PHD QUALIFY EXAMINATION — GALACTIC AND EXTRAGALACTIC ASTROPHYSICS

March, 2000

A sheet of physical and astronomical constants will be given. You are allowed to use a calculator, though for most questions no real numerical evaluation is necessary. If you need to make any assumptions, state them explicitly.

(1) (30 points)
Explain the following terms as elaboratively as possible: (3 points each)
(a) the Roche limit;
(b) the Oort limit;
(c) Parker instability;
(d) Start effect;
(e) Faraday rotation;
(f) dispersion measure;
(g) emission measure;
(h) rotation measure;
(i) cosmological redshift;
(j) gravitational redshift.

(2) (10 points)
Calculate the equilibrium temperature (T_d) of a peck of interstellar dust of size a, mass m, at a distance d from a star of surface temperature T_*.

(3) (10 points)
What is the age of a flat universe if the current Hubble constant is H_0?

(4) (10 points)
If the redshift of a galaxy is z, what is the *luminosity distance* of the galaxy in a flat universe?

(5) (20 points)
(a) (10 points) Derive the Eddington luminosity.
(b) (10 points) What are the maximum luminosities of a one-solar-mass black hole and of a 10^8-solar-mass black hole via accretion?

(6) (20 points)
Show that the observed number of galaxies with apparent magnitude m is proportional to $10^{0.6m}$ in a static, uniform Euclidean Universe.