

Name: _____
200 points
Dr. Jay H. Baltsberger

Final Test
Chemistry 121A
December 15, 1994

SHOW ALL CALCULATIONS & USE PROPER SIGNIFICANT FIGURES AND UNITS

Multiple Choice Questions: Circle the single best answer. No penalty for guessing.

- If we have a box with a gas of pressure P_0 in it and we double the volume, keeping temperature and number of molecules constant, the pressure will be? (3 points)
A) $P_0/4$ B) $P_0/2$ C) P_0 D) $2P_0$ E) $3P_0$
- Methane (CH_4) is which of the following molecular geometries. (3 points)
A) tetrahedral B) T-shaped C) trigonal planar D) octahedral E) seesaw
- What is the most probable oxidation number on bromine in BrF_3 ? (3 points)
A) -1 B) +1 C) 0 D) +3 E) +5
- Which of the following atoms has the highest 1st ionization energy? (3 points)
A) Ar B) H C) K D) Rb E) Ne
- Which of the following orbitals is of the lowest energy for a Li atom? (3 points)
A) $4s$ B) $4p_z$ C) $2p_x$ D) $3d_{xy}$ E) $6f_{z^3}$
- A solution made from 0.231 moles of $\text{Mg}(\text{NO}_3)_2$ dissolved in 250.0 ml of water will have what $[\text{NO}_3^-]$ concentration? (3 points)
A) 0.231 M B) 0.462 M C) 0.924 M D) 1.85 M E) 1.85×10^{-3} M
- What is the molecular weight of *p*-dinitrobenzene, $\text{C}_6\text{H}_4(\text{NO}_2)_2$? (3 points)
A) 122 amu B) 43 amu C) 168 amu D) 154 amu E) 244 amu
- Convert 22.1 degrees Celsius into degrees Kelvin. (3 points)
A) 312.9 K B) 295.3 K C) 251.1 K D) 22.1 K E) -251.1 K
- Which of the following atoms will have the maximum velocity in a gas at 500 K? (3 points)
A) O_2 B) Ar C) N_2 D) Kr E) I_2

Name: _____

Final Test

10. Draw the Lewis dot structure for HCN and indicate formal charges for each atom. (10 points)

11. Write the formula or name of the following ionic compounds and indicate the solubility. (2 points for each blank)

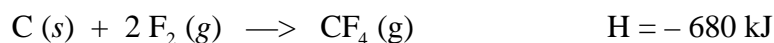
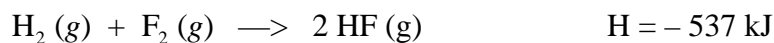
Mg(C₂H₃O₂)₂ _____

CaSO₄ _____

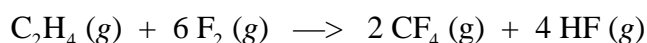
_____ Sodium nitrite _____

_____ Ammonium cyanide _____

12. Given the following data enthalpies of reaction:



Calculate the ΔH for the reaction of C₂H₄ with F₂. (10 points)



13. Calculate the number of moles of Ar (assume it is an ideal gas) present in a 351.1 cm³ box at a pressure of 532 torr and temperature of 89°C. (R = 0.082057 L atm mol⁻¹ K⁻¹, 1 atm = 760 torr) (10 points)

Name: _____

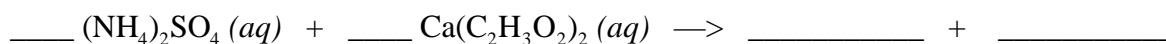
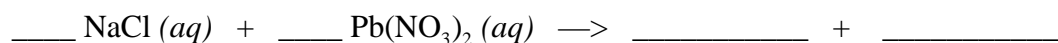
Final Test

14. Explain the trend (largest to smallest) for the second row atomic radii (Li, Be, B, C, N, O, F, Ne). Use electron configuration and effective charge arguments. (10 points)

15. Write the electron configuration for Ni, S and Cs⁺ using noble gas configuration abbreviations if you want. Indicate if any of these have unpaired electrons. (10 points)

16. Calculate the enthalpy of combustion (reaction with O₂ to make CO₂ and H₂O) for C₂H₄ (note this is a C=C with 2 hydrogen atoms per carbon), given the following bond dissociation energies: C–H 413; C=O 799; O–H 463; O=O 495; C=C 614 kJ/mol. (12 points, remember to right a balanced equation first.)

17. Balance the following two equations and write out a final net ionic equations. (12 points)



Name: _____

Final Test

18. Calculate the following number with correct significant figures. (6 points)

$$\frac{(4.11 + 3.171 + 32.1 - 41.123) \times 9.441}{10.11 - 5.881}$$

19. Suppose you mix 53.2 ml of water at 87.2°C with 33.7 ml of water at 12.1°C. Calculate the final temperature of the solution (assume no heat leaves the water during the mixing). (12 points)

20. Define an isotope. Write down two other isotopes of a ^{13}C atom. (8 points)

21. Determine the empirical formula for a compound made of 26.1% Co, 31.4% Cl and 42.5% O. Note these are mass percentages. (10 points)

Name: _____

Final Test

22. Calculate the wavelength of light emitted when an electron falls from the $n = 8$ to $n = 4$ level in atomic hydrogen. $E_n = -R_H/n^2$, $E = h\nu$, $\lambda\nu = c$, $h = 6.626 \times 10^{-34}$ J s, $c = 3.0 \times 10^8$ m/s, $R_H = 2.18 \times 10^{-18}$ J. (10 points)
23. Give the Lewis dot structure, electron pair and molecular geometry for the molecule Cl_2SO . (12 points)
24. Cyanogen, a highly toxic gas, is composed of 46.2% C and 53.8% N by mass. At 25°C and 750 torr, 1.05 g of cyanogen occupies 0.500L. Calculate the molecular formula of cyanogen. (Assume cyanogen is an ideal gas, $R = 0.082057$ L atm mol $^{-1}$ K $^{-1}$, 1 atm = 760 torr) (15 points)
25. Explain why in Li_2 , the energy separation between the $1s$ and $1s^*$ molecular orbitals is less than that between the $2s$ and $2s^*$ orbitals. Think about the size of 1s versus 2s atomic orbits and overlap. (10 points)