Gravity and Orbit

|  |  |
| --- | --- |
| **Vertical Circle:** | Top = ride – 1g, Bottom = ride + 1g |
| 4 “g”s1.9 s | 1 Supposing the round up went in a vertical circle, and you measured 3 “g” s at the top, and 5 “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? |
| 38.4 m/s/s3.9 “g”stop: 2.9 “g”sbottom: 4.9 “g”s | 2 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. m/s/s2.1 “g”s6.6 m/s | 3. An amusement park ride has a radius of 4.5 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? |
| 26 m/s/s10. m/s | 4. The loop of a roller coaster is 3.8 m in radius. You read 1.7 “g” s at the top of the loop. What is your centripetal acceleration at the top? What is your velocity at the top?  |
| **Gravity:** | , G = 6.67x10-11 Nm2/kg2 |
| 8.17x10-10 N | 5.What is the force of gravity between the two 4.2 Kg bowling balls whose centers are 1.2 m distant? |
| 1.98x1020 N | 5.1. What is the force of gravity between the Earth and the Moon? |
| 3.54x1022 N | 5.2. What is the force of gravity between the Earth and the Sun? |
| 3.1 x 107 m | 6. 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? |
| 28 kg | 7. What mass would weigh 45 N on the surface of the moon? |
| 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) |
| 1.98 x 1020 N2.7x10-3 m/s/s2.3x106 s or 27 days | 9. 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:

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |

|  |  |
| --- | --- |
| **Orbit:** |  Or , G = 6.67x10-11 Nm2/kg2 |
| 331.4 m/s | 10. What is the orbital velocity 3400. m from the center of a 5.60 x 1018 kg asteroid?  |
| 4.85x1019 kg | 11. You find that you can orbit at 516 m/s 12,150 m from the center of a small moon. What is its mass?  |
| 3.4 x 108 m | 12. What distance from the center of the moon is your orbital velocity 120 m/s?  |
| 3.2 x 1024 kg | 13. A satellite orbits a planet at a distance of 7.5 x 106 m from the center every 8900 seconds. What is the mass of the planet? |
| 7722 s | 14. What is the period of orbit of a satellite that orbits 1.950 x 106 m from the center of the moon? |
| 1.50 x 1011 m  | 15. What is the radius of an orbit with a period of 3.16 x 107 s around the sun?  |
| 880 hours4.2x10-6 m/s | 16. A flea is in orbit 2.1 m from the center of a .545 kg baseball. What is the period of orbit? What is the orbital velocity? (the flea and baseball are in deep space) |
| 6970 m/s or 15,600 mph | 17. What velocity do you need to orbit 8.20 x 106 m from the center of the earth? |
| 1470 m/s9620 s | 18. What velocity do you need to orbit 5.20 x 105 m from the **surface** of the moon? What would be your period of orbit? |
| 537 m/s1.01x1023 kg | 19. Fred the alien orbits the planet Zirkon, completing an orbit with a radius of 23.4 x 106 m every 3.17 earth days. What is his velocity, and what is the mass of the planet he is orbiting?  |
| 4.22 x 107 m6.61 Re | 20. What is the radius of a geosynchronous orbit? (Around earth, T = 23 hrs, 56 min, 4 sec - but convert it to seconds) How many earth radii is this? |
| 365 days(31556425.51 s) | 21. What is the period of an orbit 149.6x109 m from the center of the sun (in earth days)? |
| 9.58x106 m | 22. At what distance from the **surface** of the earth is the orbital velocity 5000. m/s? |
| 1480 m/s365 s | 23. A 4090 kg spacecraft is approaching the moon at 6839 m/s, and wants to orbit 510. km above its surface. What is the speed of orbit at this elevation? They aim 510 km to the side of the moon, but for what time do they need to burn their main engine (that generates 60,123 N of thrust) to reduce their speed to the proper orbital speed? |

Useful things to know:

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |