Physics G

Chapter 7 Syllabus

Gravity and Circular Motion

A/B	In Class	Due on this class
1 Jan 17/18	**DI**-Barrel of Bricks **GW**-Plate Lab **GW**-Circular Motion Quizlette (7.1)	**VF 7A Centripetal Acceleration** **VF 7B Centripetal Force**
2 Jan 22/23	**GW**-Circular Motion Quizlette **GW**-FA7.1 - Circular Motion	Turn in QL 7.1 – Circular motion
3 Jan 24/25	**SA7.1-Circular Motion (first 30)** **VF**-7C Vertical Circle **DI**-Vertical Circle Demos	Turn in FA 7.1
	Finals - See Website for Study Info	
4 Feb 5/6	**GW**-Vertical Circle Quizlette (7.2)	**VF 7C Vertical Circle**
5 Feb 7/8	**GW**-Vertical Circle QL **GW**-FA7.2	Turn in QL7.2 – Vertical Circle
6 Feb 11/12	**SA7.2-Vertical Circle (first 30)** **VF**-7D 7E - Gravity and Fundamental Forces **GW**-Gravity Questions	Turn in FA7.2
7 Feb 13/14	**GW**-Gravity and Orbit QL **GW**-Orbit Lab **GW**-FA7.3	**VF 7F Orbit Problems**
8 Feb 15/19	**GW**-Gravity and Orbit QL **GW**-Orbit Lab **GW**-FA7.3	**VF 7G Kepler's Laws** **VF 7H Banked Corners** Turn in Orbit Lab Turn in QL 7.3 – Orbit and Gravity
9 Feb 21/22	**SA7.3-Orbit and Gravity (first 30)** **VF**-5A Calculating Work **DI** – Calculating Power (5B)	Turn in FA7.3
1 Feb 25/26	**JAMBALAYA!!** **(or power and work)**	**VF 5C Jambalaya**

Assignments:

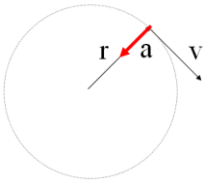
- 2 Labs:
  - *Plate Lab* – In class marble and plate thingy
  - *Orbit lab* – (Simulation on computer) /25 pts
- 3 Quizlettes/Formative/Summative Assessments:
  - 7.1 - Circular Motion
  - 7.2 - Gravity and Vertical Circle
  - 7.3 - Orbit

Handouts:

- _Syllabus-GravityAndCircularMotion-P
- 7
- FA7.1
- FA7.2
- FA7.3
- Lab-Orbit
- Noteguide7A-CentripetalAcceleration
- Noteguide7B-CentripetalForce
- Noteguide7C-VerticalCircle
- Noteguide7D-FundamentalForces
- Noteguide7E-UniversalGravitation
- Noteguide7F-Orbit
- Noteguide7G-KeplersLaws
- Noteguide7H-BankedCorners
- Quizlette-7.1Centripetal
- Quizlette-7.2VerticalCircle
- Quizlette-7.3GravityAndOrbit
- WarmupQuiz-VerticalCircle
- Worksheet-7.1-Centripetal
- Worksheet-7.2-VerticalCircle
- Worksheet-7.3-OrbitAndGravity

Noteguide for Centripetal Acceleration (Videos 7A) **Name** _____

Velocity = Speed + Direction



$a = v^2/r$
a = Centripetal acceleration
v = tangential velocity
r = radius of circle

Example - What is the centripetal acceleration of a 1200 kg car going 24 m/s around an 80. m radius corner?

What centripetal force is needed? What is the minimum coefficient of static friction required?

Whiteboards:

1. What is the centripetal acceleration if a tuna is going 6.2 m/s around a 2.3 m radius corner? (17 m/s/s)	2. A Volkswagen can do 0.650 "g"s (6.3765 m/s/s) of lateral acceleration. What is the minimum radius turn at 27.0 m/s? (114 m)

$a = 4\pi^2 r/T^2$
a = Centripetal acceleration
T = Period
r = radius of circle

Example: A merry-go-round completes a revolution every 7.15 seconds. What is your centripetal acceleration if you are 3.52 m from the center of rotation?

