Date ____________ Period ____________ Name ______________________

CHAPTER 7

Section 7-1 Quiz

Planetary Motion and Gravitation

1. Write Kepler's laws next to their respective numbers below.

1st ____

2nd ____

3rd ____

2. Mercury is 57.9×10^6 km from the Sun. Venus is 108.2×10^6 km from the Sun. If Venus has a period of 224.7 Earth days, how many Earth days does it take Mercury to make one trip around the Sun?

3. The Sun has a mass of 1.99×10^{30} kg. The planet Neptune has a mass of 1.03×10^{26} kg and is 4.50×10^{12} m from the Sun. Calculate the gravitational force between the Sun and Neptune.

4. Describe the process and equipment Cavendish used to establish an experimental value for the universal gravitational constant.

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Date ______________ Period ______________ Name ______________________

CHAPTER 7

Section 7-2 Quiz

Using the Law of Universal Gravitation

1. Explain the conditions necessary for an object to attain and then stay in orbit around Earth.

2. What are the orbital speed (in m/s) and period (in seconds) of a satellite orbiting 350 km above the surface of Earth? Earth has a mass of 5.98×10^{24} kg and a radius of 6.38×10^{6} m.

3. A satellite orbits Earth 270 km above Earth's surface. Calculate the acceleration due to gravity at this altitude.

4. Briefly explain how Einstein's general theory of relativity accounts for gravity, both its causes and effects. In your answer, include an explanation of how the general theory of relativity differs from Newton's law of universal gravitation.

Date ____________ Period ____________ Name ______________________

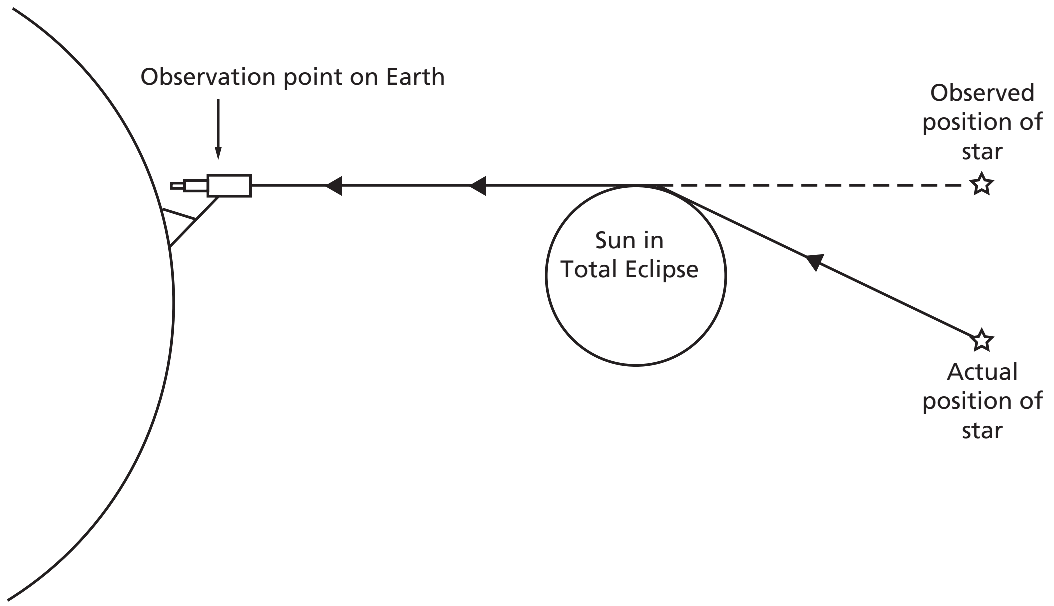
CHAPTER 7

Reinforcement

Gravitation

Problem

In 1915 Albert Einstein published an article in which he outlined his general theory of relativity, a concept that, among other things, stated that light is affected by gravitational fields. Scientists of the Royal Astronomical Society of London proposed an experiment that they believed would test Einstein's prediction. The experiment was performed on March 29, 1919, at two locations. On that day, these sites had one thing in common—each location could witness a total eclipse of the Sun. The drawing below shows the position of a star as seen during the eclipse. The actual position of the star had been established six months earlier. Study the drawing and then answer following questions.



1. Why was the Sun used for this experiment rather than the Moon or other planets?

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2. Why was it important that the actual position of the star was known before this experiment? Keep in mind that the position of the stars relative to Earth does not change significantly.

