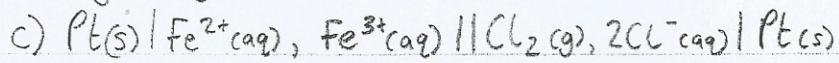
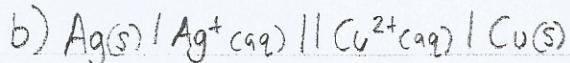
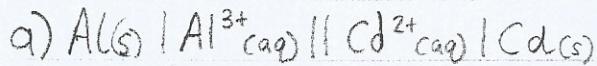


Redox Equilibria

① Find the emfs of the following cells:



$$E^\ominus_{\text{cell}} = E^\ominus_{\text{RHand}} - E^\ominus_{\text{LHand}}$$

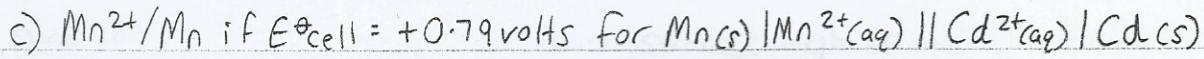
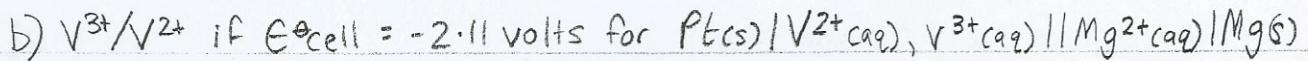
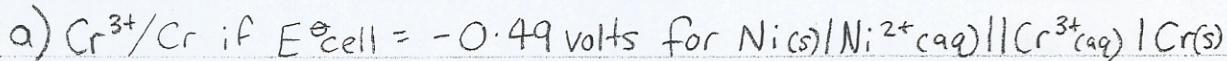
a) $-0.40 - (-1.66) = +1.26 \text{ volts}$

b) $+0.34 - (+0.80) = -0.46 \text{ volts}$

c) $+1.36 - (+0.77) = +0.59 \text{ volts}$

<u>Values (E^\ominus)</u>
$\text{Al}^{3+}/\text{Al} = -1.66 \text{ volts}$
$\text{Cd}^{2+}/\text{Cd} = -0.40 \text{ volts}$
$\text{Ag}^+/\text{Ag} = +0.80 \text{ volts}$
$\text{Cu}^{2+}/\text{Cu} = +0.34 \text{ volts}$
$\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ volts}$
$\text{Cl}_2/2\text{Cl}^- = +1.36 \text{ volts}$

② Calculate the unknown E^\ominus values from E^\ominus_{cell} and the E^\ominus given values below:



$$E^\ominus_{\text{cell}} = E^\ominus_{\text{RHand}} - E^\ominus_{\text{LHand}}$$

a) $-0.49 = ? - (-0.25) = -0.74 \text{ volts}$

b) $-2.11 = -2.37 - ? = -0.26 \text{ volts}$

c) $+0.79 = -0.40 - ? = -1.19 \text{ volts}$

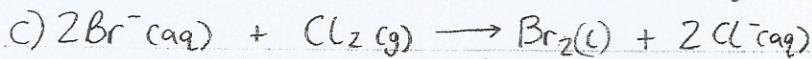
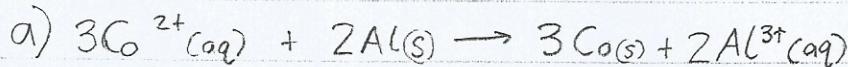
Values (E^\ominus)

$\text{Ni}^{2+}/\text{Ni} = -0.25 \text{ volts}$

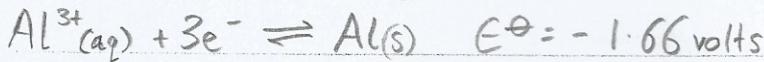
$\text{Mg}^{2+}/\text{Mg} = -2.37 \text{ volts}$

$\text{Cd}^{2+}/\text{Cd} = -0.40 \text{ volts}$

③ Which of the following reactions are feasible?



