Answers to 3.3 Paper 2

Question One

a It turns from orange to green/blue. A = both correct

b $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$
A = correct

c Name: sulfate; Formula: SO_4^{2-} A = both correct

d $2H_2O(l) + SO_2(g) \rightarrow SO_4^{2-}(aq) + 4H^+(aq) + 2e^-$
A = correct

e $Cr_2O_7^{2-}(aq) + 3SO_2(g) + 2H^+(aq) \rightarrow 2Cr^{3+}(aq) + 3SO_4^{2-}(aq) + H_2O(l)$ A

f SO_3 A

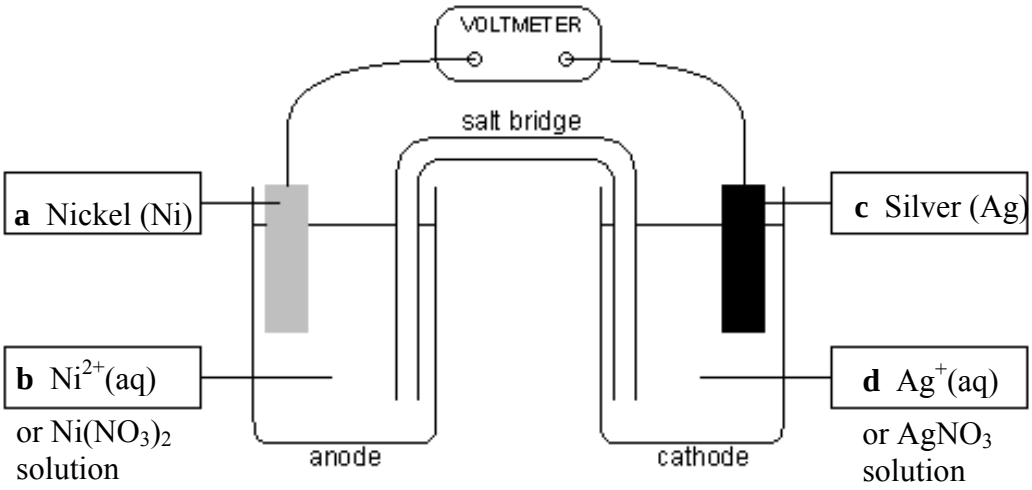
Question Two

1 a Reduction A

b The aluminium is the reducing agent. It supplies electrons to convert Ag^+ into Ag.
A = role of aluminium, M = complete answer

c $Al(s) \rightarrow Al^{3+}(aq) + 3e^-$
Overall: $2Al(s) + 3Ag_2S \rightarrow 2Al^{3+}(aq) + 6Ag + 3S^{2-}$
A = correct

2 a



A = correct, but with minor error, M = all correct

b sodium / potassium / ammonium : nitrate A

c $E^\circ_{Cell} = E_{RHE} - E_{LHE}$
$= +0.80\ V - (-0.23\ V)$
$= 1.03\ V$
A = correct formula but minor error eg. no units, M = correct voltage

d The electrons flow through the external circuit from left to right. Ions move through the salt bridge, cations moving to the Ag^+/Ag half-cell while anions move to the Ni^{2+}/Ni half-cell.
A = correct electron flow, M = both electron flow and ion flow through salt bridge,
E = full discussion including anion and cation directions

e In the Ni^{2+}/Ni half-cell the green colour will become darker as Ni^{2+} increases and the nickel electrode will erode away. In the Ag^+/Ag half-cell more silvery solid will be deposited on the silver electrode as the mass of silver increases.
A = any 2 correct observations, M = 2 correct observations with explanations, E = full discussion

Question Three

1 a $AsO_4^{3-} = +5$; $AsO_2^{-} = +3$ A = either correct

b $2AsO_2^{-}(aq) + 4H_2O(l) \rightarrow 2AsO_4^{3-}(aq) + 8H^+(aq) + 4e-$ (Eqn 1)

$O_2(aq) + 4H^+(aq) + 4e- \rightarrow 2H_2O(l)$ (Eqn 2)

$2AsO_2^{-}(aq) + 2H_2O + O_2 \rightarrow 2AsO_4^{3-}(aq) + 4H^+(aq)$ (Eqn 3)

A = correct oxidation equation (Eqn 1), M = correct ionic equation, but no cancelling of H_2O and H^+, E = correct ionic equation (Eqn 3)

c $E^\circ_{Cell} = E_{RHE} - E_{LHE}$

$= +1.23 \text{ V} - (+ 0.14 \text{ V})$

$= 1.09 \text{ V}$

This is > 0 so reaction is spontaneous.

A = stating O_2 is the stronger oxidising agent, M = using emfs to justify answer

Judgement Statement

Achievement: **9 questions answered correctly**

A minimum of 9 × A

Merit: **11 questions answered correctly with 4 at Merit level**

A minimum of 7 × A + 4 × M

Excellence: **12 questions answered correctly with 5 at Merit level and 2 at Excellence level**

A minimum of 5 × A + 5 × M + 2 × E