**Relativity Problems**

Q1) what will be the length of a meter rod appear to aperson travelling parallel to the length of the rod at a speed of 0.8c relative to rod?

🡪the length of the rod moving with a relative velocity v is given by,

L=Lo(1-v2/c2)-1/2

Here Lo=1.0m v=0.8c=0.8×3×103m/s

L=1.0 (1 **-** 0.8c/c)2 =0.6m

Q2) a meter ruler moves past an observer on the earth with a velocity of 2.5 ×1010 cm/ sec, along the direction of its length. What is its apparent length with respect to the observer?

🡪according to length contraction formula,

L=LO(c2-v2/v2)-1/2

Here, Lo=1.0m and v=2.5× 108m/s

L=1.0 {(3×108)2-(2.5×108)2 / (2.5×108)2}-1/2

L=55.27cm

Q3) a spaceship 50m long passes the earth at a speed of 2.8× 108 m/s. what will be its apparent length?

🡪let Lo be the rest length of spaceship, then its apparent length in flight is given by,

L=Lo(1-v2/c2)-1/2

L=50 {1-(2.8× 108 / 3 ×108)2}-1/2

L=18m

Q4) a rocketship is 50m long. When it is on flight its length appears to be 49.5 to an observer on ground. Find the speed of the rocket?

🡪according to length contraction formula,

L=Lo(1-v2/c2)-1/2

Here,L=49.5m, Lo=50m , V=?

49.5=50 {1-v2/c2}-1/2

1-v2/c2=0.98

V=0.141c

Q5)a certain particle called meson has a life time 2 ×10-6sec a]what is the mean life time when the particle is travelling with a speed of 2.9994× 108 m/sec?

b]how far does it go during one mean life?

🡪using time dilation equation,

t =to/

t=2×10-6 /{1-(2.994 x 108 / 3x 108)}2 =2x10-6 /0.0632

t=31.63 x 10-6 sec

distance travelled by meson during mean life time,

= (2.994x108)(31.63x10-6)

=9470m

Q6)the mean life of meson is 2x10-8 sec. calculate the mean life of a meson moving with a velocity 0.8c?

🡪time dilation equation is given by, t t=to/√(1-v2/c2)

To= 2x10-8

V=0.8c

t=(2x108)/(1-0.82)-1/2 =2x108/0.6=3.3 x 10-8 sec

Q7)a wrist watch keeps correct time on earth. If it is wornby pilot in spaceship,leaving earth with constant velocity of 108 cm/sec. how many seconds does it appear to lose in one day with respect to the observer on the earth.

* According to time dilation formula,

t=to/√(1-v2/c2)

24=to/

24[1-1/900]-1/2 = to

Here,1/900 is very small wrt 1 :. We can use the binomial expansion and neglect higher order terms

to=24-1/75 hours

hence loss in 24 hours=1/75=48 sec