PREDICTING REACTIONS USING STD REDUCTION POTENTIALS (1)

✱Predict whether or not a reaction will occur in each of the following cases and if so write a balanced red-ox reaction. Show the oxidation and reduction half -equations and their addition on separate lines. Write the E^0 values for each and calculate whether the reaction is a predicted SPONTANEOUS red/ox reaction. Once you have done this write an OBSERVATION whether or not a reaction takes place:

(a) $KMnO_4$ (aq) * Acidified + $FeSO_4$(aq) →
Acidified Potasium Permanganate solution added to Iron (II) Sulfate solution.

TRUE SPECIES →

REDUCTION: _____ **E^0 =** _____

OXIDATION : _____ **E^0 =** _____

OVERALL : _____ **E^0 =** _____

OBSERVATION:

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(b) $K_2Cr_2O_7$ (aq) * Acidified added to $H_2C_2O_4$ (aq) →
Acidified Potasium Dichromate solution added to Oxalic acid solution.

TRUE SPECIES →

REDUCTION: _____ **E^0 =** _____

OXIDATION : _____ **E^0 =** _____

OVERALL : _____ **E^0 =** _____

OBSERVATION:

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(c) KI (aq) added to $K_2Cr_2O_7$ (aq) * Acidified →
Potassium iodide solution is added to acidified Potasium Dichromate solution.

TRUE SPECIES →

REDUCTION: _____ E^0 = _____

OXIDATION : _____ E^0 = _____

OVERALL : _____ E^0 = _____

OBSERVATION:

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(d) Cl_2 (aq) is added to NaBr (aq) →
Chlorine water (a solution of chlorine gas) is added to a solution of Sodium Bromide.

TRUE SPECIES →

REDUCTION: _____ E^0 = _____

OXIDATION : _____ E^0 = _____

OVERALL : _____ E^0 = _____

OBSERVATION:

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(a) $K_{(s)} + H_2O_{(l)} \rightarrow$

TRUE SPECIES →

REDUCTION: _____ E^0 = _____

OXIDATION : _____ E^0 = _____

OVERALL : _____ E^0 = _____

OBSERVATION:

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(b) $Cu(s) + HNO_3(aq)$ Conc. →

TRUE SPECIES →

REDUCTION: _____ E^0 = _____

OXIDATION : _____ E^0 = _____

OVERALL : _____ E^0 = _____

OBSERVATION:

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(c) $Zn(s) + Pb(NO_3)_2(aq) \rightarrow$

TRUE SPECIES →

REDUCTION: _____ **E^0 =** _____

OXIDATION : _____ **E^0 =** _____

OVERALL : _____ **E^0 =** _____

OBSERVATION:

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(d) $H_2O_2(aq)$ (Acidified) $+ NaCl(aq) + I_2(s) \rightarrow$

TRUE SPECIES →

REDUCTION: _____ **E^0 =** _____

OXIDATION : _____ **E^0 =** _____

OVERALL : _____ **E^0 =** _____

OBSERVATION:

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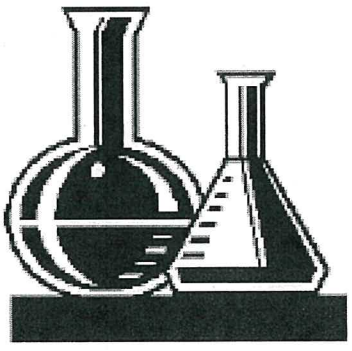

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✱Predict whether or not a reaction will occur in each of the following cases and if so write a balanced red-ox reaction. Show the oxidation and reduction half -equations and their addition on separate lines. Write the E^0 values for each and calculate whether the reaction is a predicted SPONTANEOUS red/ox reaction. Once you have done this write an OBSERVATION whether or not a reaction takes place:

(a) $KMnO_4$ (aq) * Acidified + $FeSO_4$(aq) →
Acidified Potasium Permanganate solution added to Iron (II) Sulfate solution.

TRUE SPECIES → $+5e^-$

REDUCTION: $8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$ $E^0 = +1.51$

OXIDATION : $5(Fe^{2+} \rightarrow Fe^{3+} + e^-)$ $E^0 = -0.77$

OVERALL : $8H^+_{(aq)} + MnO_4^-_{(aq)} + 5Fe^{2+}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$ $E^0 = +0.74$

OBSERVATION:

A purple solution is added to a pale green solution.
Upon addition the solution turns pale brown.

(b) $K_2Cr_2O_7$ (aq) * Acidified added to $H_2C_2O_4$ (aq) →
Acidified Potasium Dichromate solution added to Oxalic acid solution.

TRUE SPECIES → $+6e^-$

REDUCTION: $14H^+ + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O$ $E^0 = +1.36$

OXIDATION : $3(H_2C_2O_4 \rightarrow 2CO_2 + 2e^- + 2H^+)$ $E^0 = +0.43$

OVERALL : $8H^+_{(aq)} + Cr_2O_7^{2-}_{(aq)} + 3H_2C_2O_4^{2-}_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 6CO_{2(g)} + 7H_2O_{(l)}$ $E^0 = +1.79$

OBSERVATION:

An orange solution is added to a colourless solution.
Upon addition the solution turn a deep green
with an effervesce of a colourless, odourless gas

(c) KI (aq) added to $K_2Cr_2O_7$ (aq) * Acidified →
Potassium iodide solution is added to acidified Potasium Dichromate solution.