Whiteboard	Example
What should be the period of motion if you want 3.5 "g"s (34.335 m/s/s) of centripetal acceleration 5.25 m from the center of rotation? (2.5 s)	RPM Example: What is the acceleration of a point 32 cm out on a grinding wheel spinning at 1200 RPM? (5035 m/s/s – hint – T = 60 s/1200 Rev)

Noteguide for Centripetal Force (Videos 7B) **Name** _____

$a = v^2/r$
- a = Centripetal acceleration
- v = tangential velocity
- r = radius of circle

$a = 4\pi^2 r/T^2$
- a = Centripetal acceleration
- T = Period
- r = radius of circle

Example: What force is required to swing a 5.0kg object at 6.0m/s in a 75cm radius circle?

$F = mv^2/r$
- m = mass
- a = Centripetal acceleration
- v = tangential velocity
- r = radius of circle

$F = m4\pi^2 r/T^2$
- m = mass
- a = Centripetal acceleration
- T = Period
- r = radius of circle

Whiteboards:

1. Ice skates can give 420 N of turning force. What is r_{min} for a 50. kg skater @10.m/s? (11.9 m)	2. A ride makes a 60 kg small redheaded child go in a 4.1m radius circle with a force of 470 N. What period? (4.5 s)
3. It takes 35 N of force to make a glob of Jell-O go in a 2.0 m radius circle with a period of 1.85 seconds What's the mass? What's its flavor? (1.5 kg)	

Practice 7.1

1. a. What velocity must a car go around a 250. m radius corner to have a centripetal acceleration of 3.30 m/s/s? (28.7 m/s)
b. A centrifuge generates a centripetal acceleration of 3450 m/s/s with a period of 0.0258 s. What is the radius of the centrifuge? (0.0582 m)
c. What centripetal force do you need to make a 85.0 kg skier go 25.0 m/s around a 15.0 m radius corner? (3542 N)
d. A centrifuge exerts a force of 182 N on a 0.130 kg test tube spinning with a period of 0.0312 s. What is the radius of the centrifuge? (0.0345 m)
e. A 1120 kg car with a coefficient of friction of 0.730 goes around a level corner at 25.0 m/s. What is the minimum radius the corner can have? (87.4 m)

2. a. What is the centripetal acceleration of a skater going 6.40 m/s around a corner with a radius of 2.00 m? (20.48 m/s/s)
b. A centrifuge generates an acceleration of 9520 m/s/s with a radius of 0.0780 m. What is its period of motion? (0.0180 s)
c. A centrifuge has a radius of 0.0350 m, and a period of 0.0256 s. What force does it exert on a 0.0670 kg test tube? (141 N)
d. A 81.0 kg ice skater goes around a corner at 16.0 m/s. If the ice skates can generate a maximum lateral force of 480. N, what is the minimum radius of corner they can go around? (43.2 m)
e. A 0.0180 kg eraser is on a level turntable 0.170 m from the center. If there is a coefficient of friction of 0.850 between the turntable and the eraser, what is the minimum period of motion the turntable can have for the eraser to remain without flying off? (0.898 s)

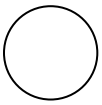
3. a. A car goes 23.0 m/s around a corner with a lateral acceleration of 4.50 m/s/s. What is the radius of the corner? (118 m)
b. A centrifuge has a radius of 0.0920 m, and a period of 0.0450 s. What is its centripetal acceleration? (1794 m/s/s)
c. What force do you need to twirl a 4.30 kg hammer in a 1.28 m radius circle at 7.20 m/s? (174 N)
d. A centrifuge exerts 298 N on a 0.0370 kg test tube spinning in a 0.0650 m radius circle. What is its period of motion? (0.0178 s)
e. There is a coefficient of friction of 0.870 between a 1670 kg car and the level road. What is its maximum possible velocity around a 130. m radius corner? (33.3 m/s)

