Engineering Mechanics: EM-L

OPEN ENDED LAB

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Objective: To investigate the Effect of Incline Steepness on Speed, acceleration and velocity of different objects.

Apparatus:

1. Steep Ramp
2. Ruler or measuring tape
3. Protractor
4. Stop Watch
5. Toy Car
6. Ball
7. Cylinder

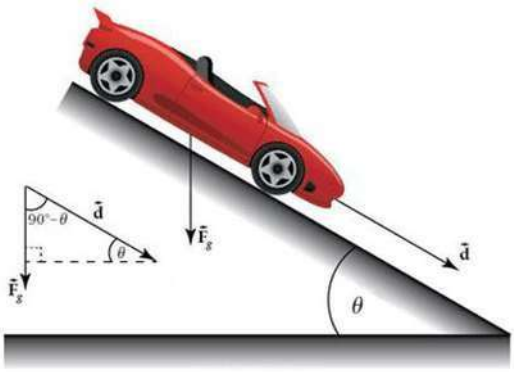
Theory:

In this experiment, we focuses on the relationship between the height of an inclined plane and the speed of a toy car rolling down. As the height increases, the gravitational force acting on the car also increases, leading to the greater acceleration down the slope.

According to the Newton's second law of motion, the force exerted on the toy car is directly proportional to its mass and acceleration. So, with a greater height, the car experiences a greater force and accelerates much rapidly. As the toy car accelerates down the incline, the conversion of gravitational potential energy into kinetic energy results in an increase in its speed.

By systematically varying the height of the incline plane and measuring the resulting speeds of the toy car, we can analyze the relationship between incline steepness and toy car speed.

Diagram:



Procedure:

1. First off all note the height of a ramp of 20 cm using a measuring tape.
2. Ensure that the object has almost no friction.
3. Hold the object on the top of the ramp at the start line.
4. Simultaneously start the stop clock and release the object (don't exert any forces on the object).
5. Stop the clock when the object reaches the finish line.
6. Record multiple readings and take average.
7. Now change the height of the inclined plane to 25cm and 30cm, repeat the readings.

Observations and Calculations:

- **Velocity**

Potential Energy at the top = Kinetic energy at the bottom

$$mgh = \frac{1}{2}mv^2$$

$$gh = \frac{1}{2}v^2$$

$$2gh = v^2$$

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

1. Velocity of (20 cm = 0.2 m) height ramp, g = 9.8 m/s2 (constant)

v = √ 2 x 9.8 x 0.2

v = 1.98 m/s

2. Velocity of (25 cm = 0.25 m) height ramp, g = 9.8 m/s2 (constant)

v = √ 2 x 9.8 x 0.25

v = 2.21 m/s

3. Velocity of (30 cm = 0.3 m) height ramp, g = 9.8 m/s2 (constant)

v = √ 2 x 9.8 x 0.3
v = 2.42 m/s

- **Speed**

Speed = Distance / Time

The Distance is 1.5 m and the average of 0.25m height

Speed = 1.5/ 0.678

Speed = 2.20 m/s

Repeating the same formula to calculate the speed on other heights.

- **Acceleration**

When the height at 0.2 m and velocity = 2.21 m/s

Acceleration (a) = (vf-vi) / t

a = 0.67 m/s2

Repeating the same formula to calculate the acceleration on other heights.

Observations:

1. Car

No. of obs.	Height of the Ramp (m)	t1 (s)	t2 (s)	t3 (s)	Average Time (s)	Speed (m/s)	Acceleration (m/s2)	Velocity (m/s)	Theo-ratical	Pract-ical	% error
1.	0.25	1.4	1.42	1.38	1.40	1.07	0.76	2.21	2.21	1.07	51.6%
2.	0.3	1.32	1.30	1.34	1.32	1.14	0.86	2.42	2.42	1.14	52.9%

2. Ball

No. of obs.	Height of the Ramp (m)	t1 (s)	t2 (s)	t3 (s)	Average Time (s)	Speed (m/s)	Acceleration (m/s2)	Velocity (m/s)	Theo-ratical	Pract-ical	% error
1.	0.25	1.30	1.28	1.32	1.30	1.15	0.88	2.21	2.21	1.15	47.9%
2.	0.30	1.20	1.18	1.22	1.20	1.25	1.04	2.42	2.42	1.25	48%

3. Cylinder

No. of obs.	Height of the Ramp (m)	t1 (s)	t2 (s)	t3 (s)	Average Time (s)	Speed (m/s)	Acceleration (m/s2)	Velocity (m/s)	Theo-ratical	Pract-ical	% error
1.	0.25	1.54	1.56	1.53	1.55	0.97	0.63	2.21	2.21	0.97	50.5%
2.	0.30	1.45	1.42	1.48	1.46	1.03	0.71	2.42	2.42	1.03	47%

4. **Angle**

Calculating the angle inclination by using trigonometry.

Tan θ = opposite / adjacent

θ = -tan (opposite / adjacent)

Height of the ramp (m)	Angle of Inclination (Degrees)
0.2	7.59
0.25	9.46
0.3	11.31

Comments:

As students researching a project on inclination, we are excited to explore how speed, velocity, and acceleration change when the height of inclination varies. This project offers a great opportunity to apply theoretical concepts to real-world scenarios.

By investigating how different objects move on inclined planes, I'll gain a deeper understanding of the relationships between speed, velocity, and acceleration. I'll be able to analyze how the angle of inclination affects the motion of objects, which is crucial in various fields like engineering, physics, and transportation.

Some potential objects I might study include:

- Marbles or balls rolling down ramps

- Toy cars on inclined tracks

- Water flowing down chutes or pipes

- Inclined planes with varying angles

By collecting data on the speed, velocity, and acceleration of these objects at different heights of inclination, I'll be able to:

- Identify patterns and correlations

- Develop graphs and charts to visualize the data

- Draw conclusions about how inclination affects motion

- Apply mathematical models to describe the relationships

This project will not only enhance my understanding of fundamental physics concepts but also develop my critical thinking, problem-solving, and data analysis skills. I'm eager to explore this topic and uncover the fascinating insights it holds!

Thanks.