

KEPLER'S LAWS OF PLANETARY MOTION

Guided Reading Comprehension

20. You are probably familiar with the fact that the planets orbit, or revolve around, the sun. However, have you ever thought about how long it takes to do this 100% revolve?

Johannes Kepler, a revolutionary German astronomer and mathematician, was intrigued by the planet Mars, and studied how the planet revolved around the sun. Using the observations and work of past astronomers, Kepler devised three laws of planetary motion, and these were used successfully to explain how planets orbit the sun.



Johannes Kepler
1571-1630

KEPLER'S 1ST LAW OF PLANETARY MOTION: THE ORBIT OF A PLANET IS AN ELLIPSE, WITH THE SUN AT ONE FOCUS



21. Kepler found that planets orbit around the sun in an **elliptical path**. This must be called an **ellipse**, or an elongated oval-shaped orbiting circle. An ellipse has two foci that determine the shape of the ellipse. Foci are plural for focus. The path of each planet around the sun is an ellipse with the sun at one focus. The other focus is represented by a point located on the opposite end of the ellipse. The further apart the foci, the more elongated an ellipse is.

22. An ellipse has a critical component known as **eccentricity**. **Eccentricity** is the measurement of how elongated a closed circle is, and is measured from the center of the ellipse. The eccentricity is the ratio of the distance between the foci to the length of the major axis (longer horizontal axis). A perfect circle has a length two and an eccentricity of zero, while the most elongated ellipses have an eccentricity of one. Basically, the greater the eccentricity, the more elongated an ellipse is.



23. The formula to find the eccentricity of an ellipse is $E = D \div L$. In words, the formula is that eccentricity is equal to the distance between the foci divided by the length or major (longer) axis of the ellipse.

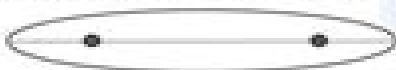
To find the eccentricity of any ellipse, follow these steps:

1. Measure the distance between the foci in cm.
2. Measure the length of the long major axis in cm.
3. Divide the distance between the two foci by the length of the major axis (L).

$$E = D \div L$$

E = eccentricity
 D = distance between the 2 foci
 L = length of the major axis of the ellipse

4. Use a ruler to find the eccentricity of the ellipse below. Show your work.



$E =$ _____
 $E =$ _____
 $E =$ _____

KEPLER'S 2ND LAW OF PLANETARY MOTION: EQUAL AREA IN EQUAL TIME

25. Kepler observed that the speed of stars in its orbit changes in a predictable way. As stars approach perihelion, or the point in its orbit closest to the sun, it speeds up. As it moves away from the sun, and approaches aphelion, or point in orbit farthest away from the sun, it slows down.



The planet sweeps the same area up and it and then it is the same amount of time. This is Kepler's 2nd Law.

26. What is the difference between aphelion and perihelion?

27. Explain Kepler's 2nd Law in your own words.

KEPLER'S 3RD LAW OF PLANETARY MOTION: ORBITAL PERIODS ARE PROPORTIONAL TO THE DISTANCE FROM THE SUN

28. A planet's orbital period is the length of time it takes to complete one orbit around the sun. The orbital period of revolution is measured in Earth years. A planet's distance to the sun is expressed in astronomical units (AU). Distance in our solar system is measured in astronomical units, and one astronomical unit is the average distance between Earth and the sun. It is about 150 million kilometers.

Planet	Distance from Sun (AU)	Orbital Period (Earth Years)
Mercury	0.39	0.24
Venus	0.72	0.61
Earth	1.00	1.00
Mars	1.52	1.88
Jupiter	5.20	11.86
Saturn	9.54	29.46
Uranus	19.20	84.01
Neptune	30.06	164.8

29. The orbital period squared is equal to its mean solar distance cubed. The formula for this calculation is $T^2 = D^3$. It works for the orbital period in Earth years and the distance from the sun in astronomical units. Note: distances of the planets can be calculated when their periods of revolution are known. For example, Venus has a period of 1.92 years, which squared equals 3.69. The cube root of 3.69 is 1.54, and that is the distance in AU. In simple terms, the planet is placed in the sun, the shorter the orbital period is. For example, an orbital period for Saturn is longer than an orbital period of Mercury because it is further away from the sun than Mercury.

