Here is some practice to get you ready for the Final.

- 1) Supply the missing names or formulas:
 - a. potassium permanganate
 - b. silver(I) oxide
 - c. NaOCl
 - d. $Fe_2(SO_4)_{3}$.
 - e. Li₂HPO₄
- Boranes (B_xH_y) are compounds which contain only boron and hydrogen. A 5.33 g sample of a borane was treated with excess O₂ causing complete reaction. The hydrogen in the borane was recovered as 9.01 g H₂O and the boron as B₂O₃.
 - a. Determine the mass percent of hydrogen and boron in the boron sample.
 - b. Determine the empirical formula of the borane.
 - c. The molar mass of the borane was found to be near 50 g/mol. What is the molecular formula of the borane.
- 3) a. Carbon dioxide and an excess of solid carbon are introduced into an evacuated

(empty) 5.00 L flask. The flask is heated to 100°C. Before any reaction occurs the

pressure in the flask is 4.00 atm. Now a reaction proceeds as follows

 $C(s) + CO_2(g) \rightarrow 2 CO (g)$. After a while the pressure has risen to 5.25 atm.

Determine the partial pressures of $CO_2(g)$ and CO(g)

- b. What would the pressures be if initially there was enough N_2 present in the flask to cause a pressure of 1.00 atm at 100°C? (assuming the reaction goes to the same extent).
- c. What would the total and partial pressures be if the flask size was 20.0 L (initially empty), but otherwise the conditions would be the same? (again, assuming the reaction goes to the same extent).
- 4) a. Give a molecular interpretation of the constants a and b in the van der Waals equation.
 - b. What is the difference between a crystalline and an amorphous solid?
 - c. What gas has the greater density, neon or nitrogen? Under what conditions might this possibly not be true?
 - d. Sketch the molecular speed distribution curves for a gas at 25°C and, on the same graph, at 200 °C.

Label the axes.

- 5) a. Which of the following substances has the lowest boiling point, which one the highest? Explain. CH₃CH₃, O₂, CH₃OH
 - b. Which of the following substances is the most soluble, which one the least soluble in octane, C₈H₁₆? Explain. CH₃OH, CH₃(CH₂)₅OH or H₂O
 - c. Which substance has the higher melting point, KF or CaO? Explain.
- 6) a. Sketch the structures of diamond and graphite (two forms of solid carbon).
 - Sketch all possible hydrogen bonds in a mixture of dimethylamine (H₃C-O-CH₃) and dimethylamine (H₃C-NH-CH₃). Include bonds between identical and different molecules.
- 7) In the emission spectrum of hydrogen, several different set of wavelengths ("series") can be identified. One such series is associated with the return of an electron from a higher level to shell n=3.
 - a. Determine the energy difference associated with the **shortest** wavelength in this series.
 - b. What is the wavelength (in nm) for the transition identified in a ?
 - c. In what region of the electromagnetic spectrum is this line located?
- 8) Sketch "point" probabilities and "radial" probabilities for
 - a.) a 2p electron b.) a 3s electron. Label the axes of your diagrams.
- 9) Sketch the orbitals ("boundary surfaces") for
 - a.) $3d_{z^2}$ b.) $3d_{yz}$ c.) $3d_{x^2-y^2}$

Include coordinate axes.

- 10) a. Write electron configurations (shorthand OK) for i.) vanadium, ii.) copper.
 - b. How many unpaired electrons are present in i.) Cr, ii.) Cr³⁺? Show work.
 - c. i.) What is the 2^{-} ion that has the electron configuration of [Kr]?
 - ii.) What is the 3+ ion that has the electron configuration of $[Ar]3d^6$?
 - d. Arrange the following species in order of ionic radius: Br⁻, F⁻, Mg²⁺, Na⁺
 - e. Arrange the following atoms in order of increasing electron affinity: F, Br, Na, Se

- 11) a. Write Lewis structures for the following anions: i.) NO_2^- , ii.) $NO_3^$
 - b. Estimate the N,O bond lengths for each anion,

	single bond	double bond	triple bond
N,N	146 pm	122 pm	110 pm
N,O	144 pm	120 pm	106 pm
0,0	148 pm	121 pm (O ₂)	

given the following average bond lengths values:

Explain your estimates.

12) For the following molecules/ions , a. NH_2^- , b. SO_3^{2-} , c.AlH₃, d. XeF_5^+ give

- i. Lewis structure
- ii. geometry of electron arrangement around the central atom (by sketch and words)
- iii. geometry of atom arrangement, by words
- iv. "hybridization" of central atom (not required for SO_3^{2-})
- 13) a. Write the conjugate bases for HClO and HClO₂
 - b. Which of the two is the stronger base? Explain
- 14) What does the carbon dioxide liquefaction experiment demonstrate?
- 15) Provide definitions/descriptions for the following terms (chemical context, of course):
 - a. degenerate b. α particle c. isoelectronic d. molecular solid e. discharge tube
 - f. diffusion g. elastic collision
- 16) Draw the two major MO energy diagrams encountered for row 2 elements.Also, indicate when they apply.
- 17) I checked the pressure in my car tire today and the gage read 32 (presumably, in psi).Estimate the absolute pressure in the tire, expressed in kPa (14.7 psi = 1 atm).
- 18) Consider ice floating down the N. Saskatchewan River. How could this state be represented on a phase diagram? Present qualitative argumentation.