Physics Lab 2A Introduction and Conclusion Guidelines

Lab 1 – Distance and Displacement

- Introduction
  1. Thesis
  2. Discuss the difference between distance and displacement.
  3. Described how a measured displacement will be determined in each activity (using a meter stick, etc.)
  4. Described how a calculated displacement will be determined in each activity (using sum/difference of distance, Pythagorean Theorem, trigonometry, etc.)
- Conclusion
  1. Summarize results of activity 1. Give numeric results. (Explain why distance 2 was subtracted to get displacement.)
  2. Summarize results of activity 2. Give numeric results. (Explain how displacement can be reported as positive or negative depending on direction used to express the displacement.)
  3. Summarize results of activity 3. Give numeric results. (Explain why Pythagorean Theorem and trigonometry were needed.)
  4. Discuss how measured and calculated results compare and give reasons for differences.

Lab 2 – Introduction to Motion

- Introduction
  1. Thesis
  2. Describe use of motion detector and computer graphical interface to study motion. (Explain it in a way that someone who has not seen it can understand what was done.)
  3. Discuss how distance-time graphs will be plotted and analyzed to understand motion.
  4. Discuss how velocity-time graphs will be related to the distance-time graphs.
- Conclusion
  1. Summarize results from every experiment. (Do not restate procedure.)
  2. Discuss meaning of graphs and slopes (correlate positive/negative slopes to direction of motion relative to the sensor, steep/shallow slopes to speed, and curves to change in speed).
  3. Mention specific methods used to increase graph accuracy (use of notebook, counting out loud, adjusting beam width, etc.)
  4. Discuss how predictions and results compare. Explain reason for differences.

Lab 3 – Accelerated Motion

- Introduction
  1. Thesis
  2. Define acceleration.
  3. Describe use of motion detector, dynamics track & car, pulley, string, mass, and computer graphical interface to study motion. (Someone who has not seen it should understand what was done.)
  4. Mention that distance-time (d-t), velocity-time (v-t), and acceleration-time (a-t) graphs will be plotted, and analyzed and compared to understand motion.
- Conclusion
  1. Summarize results from every experiment. (Do not restate procedure.)
  2. Discuss how predictions and results compare.
  3. Summarize correlations between d-t, v-t, and a-t graphs,

4. Mention any specific method used to increase graph accuracy (beam width and direction, incline, etc.)

Lab 4 – Newton's Second Law

- Introduction
  1. Thesis
  2. Discuss Newton's Second Law. (Use the equation and words.)
  3. Describe use of dynamics track & cart, pulley, string, mass, force sensor, and computer graphical interface to study motion. (Explain it in a way that someone who has not seen it can understand what was done.)
  4. Describe how experimental and theoretical values for acceleration and force will be determined and compared to verify Newton's Second Law.
- Conclusion
  1. Summarize results from both experiments.
  2. Describe use of velocity graph to determine experimental (measured) acceleration value.
  3. Describe use of force graph to determine average force (tension) and how it compared to the theoretical (calculated) value.
  4. Include percentage errors and suspected reasons for error (track or pulley friction, calibration, etc.)

Lab 5 – Vector Addition

- Introduction
  1. Thesis
  2. Describe vectors, components, and addition (Use equations. Define all symbols)
  3. Describe how vector addition for displacements will be demonstrated experimentally using a meter stick, L-shaped ruler, and protractor.
  4. Describe how vector addition for forces will be demonstrated experimentally using a force table, masses, pulleys, and strings. (Explain it in a way that someone who has not seen it can understand what was done.)
- Conclusion
  1. Report results for study of displacement vector addition.
  2. Report results for study of force vector addition.
  3. Include percentage errors and reasons for error.
  4. Mention any specific method used to increase graph accuracy (Use of protractor and L-shaped ruler, first detectable difference, etc.).

Lab 6 – Energy and Power

- Introduction
  1. Thesis
  2. Describe conservation of energy and non-conservative forces. (Use equations and words.)
  3. Describe how a graph of v^2 versus h will be found experimentally using an air track, glider, photogate, and blocks. Describe how slope of this graph is related to the gravitational acceleration of earth.
  4. Describe how horsepower will be determined for a person moving up a set of stairs.
- Conclusion
  1. Summarize results of activity 1 and explain whether energy was conserved or if there were non-conservative forces (gives examples).
  2. Give the value of the slope of the v^2 versus h graph, and how it compares to the theoretical value of $m = 2g$, where $g = 9.8\ \text{m/s}^2$. (Include percent error.)
  3. Summarize results of activity 2 and give horsepower value obtained.

4. Describe ways that horsepower can be increased (in terms of weight, height, time of travel, etc)

Lab 7 – Conservation of Linear Momentum

- Introduction
  1. Thesis
  2. Describe momentum and conservation of momentum. (Use equations and words.)
  3. Describe the difference between an elastic and an inelastic collision. (Mention which conserves kinetic energy.)
  4. Describe use of air track, gliders, motion sensor, and computer graphical interface to study conservation of momentum. (Explain it in a way that someone who has not seen it can understand what was done.)
- Conclusion
  1. Describe how momentum was determined for each glider before and after each collision using a distance-time graph and the formula for momentum.
  2. Report final results for elastic collision. Give the percent difference for conservation of momentum and conservation of kinetic energy.
  3. Report final results for inelastic collisions when the masses were similar and different. Give the percent error for conservation of momentum.
  4. Explain why kinetic energy is not conserved in inelastic collisions.

