



Romanian Master of Mathematics and Sciences
2011
Physics Section

a. (1p)

$$v_{\text{rel}} = -\frac{1}{5} \text{ l.u./t.u.}$$

b. (2p)

$$c = \frac{1}{4} \text{ l.u./t.u.}$$

$$v_{\text{abs}} = \pm \frac{1}{8} \text{ l.u./t.u.}$$

c. (1p)

$$u_{\text{rel}} = \frac{1}{4} \text{ l.u./t.u.} = c$$

d. (1p)

$$u_{\text{abs}} = \frac{1}{4} \text{ l.u./t.u.}$$

e. (1p)

It could be an electromagnetic signal sent from Earth.

f. (2p)

Time of passage	rocket A	rocket B	rocket C	rocket D	rocket E
rocket 1	00:00	03:00	06:00	09:00	12:00
rocket 2	05:00	08:00	11:00	14:00	17:00
rocket 3	10:00	13:00	16:00	19:00	22:00
rocket 4	15:00	18:00	21:00	24:00	27:00
rocket 5	20:00	23:00	26:00	29:00	32:00

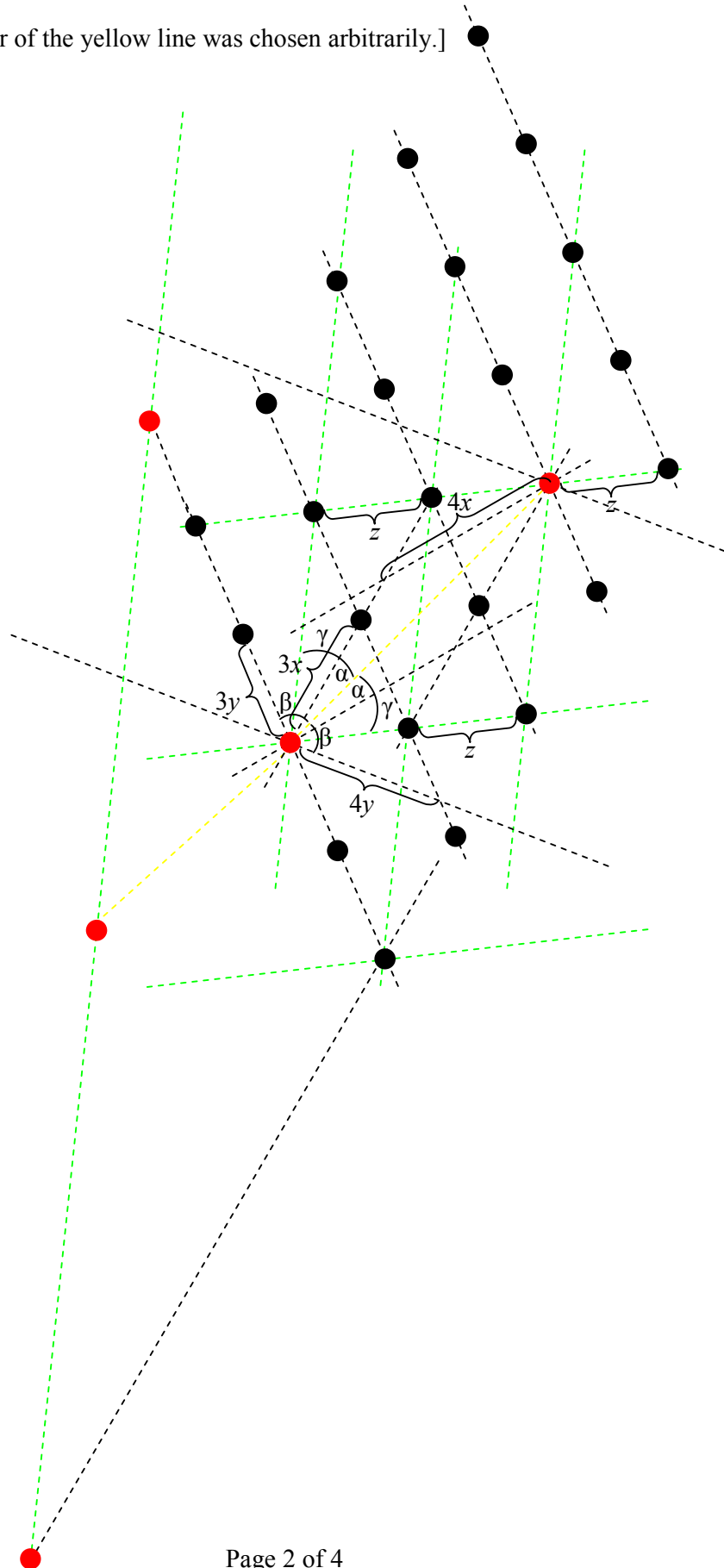


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8g - j. (8p)

[Note: The color of the yellow line was chosen arbitrarily.]



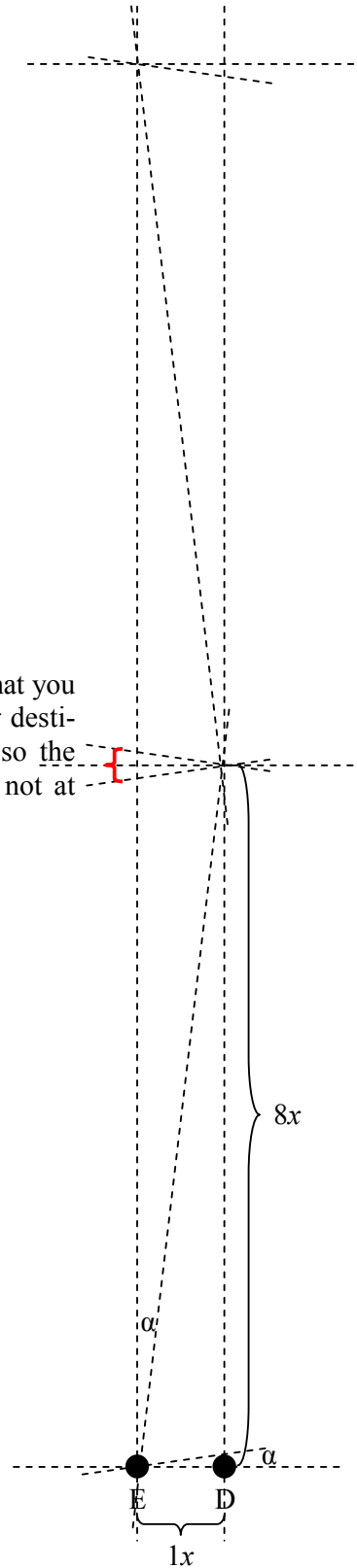


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k. (2p)

The equilocs and the equitemps in the reference frame of the Earth are perpendicular to each other.

This is the *real* time lapse that you skip when traveling to your destination and back to Earth, so the so called Twin Paradox is not at all a paradox.





l. (1p)

Starting from the clock in rocket A, the clocks in the following rockets were set forward by +02:00, +04:00, +06:00, and +08:00 respectively.

$$v = \frac{1}{6} \text{ l.u./t.u.}$$

m. (1p)

The method is absolutely correct and the relativistic effects are perfectly consistent with the nonrelativistic desynchronization of the clocks, with the only exception that in this last case the undetermined phenomenon is no longer an electromagnetic pulse, the velocity of light being much much greater (instead it might be a cosmic snail passing by you).