7.2 - Vertical Circle and Gravity

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| **Vertical Circle:** | Top = 1g - ride, Bottom = 1g + ride |
| -1.1 “g”s inv.  3.1 “g”s | 1. A ride pulls 2.1 “g”s in a vertical circle. What do the riders feel at the top, what do they feel at the bottom? |
| 3.3 “g”s  32.3 m/s/s  -2.3 “g”s inv. | 2. Riders feel 4.3 “g”s at the bottom of a vertical circle ride. What is the ride pulling, (in “g”s and m/s/s) and what do they feel at the top? |
| 2.7 “g”s  26.5 m/s/s  3.7 “g”s | 3. Riders in a vertical circle ride feel -1.7 “g”s (inverted “g”s) at the top of the loop, so what is the ride really doing, (in “g”s and m/s/s) and what do they feel at the bottom? |
| 0.90 “g”s  1.10 “g”s | 4. A Ferris wheel pulls a whopping 0.10 “g”s. What do the riders feel and measure at the top, and what at the bottom? |
| 0.70 “g”s  6.86 m/s/s | 6. On the Rock O Plane, riders feel on the average, 0.30 “g” at the top, and 1.70 “g” at the bottom. What is the ride doing in “g”s and m/s/s |
| 0.20 “g”s  1.96 m/s/s | 5. Riders on a Ferris wheel find that there is a 0.40 g difference from what they measure at the top and what they measure at the bottom. What is the centripetal acceleration of the ride in “g”s and m/s/s? |
| 23.4 m/s/s  2.39 “g”s  -1.39 “g”s inv.  3.39 “g”s | 6. A ride moves at 10.6 m/s in a 4.80 m radius vertical circle. What is the ride doing in m/s/s and “g”s, and what do the riders feel at the top and the bottom? |
| 38.4 m/s/s  3.9 “g”s  top: -2.9 “g”s  bottom: 4.9 “g”s | 7. A ride has a radius of 4.5 m, a period of revolution of 2.15 s, and moves in a vertical circle. What is the centripetal acceleration at the edge of the ride, and what “g” force do the riders feel at the top, and at the bottom? |
| 30.4 m/s/s  -2.1 “g”s  6.6 m/s | 8. An amusement park ride has a radius of 4.50 m and is going 11.7 m/s at the top of its vertical circle. What is the centripetal acceleration at the top, and what g-force do the riders feel at the top? What is the minimum speed the ride could go at the top for people to not fall out? |
| 17.64 m/s/s  3.75 s  10.5 m/s | 9. A 6.30 m radius vertical circle ride makes the riders feel 0.80 “g”s inverted at the top. What is the centripetal acceleration of the ride in m/s/s, and what is its period and velocity? |
| 4 “g”s  1.9 s | 10. Supposing the round up went in a vertical circle, and you measured 3.0 “g” s inverted at the top, and 5.0 “g”s at the bottom. How many “g” s is the ride accelerating at, and what is the period of the ride if its radius is 3.6 m? |
| 26 m/s/s  10. m/s | 11. The loop of a roller coaster is 3.8 m in radius. You read 1.7 “g” s (inverted) at the top of the loop. What is your centripetal acceleration at the top? What is your velocity at the top? |

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| **Gravity:** | , G = 6.67x10-11 Nm2/kg2 |
| 8.17x10-10 N | 1.What is the force of gravity between the two 4.20 Kg bowling balls whose centers are 1.20 m distant? |
| 1.70x10-8 N | 2. What is the force of gravity between a 4.50 kg shot and a 250. kg wrecking ball if their centers are separated by 2.10 m? |
| 2635 N | 3. What is the force of gravity between a 1.60x104 kg spaceship and a 4.50x1017 kg asteroid if their centers are separated by 13,500 m? |
| 1.98x1020 N | 4. What is the force of gravity between the Earth and the Moon? |
| 3.54x1022 N | 5. What is the force of gravity between the Earth and the Sun? |
| 73.0 N | 6. What is the force of gravity between a 45.0 kg mass resting on the surface of the moon, and the moon itself? (hint – what is the distance separating their centers?) |
| 49 N  49 N | 7. Use the gravity equation at the top of this page to find the force of gravity between a 5.0 kg mass and the earth if the mass rests on the surface of the earth.  Compare what you got with the gravity equation to what you get when you use the equation wt = mg, where g = 9.8 N/kg |
| 10.9 N | 8. What is the force of gravity on a 10. Kg object twice earth's radius above the earth? (i.e. three earth radii from the center) |
| 63.7 kg | 9. There is a force of gravity of 3.40x10-9 N between a 5.00 kg mass and a wrecking ball whose centers are separated by 2.50 m. What is the mass of the wrecking ball? |
| 2.00 kg | 10. There is a force of 1.334x10-10 N between a 1.00 kg mass and a mystery mass that is 1.00 m away. What is that mass? |
| 28 kg | 11. What mass would weigh 45 N on the surface of the moon? |
| 244 N  9.24 kg | 12. A planet has a radius of 5.20x106 m, and a mass of 4.30x1024 kg. What is the weight of a 23.0 kg mass on its surface? What mass would weigh 98.0 N? |
| 3.1 x 107 m | 13. What distance from the center of the moon is the attraction between a 500. kg object and the moon itself equal to 2.5 N? |
| 1.98 x 1020 N  2.7x10-3 m/s/s  2.3x106 s or 27 days | 14. What is the force of gravity between the earth and the moon? What acceleration does the moon undergo? (use F=ma) What is its period of motion? (Use a centripetal acceleration equation) |

Useful things to know:

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| Mass of the Earth | 5.97x1024 kg | Radius of the Moon | 1.738x106 m |
| Mass of the Moon | 7.35x1022 kg | Radius of the Earth | 6.38x106 m |
| Mass of the Sun | 1.99x1030 kg | Earth-Moon Distance | 3.84x108 m |
|  |  | Earth-Sun Distance | 1.496x1011 m |