
Classical Mechanics

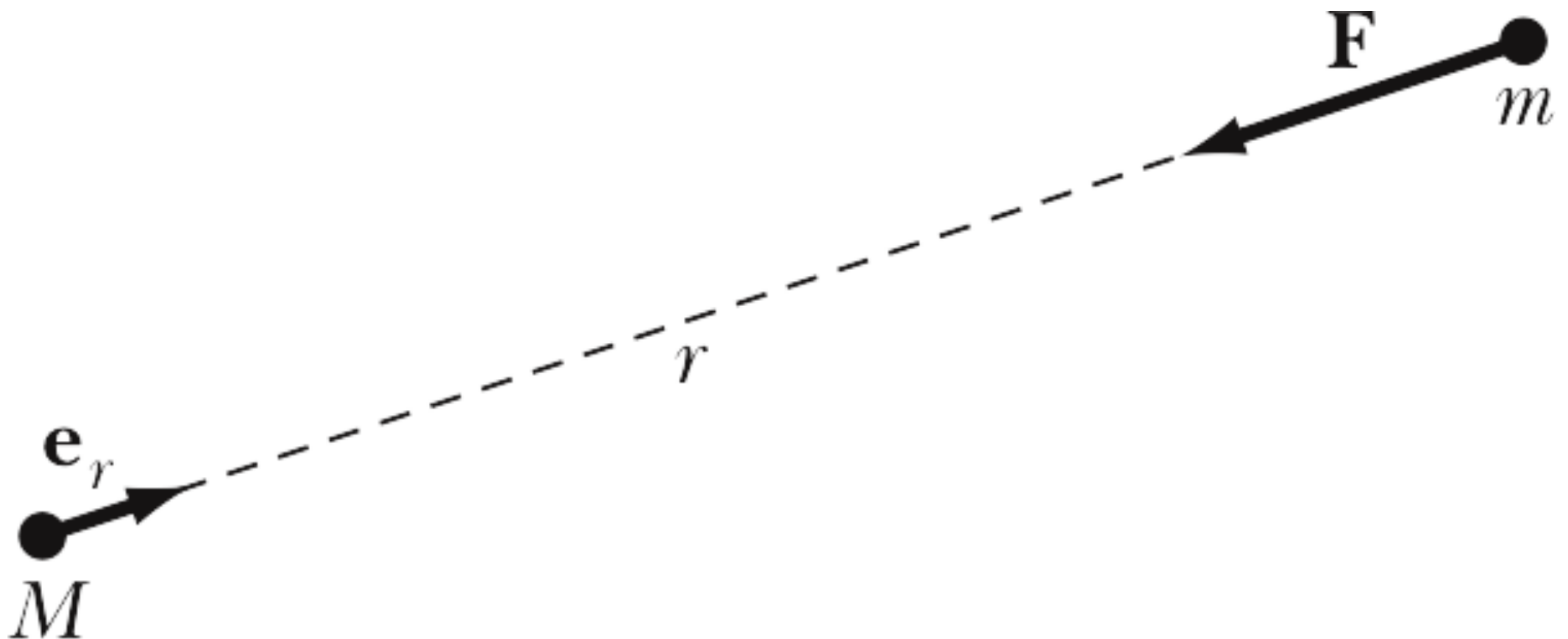
Phy 235, Lecture 07.

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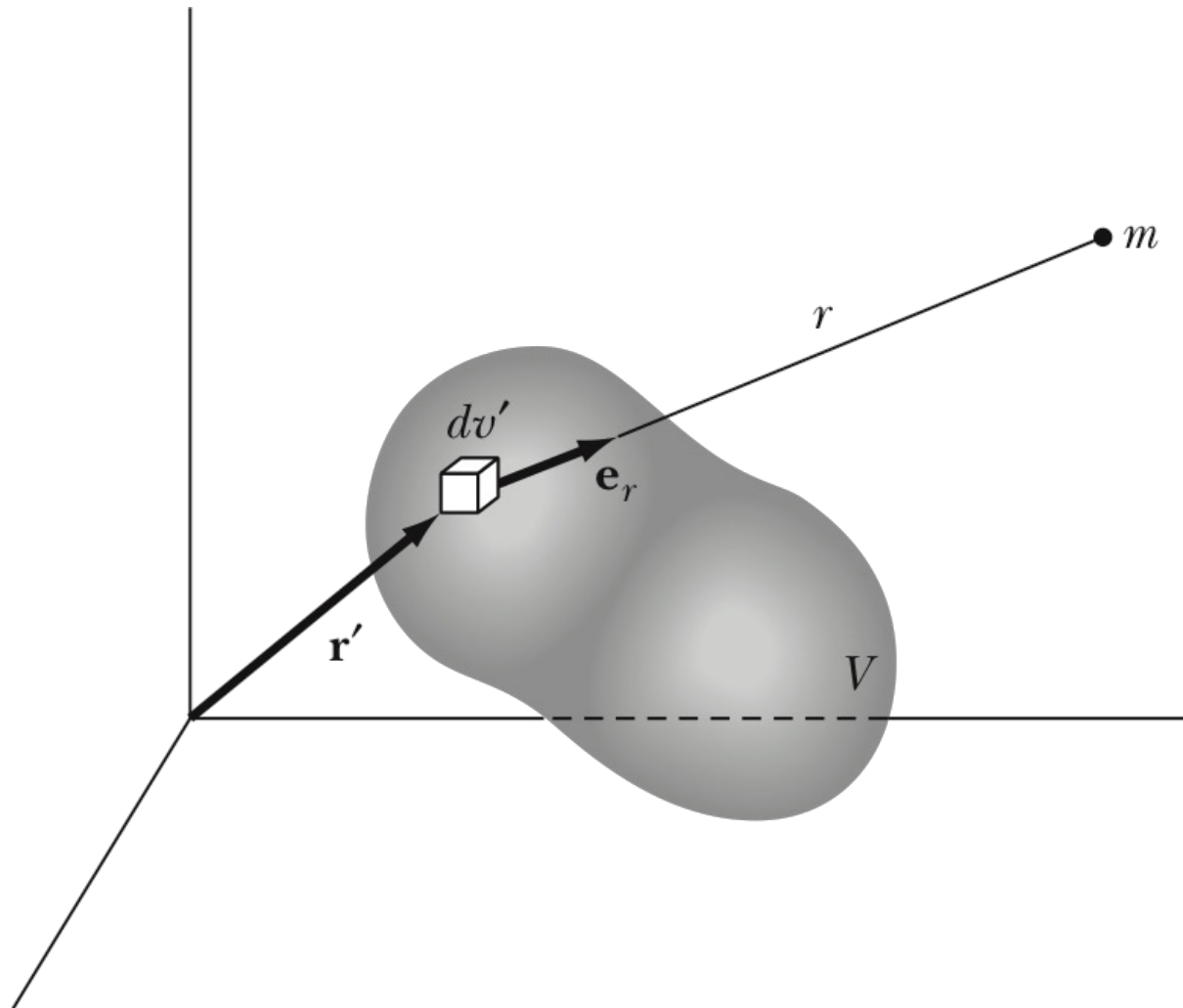
Course Comments

