Friday, Sep. 12

Syllabus, class notes, and homeworks are at:
www.as.utexas.edu → courses → AST 301, Lacy

Reading for next week: chapter 5

The exam next Friday will cover ch. 1-4.

Get a review sheet in back on your way out.

The homework handed out last Friday is due Friday of next week. It requires observations of the Moon and planets.

We will take last week's homework this week.

The Wednesday help session has been moved to GRG 424 at 5:00 (for the entire semester).

Note the new time and place.

Topics for this week

Describe the models of Aristotle, Copernicus, and Kepler. How correct and how accurate was each? How did each explain retrograde motion of the planets?

State each of Kepler's 3 laws and be able to use them to compare speeds of different planets and of one planet at different points in its orbit.

What arguments did Galileo make in favor of the Copernican model?

What did Newton add to our understanding of Kepler's laws?

State Newton's 4 laws. Know what the words in each mean. Apply them to the problem of falling balls.

Prograde and retrograde motion

Remember: all objects in the sky move east-to-west during a night due to the west-to-east rotation of the Earth.

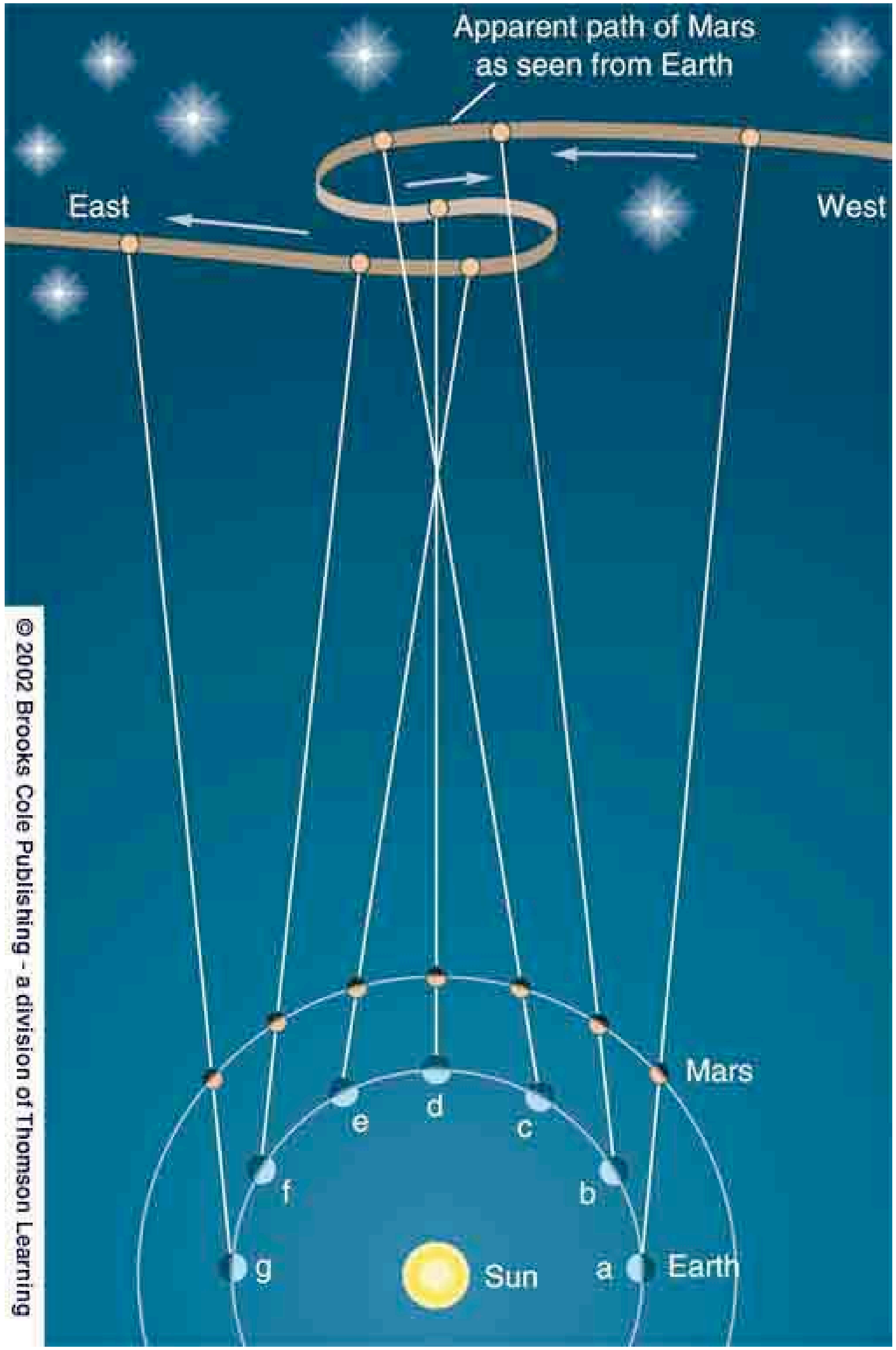
Prograde motion is when a planet moves west-to-east relative to the stars.

