Astronomy 45 Midterm Review problems - Fall '01

(October 13, 2001)

1- At greatest brilliancy, Venus has an apparent visual magnitude, $m_V = -4$. The dimmest star visible to the naked eye has a magnitude of +6. How much brighter is Venus?

2- A star has a proper motion of 2.5 parsec per year, a parallex of $0.32''$ and a radial velocity of 60 Km/s away from us. Calculate the angle between the direction of the star velocity and the line of sight from Earth.

3-Assume that the solar interior is all at a temperature of $T = 10^7 {}^\circ K$, and that a typical photon has energy kT. Are there more photons, or more particles, in the sun? Take the solar particle density to be 1.4 grams/cm^3 and assume that the particles have masses equal to the proton mass.

4-If you eyes are capable of seeing a star that delivers 10^3 photons in the V-band ($\lambda = 550$nm) per second to your pupils (8 mm diameter), what is the faintest visual magnitude m_V?

5-Consider a giant star with a radius of 1AU and a temperature of 3000 $^\circ K$. How much more energy does this star emit than an ordinary star at the same temperature but with a radius of 150,000 km?

6-At room temperature, T=300 K, oxygen molecules have an average kinetic energy of $\frac{3}{2}kT$, where $k = 1.38 \times 10^{-16}$ erg/K is the Boltzman constant. Calculate the velocity of oxygen molecules. Now calculate the velocity for escape from Earth. Is this velocity dependent on mass?

7-When the universe was smaller by a factor of Λ in linear dimension, the same photons were in a volume of Λ^3 smaller and temperature was hotter by a factor of λ. Calculate the radiation density now and when $\Lambda = 1000$.

8-A meteorite approaches the Earth from a great distance with a velocity $v_\infty = v_c/4$, where v_c is the same velocity the meteorite would have if it were in circular motion at a distance $R = R_\oplus$ about the Earth. If the falling meteorite were to just miss the Earth, what should its

initial straight line trajectory be, i. e. how far away from the Earth should it be? Calculate the eccentricity of the meteorite orbit.