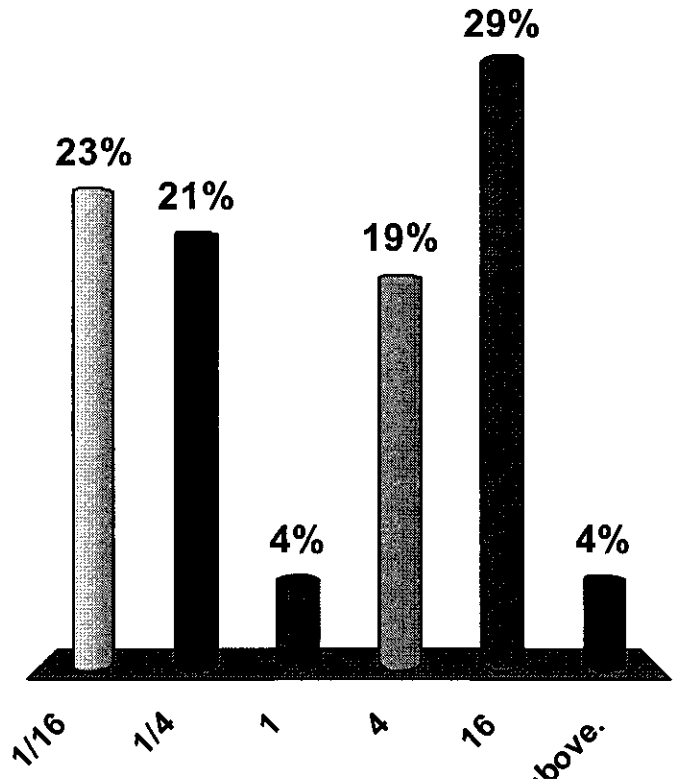
11/15/06(2)

If the relativistic momentum is $p = \gamma mc^2$, then the force required to reach a certain speed, v, (for which $\gamma = 16$) in a certain fixed time is __?___ times as large relativistically as it would have been classically.

1. 1/16
2. 1/4
3. 1.0
4. 4
5. 16
6. None of the above.



The correct answer is #5: the force is γ = 16 times larger; as follows,

- The impulse-momentum theorem states that $\mathbf{F}\Delta t = \Delta \mathbf{p} = \mathbf{p}_f - \mathbf{p}_i$.
- If we start from rest, $p_i = 0$ and $\mathbf{F}\,\Delta t = \mathbf{p}_f$.
- In classical (v<<c) realm, $\mathbf{F}\,\Delta t = \mathbf{p}_f = m\mathbf{v}_f$.
- In relativistic case, $\mathbf{p}_{\mathbf{Class}} \rightarrow p_{Rel} = \gamma m\mathbf{v}$, and is larger by the factor, γ = 16, than the classical value for a given $\mathbf{v}_f$.
- Therefore the Force must also be 16 times larger (since Δt is the same).