Names: _____ _____

_____ _____

| Grade | |
|---|---|

# Exoplanets

# Pre-Lab Quiz

Record your team's answer as well as your reasonings and explanations.

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|---|
| 1. |
| 2. |
| 3. |
| 4. |

# Part 1: Transit Simulation

1. In the in-class demonstration, when switching from the smaller exoplanet to the larger exoplanet, how much deeper is the depth of the eclipse? What exoplanet property (or properties) increase by this same numerical factor when switching from the smaller exoplanet to the larger exoplanet? Choose from: radius, diameter, area, and speed.

2. A demo simulates multiple scenarios of an exoplanet ($p$) transiting in front of its host star (*). Fill in the table below, where the ratio of the radius of each planet compared to the radius of its host star $R_p/R_*$ is tabulated along with the simulation's transit depth (the portion of the total light from the host star that has been eclipsed by the exoplanet). Jupiter has a radius a tenth the radius of the Sun, so you must divide $R_p$ ($R_{Jupiter}$) ($R_p$ measured in Jovian radii) by 10 to obtain $R_p$ ($R_{Sun}$) ($R_p$ measured in Solar radii). Round the Transit Depth column to 2 decimal places.

| $R_p$ ($R_{Jupiter}$) | $R_p$ ($R_{Sun}$) | $R_*$ ($R_{Sun}$) | $\frac{R_p\ (R_{Sun})}{R_*\ (R_{Sun})}$ | Transit Depth |
|---|---|---|---|---|
| 1 | | 1 | | |
| 1.4 | | 1 | | |
| 1.7 | | 1 | | |
| 2 | | 1 | | |

3. What is the relationship that links $R_p/R_*$ and transit depth? Do you have to add a constant to one of the values to get the other value? Raise one value to a certain power to get the other? Take the square root? Multiply by a constant? The relationship written below is incorrect; edit it so that it correctly links $R_p/R_*$ and transit depth.

$$\frac{R_p}{R_*} = \text{Transit Depth}$$

# Part 2: Detecting Alien Worlds

*labimage → Exoplanets → XO-1*

1. G1V star XO-1 is orbited by exoplanet XO-1b; we will perform photometry to create an exoplanet transit lightcurve. Following instructions from your TA also found in the tutorial on the lab webpage, create a lightcurve of XO-1 and detail your analysis below to find $R_p$ the radius of exoplanet XO-1b in kilometers (km). In the images of XO-1, of the two stars at the bottom, the top, brighter star is both XO-1 and XO-1b. The star at the very top, TYC 2041-186-1, will be our reference star for photometry; TYC 2041-186-1 has an R magnitude of ~12. **Note:** $R_{Sun}$ = 696,340 km. Host star XO-1 has a radius ($R_*$) of 0.94 $R_{Sun}$.

| | |
|---|---|
| $\mathbf{m_2}$ (Maximum Magnitude when XO-1 not Eclipsed) | |
| $\mathbf{m_1}$ (Minimum Magnitude when XO-1 Eclipsed) | |
| $\boldsymbol{\frac{b_1}{b_2}}$ (Brightness Ratio, $2.512^{m_2-m_1} = \frac{b_1}{b_2}$) | |
| **Transit Depth** ($1 - \frac{b_1}{b_2}$ = Transit Depth) | |
| $\boldsymbol{\frac{R_p}{R_*}}$ (Use Equation from Part 1) | |
| $\boldsymbol{R_p}$ ($R_{Sun}$) | |
| $\boldsymbol{R_p}$ (km) | |