

Surname (last name): _____

Given name (first name): _____

Student number: _____

Lab Section: _____

Lab TA: _____

Chemistry 1311 C

Test 1

October 2006

Please keep your work covered and keep your eyes on your own paper! Cheating or any appearance of cheating will result in an F in the course and possible expulsion from the University.

There are 10 pages of questions in this exam. A periodic table and formula sheet are provided at the end. You may rip these two pages off of the exam and use them to cover your work during the exam.

Any scratch work should be on the back of the exam pages and should be handed in with your exam.

Please show all work to receive partial credit.

You have 80 minutes to complete the exam.

For each question, please write your final answer in the space provided.

Page	Maximum	Mark	TA initial
3	9		
4	9		
5	7		
6	7		
7	6		
8	10		
Total	48		

1. Gaseous iodine pentafluoride, IF_5 , can be prepared by the reaction of solid iodine and gaseous fluorine:

a) Balance the chemical reaction: (1 points)

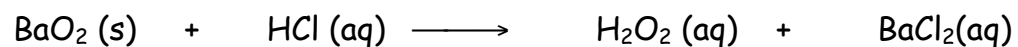


b) A 5.00 L flask containing 10.0 g I_2 is charged with 10.0 g F_2 , and the reaction proceeds until one of the reagents is completely consumed. After the reaction is complete, the temperature of the flask is 125 °C. What is the pressure of IF_5 in the flask? (6 points)

c) What is the mole fraction of IF_5 in the flask? (2 points)

2. Small quantities of hydrogen peroxide, H_2O_2 , can be prepared by the action of an acid on an alkaline earth metal peroxide, such as barium peroxide, BaO_2 .

a) Balance the chemical equation: (1 points)



b) What amount of H_2O_2 (in grams) should result when 1.5 g of barium peroxide is treated with 25 ml of HCl (0.0272 g/ml). What mass of which reagent is left. (8 points)

Mass of H_2O_2 _____

Which reagent is left? _____; Mass _____

3. An element consists of 1.4 % of an isotope with mass 203.9730 amu, 24.1% of an isotope with mass 205.9745, 22.10% of an isotope with mass 206.9759, 52.4 % of an isotope with mass 207.9766.
- a) Calculate the average atomic mass. (3 points)

Average atomic mass: _____

b) What is this element (1 point)? _____

c) A common ion of this element is M^{2+} (3 points).
How many protons does M^{2+} have? _____

How many neutrons does the most abundant isotope of
 M^{2+} have? _____

How many electrons does M^{2+} have? _____

4. The specific heat capacity of silver is $0.24 \text{ J C}^{-1} \text{ g}^{-1}$.
- a) Calculate the energy to raise the temperature of 150.0 g of silver from 0 to $25 \text{ }^{\circ}\text{C}$ (2 points).

Energy required: _____

- b) Calculate the energy required to raise the temperature of 1.0 moles of Ag by $1.0 \text{ }^{\circ}\text{C}$ (i.e. the molar heat capacity) (2 points).

Energy required: _____

- c) If it takes 1.25 kJ of energy to heat a sample of pure silver from 12.0 to $15.2 \text{ }^{\circ}\text{C}$. Calculate the number of moles and the mass in kilograms of silver in the sample (3 points).

Moles of silver in sample: _____

Mass of silver in sample : _____

5. Calculate the molarity, molality and weight percent of sulphuric acid, H_2SO_4 , solution having a mole fraction 0.53. The density of the solution is 1.7904 g/ml.

Molarity: (2 points) _____

Molality: (2 points) _____

Weight % H_2SO_4 : (2 points) _____

6. An organic compound was found to contain only C, H, and Cl. When a 1.499 g sample of the compound was completely combusted in air, 2.2 L of CO_2 (g) was collected over water at 25 °C and 700 mm Hg. In a separate experiment the chlorine in a 1.00 g sample of the compound was converted to 1.27 g of AgCl. Determine the empirical formula of the compound. (Vapour pressure of water at 25 °C is 23.76 torr). (10 points)

Empirical formula: _____

EQUATIONS SHEET

$$\Delta H^\circ_{\text{rxn}} = \sum n\Delta H^\circ_f (\text{products}) - \sum m\Delta H^\circ_f (\text{reactants})$$

$$\Delta G^\circ_{\text{rxn}} = \sum n\Delta G^\circ_f (\text{products}) - \sum m\Delta G^\circ_f (\text{reactants})$$

$$\Delta S^\circ_{\text{rxn}} = \sum nS^\circ (\text{products}) - \sum mS^\circ (\text{reactants})$$

$$PV = nRT$$

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

$$\Delta G^\circ = -RT\ln K$$

$$v_{\text{rms}} = (3RT/MM)^{1/2}$$

$$\Delta E = q + w$$

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

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

$$q = ms\Delta T$$

$$q = C\Delta T$$

$$w = -P\Delta V$$

$$[A] = -kt + [A]_0$$

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

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$1/[A] = kt + 1/[A]_0$$

$$\ln[A] = -kt + \ln[A]_0$$

$$P_A = X_A P_A^\circ$$

$$P_A = X_A P_{\text{Total}}$$

$$P_{\text{total}} = P_1 + P_2 + \dots$$

$$K_P = K_C(RT)^{\Delta n}$$

$$\text{Solubility} = k_H P_{\text{gas}}$$

$$KE = (3/2) RT$$

$$d = [P(\text{MM})/RT]$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pH} + \text{pOH} = 14$$

$$K_w = K_a \times K_b$$

$$\text{pH} = \text{pKa} + \log \frac{[\text{conjugate base}]}{[\text{acid}]}$$

$$E^\circ_{\text{cell}} = E^\circ_{\text{reduction}} + E^\circ_{\text{oxidation}}$$

$$\text{Charge (C)} = \text{current (A)} \times \text{time (s)}$$

$$E^\circ = (0.0257/n)\ln K$$

$$E = E^\circ - (0.0257/n)\ln Q$$

$$\Delta G = -nFE_{\text{cell}}$$

$$E = hc/\lambda$$

$$E = hv$$

$$c = \lambda\nu$$

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

Constants:

Factors :

Avogadro's Number (N_A)

6.02×10^{23}

Faraday's constant (F)

96,500 C/mol e^-

Universal Gas Constant (R)

8.314 J mol⁻¹ K⁻¹

8.314 kg m² mol⁻¹ K⁻¹ s⁻²

0.08206 L atm mol⁻¹ K⁻¹

Planck's constant (h)

6.626×10^{-34} J s

Rydberg Constant (R_H)

2.18×10^{-18} J

Speed of light(c)

3.00×10^8 m/s

Conversion

1 A = 1 C s⁻¹

1 C = 1 J V⁻¹ mol⁻¹

1 nm = 10⁻⁹ m

1 atm = 760 torr

= 760 mm Hg

= 101.3 kPa

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H 1 1.00794 Hydrogen	He 2 4.002602 Helium	Li 3 6.941 Lithium	Be 4 9.012182 Beryllium	Na 11 22.989768 Sodium	Mg 12 24.3050 Magnesium	Al 13 26.981539 Aluminum	Si 14 28.0855 Silicon	P 15 30.973762 Phosphorus	S 16 32.066 Sulfur	Cl 17 35.4527 Chlorine	Ar 18 39.948 Argon	K 19 39.0983 Potassium	Ca 20 40.078 Calcium	Sc 21 44.955910 Scandium	Ti 22 47.88 Titanium	V 23 50.9415 Vanadium	Cr 24 51.9961 Chromium	Mn 25 54.93805 Manganese	Fe 26 55.847 Iron	Cobalt 27 58.9332 Cobalt	Ni 28 58.6934 Nickel	Cu 29 63.546 Copper	Zn 30 65.39 Zinc	Ga 31 69.723 Gallium	Ge 32 72.61 Germanium	As 33 74.92159 Arsenic	Se 34 78.96 Selenium	Br 35 79.904 Bromine	Kr 36 83.80 Krypton	Rb 37 85.4678 Rubidium	Sr 38 87.62 Strontium	Y 39 88.90585 Yttrium	Zr 40 91.224 Zirconium	Nb 41 92.90638 Niobium	Mo 42 95.94 Molybdenum	Tc 43 98.9063 Technetium	Ru 44 101.57 Ruthenium	Rh 45 102.9055 Rhodium	Pd 46 106.42 Palladium	Ag 47 107.8682 Silver	Cd 48 112.411 Cadmium	In 49 114.82 Indium	Sn 50 118.71 Tin	Sb 51 121.757 Antimony	Te 52 127.60 Tellurium	I 53 126.90447 Iodine	Xe 54 131.29 Xenon	Cs 55 132.90543 Cesium	Ba 56 137.327 Barium	La 57 138.9055 Lanthanum	Hf 72 178.49 Hafnium	Ta 73 180.9479 Tantalum	W 74 183.85 Tungsten	Re 75 186.207 Rhenium	Os 76 190.2 Osmium	Ir 77 192.22 Iridium	Pt 78 195.08 Platinum	Au 79 196.96654 Gold	Hg 80 200.59 Mercury	Tl 81 204.3833 Thallium	Pb 82 207.2 Lead	Bi 83 208.98037 Bismuth	Po 84 209 Polonium	At 85 222.0176 Astatine	Rn 86 222 Radon	Fr 87 223.0197 Francium	Ra 88 226.0254 Radium	Ac 89 227.0278 Actinium	U 92 238.02891 Uranium	Np 93 237.04817 Neptunium	Pu 94 244.0642 Plutonium	Am 95 243.0614 Americium	Cm 96 247 Curium	Bk 97 247.0703 Berkelium	Cf 98 251.0796 Californium	Es 99 252.083 Einsteinium	Fm 100 257.10 Fermium	Md 101 288 Mendelevium	No 102 289 Nobelium	Lr 103 260.1053 Lawrencium	Uuo 118 293 Ununoctium

Under normal conditions, bold symbols correspond to solid state, bold italic correspond to liquid state, italic correspond to gaseous state and normal correspond to synthetic elements.