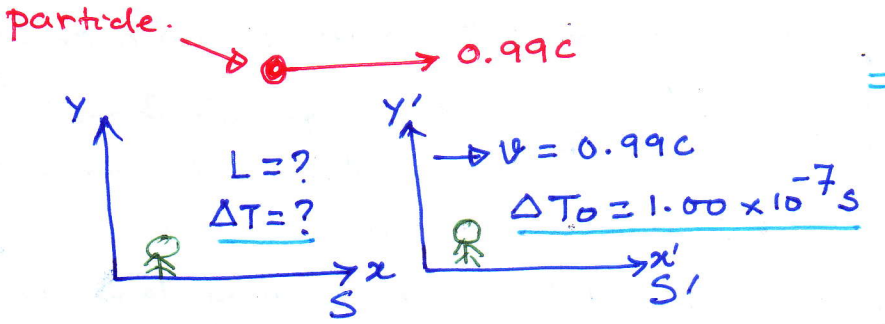
Quiz-4 Date: 12 November, 2016

Physics-1, Full marks-15, Time: 20 Min

Name: ..... **Roll No:** .....

1. A certain particle has a lifetime of 1.00×10^{-7} s when measured at rest. How far does it go before decaying if its speed is 0.99c when it is created. (4 marks)



⇒ Observer in S' frame will find the particle at-rest

Particle measured at rest That is in S' frame ΔT_0 = given.

⇓

Birth & death of the particle occurs at same point.

So $\boxed{\Delta T = \gamma \Delta T_0}$, $\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} = \frac{1}{\sqrt{1-\left(\frac{0.99c}{c}\right)^2}} = 7.09$

So $\Delta T = 7.09\times10^{-7}$s.

$L = \Delta T \times v = 7.09\times10^{-7}\text{s} \times 0.99 \times 3\times10^{8}\text{ m} = \boxed{210\text{ m}}$ Ans.

2. Find the momentum of an electron whose KE equals its rest energy of 511 keV [Express your answer in keV/c] (4 marks)

$$E^2 = p^2c^2 + (mc^2)^2$$

$$(K + E_0)^2 = (pc)^2 + (E_0)^2$$

$$(2\times 511\text{ Kev})^2 = (pc)^2 + (511\text{ keV})^2$$

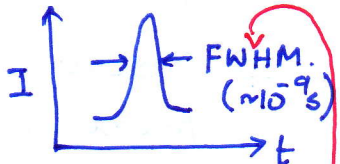
$$(pc)^2 = (511)^2[4 - 1]\text{ keV}^2$$

$$pc = 511\sqrt{3}\text{ keV}.$$

$$p = \frac{511\sqrt{3}\text{ keV}}{c} = \boxed{885\ \frac{\text{keV}}{c}}$$ Ans

3. The pulsed laser are useful to drill holes in metals. Drilling holes in metals requires high power/irradiance. Explain how is it possible in case of pulsed lasers to produce such high power/irradiance so as to drill a hole in metal. [You need to explain the mechanism behind pulsed beam in two main points as briefly as possible- use some mathematical expressions to explain that] (4 marks)

- First Point :

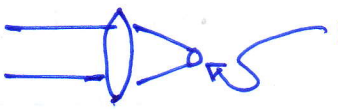


The temporal width of the pulse is very narrow – of the order of nSec or Lower So $P = \frac{\text{Energy}}{\text{Time}}$ is greater than 10^9 Watt which is known as Peak Power.

Full width at half maxima.

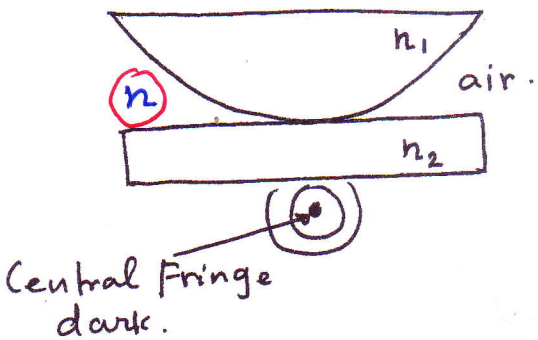
- Second Point :

The light is focussed by a converging lens which increases the irradiance & it drills hole.



irradiance very high.

4. In a usual Newton's ring experiment which is done in air, the central fringe is dark. How can you make the central fringe bright [Just one mathematical expression or sentence] (3 marks) (without disturbing the plano convex lens & glass slab)



The Central fringe can be made bright by changing the refractive index of thin film that is air here. Suppose it is n, Then

1) $n_1 > n > n_2$

2) $n_1 < n < n_2$

} Any of the two Condition will fetch full marks.

If I choose a liquid with refractive index n Then both the above Conditions will make the Central fringe bright.