CHEMISTRY 115 **Final Exam**
Spring 1999 **June 9, 1999**

Name: _____ Student Number: _____

SHOW YOUR WORK IN THE SPACE PROVIDED

GOOD LUCK !!

(Total exam = 200 points

Score page 1 _____
page 2 _____
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I. SHORT ANSWER: (4 points each)

1. (a) Write in scientific notation: 4403 = _____

   (b) Significant figures: 2.05 + 5.752 + 5 = _____

2. Chemical properties vary (slowly, rapidly) down a column of the periodic table, but vary (slowly, rapidly) across a row. (Choose correct wording)

3. Give the electronic configuration ($1s^2 2s^2$…etc) for Ca^{2+}

4. Are the following reactions redox or acid/base?

   (a) $H_2CO_3 + CO_3^{-2}$_____ $2HCO_3^-$

   (b) $Fe_20_3 + 2\ Al$ _____ $Al_20_3 + 2\ Fe$

   (c) Photosynthesis

   (d) Fuel cells

5. (T/F) "In contrast to chemical reactions, the rates of nuclear reactions do not depend on temperature or pressure.

6 Give the correct formula for the following ions:

(a) ammonium (b) nitrite (c) sulfate (d) hydroxide

7. Write a balanced chemical reaction for the combustion of octane C_8H_{18} in excess oxygen (O_2) to give H_2O and CO_2. Indicate the species undergoing oxidation, the species undergoing reduction.

8. Which of these molecules can form a hydrogen-bonded dimer with itself? Draw these H-bonded pairs of molecules.

CH_3CH_2OH CH_30CH_3

9. Complete the following nuclear reactions:

10. (T/F) Nuclear reactions conserve charge but not mass; chemical reactions conserve charge and mass.

11. Rank the ionizing radiation types in order of **decreasing** penetrating power (alpha, beta, gamma):

12. Name two natural sources of your exposure to ionizing radiation, and two man-made sources.

13. If the health limit for some toxic compound X in blood is 8 parts-per-billion by weight, express this limit in micrograms of X per kilogram of blood.

14. Name one strong acid, one weak acid, one strong base, and one weak base.

15. Name two advantages of the coming fuel-cell vehicles over the gasoline-powered cars we drive today.

16. How does a catalyst accelerate the rate of a chemical reaction?

17. Aspirin (structure below) is an ester formed by the condensation polymerization of an acid and an alcohol. Draw the structures of these two reactants.

18. The monomer vinyl chloride ($H_2C=CHCl$) undergoes addition polymerization to make what useful plastic? Draw the repeating unit of this polymer.

19. What is the oxidation of number of the element chlorine (Cl) in common household bleach (NaOCl)?

20. A piece of nucleic acid has the sequence of bases GGCAT. What is the corresponding sequence on the complementary strand? Is this DNA or RNA? What type of bonding(ionic, covalent, hydrogen) holds the base pairs in place across the double helix?

21. The polyamide bonding in proteins (polypeptides) is also found in which of the following synthetic polymer: (cellophane, nylon, teflon, rubber)?

22. Name the three steps in addition polymerization by free-radical chain reaction.

23. Vulcanization involves cross-linking bonds between polymer strands using what chemical element?

24. Which of the following molecules can exist in (d,l) mirror image forms?

25. State whether each of the following carcinogens is an element, compound, or a mixture:

(a) Radon (b) cigarette smoke (c) dioxin (d) $As_2 0_3$

II. QUANTITATIVE: (15 pts each) Show your work in the space provided.

1. The bones of a young Neanderthal girl were recently found in Spain.
The ^{14}C radioactivity of these bones was only 3% of the radioactivity of modern bones. How long ago did this young girl die? The half-life of ^{14}C is about 6000 years. After n half-lives, the fraction of radioactivity remaining is $(1/2)^n$

2. The average driver in the US drives about 20,000 miles each year, and the average fuel efficiency of US vehicles is about 20 miles per gallon of gasoline. Each gallon of gasoline contains about 2

kg of carbon. What is the emission of carbon each year for this average driver (in metric tons C/yr,
one metric ton= 10^6 grams). If the average per person emission of carbon from all sources is about 5 tons/yr, what fraction of the total comes from driving?

3. The energy in a photon of light is inversely proportional to the wavelength. If a photon of infrared radiation (lambda = 1.0 microns) has 1.0 eV of energy, what is the energy (in eV) of a photon of green light (lambda = 0.5 microns) ?

4. Living systems on earth use 20 amino acids to make a enormous variety of polypeptide polymers (proteins). How many different tripeptides are possible? Recall that for a peptide of n monomers, possibilities = $(20)^n$

III. SHORT ESSAY (20 points) In the space provided below, write a brief paragraph on **either** global warming or stratospheric ozone depletion. Summarize the basic science (chemistry!) behind this global environmental problem, the model predictions of future damage, and the current status of any international efforts to address the problem.

IV. CHEMICAL NEWS/VIEWS: (4 points each)

1. The current health scare in Belgium concerns what chlorinated organic compound? Is this chemical known to cause cancer in humans?

2. Relative to 30 years ago, a study of bottom sediments show that the waters of Puget Sound today are:
   (a) slightly more contaminated with metals and pesticides.
   (b) about the same.
   (c) less contaminated.
   (d) getting worse very rapidly.

3. Senator Gorton is involved in an effort to open a new mine in Eastern Washington, and circumvent existing federal law on environmental impacts. What would be mined there, and what is one likely environmental impact?

4. The Centralia power plant recently sold to a Canadian firm. What is the source of the power Centralia produces and what are two environmental impacts of operating that plant.?

5. Name two reasons why Mexico city has some of the worse air quality in the world.

6. The discoverer of plutonium (and many other transuranic elements) recently died. His name?

7. We watched a video on the impact of climate change on what region of the US?

8. A recent symposium at the UW/ HUB on climate change was sponsored by what business sector?

9. A garbage dump in Eastern Washington is starting to produce electrical power. How?