

# Lorentz Factor Calculations

## 2. Plot of $v$ vs. $(v/c)^2$

### Given

Set the speed of light:

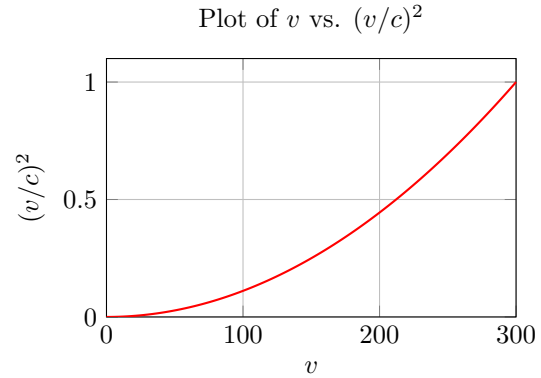
$$c = 300$$

Velocities to consider:

$$v = 0, 1, 10, 100, 300$$

### Calculations

1. Calculate  $v/c$
2. Calculate  $\left(\frac{v}{c}\right)^2$
3. Calculate  $1 - \left(\frac{v}{c}\right)^2$
4. Calculate  $\sqrt{1 - \left(\frac{v}{c}\right)^2}$
5. Calculate  $\gamma = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$



### Tabulated Results

$v$	$v/c$	$\left(\frac{v}{c}\right)^2$	$1 - \left(\frac{v}{c}\right)^2$	$\sqrt{1 - \left(\frac{v}{c}\right)^2}$	$\gamma$
0	0	0	1	1	1
1	$\frac{1}{300} \approx 0.003333$	$\approx 0.00001111$	$\approx 0.99998889$	$\approx 0.99999444$	$\approx 1.00000556$
10	$\frac{10}{300} \approx 0.033333$	$\approx 0.00111111$	$\approx 0.99888889$	$\approx 0.9994445$	$\approx 1.0005558$
100	$\frac{100}{300} \approx 0.333333$	$\approx 0.11111111$	$\approx 0.88888889$	$\approx 0.942809$	$\approx 1.06066$
300	1	1	0	0	Undefined

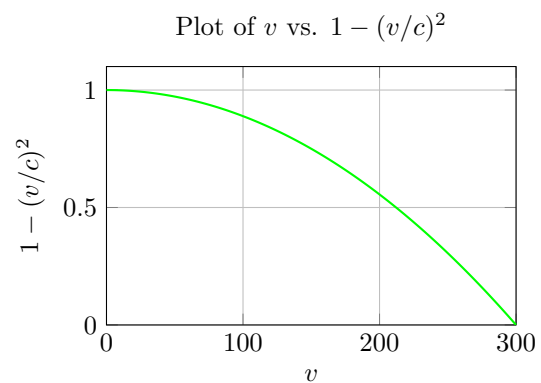
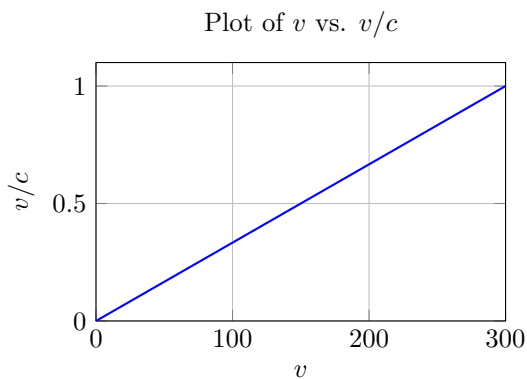
### Notes

- At  $v = c$ , the Lorentz factor  $\gamma$  becomes infinite. - For  $v > c$ , the expressions become undefined in real numbers.

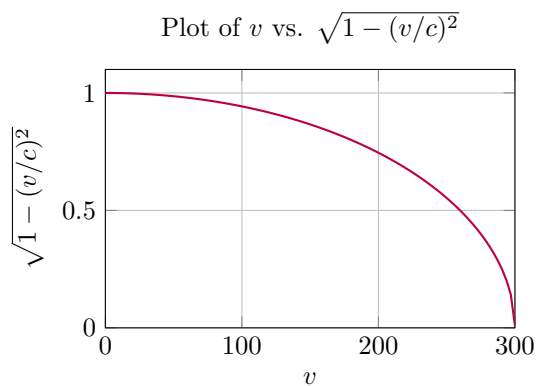
## 3. Plot of $v$ vs. $1 - (v/c)^2$

### Graphs of Each Step

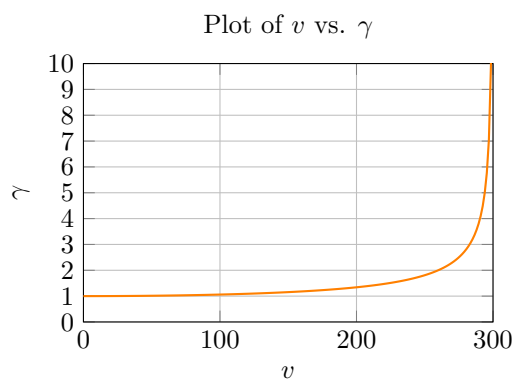
#### 1. Plot of $v$ vs. $v/c$



4. Plot of  $v$  vs.  $\sqrt{1 - (v/c)^2}$



5. Plot of  $v$  vs.  $\gamma$



### Notes on the Graphs

- In the plot of  $v$  vs.  $\gamma$ , as  $v$  approaches  $c$ ,  $\gamma$  approaches infinity.
- The graph is plotted up to  $v = 299.99$  to avoid division by zero at  $v = 300$ .

### Interpretation

- The Lorentz factor  $\gamma$  increases slowly at low velocities and increases rapidly as  $v$  approaches  $c$ .
- Time dilation and relativistic effects become significant only when  $v$  is a substantial fraction of  $c$ .