Tutorial Sheet 1 **DSC: Nuclear and Particle Physics** 1

Problem 1. Find the nuclear density of ^{235}U, if r_0 = 1.2 fm.

Problem 2. The radii of oxygen & lead are found to be 3 fm & 7 fm respectively. Their masses are 2.7×10^{-26}kg & 3.4×10^{-25} kg respectively. Calculate their density.

Problem 3. In a scattering experiment it was found that ^{12}C has a nuclear radius of 2.7 fm. The experiment is then repeated with another, unknown element and it is found the nuclear radius is twice as big. What is the mass number of this unknown element?

Problem 4. (a) Calculate the radius of ^{58}Ni one of the most tightly bound stable nuclei. **(b)** What is the ratio of the radius of $_{58}Ni$ to that of $_{258}Ha$, one of the largest nuclei ever made? (*Note that the radius of the largest nucleus is still much smaller than the size of an atom)*

Problem 5. What is the percentage error in neglecting the electronic binding energy in the hydrogen atom ^{1}H 113.6 eV) in the calculation of the nuclear mass of the atom from its atomic mass and the mass of the electron which are 1.007825 u and 5.48580 x 10 u respectively? What is the value of the proton mass.

Problem 6. Calculate the atomic mass of ^{16}O atom in ^{12}C scale. Also calculate the mean atomic weight of oxygen consisting of the three isotopes ^{16}O (99.76%), ^{17}O (0.04%) and ^{18}O (0.2%).

Problem 7. Calculate the limiting angles of scattering above which deviations may be expected may be expected from the Rutherford formula for the scattering cross sections for 10 MeV α-particles for the nuclei Ne, Na, and Mg. Assume R=$r_0 A^{1/3}$with r_0= 1.4 x 10 m.