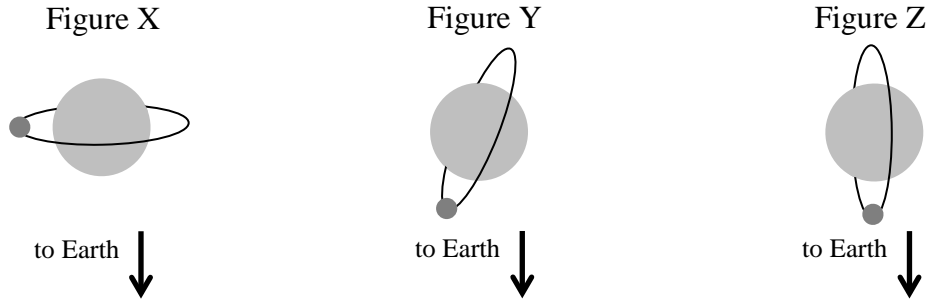


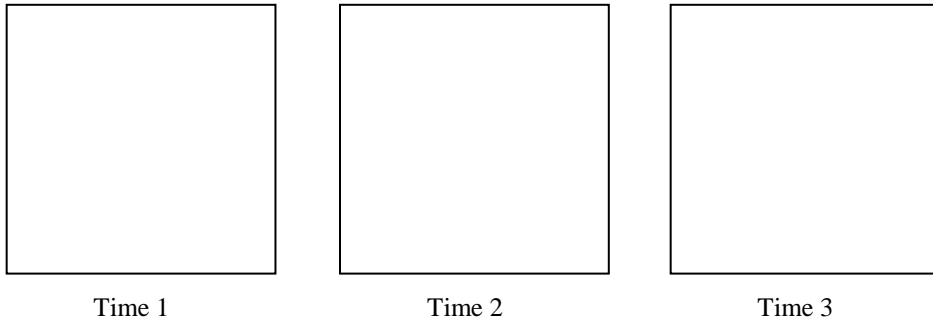
Detecting Exoplanets with the Transit Method

The figures below show the orbits of three exoplanets around their stars.



- 1) For each of the above figures (X, Y, Z), could astronomers on Earth detect the presence of the exoplanet using the transit method? Explain your reasoning.

- 2) Imagine that you observe a star being orbited by an exoplanet. When you begin observing (Time 1), the exoplanet is in front of the star. A little later (Time 2), the exoplanet has moved so that only a fraction of its surface is in front of the star. At an even later time (Time 3), the exoplanet has moved so that no part of its surface is in front of any part of its star. In the spaces below, draw three sketches showing what the star and exoplanet would look like from your view on Earth for each of these three times described above.

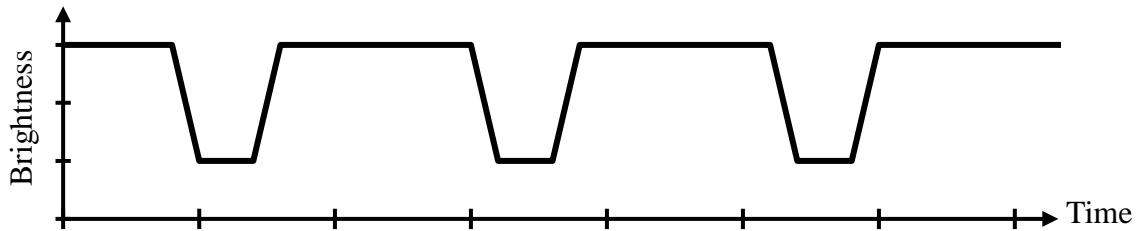


- 3) At which of the three times would you measure the greatest amount of light coming to you from the star? Explain your reasoning.

- 4) At which of the three times would you measure the least amount of light coming to you from the star? Explain your reasoning.

Detecting Exoplanets with the Transit Method

The graph below shows how the amount of light we detect from a star can change over time if it is orbited by an exoplanet.

