Answer on Question #67609, Physics / Mechanics | Relativity |

The range of a missle is 100 km and it's target is 25 km then calculate it's two possible launch angles and min or max time of flight?

Solution

x_{max} = 100 000 m
x_{tar} = 25 000 m
α_1, α_2, t_1 – ?

$v_{0x} = v_{0y} = v_0 \cos 45° = v_0 \sqrt{2}/2$
$x_{max} = v_{0x} t$
$0 = v_{0y} t - gt^2/2 = x_{max} - gt^2/2$, $t^2 = 2 x_{max}/g$
$v_{0x} = x_{max}/t = \sqrt{x_{max}\ g/2}$
$v_0 = \sqrt{x_{max}\ g}$

$v_{0x} = v_0 \cos \alpha$
$v_{0y} = v_0 \sin \alpha$
$x_{tar} = v_{0x} t = v_0 t \cos \alpha$
$0 = v_{0y} t - gt^2/2 = v_0 t \sin \alpha - gt^2/2 = x_{tar} \tan \alpha - gt^2/2$
$t^2 = 2 x_{tar} (\tan \alpha)/g$
$x_{tar} = v_{0x} t = v_0 t \cos \alpha = v_0 \sqrt{2\ x_{tar}\ (\tan \alpha)/g} \cos \alpha = v_0 \sqrt{2 \sin \alpha \cos \alpha \cdot x_{tar}/g} = v_0 \sqrt{\sin 2\alpha \cdot x_{tar}/g}$
$\sin 2\alpha = x_{tar}/ x_{max} = 0.25$
$\alpha_1 = 7.25°$, $\alpha_2 = 82.75°$
$t^2 = 2 x_{tar} (\tan \alpha_1)/g = 50\ 000\ 0.13/9.81 = 662$
$t_1 = \sqrt{662} \approx 25.7$

Answer: $\alpha_1 = 7.25°$, $\alpha_2 = 82.75°$, $t_1 = 25.7$ sec