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Simple Harmonic Motion–Lab10

Purpose

The purpose of this lab is to explore the concepts and mathematics associated with Simple Harmonic Motion(SHM). This interactive replicates the motion of a mass on a spring and provides graphs that allow you to understand the interaction visually and analytically.

Procedure

For this lab you will need pencil, paper, and the interactive link provided to you in the canvas lab interactives folder. Please also make sure to read up on Chapter 15 on SHM.

a) Before you begin you will need to check that the drop down menu on the upper left says" shm with vo=0". This is the default setting. Next click on the drop down menu onright side of this and click on" world" view. Depending on the graphs (i.e. x. vs. t. or v vs. t) being asked for below, you will need to select different world views from the drop down menu.

b) Included here is an image of a wave that was produced using this interactive. You will be asked to use the crosshairs of the interactive to adjust the velocity and initial position of the mass to exactly reproduce this graph and answer any questions below about it. You will use the image and variable information found in the graph, and the interactive to do this, along with the initial condition of x= -1.9m at time t=0 and an amplitude of 2.195m sometime later. You will need to make an SHM equation using these variables in order figure out the initial conditions and reproduce the graph accurately. The graph that you create and submit with this lab assignment should have fewer cycles than the one I created in order to distinguish between the two.

Lab Deliverables

I) Derive a SHM equation from the graph and variables given.

Answer:

Equations:

Maximum amplitude A = -1.90 m

Mass m = 1 kg

k= 1 N/m

Time period = 2*pi*sqrt(m/k)

Resultant force = -k*x

X(t) = -1.90*cos(2*pi*f*t)

Acceleration max = (k*A)/m here A = -1.90 m

Vmax = sqrt(k/m) *-1.90

V(X) = V0*sqrt(1-X^2/A^2)

T.E = ½*(k*A^2)

We can prove the equation for Total energy as, A = -1.90.

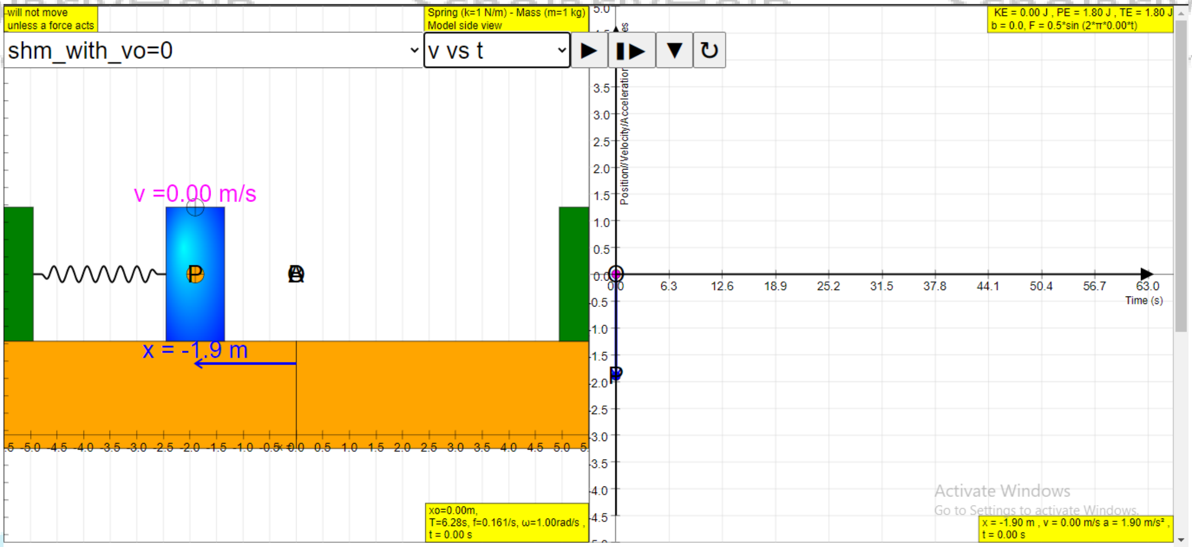
So, we can calculate T.E using the above formula as from the simulation T.E = 1.80.

