GENERAL

skateboard physics lab report answers tesccc

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Introduction

When a skateboard glides across a smooth surface, it feels effortless, but behind that seemingly simple motion lies a complex interplay of forces and motions. Understanding the physics that govern skateboarding not only satisfies curiosity but also equips students and enthusiasts with the tools to design better boards, improve performance, and conduct meaningful experiments. This comprehensive guide explores the fundamentals of skateboard physics, outlines a detailed laboratory procedure, and provides model answers for the Texas State Education Code (TESCCC) lab report requirements. Whether you're a high school physics teacher preparing a classroom demonstration or a student seeking to ace your lab assignment, the information below will help you master both the science and the reporting process.

What Is Skateboard Physics?

Skateboard physics is the study of the forces, motions, and energy transformations that occur when a skateboard is in motion. At its core, it relies on the classic principles of mechanics: Newton's laws of motion, conservation of energy, and rotational dynamics. By applying these concepts, one can predict how a board will accelerate, decelerate, turn, and respond to external disturbances such as friction or uneven terrain.

Newton's Three Laws in Action

- First Law (Inertia): A skateboard will remain at rest or move at a constant velocity unless acted upon by an external force. This explains why a board on a level surface keeps sliding until friction slows it down.
- Second Law (F = ma): The acceleration of the board is directly proportional to the net force applied and inversely proportional to its mass. Pushing off the ground applies a force that accelerates the board forward.
- Third Law (Action Reaction): For every action, there is an equal and opposite reaction. When a rider pushes off the ground, the ground pushes back with an equal force, propelling the board forward.

Friction, Rolling Resistance, and Drag

Three primary resistive forces act on a skateboard:

1. Static friction between the wheels and the board's trucks keeps the wheels from slipping during turns.
2. Rolling resistance arises from the deformation of the wheels and the board's deck; it is usually small but becomes significant over long distances.
3. Air drag grows with the square of velocity and can limit top speed, especially for larger boards or riders with higher body mass.

Rotational Dynamics and Torque

The skateboard's trucks convert forward motion into turning. When a rider leans to one side, a torque is applied to the trucks, causing the board to pivot. The relationship between torque, angular velocity, and angular acceleration determines how quickly a skateboard can change direction or perform tricks.

Lab Setup: Equipment and Safety

Conducting a skateboard physics experiment requires a controlled environment and precise instruments. Below is

a detailed list of equipment and safety precautions.

Essential Equipment

- Standard skateboard with adjustable trucks and wheels
- High speed digital camera or smartphone with a 120 /fps recording capability
- Laser distance sensor or motion tracking system
- Measuring tape or laser rangefinder for distance measurement
- Stopwatch (digital or app-based) for timing
- Force sensor or load cell (optional, for measuring push force)
- Flat, level testing surface (e.g., a concrete floor or a wooden board)
- Safety gear: helmet, knee pads, elbow pads, wrist guards

Safety Precautions

1. Wear protective gear at all times to prevent injuries from falls or collisions.
2. Ensure the testing area is free from obstacles, loose objects, or uneven surfaces.
3. Use a spotter or a safety harness if the experiment involves higher speeds or more advanced tricks.
4. Keep the force sensor and other electronics out of reach of the rider to avoid accidental damage.

Methodology: Step by Step Procedure

The following procedure is designed to capture the acceleration, velocity, and deceleration of a skateboard under controlled push forces. It also records the influence of different wheel hardnesses on rolling resistance.

1. Baseline Measurements

1. Place the skateboard on the testing surface and let it rest.
2. Measure the deck’s length, width, and weight.
3. Record the wheel diameter, hardness (durometer), and the number of wheels per truck.
4. Mark a starting point and a target distance (e.g., 10 /m).

2. Data Acquisition

1. Position the high speed camera perpendicular to the board’s motion to capture a clear view of the wheels.
2. Set up the laser distance sensor to record the board’s position at regular intervals.
3. Have the rider push off the ground with a consistent force. If a force sensor is available, record the applied force.
4. Start the stopwatch simultaneously with the push.
5. Stop the stopwatch when the board reaches the target distance or when it comes to a complete stop.
6. Repeat the experiment three times for each wheel hardness setting to ensure statistical validity.

3. Data Processing

- Extract timestamps and positions from the video footage.
- Calculate velocity as 9G,ó”t for each interval.
- Determine acceleration by differentiating velocity with respect to time.
- Plot velocity vs. time and acceleration vs. time graphs to visualize trends.
- Compute average acceleration and average velocity for each trial.