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3. Assuming the diagram correctly illustrates what the scientists discovered, did the experiment support Einstein's theory? Explain your answer.

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Date ____________ Period ____________ Name ____________________

CHAPTER 7

Enrichment

Variations in the Acceleration Due to Gravity on Earth

The tables below provide data obtained at different geographical locations on Earth. Table 1 shows data gathered from locations at similar, although not identical, latitudes but at various elevations. Table 2 shows data gathered at various latitudes but at approximately the same elevation.

Based on the knowledge gained in your study of gravitation, you should be able to make a variety of inferences from these data. To help you do this, prepare one graph for each set of data. For the data given in Table 1, graph elevation versus acceleration due to gravity. For the data in Table 2, graph latitude versus acceleration due to gravity.

Table 1

Location	Elevation (m)	Acceleration due to gravity (m/s^2)
Richmond, VA	30	9.7996
Baltimore, MD	30	9.8009
Terra Haute, IN	151	9.8007
Charleston, WV	184	9.7993
Kansas City, MO	278	9.7999
Asheville, NC	670	9.7960
Salt Lake City, UT	1322	9.7980
Las Vegas, NV	1960	9.7920

Table 2		
Location	**Latitude (°)**	**Acceleration due to gravity (m/s^2)**
Batavia, Java	6	9.782
Honolulu, HI	21	9.790
Apalachicola, FL	29	9.793
Hoboken, NJ	40	9.803
Vancouver, Canada	49	9.810
Helsinki, Finland	60	9.819
Karajak, Greenland	70	9.825

1. Based on the general trends in both of the tables, describe the geographic locations on Earth where acceleration due to gravity would be the least and where would it be the greatest. Explain your answer.

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2. Does there appear to be a stronger correlation between acceleration due to gravity and elevation or between acceleration due to gravity and latitude? Explain.

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3. Explain the general relationship shown in Table 1. Include the formula for acceleration due to gravity in your answer.

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4. What can you conclude about the higher latitudes and their distance from Earth's center?

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5. Considering the daily rotation of Earth about a central axis, create a hypothesis that accounts for your answer to question 4.

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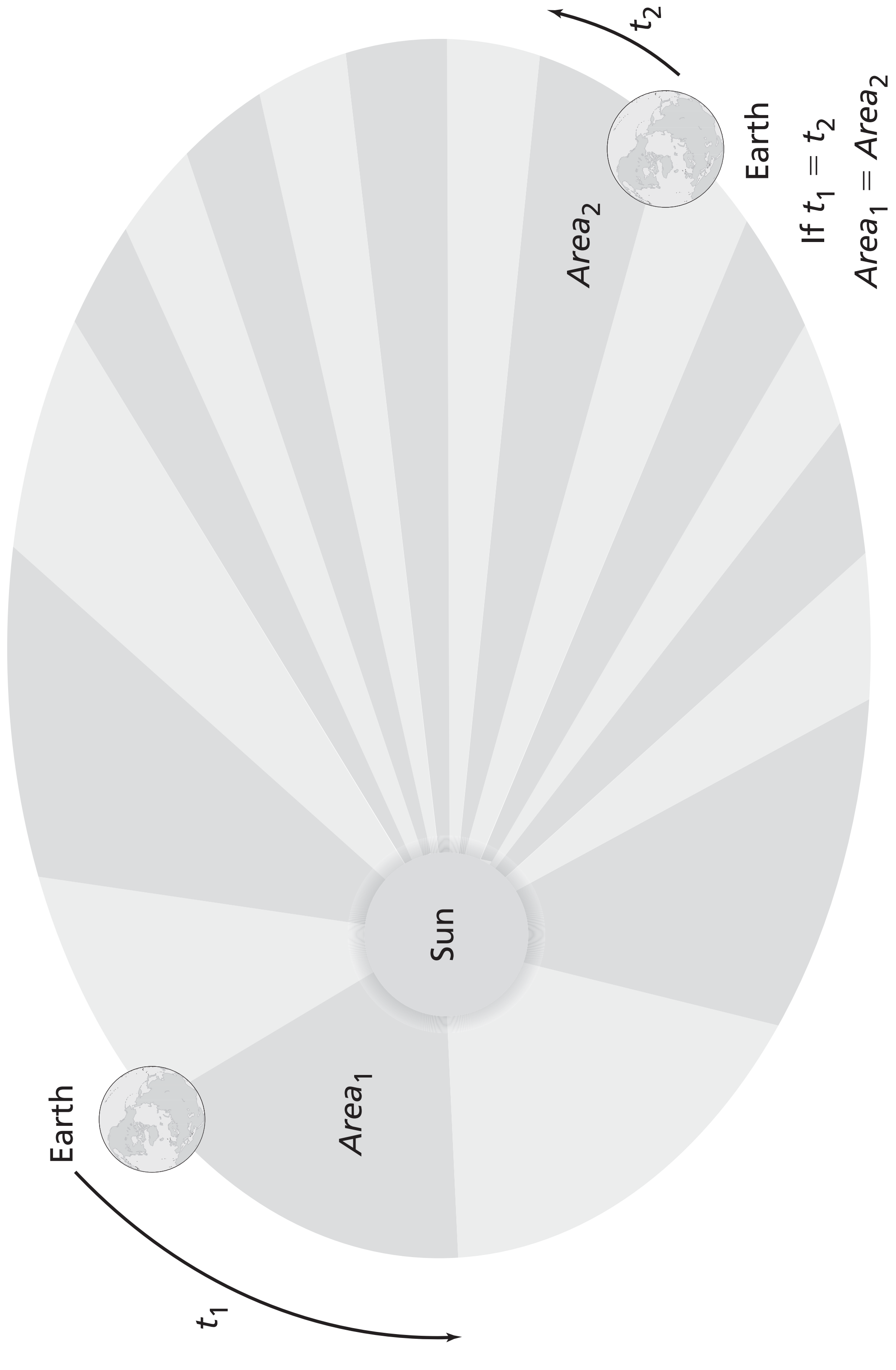
Transparency 7-1

