Single Replacement Reactions

http://group.chem.iastate.edu/Greenbowe/sections/projectfolder/flashfiles/redox/home.html

Activity 1

	$Mg(NO_3)_2$	$Zn(NO_3)_2$	$Cu(NO_3)_2$	$AgNO_3$
Mg (s)	NR	Yes (Reaction 1)	Yes (Reaction 2)	Yes (Reaction 3)
Cu (s)	NR	NR	NR	Yes (Reaction 4)
Zn (s)	NR	NR	Yes (Reaction 5)	Yes (Reaction 6)
Ag (s)	NR	NR	NR	NR

Order of activities:
Mg, Zn, Cu, Ag

1. Mg metal dipped into a $Zn(NO_3)_2$ solution.
   Balanced reaction: $Mg\ (s) + Zn(NO_3)_2\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + Zn\ (s)$
   Net Ionic reaction: $Mg\ (s) + Zn^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Zn\ (s)$
   Spectator ion: NO_3^-
   Mg metal is oxidized; Zn^{2+} is reduced.

2. Mg metal dipped into a $Cu(NO_3)_2$ solution.
   Balanced reaction: $Mg\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + Cu\ (s)$
   Net Ionic reaction: $Mg\ (s) + Cu^{2+}\ (aq) \rightarrow Mg^{2+}\ (aq) + Cu\ (s)$
   Spectator ion: NO_3^-
   Mg metal is oxidized; Cu^{2+} is reduced.

3. Mg metal dipped into a $AgNO_3$ solution.
   Balanced reaction: $Mg\ (s) + 2\ AgNO_3\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + 2\ Ag\ (s)$
   Net Ionic reaction: $Mg\ (s) + 2\ Ag^+\ (aq) \rightarrow Mg^{2+}\ (aq) + 2\ Ag\ (s)$
   Spectator ion: NO_3^-
   Mg metal is oxidized; Ag^+ is reduced.

4. Cu metal dipped into a $AgNO_3$ solution.

Balanced reaction: $Cu\ (s) + 2\ AgNO_3\ (aq) \rightarrow Cu(NO_3)_2\ (aq) + 2\ Ag\ (s)$

Net Ionic reaction: $Cu\ (s) + 2\ Ag^+\ (aq) \rightarrow Cu^{2+}\ (aq) + 2\ Ag\ (s)$

Spectator ion: NO_3^-

Cu metal is oxidized; Ag^+ is reduced.

5. Zn metal dipped into a $Cu(NO_3)_2$ solution.

Balanced reaction: $Zn\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + Cu\ (s)$

Net Ionic reaction: $Zn\ (s) + Cu^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Cu\ (s)$

Spectator ion: NO_3^-

Zn metal is oxidized; Cu^{2+} is reduced.

6. Zn metal dipped into a $AgNO_3$ solution.

Balanced reaction: $Zn\ (s) + 2\ AgNO_3\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + 2\ Ag\ (s)$

Net Ionic reaction: $Zn\ (s) + 2\ Ag^+\ (aq) \rightarrow Zn^{2+}\ (aq) + 2\ Ag\ (s)$

Spectator ion: NO_3^-

Zn metal is oxidized; Ag^+ is reduced.

Activity 2

	$Fe(NO_3)_2$	$Zn(NO_3)_2$	$Cu(NO_3)_2$	$Pb(NO_3)_2$
Fe(s)	NR	NR	Yes (Reaction 1)	Yes (Reaction 2)
Cu (s)	NR	NR	NR	NR
Zn (s)	Yes (Reaction 3)	NR	Yes (Reaction 4)	Yes (Reaction 5)
Pb (s)	NR	NR	Yes (Reaction 6)	NR

Order of activities:

Zn, Fe, Pb, Cu

1. Fe metal dipped into a $Cu(NO_3)_2$ solution.
   Balanced reaction: $Fe\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Fe(NO_3)_2\ (aq) + Cu\ (s)$
   Net Ionic reaction: $Fe\ (s) + Cu^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Cu\ (s)$
   Spectator ion: NO_3^-
   Fe metal is oxidized; Cu^{2+} is reduced.

