

Kepler's Law

Spoken Tutorial Project

<https://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

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13 August 2019



Learning Objectives



Learning Objectives

- **Verify Kepler's first law using Kepler's first law simulation**



Learning Objectives

- **Verify Kepler's first law using Kepler's first law simulation**
- **Calculate Aphelion and Perihelion distances**



Learning Objectives

- Verify Kepler's first law using Kepler's first law simulation
- Calculate Aphelion and Perihelion distances
- Verify Kepler's second law using Kepler's second law simulation



System Requirements



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- **Ubuntu Linux OS v 16.04**



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- **Ubuntu Linux OS v 16.04**
- **Firefox web browser v 62.0.3**



Pre-requisites



Pre-requisities

- Learner should be familiar with **Apps on Physics**



Pre-requisites

- Learner should be familiar with **Apps on Physics**
- For pre-requisite tutorials please visit this site
<https://spoken-tutorial.org>



Link for Apps on Physics



Link for Apps on Physics

<https://www.walter-fendt.de/html5/phen>



Apps on Physics



Apps on Physics

- **Kepler's First Law**



Apps on Physics

- **Kepler's First Law**
- **Kepler's Second Law**



Aphelion and Perihelion Distances



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
- $R_p = a(1 - e)$



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
- $R_p = a(1 - e)$
- R_a is **Aphelion distance**



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
- $R_p = a(1 - e)$
- R_a is **Aphelion distance**
- R_p is **Perihelion distance**



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
- $R_p = a(1 - e)$
- R_a is **Aphelion distance**
- R_p is **Perihelion distance**
- a is **semimajor axis**



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
- $R_p = a(1 - e)$
- R_a is **Aphelion distance**
- R_p is **Perihelion distance**
- a is **semimajor axis**
- e is **eccentricity**



Tabular Column



Tabular Column

| Planets | Eccentricity (e) | Aphelion (R_a) | Perihelion (R_p) |
|---------|------------------|--------------------|----------------------|
| Mercury | | | |
| Venus | | | |
| Earth | | | |
| Mars | | | |
| Jupiter | | | |
| Saturn | | | |
| Uranus | | | |
| Neptune | | | |
| Pluto | | | |



Aphelion and Perihelion Distances



Aphelion and Perihelion Distances

- $R_a = a(1 + e)$
 $= 0.387(1 + 0.206)$
 $= 0.466AU$
- $R_p = a(1 - e)$
 $= 0.387(1 - 0.206)$
 $= 0.307AU$



Tabular Column



Tabular Column

$$R_a = a(1+e) \quad R_p = a(1-e)$$

a = semimajor axis

| Planets | Eccentricity (e) | Aphelion (R_a) | Perihelion (R_p) |
|---------|------------------|--------------------|----------------------|
| Mercury | 0.206 | 0.466 | 0.307 |
| Venus | 0.007 | 0.728 | 0.717 |
| Earth | | | |
| Mars | | | |
| Jupiter | | | |
| Saturn | | | |
| Uranus | | | |
| Neptune | | | |
| Pluto | | | |



Assignment



Assignment

- Calculate the Aphelion and Perihelion distances of the other planets



Assignment

- Calculate the Aphelion and Perihelion distances of the other planets
- Use the values of semimajor axis and eccentricity shown in App



Halley's Comet



Halley's Comet

- Halley's comet is a periodic comet



Halley's Comet

- Halley's comet is a periodic comet
- It returns to Earth's vicinity in about every 75 years



Halley's Comet

- Halley's comet is a periodic comet
- It returns to Earth's vicinity in about every 75 years
- A comet appears as a bright head with a long tail



Halley's Comet

- Halley's comet is a periodic comet
- It returns to Earth's vicinity in about every 75 years
- A comet appears as a bright head with a long tail
- The tail of a comet is always directed away from the Sun

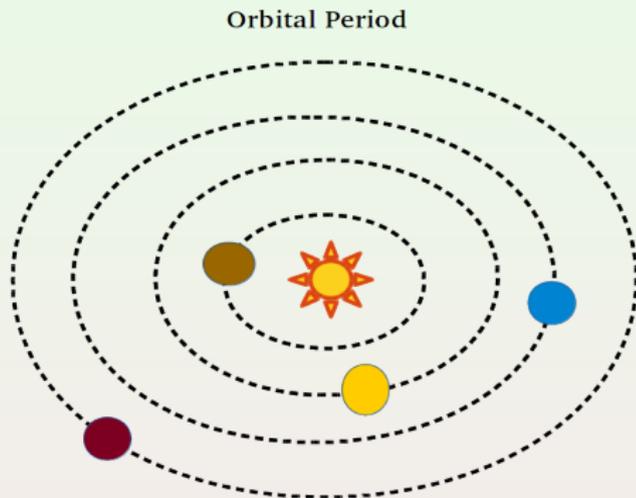


Orbital Period



Orbital Period

The orbital period is the time taken by a celestial object to go around the orbit of another celestial object



Mercury 88 days
Venus 225 days
Earth 365 days
Mars 687 days



Assignment



Assignment

- **Select planets Venus and Uranus from the drop down list**



Assignment

- **Select planets Venus and Uranus from the drop down list**
- **Observe the difference in the velocity**



Assignment

- Select planets Venus and Uranus from the drop down list
- Observe the difference in the velocity
- Explain your observation



Summary

- **Verified Kepler's first law using Kepler's first law simulation**
- **Calculated Aphelion and Perihelion distances**
- **Verified Kepler's second law using Kepler's second law simulation**



Acknowledgement

- **These Apps were created by Walter-fendt and his team**



About the Spoken Tutorial Project

- Watch the video available at https://spoken-tutorial.org/What_is_a_Spoken_Tutorial
- It summarises the Spoken Tutorial project



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Spoken Tutorial Workshops

The Spoken Tutorial Project Team

- Conducts workshops using spoken tutorials
- Gives certificates to those who pass an online test
- For more details, please write to contact@spoken-tutorial.org



Forum for specific questions

- Questions in THIS Spoken Tutorial?
- Visit <https://forums.spoken-tutorial.org>
- Choose the minute and second where you have the question
- Explain your question briefly
- The Spoken Tutorial project will ensure an answer

You will have to register to ask questions



Acknowledgement

Spoken Tutorial project is supported by

- **National Mission on Education through ICT (NMEICT)**
- **Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT)**

MHRD, Government of India

