

STEP II, 2005, Q10 MS

Q10 Take horizontal and vertical axes with origin at A and denote the position of the missile projected from A at time t by (x_1, y_1) . Then prior to the collision, at time t_c ,

$$x_1 = 80t, \quad y_1 = 60t - 5t^2.$$

If (x_2, y_2) is the position of the anti-missile missile at time t , where $t_c \leq t \leq T$, then

$$x_2 = 180 - 120(t - T), \quad y_2 = 160(t - T) - 5(t - T)^2.$$

At the collision,

$$x_1 = x_2 \Rightarrow 200t_c = 120T + 180 \quad (1), \quad y_1 = y_2 \Rightarrow 60t_c - 5t_c^2 = 160(t_c - T) - 5(t_c - T)^2 \quad (2).$$

From (2) it follows that $T^2 + (32 - 2t)T - 20t = 0$ (3) and elimination of t from (1) and (3) yields $T^2 + [(151 - 6T)/5]T - 12T - 18 = 0$. Thus $T^2 - 91T + 90 = 0 \Rightarrow T = 1, 90$. However, in the absence of the collision, the flight time of the missile, would be 12 seconds, so that without ambiguity it may be concluded that $T = 1$.



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