2. Fe metal dipped into a $Pb(NO_3)_2$ solution.
   Balanced reaction: $Fe\ (s) + Pb(NO_3)_2\ (aq) \rightarrow Fe(NO_3)_2\ (aq) + Pb\ (s)$
   Net Ionic reaction: $Fe\ (s) + Pb^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Pb\ (s)$
   Spectator ion: NO_3^-
   Fe metal is oxidized; Pb^{2+} is reduced.

3. Zn metal dipped into a $Fe(NO_3)_2$ solution.
   Balanced reaction: $Zn\ (s) + Fe(NO_3)_2\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + Fe\ (s)$
   Net Ionic reaction: $Zn\ (s) + Fe^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Fe\ (s)$
   Spectator ion: NO_3^-
   Zn metal is oxidized; Fe^{2+} is reduced.

4. Zn metal dipped into a $Cu(NO_3)_2$ solution.
   Balanced reaction: $Zn\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + Cu\ (s)$
   Net Ionic reaction: $Zn\ (s) + Cu^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Cu\ (s)$

Spectator ion: NO_3^-

Zn metal is oxidized; Cu^{2+} is reduced.

5. Zn metal dipped into a $Pb(NO_3)_2$ solution.

Balanced reaction: $Zn\ (s) + Pb(NO_3)_2\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + Pb\ (s)$

Net Ionic reaction: $Zn\ (s) + Pb^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Pb\ (s)$

Spectator ion: NO_3^-

Zn metal is oxidized; Pb^{2+} is reduced.

6. Pb metal dipped into a $Cu(NO_3)_2$ solution.

Balanced reaction: $Pb\ (s) + Cu(NO_3)_2\ (aq) \rightarrow Pb(NO_3)_2\ (aq) + Cu\ (s)$

Net Ionic reaction: $Pb\ (s) + Cu^{2+}\ (aq) \rightarrow Pb^{2+}\ (aq) + Cu\ (s)$

Spectator ion: NO_3^-

Pb metal is oxidized; Cu^{2+} is reduced.

Activity 3

	$Fe(NO_3)_2$	$Pb(NO_3)_2$	$Ni(NO_3)_2$	$Sn(NO_3)_2$
Fe(s)	NR	Yes (Reaction 1)	Yes (Reaction 2)	Yes (Reaction 3)
Pb (s)	NR	NR	NR	NR
Ni (s)	NR	Yes (Reaction 4)	NR	Yes (Reaction 5)
Sn (s)	NR	Yes (Reaction 6)	NR	NR

Order of activities:

Fe, Ni, Sn, Pb

1. Fe metal dipped into a $Pb(NO_3)_2$ solution.
   Balanced reaction: $Fe\ (s) + Pb(NO_3)_2\ (aq) \rightarrow Fe(NO_3)_2\ (aq) + Pb\ (s)$
   Net Ionic reaction: $Fe\ (s) + Pb^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Pb\ (s)$
   Spectator ion: NO_3^-
   Fe metal is oxidized; Pb^{2+} is reduced.

2. Fe metal dipped into a $Ni(NO_3)_2$ solution.
   Balanced reaction: $Fe\ (s) + Ni(NO_3)_2\ (aq) \rightarrow Fe(NO_3)_2\ (aq) + Ni\ (s)$
   Net Ionic reaction: $Fe\ (s) + Ni^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Ni\ (s)$
   Spectator ion: NO_3^-
   Fe metal is oxidized; Ni^{2+} is reduced.

3. Fe metal dipped into a $Sn(NO_3)_2$ solution.
   Balanced reaction: $Fe\ (s) + Sn(NO_3)_2\ (aq) \rightarrow Fe(NO_3)_2\ (aq) + Sn\ (s)$
   Net Ionic reaction: $Fe\ (s) + Sn^{2+}\ (aq) \rightarrow Fe^{2+}\ (aq) + Sn\ (s)$
   Spectator ion: NO_3^-
   Fe metal is oxidized; Sn^{2+} is reduced.

4. Ni metal dipped into a $Pb(NO_3)_2$ solution.
   Balanced reaction: $Ni\ (s) + Pb(NO_3)_2\ (aq) \rightarrow Ni(NO_3)_2\ (aq) + Pb\ (s)$
   Net Ionic reaction: $Ni\ (s) + Pb^{2+}\ (aq) \rightarrow Ni^{2+}\ (aq) + Pb\ (s)$

Spectator ion: NO_3^-

Ni metal is oxidized; Pb^{2+} is reduced.