TRUE SPECIES →

REDUCTION: $+14H^+ + Cr_2O_7^{2-} + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ $E^0 = +1.36$

OXIDATION : $3(2I^- \rightarrow I_2 + 2e^-)$ $E^0 = -0.54$

OVERALL : $14H^+ + Cr_2O_7^{2-} + 6I^- \rightarrow 3I_2 + 2Cr^{3+} + 7H_2O$ $E^0 = +0.82$
(d) (a) (b) (5) (2) (c)

OBSERVATION:

A colourless solution is added to an orange solution. Upon addition a brown solid is formed, with a deep green solution.

(d) Cl_2 (aq) is added to NaBr (aq) →
Chlorine water (a solution of chlorine gas) is added to a solution of Sodium Bromide.

TRUE SPECIES →

REDUCTION: $2e^- + Cl_2 \rightarrow 2Cl^-$ $E^0 = +1.36$

OXIDATION : $2Br^- \rightarrow Br_2 + 2e^-$ $E^0 = -1.08$

OVERALL : $2Br^-(aq) + Cl_2(aq) \rightarrow Br_2(aq) + 2Cl^-(aq)$ $E^0 = +0.28$.

OBSERVATION:

A pale yellow solution is added to a colourless solution. Upon addition the solution turns orange.

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(a) $2K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_{2(g)}$

TRUE SPECIES →

REDUCTION: $2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$ $E^0 = -0.83$

OXIDATION : $2K_{(s)} \rightarrow 2K^+_{(aq)} + 2e^-$ $E^0 = +2.94$

OVERALL : $2K_{(s)} + 2H_2O_{(l)} \rightarrow H_{2(g)} + 2OH^-_{(aq)} + 2H^+_{(aq)}$ $E^0 = +2.11$

OBSERVATION:

A silvery metal is added to a colourless solution. Upon addition the silvery metal dissolves, producing a lilac flame and a gas effervescence.

(b) $Cu(s) + 4HNO_3(aq)$ Conc. $\rightarrow Cu(NO_3)_{2(aq)} + 2\overset{+4}{N}O_{2(g)} + 2H_2O_{(l)}$

TRUE SPECIES →

REDUCTION: $2(NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O)$ $E^0 = +0.78$

OXIDATION : $Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$ $E^0 = -0.34$

OVERALL : $2NO_3^-_{(aq)} + 4H^+_{(aq)} + Cu_{(s)} \rightarrow 2NO_{2(g)} + 2H_2O_{(l)} + Cu^{2+}_{(aq)}$ $E^0 = +0.44$

OBSERVATION:

A salmon pink metal is added to a colourless solution. The metal dissolves and a brown gas effervesces & a blue soln is formed.

Dilute HNO_3

$2 \times$ Reduction $\overset{+5}{N}O_3^- + 4H^+ + 3e^- \rightarrow \overset{+2}{N}O + 2H_2O$ $+0.96$

$3 \times$ Oxidation $Cu \rightarrow Cu^{2+} + 2e^-$ $E^0 = -0.34$

NB : dilute HNO_3 $3Cu_{(s)} + 8HNO_{3(aq)} \rightarrow 3Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$

(c) $Zn(s) + Pb(NO_3)_2(aq) \rightarrow Zn(NO_3)_2(aq) + Pb(s)$

TRUE SPECIES →

REDUCTION: $Pb^{2+} + 2e^- \rightarrow Pb$ **E⁰ =** −0,13

OXIDATION : $Zn \rightarrow Zn^{2+} + 2e^-$ **E⁰ =** +0,76

OVERALL : $Zn(s) + Pb^{2+}(aq) \rightarrow Pb(s) + Zn^{2+}(aq)$ **E⁰ =** +0,63

OBSERVATION:

A silvery metal is added to a colorless solution. Upon addition the metal dissolves and a dark metal is precipitated at the bottom of the solution.

Bray - Liebhafsky (clock reaction)

(d) $5H_2O_2(aq)$ (Acidified) + ~~NaCl~~(aq) + $I_2(s) \rightarrow 2IO_3^- + 2H^+ + 4H_2O$

$5H_2O_2 + 2IO_3^- + 2H^+ \rightarrow I_2 + 5O_2 + 6H_2O$

TRUE SPECIES →

REDUCTION: $5H_2O_2 + 2\overset{+5}{I}O_3^- + 2H^+ \rightarrow \overset{0}{I}_2 + 5O_2 + 6H_2O$ **E⁰ =** _____

OXIDATION : $5H_2O_2 + \overset{0}{I}_2 \rightarrow 2\overset{+5}{I}O_3^- + 2H^+ + 4H_2O$ **E⁰ =** _____

OVERALL : $2H_2O_2 \rightarrow H_2O + O_2$ **E⁰ =** _____

OBSERVATION:

$2IO_3^- + 12H^+ + 10e^- \rightarrow I_2 + 6H_2O \quad E^\circ = 1,195\ V$

Iodine oscillates between being consumed and produced.