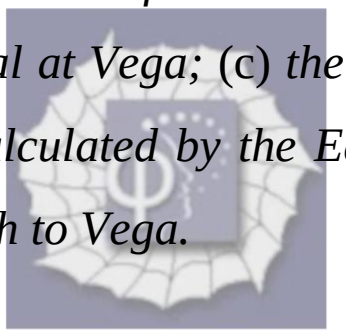
169.

Problem 21.33 (RHK)

A space traveller takes off from Earth and moves at speed 0.988 *c toward the star Vega, which is* 26.0 ly *distant. We have to find the time lapsed with respect to Earth clocks* (a) *for the space traveller in reaching Vega;* (b) *the time lapse from the beginning of the space journey to the arrival of the message from the space traveller on arrival at Vega;* (c) *the change in age of the space traveller calculated by the Earth observers in his journey from Earth to Vega.*



Solution:

(a)

Speed of the spaceship, $v = 0.988\ c$.

Distance of Vega from Earth, $l = 26.0$ ly.

Time taken by the space traveller in reaching Vega,

$$t = \frac{l}{v} = \frac{26.0 \times c}{0.988c} \text{ year} = 26.3 \text{ year}.$$

(b)

On arrival at Vega the space traveller will send message to Earth as a light signal. The time taken by the light signal in reaching Earth from Vega will be 26.0 year. Therefore, the time lapse from the beginning of the space journey to the arrival of the message from the space traveller on arrival at Vega will be

$(26.3 + 26.0)$ year $= 52.3$ year.

(c)

The change in age of the space traveller in his journey to Vega will be the lapse of time in the clock of the traveller during his journey that is the proper time. The proper time of the space traveller calculated by the observers on Earth will be,

$$\text{change in age} = t_0 = t\sqrt{1-(v/c)^2} = 26.3 \times \sqrt{1-0.988^2} \text{ year},$$
$$= 4.06 \text{ year}.$$