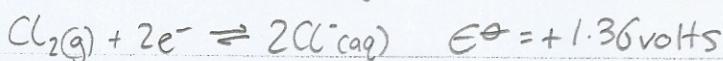
$$\mathcal{E}^\ominus_{\text{cell}} = R\text{H}_{\text{red}} - L\text{H}_{\text{red}}$$



(feasible) $\mathcal{E}^\ominus_{\text{cell}} = -0.28 - (-1.66) = +1.38 \text{ volts}$



(Not feasible) $\mathcal{E}^\ominus_{\text{cell}} = -2.71 - (-2.37) = -0.34 \text{ volts}$



(feasible) $\mathcal{E}^\ominus_{\text{cell}} = +1.36 - (+1.07) = +0.29 \text{ volts}$

Values (E^\ominus)

$$\text{Al}^{3+}/\text{Al} = -1.66 \text{ volts}$$

$$\text{Co}^{2+}/\text{Co} = -0.28 \text{ volts}$$

$$\text{Na}^+/\text{Na} = -2.71 \text{ volts}$$

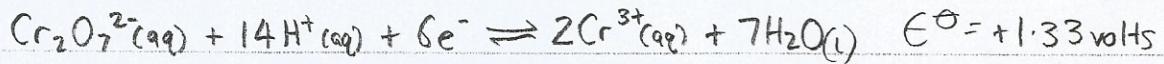
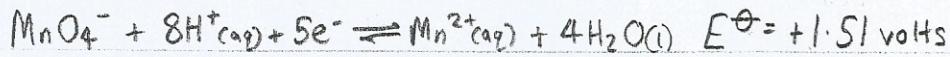
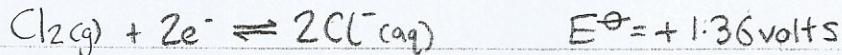
$$\text{Mg}^{2+}/\text{Mg} = -2.37 \text{ volts}$$

$$\text{Br}_2/2\text{Br}^- = +1.07 \text{ volts}$$

$$\text{Cl}_2/2\text{Cl}^- = +1.36 \text{ volts}$$

$$\text{Fe}^{3+}/\text{Fe}^{2+} = +0.77 \text{ volts}$$

④ Potassium Manganate (VII) solution acidified with dilute sulphuric acid, and potassium dichromate (VI) solution acidified with dilute sulphuric acid are both oxidising agents. Are either, or both, strong enough to oxidise chloride ions to chlorine?



MnO_4^- - feasible as less negative so itself will be reduced!

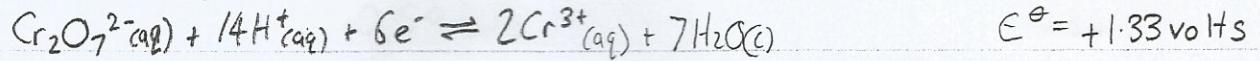
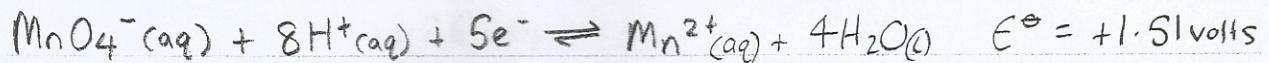
$\text{Cr}_2\text{O}_7^{2-}$ - Not feasible as more negative so will reduce chlorine to Cl^- !

BUT! : often acidified by more than 1 mol dm⁻³ HCl ∵ not standard conditions and in reality will work!

⑤ Water can be oxidised to oxygen according to the equation



Given the following E^\ominus values, what can you use to oxidise water in this way?



All of them except Bromine! (Bromine is the better reducer).

BUT! = Not true as $\text{Cr}_2\text{O}_7^{2-}$ never oxidises water to oxygen.
This is because EA is too high!