Physics 12   Name:_____

                                                                              Block: _____

Lab 3: Energy Changes of a Swinging Pendulum

Purpose: To predict, by energy calculations, the maximum speed reached by a swinging pendulum, and to check the prediction by measurement using a phone measure velocity.

Materials:
- String
- 0.50 kg mass
- Meter stick and ruler
- Phone for videoing

Procedure/Data/Observations:

Prediction using energy:

1. Attach a 0.50 kg pendulum bob to a string hanging around the room.
2. Design a system so that you can raise the bob to the same height, h, repeatedly. Measure h relative to the lowest position the mass reaches on each swing. Draw a diagram of the set up.

3. Calculate how much gravitational potential energy, E_p, the mass will have a height, h.

4. Let the mass swing "once" (=start, to other side, and return to starting side again), and record the new height, h', reached by the bob on its return swing. Repeat this measurement 4 more times (5 times in total) and calculate the average of h'.

5. Calculate the loss of E_p during one full swing (mgh – mgh'). What happens to this energy?

6. At the bottom of the swing, what kind of energy does the mass have?

7. If we consider the entire swing (back and forth) there are 4 sections. The energy loss for each quarter is ¼(mgh – mgh'). We can therefore use energy to calculate the velocity at the bottom of the first swing using the following formula:
$$½mv^2 = mgh – ¼(mgh\text{-}mgh')$$

Video measurement:
8. Video the 0.50 kg mass swinging through the lowest point on the first pass. Do this several times to be able to obtain an average. Calculate the average maximum speed of the mass (v=d/t). Note that the maximum speed happens right at the bottom so use a narrow distance (10cm?) close to the bottom of the swing. Calculate and explain...

9. Calculate the percent difference between your energy predicted and video measured velocities (as recorded on the ticker tape):
$$percent\ difference = \frac{|\,videoed\ v - predicted\ v\,|}{predicted\ v} \times 100\%$$

10. Calculate how many swings it would be before the mass would stop? Let the pendulum swing to see if you are close – if the number is very different, why might that be?

Analysis/Conclusion: (own words, not your partner's)

Write-up hints for Analysis and Conclusions:

- Did you accomplish the purpose of the lab? Explain, don't just say "yes".
- Discuss what your results mean in terms of the physics concept being studied. Connection to formula/theory. What was learned through the lab? Did it prove a physics concept? Explain.
- Did the procedure lead to good results? Is there a better way to do the lab? Explain.
- List any inherent errors that affected, or could have affected, the results like: equipment issues ___, friction of ___ , etc (NOT "human error", NOT "I measured wrong"). Be specific, detailed.

Marking guide:

- All procedure steps completed   6 marks
- Questions in procedure answered   3 marks
- Analysis/Conclusions is complete (including multiple possible errors)   6 marks

                                                Total: /15 marks

Due date:_____

Labs must be handed in on the due date. Labs will not be accepted after they have been marked and returned. (*Personal Awareness and Responsibility Core Competency*)
If a student was away on the day of the lab, he/she can come to make up the lab, before it is handed back, immediately when he/she returns to school.