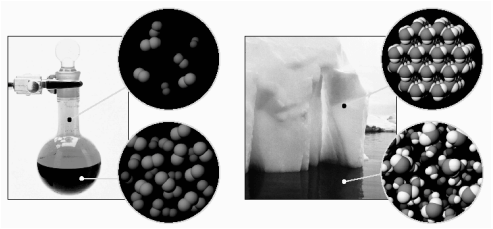
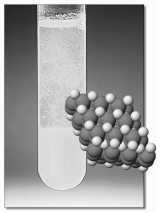
Chemistry 223 Exam II Review
Chapters 15, 16 and 17



Chemistry 223
Professor Michael Russell

MAR

Last update: 6/14/23



MAR

Decide if a precipitate will form when mixing the indicated reagents (all concentrations are 1.0 M).

$KCl(aq) + Pb(NO_3)_2(aq) \rightarrow ?$

A. Yes
B. No
C. Who knows!

If the solubility of BaF_2 is 3.6×10^{-3}, a reasonable value for K_{sp} for BaF_2 is

A. 3.6×10^{-3}
B. 7.2×10^{-3}
C. 1.1×10^{-2}
D. 1.9×10^{-7}
E. 4.7×10^{-8}

MAR

Which lead salt has the greatest molar solubility in water at 25 °C?

A. $PbCO_3$ $K_{sp} = 1.5 \times 10^{-13}$
B. PbS $K_{sp} = 8.4 \times 10^{-28}$
C. $PbSO_4$ $K_{sp} = 1.8 \times 10^{-4}$

MAR

A solution contains 0.10 M K_2SO_3 and 0.30 M Na_2SO_4. Solid $Ca(NO_3)_2$ is added slowly. Which precipitates first, $CaSO_3$ or $CaSO_4$?

K_{sp} for $CaSO_3 = 1.3 \times 10^{-8}$
K_{sp} for $CaSO_4 = 2.4 \times 10^{-5}$

A. $CaSO_3$
B. $CaSO_4$
C. 42

MAR

$CaSO_3$ precipitates first as Ca^{2+} ions are added to a solution containing 0.10 M K_2SO_3 and 0.30 M Na_2SO_4. What is $[SO_3^{2-}]$ as the $CaSO_4$ begins to precipitate?

$K_{sp}(CaSO_3) = 1.3 \times 10^{-8}$ $K_{sp}(CaSO_4) = 2.4 \times 10^{-5}$

A. 0.10 M
B. 0.30 M
C. 1.6×10^{-4} M
D. 5.4×10^{-4} M
E. 42

MAR

What is the pH of a saturated solution of $Mg(OH)_2$? (K_{sp} ($Mg(OH)_2$) = 5.6 x 10^{-12})

A. 3.65
B. 8.37
C. 10.35
D. 0.15
E. 11.25

MAR

A solution has $[Pb^{2+}]$ = 0.0012 M and $[Cl^-]$ = 0.010 M. Will $PbCl_2$ precipitate?
K_{sp} ($PbCl_2$) = 1.7 x 10^{-5}

A. Yes, $PbCl_2$ precipitates
B. No, $PbCl_2$ does NOT precipitate

MAR

Which of the following shows the correct formation constant (K_f) equation for $Cr(CN)_6^{3-}$?

A. $Cr(CN)_3(s) + 3\ CN^{-1}(aq) \rightleftarrows Cr(CN)_6^{3-}(aq)$
B. $Cr(NO_3)_3(s) + 6\ NaCN(aq) \rightleftarrows Cr(CN)_6^{3-}(aq) + 3\ NaNO_3(aq) + 3\ Na^+(aq)$
C. $Cr(CN)_6^{3-}(s) \rightleftarrows Cr^{3+}(aq) + 6\ CN^{-1}(aq)$
D. $Cr(CN)_6^{3-}(aq) \rightleftarrows Cr^{3+}(aq) + 6\ CN^{-1}(aq)$
E. $Cr^{3+}(aq) + 6\ CN^{-1}(aq) \rightleftarrows Cr(CN)_6^{3-}(aq)$

MAR

Calculate the standard entropy change for the following reaction:

$CCl_4(l) + O_2(g) \rightarrow CO_2(g) + 2\ Cl_2(g)$

* $S°[CCl_4(l)]$ = 214.39 J/K • mol
* $S°[CO_2(g)]$ = 213.74 J/K • mol
* $S°[O_2(g)]$ = 205.07 J/K • mol
* $S°[Cl_2(g)]$ = 223.08 J/K • mol

A. -17.36 J/K
B. +17.36 J/K
C. +240.44 J/K
D. -25.78 J/K
E. 42

MAR

Calculate $\Delta G_{rxn}°$ for the following reaction:

$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$

* $\Delta G_f°[CO_2(g)]$ = -394.4 kJ/mol
* $\Delta G_f°[CH_4(g)]$ = -50.8 kJ/mol
* $\Delta G_f°[H_2O(g)]$ = -228.6 kJ/mol

A. 572.2 kJ/mol•rxn
B. -673.7 kJ/mol•rxn
C. -572.2 kJ/mol•rxn
D. -436.4 kJ/mol•rxn
E. -800.8 kJ/mol•rxn

MAR

Given the following information, calculate $\Delta G°$ for the reaction below at 25 °C:

$Mg(s) + 1/2\ O_2(g) \rightarrow MgO(s)$

$\Delta H°$ = -601.24 kJ/mol•rxn
$\Delta S°$ = -108.36 J/K•rxn

A. 664.5 kJ/mol•rxn
B. -568.9 kJ/mol•rxn
C. 31700 kJ/mol•rxn
D. -528.3 kJ/mol•rxn
E. 42

MAR

A reaction has a ΔH° which is ***positive*** and a ΔS° which is ***positive***. What can be said about the reaction spontaneity at different temperatures?

