Name: Matr. Nr.: Stud.Kzl.:

Bitte die Heftung nicht öffnen ! Bitte um kurze prägnante Antworten und achten Sie bitte etwas auf Schriftbild und Form ! Please do not open the stitching ! Please, short concise answers and pay attention a little bit on script and form !

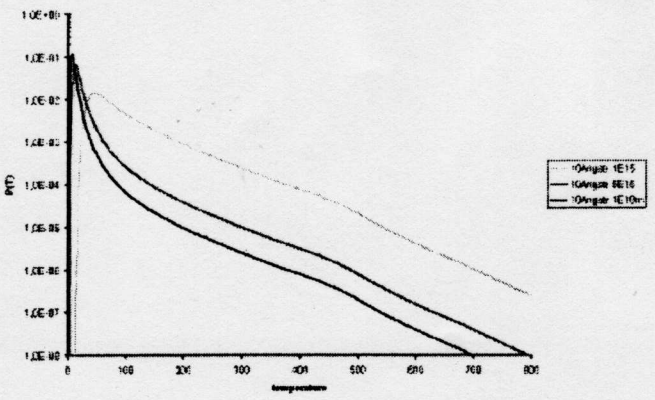
1. Thereby you find the base function of the stellar statistics
   a) describe the terms and
   b) give short descriptions of 3 different ways of solution (restrictions and how/why they work)

$$N(m) = \iiint \Phi(M,\vec{x})\ \rho(M,\vec{x}) \mathrm{d}^3x \qquad M(m) = m - 5\log(|\vec{x}|) - 5 - A$$

$$A = \int_0^{|x|} \tau(l) dl$$

2. Describe the terms of the calculation for the equilibrium temperature of a dust grain. Why is the integral still required if the stellar radiation function L → to the planck function B ? Why do small grains do not follow this equilibrium (resp. what is given at the graph) ?

$$\int_0^\infty 4\pi a^2 Q_{abs}(a,\nu)\, B_\nu(T_d)\, \mathrm{d}\nu \quad = \quad \int_0^\infty \frac{L_\nu}{4\pi r^2} \pi a^2 Q_{abs}(a,\nu)\, \mathrm{d}\nu$$



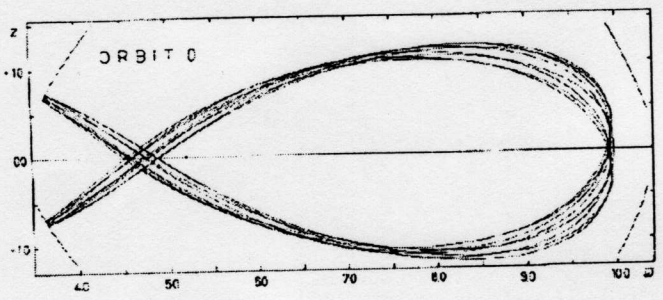
T* = 150 000 K

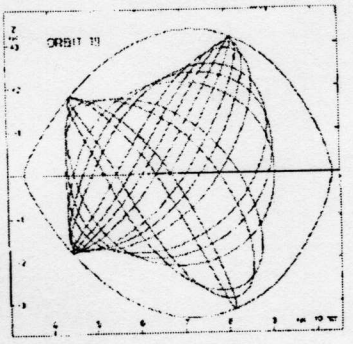
L* = 10 000 L_0

3. How is this function called and what does it describe

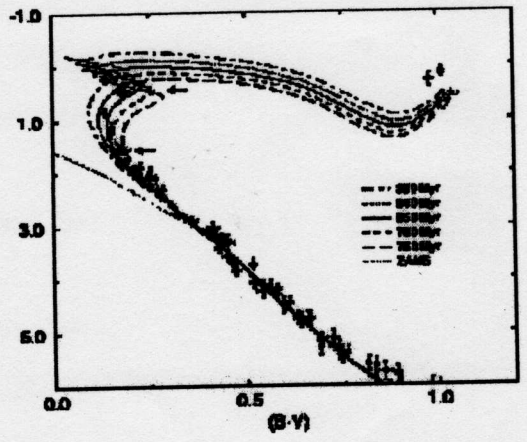
$$0 = \frac{\partial f}{\partial t} + u\frac{\partial f}{\partial x} + v\frac{\partial f}{\partial y} + w\frac{\partial f}{\partial z} - \frac{\partial \psi}{\partial x}\frac{\partial f}{\partial u} - \frac{\partial \psi}{\partial y}\frac{\partial f}{\partial v} - \frac{\partial \psi}{\partial z}\frac{\partial f}{\partial w}$$

