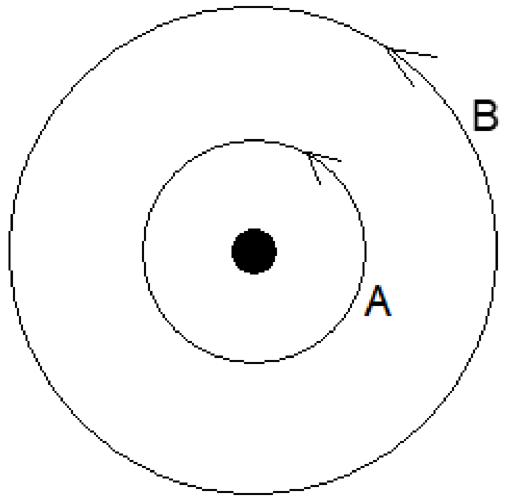
Discuss and Answer:

Two satellites, A and B, are in circular orbit around the earth. The distance of satellite B from the center of the Earth is twice that of satellite A. What is the ratio of the magnitudes of the accelerations of A to B?

$$\frac{a_A}{a_B} = \ldots.$$

A) 1 B) 2 C) 4
D) 1/2 E) 1/4



Notes

Midsemester survey – 98+ responses! Some requests:

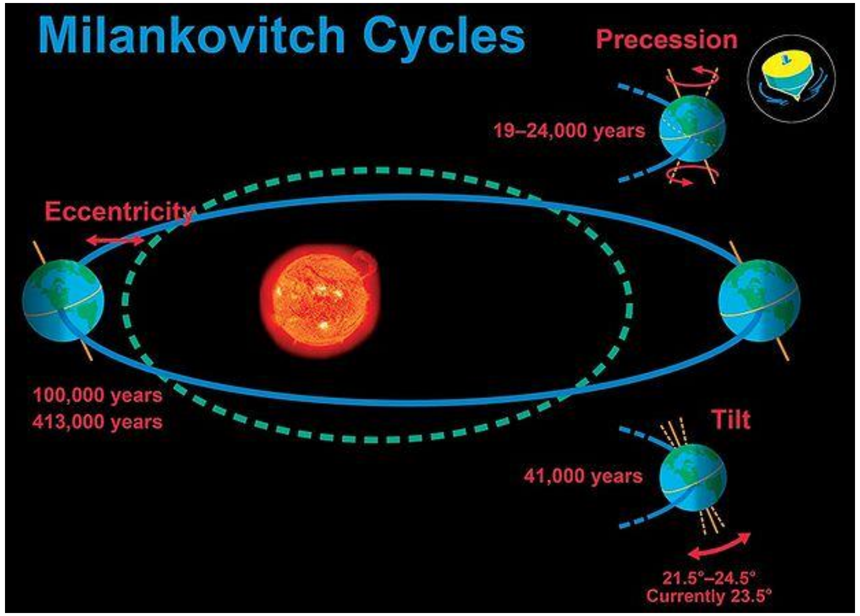
- More demos
- More practice problems
- More textbook readings in the prelectures

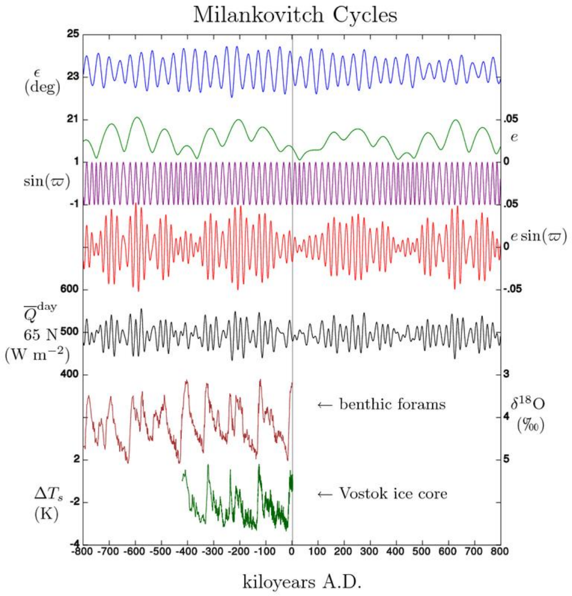
- Homework on Gravity released today! Should finish topics for it today

- Exam II will be Nov 20 (Momentum, Rotational Motion - Dynamics, and Gravity)