- Exam # 1:
 - Tomorrow, Tuesday, between 8 am and 9.20 am in B&L 109.
 - Material to be covered is Chapters 1 – 4.
 - All exam materials will be in a brown envelope. The same envelope will be used by you to return the materials.
- There will be no office hours on Wednesday and Thursday this week.
- There will be no recitations on Tuesday and Thursday this week.
- Exam # 1 will be returned to you during recitations next week.

The gravitational force between point particles.



The gravitational force between a point particle and an extended object.



Gravitational Potential

- Gravitational potential:

$$\vec{g} = -\nabla\Phi$$

- Gravitational potential due to a point mass:

$$\Phi = -G \frac{M}{r}$$

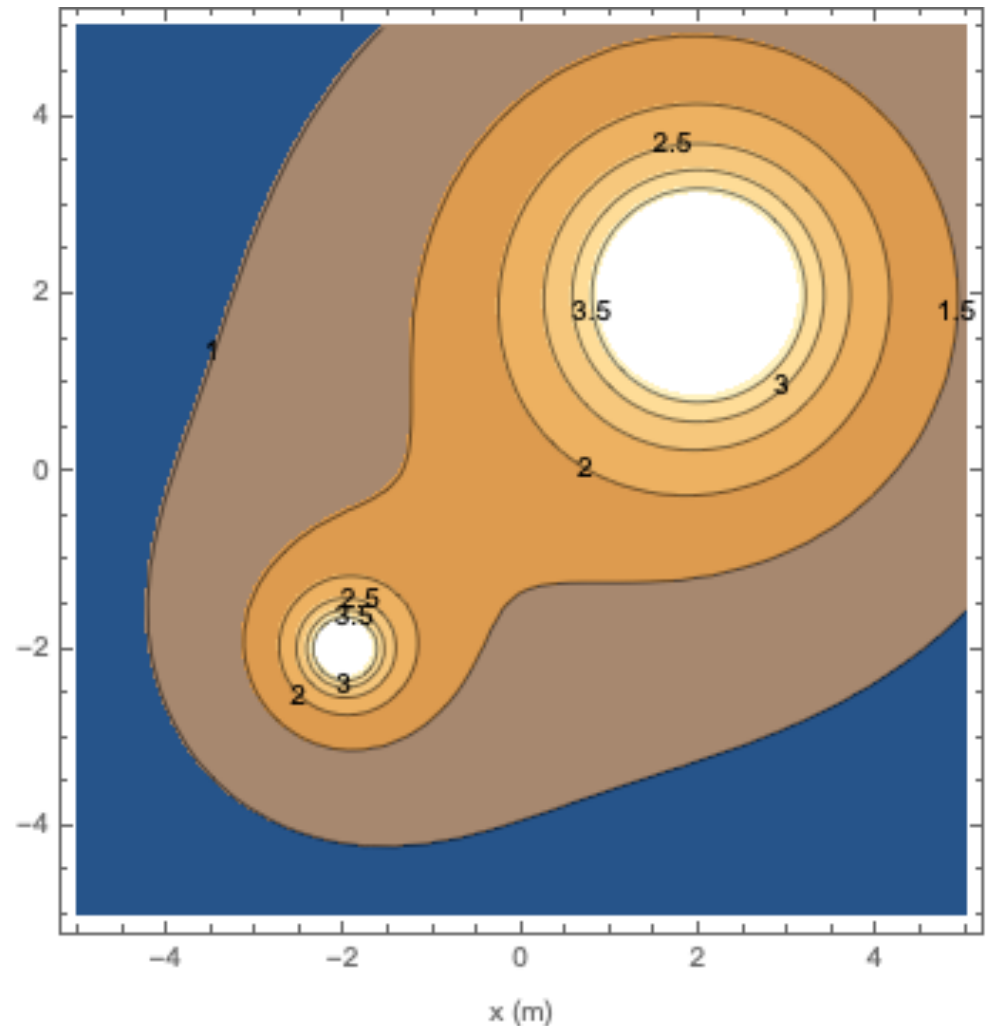
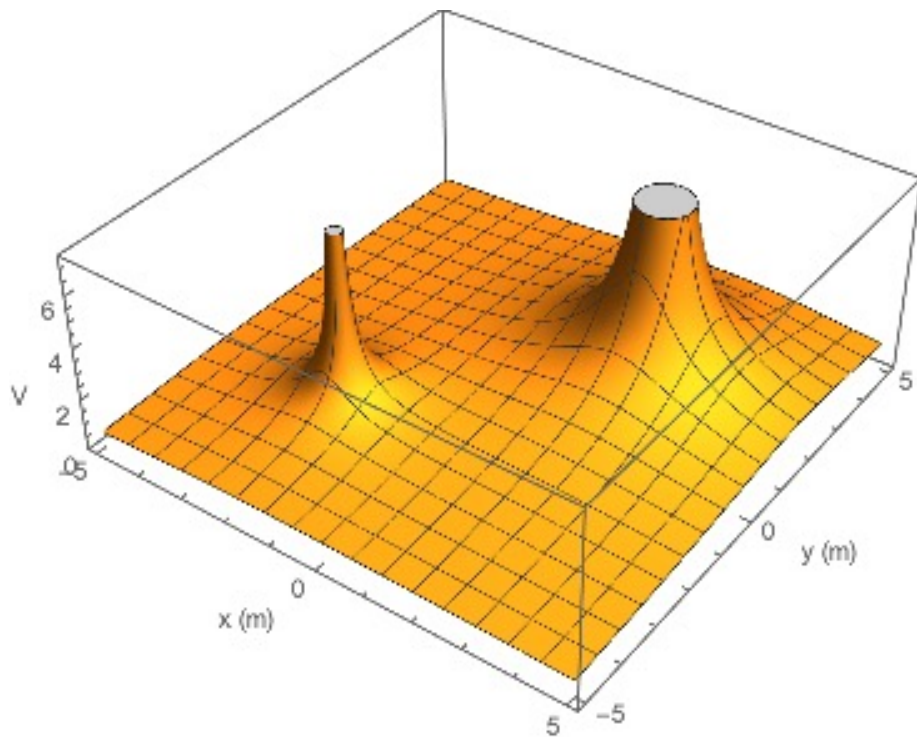
- Gravitational potential due to a continuous mass distribution:

$$\Phi = -G \int_V \frac{\rho(\vec{r}')}{r'} dv'$$

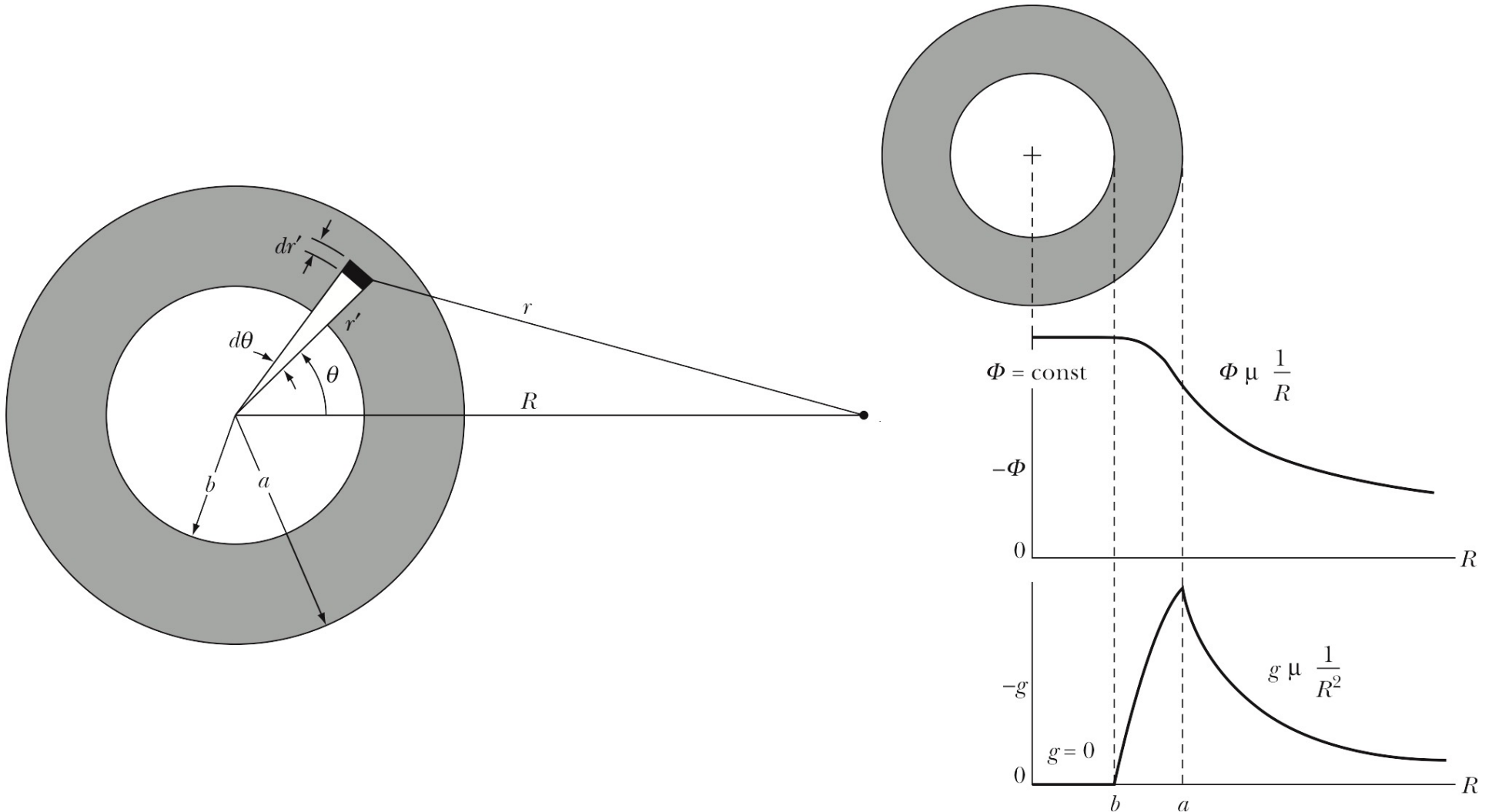
- Note: the gravitational potential is a scalar.

Visualizing the gravitational potential.

