

60. (a) $v_r = 2v = 2(27000 \text{ km/h}) = 54000 \text{ km/h}$.

(b) We can express c in these units by multiplying by 3.6: $c = 1.08 \times 10^9 \text{ km/h}$. The correct formula for v_r is $v_r = 2v/(1 + v^2/c^2)$, so the fractional error is

$$1 - \frac{1}{1 + v^2/c^2} = 1 - \frac{1}{1 + [(27000 \text{ km/h})/(1.08 \times 10^9 \text{ km/h})]^2} = 6.3 \times 10^{-10} .$$

The discussion in Sample Problem 38-7 dealing with numerical considerations may prove helpful for those whose calculators do not yield this answer.