The Sun and Moon always move prograde.

Retrograde motion is when a planet moves east-to-west relative to the stars.

Looking down on the solar system from the north, prograde motion occurs when the line from the Earth to the object rotates counterclockwise (in the same way the planets actually move).

Retrograde motion occurs when the line rotates clockwise because the Earth passes the planet.


Apparent path of Mars
as seen from Earth
East
West
Mars
Earth
Sun
a
b
c
d
e
f
g

Copernicus, Tycho, and Kepler

Copernicus (500 yr ago) put the Sun at the center of his model, but wanted to keep the planets moving on circular paths at constant speed.

His model was no more accurate than those of Aristotle and Ptolemy.

Tycho (450 yr ago) showed that neither model could reproduce the observed paths of the planets in the sky.

Kepler (400 yr ago) allowed the planets to move on elliptical paths with varying speeds, according to his 3 rules.

His model predicted planetary positions very accurately.

Kepler’s laws (or rules)

1. The planets move on elliptical paths with the Sun at one focus of the ellipse for each planet.

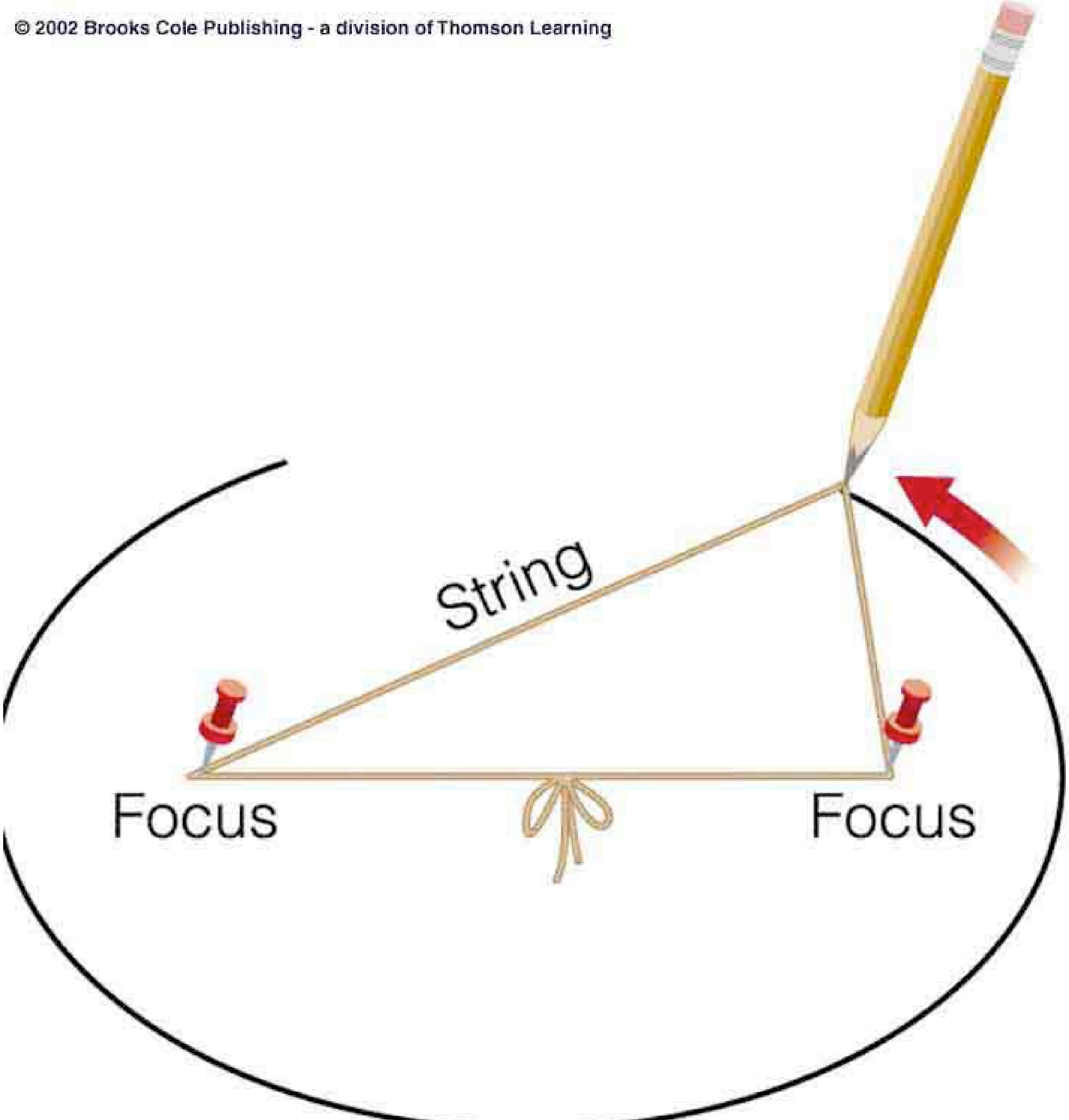
2. The speed of a planet changes during its orbit, moving fastest when it is closest to the Sun and slowest when it is farthest from the Sun.

