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General Physics I, Quiz 3
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Quiz-3 Solution

1. Solution:

(a) We know the angular momentum for rigid body

$L = I\dot{\omega} = mr^2\,(v/r) = mvr$

Using this formula

$L_1 = 6 \times (2\pi \times 0.25) \times 0.25 = 2.35$ kg.m/s

$L_2 = 1.5 \times (2\pi \times 0.50) \times 0.50 = 2.35$ kg.m/s

So the angular momentum is same for the both wheels.

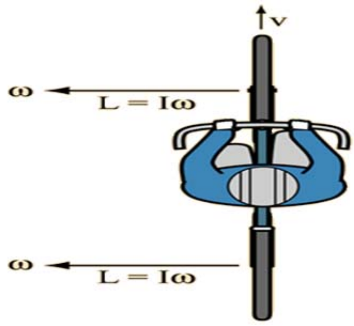
(b) Yes, the torque will be produced.

(c) If the wheels rotate across XY plane the torque will be produced in Z- direction. (Left direction)

Here,

$v_1 = 2\pi r_1$ m/s

$v_2 = 2\pi r_2$ m/s



$m_1 = 6$ kg , $r_1 = 0.25$ m

$m_2 = 1.5$ kg, $r_2 = 0.50$ m

2. Solution:

(a) The dimension:

$[\text{Stress}] = [F] / [A] = [MLT^{-2}] / [L^2] = [MLT^{-4}]$

Strain is the ratio of same physical quantity, like Strain= Length/ Length, so it doesn't have any dimension.

(b) The area of the bus $A = (20 \times 3)\ m^2 = 60\ m^2$, F= 600 N which is applied to A

We know, Shear stress = F/A = 600/ 60 = 100 N/m^2

Shear strain = $\Delta x/h = 0.3/3 = 0.1$

Shear Modulus, K = Shear stress / Shear strain

$K = 100/0.1 = 1000$ N/m^2

3. Solution:

(a) We know the gravitational potential,

$V = -\,GM\,m / r$

$= -\,(6.67\times10^{-11} \times 5.97\times10^{24} \times 3\times10^{5})/3.07\times10^{8}$

$= -\,3.90 \times 10^{11}$ J towards the earth.

(b) We know the gravitational force

$F = GM\,m / r^2$

$m_1 g = GM\,m_1/r_1^{\,2}$, here $r = r_1$ only.

So, $g = GM/ r_1^{\,2} = (6.67\times10^{-11} \times 5.97\times10^{24})/ (3\times10^{8})^2$

$g = 4.4\times10^{-3}$ m/s^2

Here,

$r = (R + r_1) = (6.4\times10^{6} + 3\times10^{8})$

$= 3.07\times10^{8}$ m

where , R = Radius of Earth

r_1= Distance of the satellite from the surface of the earth