = –gradient of expt 1 = $-\left(\frac{0.6-0.35}{0-300}\right)$ = 0.000833 s^{-1}

Rate of expt 2 = –gradient of expt 2 = $-\left(\frac{0.6-0.1}{0-300}\right)$ = 0.00166 s^{-1}

Since rate of reaction doubled when $[H^+]$ is doubled, reaction is first order with respect to H^+.

(v) Let the rate equation be rate = $k[H^+][CH_3COCH_3]^n$

$$\frac{(\text{Rate})_3}{(\text{Rate})_4} = \frac{k[H^+]_3[CH_3COCH_3]_3^n}{k[H^+]_4[CH_3COCH_3]_4^n}$$

$$\frac{(2.45)}{(3.68)} = \frac{k(0.002)(0.001)^n}{k(0.001)(0.003)^n}$$

n = 1

Reaction is first order with respect to CH_3COCH_3.

SAJC 5b

(i)	Write an equation to represent the discharging of this battery.
	$Ti^{3+} + Mn^{3+} + H_2O \rightarrow TiO^{2+} + 2H^+ + Mn^{2+}$
(ii)	Use the *Data Booklet* to calculate the $E^{\ominus}_{cell}$ when the battery is discharged. Hence, calculate the standard Gibbs free energy change, $\Delta G^{\ominus}$, per mole of Mn^{3+} used in the discharging process.
	$E^{\ominus}_{cell} = (+1.54) - (+0.10) = +\mathbf{1.44}$ V $\Delta G^{\ominus} = -nFE^{\ominus} = -(1)(96500)(+1.44)$ $= -138960$ J mol^{-1} $\approx$ **-139 kJ mol^{-1}**
(iii)	Suggest and explain the effect on E_{cell} if an electrolyte of lower pH was used.
	$TiO^{2+} + 2H^+ + e^- \rightleftharpoons Ti^{3+} + H_2O$ At lower pH, **$[H^+]$ is high** and would cause the **position of equilibrium for the above to shift right**. [$E(TiO^{2+}/Ti^{3+})$ would become **more positive**, causing **E_{cell} to become less positive**. *Ecf from (ii) for E_{cell}*
(iv)	Sulfuric acid, which is a source of H^+, will flow through the exchange membrane as the battery discharges. Suggest the direction of flow of H^+ through the membrane. Explain your answer.
	H^+ flow from **Tank B towards Tank A** to maintain electrical neutrality as **H^+ is being produced in Tank B**.
(v)	Suggest an advantage of using *porous* carbon electrodes.
	It **increases the surface area** for exchange of electrons to occur faster.

DHS Qn 2

(i) State the role of magnesium in the first step of Fig. 2.1 and give a reason for its suitability in this reaction. [2]

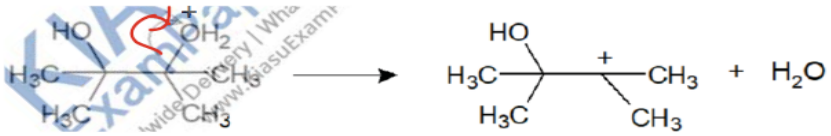
Magnesium is functioning as a reducing agent in the first step.
It is suitable due to its relatively low ionisation energies/ low electronegativity.

(ii) It is possible to synthesise a desired unsymmetrical diol using methods similar to the *pinacol coupling reaction* but a mixture of diols will be obtained.

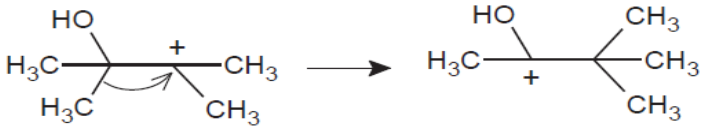
Explain why a mixture of diols is formed. Suggest why this is unfavourable other than a low yield of the desired diol. [2]

Two different carbonyl compounds have to be used to synthesise an unsymmetrical diol. In the process, two different radical ion intermediates will be formed and different combinations of these radicals will couple to form a mixture of (three) diols.
Obtaining a mixture of diols is unfavourable as the separation of the diols to yield the desired one would be complex.

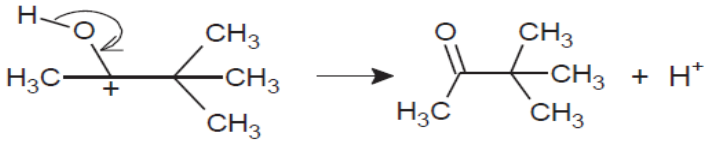
Step 2:



Step 3:

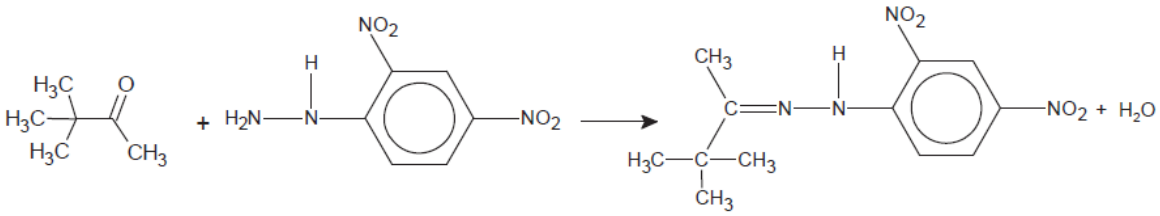


Step 4:

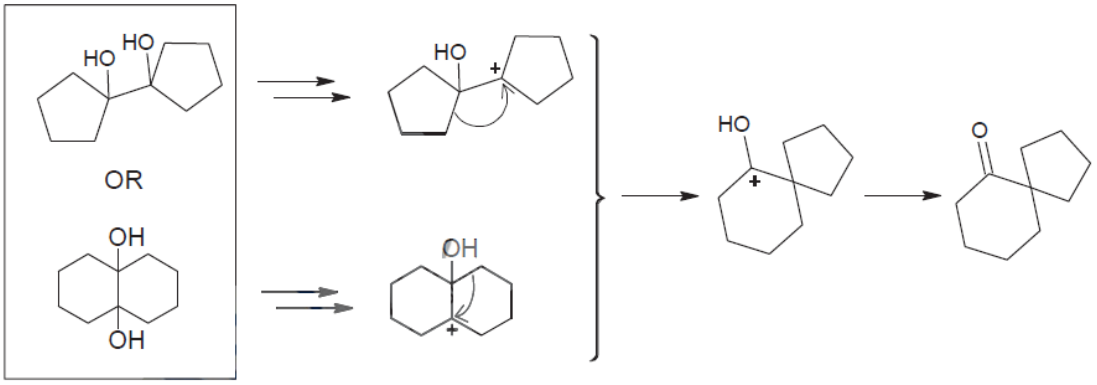


iv. Add 2,4–DNPH to the reaction mixture.

The formation of an orange ppt indicates the formation of pinacolone



Draw the structure of the 1,2-diol responsible for producing **X**. [1]



1,2-diol