

Homework 5

Due **October 8 by 11:59pm via Canvas upload**

Please show all work, writing solutions/explanations clearly, or no credit will be given. You are encouraged to work together, but everyone must turn in independent solutions; do not copy from others or from any other sources.

1. Some people ascribe our seasonal temperature variations to Earth being at different distances from the Sun throughout its orbit, which has an eccentricity of $e = 0.017$.
 - (a) What is the difference between aphelion and perihelion for Earth's orbit? Give your answer in meters.
 - (b) The difference you calculated in part a), Δd , is the full range of distance from the Sun that the Earth undergoes during a year. What is the range in solar flux ΔF (in W m^{-2}) received at Earth's position over the course of a year?
 - (c) Assuming Earth behaves like a perfect blackbody (i.e., re-radiating all energy it receives), and has an albedo of $A = 0.3$, what range of temperature ΔT (in K) should it experience over the course of a year, due the variation in solar flux?
 - (d) Does your answer to part c) support this theory of seasonal temperature variations; why or why not?
2. While doing a planetary transit survey, you find an exoplanet around a nearby solar twin (i.e., $M_* = 1 M_\odot$, $R_* = 1 R_\odot$). The depth of this exoplanet's transits is $\delta F/F = 0.01$, and the time between successive transits is $P = 32.0$ days. The host star also has a known peak radial velocity of $v = 65 \text{ m s}^{-1}$.
 - (a) What is the semi-major axis of the planet's orbit?
 - (b) What is the radius of the planet?
 - (c) What is the mass of the planet?
 - (d) What is its average density, and is it likelier to be a gaseous or a rocky planet?

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3. It's time to start thinking about your Communicating Science project! Please read through the description / assessment / timeline on the project page: (<https://www.astro.utah.edu/~wik/courses/astr3070fall2021/projects.html>) and start thinking about potential topics / media and whether you want to work on your own or in a 2-3 person group. Given the ongoing pandemic, if you decide to work in a group be sure to collaborate safely. For full credit on this HW problem, indicate
- (a) whether you will work alone or in a group (and provide group member names),
 - (b) what kind of project you're thinking about doing (will you make a demo, activity, or infographic?),
 - (c) and what topic(s) are you thinking of tackling?

You can change your mind later—this exercise is meant to get you started.