4. a. A car going around a corner with a radius of 180. m is accelerating laterally at 3.40 m/s/s. What is its speed? (24.7 m/s)
b. A centrifuge generates an acceleration of 6590 m/s/s spinning test tubes in a circle with a period of 0.0370 s. What is the radius of the centrifuge? (0.229 m)
c. A centrifuge makes 0.0790 kg test tubes go in a 0.0750 m radius circle with a period of 0.0545 s. What force does it exert on the test tubes? (78.8 N)
d. What is the maximum velocity you can twirl a 3.76 kg hammer in a 1.40 m radius circle if the string it is attached to has a tensile strength of 158 N? (i.e. that is the centripetal force) (7.67 m/s)
e. A 0.100 kg mass is on a level turntable 0.120 m from the center. If there is a coefficient of friction of 0.210 between the turntable and the mass, what is the minimum period of motion the turntable can have for the mass to remain without flying off? (1.52 s)

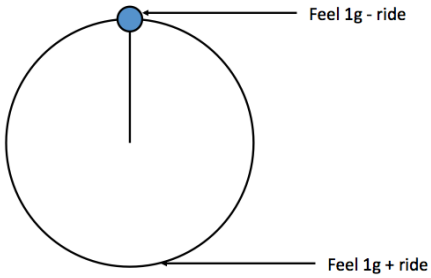
5. a. What is the centripetal acceleration of a skier going 13.0 m/s around a corner with a radius of 26.0 m? (6.5 m/s/s)
b. A centrifuge generates an acceleration of 2560 m/s/s with a radius of 0.0870 m. What is its period of motion? (0.0366 s)
c. What force do you need to twirl a 7.40 kg hammer in a 1.50 m radius circle at 12.0 m/s?? (710.4 N)
d. A 0.0650 m radius centrifuge exerts a force of 190. N on a test tube. What is the mass of the test tube if its period of motion is 0.0380 s? (0.107 kg)
e. There is a coefficient of friction of 0.740 between a 1780 kg car and the level road. What is its maximum possible velocity around a 180. m radius corner? (36.1 m/s)

Noteguide for Vertical Circle – Videos 7C **Name_____**

Concept 0: $a_c > 9.8$ m/s/s so the string stays taut/water stays in cup

Show why this is true: 	Example 1: What is the minimum speed at the top for my bucket if r = 1.12 m? (So the cup does not fall off)
A roller coaster goes in a 3.8 m radius vertical circle. What is the minimum speed it can have at the top to stay on the rails? (6.1 m/s)	What is the maximum radius you can twirl a bucket full of water going 2.3 m/s at the top? (0.54 m)

Concept 1: The "g" force of the ride adds to earth's "g" force: (draw arrows to explain why)



Whiteboards:

1. A Ferris Wheel pulls 0.2 "g"s. What is the "g" force at the top and the bottom? (0.80 "g"s top and 1.20 "g"s bottom)	2. The Rock O Plane pulls 0.70 "g"s. What do you feel at the top and the bottom? (0.30 "g"s top, 1.70 "g"s bottom)
3. A Ferris wheel makes riders feel 0.70 "g"s at the top, and 1.30 "g"s at the bottom. What is the ride pulling? (0.30 "g"s)	4. You feel 2.1 "g"s at the bottom of a roller coaster loop. What is the ride "pulling" and what do you feel at the top? (1.1 "g"s ride, -0.10 "g"s top [inverted])

Example 1 – You calculate centripetal acceleration first:

A Ferris wheel has a radius of 9.40 m, and a period of 15.0 s. What is the acceleration of the ride in m/s/s and "g"s? What "g" force do they measure at the top and at the bottom?