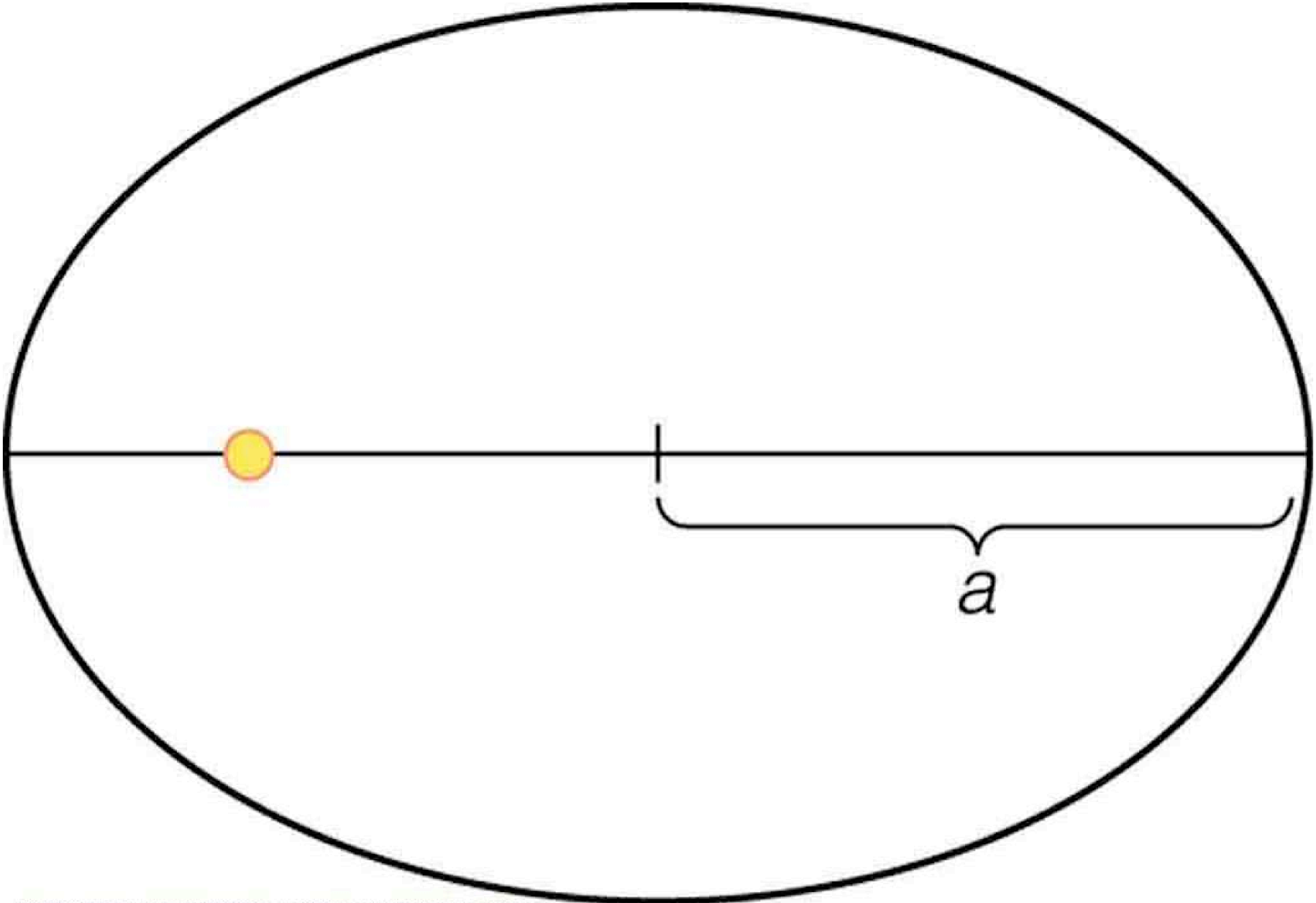
   A line from the Sun to the planet sweeps out equal areas in equal times.

