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Free Fall

Objective- To find the acceleration of an object due to the gravity of the earth.

Procedure- A plastic ruler with back stripes folded on it was used as an object. The distance between two consecutive stripes was fifty(50) cm or .050 meters. The ruler was covered with six of those black stripes. Then, this ruler was allowed to pass between a laser beam guided by sensor, which was attached to the computer. As the ruler passes the laser, each of the black folded stripes blocked the laser beam, and the sensor attached to the software in computer recorded the data in a chart in terms of time and position.

Data-

Table 1).

|  |  |
| --- | --- |
| Time(s) | Position(m) |
| 6.8550 | 050 |
| 6.8818 | .100 |
| 6.9055 | .150 |
| 6.9296 | .200 |
| 6.9467 | .250 |
| 6.9651 | .300 |

\* The time in the computer software was started from 6.8550

In order to find the time taken to travel the distance between the consecutive stripes (∆y=.050 m) difference of time is found by subtracting the respective consecutive time(∆t). The following table shows the respective ∆y and ∆t.

Table 2).

|  |  |  |
| --- | --- | --- |
|  | ∆t(sec) | ∆y(m) |
| 6.8818-6.8550 | .0268 | .050 |
| 6.9055-6.8818 | .0237 | .050 |
| 6.9296-6.9055 | .0214 | .050 |
| 6.9467-6.9296 | .0198 | .050 |
| 6.9651-6.9467 | .0184 | .050 |

\*∆y(m) will be constant because the distance between each stripes is .050m.

Average Velocity(Vav) of the object was found by dividing the respective distance with the respective time.

Table 3).

|  |  |
| --- | --- |
| Distance(m)/time(s) | Vav(m/sec) |
| .050/.0216 | 1.866 |
| .050/.0237 | 2.110 |
| .050/.0214 | 2.337 |
| .050/.0198 | 2.525 |
| .050/.0184 | 2.717 |

We observe from the above table that the velocity increases as the time decreases. It is because the object was started at rest and it gains its acceleration as is gains it's velocity. Since the acceleration of earth is almost same everywhere we can take the acceleration as a constant value. And, when the acceleration is constant the average time taken to travel the distance is given by

(tf (time at final position) +ti (time at initial position))/2. And by using the formula average time (t') was found

Table 4).

|  |  |  |
| --- | --- | --- |
| (tf + ti)/2 | t' (sec) | Vav (m/sec)(Respective average velocity, from table 3) |
| (6.8818+6.8550)/2 | 6.8684 | 1.866 |
| (6.9055+6.8818)/2 | 6.8937 | 2.110 |
| (6.9269+6.9055)/2 | 6.9162 | 2.337 |
| (6.9467+6.9269)/2 | 6.9368 | 2.525 |
| (6.9651+6.9467)/2 | 6.9559 | 2.717 |

In order to find the acceleration the difference of t'(∆t') and Vav(∆Vav) was found.

Analytical method-

Table 5).

|  |  |  |  |
| --- | --- | --- | --- |
| ∆Vav=Vf-Vi | ∆Vav(m/s) | ∆t'=t'f-t'i | ∆t'(sec) |
| 2.110-1.866 | .245 | 6.8937-6.8684 | .0253 |
| 2.337-2.110 | .227 | 6.9162-6.8937 | .0225 |
| 2.525-2.337 | .188 | 6.9368-6.9162 | .0206 |
| 2.717-2.525 | .192 | 6.9559-6.9368 | .0191 |

Acceleration is equal to ∆Vav divided by the respective ∆t'.

Table 6)

|  |  |
| --- | --- |
| a=∆Vav/∆t' | a(m/sec2) |
| .244/.0253 | 9.644 |
| .227/.0225 | 10.04 |
| .188/.0206 | 9.126 |
| 0192/.0191 | 10.05 |

To get more precise answer the mean of all acceleration was taken.

(9.644+10.04+9.126+10.05)/4 = **9.73 (m/sec2)**

The accepted value of the acceleration of an object due to the gravity near the surface of the earth is 9.8(m/sec2). And the acceleration calculated in the experiment is 9.73 (m/sec2). The deviation is .71%.