Whiteboards:

1. A Ferris wheel makes riders go 4.08 m/s in an 8.50 m radius circle. What is the centripetal acceleration of the ride in "g"s? What do the riders feel at the top and the bottom? (ac = 1.9584 m/s/s = 0.20 "g"s, 0.80 "g"s top, 1.20 "g"s bottom)	2. A ride makes riders go in a 3.40 m radius vertical circle with a period of 2.93 s. What "g"s is the ride pulling, and what do the riders feel at the top and at the bottom? (ac = 15.635 m/s/s = 1.60 "g"s, -0.60 "g"s inverted top, 2.60 "g"s bottom)

Example 2: - You calculate the "g"s first:

A rider moving in a 3.75 m radius vertical circle feels -1.2 "g"s (inverted "g"s) at the top of the circle. A) How many "g"s is the ride pulling? B) How many "g"s do they feel at the bottom? C) What is their tangential velocity?

Whiteboards:

1 You are riding a rollercoaster, and you read an inverted "g" force of 0.75 "g"s at the top of a 3.8 m radius loop. (You are upside down!) (you feel -0.75 "g"s) A) How many "g"s is the ride pulling? B) What is that in m/s/s? C) What is your speed? (1.75 "g"s = 17.15 m/s/s. v = 8.07 m/s)	2. A ride goes in a 5.0 m radius vertical circle. The ride itself pulls 1.80 "g"s. What do the riders feel at the bottom, and at the top, and what is the period of motion of the ride? (2.80 "g"s bottom, -0.80 "g"s inverted top, T = 3.345 s)

Practice 7.2

1. a. A very clever Physics teacher twirls a bucket in a 1.50 m radius vertical circle at a constant speed. What is the maximum period the motion can have for the water to stay in the bucket? (2.46 s)
b. A Ferris wheel has an acceleration of 0.210 "g"s. What do the riders feel at the top and at the bottom? (0.790 "g"s top, 1.210 "g"s bottom)
c. Riders on a Ferris wheel measure 1.200 "g"s at the bottom of the ride. What "g"s do the riders feel and measure at the top, and how many "g"s is the ride really pulling? What is the acceleration of the ride in m/s/s? (0.800 "g"s, 0.200 "g"s, 1.96 m/s/s)
d. A Ferris wheel has a radius of 7.80 m, and a period of 9.00 s. What "g" force do they read at the top and bottom of the ride? (0.612 "g"s, 1.388 "g"s)
e. A 3.10 m radius vertical circle ride that holds its riders upside down at the top makes riders feel 2.60 "g"s at the bottom of the ride. What is the tangential velocity of the ride? (6.97 m/s)

2. a. The Chuck wagon makes riders go in a 4.60 m radius vertical circle. What is the maximum period the motion can have for the riders to not fall off the ride when they turn upside down at the top? (4.30 s)
b. b. A Zero-G has an acceleration of 1.650 "g"s. What to the riders feel at the top and at the bottom? (-0.650 "g"s inverted top, 2.650 "g"s bottom)
c. A Ferris wheel is pulling 0.170 "g"s of centripetal acceleration. What "g"s do the riders feel and measure at the top and bottom of the ride? What is the acceleration of the ride in m/s/s? (0.830 "g"s, 1.170 "g"s, 1.67 m/s/s)
d. A vertical circle ride that holds its riders upside down at the top has a radius of 9.20 m, and a period of 4.60 s. What "g" force to the riders feel and measure at the top and at the bottom of the ride? (-0.751 "g"s (inverted), 2.751 "g"s)
e. Riders at the bottom of the Ferris wheel measure a "g" force of 1.320 "g"s. What is the tangential velocity of the ride if the radius is 7.50 m? (4.85 m/s)

3. a. The old Looping Thunder had 3.80 m radius inverting loop. What was the minimum tangential velocity at the top for the riders to stay on the ride without falling off? (6.10 m/s)
b. A Ferris wheel has an acceleration of 0.140 "g"s. What do the riders feel at the top and at the bottom? (0.860 "g"s top, 1.140 "g"s bottom)
c. Riders on a Ferris wheel measure 0.910 "g"s at the top of the ride. What "g"s do the riders feel and measure at the bottom, and how many "g"s is the ride really pulling? What is the acceleration of the ride in m/s/s? (1.090 "g"s. 0.090 "g"s, 0.882 m/s/s)
d. A Ferris wheel has a radius of 8.20 m, and a tangential velocity of 4.50 m/s. What "g" force do they read at the top and bottom of the ride? (0.748 "g"s, 1.252 "g"s)
e. A vertical circle ride that holds its riders upside down at the top has a radius of 5.30 m and generates an inverted "g" force of -0.420 "g"s at the top. What is the period of the ride? (3.88 s)

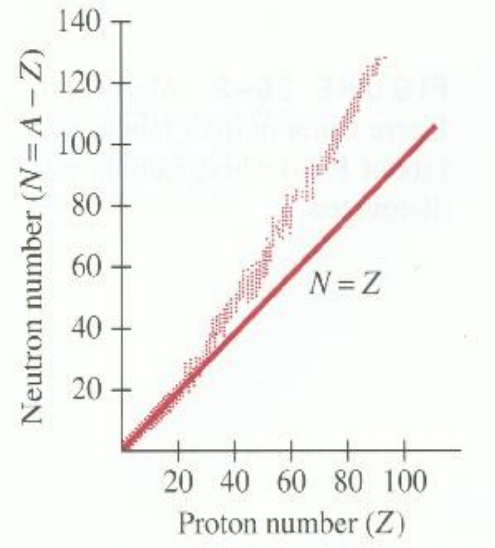
4. a. An airplane goes in a 112 m radius vertical circle (inside loop). What is the minimum velocity the plane can have for the pilot to stay in her seat without requiring a seatbelt? (33.1 m/s)
b. A Zero-G has an acceleration of 1.420 "g"s. What to the riders feel at the top and at the bottom? (-0.420 "g"s inverted top, 2.420 "g"s bottom)
c. Riders on a Ferris wheel measure 1.350 "g"s at the bottom of the ride. What "g"s do the riders feel and measure at the top, and how many "g"s is the ride really pulling? What is the acceleration of the ride in m/s/s? (0.650 "g"s, 0.350 "g"s, 3.43 m/s/s)
d. A vertical circle ride that holds its riders upside down at the top has a radius of 4.50 m, and a velocity of 9.70 m/s. What "g" force to the riders feel and measure at the top and at the bottom of the ride? (-1.134 "g"s (inverted), 3.134 "g"s)
e. Riders at the bottom of the Ferris wheel measure a "g" force of 1.120 "g"s. What is the period of the ride if the radius is 9.50 m? (17.9 s)

5. a. The Zero G has a radius of 4.30 m. What is the maximum period the ride can have to keep the riders from falling off the ride at the top when it is vertical? (4.16 s)
b. A Ferris wheel has an acceleration of 0.350 "g"s. What do the riders feel at the top and at the bottom? (0.650 "g"s top, 1.350 "g"s bottom)
c. A Ferris wheel is pulling 0.210 "g"s of centripetal acceleration. What "g"s do the riders feel and measure at the top and bottom of the ride? What is the acceleration of the ride in m/s/s? (0.790 "g"s, 1.210 "g"s, 2.06 m/s/s)
d. A Ferris wheel has a radius of 7.60 m, and a period of 11.50 s. What "g" force do they read at the top and bottom of the ride? (0.768 "g"s, 1.232 "g"s)
e. A vertical circle ride that holds its riders upside down at the top has a radius of 5.80 m and generates an inverted "g" force of -0.720 "g"s at the top. What is the tangential velocity of the ride? (9.89 m/s)