5. Ni metal dipped into a $Sn(NO_3)_2$ solution.

Balanced reaction: $Ni\ (s) + Sn(NO_3)_2\ (aq) \rightarrow Ni(NO_3)_2\ (aq) + Sn\ (s)$

Net Ionic reaction: $Ni\ (s) + Sn^{2+}\ (aq) \rightarrow Ni^{2+}\ (aq) + Sn\ (s)$

Spectator ion: NO_3^-

Ni metal is oxidized; Sn^{2+} is reduced.

6. Sn metal dipped into a $Pb(NO_3)_2$ solution.

Balanced reaction: $Sn\ (s) + Pb(NO_3)_2\ (aq) \rightarrow Sn(NO_3)_2\ (aq) + Pb\ (s)$

Net Ionic reaction: $Sn\ (s) + Pb^{2+}\ (aq) \rightarrow Sn^{2+}\ (aq) + Pb\ (s)$

Spectator ion: NO_3^-

Sn metal is oxidized; Pb^{2+} is reduced.

Activity 4

	HCl (aq)	If a reaction occurs, rank the speed of the reaction. (1) for the fastest reaction, (2) for the 2nd fastest reaction, etc.
Ag (s)	NR	-
Cu (s)	NR	-
Fe (s)	Yes	3
Mg (s)	Yes	1
Ni (s)	Yes	4
Pb (s)	Yes	6
Sn (s)	Yes	5
Zn (s)	Yes	2

Order of activity:

Mg, Zn, Fe, Ni, Sn, Pb

1. Mg metal is dipped into a HCl solution.

Balanced reaction: $Mg\ (s) + 2\ HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$

Net ionic reaction: $Mg\ (s) + 2H^+\ (aq) \rightarrow Mg^{2+}\ (aq) + H_2\ (g)$

Spectator ion: Cl^-

Mg metal is oxidized; H^+ ion is reduced.

2. Zn metal is dipped into a HCl solution.

Balanced reaction: $Zn\ (s) + 2\ HCl\ (aq) \rightarrow ZnCl_2\ (aq) + H_2\ (g)$

Net ionic reaction: $Zn\ (s) + 2H^+\ (aq) \rightarrow Zn^{2+}\ (aq) + H_2\ (g)$

Spectator ion: Cl^-

Zn metal is oxidized; H^+ ion is reduced.

3. Fe metal is dipped into a HCl solution.

Balanced reaction: $Fe\ (s) + 2\ HCl\ (aq) \rightarrow FeCl_2\ (aq) + H_2\ (g)$

Net ionic reaction: $Fe\ (s) + 2H^+\ (aq) \rightarrow Fe^{2+}\ (aq) + H_2\ (g)$

Spectator ion: Cl^-

Fe metal is oxidized; H^+ ion is reduced.

4. Ni metal is dipped into a HCl solution.

Balanced reaction: $Ni\ (s) + 2\ HCl\ (aq) \rightarrow NiCl_2\ (aq) + H_2\ (g)$

Net ionic reaction: $Ni\ (s) + 2H^+\ (aq) \rightarrow Ni^{2+}\ (aq) + H_2\ (g)$

Spectator ion: Cl^-

Ni metal is oxidized; H^+ ion is reduced.

5. Sn metal is dipped into a HCl solution.

Balanced reaction: $Sn\ (s) + 2\ HCl\ (aq) \rightarrow SnCl_2\ (aq) + H_2\ (g)$

Net ionic reaction: $Sn\ (s) + 2H^+\ (aq) \rightarrow Sn^{2+}\ (aq) + H_2\ (g)$

Spectator ion: Cl^-

Sn metal is oxidized; H^+ ion is reduced.

6. Pb metal is dipped into a HCl solution.

Balanced reaction: $Pb\ (s) + 2\ HCl\ (aq) \rightarrow PbCl_2\ (s) + H_2\ (g)$

Net ionic reaction: $Pb\ (s) + 2H^+\ (aq) + 2Cl^=\ (aq) \rightarrow PbCl_2\ (s) + H_2\ (g)$

Spectator ion: none

Pb metal is oxidized; H^+ ion is reduced.