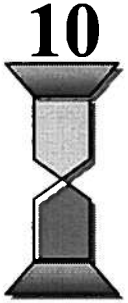
James J. Griffin 11/14/07 @

If $v/c = 0.999\ 999\ 999\ 999 = 1-\varepsilon$, with $\varepsilon = 10^{-12}$, then $\gamma = (1-(v/c)^2)^{-1/2}$ has, most nearly, the value



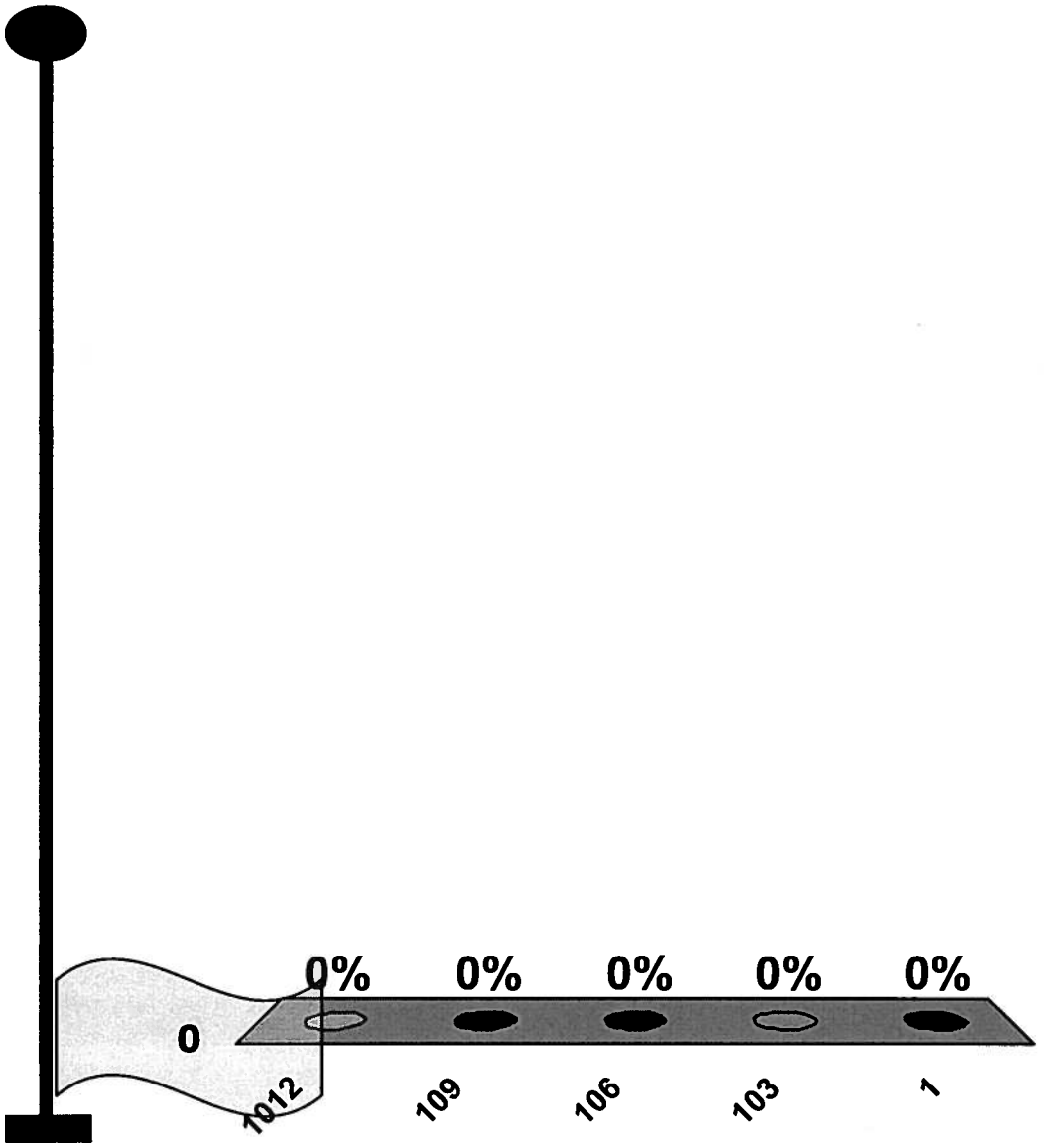
a) 10^{12}

b) 10^{9}

✓ c) 10^{6}

d) 10^{3}

e) 1.0



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The correct answer is c), $\gamma = 10^6$, most nearly.

- When v/c is very close to 1, one's calculator may produce an irrelevant and erroneous result for γ if one inserts v/c directly, squares it, and attempts to subtract the result from 1, due to the fact that $(1-(v/c)^2)$ is smaller than the smallest number the calculator can accurately store.
- But by inserting $v/c = 1-\varepsilon$, we can convert $\{1-(v/c)^2\} = \{1-(1-\varepsilon)^2\}$ into $\{1 -1 +2\varepsilon - \varepsilon^2\} = \{2\varepsilon\}$, (here using $\varepsilon^2 << \varepsilon$ to neglect ε^2). Then for $\varepsilon = 10^{-12}$, we find

$$\gamma = \{2\varepsilon\}^{-1/2} = \{2\times10^{-12}\}^{-1/2} = \sqrt{10^{12}}/(\sqrt{2})$$
$$= 10^6/(1.414) = 7.07 \times 10^5$$
$$= 10^6, \text{ most nearly: c) is correct.}$$