$\qquad$ Period: $\qquad$
AP Chemistry

## Balancing Redox Reactions

1. Determine the oxidation state of each of the elements in the following:

$$
\begin{array}{lllll}
\text { sulfur trioxide } & \text { nitric acid } & \mathrm{P}_{2} \mathrm{O}_{3} & \mathrm{P}_{2} \mathrm{O}_{5} & \mathrm{IF}_{3}
\end{array}
$$

$\mathrm{PO}_{4}{ }^{-3}$
$\mathrm{PO}_{3}{ }^{-3}$
$\mathrm{HPO}_{4}{ }^{-1}$
$\mathrm{H}_{2} \mathrm{PO}_{4}{ }^{-2}$
$\mathrm{CH}_{4}$
potassium permanganate
manganese (II) oxide
2. For each of the following, assign oxidation numbers then label which element is oxidized and which is reduced.

$$
\begin{aligned}
& 2 \mathrm{Fe}(\mathrm{~s})+3 \mathrm{Cl}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{FeCl}_{3}(\mathrm{~s}) \\
& 2 \mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~g})+5 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 4 \mathrm{CO}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \\
& 5 \mathrm{CO}(\mathrm{~g})+\mathrm{I}_{2} \mathrm{O}_{5}(\mathrm{~g}) \rightarrow \mathrm{I}_{2}(\mathrm{l})+5 \mathrm{CO}_{2}(\mathrm{~g})
\end{aligned}
$$

Balance the following two reactions in acid
3. $\mathrm{Cr}_{2} \mathrm{O}_{7}^{-2}(\mathrm{aq})+\mathrm{I}^{-1}(\mathrm{aq}) \rightarrow \mathrm{Cr}^{+3}(\mathrm{aq})+\mathrm{I}_{2}(\mathrm{l})$
4. $\mathrm{Mn}^{2+}(\mathrm{aq})+\mathrm{BiO}_{3}^{-1}(\mathrm{aq}) \rightarrow \mathrm{MnO}_{4}^{-1}(\mathrm{aq})+\mathrm{Bi}^{+3}(\mathrm{aq})$

Balance the following two reactions in base
5. $\mathrm{MnO}_{4}^{-1}(\mathrm{aq})+\mathrm{C}_{2} \mathrm{O}_{4}^{-2}(\mathrm{aq}) \rightarrow \mathrm{MnO}_{2}(\mathrm{~s})+\mathrm{CO}_{3}^{-2}(\mathrm{aq})$
6. $\mathrm{BH}_{4}^{-1}(\mathrm{aq})+\mathrm{ClO}_{3}^{-1}(\mathrm{aq}) \rightarrow \mathrm{H}_{2} \mathrm{BO}_{3}^{-1}(\mathrm{aq})+\mathrm{Cl}^{-1}(\mathrm{aq})$
7. Potassium dichromate is a bright orange compound that can be reduced to a blue violet solution of $\mathrm{Cr}^{+3}$ ions. Under certain conditions potassium dichromate reacts with ethyl alcohol $\left(\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}\right)$ according to the equation below. Identify the atoms that are oxidized and those that are reduced.

$$
\mathrm{H}^{+}(\mathrm{aq})+\mathrm{Cr}_{2} \mathrm{O}_{7}^{-2}(\mathrm{aq})+\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}(\mathrm{l}) \rightarrow \mathrm{Cr}^{+3}(\mathrm{aq})+\mathrm{CO}_{2}(\mathrm{~g})+\mathrm{H}_{2} \mathrm{O}(\mathrm{l})
$$

8. Balance the equation for the reaction between permanganate and bromide ions in acidic solution.

$$
\mathrm{Br}^{-}(\mathrm{aq})+\mathrm{Cr}_{2} \mathrm{O}_{7}^{-2}(\mathrm{aq}) \rightarrow \mathrm{Br}_{2}(\mathrm{aq})+\mathrm{CrO}_{2}(\mathrm{~s})
$$

9. Balance the following oxidation-reduction reaction that occurs in basic solution

$$
\mathrm{Pb}(\mathrm{~s})+\mathrm{MnO}_{4}^{-1}(\mathrm{aq}) \rightarrow \mathrm{PbO}_{2}(\mathrm{aq})+\mathrm{MnO}_{2}
$$

