

Chem 1B Midterm 3

Practice Test

Credit will only be given for answers on this sheet. Units must be included in your answers and points will be taken off for incorrect or missing units. No partial credit will be awarded. Calculators are allowed. Cell phones may not be used as calculators. **If any of the following occurs you will receive a 0 on your test: 1) your cell phone goes off or if 2) you are not following masking policies.**

Name:	Perm Number

Make sure writing is dark and large enough to be picked up by a scanner. Failure to do this results in the loss of 5 points on the exam.

If you are sitting next to someone with the same version of the test you both will lose 5 points.

Fundamentals	
Question (Points)	Answer
1 (6 pts) 4,2	$-12.7 \frac{kJ}{mol}$
	☒ Spontaneous ☐ Not Spontaneous
2 (8 pts) 6,2	$-153.16 \frac{kJ}{mol}$
	☒ Forward ☐ At Equilibrium ☐ Reverse
3 (8 pts) 6,2	9.7×10^{21}
	☐ Reactant ☐ Same Number of Reactants and Products ☒ Products
4 (6 pts)	1.03 V
5 (10 pts) 2,2,2,2,2	Work: ☒ Negative ☐ Zero ☐ Positive ☐ Unable to tell
	ΔH : ☒ Negative ☐ Zero ☐ Positive ☐ Unable to tell
	ΔE : ☒ Negative ☐ Zero ☐ Positive ☐ Unable to tell
	ΔS : ☐ Negative ☐ Zero ☒ Positive ☐ Unable to tell
	ΔG : ☒ Negative ☐ Zero ☐ Positive ☐ Unable to tell
6 (6 pts) 3,3	☒ Not a Redox Rxn ☐ Redox Rxn Oxidized: Reduced:
	☐ Not a Redox Rxn ☒ Redox Rxn Oxidized: C Reduced: Fe

Challenge Problems	
Question (Points)	Answer
7 (10 pts)	$52.0 \frac{g}{mol}$
8 (10 pts)	$25.0 \frac{kJ}{mol}$

Multiple Choice	
Question (Points)	Answer
9 (5 pts)	☐ A ☐ B ☐ C ☒ D ☐ E
10 (5 pts)	☐ A ☒ B ☐ C ☐ D ☐ E
11 (6 pts)	☐ A ☒ B ☐ C ☐ D ☐ E
12 (7 pts)	☒ A ☐ B ☐ C ☐ D ☐ E
13 (6 pts)	☐ A ☐ B ☒ C ☐ D ☐ E
14 (7 pts)	☒ A ☐ B ☐ C ☐ D ☐ E

Fundamental Questions

1a) 4 pts If ΔH is $-12.4 \frac{\text{kJ}}{\text{mol}}$ and ΔS is $0.91 \frac{\text{J}}{\text{mol}\cdot\text{K}}$, what is ΔG (in $\frac{\text{kJ}}{\text{mol}}$) at 75°C ?

1b) 2 pts Is the reaction spontaneous?

2a) 6 pts $\Delta G^\circ_{\text{rxn}}$ for $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$ is $-141.74 \frac{\text{kJ}}{\text{mol}}$ at 25.00°C . What is ΔG_{rxn} (in $\frac{\text{kJ}}{\text{mol}}$) when the partial pressure of each gas is 100. atm?

2b) 2 pts What is the spontaneous direction of the reaction under these conditions?

3a) 6 pts What is K for the following reaction at 25°C ?
 $\text{Sn}^{4+}(\text{aq}) + 2\text{Ag}(\text{s}) \rightarrow \text{Sn}^{2+}(\text{aq}) + 2\text{Ag}^+(\text{aq}) \quad E^\circ = 0.65 \text{ V}$

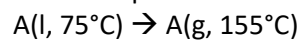
3b) 2 pts Are there more reactants or products at equilibrium?

- 4) 6 pts What is E_{cell} for the following reaction at 25°C?
 $\text{I}_2(\text{s}) + \text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}, 0.20 \text{ M}) + 2\text{I}^{-}(\text{aq}, 0.30 \text{ M})$
- 5a) 2 pts Consider the following exothermic reaction at 25°C and 1 atm.
 $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$
What is the sign of w ?
- 5b) 2 pts What is the sign of ΔH ?
- 5c) 2 pts What is the sign ΔE ?
- 5d) 2 pts What is the sign ΔS ?
- 5e) 2 pts What is the sign ΔG ?
- 6a) 3 pts Is the following a redox reaction? If so, what is oxidized and what is reduced?
 $\text{Cu}(\text{OH})_2(\text{s}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
- 6b) 3 pts Is the following a redox reaction? If so, what is oxidized and what is reduced?
 $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g})$

Challenge Problems

- 7) *10 pts* A metal forms the salt MCl_3 . Electrolysis of the molten salt with a current of 0.700 A for 6.63 h produced 3.00 g of the metal. What is the molar mass of the metal?

8) 10 pts Consider the process



which is carried out at constant pressure. The total ΔS for this process is known to be $75.0 \frac{\text{J}}{\text{K}\cdot\text{mol}}$. For $A(l)$ and $A(g)$, C_p values are $75.0 \frac{\text{J}}{\text{K}\cdot\text{mol}}$, and $29.0 \frac{\text{J}}{\text{K}\cdot\text{mol}}$, respectively, and are not dependent on temperature. Calculate ΔH_{vap} (in $\frac{\text{kJ}}{\text{mol}}$) for $A(l)$ at 125°C (its boiling point).

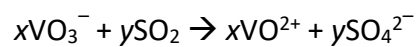
Multiple Choice

- 9) 5 pts For the vaporization of a liquid at a given pressure,
- a. ΔG is negative at all temperatures.
 - b. ΔG is negative at low temperature but positive at high temperatures (and zero at some temperature)
 - c. ΔG is positive at all temperatures.
 - d. ΔG is positive at low temperature but negative at high temperatures (and zero at some temperature)
- 10) 5 pts Predict which of the following reactions has a negative entropy change.
- I. $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
 - II. $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
 - III. $2\text{KClO}_4(\text{s}) \rightarrow 2\text{KClO}_3(\text{s}) + \text{O}_2(\text{g})$
- a. II
 - b. I and II
 - c. I
 - d. III
 - e. None of the above
- 11) 6 pts For a reaction in a voltaic cell, both ΔH° and ΔS° are positive. Which of the following statements is true?
- a. $\Delta G^\circ > 0$ for all temperatures
 - b. E°_{cell} will increase with an increase in temperature.
 - c. E°_{cell} will decrease with an increase in temperature.
 - d. E°_{cell} will not change when the temperature increases.
 - e. None of the above statements are true.
- 12) 7 pts A concentration cell is constructed using two Ni electrodes with Ni^{2+} concentrations of 1.26 M (cathode) and 4.95×10^{-4} M (anode) in the two half-cells. The reduction potential of Ni^{2+} is -0.23 V. Calculate the potential of the cell at 25°C .
- a. +0.101 V
 - b. +0.331 V
 - c. -0.201 V
 - d. -0.0287 V
 - e. None of the above

13) 6 pts Of the following five ions or molecules, which is the strongest reducing agent?

- a. Al^{3+}
- b. Fe^{2+}
- c. Cr^{2+}
- d. F^-
- e. H_2

14) 7 pts Ammonium metavanadate reacts with sulfur dioxide in acidic solution as follows (hydrogen ions and H_2O omitted):



The ratio $x : y$ is

- a. 2 : 1
- b. 1 : 1
- c. 1 : 3
- d. 1 : 2
- e. None of the above