Noteguide for Fundamental Forces: (Videos 7D) **Name**_____

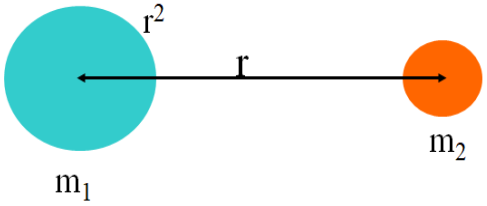
Gravity	Weak Nuclear
Electro-Magnetic	Strong Nuclear

Murray goes on a rant about how the short range nature of the Strong Nuclear (Binds neutrons and protons together) limits the number of stable nuclei (they get too big) and influences the number of neutrons.



Noteguide for Universal Gravitation: (Videos 7E) **Name**_____

$F = \frac{Gm_1m_2}{r^2}$



r = Center to center distance
m_1 = One of the masses
m_2 = The other mass
G = Universal gravitation constant

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

Example 1 - Find the force of gravity between a 0.756 kg stapler, and a 0.341 kg marker that is 1.75 m away?

Example 2 - What is the force of gravity between a 1.0 kg mass, and the earth?
($r = 6.38 \times 10^6$ m, $m_{earth} = 5.97 \times 10^{24}$ kg)

Whiteboards:

1. What is the force of gravity between a 5.2 kg shot and a 250. kg wrecking ball whose centers are 2.45 m distant? (1.44×10^{-8} N)	2. Another shot is 1.45 m from the center of a 250. kg wrecking ball and experiences a force of 1.55×10^{-7} N, what is the mass of the shot? (19.5 kg)
3. What distance from the center of a 512 kg wrecking ball must a 4.5 kg bowling ball be to experience a force of 1.13×10^{-9} N? (11.7 m)	4. The moon has a mass of 7.36×10^{22} kg, and a radius of 1.74×10^6 m. What does a 34.2 kg mass weigh on the surface? (55.5 N)

Noteguide for Orbit problems - Videos 7F **Name**_____

Use $\frac{m_s v^2}{r} = \frac{G m_c m_s}{r^2}$ or $\frac{m_s 4\pi^2 r}{T^2} = \frac{G m_c m_s}{r^2}$

G = 6.67 x 10^{-11} Nm^2/kg^2

These come from these formulas:

$F = \frac{G m_c m_s}{r^2}$ $a = \frac{4\pi^2 r}{T^2} = \frac{v^2}{r}$ $F = ma$

Example 1 - What is the velocity of orbit 250 miles above the earth?

r = 6.38x10^6 m + (250 mi)(1609 m/mi) = 6782250 m, me = 5.97 x 10^{24} kg

Example 2 - What is the radius of a geosynchronous orbit?

T = 23:56:04 = 23(3600) + 56(60) + 4 = 86164 s, m_e = 5.97 x 10^{24} kg

Fill in the Solutions:

$\frac{m_s v^2}{r} = \frac{G m_c m_s}{r^2}$ **Formula:**	**Calculator:**
v =	
m_c =	
r =	

$\frac{m_s 4\pi^2 r}{T^2} = \frac{G m_c m_s}{r^2}$ **Formula:**	**Calculator:**
T =	
m_c =	
r =	

