

Conservation of Angular Momentum and Energy

Questions

1. The first source of error is human error in measuring the mass, length and time. Most of the data that was obtained in the experiment had to be viewed with human eyes that are not perfect such as the mass of the pendulum and projectile, the time of the oscillations and the length of the movement arm and height.

The second source of error was air resistance and friction. They both weren't accounted for in the calculations and they will both slow down the projectile because of this it will reduce the initial velocity in the calculation.

The last error source is the instrumental error in how the spring cannon cannot get the same shot in terms of how high the projectile can go. As well as the oscillations in the arm do not have the same period every time.

2. The ball is added to the pendulum because the height of the swing ends with the ball in the pendulum. The period is needed in the experiment as in order to get the radius of gyration which is dependent on the mass of the ball, removing the ball would not represent the true value of the ball. If the ball was removed then there would be a bigger period and therefore a different result. The mass of the ball affects the swing of the pendulum in this equation.

$$T = 2\pi\sqrt{\frac{I}{(m + M)g r_{cm}}}$$

3. Comparing the initial velocity from experiment 8 and 12 was somewhat different. In experiment 8 the initial velocity was 6.625m/s while in experiment 12 the initial velocity was 5.429m/s. The change of results may be caused due to different guns used in the experiment and the different heights recorded. The equation of the experiment 8 is $v = \frac{m + M}{m}\sqrt{2gh}$ while the equation of

the experiment 12 is $y = \frac{m + M}{m}\left(\frac{rg}{rp}\right)\sqrt{2gh}$. Where is the difference between the two equations rg over rp and since that value was close to 1 there should not be much difference between the two.

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Advance Study Assignment

1. How is this experiment different from experiment 8?

Experiment 14 and 8 are about getting the initial velocity from the spring of the pendulum. For experiment 8 velocity is calculated through momentum and from how high the ball goes and how much weight is added. It is also calculated through the energy of the projectile as it hits the ground. For experiment 14 velocity is calculated through angular velocity and momentum.

2. How is angular momentum conserved during the ball-pendulum collision?

The momentum before and after collision is the same. The mass and velocity of the collision before the collision is turned into angular velocity around the moment of inertia. The linear force becomes angular forces around the pivot of the pendulum.

3. What is the radius of gyration?

The radius of gyration is the distance from the axis of rotation so that the mass could be concentrated from the point. It is representing a block of mass as a point. It helps simplify the rotational motion by only factoring on one point of mass.

4. What is measured in the experiment to determine the initial velocity of the ball?

The equation to get initial velocity is $\frac{1}{m} \sqrt{2I(m+M)gh}$ Where m is the mass of the ball and M is the mass of the pendulum and h is the height. The I is the inertia and needs to be

calculated with $I = (m+M)rg^2$ and $rg = \frac{T}{2\pi} \sqrt{g rcm}$. The equation to calculate the gyration is needed to calculate the moment of inertia and rcm or the movement needs to be measured along with the period of the oscillations, T.

