Balancing Redox Equations WorkSheet

Oxidation Number Method for Balancing Redox Equations

- 1. Assign oxidation numbers to all elements and identify those that are oxidized and reduced. If only one element is both oxidized and reduced (disproportionation), write it down twice (then recombine it after the equation is balanced).
- 2. Balance electron loss and gain by adding coefficients to the reactants.
- 3. Balance the elements oxidized and reduced by adding coefficients to the products. (If one of the elements appears in more than one product and with the same oxidation number in each, don't balance it yet). (If one of the elements appears in products unchanged as well as oxidized or reduced, balance only the ones with a new oxidation number).
- 4. Balance everything except H and O by inspection. (If no ions are present, finish balancing the equation by inspection. Check to see that each element is balanced.)
- 5. If ions are present, balance the charge by adding H⁺ for acid solutions or OH for basic solutions.
- 6. Finish balancing the equation by adding H₂O.
- 7. Check to see that each element is balanced and that the charge is balanced.

Balance the following equations: Underline the oxidizing agent.

1.
$$H_2S$$
 + HNO_3 \rightarrow S + NO + H_2O

2.
$$H_2SO_4 + HBr \rightarrow SO_2 + Br_2 + H_2O$$

3.
$$H_2SO_4 + HI \rightarrow H_2S + I_2 + H_2O$$

4.
$$N_2O + H_2 \rightarrow H_2O + NH_3$$

5.
$$K + KNO_3 \rightarrow N_2 + K_2O$$

6.
$$Fe_2O_3 + S \rightarrow Fe + SO_2$$

7.
$$NH_3 + O_2 \rightarrow NO + H_2O$$

8.
$$N_2H_4 + H_2O_2 \rightarrow HNO_3 + H_2O$$

9.
$$NO_2$$
 + H_2O \rightarrow HNO_3 + NO

10.
$$MnO_2$$
 + HBr \rightarrow Br_2 + $MnBr_2$ + H_2O

11.
$$HClO_4 + ClO_2 + H_2O \rightarrow HClO_3$$

12.
$$PbO_2 + Sb + NaOH \rightarrow PbO + NaSbO_2 + H_2O$$

13.
$$KMnO_4 + HCl \rightarrow MnCl_2 + Cl_2 + KCl + H_2O$$

14.
$$C_3H_7OH + Na_2Cr_2O_7 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + Na_2SO_4 + H_2O + HC_3H_5O_2$$

The following reactions occur in acidic solution:

15.
$$Cu + NO_3$$
 $\rightarrow Cu^{2+} + NO$

16.
$$MnO_4^- + H_2S \rightarrow Mn^{2+} + S$$

17.
$$As_2O_3 + NO_3$$
 \rightarrow $H_3AsO_4 + N_2O_3$

18.
$$\operatorname{Zn} + \operatorname{NO}_3^- \rightarrow \operatorname{Zn}^{2+} + \operatorname{NH}_4^+$$

19.
$$NO_2$$
 \rightarrow $NO_3^- + NO$

20.
$$H_2O_2 + Cr^{3+}$$
 \rightarrow $Cr_2O_7^{2-}$

21.
$$Cr_2O_7^{2-} + I^ \rightarrow$$
 $Cr^{3+} + I_3^-$

22.
$$ClO_3^- + Cl^- \rightarrow Cl_2 + ClO_2$$

23.
$$MnO_4^- + C_2O_4^{2-} \rightarrow CO_2 + Mn^{2+}$$

24.
$$\operatorname{Cr}_2\operatorname{O_7}^{2^-} + \operatorname{Cl}^- \rightarrow \operatorname{Cr}^{3^+} + \operatorname{Cl}_2$$

The following reactions occur in basic solution:

25. Al + OH
$$\rightarrow$$
 AlO₂ + H₂ (Drano)

26.
$$Cu(NH_3)_4^{2+} + S_2O_4^{2-} \rightarrow SO_3^{2-} + Cu + NH_3$$

27.
$$NO_2$$
 \rightarrow NO_3^- + NO_2^-

28.
$$Cl_2$$
 \rightarrow $ClO_3^- + Cl^-$

29.
$$MnO_4^- + C_2O_4^{2-} \rightarrow CO_2 + MnO_2$$

30.
$$Zn + NO_3$$
 $\rightarrow Zn(OH)_4^{2-} + NH_3$

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4. Balance everything except H and O by inspection. (If no ions are present, finish balancing the equation by inspection. Check to see that each element is balanced.)

5. If ions are present, balance the charge by adding H⁺ for acid solutions or OH⁻ for basic solutions.

6. Finish balancing the equation by adding H₂O.

7. Check to see that each element is balanced and that the charge is balanced.

Balance the following equations: Underline the oxidizing agent.