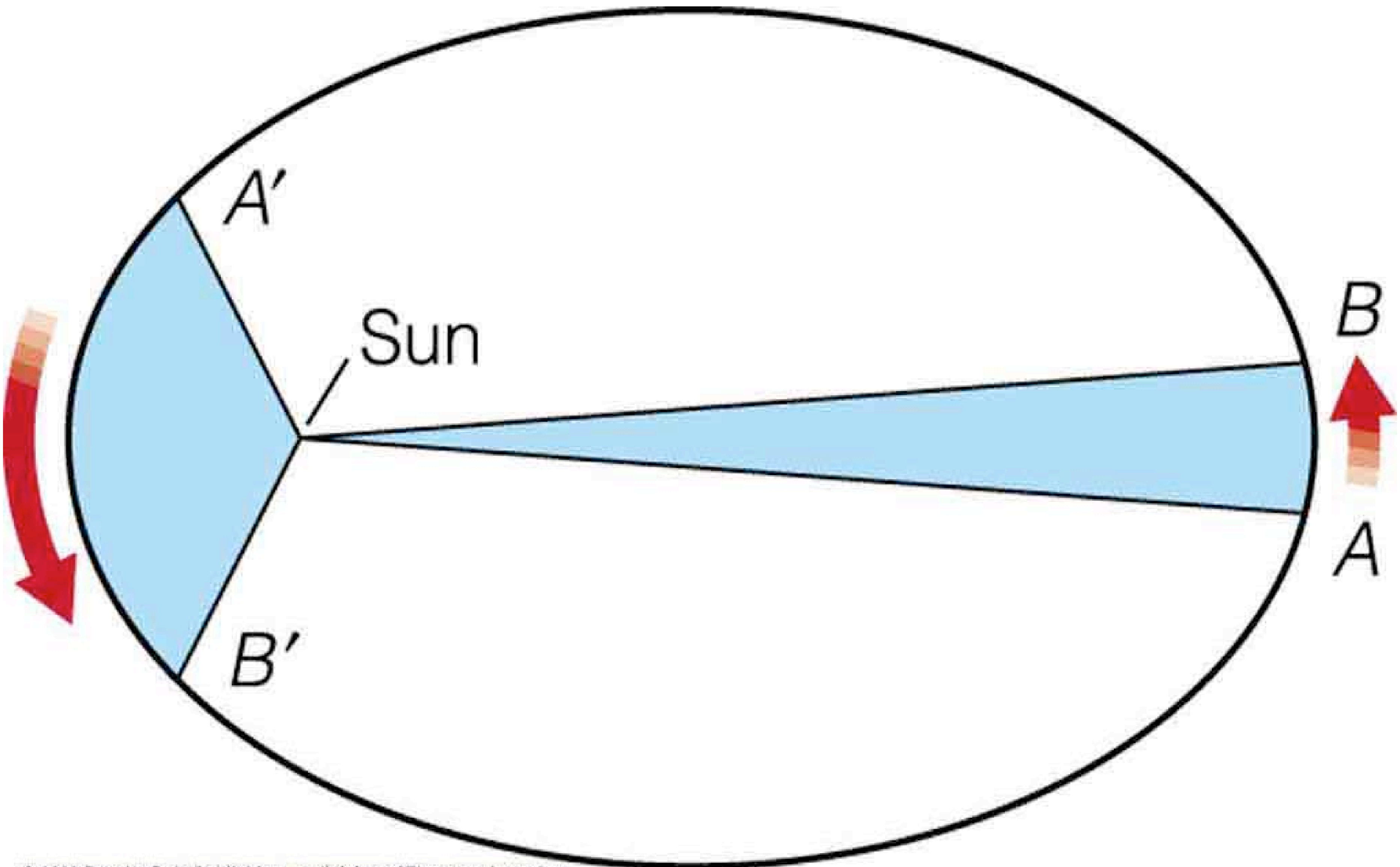
3. Different planets move at different speeds, with a planet in a smaller orbit moving faster than one in a larger orbit.

