Astronomy 2110 Homework #6

Spring 2024 Due Thursday, March 21

For full credit you must write your solutions neatly and include all work. Do not forget the units.

1) What is meant by a substance's condensation temperature? What role did condensation temperatures play in the formation of the planets?

2) Why did the terrestrial planets form close to the Sun while the Jovian planets formed far from the Sun?

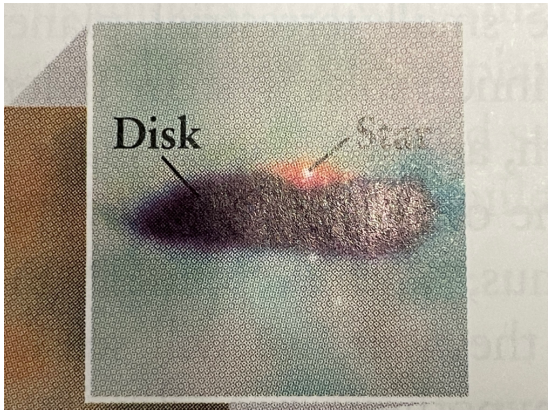
3) Explain how our current understanding of the formation of the solar system can account for the following characteristics: (a) All planetary orbits lie in nearly the same plane; (b) All planetary orbits are nearly circular; (c) The planets orbit the Sun in the same direction in which the Sun itself rotates.

4) What is the radial velocity method for detecting planets orbiting other stars? Why is it difficult to use this method to detect planets like Earth?

5) If you start with 0.8 kg of radioactive potassium (^{40}K), how much will remain after 1.3 billion years? After 2.6 billion years? After 3.9 billion years? How long would you have to wait until there was no ^{40}K remaining?

6) Three-quarters of the radioactive potassium (^{40}K) originally contained in a volcanic rock has decayed into Argon (^{40}Ar). How long ago did this rock form?

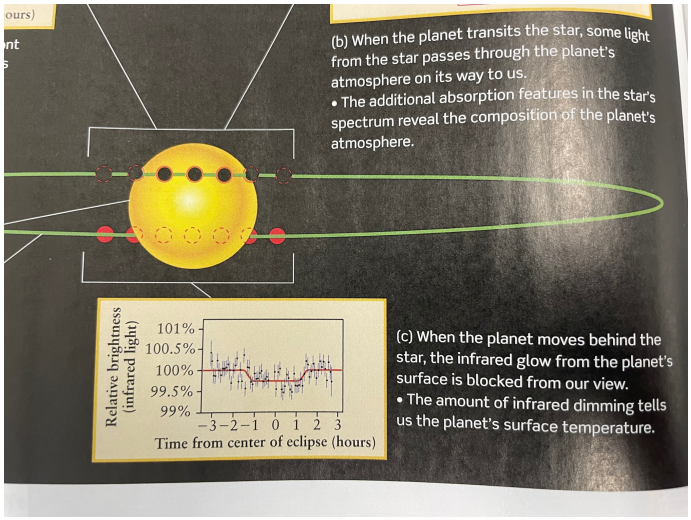
7) The protoplanetary disk shown in the upper right inset of figure 8-8b of the center of the Orion nebula is seen edge-on (see below). The diameter of the disk is 700 AU. (a) Make measurements on this image to determine the thickness of the disk in AU. (b) Explain why the disk will continue to flatten as time goes by.



8) The planet discovered orbiting the star 70 Virginis ("70Vir" in Figure 8-17) 59 light-years from Earth, moves in an orbit with semimajor axis 0.48 AU, and eccentricity 0.4. The period of the orbit is

116.7 days. Find the mass of 70Vir and compare your answer to the mass of the Sun (hint: the planet has far less mass than the star.).

9) (a) Figure 8-20c (below) shows how astronomers determine that the planet of HD 209458 has a surface temperature of 1130 K. Treating the planet as a blackbody, calculate the wavelength at which it emits most strongly. (b) The star HD 209458 itself has a surface temperature of 6030 K. Calculate its wavelength of maximum emission , assuming it to be a blackbody. (c) If a high-resolution telescope were to be used in attempt to record an image of the planet orbiting HD 209458, would it be better for the telescope to observe in the visible or infrared light? Explain your reasoning.



10) The deepest wells and mines on Earth go down only a few kilometers. What, then, is the evidence that iron is abundant in the Earth's core? How do we know that Earth's outer core is molten but the inner core is solid?