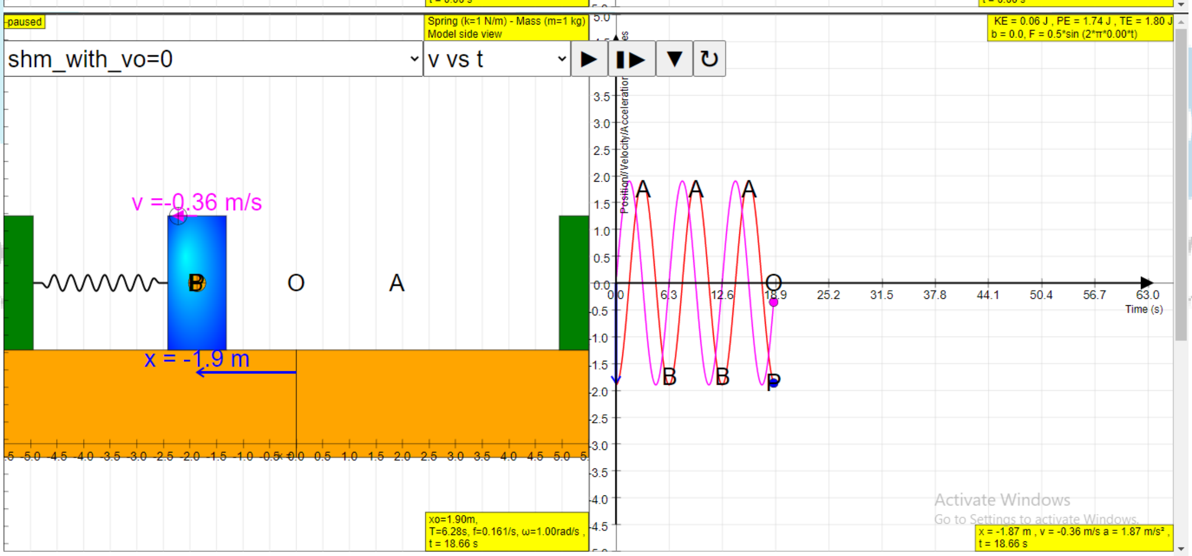
Now, T.E = ½*(1*(-1.90) ^2)

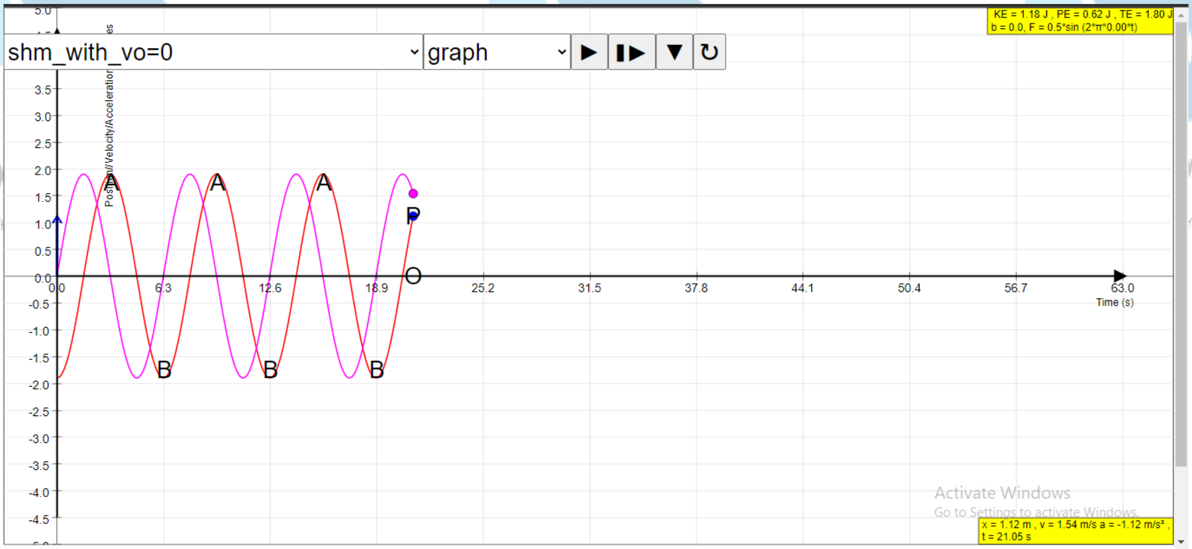
T.E = ½*(3.61)

T.E = 1.805 J.