Kepler's First and Second Laws



Date ______________ Period ______________ Name ______________________________

7 Transparency 7-1 Worksheet

Kepler's First and Second Laws

1. What force holds Earth in orbit around the Sun?

2. What is the shape of Earth's orbit?

3. Where is the Sun located, relative to Earth's orbit?

4. At which point in its orbit around the Sun does Earth move fastest?

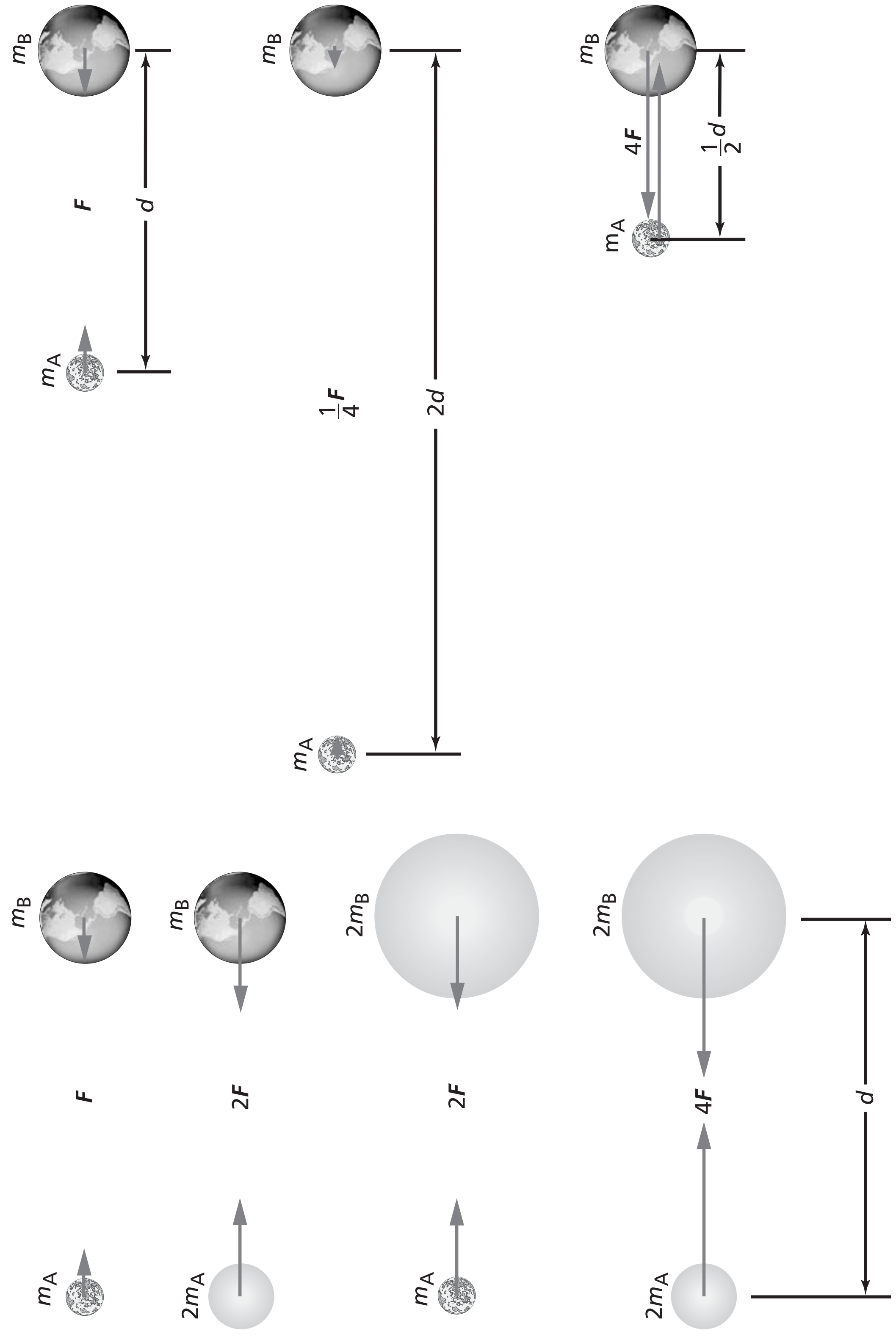
5. At which point in its orbit does Earth move slowest?

