

Redox Practice (Spontaneity)

Data Booklet last page

Spontaneous

not spontaneous

no reaction

Multiple Choice - circle the best response

1. Using the table of standard reduction potentials, it can be predicted that I^- will react spontaneously with

A. Co

B. Br_2

C. Cl^-

D. Cu^{2+}

① find $I^- \rightarrow$ right side of table

② look for something on the left AND higher than I^-

2. Which of the following is the strongest oxidizing agent? = highest on left

A. Cu^{2+}

B. Pb^{2+}

C. Ni^{2+}

D. Sn^{2+}

3. Which of the following reactions is spontaneous?

A. $2I^- + Ag \rightarrow Ag^+ + I_2$

B. $Co^{2+} + Cu \rightarrow Co + Cu^{2+}$

C. $Cu^{2+} + Pb \rightarrow Pb^{2+} + Cu$

D. $Ni^{2+} + 2Ag \rightarrow 2Ag^+ + Ni$

same side x

one on left must be higher than one on right

4. A student wants to determine the $[Sn^{2+}]$ in a solution of $SnCl_2$ by a redox titration. A suitable ion to use would be

A. Br^-

B. Cr^{3+}

C. Pb^{2+}

D. MnO_4^-

$Sn^{+2} \rightarrow$ answer must be on opposite side
AND left higher than right

Sn^{2+} is on the table twice

on left... -0.14

\rightarrow possible answer must be below on right NONE

on right... +0.15

\rightarrow possible answer must be above on left. MnO_4^-

5. Which of the following chemical species is capable of oxidizing silver?

A. F^-

B. K^+

C. Br_2

D. Mg

oxidizing agent on left side of table MUST be higher than Ag (on right side)

6. Which of the following could react spontaneously with Ag metal?

A. Cl^-

B. Fe^{2+}

C. acidified SO_4^{2-}

D. acidified NO_3^-

Ag is on right side only \therefore looking for something on left.

Spontaneously = higher than Ag.

* do not look @ Ag at -0.69 b/c it needs S^{2-} to be present.

7. Solid copper forms spontaneously in the following reaction:



Since Cu^{2+} reduces, it is an oxidizing agent. (Cu is reducing agent) since V oxidizes, it is a reducing agent. (V^{2+} is an oxidizing agent.)

Based on this observation, Cu^{2+} is a

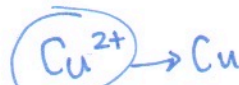
A. weaker reducing agent than V^{2+}

B. weaker oxidizing agent than V^{2+}

C. stronger reducing agent than V^{2+}

D. stronger oxidizing agent than V^{2+}

strong oxidizing agent



$Cu^{2+} \rightarrow Cu$ $\therefore Cu^{2+}$ is oxidizing agent gaining e^- (reduction) = left

$V \rightarrow V^{2+}$ losing e^- (oxidation) = right $\therefore V$ is reducing agent.

strong reducing agent

8. A piece of zinc metal is dropped into a solution of $FeCl_2$. The result of this procedure is

A. no reaction

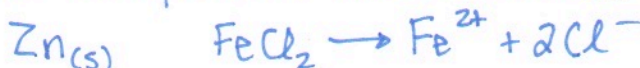
B. the zinc is oxidized by Cl_2

in H_2O

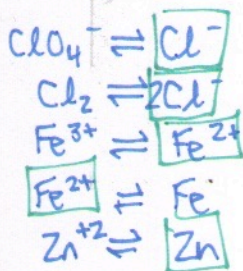
C. the iron is oxidized by Zn^{2+}

D. the zinc is oxidized by Fe^{2+}

Tip: write all possible reactants down



Reactants = Zn, Fe^{2+}, Cl^- * The highest on the left always reacts with the lowest on the right.

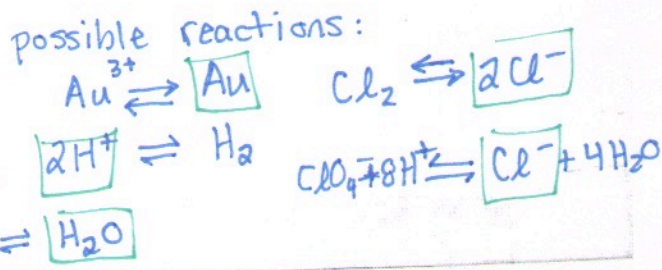


9. A piece of Au does not react spontaneously with 1.0M HCl.
Which of the following statements is true?

- A. Au is a weaker reducing agent than H₂
- B. Au is a stronger reducing agent than H₂
- C. Au is a weaker oxidizing agent than H⁺
- D. Au is a stronger oxidizing agent than H⁺

* Au is only on the right ∴ other should be on left BUT lower (b/c not spontaneous)

remember means dissolved in H₂O
Possible reactants: Au, H⁺, Cl⁻, H₂O



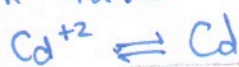
10. Vanadium metal, V, reacts spontaneously with Cd²⁺, but not with Ti²⁺. Based on these results, the order of oxidizing agents, from strongest to weakest, is