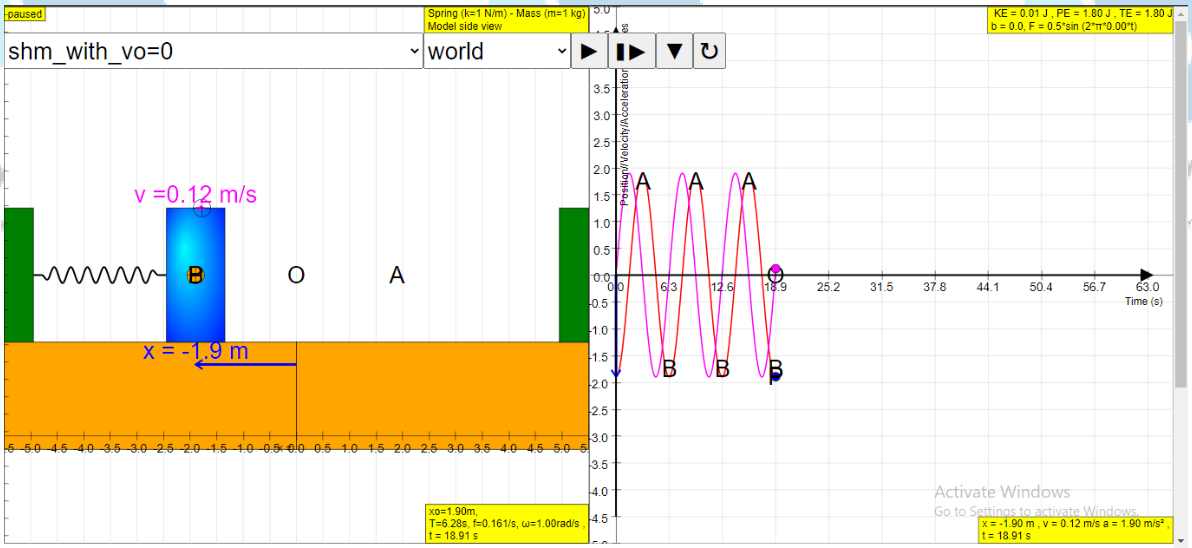
II) Select v vs. t from the drop down menu and a screen shot of your reproduced graph minus few cycles in difference from the graph provided,







III) Select x vs. t from the drop down menu and a screen shot of your reproduced graph minus few cycles in difference from the graph provided,



IV) What were the initial conditions (x, and v) when this graph began (motion started by me)?

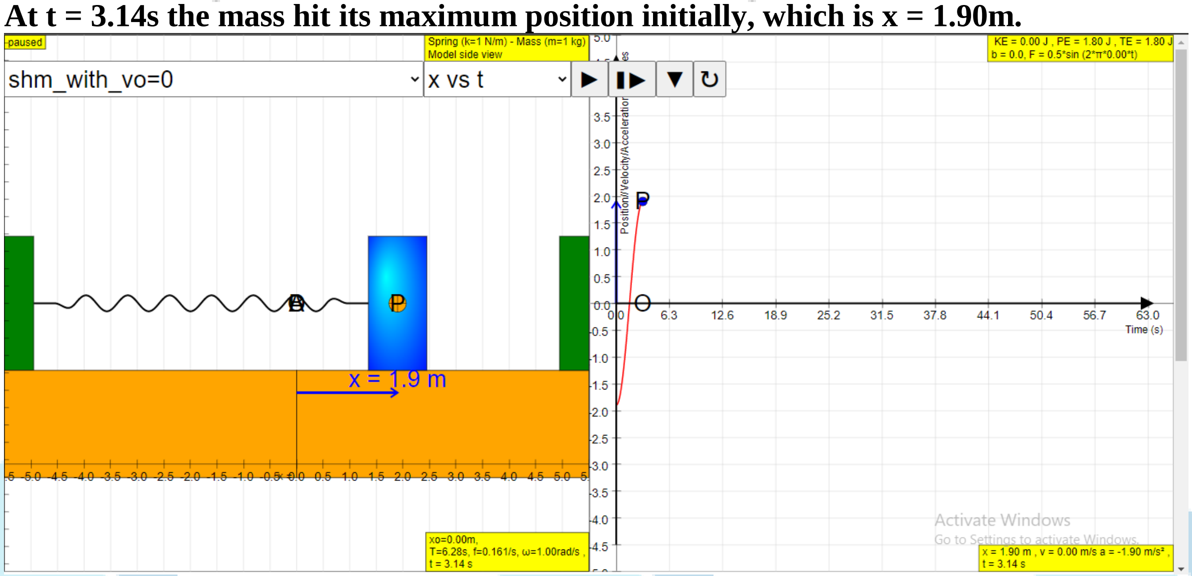
Answer:

The value of x is "1.33 m" and the initial condition value of v is "1.75 m/s".

V) At what time does the mass hit its maximum position initially?

