Physics coursework- investigation on pendulums

In this experiment, I will investigate what affects the frequency of a pendulum. Pendulum clocks have been used to keep time since 1656 and were the first clocks made to have any sort of accuracy. Clock designers had to face and solved a number of interesting problems to create accurate timekeeping devices. Today I will investigate what variables could affect the period of the pendulum. I will change the independent variable 5 times, so as to get sufficient results.

Independent Variable

Predicted effect on Frequency

1. Increase in mass of pendulum

Decrease frequency

2. Increase the length of the swing

Decrease frequency

3. Change aerodynamics (smooth)

Increase frequency

4. Increase width of displacement.

Increase frequency

5. Increase height of clamp stand.

No effect

Reasons for my predictions

1. Increase in mass of pendulum:

When the mass of the pendulum is increased, I think the frequency is likely to decrease. This is because if the pendulum is heavier, it is inclined to move slower.

2. Increase the length of the swing:

If the swing is longer, the arc of the circle, which the pendulum traces, will be longer, so the swing will take longer.

3. Increase the width of displacement:

I think this will cause the frequency to be increased, as the greater the angle of displacement, the more time the pendulum will have to gather speed, therefore, the period will be increase.

4. Aerodynamics:

If the aerodynamics were less streamlines (if the bob was not a smooth circle), there would be more air-resistance, therefore decreasing the frequency.

5. Increase the height of the Clamp stand:

I believe this would have no effect on the frequency of the pendulum, as it is not directly affecting it, only where it takes place. If the height of the stand did effect the pendulum swing, pendulums would not be suitable to use inside clocks, as they would vary depending on where they are.

Method

1. Increase mass of pendulum:

I will now investigate whether or not the change in weight of the bob will affect the frequency of the pendulum.

For this experiment, the equipment I will need is:

* A lump of plastacine

* A long piece of string

* A split cork

* A clamp stand

* A ruler (with mm measurements)

* An accurate stop clock

1. Before I could start the experiment, I needed to decided on the measurements I would use for the experiment. I set up a clamp stand, with the clamp 20cm exactly from the surface of the desk. The string was threaded through the cork, and there was exactly 15cm of string between the clamp and the bob.

2. I used a wide range of masses, so I woul get a wide range of results. I accurately measured a bob of 10g to start with.

3. The bob was attached to the string securely, by wrapping the plastacine around the excess piece of string.

4. I raised the bob to exactly 90 degrees of where it had hung, and held it there.

5. I then started the stop clock, as the same time as I let the bob go (careful not to push it).

6. I counted how many periods it did in 20 seconds. I then repeated this 3 times, and recorded my results.

7. I repeated the same experiment with different weighted bobs, each three times, and then recording my results. The range I chose to use for this experiment was from 10g – 100g. (see table below)

Results

Number Of Oscillations in 20 Seconds

Weight of Bob (g)

1st

attempt

2nd

attempt

3rd attempt

Average number

10

19

20

20

19. 7

20

20

20

21

20. 3

30

20

21

20

20. 3

40

20

20

19

19. 7

50

19

21

20

20

60

20

21

20

20. 3

70

21

19

20

19. 7

80

20

20

19

19. 7

90

20

20

21

20. 3

100

19

22

20

20. 3

Overall average oscillations = 20. 03 oscillations

My prediction was wrong, the weight of the Bob does not have an effect on the number of periods the bob does. (see the graph)

2. Increase width of displacement:

In the next test, I find out whether the angle of displacement really does increase the frequency of the pendulum.

1. I used the same equipment as in the last experiment, and it was set up in the same way. I used string, with a length of 15cm (as before) and a stand at 20cm from the surface of the table (as before). The bob I used was 50g in weight.

2. I raised the bob to exactly 90 degrees, measuring with a protractor.

3. As before, I let it go, not pushing it, at the same time as starting the stop clock.

4. I counted how many oscillations the pendulum made. I repeated this three times.

5. I repeated the same experiment, except each time changing the angle of displacement. I did this three times each, and recorded my results. The range I chose to use for this was 90 degrees, down to 10 degrees. (see below)

Results

Number Of Oscillations in 20 Seconds

Angle of displacemnt (degrees)

1st

attempt

2nd

attempt

3rd

attempt

Average

90

21

21

20

20. 6

80

20

20

20

20

70

20

20

19

19. 7

60

20

20

21

20. 3

50

19

20

20

19. 7

40

20

20

20

20

30

20

19

21

20

20

18

21

20

19. 6

10

20

20

20

20

Overall average oscillations = 19. 98 oscillations

These results show the angle of the arc through which the pendulum swings does not affect the pendulum’s period. (see the graph)

So far, neither of my predictions have been correct. Perhaps the frequency of a pendulum will not change, no matter what it’s variable. However, I will do one final test.

Increase the length of the string:

1. I used the same equipment as previously, and it was set up in the same way. I used a bob of 50g in weight. (as before) and a stand at 20cm from the surface of the table (as before).

2. I used a piece of string, with a length of 5cms, to start with.

3. I carried out the experiment as I had done the previous two times. (Releasing the bob from about 45 degrees and counting how many oscillations in 20 seconds.)

4. I repeated the experiment three times, and recorded my results. I then repeated it for all of the other lengths of string, (each three times) and recorded my results. I chose to use a range of 5 cm – 50cm of string for this experiment. (see table below)

Results

Number Of Oscillations in 20 Seconds

Length of string (cm)

1st

Attempt

2nd

Attempt

3rd

Attempt

Average

5

34

36

32

34

10

27

28

26

27

15

25

23

22

23. 3

20

22

20

21

21

25

21

18

20

19. 6

30

18

16

17

17

35

16

14

14

14. 7

40

9

8

10

9

45

7

6

7

6. 7

50

5

4

4

4. 3

From this table, I can clearly see a different pattern than those of the other two tables. This clearly shows that the length of the string used, does affect the number of oscillations the pendulum makes. (see the graph)

My prediction for this variable was correct!

Evaluation

From my graphs, I can see a clearer picture of the pattern I got in the results tables. Both the line in the graph for ‘ the weight of the bob’ and for ‘ the angle of displacement’ vary very little. However the points are not completely identical, and this was probably

caused by the inaccuracy of the experiment.

Every time we repeated the experiment, it

was very slightly different, therefore not

achieving the same results each time.

Nevertheless, my attempts proved similar

enough to attain these unmistakable results,

showing the obvious pattern in the results.

It is also very obvious from looking at the other

graph that number of oscillations definetly

depended on the length of the string used. The points on this graph make a reasonably smooth curve, only slightly incongruous where the experiment was not completely accurate (as in the other graphs).