

Name: _____

Instructor: Mills

Chemistry 102: 2nd Practice Examination

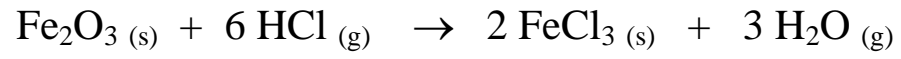
Answer all five questions. Each question is worth 30 points. Please ensure you have all *five* pages of questions, as well as a formula sheet and a copy of the periodic table, *before* starting.

SHOW ALL WORK

Question	Score
1	
2	
3	
4	
5	
<u>Total</u>	

“Gibbs”

Question 1 (30 points): Using the thermodynamic information given in the data sheet, calculate ΔG° for the following reaction:



“What’s the pH?”

Question 2 (30 points): Calculate the pH of each of the following solutions:

1. 0.015 M HCl (aq) (assume complete dissociation)
2. 0.015 M H₂SO₄ (aq) (assume complete dissociation)
3. 0.015 M NaOH (aq) (assume complete dissociation)
4. 0.015 M HC₂H₃O₂ (aq), $K_a = 1.8 \times 10^{-5}$

“Weak Acid”

Question 3 (30 points): A 0.200 M solution of a weak acid HA (aq) is 9.4 % ionized (dissociated) at equilibrium. Use this information to calculate $[H^+]$, $[HA]$ and K_a for HA.

“Weak Base”

Codeine ($C_{18}H_{21}NO_3$) is a weak organic base. A 5.0×10^{-3} M solution of codeine has a pH of 9.95.

Question 4a (30 points): Calculate K_b for codeine.

Question 4b (5 points): Calculate pK_b for codeine.

“Common Ion”

Question 5 (30 points): A solution contains 2.5×10^{-4} M $\text{Ag}^+(\text{aq})$ and 1.7×10^{-3} M $\text{Pb}^{2+}(\text{aq})$.

- A. If $\text{NaI}(\text{aq})$ is added, will AgI ($K_{\text{sp}} = 8.3 \times 10^{-17}$) or PbI_2 ($K_{\text{sp}} = 7.9 \times 10^{-9}$) precipitate first?
- B. Specify the concentration of I^- (aq) needed to begin precipitation of the material you determined would precipitate first in part A.

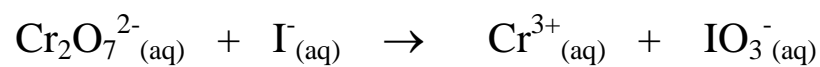
“REDOX”

Question 5a (10 points): State the oxidation state of the specified atom in each of the chemical species listed below:

Cr in $\text{Cr}_2\text{O}_7^{2-}$

I in IO_3^-

Question 5b (20 points): Balance the following REDOX reaction. Assume acidic conditions.



Data sheet

Molar volume: $V_m = 22.41 \text{ L}\cdot\text{mol}^{-1}$ at STP
(0.00°C, 1.00 atm)

Ideal gas law: $PV = nRT$

Combined gas law: $P_1V_1/T_1 = P_2V_2/T_2$

Boyle's Law: $P \propto 1/V$ (at fixed T and n)

Charles's Law: $P \propto T$ (at fixed V and n)

Avagadro's Law: $V = nV_m$

1st order rate equations

$$\ln([A]_t/[A]_o) = -kt$$

$$t_{1/2} = 0.693/k$$

Arrhenius equation

$$\ln(k_2/k_1) = E_a(1/T_1 - 1/T_2) / R$$

$$K_w = [H^+][OH^-] = 1 \times 10^{-14}$$

$$pH + pOH = 14$$

$$\Delta G = \Delta H - T\Delta S$$

Dalton's law of partial pressures:

$$P_{\text{Tot}} = P_a + P_b + P_c \dots$$

Beer's law

$$A = \log(I_o/I) = \epsilon bc$$

$$R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$= 8.315 \text{ Jmol}^{-1} \text{ K}^{-1}$$

$$d = m/v$$

$$1.00 \text{ atm} = 760 \text{ mmHg} = 101.5 \text{ kPa}$$

$$\rho_{\text{H}_2\text{O}} = 1.00 \text{ gmL}^{-1}$$

2nd order rate equations

$$1/[A]_t = kt + 1/[A]_o$$

$$t_{1/2} = 1/k[A]_o$$

Equilibrium constants: $K_p = K_c(RT)^{\Delta n}$

$$pH = -\log [H^+]$$

$$K_a K_b = K_w$$

$$\Delta H_{\text{rxn}} = \Delta H_f(\text{products}) - \Delta H_f(\text{reactants})$$

Substance	S° ($\text{Jmol}^{-1}\text{K}^{-1}$)
H ₂ O (g)	188.83
Fe ₂ O ₃ (s)	89.96
FeCl ₃ (s)	142.3
HCl (g)	186.69

Substance	ΔH_f° (kJmol^{-1})
H ₂ O (g)	- 241.8
Fe ₂ O ₃ (s)	- 822.16
FeCl ₃ (s)	- 400.0
HCl (g)	- 92.30