PY4A03 Planetary and Space Science
Problem Set 1 (10% of module marks)

Note: Use IDL/Python/etc. for all parts.
Submit short report including code to peter.gallagher@tcd.ie by 17:00 on Friday, December 12.

1. The masses of the planets in the Solar System and factors to adjust from planetary to solar compositions (*F)* are given in the table below.

Planet	**Mass (x10^26 g)**	***F***	**Distance (AU)**
Mercury	3.3	350	0.387
Venus	48.7	270	0.723
Earth	59.8	235	1
Mars	6.4	235	1.524
Asteroids	0.1	200	2.7
Jupiter	19,040	5	5.203
Saturn	5,695	8	9.523
Uranus	870	15	19.208
Neptune	1,032	20	30.087

i) Calculate the mass of solar composition material required to form each of the planets. Plot your results using IDL or Python.

ii) Calculate the surface density in g/cm^2 of solar nebula material for each of the planets. Plot your results using IDL or Python.

iii) Fit the surface density with a function of the form, $\sigma(r) = \sigma_0 r^{-\alpha}$. What best-fit values do you obtain for σ_0 and α?

iv) The mass of solar nebula material required to form the planets can be estimated using

$$M = \int \sigma(r) dA = \int_0^{2\pi} \int_{R_S}^{R_F} \sigma(r) r dr d\theta$$

Evaluate this integral numerically over an appropriate distance range, using the best-fit surface density values from (iii).