TITLE: CONVERTION OF ENERGY

Aim: to investigate ,

a) How energy is converted from GPE to K.E during free fall.
b) How much energy is lost to the surrounding and the system.

Apparatus; interface(spark),metre rule, rigid stand, steel ball, freefall adapter.

Theory

One dimensional kinematic motion assumes constant acceleration for dense objects falling under short distance, equation 13.1 accurately predicts the motions .

$y = y_0 + v_0 t + \frac{1}{2} a t^2$
12.1

Since the objects is initially at rest, then $v_0 = 0$,if the initial position is taken as the reference point then $y_0 = 0$.The equation 13.12 becomes

$y = \frac{1}{2} a t^2$

The net work done by a non-conservative force external to the system is,

$W_{ext} = \Delta KE + \Delta GPE + \Delta TE$
12.2

Where; W_{ext} is the external non-conservation force and ΔTE is the change in the internal energy

This energy will include air resistance for a freefalling body. If there is no external non-conservative force acting on the system, then equation 12.2 reduces to

$\Delta KE + \Delta GPE + \Delta TE = 0$

PROCEDURE

1. The apparatus was arranged as shown below in figure 12.1

2. The time taken for the steel ball to fall through the height (d=1.0m) was measured, and three values were taken.

DATA ANALYSIS

2.a. Average of the time

(i) $\sum t$

From equation (1.3)

$$\sum \mathrm{t} = (0.447860 + 0.446674 + 0.451466)\mathrm{s}$$

$$\sum \boldsymbol{t} = \underline{\mathbf{1.346s}}$$

(ii) mean t ($\bar{\mathrm{t}}$)

From equation (1.2)

$$\text{mean t} = \bar{\mathrm{t}} = \frac{1}{\mathrm{N}}\sum_{\mathrm{i}=1}^{\mathrm{N}} \mathrm{t_i}$$

$$\text{where N} = 3,\ \sum_{\mathrm{i}=1}^{\mathrm{N}} \mathrm{t_i} = \mathrm{t_1} + \mathrm{t_2} + \mathrm{t_3} = \sum \mathrm{t} = 1.346s$$

$$\therefore\ \bar{t} = \frac{1}{3}(1.346)$$

$$\bar{\mathbf{t}} = \mathbf{0.44867s}$$

2.b. Percentage Error in t

From equation (1.7) $\text{Percentage Error} = \frac{\bar{\delta}\mathrm{t}}{\bar{\mathrm{t}}} \times 100\%$

And from equation (1.5) $\bar{\delta t} = \frac{1}{N}\sum |(t_i - \bar{t})|$

$$\therefore\ \bar{\delta t} = \frac{1}{3}[|0.447860 - 0.44867| + |0.446674 - 0.44867| + |0.451466 - 0.44867|]$$

$$\bar{\delta t} = \frac{1}{3}(0.00081 + 0.001996 + 0.002796)$$

$$\bar{\delta t} = \frac{1}{3}(0.008398)$$

$$\underline{\bar{\delta t} = \mathbf{0.002799s}}$$

$$\text{Percentage Error} = \frac{\bar{\delta t}}{\bar{t}} \times 100\%$$

$$\text{Percentage Error} = \frac{\mathbf{0.002799s}}{0.44867s} \times 100\%$$

$$\therefore \mathbf{Percentage\ Error\ in\ t = 0.6239\%}$$

3.Acceleration due to gravity

From equation 13.12 $y = \frac{1}{2}at^2$

$$g = \frac{2y}{t^2} \; g = \frac{2 \times 1}{0.44867^2}$$

$$g = \frac{2}{0.2013}$$

$$\mathbf{g = 9.935m/s}$$

4.Velocity

$$v = \sqrt{2gh}$$

$$v = \sqrt{2 \times 9.935 \times 1}$$

$$v = \sqrt{19.87}$$

$$\mathbf{v = 4.458m/s}$$

5.Mass of the steel ball

From the experiment the mass was found to be 16.2g

$$= 16.2g \times \frac{1kg}{1000g}$$

$$\mathbf{= 0.0162kg}$$

6.a.Gravitational Potential Energy

$$G.P.E = mgh$$

$$G.P.E = 0.0162 \times 9.81 \times 1$$

$$\mathbf{G.P.E = 0.159J}$$

6.b.Kinetic Energy

$$K.E = \frac{1}{2}MV^2$$

$$K.E = \frac{1}{2} \times 0.0162 \times 4.458^2$$

$$\mathbf{K.E = 0.161J}$$

7.Change in Internal Energy

From equation 12.2 $\Delta KE + \Delta GPE + \Delta TE = 0$

$$0.161 + 0.159 + \Delta TE = 0$$

$$320 + \Delta TE = 0$$

$$\mathbf{\Delta TE = -0.320J}$$

8.The difference in the theoretical value of g and the experimental value is due to the air resistance as the ball was falling.

DISCUSSION

a) How energy is converted from GPE to KE during free fall. Before the steel ball is released it is at rest and has no kinetic energy, but when it was released the ball acquired KE in falling. Hence in it's state of rest at a height of 1m the ball had a potential energy of 0.159J.When the ball was released, it moved to a lower position and its PE was converted in KE, which was 0.161J The kinetic energy of the ball increases because the earth's gravity does work on the ball. All the PE was converted into KE the 0.002J difference was due to air resistance.

b) How much energy is lost to the surrounding and the system. When the ball striked the adaptor, some kinetic energy was lost. The energy was converted in other forms of energy, the energy lost was 0.320J.

CONCLUSION

The energy of the steel ball was converted from GPE to KE during free fall, at the point of impact with the ground the KE energy was converted to other forms of energy.Energy can neither created nor destroyed it can only be changed from one form to another. This is what is known as the conservation of energy.

REFERENCES

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J. Serway, *Physics for Scientists and Engineers, 6th edition*, (2004), California State Polytechnic University, Pomona.