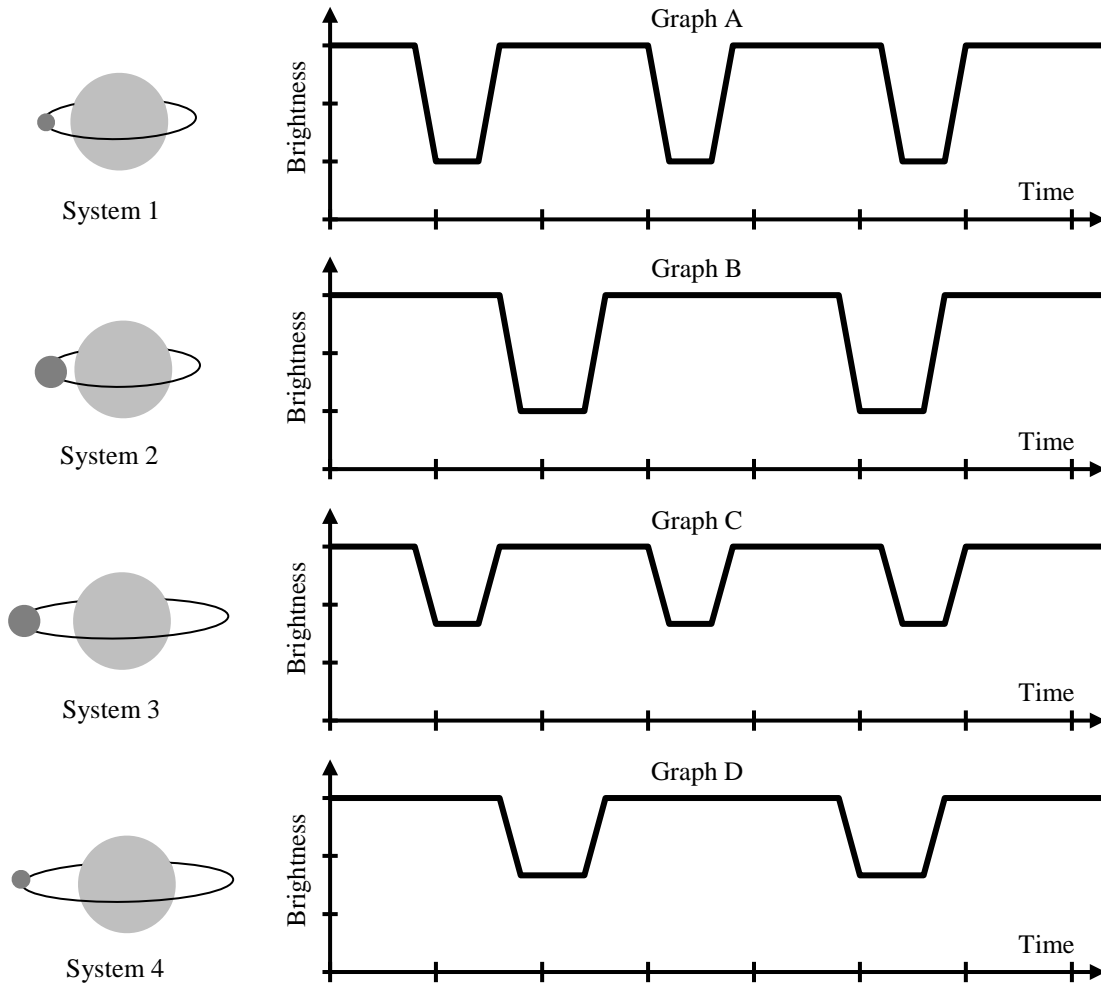


- 5) Using the letter "A," label the locations on the graph that correspond to the times when the exoplanet is completely in front of the star.
- 6) Using the letter "B," label the locations on the graph that correspond to the times when the exoplanet is not in front of the star at all.
- 7) Using the letter "C," label the locations on the graph that correspond to the times when the exoplanet is moving from not being in front of the star at all to being completely in front of the star. Explain your reasoning.
- 8) Describe what the exoplanet is doing when the light we detect from the star begins to increase from the least amount of light to the greatest amount of light.
- 9) Explain why the bottom of a dip in the graph is a horizontal line rather than a single point.

Detecting Exoplanets with the Transit Method

10) In the following figure, four different exoplanet systems are shown on the left, and four different graphs of brightness vs. time are shown on the right. Match each exoplanet system with the graph that best represents the brightness we would observe for the star in that system. All the stars are identical and that each exoplanet crosses directly between its parent star and Earth.

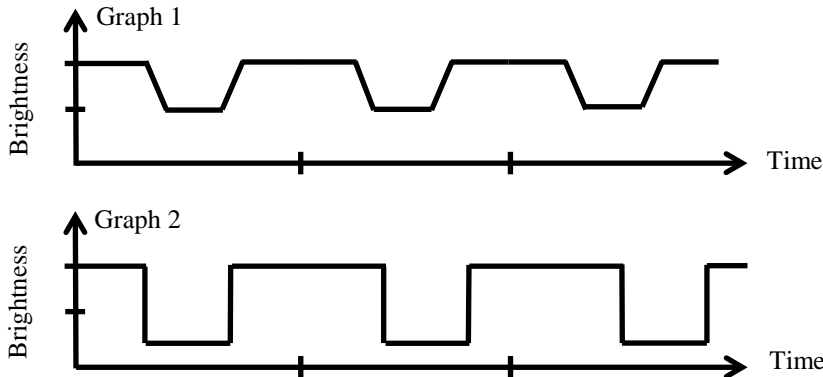
Recall that the size of an exoplanet affects how much light it blocks, and that the distance between an exoplanet and its parent star affects how long it takes to complete an orbit around its parent star.



Explain your reasoning for the matches you chose.

Detecting Exoplanets with the Transit Method

- 11) Graphs 1 and 2 below show the observed brightness of two identical stars over time. Graph 1 shows the observed brightness of Star 1, which is orbited by a small exoplanet. Graph 2 shows the observed brightness of Star 2, which is orbited by a large exoplanet. Both exoplanets are the same distance from their parent stars.

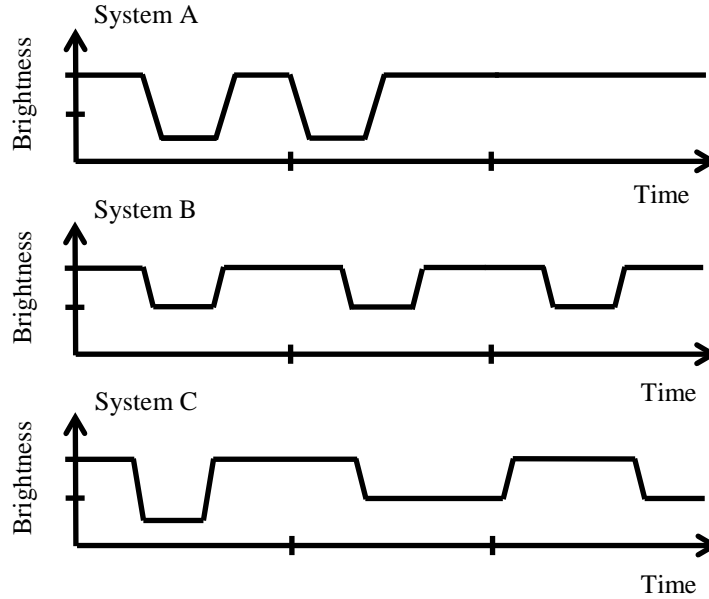


Assume Graph 1 is correct. State whether each of the features of Graph 2 listed below is correct or incorrect, and explain your reasoning.

- Sides of the dips
 - Duration of the dips
 - Time between dips
 - Depths of the dips
- 12) Imagine you are an astronomer outside our solar system. How long would you have to observe the Sun in order to detect four dips in the Sun's brightness due to Earth?
- 13) If you can only observe a star for a limited amount of time (e.g., 6 months), are you more likely to find planets that orbit close to their star or far away from their star? Explain your reasoning.

