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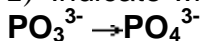
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23 Electrochemical Terms (Homework)

1) Determine the oxidation state of nitrogen in N_2H_4 .

2) Indicate whether the chemical conversion:



requires an oxidizing agent, a reducing agent, or neither.

oxidizing agent

neither

reducing agent

3) Use the energy level diagrams for the valence electrons of elements X, Y, and Z shown below and assume that the redox orbital energies are the dominant term in the free energies of all reactions to determine which of the following reactions would be spontaneous.

Energy Diagram	Possible Processes	Spontaneous?
	a) $X + Y^{2+} \rightarrow X^{2+} + Y$	Yes / No
	b) $Z + X^{2+} \rightarrow Z^{2+} + X$	Yes / No
	c) $Y + Z^{2+} \rightarrow Y^{2+} + Z$	Yes / No
	d) $Y + X^{2+} \rightarrow Y^{2+} + X$	Yes / No
	e) $Z + Y^{2+} \rightarrow Z^{2+} + Y$	Yes / No

best oxidizing agent	best reducing agent	redox couple with the most negative standard reduction potential
<p>Z</p> <p>Y^{2+}</p> <p>X</p> <p>X^{2+}</p> <p>Y</p> <p>Z^{2+}</p>	<p>X^{2+}</p> <p>Y^{2+}</p> <p>X</p> <p>Z^{2+}</p> <p>Y</p> <p>Z</p>	<p>Y^{2+}/Y</p> <p>X^{2+}/X</p> <p>Z^{2+}/Z</p>

4) Consider the valence electron energy level diagrams for substances A and B:

Energy Diagram	Process	Spontaneous?	Best Oxidant	Best Reductant
	$A + B \rightarrow A^{2+} + B^{2-}$	Yes / No	A A^{2+} A^{4+} B B^{2-} B^{2+}	A A^{2+} A^{4+} B B^{2-} B^{2+}
	$A^{2+} + B \rightarrow A + B^{2+}$	Yes / No		
	$A + B^{2-} \rightarrow A^{2-} + B$	Yes / No		
	$A^{4+} + B^{2-} \rightarrow A^{2+} + B$	Yes / No		

5) Identify the reductant and the number of electrons transferred (n) in each redox reaction below.

Reaction	reductant	n
$3Cl_2 + 2Fe \rightarrow 2FeCl_3$	Fe Cl_2	
$H_2O + Hg^{2+} + NO_2^{1-} \rightarrow 2H^{1+} + Hg + NO_3^{1-}$	H_2O Hg^{2+} NO_2^{1-}	
$3SO_3^{2-} + 2MnO_4^{1-} + H_2O \rightarrow 3SO_4^{2-} + 2MnO_2 + 2OH^{1-}$	SO_3^{2-} MnO_4^{1-} H_2O	

24 Redox Reactions (Homework)

1) Select the strongest oxidant and reductant given that all of the following processes are extensive.

Extensive Processes	best oxidant	best reductant
$A + B^{2+} \rightarrow A^{2+} + B$	A A ²⁺ B B ²⁺ C C ²⁺ D D ²⁺	A A ²⁺ B B ²⁺ C C ²⁺ D D ²⁺
$B + C^{2+} \rightarrow B^{2+} + C$		
$D + B^{2+} \rightarrow D^{2+} + B$		
$A + D^{2+} \rightarrow A^{2+} + D$		

2) Write balanced redox equations and determine both the cell potential and the number of electrons transferred for the spontaneous redox process that occurs when the following couples are connected. See "Instructions for Writing Chemical Equations" in the assignment heading.

Be sure to enter the substances in the required order. It is different than that given online.			
Couples	OX(1) + RED(2) -> RED(1) + OX(2)	E° (V)	n
H ¹⁺ /H ₂ + Al ³⁺ /Al			
Cu ²⁺ /Cu + Pb ²⁺ /Pb			
I ₂ /I ¹⁻ + Br ₂ /Br ¹⁻			

3) Write net equations for the spontaneous redox reactions that occur during the following or **none** if there is no extensive reaction. See "Writing Chemical Equations" in the Instructions section of the assignment heading.

- Sulfate ion should be treated as a spectator ion.

Reactants	RED(1) + OX(2) + other -> OX(1) + RED(2) + other
Iron metal is dipped into a NiSO ₄ solution	
Silver metal is added to hydrochloric acid	
A silver wire is dipped into nitric acid	
Potassium metal is added to water	
Chromium metal is added to a solution of MgSO ₄	

25 Batteries, Corrosion, and Electrolysis (Homework)

1) Identify the battery that uses each of the following half-reactions:

Half-reaction	Battery
$\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2\text{e}^{-1} \rightarrow 2\text{Ag} + 2\text{OH}^{1-}$	Dry cell Automobile Button
$2\text{MnO}_2 + \text{H}_2\text{O} + 2\text{e}^{-1} \rightarrow \text{Mn}_2\text{O}_3 + 2\text{OH}^{1-}$	Dry cell Automobile Button
$\text{Pb} + \text{SO}_4^{2-} \rightarrow \text{PbSO}_4 + 2\text{e}^{-1}$	Dry cell Automobile Button

2) Automobile bodies are galvanized by the addition of zinc. Write the **balanced chemical equations** using smallest whole number coefficients for the following processes:

- Use complete reactions with molecules and atoms; i.e., no ions or half-reactions. For example, $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$.

The corrosion that is prevented by galvanization.

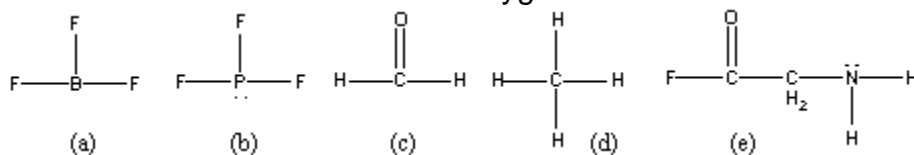
The galvanization reaction that occurs instead of the above corrosion.

3) Indicate whether each reaction could form the basis of a galvanic cell or require an electrolytic cell to be accomplished.

Reactants	Cell Type
$\text{Cu} + \text{Ni}^{2+} \rightarrow \text{Cu}^{2+} + \text{Ni}$	Galvanic Electrolytic
$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$	Galvanic Electrolytic
$2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$	Galvanic Electrolytic

26 Acids & Bases (Homework)

1) Lone pairs are shown only on central atoms in the following Lewis structures. Assume that the double bonded oxygen atoms are neither acidic or basic.



Select all species that are Lewis acidic

- a
- b
- c
- d
- e

Select all species that are Lewis basic

- a
- b
- c
- d
- e

2) Give the conjugate base or acid in each case. Enter subscripts normally. For example, NH_4^{1+} would be entered as NH41+ or, since spaces are ignored, as NH4 1+. The answers are case sensitive.

acid	conjugate base
HClO	
NH_3	
H_3PO_4	
HSO_3^{1-}	
	OH^{1-}
	F^{1-}
	S^{2-}
	NH_3

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