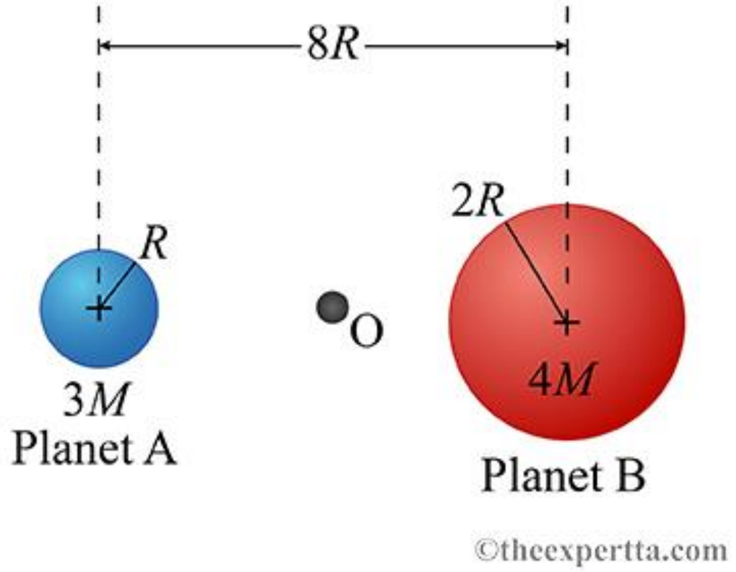
Recap: Comments and Questions

- If the areas are swept out in equal times according to Kepler's Second Law, doesn't that mean the tangential velocity of the terrestrial body orbiting around the sun have a higher velocity at some point compared to others? Also, the circumference distance that the terrestrial body has to cover as it rotates around the sun changes per equal allotted area based on its location in relation to the sun.
- Another question I have is if it's true that the tangential velocity of Earth changes as it rotates around the sun based on the Earth's location along its orbit, how does this affect life on Earth?





Recap: Universal Gravitation



Planet A has mass 3M and radius R, while Planet B has mass 4M and radius 2R. They are separated by center-to-center distance 8R. A rock is released halfway between the planets' centers at point O. It is released from rest. Ignore any motion of the planets.

Part (a) **Enter an expression for the magnitude of the acceleration of the rock immediately after it is released, in terms of *M*, *R*, and the gravitational constant, *G*.**

Part (b) **Calculate the magnitude of the rock's acceleration, in meters per second squared, for $M = 5.1 \times 10^{23}$ kg and $R = 4.1 \times 10^{6}$ m.**

Part (c) **Toward which planet is the rock's acceleration directed?**

SQUARECAP

Discuss and Answer:

Imagine a rock is dropped from a spaceship a distance $d = 2R_E$ from the surface of the Earth, where R_E is the radius of the Earth. How could we determine how fast will it be moving when it hits the ground? (there are multiple answers, which seems easiest to you?)

Gravitational Work and Energy

- We can find the work done by the gravitational force
- We can assign an associated potential energy
- We can find the total energy in different situations: negative, zero, positive