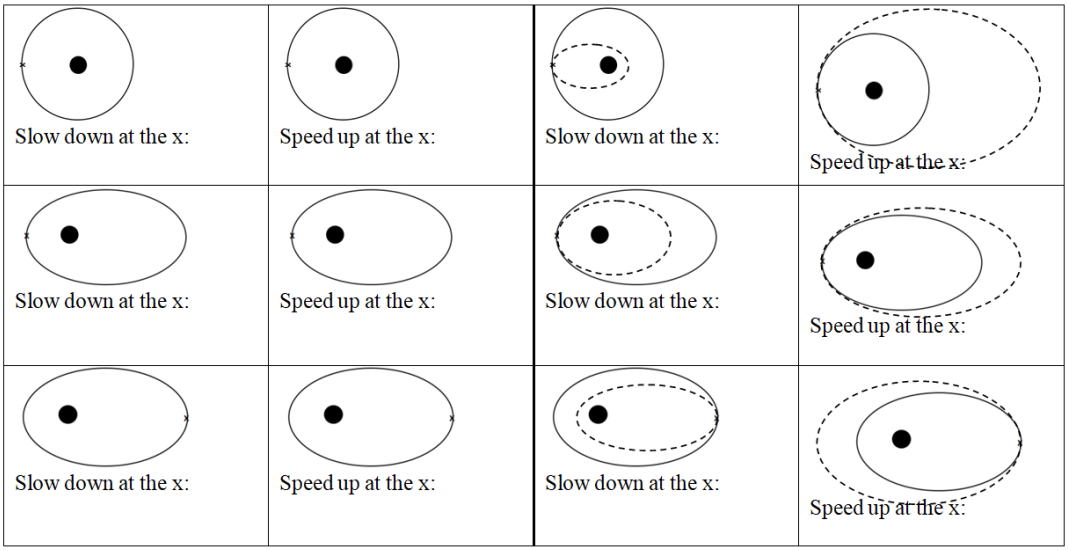
Orbit and Gravity Questions from SA7.3

Use the value of $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

38,600 N 44.5 kg 2.53×10^{24} kg 2.43×10^{6} s	1. a. What is the force of gravity between a 6.50×10^{16} kg asteroid and a 18,700 kg spaceship if their centers are 1,450 m distant? b. The centers of two lead spheres are separated by 6.70 m. If one sphere has a mass of 56.0 kg, and there is an attractive force of 3.70×10^{-9} N, what is the mass of the other sphere? c. You are orbiting the planet Qwrmczl at a radius of 1.45×10^{7} m, at a velocity of 3410 m/s. What is its mass? d. What is the period of an orbit that is 3.90×10^{8} m from earth's center? ($m = 5.97 \times 10^{24}$ kg)
7.68 N 175 m 5.31×10^{23} kg 5.38×10^{11} m	2. a. What is the force of gravity between a 2.60×10^{13} kg asteroid and a 56,100 kg spaceship if their centers are 3,560 m distant? b. What distance separates the centers of two lead spheres if one has a mass of 123 kg, the other a mass of 12.0 kg and there is an attractive force of 3.20×10^{-12} N? c. You are orbiting the planet Wnnydrydrl at a radius of 7.80×10^{6} m, and a period of 2.30×10^{4} seconds. What is the planet's mass? d. What is the radius of an orbit around earth ($m = 5.97 \times 10^{24}$ kg) that has an orbital velocity of 27.2 m/s?
3,980 N 2.84 kg 2.51×10^{8} m 4.89×10^{5} s	3. a. What is the force of gravity between a 2.10×10^{15} kg asteroid and a 23,800 kg spaceship if their centers are 915 m distant? b. The centers of two lead spheres are separated by 1.35 m. If one sphere has a mass of 125 kg, and there is an attractive force of 1.30×10^{-8} N, what is the mass of the other sphere? c. What is the radius of the orbit that has an orbital velocity of 1260 m/s around the earth? ($m = 5.97 \times 10^{24}$ kg) d. What is the period of an orbit with a radius of 3.10×10^{7} m around the moon? (Moon's mass is 7.36×10^{22} kg)
72.4 N 1.67 m 2.92×10^{5} s 7.54×10^{25} kg	4. a. What is the force of gravity between a 2.30×10^{14} kg asteroid and a 12,700 kg spaceship if their centers are 1,640 m distant? b. What distance separates the centers of two lead spheres if one has a mass of 215 kg, the other a mass of 125 kg and there is an attractive force of 6.40×10^{-7} N? c. What is the period of the orbit that has a radius of 9.50×10^{7} m around the earth? ($m = 5.97 \times 10^{24}$ kg) d. You orbit the planet Kssnndnnwrr at a radius of 8.20×10^{7} m with a velocity of 7830 m/s. What is its mass?
40.0 N 9.60 kg 986 m/s 2.15×10^{23} kg	5. a. What is the force of gravity between a 23.6×10^{12} kg asteroid and a 14,600 kg spaceship if their centers are 758 m distant? b. The centers of two lead spheres are separated by 4.90 m. If one sphere has a mass of 45.0 kg, and there is an attractive force of 1.20×10^{-9} N, what is the mass of the other sphere? c. What is the velocity of the orbit that has a radius of 4.10×10^{8} m around the earth? ($m = 5.97 \times 10^{24}$ kg) d. You are in an orbit with a radius of 8.50×10^{7} m and a period of 1.30×10^{6} s around the planet Rjxnstdnnr. What is its mass?

e.

Questions: Answers:

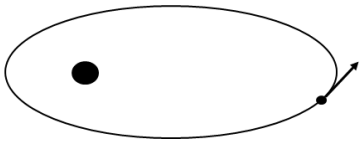


In general, speeding up brings the far side <u>out</u>, slowing down brings the far side <u>in</u>. Speeding up brings the entire trajectory <u>outside</u> the old one, and slowing down brings entire trajectory <u>inside</u> the old one.

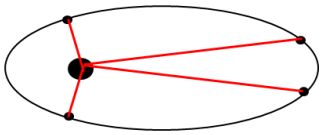
Noteguide for Kepler's Laws: (Videos 7G) **Name**_____

Johannes Kepler **1571 - 1630**
Tycho Brahe **1546 - 1601**

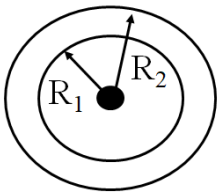
1. Orbits are ellipses.
(Central body a focal point)



2. Objects sweep equal area in equal time
(closer = faster)



3. Period – Radius



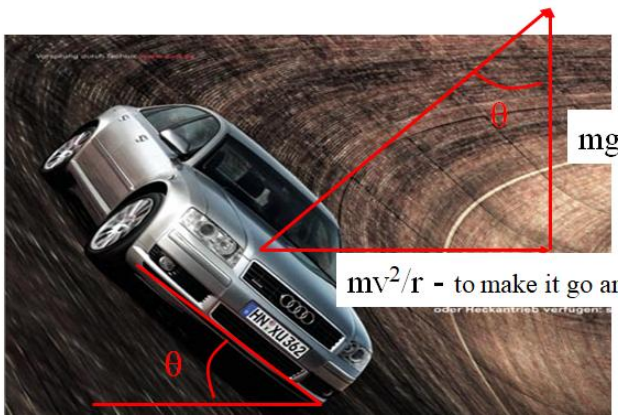
$$\frac{R_1^3}{T_1^2} = \frac{R_2^3}{T_2^2}$$

Example 1: What is the radius of a geostationary orbit (T = 1 day) if for the moon T = 27.4 days, R = 3.8×10^8 m

Example 2: Mars is 1.524 AUs from the sun. If our year is 365.26 days long, how many earth days is Mars's year?

Noteguide for Banked Corners: (Videos 7H) **Name**_____

$$\theta = \tan^{-1}(v^2/rg)$$



mg - to hold it up

mv^2/r - to make it go around the corner

Example: The on ramp from onto I-5 from Nyberg is 40. m in radius maybe. What should be the bank angle to go 27 m/s around it?

Whiteboards:

1. One of the Terwilliger curves has a radius of 270 m. What is the bank angle for cars to go 29 m/s around it? (18^o)	2. The on ramp from onto I-5 from Nyberg is 40. m in radius maybe. What should be the bank angle to go 45. m/s (101 mph) around it? (79^o) What about 112. m/s (250 mph) around it? (88^o) What does the angle approach? (90^o)