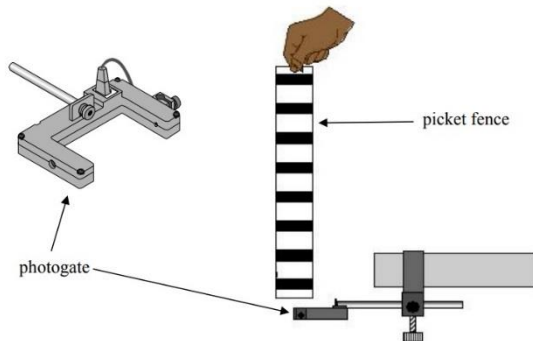


Uniform Accelerated Motion: The Picket Fence







Equipment	Quan
picket fence	1
photogate	1
table clamp	1
mouse pad	1

The acceleration due to gravity at Earth's surface is of course, the same for all falling objects, at about 9.80 m/s^2 . It varies over the Earth's surface, primarily with latitude, being about $\frac{1}{2}\%$ lower at the equator than at the poles. At 34° latitude (Atlanta's latitude), the value is just under 9.80 m/s^2 , so we'll use this value as our accepted g .



The "picket fence" is a Plexiglas strip with regularly spaced black bands. You'll hold vertically above the photogate and drop it through it so that the bands pass through the beam in succession. As each band passes, the computer will measure the passage time and calculate the average speed of passage, $v = d/t$, where d is the width of the band. Since the picket fence is accelerating, each band will have a higher speed than the previous one that passed. The computer will automatically calculate the time rate of change speed (acceleration).

Procedure

1. Mount the table clamp to the edge of the table as indicated in the diagram.
2. Screw the rod into the photogate so that it can be mounted into the clamp as in the figure.
3. Place a mouse pad on the floor underneath the photogate to cushion the fall of the picket fence.
4. Plug the photogate into digital channel #1 on the 850 data collection box on your lab table.
5. Plug the photogate into port 1 of "DIGITAL INPUTS" on the 850 interface box.
6. Double click the PASCO Capstone icon to start the software. 
7. Click on the "Hardware Setup" icon. 
8. You should see an image of the 850 box. Click on the port 1 plug in "Digital Inputs."
9. Choose "Picket Fence."
10. Click again on "Hardware Setup" to dismiss it.
11. The "Record" button should now be red, indicating that the photogate can collect data. 
12. There should be a column of icons on the right side of the screen. If you don't see them, click the symbol shown at right. 
13. Double click the table icon (shown at right) to bring up a table for data. 
14. Double click the graph icon (shown) to also bring up a graph. 

15. Add two columns to the table by clicking on this icon twice (it's at the top of the table).



16. The table columns will contain time, position, speed, & acceleration data. Click on <Select Measurements> of the first column and choose "Time."

17. Click on <Select Measurement> of the second column and choose "Position."

18. Likewise, assign the third and fourth columns to display speed and acceleration.

19. The graph will display position vs time. Click on the <Select Measurements> of the vertical axis and choose "Position." The horizontal axis should automatically set to "Time."

20. To run the experiment, click "Start," drop the picket fence through the gate, and then click "Stop." Data points will appear on the graphs and numbers in the table.

21. Under constant acceleration, the position of a falling object obeys the following kinematic equation:

$$y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2$$

22. Click on the fit icon and choose "quadratic." Since the above kinematic equation describes the motion, then a quadratic fit should match the data closely. The parameters of the quadratic fit are displayed in the box that appeared on the graph. Which of the parameters should indicate the acceleration? Circle one below.



A B C

23. From this parameter of the fit, what is the acceleration of the picket fence?

$$a_y = \text{_____} m/s^2$$

24. Since the acceleration is constant, the velocity of the picket fence should obey the following kinematic equation:

$$v_y = v_{y0} + a_y t$$

25. Change the vertical axis of the graph to "Speed." You will now see a graph of speed vs. time.

26. Remove the quadratic fit by left clicking on the box and clicking the X

27. Since speed is plotted vs time, the slope of this graph is acceleration. You can fit the data to a straight line by clicking on the fit button and choosing "linear."



28. Which of the parameters of the fit will indicate the acceleration this time?

m b

29. From this parameter, what is the acceleration?

$$a_y = \text{_____} m/s^2$$