30. Which planets have a shorter orbital period than Earth's?



Questions

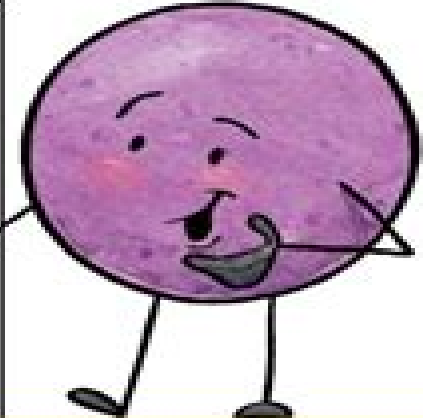
KEPLER'S LAWS OF PLANETARY MOTION

TERM	DEFINITION
1. Eccentricity	a. ellipse orbit description for an orbiting planet
2. Kepler's 1 st Law	b. orbit in a planet's path around the sun
3. Aphelion	c. elongated oval-shaped orbiting circle
4. Perihelion	d. the point in orbit closest to the sun
5. Astronomical unit	e. the average distance between Earth and the sun
6. Orbital period	f. the time it takes for a planet to complete one orbit around the sun

1. What is the eccentricity of an ellipse orbit?
 - a. 0
 - b. 1
 - c. 100
 - d. 1000
2. Which of the following is not a determining factor of an ellipse?
 - a. $E = D \div L$
 - b. $E = D \times L$
 - c. $E = D + L$
 - d. $E = D - L$
3. Which of the following is not a determining factor of an ellipse?
 - a. Eccentricity
 - b. Semi-major axis
 - c. Semi-minor axis
 - d. Semi-latus rectum
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Guided Science Urban Life Answers

Rachel S Tattersall



Guided Science Urban Life Answers:

The Top Books of the Year Guided Science Urban Life Answers The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous compelling novels captivating the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the engaging narratives that have enthralled audiences this year.

The Must-Read : Colleen Hoover "It Ends with Us" This heartfelt tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover masterfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can succeed.

Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids absorbing storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery.

Discover the Magic : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting.

These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of compelling stories waiting to be discovered.

The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts.

The Secret History is a brilliant and suspenseful novel that will keep you guessing until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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Table of Contents Guided Science Urban Life Answers

1. Understanding the eBook Guided Science Urban Life Answers
 - The Rise of Digital Reading Guided Science Urban Life Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying Guided Science Urban Life Answers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Guided Science Urban Life Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Guided Science Urban Life Answers
 - Personalized Recommendations
 - Guided Science Urban Life Answers User Reviews and Ratings
 - Guided Science Urban Life Answers and Bestseller Lists
5. Accessing Guided Science Urban Life Answers Free and Paid eBooks
 - Guided Science Urban Life Answers Public Domain eBooks
 - Guided Science Urban Life Answers eBook Subscription Services
 - Guided Science Urban Life Answers Budget-Friendly Options
6. Navigating Guided Science Urban Life Answers eBook Formats
 - ePub, PDF, MOBI, and More
 - Guided Science Urban Life Answers Compatibility with Devices
 - Guided Science Urban Life Answers Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Guided Science Urban Life Answers
 - Highlighting and Note-Taking Guided Science Urban Life Answers
 - Interactive Elements Guided Science Urban Life Answers
8. Staying Engaged with Guided Science Urban Life Answers

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Guided Science Urban Life Answers
- 9. Balancing eBooks and Physical Books Guided Science Urban Life Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Guided Science Urban Life Answers
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Guided Science Urban Life Answers
 - Setting Reading Goals Guided Science Urban Life Answers
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Guided Science Urban Life Answers
 - Fact-Checking eBook Content of Guided Science Urban Life Answers
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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