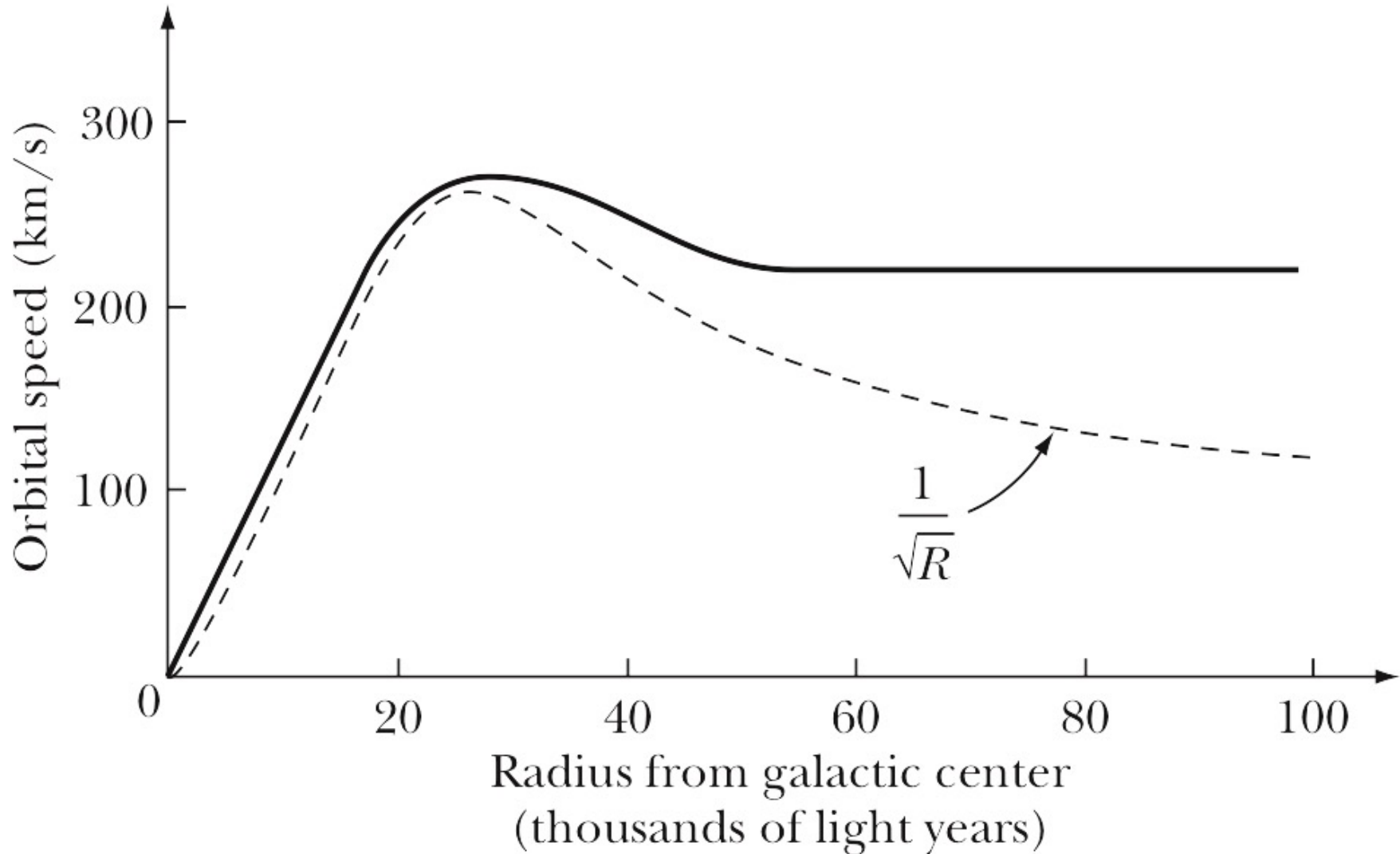
Two point masses: 1 kg and 4 kg.



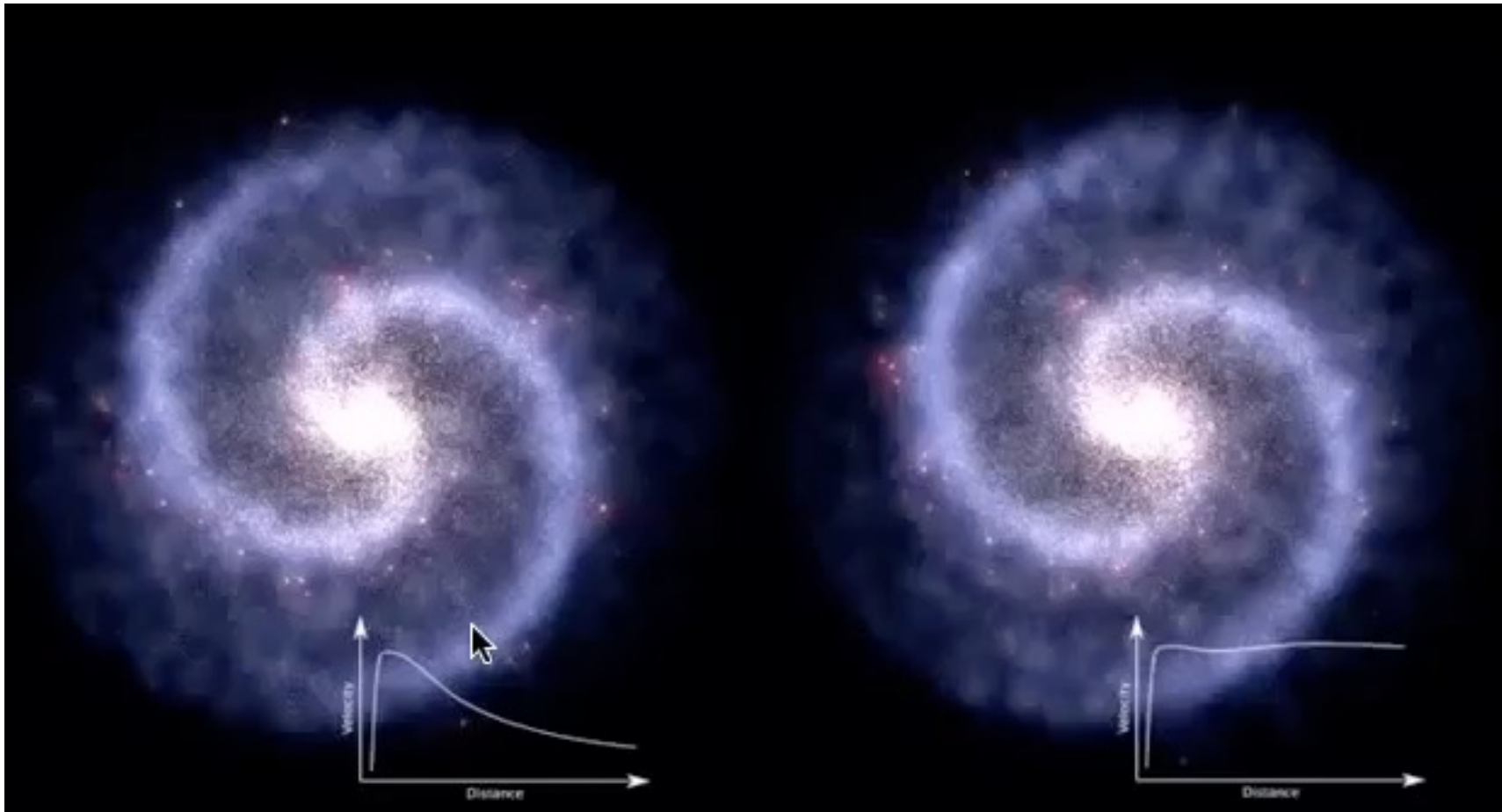
Shell theorem.



