PHY 1091/2081-2025 Tutorial -Atomic Physics Section- Please complete the tutorial before attending the session, and bring along any doubts for discussion.

1. Find the radius and speed of the electron in the first Bohr orbit of the hydrogen atom. How will the radius and speed of electron change with the increase in atomic number of the atom. Ex.6.15-page 228)
2. Calculate the difference in wavelength in the spectra of hydrogen and heavy hydrogen corresponding to the first line on the long wave side of Balmer Series. (Ex 6.17-page 230)
3. An X-ray line of wavelength 0.53832 Angstroms found to be emitted from an x-ray tube with Zinc (Z=30) target in addition to the characteristic Kα line of Zinc of wavelength 1.43603 Angstroms. If the unknown line is due to an impurity in the target, obtain the atomic number of impurity. (Ex.6.24-page 235)
4. Write all the quantum numbers of electrons in atom with 10 electrons.
5. A ruby laser uses photons emitted by Cr^{+3} ions that are embedded in a crystal of Al_2O_3. The light emitted by a ruby laser has a wavelength of 694 nm.

i. What is the frequency of the emitted light from the ruby laser?
ii. What is the spacing between the energy levels in Cr^{+3} that are responsible for these photons?
iii. If the power output of the ruby laser is 10 W, how many photons are emitted per second?

6. A beam of electrons is used to bombard gaseous hydrogen.

    i. What is the minimum energy in electron-volts the electrons must have if the first number of the Balmer series corresponding to a transition from $n_2 = 3$ state to $n_1 = 2$ state is to be emitted? (Ex.6.11-page 226)
    ii. The wavelength of the second line of the Balmer series in the hydrogen spectrum is 4861 Angstroms. What is the wavelength of the first line? (Ex. 6.13-page 227)

7. The measured values of the total kinetic energy of the fission fragments from the thermal neutron fission of U_{235}^{92} is 196 MeV. If the respective values of Z and A of the fission fragments as (35,72) and (57, 162), calculate the distance r between fragments at the instant of separation. Compare this value with the sum of the radio of the two fragments. Nuclear radius R = $r_0 A^{1/3}$ where $\times 10^{-15}$m. (x.6.29-page 238)
8. Calculate the energy and wavelength of the photon emitted from a tungsten target Z = 74 when electron jumps from n = 3 state to n = 1 state due to a vacancy in n = 1 state. Given energy of electron in n =1 state of hydrogen atom = -13.6 eV. (Ex.6.30-page 239)
9. Of the following configurations, which ones are not allowed for the outermost shell of an atom by quantum theory? (a) $4S^4$ (b)$3d^7$ (c)$4f^9$ (d) $2d^3$
10. What experiment would you do to determine if there is Oxygen in a distant star?