- A. Cd²⁺, V²⁺, Ti²⁺
- B. V²⁺, Ti²⁺, Cd²⁺
- C. Ti²⁺, Cd²⁺, V²⁺
- D. Ti²⁺, V²⁺, Cd²⁺

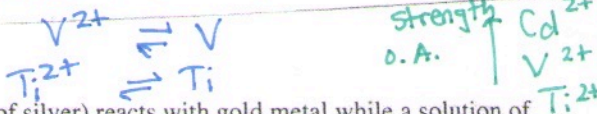
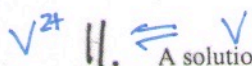
oxidizing agents ∴ comparing on left side

① if V reacts with Cd²⁺, it is lower in table

metals (V, Cd, Ti) will not gain electrons ∴ become negative. They ALWAYS lose ∴ ALWAYS oxidize = right side in table



② if it does not react with Ti²⁺, it is higher



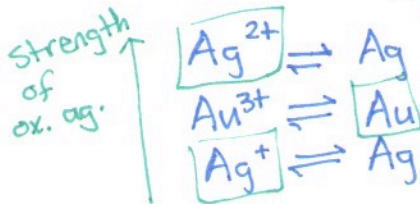
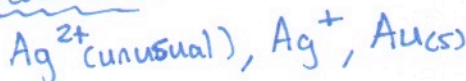
strength of o.a. ↑
Cd²⁺
V²⁺
Ti²⁺

11. A solution of Ag(NO₃)₂ (an unusual form of silver) reacts with gold metal while a solution of AgNO₃ does not react with gold. What is the order of oxidizing agents when arranged from strongest to weakest?

- A. Ag⁺, Au³⁺, Ag²⁺
- B. Au³⁺, Ag²⁺, Ag⁺
- C. Ag²⁺, Au³⁺, Ag⁺
- D. Ag²⁺, Ag⁺, Au³⁺

no NO₃⁻ ∴ just silvers and gold

possible reactants:

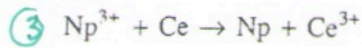
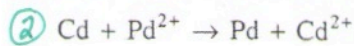
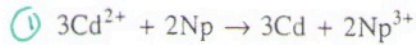


usually don't have to worry about H₂O reacting except in electrolytic cells (last Redox topic in unit)

But b/c H₂O is present with Cl⁻, the reaction ClO₄⁻ + 8H⁺ ← Cl⁻ + 4H₂O is possible

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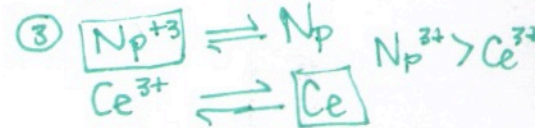
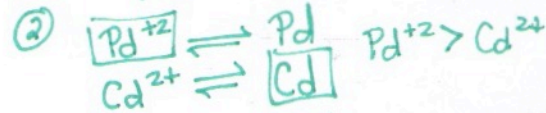
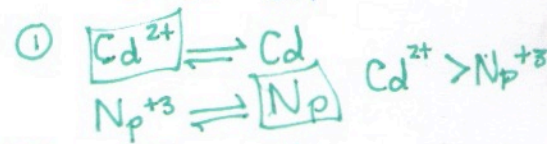
Consider the following spontaneous reactions:



Which is the strongest oxidizing agent?

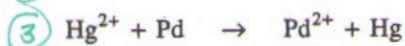
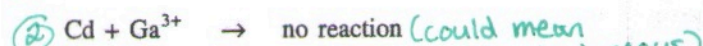
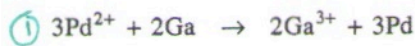
- A. Cd^{2+}
- B. Ce^{3+}
- C. Np^{3+}
- D. Pd^{2+}

Tip: the more \oplus form of the metal will be on left



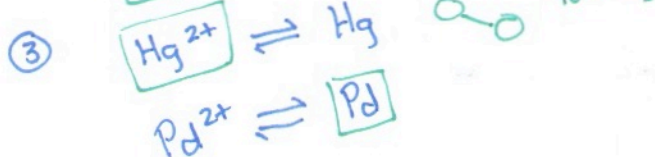
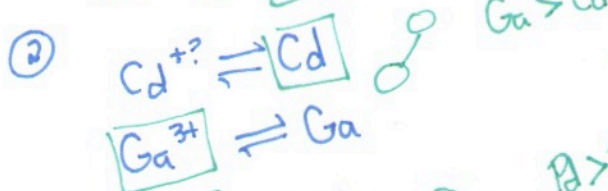
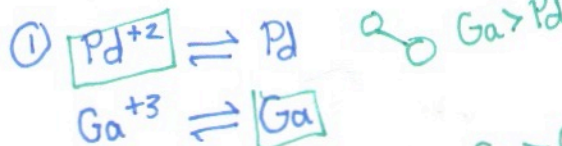
13.