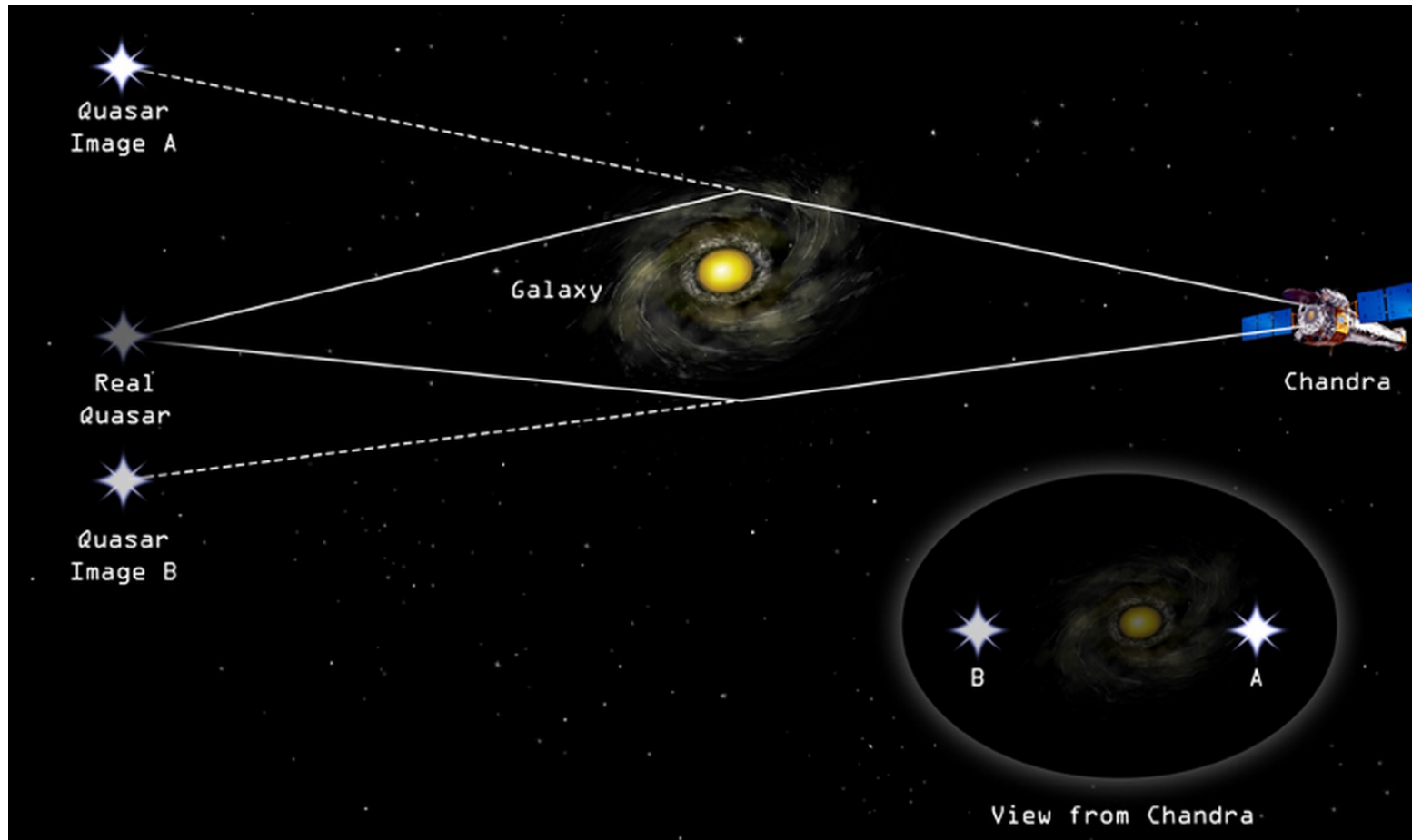
Measure the rotational velocity, determine the gravitational force, find the enclosed mass.



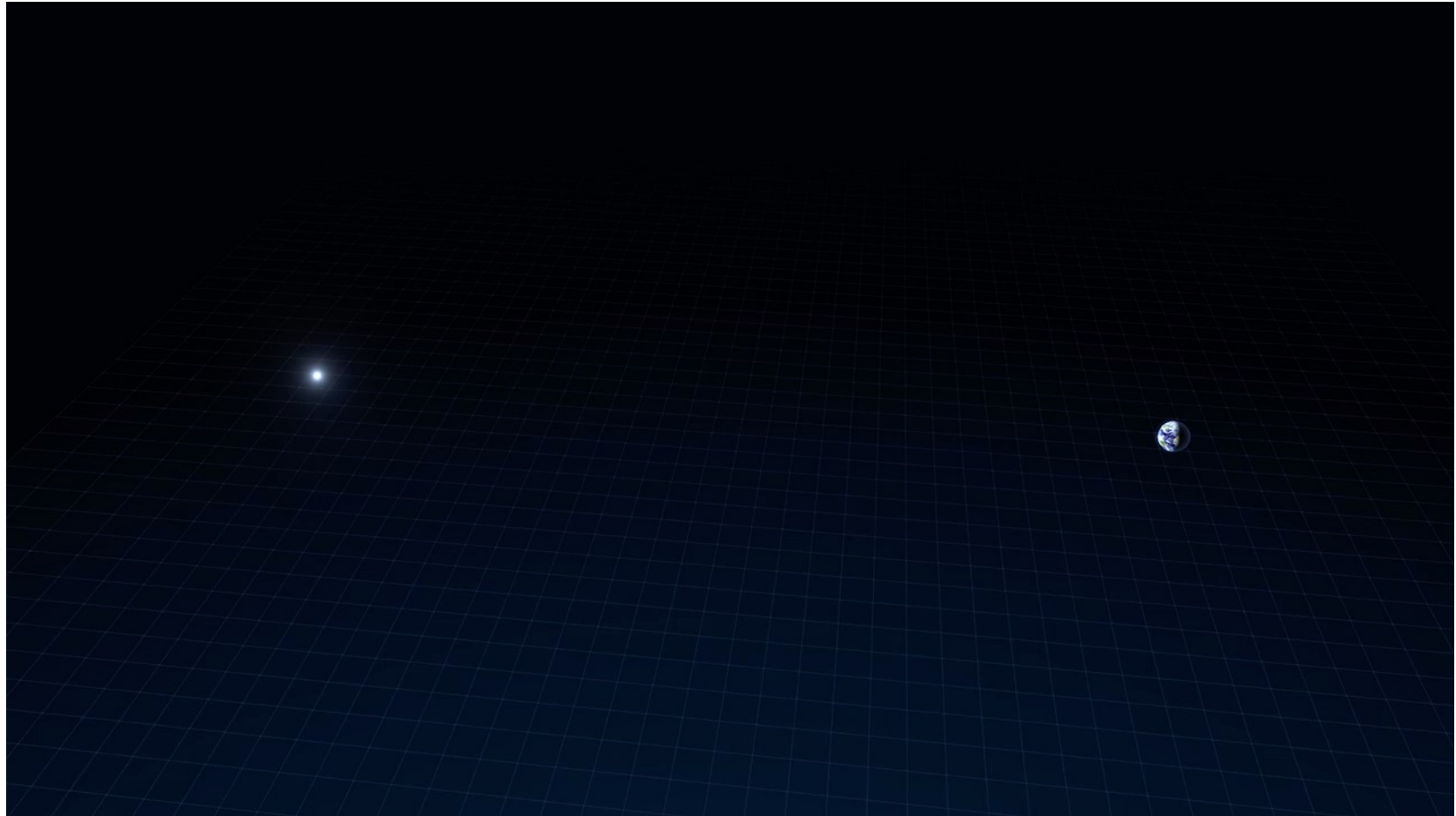
Rotation Curves.



