Swing Time Lab

Follow a pendulum procedure and use the data to explain a pattern.

CCSS.ELA-Literacy.RST.11-12.3 "Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Number the procedure actions in order, underline every measurement or condition that must be controlled, and circle the results and explanations that show what the data mean.

Testing Pendulum Periods

1. To investigate how pendulum length affects period, gather a ring stand, clamp, string, metal washer, meterstick, stopwatch, and a data table. Tie the washer to one end of the string. Secure the other end in the clamp so the washer can swing freely without striking the stand. Measure from the clamp point to the center of the washer, then adjust the string to 25.0 centimeters. Record this length before releasing the pendulum. Keep the same washer for every trial, because changing its mass would add an unnecessary variable.

2. Pull the washer sideways until the string forms an angle smaller than 10 degrees from vertical. Do not push it. Start the stopwatch as the washer passes the center position, count ten complete swings, and stop the watch when it next passes the center after the tenth swing. Divide the recorded time by ten to find one period. Repeat this timing procedure twice more at 25.0 centimeters, then average the three periods. Next, change only the measured length to 50.0 centimeters and 75.0 centimeters, completing three trials and an average at each length.

3. The averages were 1.01 seconds at 25.0 centimeters, 1.42 seconds at 50.0 centimeters, and 1.74 seconds at 75.0 centimeters. Thus, longer pendulums took more time for each swing, but doubling the length did not double the period. This pattern fits the relationship for a small-angle pendulum, in which period increases with the square root of length. If a trial produced a much shorter period at 75.0 centimeters, check whether the length was measured to the washer's center or whether the pendulum was pushed during release. Either error could change the result.

2 ANSWER WITH EVIDENCE

Use the passage

1. Describe the exact timing sequence, from starting the stopwatch through finding one period.

2. What two release conditions must stay the same before each timing trial, and why do they matter when comparing lengths?

3. Use the averages at 25.0 and 50.0 centimeters to explain why doubling the length did not double the period.

4. A 75.0-centimeter trial has a much shorter period than expected. What two possible errors should you check?

3 YOUR TURN

Your own words

Plan an extension of this investigation at a length of 100.0 centimeters. Write four numbered procedure steps that preserve the important controls, then write one sentence predicting the approximate average period and explaining your prediction.

ANSWER KEY

Swing Time Lab

HIGH SCHOOL · RST.11-12.3

PART 1 · READ AND MARK

Number the procedure actions in order, underline every measurement or condition that must be controlled, and circle the results and explanations that show what the data mean. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Describe the exact timing sequence, from starting the stopwatch through finding one period.	**Start the stopwatch as the washer passes the center, count ten complete swings, stop it at the next center pass after the tenth swing, then divide the time by ten.**
2	What two release conditions must stay the same before each timing trial, and why do they matter when comparing lengths?	**Keep the release angle smaller than 10 degrees and do not push the washer. Keeping these conditions consistent makes length the intended changing variable.**
3	Use the averages at 25.0 and 50.0 centimeters to explain why doubling the length did not double the period.	**The length doubles from 25.0 to 50.0 centimeters, but the period rises from 1.01 to 1.42 seconds, not to 2.02 seconds. This supports the square-root relationship.**
4	A 75.0-centimeter trial has a much shorter period than expected. What two possible errors should you check?	**Check whether the length was measured to the washer's center and whether the pendulum was pushed during release.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

1. Adjust the string so the distance from the clamp point to the washer's center is 100.0 centimeters, using the same washer and apparatus. 2. Pull the washer to an angle smaller than 10 degrees and release it without pushing. 3. Time ten complete swings from a center pass to the center pass after the tenth swing, then divide the time by ten. 4. Complete two more trials and calculate the average period for 100.0 centimeters. I predict an average period of about 2.0 seconds because 100.0 centimeters is four times 25.0 centimeters, and the square-root relationship predicts about twice the 1.01-second period.

Accept equivalent wording when the timing order, the small release angle, no push, repeated trials, and averaging are retained. For the prediction, accept approximately 2.0 seconds with an explanation based on the square-root relationship or on the 25.0-centimeter result.