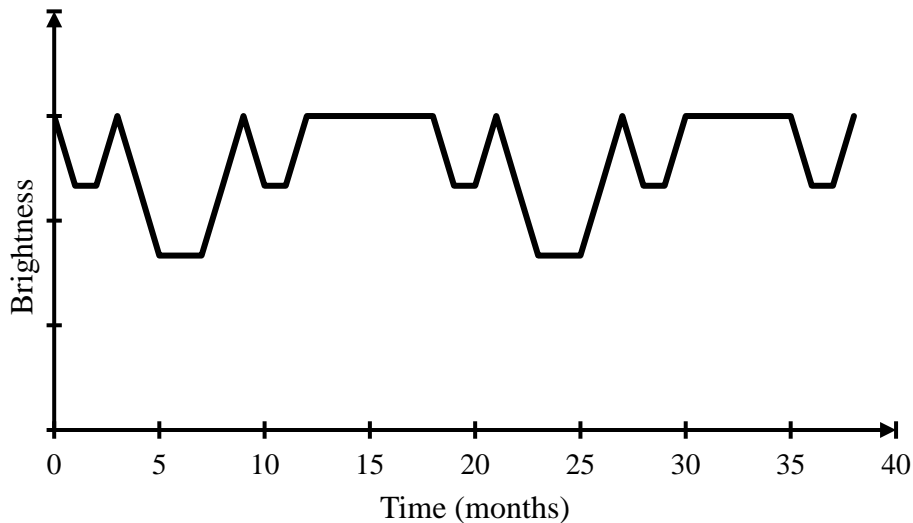
Detecting Exoplanets with the Transit Method

When judging a brightness vs. time graph to determine if it could be caused by an exoplanet, we must consider that the planet causes the same size and shape of dip each time it transits the star, and the dips occur regularly with the same amount of time between dips. Below are three brightness vs. time graphs.



14) How many of these graphs match what you should see if each star is orbited by only one exoplanet? Explain your reasoning.

The graph below shows the observed brightness of a star over time.



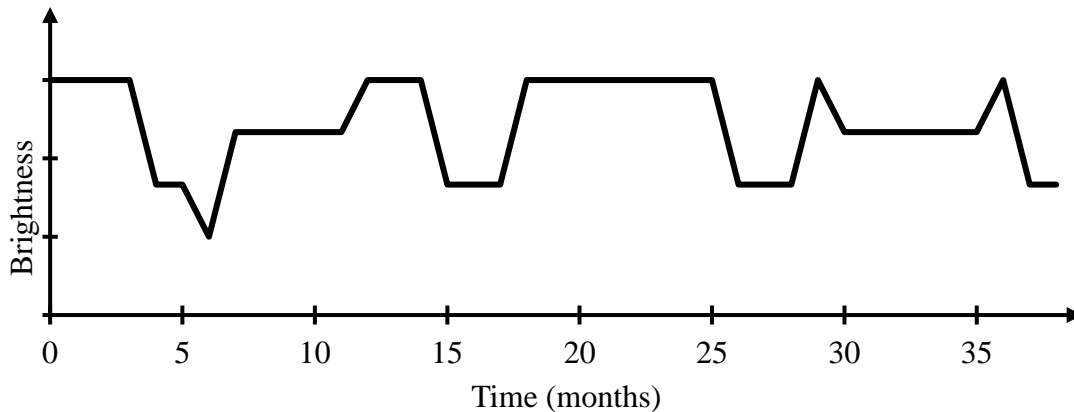
Detecting Exoplanets with the Transit Method

15) How many exoplanets likely orbit this star? Explain your reasoning.

16) Based on the information in the graph, complete the blanks in the sentence below by circling the correct words or phrases.

The _____ (larger/smaller) exoplanet is _____ (closer to/further from) its parent star and the _____ (larger/smaller) exoplanet is _____ (closer to/further from) its parent star.

The graph below shows how much visible light we receive from a star over a period of time. Use this graph to answer the following three questions



17) How many exoplanets orbit this star? Explain your reasoning.

18) How do the sizes and orbital periods of the exoplanets compare to each other? Explain your reasoning.

19) Draw a sketch of the star and its planets.