EXP 4

Discussion

Acceleration on the linear air track was determined using materials such as gliders, linear aluminum track, stopwatch, iron stand, meter stick, and digital balance. Distances were chosen and their respective time were recorded while velocity was calculated using the formula provided. The main source of error during the experiment was the ability of the recorders themselves to quickly start and stop the stopwatch once the glider is released and when it reaches the final destination. As light is faster than sound, they have relied on their sight to react once the glider finishes its course. Moreover, three students acted as the recorders and with their combined hand and eye coordination efforts—decreased the rate of error. Velocity was calculated using the distance over time formula for each distance. Distances traveled such as 50 to90 were divided by their respective average time with units of cm/s. With the exception of the second velocity, an increasing trend was observed and therefore concluded that as the distance increases, so should be the time and velocity.

The theoretical acceleration value was calculated using the a=gsintheta where theta is 15 and it resulted in 253 cm/s^2. On the other hand, experimental value was determined using an online software where it plotted the T/2 as x along with Vave as y contrary to the instruction. This act is partially due to the fact that T/2 is the independent variable that causes Vave to occur and x is always the independent variable while y will always be the dependent variable. Additionally, the values started from T/2=0 and Vave=0. The slope was found to be 219.9 with a correlation of 0.93 therefore positive linear correlation. It is clear that the slope is the acceleration because acceleration is velocity over time.

On the second graph where x is distance paired with t^2 as y, it resulted in 104.1 slope and a correlation of 0.97 which is another strong linear relationship. Looking at the equation of line, it is clear that using m=1/2a which was given in the module for solving acceleration will result in a=2m =208.2. The result of the theoretical answer is nonetheless similar to the experimental value with 13.44% for Vave VS t/2 and 17.78% for x and t^2. As errors are lower than 20%, the experiment did not fail.

EXP 5

Experiment 5 aims to measure the coefficients of static and kinetic friction between two surfaces along with the critical angles involved with the use of steel track, angle indicator, pulley, a block of wood with two surfaces, weight holder, set of weights, thread, and digital weighing scale. Four trials are done for each four different surfaces with two different methods wherein both wood on steel (small large area) have a lesser coefficient of static friction compared with rubber on steel (small&large). Since the coefficient for both wood on steel is lesser, it means it has less resistance to force where in this case, solely gravity. Likewise, rubber has stickier surfaces and requires more force or weight to move on the track which correlates to the larger static friction found during experiment. Moving on to the kinetic friction, rubber on steel remains higher compared to wood on steel. As previously said, rubber has high friction because it opposes the motion during its movement. Henceforth, there's a direct relationship between static and kinetic friction wherein an object having a larger static friction will also have a higher kinetic friction. Another observation is that friction depends on the area of contact. The small area of both wood and rubber during its contact with the steel resulted in lesser static and kinetic friction compared to the larger areas. More contact area of roughness and adhesion means more friction, hindering the movement of the object.

In theory, for most materials, static friction should be higher compared to kinetic friction because more force is needed to overcome its resting phase/inertia before it moves. This was further observed during the experiment where the block couldn't budge no matter how the track is raised, even reaching more than 50 degrees. Moreover, kinetic friction is lower because the adhesive forces or contact area becomes less significant during its movement. This theory is consistent with the findings.

Last but not least, the possible sources of error can be traced back from the first method where sometimes the block does not move which calls for a redo for the entire surface, specifically the rubber on steel. Additionally, since a person is in charge of holding the track as we determine the critical angle and another for reading the angle, there's human error involved. The position of the thread as it slightly swings and cannot stop because the person holding the track is not quite stable, inaccuracies in reading the angle is a possibility.

EXP 6

Experiment 6 aims to verify the conditions for equilibrium and to determine an unknown mass using the concept of equilibrium using materials such as iron stand, meter stick, set of masses, weighing scale and thread.

The first procedure is locating the center of gravity by suspending it and letting the distribution of its mass determine the position of central gravity. It was found to be 50.5 cm instead of 50.0 cm possibly due to a lot of factors like the meter stick was not perfectly uniform where part of the meter stick is denser due to manufacturing issues and partially due to its material, thus: the center of gravity is closer to the denser part. This in turn causes the meter stick to not be suspended symmetrically no matter how the students try to balance it.

On to trial 1 with the actual mass of pan 1 found to be 100 grams located 20.0 cm away from the center of gravity and it was balanced by the mass of 50 grams located 40.0 cm away from the center. This signifies that heavier materials should be near center and lighter materials should be farther away in order to achieve equilibrium and thus, confirming to the concept of torque. Heavier materials produce strong torque and thus need less distance and lighter materials produce weaker torque and therefore need more distance. These respective locations helped balance the stick. Trial II involves moving pan 2 20.0 cm from the center of gravity. The dependent variable is the mass and location of pan 1 until equilibrium. Since pan 2's location decreased by 20.0cm and is now closer to the center of gravity, pan 1's location will also decrease by 10.0 cm. It was moved closer because pan 1 near central gravity helps lower the gravity of the heavier material and moreover the forces acting on pan 1 are evenly distributed and hence, achieving equilibrium with respect to pan 2.

