Chapter 12 In a spin

Short investigation 12.1: Pendulum motion

Name: .....

Aim

To investigate the factors that influence the period of a simple pendulum

Materials

Retort stand and clamp, 3 lead sinkers, thread, stopwatch, metre ruler, sticky tape

Method

Part A: The effect of mass

1. Set up the retort stand and clamp.
2. Thread one end of a 50 cm length of thread through one of the lead sinkers. Tie the other end to the clamp.
3. Pull the sinker 10 cm to one side of its vertical position. Release the sinker and use the stopwatch to measure the time taken for 20 complete swings (one swing is forward and then back again).
4. Repeat two more times and enter the values obtained into table 12.1A. Using these values, determine the average period *T* for one swing of the pendulum.
5. Without changing the length of the thread, use sticky tape to attach another sinker to the one tied on. Repeat steps 3 and 4 for the two sinkers.
6. Attach the last sinker and then repeat steps 3 and 4.

Part B: The effect of amplitude

1. Thread a sinker and tie it onto one end of a 50 cm length of thread. Tie the other end of the thread to the clamp.
2. Pull the sinker 4 cm to one side of its vertical position. Release the sinker and use the stopwatch to measure the time taken for 20 complete swings (one swing is forward and then back again).
3. Repeat 2 more times and enter the values obtained into table 12.1B. Using these values, determine the average period *T* for one swing of the pendulum.
4. Repeat steps 2 and 3, changing the distance that the sinker is pulled to one side to 6 cm, 8 cm and 10 cm.

Part C: The effect of pendulum length

1. Thread a sinker and tie it onto one end of a 50 cm length of thread. Tie the other end to the clamp.
2. Wind the thread around the clamp until the distance between the clamp and the top of the sinker is equal to 10 cm. Use a piece of sticky tape to keep the thread from unwinding.
3. Pull the sinker 10 cm to one side of its vertical position. Release the sinker and use the stopwatch to measure the time taken for 20 complete swings (one swing is forward and then back again).
4. Repeat 2 more times and enter the values obtained into table 12.1C. Using these values, determine the average period *T* for one swing of the pendulum.
5. Repeat steps 2–4, using thread lengths of 20 cm, 30 cm and 40 cm.

Results

Table 12.1A

Mass (sinkers)	**Time for 20 swings (s)**			***T* (s)**
	Trial 1	**Trial 2**	**Trial 3**	
1				
2				
3				

Table 12.1B

Amplitude (cm)	**Time for 20 swings (s)**			***T* (s)**
	Trial 1	**Trial 2**	**Trial 3**	
4				
6				
8				
10				

Table 12.1C

Length (cm)	**Time for 20 swings (s)**	***T* (s)**

	Trial 1	Trial 2	Trial 3	
10				
20				
30				
40				

Analysing the results

1. Considering your results, which of the variables — mass, amplitude or length — had an obvious effect on the pendulum's period *T*?

2. In what way did increasing the length of the pendulum affect the period *T*?

3. Given that the equation relating the period *T* (s) of a pendulum to its length *L* (m) is $T = 2\pi\sqrt{\frac{L}{g}}$ where g is 9.8 m s^{-2}, calculate the theoretical periods that you should have obtained for the lengths of pendulum used.
   (a) *L* = 10 cm= 0.1 m

   (b) *L* = 20 cm= 0.2 m

   (c) *L* = 30 cm= 0.3 m

   (d) *L* = 40 cm= 0.4 m

4. What explanations can you give for any discrepancy between the theoretical and investigational values of the period?

Conclusion

State the effect of increasing mass, amplitude or length on the period of the pendulum.

Notes: