

Question #77629, Physics / Molecular Physics | Thermodynamics

Two cars start off to race with velocities v_1 and v_2 and travel in a straight line with uniform acceleration a_1 and a_2 respectively. If the race ends in a dead heat (i.e they reach the finishing point at the same time) Prove the length of the course is

$$2(v_1-v_2)(v_1a_2-v_2a_1)/(a_1-a_2)^2$$

Solution

$$d = v_1t + \frac{a_1}{2}t^2 = v_2t + \frac{a_2}{2}t^2$$

$$(v_1 - v_2)t = \frac{1}{2}t^2(a_2 - a_1)$$

$$t = \frac{2(v_1 - v_2)}{a_2 - a_1}$$

Thus,

$$d = v_2 \left(\frac{2(v_1 - v_2)}{a_2 - a_1} \right) + \frac{a_2}{2} \left(\frac{2(v_1 - v_2)}{a_2 - a_1} \right)^2 = \frac{2v_2(v_1 - v_2)(a_2 - a_1) + 2a_2(v_1 - v_2)^2}{(a_2 - a_1)^2}$$

$$d = \frac{2(v_1 - v_2)(v_1a_2 - v_2a_1)}{(a_1 - a_2)^2}$$

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