Analysis and Results

After processing the data, you will be able to answer several key questions about skateboard performance:

1. How does wheel hardness affect rolling resistance?

2. What is the relationship between applied force and acceleration?
3. Does the skateboard's mass significantly influence its top speed?

Sample Findings

In a typical experiment, the following results may emerge:

- Harder wheels (e.g., 78a) exhibit lower rolling resistance, leading to higher average speeds over the same distance compared to softer wheels (e.g., 73a).
- Acceleration is directly proportional to the applied push force, confirming Newton's second law.
- Increasing board mass slightly reduces acceleration but has minimal effect on maximum velocity, indicating that kinetic energy is largely governed by the rider's push.

Sample TESCCC Lab Report Answers

Below is a concise, well structured example of how to present your findings in a TESCCC lab report. The format follows the common structure: Introduction, Hypothesis, Materials, Methods, Results, Discussion, Conclusion, and References. The content is tailored to meet the rubric requirements while keeping the language clear and engaging.

Introduction

Skateboard physics encompasses the forces that govern acceleration, velocity, and turning dynamics. This experiment investigates how wheel hardness and applied push force influence a skateboard's motion. By measuring acceleration and velocity, we aim to validate Newton's laws and quantify rolling resistance effects.

Hypothesis

We hypothesize that (1) harder wheels will produce higher average velocities due to lower rolling resistance, and (2) the acceleration of the skateboard will increase linearly with the applied push force.

Materials

- Standard skateboard (deck weight 1.5 /kg)
- Four sets of wheels with durometers 73a, 75a, 77a, 78a
- High speed camera (120 /fps)
- Laser distance sensor
- Stopwatch
- Force sensor (optional)
- Safety gear: helmet, knee pads, elbow pads, wrist guards

Methods

For each wheel hardness, the rider performed a straight line push over a 10 m track. The push force was recorded using a force sensor. The skateboard's position was captured by the laser sensor and high speed camera. Each trial was repeated three times, and the average acceleration and velocity were calculated.

Results

Table 1 summarizes the average acceleration and velocity for each wheel hardness setting. The data reveal a clear trend of increasing velocity with wheel hardness, while acceleration remains largely constant across all trials, supporting the hypothesis that rolling resistance primarily affects speed, not acceleration.

Wheel Hardness (a)	Average Acceleration (m/s²)	Average Velocity (m/s)
73	2.15	3.12
75	2.18	3.45
77	2.21	3.78
78	2.23	4.01

Discussion

The experimental data confirm that wheel hardness significantly influences maximum velocity, likely due to reduced deformation and rolling resistance. The near constant acceleration across all wheel hardnesses indicates that the applied force dominates the acceleration phase, aligning with Newton's second law. Minor variations in acceleration may arise from differences in wheel alignment or deck stiffness.

Conclusion

Our findings demonstrate that selecting harder wheels can improve a skateboard's speed without compromising acceleration. The experiment also validates fundamental physics principles and illustrates how controlled variables affect motion. Future studies could explore the impact of rider mass, truck camber angles, or surface texture on skateboard dynamics.

References

- Serway, R. A., & Jewett, J. W. (2014). Physics for Scientists and Engineers.
- McGrath, M. (2019). "Rolling Resistance in Skateboards." Journal of Applied Mechanics.
- Texas Education Agency. (2023). TESCCC Lab Report Guidelines.

Common Mistakes to Avoid in Lab Reports

Even with solid data, a poorly written report can lose points. Keep these pitfalls in mind:

- Failing to state a clear hypothesis or research question.
- Using vague or ambiguous terminology ("fast," "slow," "hard").
- Neglecting to report uncertainties or error analysis.
- Overlooking the importance of a clean, logical structure.
- Including extraneous information that does not directly support the conclusions.

Tips for Writing a Clear, SEO Friendly Lab Report

1. Use descriptive headings: Each section should have a clear title that signals its content (e.g., "Materials and Methods").
2. Incorporate semantic keywords naturally: Words such as "skateboard dynamics," "rolling resistance," and "Newton's laws" should appear in context, not forced.
3. Embed visuals: Graphs, tables, and annotated screenshots help readers grasp complex data quickly.
4. Maintain concise language: Avoid overly long sentences; break complex ideas into digestible parts.
5. Proofread for clarity: Technical jargon should be explained or defined for a broader audience.

Conclusion

Mastering skateboard physics not only deepens your appreciation for this popular sport but also provides a tangible framework for exploring fundamental mechanics. By combining a systematic laboratory approach with clear, well structured reporting—particularly for TESCCC lab report standards—you can transform raw data into compelling scientific insights. Whether

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