The actual and analytical mass of the pans are equal with both pan 1 having 100.0 grams and pan 2 with 50.0 grams and this resulted in no error indicating a well done experiment. Using the masses from table 6.2, and locations such as 28.5 cm for pan 1 and 7.5 cm for pan 2–the experimental mass is calculated to be 123.0 cm for table 6.3. Notice that pan 2 with lesser material is nearer to the point of support partially because it's on the longer side of stick and conversely pan 1 is farther from point because it's on the shorter side. The meter stick is not in equilibrium but placing the heavier mass on the shorter side and lighter mass on the longer side stabilizes the stick.The only error occurred during gathering data for table 6.3 as it resulted in 1.7 % error. This seemed to occur partially because the center of gravity is not located on 50.5 cm anymore and due to the locations of added masses from the point of support. Using our sight, we cannot fully determine if the meter stick is really proportionally balanced but it seemed balanced enough thus the location chosen. With regards to the guide question presented specifically number 4, if the mass of the meter stick is changed it will not change the position of the pans so long as the meter stick has the same center of gravity being 50.5 cm. But if it has a uniform mass throughout its suspension then the scent of gravity will shift along with the position of the pans.

Exp7

Experiment 7 through using a simple pendulum, aims to determine the period of oscillation if the length of the string, mass of bob, and angle are changed during trials along with determining the acceleration due to gravity. For the first 3 tables, experimental period is calculated through dividing the average time with 20 and theoretical was achieved through using (insert formula). On the first procedure of turning the angle into a dependent variable, the mass chosen was 100 grams and string length is 37.5 cm. All of the results from the angles are almost similar, highlighting the idea that it is only for small angles that time recorded during its' 20 times oscillation is not affected. It can be noted that once an angle reaches a certain threshold or in the experiment 60 degrees, a slight change in recorded time occurred wherein it increased by one. This is due to the restoring force which is proportional to the angle of displacement. Since it's the largest angle, the pendulum swings farther and the restoring force which pushes the pendulum to swing becomes weaker resulting in slower acceleration and leading to more time expended.

Moving on to procedure two where the mass of the pendulum Bob becomes the dependent variable, the masses are 10grams, 20grams, 50grams, and 100 grams. No large changes in time recorded as every value is almost similar suggesting that mass doesn't affect the period of a simple pendulum. This can be said with great confidence as mass was not a factor in calculating the time period. This is due to gravity pulling the Bob downward while the tension of the string stabilizes this force as it moves. The force and inertia of the Bob is proportional to mass thus mass does not affect the motion no matter how small or large it is. With large mass comes great inertia and requires more acceleration so it responds to gravity similar to a lighter mass.

The third procedure is the length of the string becoming the dependent variable and notable changes in time period occurred for each length. As length of the pendulum is directly related to the time period: the longer the length,the slower the swing resulting in longer time. Inversely, a shorter pendulum length will have faster oscillation within a lesser time period.

With 0.51% of error, the value of acceleration due to gravity using a pendulum and linear regression was determined. Theoretical value was solved through manipulation of the original time period formula to have g the unknown value and this bore 9.82 m/s^2. Experimental value was found to be 9.87 m/s^2 through graphing the values of T^2 VS L. Manipulate the formula again to be in the form y=mx+b and you've got “”. The slope was given by excel to be 3.91

which is equivalent to 4pi^2 over g. Equating those two and solving for the unknown g is how the gravitational acceleration was calculated.
Rate of errors are within minimal levels, making the findings valid. Certain sources of error are undoubtedly present. The first possible source is reaction time during stopwatch recording where hand-and-eye coordination is put to the test. Second is the way the angle is measured during the experiment where again, eyesight is put to the test along with how stable or a person does not experience slight hand shaking during performing tasks (tremors).

Conclusion
In conclusion, Experiment 7 involved the examination of a simple pendulum to determine the period of oscillation under varying conditions of string length, bob mass, and angle, alongside calculating the acceleration due to gravity. The procedures revealed that for small angles, the oscillation period remains relatively constant, with notable changes occurring when the angle exceeds 60 degrees due to the weakening restoring force. The results indicated that mass does not influence the period of a simple pendulum, as the gravitational pull and string tension offset any potential effects. In contrast, significant changes in the period were observed as the string length varied, confirming its direct relationship with oscillation time. The experiment yielded an experimental value for gravitational acceleration of 9. 87 m/s^2, closely aligning with the theoretical value of 9. 82 m/s^2, resulting in a minimal error rate. Possible sources of error were identified, including reaction time and measurement inaccuracies. Overall, the findings were deemed valid and supported by the data collected.