PHYSICS 208 **FINAL EXAM** **May 11, 2003**

NAME: _____

SECTION #: _____

TA: _____

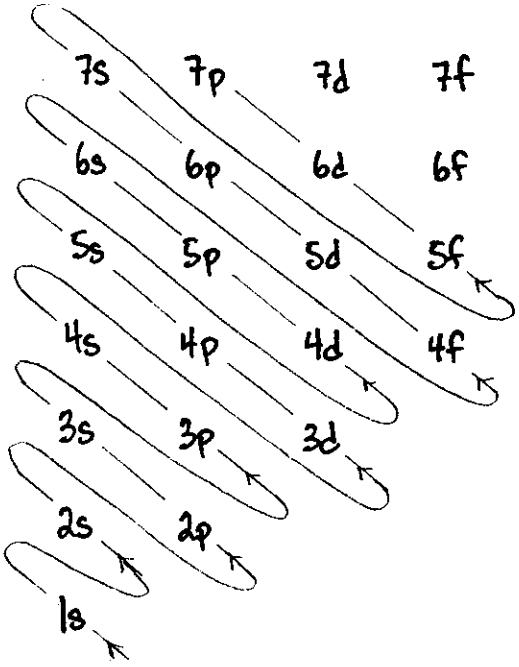
Problem	Points	Score
1	20	
2	15	
3	15	
4	15	
5	20	
6	15	
7	20	
8	15	
9	15	
Total	100	

- Write your final answer in the box provided.
- All answers should include units.
- To get credit for a problem you need to show your work in the space provided. If no work is shown you will get no credit, even if the answer in the box is correct. You are expected to work all problems using the basic laws of physics and the equations provided on the formula sheet. If you happen to remember the answer to a particular problem or know a shortcut formula you must still work the problem to get full credit.
- If you need more space, use the back of one of the sheets, and make a note that the work is continued on the back.
- Turn your exam in to your TA when you are finished.

1) (a) List the possible values of n, ℓ, and m for an electron in the 4p state.

(b) What are the possible values of the angular momentum, L, for an electron with $n = 3$.

(c) Except for helium, the inert gasses are elements with just enough electrons to fill the outermost p-shell. Assuming that the filling order is given by the drawing at the right, find element number (Z) of the first 5 inert gas elements beyond helium.



Answer: _____

2) An electron is confined in a one-dimensional square well potential 0.5 nm wide. Find the wavelength of the photon that is emitted if the electron jumps from the first excited state to the ground state. The electron's mass is 9.11×10^{-31} kg which corresponds to $mc^2 = 5.11 \times 10^5$ eV.

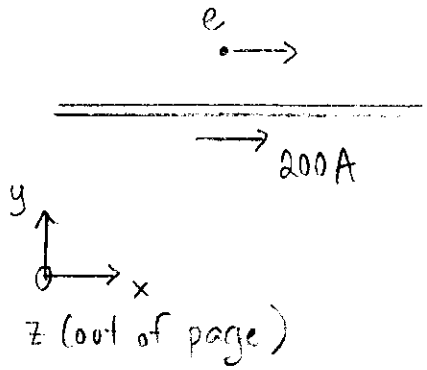
3) Suppose your eyes are able to focus objects that are between 20 cm and 50 cm. You would like contact lenses that permit you to clearly see things that are very far away.

(a) What focal length should the lenses have?

(b) If you wear your lenses while reading, how far away do you need to hold the book in order to see the words clearly.

4) π-mesons normally decay into a muon and a neutrino. When the π is at rest, the muon is always emitted with a velocity of 0.28 c. Find the velocity of the muon emitted in the decay of a moving π; assume that the π's velocity is 0.8 c and that the muon is emitted along the direction of motion.

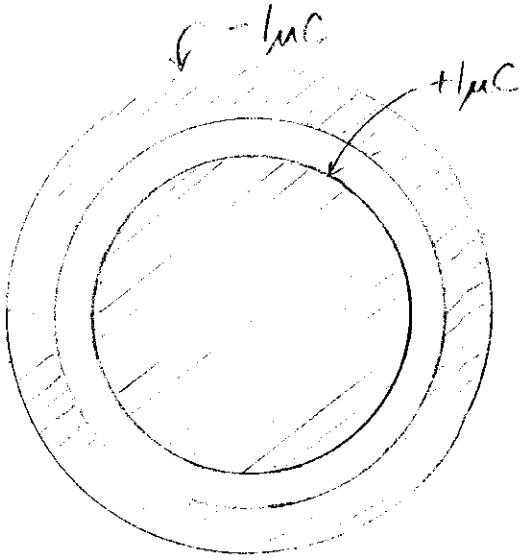
5) An electron is 5 cm from an infinitely long wire carrying a current of 200 A. Find the magnitude and direction of the force acting on the electron if it's kinetic energy is 3×10^5 eV. The electron mass is given in Problem 2.



Magnitude: _____

Direction: _____

6) A conducting sphere of radius 20 cm carries a net charge of $1\,\mu\mathrm{C}$. Around the sphere is a conducting spherical shell with inner radius of 22 cm and outer radius 25 cm. The shell carries a net charge of $-1\,\mu\mathrm{C}$.



(a) Find the electric field at the surface of the sphere.

(b) Approximately what is the voltage difference between the two conductors?

7) For any state with $\ell = 0$ the Schrodinger equation for hydrogen can be written in the form

$$-\frac{\hbar^2}{2m}\frac{d^2}{dr^2}[r\psi(r)] + U(r)[r\psi(r)] = E[r\psi(r)].$$

where

$$U(r) = -\frac{e^2}{4\pi\epsilon_0}\frac{1}{r}$$

Show that $\psi = Ce^{-\lambda r}$ solves the equation for the right value of λ. Find the correct λ and the energy of the corresponding state. Your results should be given as formulas. Work must be shown to get credit.

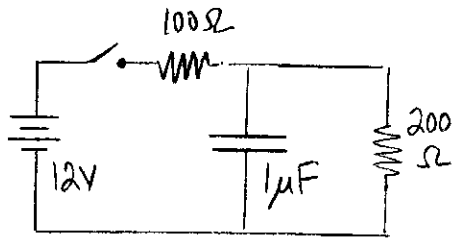
λ:

E:

8) (a) The isotope ^{15}O has a halflife of 120 s, and an atomic mass of 15 u. Find the activity of a 1 μg sample of ^{15}O.

(b) Find the activity of the sample after 5 minutes.

9) In the circuit shown at the right, the switch is initially open and the capacitor is uncharged.



(a) Find the current in the 100 Ω resistor the instant after the switch is closed.

(b) Find the current in the 100 Ω resistor after the switch has been closed for a long time.