Class 19
Gravity
Announcements
Concepts overview

1. Universal gravity
Problem Solving
Overview

- Gravity equations and orbits
Gravitational force

• Force acts between two bodies that have mass
• \( F = \frac{Gm_1m_2}{r^2} \)
• Acceleration due to gravity, \( g \), where does it come from?
Your weight on the moon is around 1/6 of what it is on the earth. This is because:

1. Since your mass on the moon is less, the force due to gravity (your weight) from Newton’s equation is less

2. You are far from earth and Earth’s gravitational attraction falls off with distance

3. The moon weighs less than the earth

4. All the above

5. 2 and 3 above.
An astronaut in orbit feels “weightless” and can float around the space capsule. This is because:

1. She is far above the earth and gravity is less there.
2. She is in free-fall. In free fall, your weight (gravitational attraction) goes down
3. The centrifugal acceleration pushing her outwards in a circle exactly matches the gravitational attraction pulling in towards the earth so the net force (weight) is zero
4. None of the above
An astronaut blast off from earth, makes 4 low-earth orbits, then briefly fires booster rockets that blast him out of orbit and sends him racing off towards the moon. The low-earth orbit is a few hundred km above the surface of the earth. The moon is hundreds of thousands of miles away. As measured on a weigh scale in the capsule, the astronauts weight is:

1. Greater when he is in orbit
2. Greater when he is traveling to the moon
3. The same in each case
An astronaut blast off from earth, makes 4 low-earth orbits, then briefly fires booster rockets that blast him out of orbit and sends him racing off towards the moon. The low-earth orbit is a few hundred km above the surface of the earth. The moon is hundreds of thousands of miles away. The gravitational attraction due to the earth is:

1. Greater when he is in orbit
2. Greater when he is traveling to the moon
3. The same in each case
The Moon does not fall to Earth because

1. It is in Earth’s gravitational field.
2. The net force on it is zero.
3. It is beyond the main pull of Earth’s gravity.
4. all of the above
5. none of the above
Gravitational potential energy

- \( PE = -\frac{GMm}{r} \)
- Note, very similar to the force equation except
  1. Minus sign
  2. \( \frac{1}{r} \) dependence instead of \( \frac{1}{r^2} \)
Two satellites $A$ and $B$ of the same mass are going around Earth in concentric orbits. The distance of satellite $B$ from Earth’s center is twice that of satellite $A$. What is the ratio of the centripetal force acting on $B$ to that acting on $A$?

1. $1/8$
2. $1/4$
3. $1/2$
4. $\frac{1}{\sqrt{2}}$
5. 1
Suppose Earth had no atmosphere and a ball were fired from the top of Mt. Everest in a direction tangent to the ground. If the initial speed were high enough to cause the ball to travel in a circular trajectory around Earth, the ball’s acceleration would

1. be much less than \( g \) (because the ball doesn’t fall to the ground).
2. be approximately \( g \).
3. depend on the ball’s speed.