The metals Hg, Cd, Ga and Pd react as follows:



Which of the following metals is the strongest reducing agent?

- A. Pd
- B. Ga
- C. Cd
- D. Hg



Right side
 strength of reducing agents
 compare those on right (lowest = strongest)

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When a piece of Cu is placed in 1.0 M AgNO_3 .

- A. the $[\text{Ag}^+]$ increases.
 B. the $[\text{Cu}^{2+}]$ increases.
 C. the $[\text{NO}_3^-]$ decreases.
 D. no change occurs.

possible reactants: Cu(s) , Ag^+ , NO_3^- ↗ not acidic or basic

highest on left with lowest on right

highest left = $\text{Ag}^+ \rightarrow \text{Ag}$

lowest right = $\text{Cu} \rightarrow \text{Cu}^{2+}$



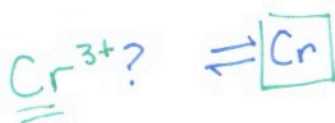
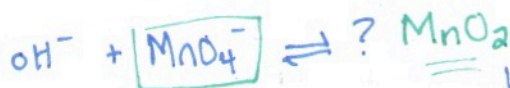
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What two substances are produced when Cr and 1.0 M MnO_4^- react in basic solution?

- A. Mn^{2+} and Cr^{3+}
 B. MnO_2 and Cr^{3+}
 C. Mn^{2+} and Cr^{2+}
 D. MnO_2 and CrO_4^{2-}

on right only (metals NEVER gain e^-)

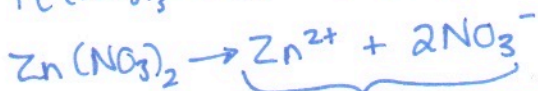
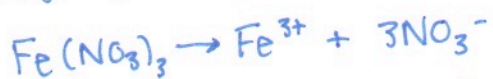
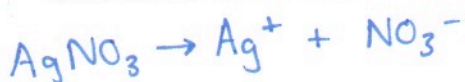
OH^- , H_2O present (no H^+)



highest on left will react with lowest on right BUT can't be MnO_4^- @ +1.51 b/c no H^+ present.

Short Answer - write your response in the space provided. Express your answer in correct sig figs & units where appropriate.

1. An excess of copper solid is dropped into a solution which contains AgNO_3 , $\text{Fe}(\text{NO}_3)_3$ and $\text{Zn}(\text{NO}_3)_2$. Write the equations for any reduction half-reactions that occur over time under standard conditions. (2 marks)

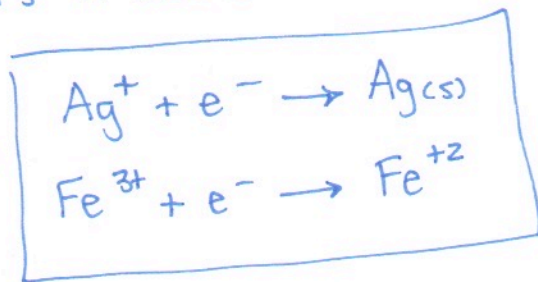


(not acidic or basic but H_2O present)

possible reactants \neq $\text{Cu}(\text{s})$

* reactions must be spontaneous \therefore higher on left as opposed to $\text{Cu}(\text{s})$ which will be on the right. (Cu @ +0.34V and 0.52V)
 Ag^+ & Fe^{3+} are higher (so is NO_3^- but only if it's in acidic conditions)

answer \rightarrow



* only asking for the reduction reactions

2.

a) Indicate in the blank spaces on the following chart whether or not a reaction will occur when the metals are added to aqueous ions. (1 mark)

metal \ ion	Pd	Rh	Pt
Pd ²⁺			
Rh ²⁺	no reaction		no reaction
Pt ²⁺	reaction	reaction	

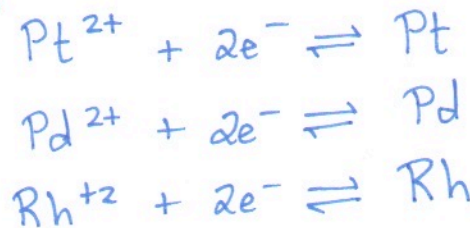
← ? $Rh^{2+} < Pt^{2+}$
 ← $Rh^{+2} < Pd^{+2}$
 ← $Pt^{2+} > Rh^{+2}$
 $Pt^{2+} > Pd^{2+}$

①
②

b) List the oxidizing agents in order of strongest to weakest. (1 mark)

- ① Rh^{2+} must be lower than $Pt^{+2} \frac{1}{2} Pd^{+2}$
 ② Pt^{2+} must be higher than $Pd^{+2} \frac{1}{2} Rh^{+2}$

strength ↑
oxidizing agents ↑



answer to b) $Pt^{2+} > Pd^{2+} > Rh^{2+}$

answer to a)

	Rh	Pt
Pd^{+2}	reaction	no reaction