Answer:

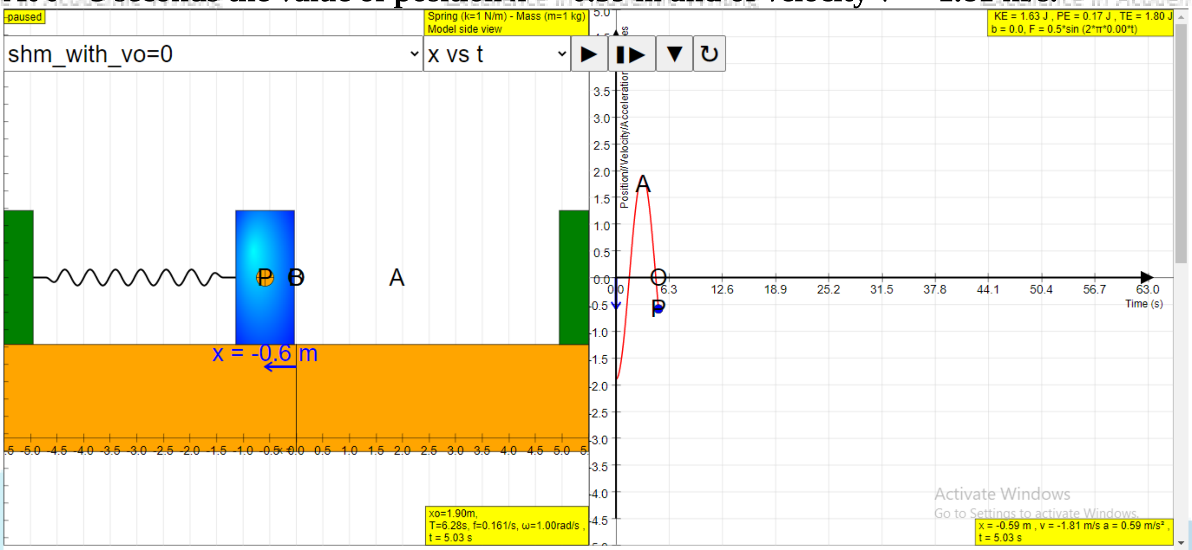
At t = 3.14s the mass hit its maximum position initially, which is x = 1.90m.



VI) Calculate what the position and velocity would be at t=5 seconds.

Answer:

At t = 5 seconds the value of position x = -0.59 m and of velocity v = -1.81 m/s.



VII) Draw a force vs position graph corresponding to the oscillator in this interactive.

Answer:

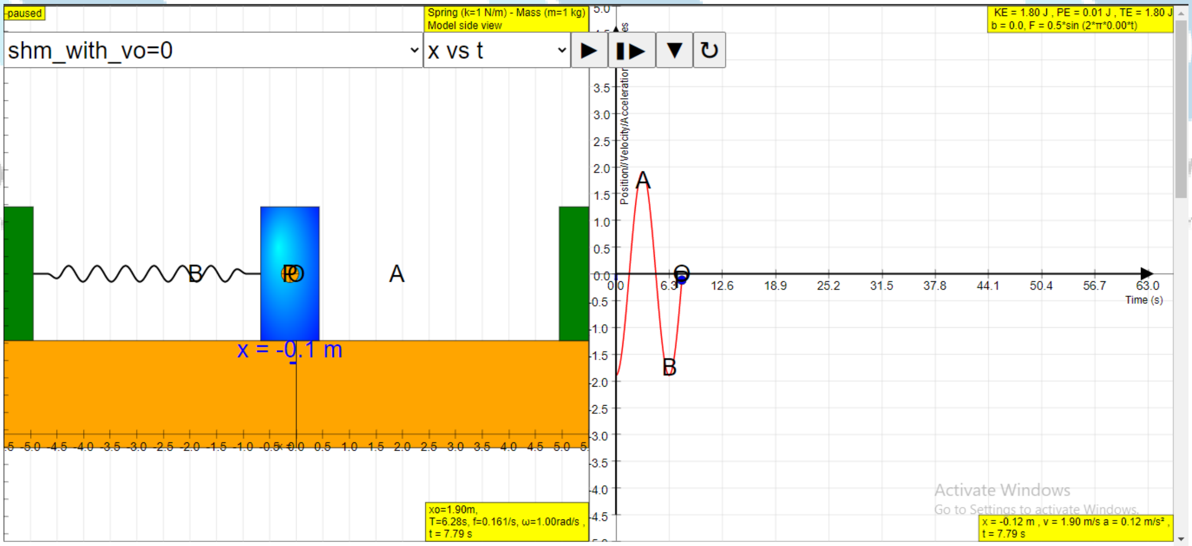
There is no option available for plotting force versus position graph in the provided interactive link.

VIII) Examining the graph of position and velocity versus time with one to two cycles, where is the mass relative to the equilibrium position when the absolute value of the velocity is the greatest?

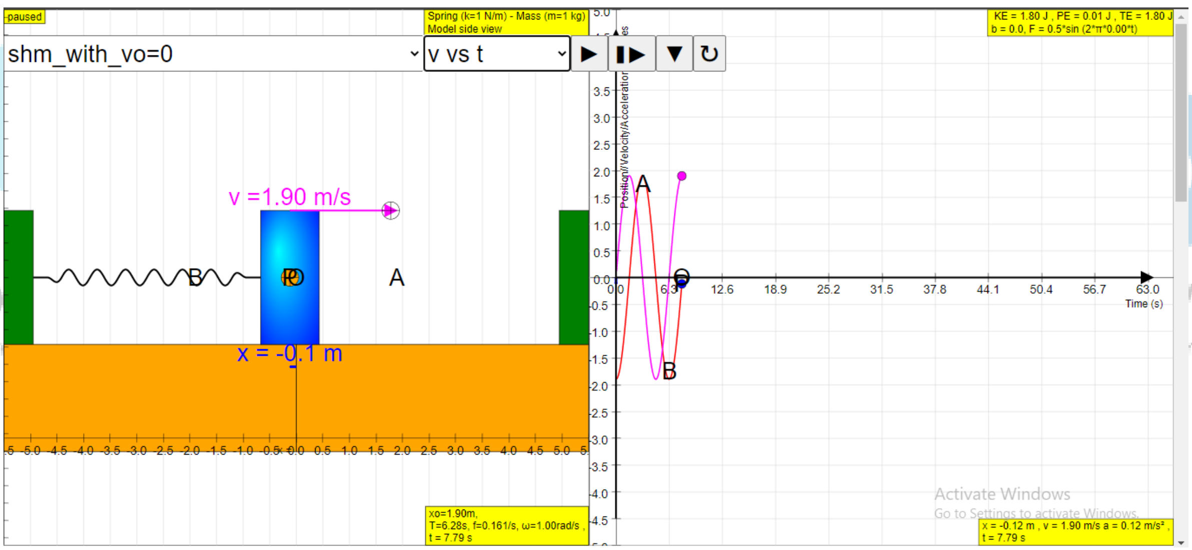
Answer:

So, by comparing and examining the position versus time and velocity versus time graph we found that where the velocity is zero acceleration is max and distance x reaches its max value of 1.90 meters. Similarly, where the velocity reaches its maximum value acceleration of the system is zero and the value of x = 0 m.

Position vs time:



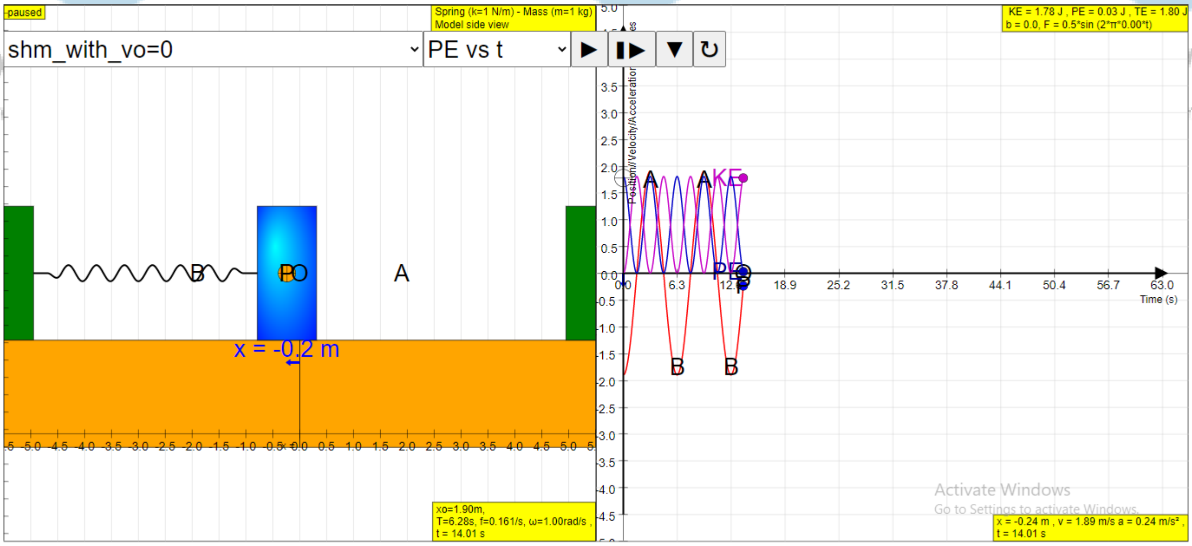
Velocity vs time:



IX) Was energy conserved?

