Do Now: Find the centripetal force acting on a 65kg person on a Gravitron with a radius of 12m and a period 3.4s.

Today

- Circular motion and amusement park rides.
- Universal Gravitation and satellite motion.

Centripetal Force and Friction

- The centripetal acceleration on an object creates a normal force if it is in contact with the rotating surface.
- If we know the normal force and the coefficient of friction, we can figure out frictional forces.

Gravitron Problem

- We know the normal force acting on the person on the gravitron is 2667N.
- To keep the person from slipping down the side of the gravitron wall, the force of static friction has to be higher than the force of gravity.
- Need coefficient of static friction.

If the coefficient of static friction is 0.25, does the person slide down the side?

Fighting Gravity

- In order not to fall, the forces have to be grater than the force of gravity.
- Centripetal force can create this.

A carnival ride allows riders to board a barrel with a radius of 8m. The barrel spins 20 times a minute and the bottom drops out. What is the minimum coefficient of static friction required to keep the riders from falling out the bottom of the barrel?

Step 1: Solve for the centripetal acceleration.

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Step 2: Compare it to the acceleration of gravity.

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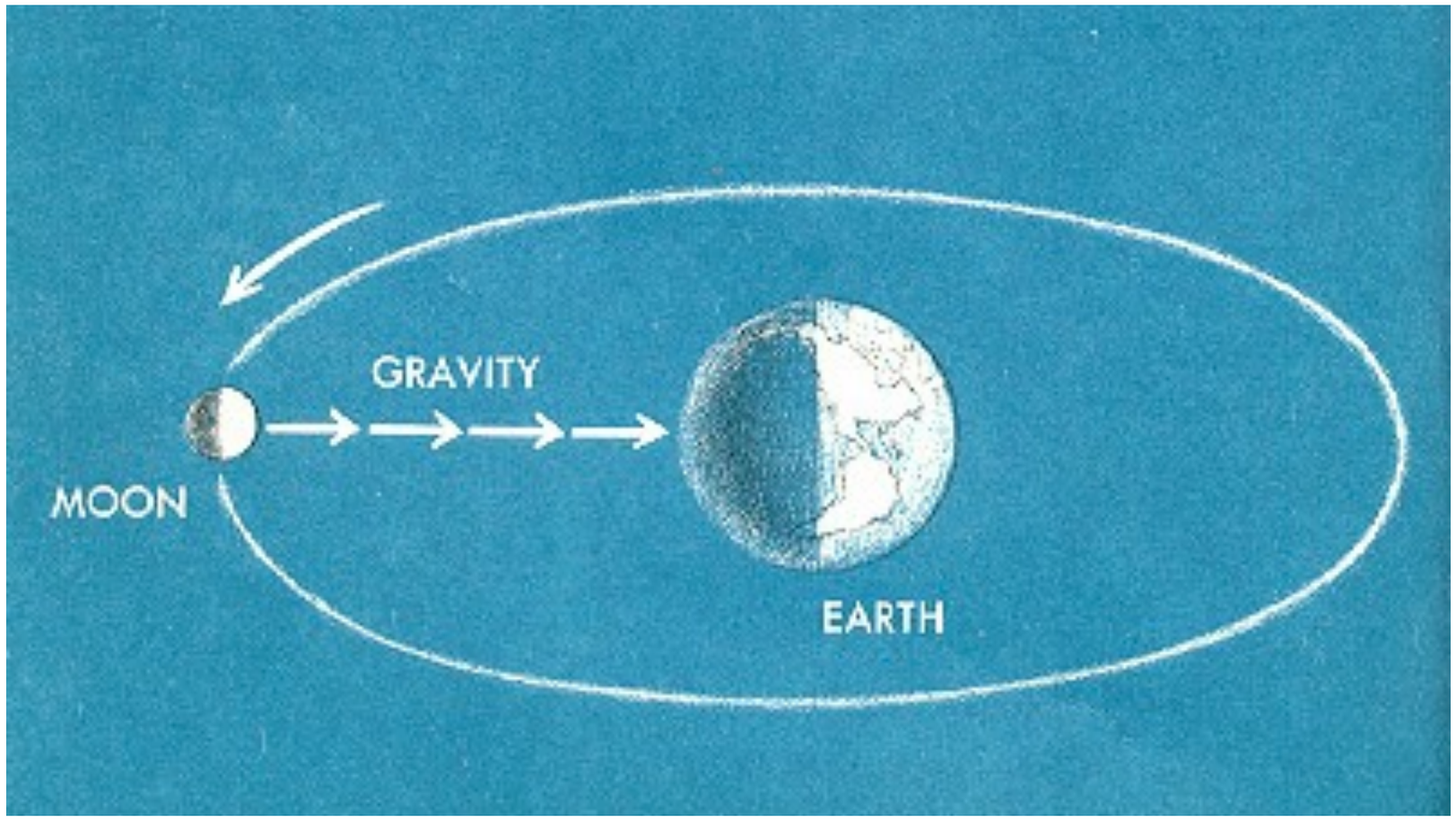
The ratio **is** the minimum coefficient of friction needed to keep the riders from sliding.

A plane flies at 250km/hr. What is the maximum radius of the loop needed to keep a rider in her seat at the top of the loop?

Sum of the Forces

- We now have forces due to centripetal acceleration.
- Solve for the net force at he top and bottom of a loop.
- Top: Fc-Fg.
- BottomFc+Fg.

A ninja swings a slingshot with a radius of 1.3m at 70rpm. If the stone has a mass of 0.7kg, what are the sum of the forces at the top and bottom of the circle?



Universal Gravitation

Force of Gravity

- Gravity affects everything with mass.
- We are attracted to the object with the larges gravitational force relative to proximity.
- The further away you are, the less effect gravity has on you.

How to think about gravity

Write this Down!

- Mass of Earth: 5.97x10^24kg.
- Radius of Earth: 6.371x10^6m.
- Universal Gravitational Constant: $6.67384 \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$

Force of gravity

- The force drawing any two objects with mass towards one another.
- Fg=(Gm1m2)/(r^2)
- m1 and m2 are objects with a particular mass.
- r is the distance between their centers of mass.

Find the force of gravity between you are the earth if you are on it's surface. How does it compare to F=mg?

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What is the centripetal acceleration of the Earth?

Satellite Motion

- The centripetal force must be equal to the gravitational force.
- You are falling at the same rate that you are moving to the side.

Free Falling in Outer Space

A 1200kg satellite is 500km from the surface of the Earth. What does it's angular velocity need to be in order to stay on a constant orbit? Hint: the centripetal force must be equal to the force of gravity.

Step 1:Solve for the force of gravity.

A 1200kg satellite is 500km from the surface of the Earth. What does it's angular velocity need to be in order to stay on a constant orbit? Hint: the centripetal force must be equal to the force of gravity.

Step 2: Solve for the velocity necessary to have the same force as gravity.

At what height above the surface of the Earth will a satellite of 500kg stay stationary over a city on the equator?