6. If $t_1 = t_2$, how do $Area_1$ and $Area_2$ compare?

7. If $Area_1 = Area_2$, how do t_1 and t_2 compare? Explain your answer in terms of the velocity of Earth.

Transparency 7-2

Gravitation



Date ____________ Period ____________ Name ______________________

7 Transparency 7-2 Worksheet

Gravitation

1. Between what two bodies at distance d is the force of attraction greatest?

2. What is the force of attraction between m_A and $2m_B$?

3. How many times greater than the attraction between $2m_A$ and m_B is the force of attraction between m_A and $2m_B$? Explain.

4. Which two bodies have the least force of attraction between them? What is the distance between them?

5. Suppose that m_A is 8.1 kg and m_B is 6.5 kg. The distance between their centers is 0.50 m. Calculate the force of attraction between these two bodies.

6. What would be the relative force of attraction between m_A and m_B at distance $3d$?

7. What would be the relative force of attraction between m_A and a body, $3m_B$, at distance d?

8. What would be the relative force of attraction between the two bodies in problem 7 at distance $3d$?

9. What would be the relative force of attraction between $2m_A$ and $2m_B$ at distance $2d$?

Transparency 7-3

Kepler's Third Law

Planet	Minium Distance from Sun (km)	Maxium Distance from Sun (km)	Average Distance from Sun (km)	Period (Earth Years)
Mercury	4.608×10^7	6.982×10^7	5.791×10^7	0.241
Venus	1.075×10^8	1.089×10^8	1.082×10^8	0.615
Earth	1.471×10^8	1.521×10^8	1.496×10^8	1.000
Mars	2.066×10^8	2.492×10^8	2.279×10^8	1.881
Jupiter	7.405×10^8	8.166×10^8	7.786×10^8	11.860
Saturn	1.353×10^9	1.515×10^9	1.434×10^9	29.420
Uranus	2.741×10^9	3.004×10^9	2.872×10^9	84.010
Neptune	4.444×10^9	4.546×10^9	4.495×10^9	164.790
Pluto	4.435×10^9	7.304×10^9	5.870×10^9	247.680

Kepler's Third Law $\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{r_A}{r_B}\right)^3$

Date ____________ Period ____________ Name ____________________

7 Transparency 7-3 Worksheet

Kepler's Third Law

1. Do the data given for Mercury and Jupiter agree with Kepler's third law?

____

____

2. Suppose that you were not sure that the period given for Neptune's period was correct. How could you use the remaining data to calculate it?

____

____

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3. The newly discovered Kuiper Belt object, Quaoar, revolves around the Sun at a distance of about 7.5×10^{12} m. What is Quaoar's period?

4. The asteriod Ceres revolves around the Sun at a distance of 4.14×10^{11} m. Calculate Ceres' period in years.

5. Is your answer to problem 6 realistic? Why or why not?

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____

6. The Moon revolves around Earth with a period of 27.32 days. Can you use Kepler's third law to calculate its distance from Earth? Why or why not?

