

① A motorcyclist in the 'Globe of Death' rides in a 2.2 meter radius vertical loop. To keep control of the bike, the rider wants the normal force on his tires at the top of the loop to equal his and the bike's weight. What is the minimum speed at which the rider can take the loop?

② An 18 cm diameter centrifuge produces an extraordinarily large centripetal acceleration of 250,000 g's. What is its frequency in rpm? What is the apparent weight of a sample with mass .003 kg? ($W_{app} = F_{net}$)

③ A car rolling over the top of a hill at constant speed \vec{v} . At the peak: A) $n > W$ B) $n < W$ C) $n = W$



④ Weight is the centripetal force that keeps satellites in orbit.

$$a = \frac{F_{net}}{m} = \frac{W}{m} = \frac{mg}{m} = g \quad a_c = \frac{v_{orbit}^2}{r} = g \quad v_{orbit} = \sqrt{g \cdot r}$$

What is the orbital speed of a projectile just skimming the surface of a smooth, airless earth? $r = R_e = 6.37 \times 10^6$ meters

What is the period of the projectile/satellite? $T = \frac{2\pi r}{v_{orbit}} = 2\pi \sqrt{\frac{r}{g}}$

⑤ $F_{1 \rightarrow 2} = F_{2 \rightarrow 1} = \frac{G m_1 m_2}{r^2}$ where $G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2$

The force of gravity between two giant lead spheres is .01 N when the centers are 20 meters apart. What is the distance between their centers when the gravitational force is .16 N?

⑥ You are seated in physics class next to another student .6 m away. Estimate the gravitational force between you. Assume $m_1 = m_2 = 65 \text{ kg}$

⑦ What is the gravitational force of the earth on a 60 kg person? The earth has mass $5.98 \times 10^{24} \text{ kg}$ and radius 6.37×10^6 meters.

⑧ A stone age hunter stands on a cliff overlooking a flat plain. He places a 1 kg rock in a sling and ties it to a 1 m long vine. He swings the rock in a horizontal circle around his head. The plane of motion is 25 m above the plain below. When the tension reaches 200 N, the vine snaps. If the rock is moving toward the cliff at the instant the vine snaps, how far out on the plain (from the cliff base) will the rock land?

