

Chapter 2 Problem 46 [†]

Given

$$v_{me} = 9.0 \text{ m/s (20\% faster than my brother)}$$

$$d = 100 \text{ m}$$

Solution

Find the brother's head start for a tie.

The time for my 100 m run is

$$v = \frac{\Delta x}{\Delta t}$$

$$\Delta t = t_{me} = \frac{\Delta x}{v} = \frac{100 \text{ m}}{9.0 \text{ m/s}} = 11.1 \text{ s}$$

Brother's time for the 100 m run will be 20% longer. (Multiply by 120%)

$$t_{brother} = 1.2t_{me} = 1.2(11.1 \text{ s}) = 13.3 \text{ s}$$

The brother should get a $13.3 \text{ s} - 11.1 \text{ s} = 2.2 \text{ s}$ head start.

By the way, your brother's velocity is given by the relationship

$$v_{me} = (120\%)v_{brother}$$

Therefore, the brother's speed is

$$v_{brother} = \frac{v_{me}}{120\%} = \frac{9.0 \text{ m/s}}{1.20} = 7.5 \text{ m/s}$$

Also, since it takes you 11.1 s to travel 100 m, your brother travels a distance of

$$(7.5 \text{ m/s})(11.1 \text{ s}) = 83.3 \text{ m}$$

Therefore, you could give your brother a 16.7 m head start.

[†]Problem from Essential University Physics, Wolfson