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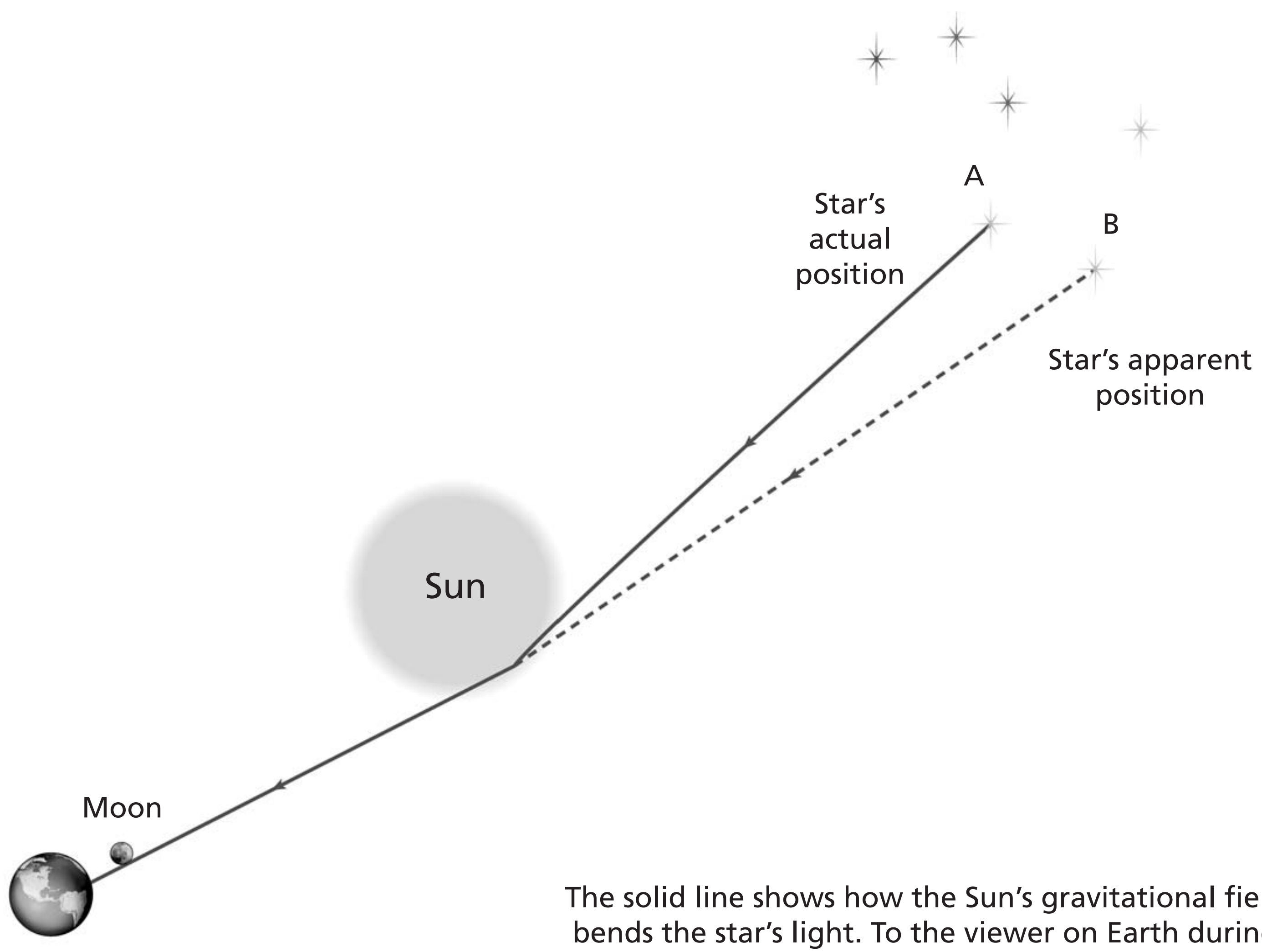
Effect of Gravity on Light



The solid line shows how the Sun's gravitational field bends the star's light. To the viewer on Earth during a solar eclipse, the star appears to be at position B.

Date ____________ Period ____________ Name ________________________

7 Transparency 7-4 Worksheet

Effect of Gravity on Light

1. How is Einstein's theory of gravity different from Newton's?

2. Describe a common model of Einstein's theory of gravity.

3. How is light affected by massive objects?

4. A neutron star is smaller than an average star, but more massive. How and why does a neutron star affect light near it?

5. If light cannot escape from a black hole, how do we know black holes exist?

6. Imagine that you were observing a star as it collapsed and became a black hole. What would you see?