

FINAL
EXAMINATION
SAMPLES

DURATION: 3 HOURS

No. of Students:

Department Name & Course Number: CHEM 1101 C
Course Instructor(s) Pamela Wolff

AUTHORIZED MEMORANDA
CALCULATORS

Students MUST count the number of pages in this examination question paper before beginning to write, and report any discrepancy to a proctor. This question paper has pages.

This examination question paper MAY be taken from the examination room.

In addition to this question paper, students require: an examination booklet **yes**
a Scantron sheet no

ANSWER ALL 10 QUESTIONS. EACH IS WORTH 10 MARKS. (THIS DOESN'T NECESSARILY MEAN
YOU SHOULD SPEND THE SAME AMOUNT OF TIME ON EACH!)

- You may do the questions in any order
- You may detach the question pages (you don't need to hand in the exam paper)

PLEASE: **Space out your answers – if I can't read it, I can't give
you marks for it**

Don't write in the margins – except the question number

- If you need an extra exam booklet, **HOLD UP the one you have in the air** – we'll bring you another.
- If you don't have a calculator, or have trouble with yours, ask for one; we have spares

DATA/EQUATIONS

$$E = hv$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$E = hc/\lambda$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$E = R_H \left(\frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

$$R_H = 2.18 \times 10^{-18} \text{ J}$$

$$PV = nRT$$

$$R = 0.08206 \text{ L}\cdot\text{atm/K}\cdot\text{mol}$$

$$\left[P + \frac{an^2}{V^2} \right] [V - nb] = nRT$$

$$= 8.314 \text{ J/K}\cdot\text{mol}$$

$$\ln \frac{P_2}{P_1} = \frac{\Delta H^\circ_{\text{vap}}}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$T(\text{K}) = T(^{\circ}\text{C}) + 273$$

$$\Delta T_b = K_b m \iota$$

$$K_b (\text{H}_2\text{O}) = 0.52 \text{ }^{\circ}\text{C/m}$$

$$\Delta T_f = K_f m \iota$$

$$K_f (\text{H}_2\text{O}) = 1.86 \text{ }^{\circ}\text{C/m}$$

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

$$\text{Avogadro's number: } 6.02 \times 10^{23}$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

	ΔH_f° (kJ/mol)	S° (J/K mol)
$\text{C}_2\text{H}_8\text{N}_2(\text{l})$	48.3	200.25
$\text{N}_2\text{O}_4(\text{l})$	9.16	304.3
$\text{CO}_2(\text{g})$	-393.5	213.6
$\text{H}_2\text{O}(\text{l})$	-285.8	69.9
$\text{H}_2\text{O}(\text{g})$	-241.8	188.7
$\text{N}_2(\text{g})$	0	191.61

CHEMISTRY CHEM 1101

SAMPLE FINAL EXAMINATION

It was real in December, 2015

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PHASE DIAGRAM: H₂O

Use one from your notes

PERIODIC TABLE

Use one from your notes

1. The ionization energy of oxygen is 1313.9 kJ/mol.
 - a) Calculate the wavelength of the electromagnetic radiation just energetic enough to ionize oxygen.
 - b) Give this wavelength in nanometers.
 - c) Show the chemical equation for the ionization of oxygen.

2.
 - a) Give the electron configuration for molybdenum, $_{42}\text{Mo}$.
 - b) Identify the valence subshell(s) of molybdenum, and give the orbital diagram and quantum numbers for it/them.
 - c) Identify the highest energy subshell of molybdenum, and give the orbital diagram and quantum numbers for it.
 - d) Give the electron configuration of the molybdenum(III) ion.

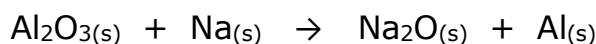
3. For the elements: Be, F, He, K, N, Na, O
 - a) Rank them in order of **increasing** size (or atomic radius).
 - b) Rank them in order of **increasing** ionization energy.
 - c) Predict the most likely ion or ions for each

4. For the sulphur pentafluoride anion, SF_5^- :
 - a) Draw the Lewis Diagram.
 - b) Draw the VSEPR (molecular) geometry.
 - c) Indicate the bond orders
 - d) Indicate the bond dipoles and net dipole (redraw the structure for this, please, so that I can see it better.)

5. a) Draw and label a molecular orbital diagram for nitrogen monofluoride, NF.
Use at least half a page.
- b) Give the bond order
- c) Give the magnetism, and explain your choice briefly (a few words are enough)
- d) If you ionized NF to give NF^+ , would the bond be shorter or longer? Explain your reasoning briefly (again, a few words are plenty.)
6. Octane (the main component of gasoline) has a standard heat of vaporization of 38.9 kJ/mol, and a vapour pressure of 0.0145 atm at 20.0°C. Calculate its normal boiling point, **in Celsius**.
7. Using the phase diagram of water given with the data sheets:
- a) Label regions A, B, and C, lines 1, 2, and 3, and points a and b. (*Use the letters and numbers given on the diagram and answer in your exam booklet. **Don't write it on the question paper; I don't want that handed in!***)
- b) Describe **in POINT FORM** what happens when H_2O is heated from -50°C to 370°C at a pressure of 25 atm. Make reasonable pressure and temperature estimates as needed.
- c) Describe **in POINT FORM** what happens when the pressure of the H_2O is raised from 0.1 atm to 217 atm at a temperature of 100°C . Make reasonable pressure and temperature estimates as needed.

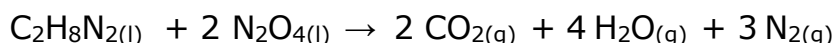
8. Magnesium acetate $\text{Mg}(\text{CH}_3\text{COO})_2$ has been suggested as a less damaging option for road salt. A 3.85 M magnesium acetate solution has a density of 1.47 g/ml.
- Given the data on the data page, determine its normal freezing point.
 - If you had a solution of sodium chloride with exactly the same molarity, would you expect its normal freezing point to be higher or lower than the magnesium acetate solution? Explain briefly (a few words is plenty)

9. The reaction of aluminum oxide reacts with sodium metal in the reaction:



If 5.00 kg of aluminium oxide are allowed to react with 6.70 kg of sodium, determine the mass of sodium oxide that is produced, in kilograms. **Show enough work to justify your answer.**

10. Dimethyl hydrazine (DMH) is used as a rocket fuel. It burns according to the reaction:



- Determine the standard enthalpy of reaction at 25°C
- Determine the standard entropy of reaction at 25°C
- Determine the standard free energy of reaction at 25°C
- Determine the free energy of reaction at 120.°C, when the pressure of the carbon dioxide is 10.0 atm, the pressure of the water vapour is 20.0 atm, and the pressure of the nitrogen gas is 15.0 atm.

NOTE: there is data on the data page for this question