Student Name_____

Student Number _____

Chemistry 881   September 14, 2001
Exam 1

1.   (10 points) A certain population is growing exponentially, so that it doubles in size each 30 years.

   a. If the population has a size of 4.00 x 10^6 individuals at t=0 write the formula giving the population after a number of years equal to t.

   b. Find the population at t=150 years.

2.   (6 points) Consider the following vectors: $\vec{A} = 2.5\hat{i} + 4\hat{j}$ & $\vec{B} = 3\hat{i} - 5\hat{j}$

a. Find $\vec{A} \bullet \vec{B}$

b. Find $\left|\vec{A}\right|$ and $\left|\vec{B}\right|$ and use them to find the angle between $\vec{A}$ and $\vec{B}$

3. (10 points) Consider the vectors $\vec{A} = (1, 2, 3)$ and $\vec{B} = (1, 1, 1)$

a. Find the cross product $\vec{A} x \vec{B}$

b. Show that this cross product is perpendicular to $\vec{A}$ and $\vec{B}$

4.   (14 points) Express the following complex numbers in the form $re^{i\theta}$:

       a. 4 + 4i
       b. -1
       c. 1
       d. 1-i

       Express the following complex numbers in the form x + iy:

       a. $e^{i\pi}$
       b. $3e^{i\pi/2}$
       c. $e^{i3\pi/2}$

5.   (6 points) Find the 3 cube roots of 3 - 2i

6. (24 points) Find the following derivatives. All letters stand for constants except for the dependent and independent variables indicated.

a. $\dfrac{dy}{dx}$, where $y = (ax^2 + bx + c)^{-3/2}$

b. $\dfrac{d \ln(P)}{dT}$, where $P = ke^{-Q/T}$

c. $\dfrac{dy}{dx}$, where $y = a\cos(bx^3)$

d. $\dfrac{d(yz)}{dx}$, where $y = ax^2$, $z = \sin(bx)$

e. $\dfrac{dP}{dV}$, where $P = nRT/(V - nb) - an^2/V^2$

f. $\dfrac{d\eta}{d\lambda}$, where $\eta = 2\pi hc^2 / \lambda^5 (e^{hc/\lambda kt} - 1)$

7. (10 points) Find the indefinite integral

$$\int x \sin(x)dx$$

without using a table.

8.   (10 points) The power output of a laser is measured in units of watts(W), where one watt is equal to one joule/sec. (1 W = 1 Js^{-1}). What is the number of photons emitted per second by a 1.00 mW nitrogen laser? The wavelength emitted by a nitrogen laser is 337 nm.

9.	(10 points) Given that the work function of chromium is 4.40 eV, calculate the kinetic energy of electrons emitted from a chromium surface that is irradiated with ultraviolet radiation of wavelength 200 nm.