Lab 8 – Forces and Torques in Equilibrium

- Introduction
  1. Thesis
  2. Describe torque and equilibrium. (Use equations and words. Define all symbols)
  3. Describe how the use of a meter stick and pin to determine the center of gravity of the meter stick.
  4. Describe how the meter stick, string, and masses will be used to compare torques and forces in equilibrium.
- Conclusion
  1. Briefly summarize the results from each activity.
  2. Report percentage errors and suspected reasons for errors.
  3. Explain the difference between having zero net force and zero net torque (in terms of *translational* acceleration and *rotational* acceleration, respectively).
  4. Explain why the force of the pin does not contribute to the torque at the pin.

Lab 9 – Centripetal Force

- Introduction
  1. Thesis
  2. Describe centripetal acceleration and centripetal force. (Use equations and words. Define all symbols.)
  3. Describe how centripetal force will be measured using an apparatus consisting of a rotating crossarm, hanging mass with spring, and counterbalance.
  4. Mention that the gravitational force on the earth due to the sun will be calculated and compared to a calculation of the centripetal force using the period of the earth.
- Conclusion
  1. Report the value of the spring force and how it was determined.
  2. Report the value of the centripetal force and how it was determined.
  3. Report the percent error and suspected reasons for error.

4. Explain why the gravitational force of the sun on the earth is approximate a centripetal force. Explain the reason for the percent error. (For example, is the orbit a perfect circle? Is the period exactly 365 days? Etc.)

Lab 10 – Buoyancy and Archimedes' Principle

- Introduction
  1. Thesis
  2. Describe how the caliper and graduated cylinder can be used to find the volume of an object. (Include equations.)
  3. Define Archimedes' Principle and explain how it will be used to determine the volume of an object. (Use equations and words. Define all symbols.)
  4. Define density and mention that it will be determined for an object and matched to a table of densities to determine the material of the object.
- Conclusion
  1. Report results for the measurement of the volume of an object using a caliper, graduate cylinder, and Archimedes' Principle.
  2. Report the density calculated for the object and the type of material the object was identified to be.
  3. Report the percentage error compared to the density of the material in the table and give suspected reasons for any difference.
  4. Explain the reasons for the results of the experiment with the boat dropping its load in the water when the load was iron and when it was wood.

Lab 11 – Specific Heat

- Introduction
  1. Thesis
  2. Define specific heat and its relation to mass, temperature, and heat. (Use equations and words. Define all symbols.)
  3. Describe the equation for conservation of thermal energy in a calorimeter. (Define all symbols.)
  4. Describe how a calorimeter will be used to determine the specific heat of copper.
- Conclusion
  1. Report the value obtained for the specific heat of copper.
  2. Report the percent error compared to the known value for the specific heat of copper.
  3. Explain the possible reasons for your results being higher or lower than the known value. (Use the answers to the questions in the lab procedure section.)
  4. Mention how you could limit any error that was obtained.

Lab 12 – Simple Harmonic Motion

- Introduction
  1. Thesis
  2. Describe Hook's Law and the period of oscillation for an oscillating mass. (Use equations and words.)
  3. Describe how a mass attached between two springs will be used to find the effective spring constant of the system, and the theoretical period.
  4. Describe how the experimental period of the system will also be determined using a photogate.
- Conclusion
  1. Report results for the effective spring constant determined. Describe the use of Hook's law and a graph of the force versus displacement.

2. Report results for the period of oscillation (found using the spring constant) for the cart alone as well as the cart with a mass on it.
3. Report result for the period of oscillation found using a photogate.
4. Report all percent errors and give suspected reasons for any errors.

Lab 13 – Waves in Strings, Metal Rods, and Air

- Introduction
  1. Thesis
  2. Describe the relationships between speed, tension, mass, length, frequency, and wavelength for waves on a string. Also describe the relationships between speed, mass density, and Young's Modulus for the speed of sound in a metal tube. (Use words and equations. Define all symbols.)
  3. Describe the how the wavelength will be determined for a wave on a string knowing the mass, length, and distance between nodes on the string. Also describe how the frequency will be determined and compared to the frequency of the wave driver.
  4. Describe how longitudinal vibrations in a rod (inside a tube with cork dust) will be used to calculate the speed of sound in air and how this will be compared to the speed of sound using the temperature.
- Conclusion
  1. Report results for the frequency calculated for the vibrating string.
  2. Report percent difference between the frequency calculated and the frequency of the wave driver. Explain the possible reason for any differences.
  3. Report results for the speed of sound calculated using the vibrating rod.
  4. Report the percent difference between the speed of sound calculated using the Kundst tube and the speed of sound calculated using the temperature.