1.
$$3 \text{ H}_2\text{S} + 2 \text{ HNO}_3 \rightarrow 3 \text{ S} + 2 \text{ NO} + 4 \text{ H}_2\text{O}$$

2.
$$H_2SO_4 + \mathcal{A} HBr \rightarrow SO_2 + Br_2 + \mathcal{A} H_2O$$

3.
$$H_2SO_4 + 8 HI \rightarrow H_2S + 4 I_2 + 4 H_2O$$

4.
$$N_2O + {}^{\downarrow}H_2 \rightarrow H_2O + {}^{\downarrow}NH_3$$

5.
$$/0 \text{ K} + \mathcal{A} \text{ KNO}_3 \rightarrow \text{N}_2 + \mathcal{A} \text{ K}_2\text{O}$$

6.
$$2 \text{ Fe}_2\text{O}_3 + 3 \text{ S} \rightarrow 4 \text{ Fe} + 3 \text{ SO}_2$$

7.
$$4 \text{ NH}_3 + 5 \text{ O}_2 \rightarrow 4 \text{ NO} + 6 \text{ H}_2\text{O}$$

8.
$$N_2H_4 + 7 H_2O_2 \rightarrow 2 HNO_3 + 8 H_2O$$

9.
$$3 \text{ NO}_2 + \text{H}_2\text{O} \rightarrow \mathcal{A} \text{HNO}_3 + \text{NO}$$

10.
$$MnO_2 + H HBr \rightarrow Br_2 + MnBr_2 + A H_2O$$

11.
$$HClO_4 + A ClO_2 + H_2O \rightarrow 3 HClO_3$$

12.
$$\frac{3}{2}$$
 PbO₂ + $\frac{2}{2}$ Sb + $\frac{2}{2}$ NaOH \rightarrow 3 PbO + $\frac{2}{2}$ NaSbO₂ + H₂O

13.
$$2 \text{ KMnO}_4 + 16 \text{ HCl} \rightarrow 2 \text{ MnCl}_2 + 5 \text{ Cl}_2 + 2 \text{ KCl} + 8 \text{ H}_2\text{O}$$

The following reactions occur in acidic solution:

15.
$$3 \text{ Cu} + 2 \text{ NO}_3^- + 8 \text{ H}^+ \rightarrow 3 \text{ Cu}^{2+} + 2 \text{ NO} + 4 \text{ H}_2 \text{ D}$$

16.
$$2 \text{ MnO}_4^- + 5 \text{ H}_2\text{S} + 6 \text{ H}^+ \rightarrow 2 \text{ Mn}^{2+} + 5 \text{ S} + 8 \text{ H}_2\text{O}$$

17.
$$As_2O_3 + 2 NO_3 + 2H_{20} + 2H_{7} \rightarrow 2H_3AsO_4 + N_2O_3$$

18.
$$4 \text{ Zn} + NO_3^- + 10 H^+ \rightarrow 4 \text{ Zn}^{2+} + NH_4^+ + 3H_2O_3^-$$

19.
$$3 \text{ NO}_2 + H_2O \rightarrow 2 \text{ NO}_3^- + \text{ NO} + 2 H^+$$

20.
$$3 \text{ H}_2\text{O}_2 + 2 \text{ Cr}^{3+} + H_2 O \rightarrow \text{Cr}_2\text{O}_7^{2-} + 8 H^+$$

⇒ 21.
$$\operatorname{Cr}_2\operatorname{O_7}^{2-} + \operatorname{9} \operatorname{1}^- + \operatorname{14} \operatorname{H}^+$$
 ⇒ $\operatorname{2} \operatorname{Cr}^{3+} + \operatorname{3} \operatorname{1}_3^- + \operatorname{7} \operatorname{H}_2\operatorname{O}$

$$\rightarrow$$
 22. $2 \text{ClO}_3^- + 2 \text{Cl}^- + 4 \text{H}^+ \rightarrow \text{Cl}_2 + 2 \text{ClO}_2 + 2 \text{H}_2 \text{O}$

23.
$$2 \text{ MnO}_4^- + 5 \text{ C}_2 \text{O}_4^{2-} + 16 \text{ H}^+ \rightarrow 10 \text{ CO}_2 + 2 \text{ Mn}^{2+} + 8 \text{ H}_2^{2-}$$

24.
$$Cr_2O_7^{2-} + 6 Cl^- + 14H^+ \rightarrow 2 Cr^{3+} + 3 Cl_2 + 7420$$

The following reactions occur in basic solution:

25.
$$2A1 + 2OH + 2H_2O \rightarrow 2A1O_2 + 3H_2$$
 (Drano)

26.
$$Cu(NH_3)_4^{2+} + S_2O_4^{2-} + 4OH^- \rightarrow 2SO_3^{2-} + Cu + 4NH_3 + 24_2O$$

27.
$$2 \text{ NO}_2 + 20 \text{H}^- \rightarrow \text{NO}_3^- + \text{NO}_2^- + \text{H}_20$$

28.
$$3 \text{ Cl}_2 + 60 \text{ H}^- \rightarrow \text{ClO}_3^- + 5 \text{ Cl}^- + 3 \text{ H}_2 \text{ D}$$

29.
$$2 \text{ MnO}_4^- + 3 \text{ C}_2 \text{O}_4^{2-} + 4 \text{ H}_2 \text{D} \rightarrow 6 \text{ CO}_2 + 2 \text{ MnO}_2 + 80 \text{ H}_2^-$$

30.
$$\forall$$
 Zn + NO₃⁻ + \uparrow OH⁻ + θ \forall \forall Zn(OH)₄²⁻ + NH₃