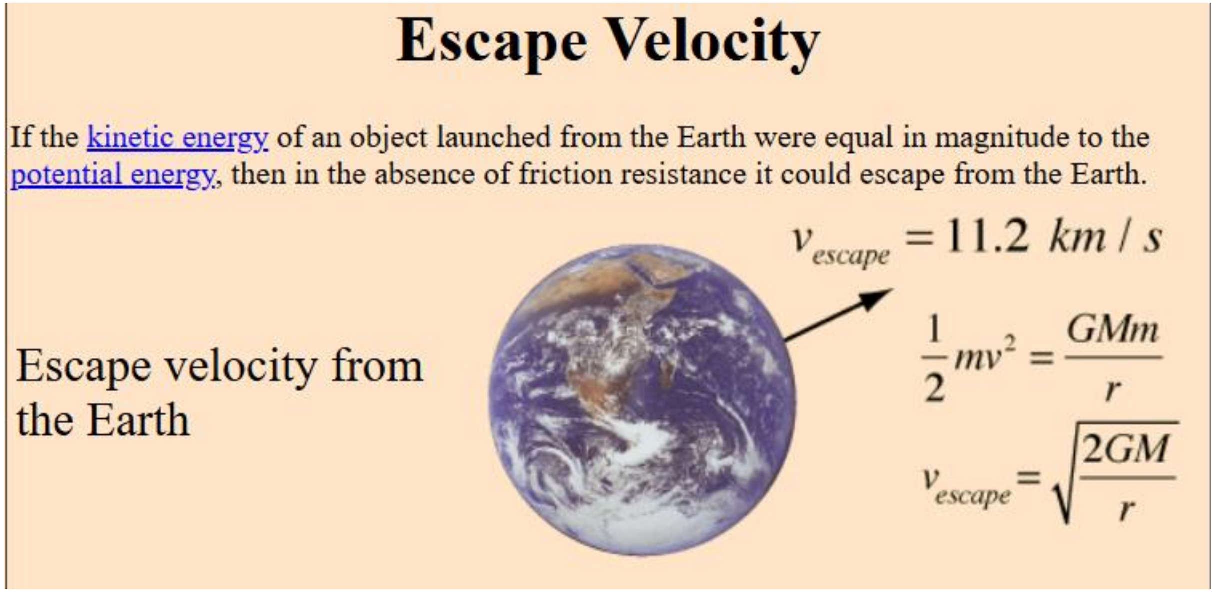
Gravitation

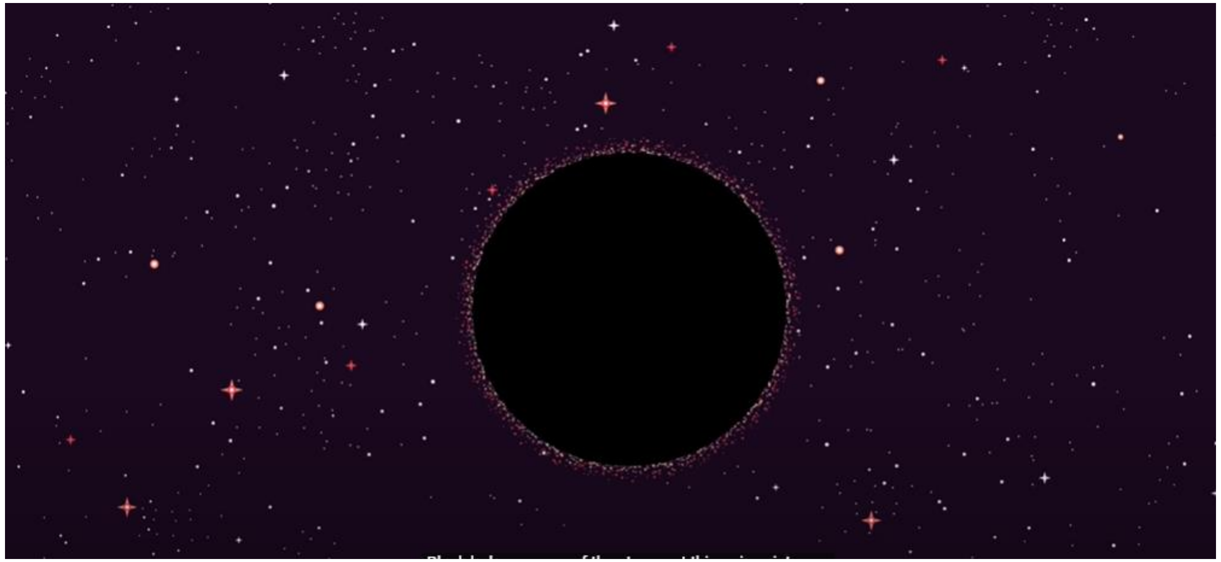
$$\vec{F}_g = \vec{g}m = -\frac{GMm}{r^2}\hat{r} \qquad U = -\frac{GMm}{r}$$

$$E_{escape} = 0 \qquad E_{orbit} = -\frac{1}{2}\frac{GMm}{r} \qquad E_{surf} = -\frac{GMm}{R}$$

$$\eta_{Kepler} = 4\frac{\pi^2}{GM}$$

Prelecture Review: Escape Velocity and Black Holes





Escape Speed

$$0 = \frac{1}{2}mv_e^2 - \frac{GMm}{r}$$

What are our comments and questions?

Comments and Questions

- Does the "escape velocity" only apply to escaping the gravitational pull of earth, or is it for any two objects being pulled together?
- Is the space of a black hole actual physical matter, or is it emptiness that just has immense gravitational pull?
- How does the concept of escape speed relate back to what we learned during unit 1 about kinematics?

My Comments and Questions

- Comment: The equation for escape speed allows us to determine the event horizon radius of a black hole correctly, even without taking into account General Relativity!

- Question: If something (like a book) is thrown into a black hole, is the information it contains lost forever?

SQUARECAP

Discuss and Answer:

Suppose a projectile is fired straight upward from the surface of an airless planet of radius R with the escape velocity vesc (meaning the projectile will just barely escape the planet's gravity -- it will assymtotically approach infinite distance and zero speed.) What is the projectile's speed when it is a distance 4R from the planet's center (3R from the surface).

A) 1/2 vesc
B) 1/4 vesc
C) 1/9 vesc
D) 1/3 vesc
E) None of these is correct.

(Ignore the gravity of the Sun and other astronomical bodies.)