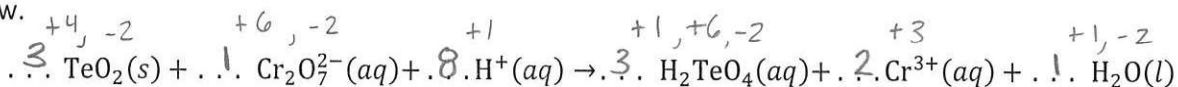


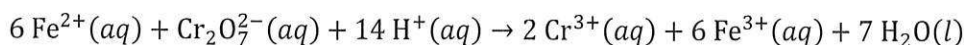
50
#3
Unit 3: AP Free Response Practice #1 [2010B #3, 10 points]

1. A sample of ore containing the mineral tellurite, TeO_2 , was dissolved in acid. The resulting solution was then reacted with a solution of $\text{K}_2\text{Cr}_2\text{O}_7$ to form telluric acid, H_2TeO_4 . The unbalanced chemical equation for the reaction is given below.



- Identify the molecule or ion that is being oxidized in the reaction. [1 point]
- Give the oxidation number of Cr in the $\text{Cr}_2\text{O}_7^{2-}(aq)$ ion. [1 point]
- Balance the chemical equation above by writing the correct lowest whole-number coefficients on the dotted lines. [2 points]

In the procedure described above, 46.00 mL of 0.03109 M $\text{K}_2\text{Cr}_2\text{O}_7$ was added to the ore sample after it was dissolved in acid. When the chemical reaction had progressed as completely as possible, the amount of unreacted (excess) $\text{Cr}_2\text{O}_7^{2-}(aq)$ was determined by titrating the solution with 0.110 M $\text{Fe}(\text{NO}_3)_2$. The reaction that occurred during the titration is represented by the following balanced equation.



A volume of 9.85 mL of 0.110 M $\text{Fe}(\text{NO}_3)_2$ was required to reach the equivalence point.

- Calculate the number of moles of excess $\text{Cr}_2\text{O}_7^{2-}(aq)$ that was titrated. [2 points]
- Calculate the number of moles of $\text{Cr}_2\text{O}_7^{2-}(aq)$ that reacted with the tellurite. [2 points]
- Calculate the mass, in grams, of tellurite that was in the ore sample. [2 points]

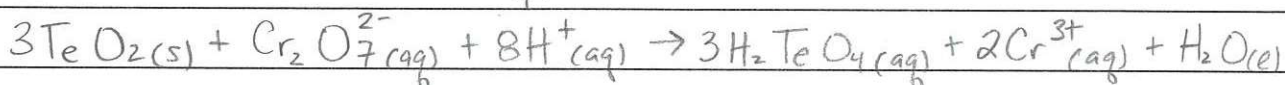
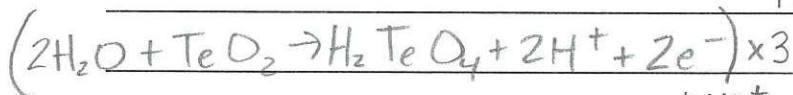
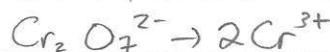
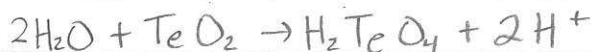
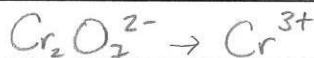
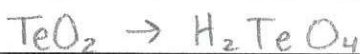
a) TeO_2 or Te^{4+} (no point for "Te")

b) +6

c)

ox

red



d) $0.00985 \text{ L} \times 0.110 \text{ M} = 0.00108 \text{ mol Fe}(\text{NO}_3)_2 \times \frac{1 \text{ mol Fe}^{2+}}{1 \text{ mol Fe}(\text{NO}_3)_2} \times \frac{1 \text{ mol Cr}_2\text{O}_7^{2-}}{6 \text{ mol Fe}^{2+}}$

$$= 1.81 \times 10^{-4} \text{ mol Cr}_2\text{O}_7^{2-}$$

(or 0.000181 mol)

e) total moles $\text{Cr}_2\text{O}_7^{2-}$ that reacted = mol $\text{Cr}_2\text{O}_7^{2-}$ added - excess $\text{Cr}_2\text{O}_7^{2-}$ titrated

$$\begin{aligned} \text{mol } \text{Cr}_2\text{O}_7^{2-} \text{ added} &= 0.04600 \text{ L} \times 0.03169 \text{ M} = 0.001430 \text{ mol } \text{K}_2\text{Cr}_2\text{O}_7 \times \frac{1 \text{ Cr}_2\text{O}_7^{2-}}{1 \text{ mol } \text{K}_2\text{Cr}_2\text{O}_7} \\ &= 0.001430 \text{ mol } \text{Cr}_2\text{O}_7^{2-} \text{ added} \end{aligned}$$

$$\Rightarrow \text{mol } \text{Cr}_2\text{O}_7^{2-} \text{ that reacted} = 0.001430 - 0.000181 = \boxed{0.001249 \text{ mol } \text{Cr}_2\text{O}_7^{2-}}$$

$$\text{f) } 0.001249 \text{ mol } \text{Cr}_2\text{O}_7^{2-} \times \frac{3 \text{ mol } \text{TeO}_2}{1 \text{ mol } \text{Cr}_2\text{O}_7^{2-}} \times \frac{159.6 \text{ g } \text{TeO}_2}{1 \text{ mol } \text{TeO}_2} = \boxed{0.5980 \text{ g } \text{TeO}_2}$$