Homework Assignment Project #1

For this assignment... Apply standard atmospheric empirical models to specify and plot typical ambient atmospheric conditions, from ground to 200 km altitude, for the date, time, and location of your birth. Your report will include your Fortran "driver" code (to call HWM/MSIS), your Matlab (or Octave) plotting code, and the output figures with text discussion.

1) Acquire NRLMSISE-00 FORTRAN code online.
(http://nssdcftp.gsfc.nasa.gov/models/atmospheric/msis/nrlmsise00/)
Similarly, acquire HWM-14 FORTRAN code online (and maybe read the paper, too).
(https://ccmc.gsfc.nasa.gov/pub/modelweb/atmospheric/msis/nrlmsise00/)

2) With help from the test drivers and sample codes, create a Fortran (or, if adventurous, Matlab) code that calls these two models to generate vertical profiles of parameters as they vary with altitude at Δz=1km intervals, using the following 10 column format:

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Height [O] [N2] [O2] Density Temperature [H] [N] Wind_Meridional Wind_Zonal
```

For example, you may choose to output these to a file directly via your Fortran code, or to simply "print" them so that you can redirect the output to a file, i.e., "`profiles > outfile`". In the end, you should have a 201 row, 10 column text array.
Additional ($F_{10.7}$ and Ap) parameters are needed to generate these model data – Please use either "typical" values or values obtained from historic measured data (if available).

3) Utilize MATLAB to load the output data file contents into an array. Calculate and plot the following parameters as they vary with altitude, with the z-axis oriented vertically:

- **a.** On one plot, show [O], [O_2], [N_2] on a semilog scale in m^{-3}.
- **b.** Specific gas constant R ($R=R^*/M \approx 287$ [J/kg•K] for "dry air", valid to ~mesopause).
- **c.** Specific heats c_p and c_v, and their ratio γ.
- **d.** Temperature in Kelvin.
- **e.** Mass density (on semilog scale) in kg•m^{-3}.
- **f.** Pressure (on semilog scale) in Pa, derived from density, temperature, and R.
- **g.** Potential temperature (on semilog scale), derived from temperature, pressure, and γ.
- **h.** Gravitational acceleration g theoretically-calculated under Newtonian assumptions, and (superposed on the same plot) gravitational acceleration derived from MSISE model data under the assumption of hydrostatic equilibrium.
- **i.** Meridional and Zonal wind profiles overlaid on a single plot and labeled.

For each plot of a quantity not obtained directly from the model, please include in your report some brief discussion of how it was obtained.