   The time for a planet to orbit the Sun depends on the size of it orbit according to the rule:

   $P^2 = a^3$, where P is in years and a is in AU


String
Focus
Focus


a


A′
Sun
B
A
B′

Kepler's 2^{nd} law

A simpler, although not exact, way to state Kepler's second law is to say:

The distance traveled by a planet in a given time is inversely proportional to the planet's distance from the Sun during that time.

Or the speed of a planet is inversely proportional to its distance from the Sun.

This means that if at one time a planet is twice as far from the Sun as at a second time, it is moving ½ as fast.

Or: closer to Sun means faster.

twice as close means twice as fast

twice as far means ½ as fast

Quiz

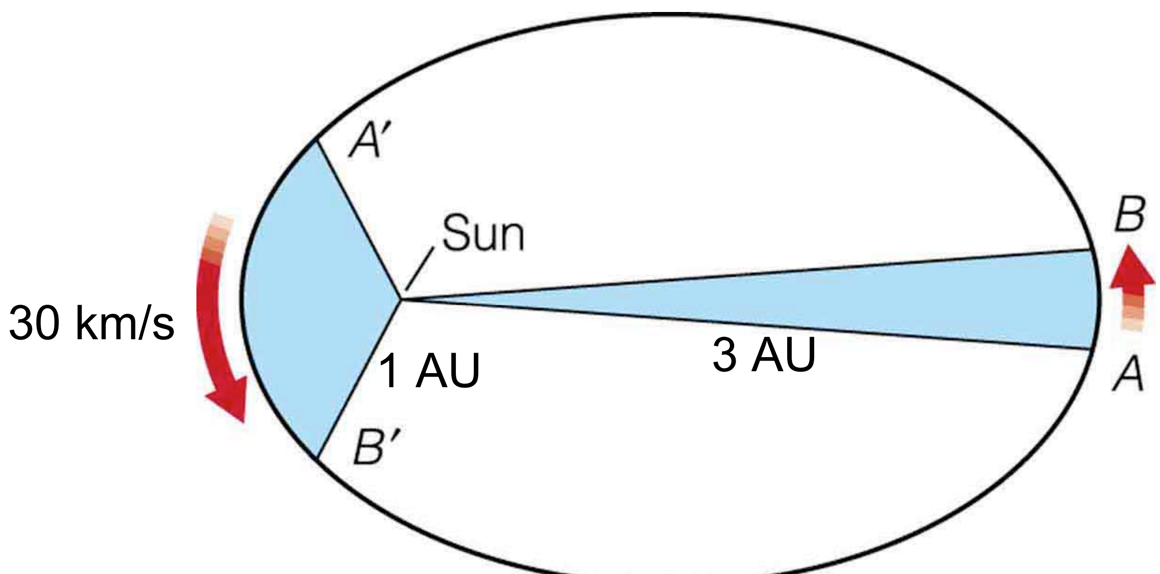
If the speed of the planet between A` and B` is 30 km/s, what is its speed between A and B?

A. 10 km/s

B. 28 km/s

C. 32 km/s

D. 90 km/s



Quiz

In the figure below, given that the distance from the Sun to points A and B is 3 AU, the distance to points A` and B` is 1 AU, and the distance from A to B is 0.5 AU, what is the distance from A` to B` (along the orbit)?

A. 0.5 AU
B. 1 AU
C. 1.5 AU
D. 3 AU