Sci 265 - Energy and Power

Galileo's Pendulum Experiment 1: Click on the "Galileo Pendulum I" on your desktop

1. Observe the experiment, describe your observations and explain them using your knowledge of energy.

The pendulum mass starts at the same height as the bar, swings and rises up to the same height on the other side of the stand and swings back. It's similar to the skater where the skater starts with a certain amount of potential energy due to his height, then he speeds up as he goes down converting potential energy into kinetic energy. Then as he goes back up, he slows as the kinetic is converted back to potential.

2. What changes occur to the pendulum motion during the experiment?

3. What aspects of motion do not change?

4. What is the initial and final height of the pendulum in each sub experiment?

The initial and final height are the same in both experiments. Even when the bar is put in the way of the string, the mass still rises to the same height above the table as it started.

5. How can you explain your observations using the ideas of energy?

See #1

Galileo's Pendulum Experiment 2:

It is important that you only watch this video one bit at a time. You should draw a prediction before you watch the result for each step. This will make it easier to remember what happens and sort out why it happens. Luis will release the pendulum bob at a specific height and let it swing freely. Then he will place an obstacle in the way of the bob and repeat the experiment releasing the bob at the same height as before. There are 6 levels of the experiment.

1. Watch from **00:00:00 to 00:00:13** of the "Galileo Pendulum II" on your desktop. Stop before he swings the pendulum again. Predict how high the bob will rise this time. Draw a picture of the pendulum when it's closest to Luis and when it's furthest from Luis, the highest point it reaches on each side.

2. Watch from **00:00:13 – 00:00:25**. How high did it rise? Draw a diagram showing maximum height on each side.

3. Watch the next (2nd) setting from **00:00:25 – 00:00:33**. Make a prediction for the new height of the obstacle. Include a drawing.

4. Watch from 00:00:33 – 00:00:41. How high did it rise? Draw a diagram showing maximum height on each side.

5. Now watch the placement of the 3rd position (**stop at 00:00:51**) and predict how high the pendulum will go. Include a diagram showing final height on each side.

6. Watch the experiment and draw a diagram showing maximum height on each side.

7. Now watch the placement of the 4th position (**stop at 00:01:14**) and predict how high the pendulum will go. Include a diagram showing final height on each side.

8. Watch the experiment and draw a diagram showing the maximum height on each side.

9. Now watch the placement of the 5th position (**stop at 00:01:25**) and predict how high the pendulum will go. Include a diagram showing final height on each side

10. Watch the experiment and draw a diagram showing the maximum height on each side.

11. Now watch the placement of the 6th position (**stop at 00:01:38**) and predict how high the pendulum will go. Include a diagram showing final height on each side.

12. Watch the experiment and draw a diagram showing the maximum height on each side.

13. What are the key points that cause a different result for the pendulum? Explain why the behavior changes at these key points.

    Putting a bar in the way of the string just changes the path of the string. It now has a sharp bend in it. But the mass still rises to the same height above the table.
    However, once the bar is low enough and there is not enough string to allow the mass to rise to the same height, the mass wraps around the pole.

14. How does the final height on each side compare for each experiment?

    The final height on each side is equal. Until the bar that is placed in the way is so low that there is not enough string for the mass to rise to the same height.

15. How is this experiment different from the first observational experiment with the pendulum?

It was nice that it lowered the bar just a little at a time so that we could see where the behavior changes. It also showed us that the mass does always rise to the original height and it wasn't just the one special case shown in the first video.

16. What were the unexpected features of the experiment that made you rethink your model?

How powerful are you?

Materials and Equipment: stopwatch, 2 meter stick or ruler, human

Predict

Which person in your group is capable of the largest burst of power over a short distance?

Plan

Create an experiment that will allow you to determine the power output of each person in your group as you run up a flight of stairs.

Investigate

Collect data for each member of your group and then convert the power output to horsepower and post the largest value on the white board. *Hint:* Your reading for this week contains all the equations and examples to help you complete the necessary calculations.

Analyze

Discuss the accuracy of this experiment. What factors were not accounted for in your calculations? Which of these would cause you to overestimate the person's power output and which would cause you to underestimate?

- I decided to test my dog, Aldo. I had him run up one flight of stairs so that he didn't lose time turning the corner.
- Measuring the height change was a challenge. Trying to eyeball the top of the stairs while standing at the bottom was really inaccurate. So I tried using two 2-meter sticks where one of them I held horizontal to the top of the stairs and then lined up the 2nd one. It was still hard to be sure that the meter stick was level. So instead I measured the height of one step, counted the total steps and multiplied. That seemed much more accurate. I got 19 cm per step and 11 steps. 190 cm
  I know I'll need meters so 190 cm (1 m/ 100 cm) = 1.9 m
- Now I converted Aldo's mass to kilograms. 92lbs (1 kg / 2.2 lbs) = 42 kg.
- I timed him running (more jumping really) up the stairs three times. He averaged 1.1 seconds.
- His potential energy change is mass*gravity*height = 42 kg * 9.8 m/s2 * 1.9 m = 782 Joules
- His power in watts is Energy / time = 782 J/1.1s = 711 W
- His power in horsepower is 711 W (1 hp / 746 W) = 0.95 hp