Quiz Average 4.3 **Quiz High Score** 8

PH 220 **Quiz # 06 (10 pts)** **Name** Solution

An object in space has a mass of 7.87 kg is moving along a circular path of radius 17.9 m. Its speed is described by $v = (-6.73 + 4.21t - 1.31t^2)\ ^{m}/_{s}$. What is the magnitude of the object's tangential acceleration at a time of $t = 3.00$ s?

A. $\mathbf{3.65\ ^{m}/_{s^2}}$ **B.** $5.89\ ^{m}/_{s^2}$ **C.** $1.94\ ^{m}/_{s^2}$ **D.** $12.1\ ^{m}/_{s^2}$

$$a_T = \frac{dv}{dt} = \frac{d}{dt}(-6.73 + 4.21t - 1.31t^2) = 4.21 - 2.62t$$

At $t = 3.00s$

$$a_T = 4.21 - 2.62t = 4.21 - 2.62(3.00) = -3.65\ ^{m}/_{s^2}$$

So, the correct answer is A !

The mass of the Moon is 7.35×10^{22} kg. The radius of the Moon is 1.74×10^{6} m. The period of the Moon's rotation about its internal axis is 2.36×10^{6}s. At what distance from the center of the Moon would a satellite have to be so that it orbited the Moon remaining above the same spot on the Moon. This is the Moon's equivalent to a geostationary satellite orbiting the Earth.

A. 6.92×10^{23} m **B.** $\mathbf{8.84 \times 10^{7}\ m}$ **C.** 8.32×10^{11} m **D.** 3.84×10^{8} m

$$\sum F_R = \frac{Gm_M m}{r^2} = ma_c = m\frac{v^2}{r} = \frac{m}{r}\left(\frac{2\pi r}{T}\right)^2 = \frac{4\pi^2 m}{T^2}r$$

$$r^3 = \frac{Gm_M}{4\pi^2}T^2$$

$$r = \left[\frac{Gm_M}{4\pi^2}T^2\right]^{1/3} = \left[\frac{\left(6.67\ x\ 10^{-11}\ Nm^2/kg^2\right)(7.35\ x\ 10^{22}\ kg)}{4\pi^2}(2.36\ x\ 10^{6}s)^2\right]^{1/3}$$

$$r = [6.916\ x\ 10^{23}\ m^3]^{1/3} = 8.84\ x\ 10^{7}\ m$$

So, the correct answer is B !

A person has a mass ($m_P = 67.0\ \text{kg}$) is riding on a Ferris wheel which has a radius of $16.7\ \text{m}$ and the wheel takes a time of $13.3\ \text{s}$. What is the apparent weight of the person as they rotate through the top of the wheel?

A. $657.\text{N}$ **B.** $906.\text{N}$ **C.** $\mathbf{407.N}$ **D.** $577.\text{N}$

At top of wheel:

$$\sum \boldsymbol{F_R = m_P g - N = m_P a_C = m_P \frac{v^2}{R} = \frac{m_P}{R}\left(\frac{2\pi R}{T}\right)^2 = \frac{4\pi^2 m_P R}{T^2}}$$

Apparent Weight is normal force

$$\boldsymbol{N = m_P g - \frac{4\pi^2 m_P R}{T^2} = m_P\left(g - \frac{4\pi^2 R}{T^2}\right)}$$

$$\boldsymbol{N = (67.0\ kg)\left(9.80\ {}^{m}/_{s^2} - \frac{4\pi^2(16.7\ m)}{(13.3\ s)^2}\right) = (67.0\ kg)\left(9.80\ {}^{m}/_{s^2} - 3.73\ {}^{m}/_{s^2}\right)}$$

$$\boldsymbol{N = (67.0\ kg)\left(6.07\ {}^{m}/_{s^2}\right) = 407.N}$$

So, the correct answer is C !

A Ford Mustang with a driver in it has a combined mass of $1470.\text{kg}$ is driving over a circular hill which has a radius of $45.0\ \text{m}$. At what speed will the car leave the road surface?

A. $14.8\ {}^{\text{m}}/_{\text{S}}$ **B.** $29.7\ {}^{\text{m}}/_{\text{S}}$ **C.** $65.7\ {}^{\text{m}}/_{\text{S}}$ **D.** $\mathbf{21.0\ {}^{m}/_{s}}$

$$\sum \boldsymbol{F_R = mg - N = ma_C = m\frac{v^2}{R}}$$

Car leaves the road if N=> 0.

$$\boldsymbol{mg = m\frac{v^2}{R}}$$

$$\boldsymbol{v^2 = Rg}$$

$$\boldsymbol{v = \sqrt{Rg} = \sqrt{(45.0\ m)\left(9.80\ {}^{m}/_{s^2}\right)} = \sqrt{441.\ {}^{m^2}/_{s^2}} = 21.0\ {}^{m}/_{s}}$$

So, the correct answer is D !

The International Space Station orbits about 6.77×10^6 m. The mass of the Earth is 5.98×10^{24} kg. What would they find the acceleration of gravity due to the Earth on the space station?

A. $\mathbf{8.70\ {}^{m}/_{s^2}}$ **C.** $5.11\ {}^{m}/_{s^2}$

B. $5.89\ {}^{m}/_{s^2}$ **D.** $9.80\ {}^{m}/_{s^2}$

$$g = G\frac{m_E}{r^2} = \left(6.67\ x\ 10^{-11} N\ {}^{m^2}/_{kg^2}\right)\frac{(5.98\ x\ 10^{24}\ kg)}{(6.77\ x\ 10^{6}\ m)^2} = 8.70\ {}^{m}/_{s^2}$$

So, the correct answer is A !

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