Pendulum Precision

Read a laboratory procedure for measuring a pendulum's period precisely.

CCSS.ELA-Literacy.RST.9-10.3 "Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline every action you must take, circle every number or measurement, and box each condition that tells you to discard or restart a trial. Number the main steps in the order you would perform them.

Measuring a Pendulum's Period

1. To measure the period of a pendulum, clamp a string so it can swing freely, then tie a metal washer to its lower end. Measure the string length from the pivot point to the center of the washer, and record the length in meters. Pull the washer to one side so the string makes an angle smaller than 15 degrees from vertical. Place a ruler beside the starting position, but do not let the washer touch it. Before timing, check that the washer has room to swing without striking the stand or table.

2. Release the washer without pushing it. Start a stopwatch as the washer passes the ruler in one chosen direction, and count that pass as swing zero. Count each later pass at the same point in the same direction until the washer completes 20 full swings. Stop the watch on the twentieth return to that point. Record the total time to the nearest tenth of a second. Repeat the timing two more times, always releasing from the same marked position. If a release angle is 15 degrees or greater, do not use that trial because a large angle can change the period.

3. Add the three acceptable total times and divide by three to find the average time for 20 swings. Divide that average by 20 to calculate the period of one swing, then report the result in seconds. If you miss a count, bump the stand, or start the watch late, discard the entire trial and repeat it instead of correcting the number afterward. If the string slips in the clamp, first stop the test, remeasure the pivot-to-center length, and restart all three trials. In your data table, label length, trial times, average time, and period with units.

2 ANSWER WITH EVIDENCE

Use the passage

1. What must you check before you begin timing, and why does this check matter?

2. Describe exactly when you start and stop the stopwatch for one trial.

3. A student releases the washer from an angle of 16 degrees. What should the student do with that trial, and why?

4. During the second trial, the string slips in the clamp. List the required actions in order.

3 YOUR TURN

Your own words

Write the six-step comparison plan for 0.50 m and 1.00 m, then carry it out with teacher supervision and a securely clamped light washer in a clear swing area, away from people. Use the passage's exact timing/release and exception rules. Record actual pivot-to-center lengths and three acceptable twenty-swing times per length on a separate labeled data sheet, calculate each average and period, and compare. Record any discarded trial and reason, or state that no exception occurred. If the string slips, remeasure and restart all three trials.

ANSWER KEY

Pendulum Precision

HIGH SCHOOL · RST.9-10.3

PART 1 · READ AND MARK

Underline every action you must take, circle every number or measurement, and box each condition that tells you to discard or restart a trial. Number the main steps in the order you would perform them. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What must you check before you begin timing, and why does this check matter?	**Check that the washer can swing without hitting the stand or table. A collision would interfere with the pendulum's motion.**
2	Describe exactly when you start and stop the stopwatch for one trial.	**Start as the washer passes the ruler in one chosen direction, counting that pass as swing zero. Stop on the twentieth return to that point in the same direction.**
3	A student releases the washer from an angle of 16 degrees. What should the student do with that trial, and why?	**Discard the trial because the release angle is 15 degrees or greater, and a large angle can change the period.**
4	During the second trial, the string slips in the clamp. List the required actions in order.	**Stop the test, remeasure the pivot-to-center length, and restart all three trials.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

1. Clamp the string, attach the washer, and measure a pivot-to-center length of 0.50 m.
2. Mark a release angle smaller than 15 degrees and use the same marked angle for every release.
3. Release without pushing, time 20 full swings, and record the total time to the nearest tenth of a second.
4. Collect three acceptable trials, discarding and repeating any trial with a missed count, a bumped stand, or a late stopwatch start.
5. Reset the pivot-to-center length to 1.00 m and repeat the same release and timing procedure for three acceptable trials.
6. Average the three total times for each length, divide each average by 20, record both periods in seconds, and compare them.

Illustrative record, not student measurements: 0.50 m times 28.2, 28.4, 28.6 s average 28.4 s; period 28.4/20 = 1.42 s. At 1.00 m, 40.0, 40.2, 40.4 s average 40.2 s; period 2.01 s. The longer pendulum has a longer period. No exception in this example. Actual results vary.

Retain the six ordered plan steps with both lengths, consistent release below 15 degrees, three acceptable trials and both calculation steps. Teacher supervises secure setup and observes actual learner procedure-following. Require the actual labeled data sheet, averages, periods and recorded exception response or no-exception statement. A missed count, bump or late start requires discard/repeat; string slip requires remeasurement and restarting three trials. Do not accept plan or copied model data as execution.