proprep™

Workbook

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Angular Momentum

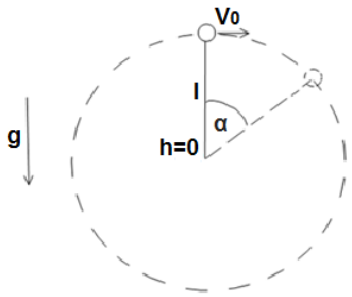
Equation and Laws Conservation

Questions

1) Ball Rotating.

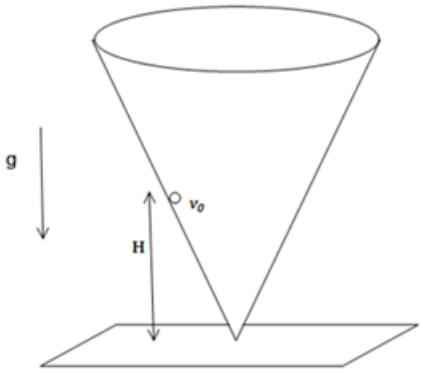
A ball of mass m is attached to a string of length l and is rotating in a circle perpendicular to the ground.
The velocity of the ball at its maximum height is v_0.

a. Find the torque acting on the ball as a function of the angle α.
b. Find the angular momentum of the ball as a function of α.



2) Ball in a Cone.

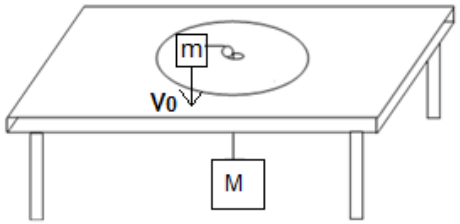
A small ball rolls through a cone which is attached to the ground via its tip. The initial velocity of the ball is v_0 in the horizontal direction tangent to the side of the cone.
The initial height of the ball is H.
Find the maximum height which the ball will reach.
The cone is stationary.
A cubic equation will be accepted as an answer.



3) Ball Attached to Hanging Mass.

A mass m moves on a frictionless table. The mass is attached via a string of length L, which is threaded through the center of the table, to another mass M which hangs in the air. At $t=0$ mass M is at rest and mass m is a distance R from the center of the table, travelling at v_0 tangent to the radius.

Write an equation for the conservation of energy and angular momentum and find the differential equation which is dependent only on the size r.

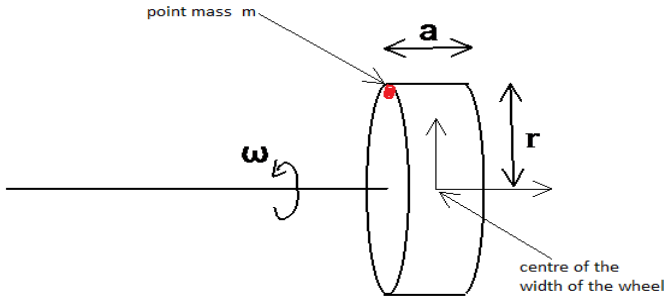


End of Chapter Questions

4) Point on Wheel.

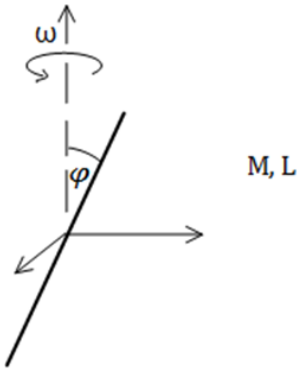
A wheel of radius R spins with a constant angular velocity, ω.
The wheel has width a. The origin is at the centre of the width of the wheel.
A point mass, m, is attached to the top of the wheel (see diagram)
and rotates with the wheel.

a. Show that the angular velocity of the mass is dependent on time.
b. Show that the change in angular momentum is given by the moment of force of the centrifugal force.



5) Rod Rotates at an Angle.

A rod of length L and mass M rests at angle $\theta°$ relative to the z-axis.
The rod rotates about the z-axis at a constant angular momentum ω.
What moment of force is acting on the rod?



Answer Key

1) a. $\sum \mathrm{T} = Lmg\sin\alpha$ b. $\vec{L} = -lm\sqrt{v_0^2 + 2gl\left(1-\cos\alpha\right)}\hat{z}$

2) $\left(2gH + v_0^2\right)h_{\max}^2 = 2gh_{\max}^3 + v_0^2 H^2$

3) Solution in the recording.

4) a. $m\omega_0 r_1^2\hat{z} + \frac{a}{2}\omega_0 r_1\left(\cos\left(\omega_0 t\right)\hat{x} + \sin\left(\omega_0 t\right)\hat{y}\right)$ b. Solution in the recording.

5) $\sum \vec{\tau} = \frac{-\omega ML^2\sin 2\phi}{3}\hat{\theta}$