Gravitational Lensing.



Gravitational Lensing.



Dark-matter rings in galaxy clusters. Hubble studies of ZwC10024+1652.



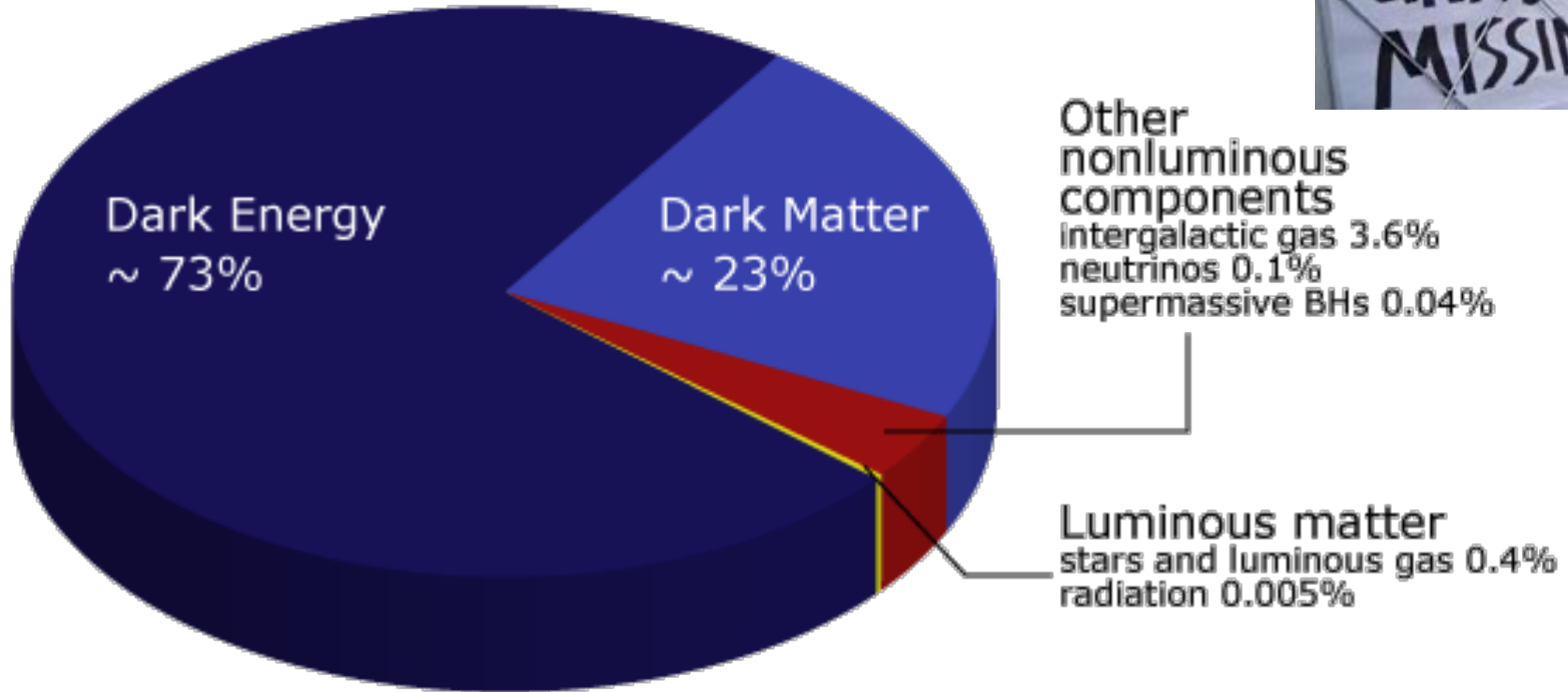
Rings of dark matter.



http://www.esa.int/esaCP/SEM5SHV681F_index_0.html

Help!

96% of the universe is missing!



My research: trying to find dark matter in a gold mine in South Dakota.





2 Minute 5 Second Intermission.

- Since paying attention for 1 hour and 15 minutes is hard when the topic is physics, let's take a 2 minute 5 second intermission.
- You can:
 - Stretch out.
 - Talk to your neighbors.
 - Ask me a quick question.
 - Enjoy the fantastic music.



Poisson's Equation.

- Gravitational flux due to a point mass m :

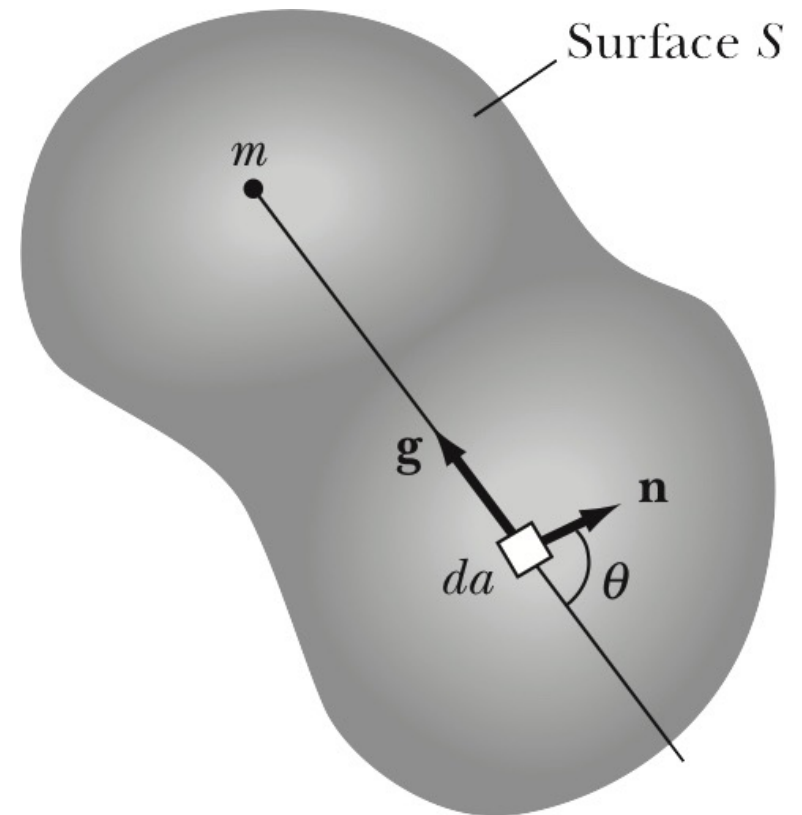
$$\Phi_{flux} = -4\pi Gm$$

- When we have a mass distribution inside S :