A. product favored at all temperatures
B. product favored only at high temperature
C. product favored only at low temperature
D. not product favored at any temperature

MAR

Calculate ΔG° at 25 °C for: **$2\ H_2O_2(l) \rightarrow 2\ H_2O(l) + O_2(g)$**

	ΔH°(kJ/mol)	**S°(J/K • mol)**
$H_2O_2(l)$	-187.8	109.6
$H_2O(l)$	-285.8	69.9
$O_2(g)$	-----	205.1

A. -157.9 kJ/mol•rxn
B. -192.3 kJ/mol•rxn
C. -37700 kJ/mol•rxn
D. -233.5 kJ/mol•rxn
E. 42

MAR

A reaction has ΔH = -96.0 kJ/mol and ΔS = -12.6 J/K•mol. If the temperature is increased slowly, at what temperature will this reaction become nonspontaneous?

A. It will never be spontaneous
B. 7162 °C
C. 762 K
D. 7620 K
E. -57.6 K

MAR

Barium sulfite is poorly soluble in water with a K_{sp} value of 8.0×10^{-7}. What is ΔG° at 25 °C?

A. 15.1 kJ/mol•rxn
B. 34.8 kJ/mol•rxn
C. -34.8 kJ/mol•rxn
D. 343 kJ/mol•rxn
E. 42

MAR

Balance the following reaction (pH = 8.37):

$$MnO_4^- + I^- \rightarrow MnO_2 + I_2$$

A. $MnO_4^- + 2\ I^- \rightarrow MnO_2 + I_2 + O_2^{2-}$
B. $8\ H^+ + 2\ MnO_4^- + 6\ I^- \rightarrow 2\ MnO_2 + 3\ I_2 + 4\ H_2O$
C. $8\ H_2O + 4\ MnO_4^- + 12\ I^- \rightarrow 4\ MnO_2 + 6\ I_2 + 16\ OH^-$
D. $4\ H_2O + 2\ MnO_4^- + 6\ I^- \rightarrow 2\ MnO_2 + 3\ I_2 + 8\ OH^-$

MAR

What is the strongest reducing agent in the list?

Half-Reaction	*E°(V)*
$Ce^{4+}(aq) + e^- \rightarrow Ce^{3+}(aq)$	+1.61
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$Hg_2^{2+}(aq) + 2\ e^- \rightarrow 2\ Hg(\ell)$	+0.79
$Sn^{2+}(aq) + 2\ e^- \rightarrow Sn(s)$	-0.14
$Ni^{2+}(aq) + 2\ e^- \rightarrow Ni(s)$	-0.25
$Al^{3+}(aq) + 3\ e^- \rightarrow Al(s)$	-1.66

A. Ce^{4+}
B. Al^{3+}
C. Sn
D. Al
E. Jq

MAR

Will Sn(s) reduce $Ag^+(aq)$ to Ag(s)?

Half-Reaction	*E°(V)*
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$Sn^{2+}(aq) + 2\ e^- \rightarrow Sn(s)$	-0.14

A. Yes
B. No
C. Only if it feels like it

MAR

Determine the equilibrium constant for the following reaction at 25 °C:
$Cl_2(aq) + 2I^-(aq) \rightarrow 2\ Cl^-(aq) + I_2(aq)$ $E° = +0.825$ V

A. 1.31×10^{-28}
B. 8.74×10^{13}
C. 8.03×10^{27}
D. 0.217
E. -1.16×10^5

MAR

A **voltaic** cell is created using the information below to be used in Alaska where the average temperature is 5.00 °C. Calculate the expected cell potential under these conditions.

$Al(s) \mid Al^{3+}(aq, 0.0010\ M) \parallel Ni^{2+}(aq, 0.50\ M) \mid Ni(s)$

$Ni^{2+}(aq) + 2\ e^- \rightarrow Ni(s)$	-0.25 V
$Al^{3+}(aq) + 3\ e^- \rightarrow Al(s)$	-1.66 V

A. 1.46 V
B. 1.31 V
C. 1.17 V
D. 0.51 V
E. -1.91 V

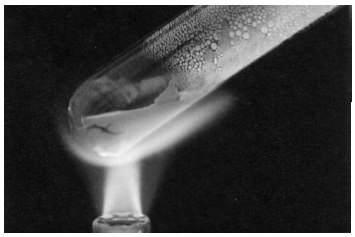
MAR

How long must a 2.00 amp current flow through a gold solution to convert 0.0100 mol of $Au^{3+}(aq)$ into Au(s)?

A. 483 s
B. 4.83×10^4 s
C. 965 s
D. 1450 s
E. 1 zillion s

MAR

End of Review - *good luck with your studying!*



Need more practice?

- *Practice Problem Sets (online)*
- *Concept Guides (Companion and online)*
- *Chapter Guides (online)*
- *End of Chapter Problems in Textbook (every other question has answer at end)*

Good luck with your studying!

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