Science-1

Assignment-2

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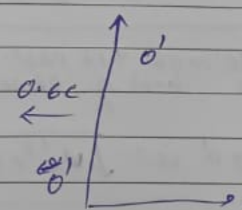
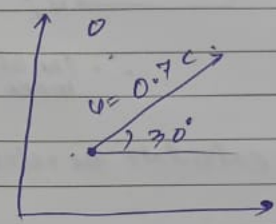
Q1 and Q3 in below attached images.

① According to the given information there are two observer O and O' is moving with $-0.6c$ relative to O.

Now the particle is moving with $0.7c$ respective to O. with $30°$ angle with horizontal axis.





For observer O

$$U_x = 0.7c \cos 30 = \frac{0.7c\sqrt{3}}{2}$$

$$U_y = 0.7c \sin 30 = 0.7c/2$$

Now according to Lorentz velocity transformation :

$$U_x' = \frac{(U_x - v)}{1 - \frac{U_x v}{c^2}} \quad \text{and} \quad U_y' = \frac{\sqrt{1 - v^2/c^2}\; U_y}{1 - \frac{v U_x}{c^2}}$$

And hence $$U_x' = \frac{\frac{\sqrt{3}}{2}\, 0.7c - (-0.6c)}{1 - \frac{\frac{\sqrt{3}}{2}\, 0.7c \cdot (-0.6c)}{c^2}},$$

$$= 0.88\, c$$

and $$U_y' = \frac{\sqrt{1 - \left(\frac{-0.6c}{c}\right)^2} \cdot \frac{0.7c}{2}}{1 - \frac{(-0.6c)}{c^2}\frac{0.7c\sqrt{3}}{2}}$$

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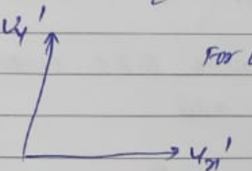
$$= \frac{0.8 \times 0.7c}{2\left(1 + \frac{0.6 \times 0.7\sqrt{3}}{2}\right)} = 0.205\,c = u_y'$$

Hence



For observer O'. $\tan\theta = \frac{0.205}{0.88}$

$$\boxed{\theta = \tan^{-1}\left(\frac{0.205}{0.88}\right)}$$

$\therefore$ The above calculate angle the particle will make with the +x axis of observer O'.

Now to calculate the velocity observed by O' is $= \sqrt{u_x'^2 + u_y'^2 + u_z'^2}$

$$\boxed{u' = c\sqrt{0.88^2 + 0.205^2} = 0.903\,c}$$

Ans.

3. Given the total energy of the electron $= 1$ MeV.
and $m_0 = 0.511\ \text{MeV}/c^2$

By energy-momentum mass relation, $E^2 = (pc)^2 + (m_0c^2)^2$

$$\Rightarrow \cancel{(1 \cdot (1.603 \times 10^{-13}))^2}$$

$$\Rightarrow (1\ \text{MeV})^2 = p^2c^2 + \left(\frac{0.511\ \text{MeV}}{c^2}\right)^2 \cdot c^4$$

$$\Rightarrow p^2c^2 = 1 - (0.511)^2\ (\text{MeV})^2$$

$$\Rightarrow p = \sqrt{\frac{0.738879\ (\text{MeV})^2}{c^2}}$$

$$\Rightarrow \boxed{p = \frac{0.86\ \text{MeV}}{c}}$$

Ans.

Q2.

https://prod-files-secure.s3.us-west-2.amazonaws.com/465cc8af-9139-41c7-840a-9e679a53ef3c/a0ff7869-290a-4faf-8b5c-4108987af1ad/Q2_science_assignement_2_(1).pdf

Diffculties with speed of light:

Momentum Difficulty: As an object with mass approaches the speed of light (c), according to the relativistic momentum formula, its momentum increases at a decreasing rate. This means that it would require an infinite amount of energy to accelerate the object to the speed of light. Real-world objects with mass cannot achieve or exceed the speed of light due to this requirement for infinite energy.

Kinetic Energy Difficulty: In the relativistic kinetic energy formula, as velocity approaches c, the kinetic energy increases dramatically. It implies that an object with mass would need an infinite amount of energy to reach the speed of light, which is practically impossible. Additionally, the relativistic kinetic energy shows that as an object gets closer to the speed of light, the energy required to further increase its velocity becomes astronomical.