Circular Motion and Gravitation Auxilliary Items

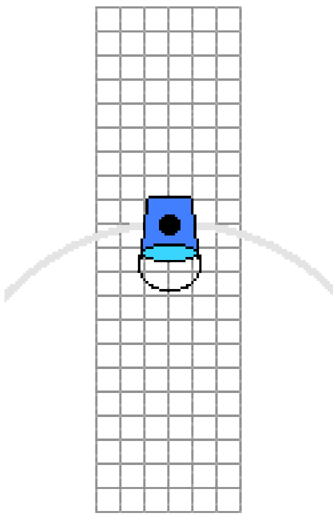
For The Loop-the-Loop Lab

(Tape the following into your Data section and complete using the simulation program.)

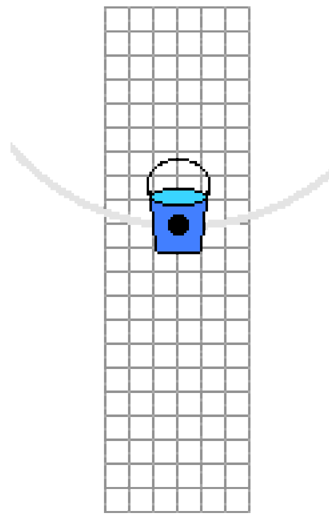
Post-Lab Questions:

1. Construct a free-body diagram showing the forces acting upon the bucket at the top and the bottom of the loop. The size of the force vector should be in proportion to the size of the force. Label each force according to type.

Loop Top



Loop Bottom



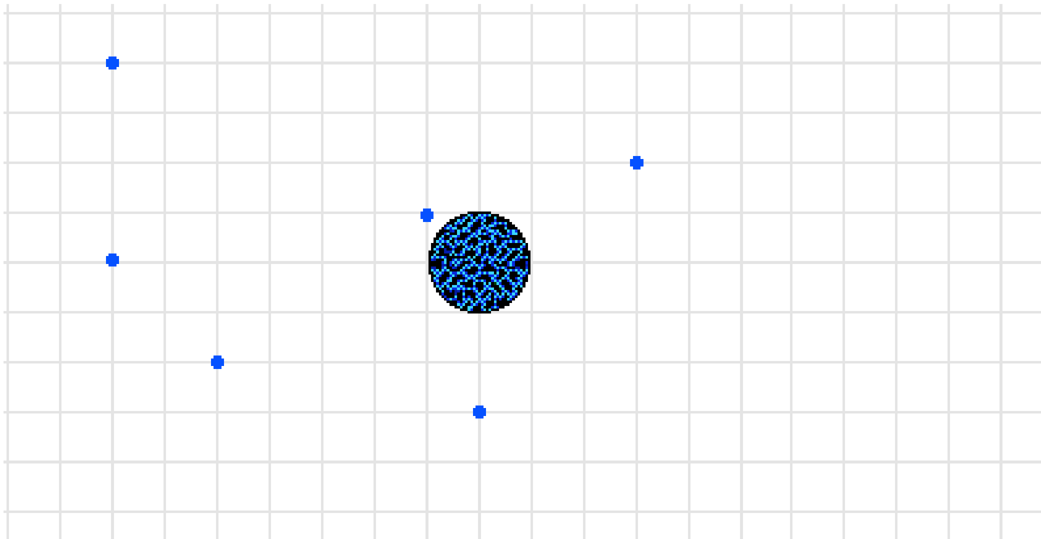
2. Use the following information about speed and radius to determine the acceleration, net force and tension force acting on the bucket at the top and the bottom of the loop. Show your work in an organized fashion.

Loop Top	Loop Bottom
m = 1.2-kg R = 1.1 m v = 4.4 m/s	m = 1.2-kg R = 1.1 m v = 6.2 m/s
a = ________________ m/s/s	a = ________________ m/s/s
F_{net} = __________________ N	F_{net} = __________________ N
F_{tens} = _________________ N	F_{tens} = _________________ N

For The Great Mass Attraction Simulation

(Tape the following into your Data section and complete using the simulation program.)

Draw a force vector (arrow with arrowhead) to depict the direction and magnitude of the force acting between the earth and the object. **Note**: the size of the arrow is indicative of the strength of the force.



Consider the earth's surface to be a distance of one Earth-radius (1 R_{Earth}). Use the table at the right to record data for whole-number multiples of R_{Earth}. Then use the data and the simulation program to answer the questions at the right.

Distance	F_{grav} (N)
1•R_E	____________
2•R_E	____________
3•R_E	____________
4•R_E	____________
5•R_E	____________
6•R_E	____________
7•R_E	____________
8•R_E	____________
9•R_E	____________

Use the simulation program to answer the following questions:

As the **separation distance** between the object and the Earth is increased by a factor of ...

... 2, the F_{grav} is ______________ by a factor of _____.

... 3, the F_{grav} is ______________ by a factor of _____.

... 4, then F_{grav} is ______________ by a factor of _____.

As the mass of the object is increased by a factor of ...

... 2, then the F_{grav} is ____________ by a factor of ____.

... 3, then the F_{grav} is ____________ by a factor of ____.

... 4, then the F_{grav} is ____________ by a factor of ____.

As the mass of the Earth is increased by a factor of ...