4. What is the difference of a Boxed and a tube orbit ?

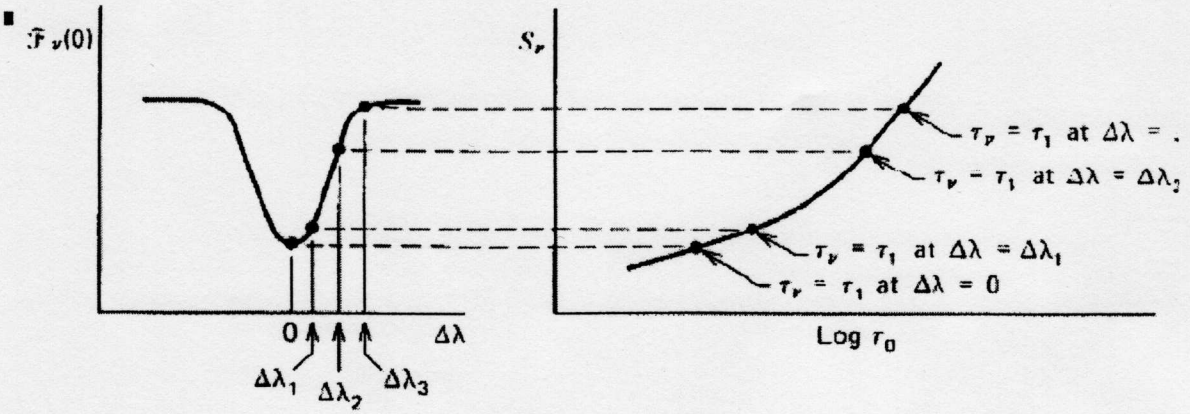




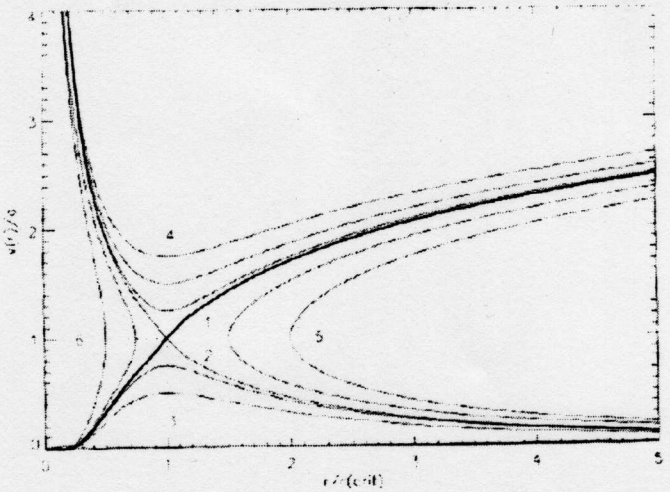
5. HR diagram: Which line marks the youngest and which one the oldest cluster and mark what we call the "turnoff". Shortly describe what we can derive (and from which part) with these curves.



6. What do we see in a line (along the profile)



7. Why does a static stellar wind (here the isothermal case) has only a single solution for the mass-loss



$$v\frac{dv}{dr}+\frac{1}{\rho(r)}\frac{dp}{dr}+\frac{GM_*}{r^2}=0$$

8. Draw a diagram of the cosmic ray spectrum. Indicate where "knee" and "ankle" are!

9. What type of cosmic objects emit gamma rays? List at least 3 types!

10. Which properties are common to quarks and leptons ?
In which properties do they differ ?

11. Consider e+ e- annihilation into quark anti-quark pairs at high energies. Draw the leading order Feynman diagram(s) for this electro-magnetic process. Is the virtual photon spacelike or timelike ? How does the total cross section depend on the energy and on the quark charge ? Compute the ratio of (charm anti-charm) to (strange anti-strange) production.

12. Which are the gauge groups, the corresponding coupling constants and the physical vector bosons of electro-weak interaction ? Which are the basic (fermionic) particle states (of the first lepton family only) ? Which of the vector bosons carry large masses ? Give order-of-magnitude values. Write down the relation between the Fermi constant (G_F) and the weak boson mass (numerical factors need not be correct).

13. Consider the Pi-meson and the Rho-meson, both negatively charged. What are their spins ? Which of the two is heavier ? What is their quark composition ? How can their mass difference be explained within the constituent quark model ?

14. Which is the gauge group of QCD, describing strong interactions ? From which measurable quantity at high energies can the number of quark colors (N_C) be determined ? Give the value of N_C. Which type of events in e+e- annihilation have shown (in 1979) the existence of gluons ? Which parameter of the theory can be determined with them ? Give an approximate value. Draw a Feynman diagram.