Circular Motion Sample Problems

1.) Mr. Forrest is driving his 1500kg Nissan Z through a curve with a radius of 21m. He's able to do this at a maximum speed of 14.0 m/s. Determine the coefficient of friction that will allow him to do this. a) Find A_c

B.) $\mu = \frac{F_{friction}}{F_{normal}} = \frac{F_{centripetal}}{F_{normal}} = \frac{(m)\, v^2/r}{(m)\, 9.8\, m/s^2} = \frac{(1500)(14.0)^2/21}{(1500)(9.8)} = 0.95$

(2.) Assume Mr. Forrest (80kg) and a gorilla (180kg) are floating in outer space 4 meters apart. What gravitational attraction will the gorilla have on Mr. Forrest?

$F_g = G\frac{m_1 m_2}{r^2} = \frac{(6.67\times10^{-11})(80kg)(180kg)}{(4m)^2} = 6.0\times10^{-8}$ Newtons

- How does this compare to the force of Mr. Forrest on the gorilla? It's the exact same force!

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(3.) Determine the gravitational force on a 1 kg object on the surface of the earth if the earth's radius is 6.38×10^6 meters and the earth's mass is 5.98×10^{24} kg.

$$F_g = \frac{(G)(m_1)(m_2)}{r^2} = \frac{(6.67\times10^{-11})(1\,kg)(5.98\times10^{24}\,kg)}{(6.38\times10^6\,m)^2} = 9.8 \text{ Newtons}$$

(Earth's radius is 6.38×10^6 meters) Earth mass $= 5.98 \times 10^{24}$ kg

(4.) Find the gravitational field strength of an extrasolar planet that has a mass 4 times that of earth and a diameter 3 times that of earth. Your answer should be in terms of 'g', the earth's gravitational field strength.

$$a = \frac{F_{net}}{M_{object}}, \text{ but } F_{net} = F_{grav} = \frac{G(M_{object})(M_{earth})}{(r_{earth})^2}$$

So... $$a = g = \frac{G\cdot(M_{object})(M_{earth})}{(M_{object})(r_{earth})^2} \qquad g = \frac{G\cdot(M_{earth})}{r^2} = 1g$$

For new planet:

$$g' = \frac{G\cdot(M_{object})(4M_{earth})}{(M_{object})(3r_{earth})^2} \quad \& \quad g' \Rightarrow \frac{4G(M_{earth})}{9r^2} = \frac{4}{9}g$$