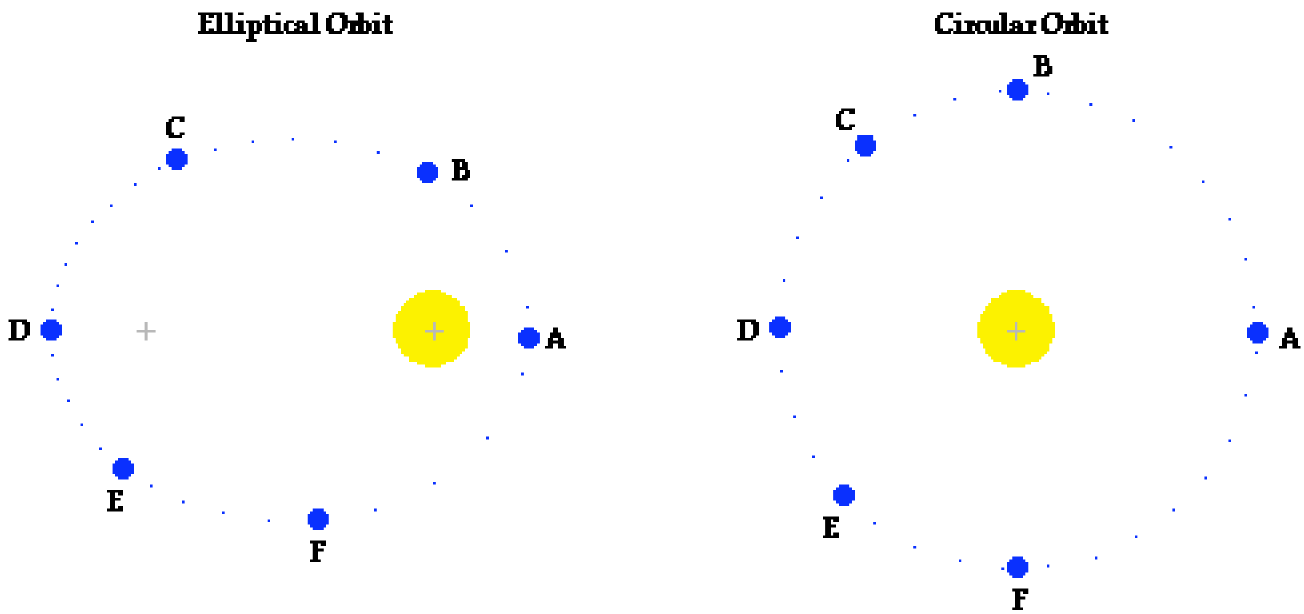
... 2, the F_{grav} is ______________ by a factor of _____.

... 3, the F_{grav} is ______________ by a factor of _____.

... 4, the F_{grav} is ______________ by a factor of _____.

For the Satellite Motion Simulation:
(Tape the following table into your lab notebook and complete.)

1. A circular orbit and a highly elliptical orbit are shown in the diagram below. Draw and label the net force (**F**) and velocity (**v**) vectors for each of the six marked positions for a counter-clockwise orbit. Draw the vectors in the appropriate direction and of the proper magnitude (relatively speaking).



2. Complete the following sentences by filling in the blanks:

   For elliptical obits: the direction of the velocity of the satellite is ___________________ (always, seldom, never) perpendicular to the net force acting upon the satellite.

   For circular obits: the direction of the velocity of the satellite is ___________________ (always, seldom, never) perpendicular to the net force acting upon the satellite.

3. Fill in the blanks in the following paragraph:

   If a satellite is orbiting the Earth in elliptical motion, then it will move ___________ (slowest, fastest) when its closest to the Earth. While moving towards the Earth (along the path from C to D) there is a component of force in the ________ (same, opposite) direction as the motion; this causes the satellite to ___________ (slow down, speed up). While moving away from the Earth (along the path from D to A) there is a component of force in the ________ (same, opposite) direction as the motion; this causes the satellite to ___________ (slow down, speed up).

For the Law of Harmonies Analysis:

(Tape the following table into your lab notebook and complete.)

Planet	**Period (Earth years)**	**Ave. Radius (astron. units)**	
Mercury	0.241	0.39	
Venus	0.615	0.72	
Earth	1.00	1.00	
Mars	1.88	1.52	
Jupiter	11.8	5.20	
Saturn	29.5	9.54	
Uranus	84.0	19.18	
Neptune	165	30.06	
Pluto	248	39.44	

For the Jupiter's Moons Analysis:

(Tape the following table into your lab notebook and complete.)

Jupiter's Moon	**Period (sec)**	**Radius of Orbit (m)**	
Io	1.53×10^5	4.2×10^8	
Europa	3.07×10^5	6.7×10^8	
Ganymede	6.18×10^5	1.1×10^9	
Callisto	1.44×10^6	1.9×10^9	

For the Mass of Saturn Analysis:
(Tape the following table into your lab notebook and complete.)

Satellite	Mean Distance (km)	Period (days)	
Pan	134000	0.58	
Prometheus	139000	0.61	
Pandora	142000	0.63	
Janus	151000	0.69	
Mimas	186000	0.94	
Enceladus	238000	1.37	
Calypso	295000	1.89	
Helene	377000	2.74	
Rhea	527000	4.52	
Titan	1222000	15.95	
Hyperion	1481000	21.28	
Iapetus	3561000	79.33	
		Average ----->	