3. Ammonia gas undergoes combustion to produce nitrogen dioxide gas and water vapour. Write and balance (using oxidation numbers) the reaction equation. Confirm using the half-reaction method.

$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$

$-3\ +1 \quad 0 \quad +4\ -2 \quad +1\ -2$

$-7e^-$ (N: $-3 \rightarrow +4$) $\times 4$

$+2e^- \times 2 = +4e^-$ (O: $0 \rightarrow -2$) $\times 7$

$2H_2O + NH_3 \rightarrow NO_2 + 7H^+ + 7e^-) \times 4$

$4e^- + 4H^+ + O_2 \rightarrow 2H_2O) \times 7$

$8H_2O + 4NH_3 + 28H^+ + 7O_2 \rightarrow 4NO_2 + 28H^+ + 6H_2O$

$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$

4. A 10.00 mL sample of acidified chromium (II) nitrate solution are titrated with a 0.350 mol/L solution of sodium perchlorate. Using the titration information below, determine the concentration of the sample.

Volume of titrant (sodium perchlorate solution) added.

Trial	1	2	3	4	5
Final burette reading (mL)	12.3	25.2	37.6	12.2	24.9
Initial burette reading (mL)	0.0	12.3	25.2	0.0	12.2
Volume added	12.3	12.9	12.4	12.2	12.7

OA: Cr^{2+} (RA), NO_3^-, H^+, H_2O (RA), Na^+, ClO_4^-

SOA: red: $ClO_4^- + 8H^+ + 8e^- \rightarrow Cl^- + 4H_2O$

SRA: ox: $(Cr^{2+} \rightarrow Cr^{3+} + e^-) \times 8$

$ClO_4^-(aq) + 8H^+(aq) + 8Cr^{2+} \rightarrow Cl^-(aq) + 4H_2O(l) + 8Cr^{3+}(aq)$

$c = 0.350\ mol/L$

$V = 12.3\ mL$

$n = cV$

$= 4.305\ mmol \times \frac{8}{1} = 34.44\ mmol_{Cr^{2+}}$

$V = 10.00\ mL$

$n = 34.44\ mmol$

$c = \frac{n}{V} = \frac{34.44\ mmol}{10.00\ mL} = 3.444\ mol/L$

$3.44\ mol/L$