Wednesday, May 22/13
Science 122

Announcements

**** Need an activity re a course topic before the end of <u>May</u>.**

1. Worksheet - Energy of Photons, Work Function, Etc.
   Worksheet - Energy Levels

2. Test - Nuclear and Quantum Physics -> Thursday

3. Redox Half-Reaction Tables - HW for Friday

Part I - Short Answer

→ terms
ie / nucleon, nuclide etc.

→ notation
ie / isotope

ie / decay particles.
α or ^4_2He
β^- or $^0_{-1}e$ ~~etc~~.

→ formation of e^- and e^+

→ write decay reactions
ie / parent nucleus → daughter nucleus + □

→ Planck, Einstein

→ photo electric effect.
+ terminology
+ graph

→ energy level diagrams.

Part II - Problems.

Formulas:

Nuclear Physics ⇒ A, λ, N, N_0, m, $T_{1/2}$, etc.
(2 worksheets)

Quantum physics ⇒ E, ϕ, f_c, E_n, etc
(2 worksheets)

c) $Br_{2(l)} + KI_{(s)} \rightarrow I_{2(s)} + KBr_{(s)}$

R $Br_2 + 2e^- \rightarrow 2Br^-$

O $2I^- \rightarrow I_2 + 2e^-$

$Br_2 + 2I^- \rightarrow 2Br^- + I_2$

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b) $Al_{(s)} + Fe_2O_{3(s)} \rightarrow Fe_{(s)} + Al_2O_{3(s)}$

O $2Al \rightarrow 2Al^{+3} + 6e^-$

R $2Fe^{+3} + 6e^- \Rightarrow 2Fe$

$2Al + 2Fe^{+3} \rightarrow 2Al^{+3} + 2Fe$

Question: Has a redox reaction taken place in the example below?

$FeCl_{3(aq)} + 3NaOH_{(aq)} \rightarrow Fe(OH)_{3(s)} + 3NaCl_{(aq)}$

double replacement rxn.

$Fe^{+3} \rightarrow Fe^{+3}$ $\quad Na^{+} \rightarrow Na^{+}$

$Cl^{-} \rightarrow Cl^{-}$ $\quad OH^{-} \rightarrow OH^{-}$

$\rightarrow$ No reduction/oxidation.

Usually it is assumed that chemical rxns are spontaneous; that is, they occur without a continuous addition of energy to the system.

Are all single replacement reactions spontaneous?

Which combinations of copper, lead, silver and zinc metals and their aqueous metal ion solutions produce spontaneous reactions? (Nitrate solutions were used.)

ppt ⇒ precipitate

	$Cu_{(s)}$	$Pb_{(s)}$	$Ag_{(s)}$	$Zn_{(s)}$
$Cu^{+2}_{(aq)}$	no change	red-brown ppt	no change	red-brown ppt
$Pb^{+2}_{(aq)}$	no change	no change	no change	black ppt
$Ag^{+}_{(aq)}$	silver crystals	silver crystals	no change	silver crystals
$Zn^{+2}_{(aq)}$	no change	no change	no change	no change

The reactivity of the four metal ions can be compared.

# of Rxns that occured	3	2	1	0
Ions	$Ag^{+}_{(aq)}$	$Cu^{2+}_{(aq)}$	$Pb^{2+}_{(aq)}$	$Zn^{2+}_{(aq)}$

→ decrease in reactivity of oxidizing agents

ions → oxidizing agents

#Rxns occuring metals	3	2	1	0
	$Zn_{(s)}$	$Pb_{(s)}$	$Cu_{(s)}$	$Ag_{(s)}$

→ decrease in reactivity of reducing agents.

metals → reducing agents

SOA → strongest oxidizing agent → $Ag^{+}_{(aq)}$

SRA → " reducing agent → $Zn_{(s)}$

Table of Redox Half-Reactions ⇌

SOA

$Ag^+_{(aq)} + e^- \rightleftharpoons Ag_{(s)}$

$Cu^{+2}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$

$Pb^{+2}_{(aq)} + 2e^- \rightleftharpoons Pb_{(s)}$

$Zn^{+2}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$ SRA

Dec. reactivity ↓

Dec. reactivity ↑

Redox Spontaneity Rule

A spontaneous redox reaction occurs only if the oxidizing agent is above the reducing agent in the table of redox half rxns.

OA + RA ⟹ spontaneous ✓

RA + OA ⟹ not spontaneous

Redox tables can be built by analyzing net ionic equations and observations about spontaneity.

$3Co^{+2}_{(aq)} + 2In_{(s)} \rightarrow 2In^{+3}_{(aq)} + 3Co_{(s)}$ spont.

$Cu^{+2}_{(aq)} + Co_{(s)} \rightarrow Co^{+2}_{(aq)} + Cu_{(s)}$ spont

$Cu^{+2}_{(aq)} + Pd_{(s)} \rightarrow$ no evidence of reaction. non-spont.

Redox Half-Reactions

SOA

$Pd^{+2}_{(aq)} + 2e^- \rightleftharpoons Pd_{(s)}$

$Cu^{+2}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$

$Co^{+2}_{(aq)} + 2e^- \rightleftharpoons Co_{(s)}$

$In^{+3}_{(aq)} + 3e^- \rightleftharpoons In_{(s)}$

decrease activity

decrease activity

SRA

Redox Half-Reactions

SOA

$Pd^{+2} + 2e^- \rightleftharpoons Pd$

$Cu^{+2} + 2e^- \rightleftharpoons Cu$

$Co^{+2} + 2e^- \rightleftharpoons Co$

$In^{+3} + 3e^- \rightleftharpoons In$

decrease activity

decrease activity

SRA

Try:

#1. $Co^{+2}(aq) + Zn(s) \rightarrow Co(s) + Zn^{2+}(aq)$

$Mg^{+2}(aq) + Zn(s) \rightarrow$ no evidence

SOA ↓ act. dec.

↑ act dec SRA

#2. $Be(s) + Cd^{+2}(aq) \rightarrow Be^{2+}(aq) + Cd(s)$

$Cd(s) + 2H^{+}(aq) \rightarrow Cd^{+2}(aq) + H_2(g)$

$Ca^{+2}(aq) + Be(s) \rightarrow$ no evidence

$Cu(s) + 2H^{+}(aq) \rightarrow$ no evidence

SOA ↓ act. dec

↑ act. dec. SRA

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