Answer:
From the graph below we can see that the energy of the system is conserved, kinetic energy is converted to potential energy and potential energy is converted back to kinetic energy by total energy of the system is conserved. At point where the value of kinetic energy is 1.80 J the value of potential energy is zero, and at point where

potential energy value is 1.80 J value of kinetic energy is zero. This can be seen through the graph attached below.



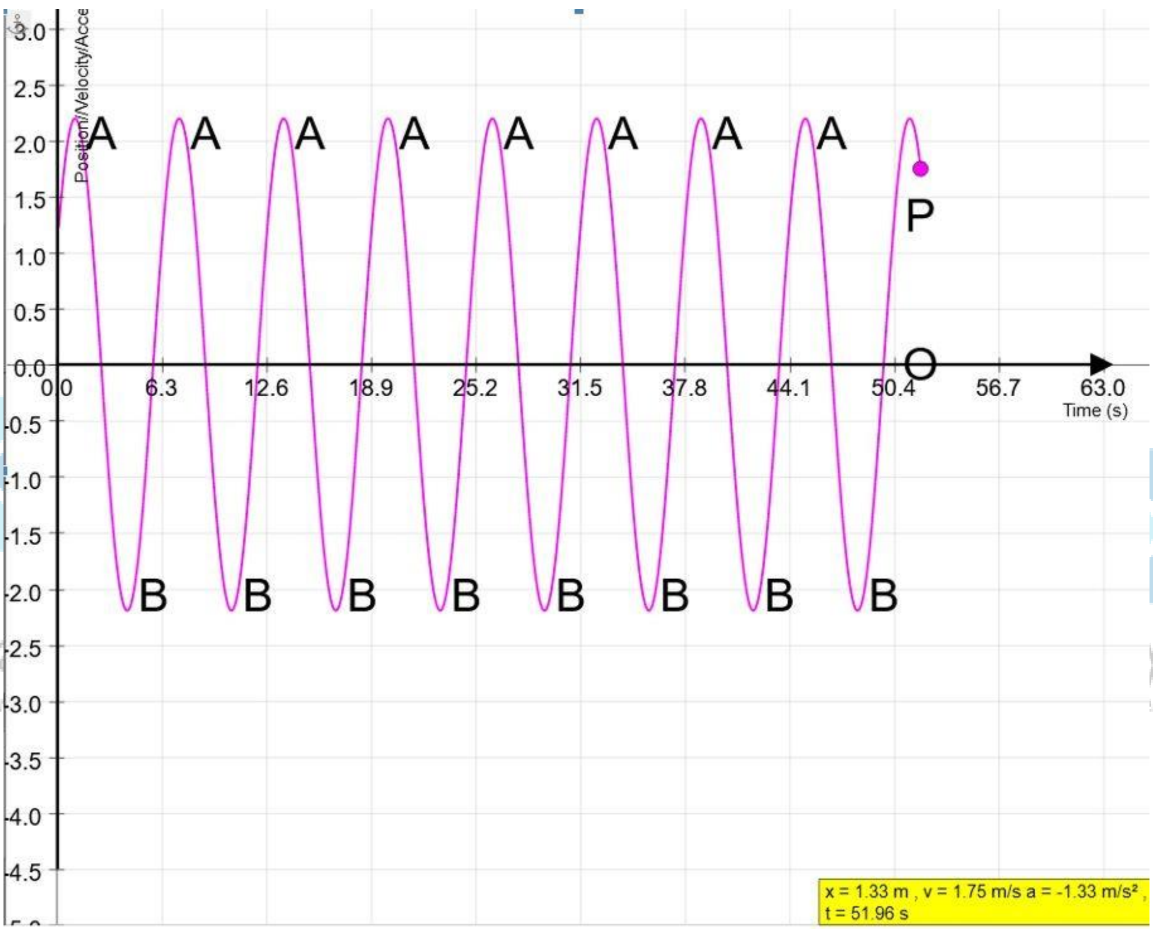


Figure 1: SHM wave