$$\Phi_{flux} = -4\pi G \int_V \rho dv$$

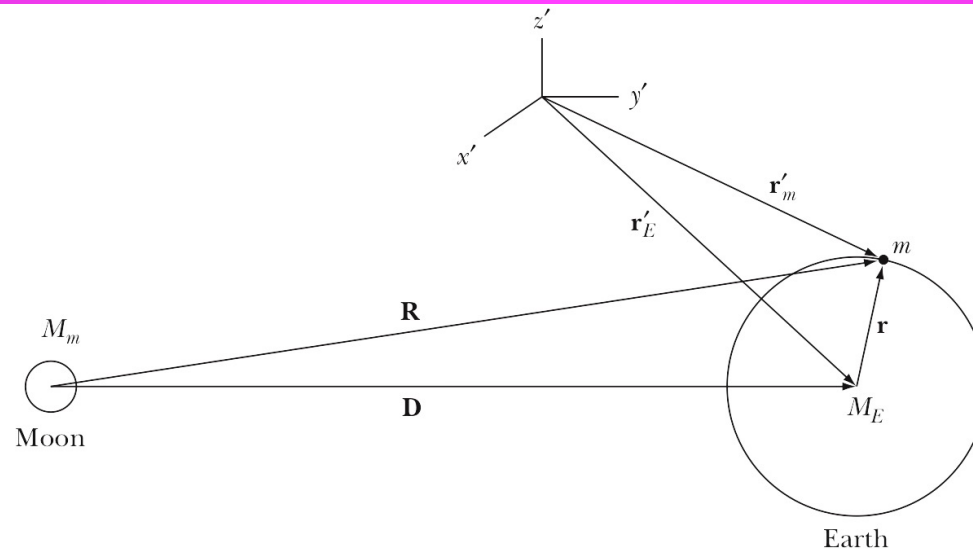
- This relation can be used to show that the gravitational potential satisfies the following equation:

$$\vec{\nabla}^2 \Phi_{flux} = 4\pi G\rho$$

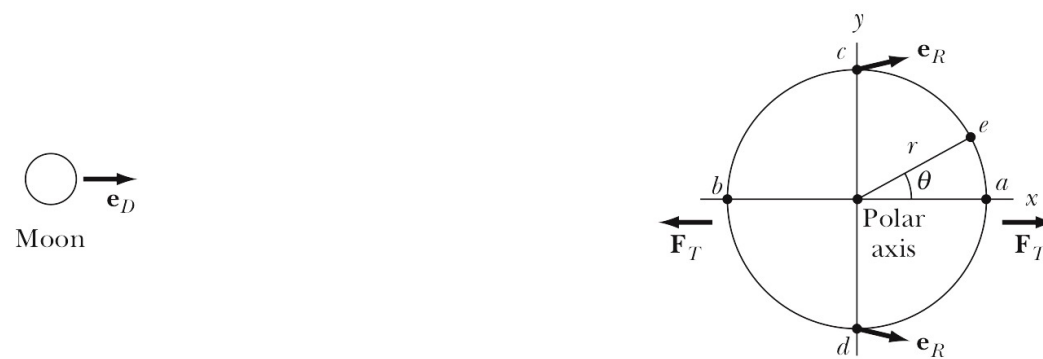


Tides.

The real story.

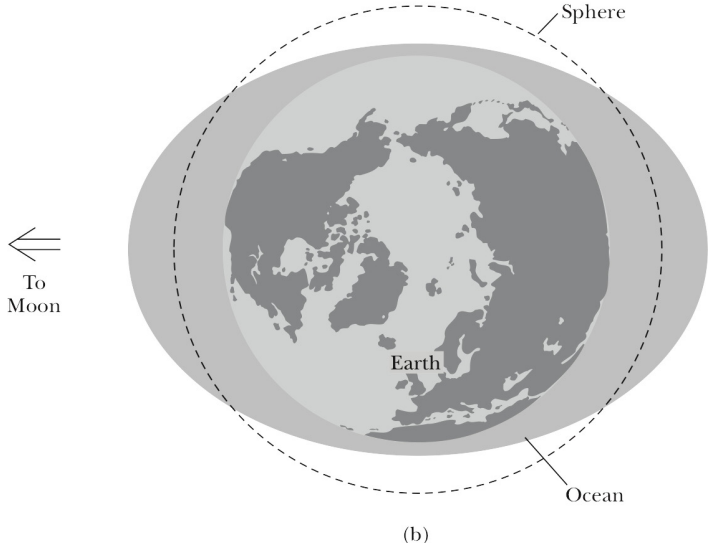
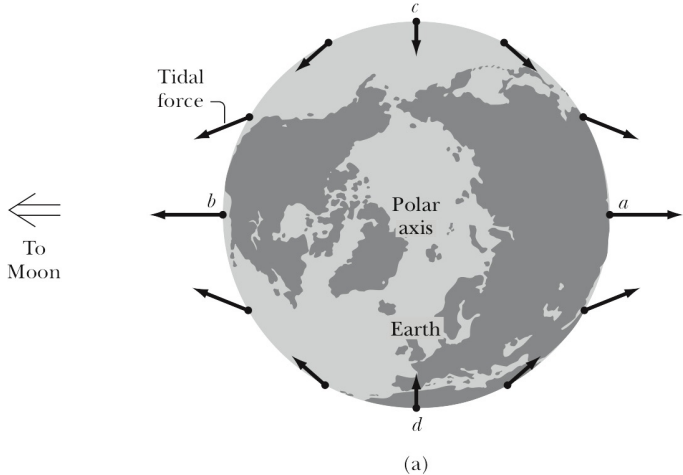


(a)

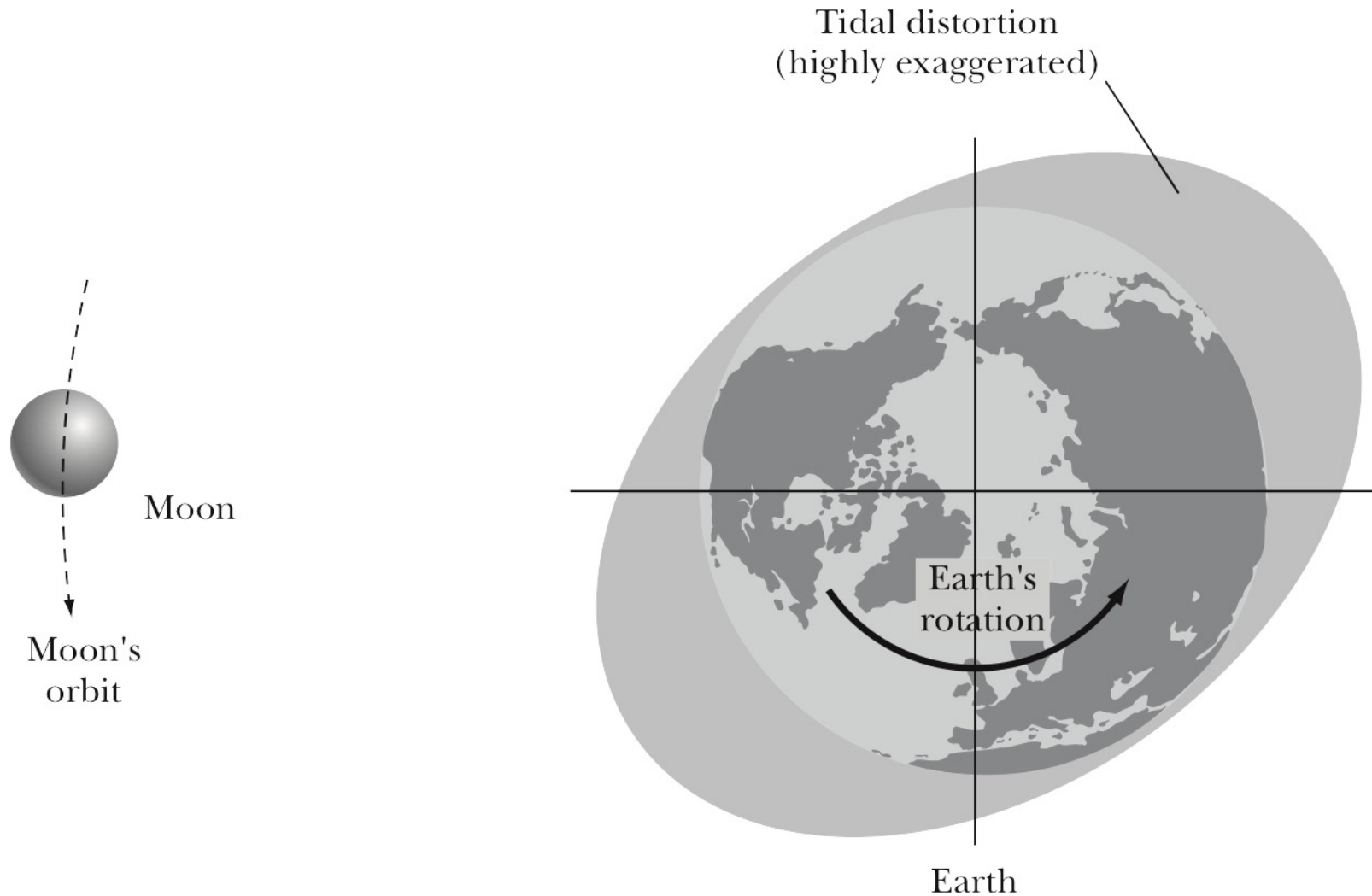


(b)

Forces, as viewed from a reference frame on Earth.

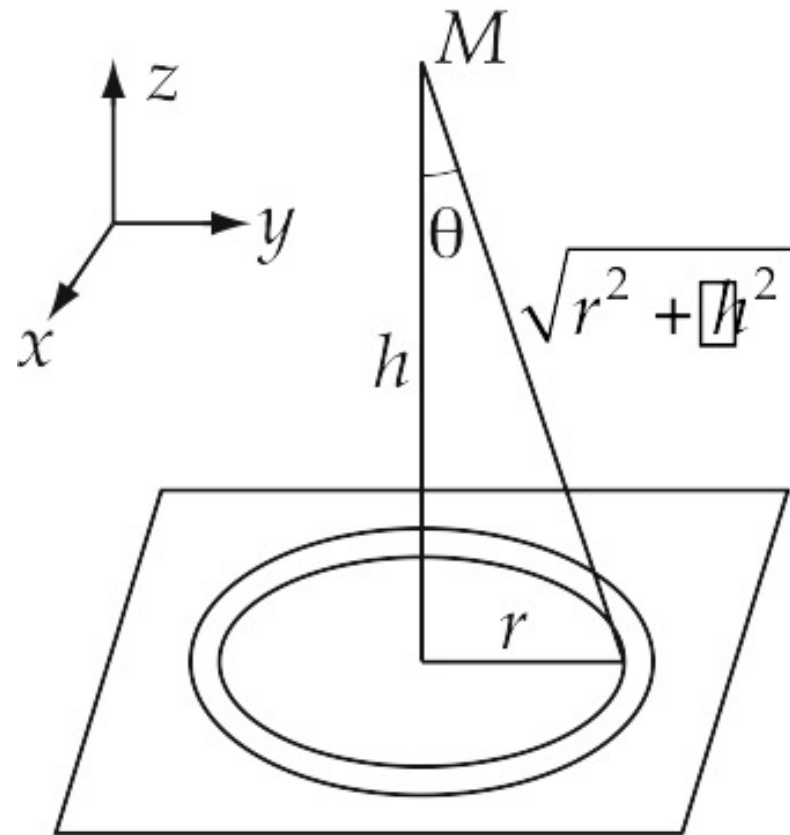


Effect of rotation.



Problem 5.16

- A uniformly charged sphere of mass M and radius R is fixed a distance h above a thin infinite sheet of mass density ρ (mass/area).
- With what force does the sphere attract the sheet?



ENOUGH FOR TODAY?