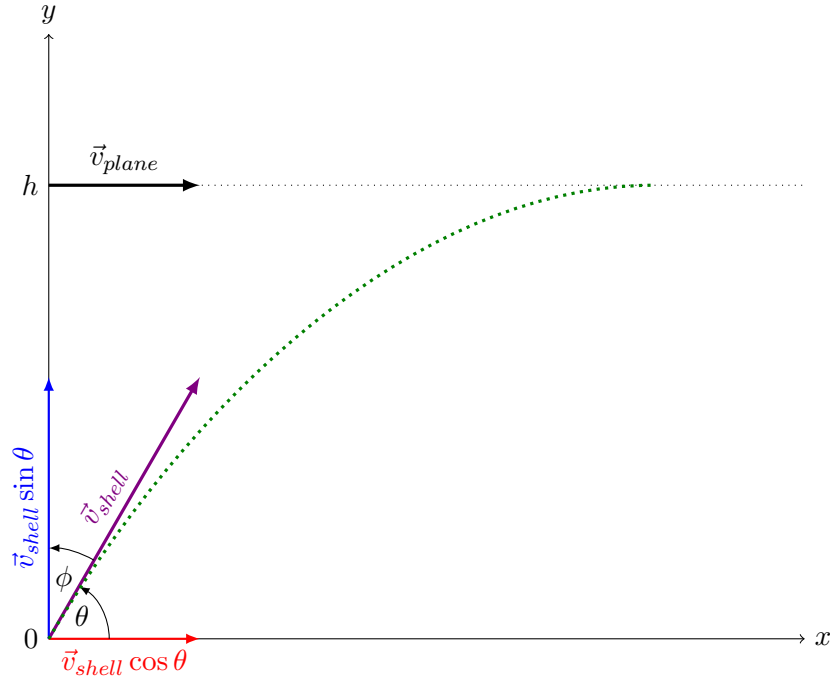


# Aiming a Projectile at an Aircraft

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**Question** A shell is fired from a gun with initial velocity  $\vec{v}_{shell}$ , at an elevation  $\theta$ . What value of  $\theta$  should be chosen such that the shell hits an aircraft cruising at an altitude  $h$ , directly overhead the gun when the shell is to be fired, and travelling at a constant velocity  $\vec{v}_{plane}$ ?



**Solution** Considering motion along the  $x$ -axis, clearly the velocity of the shell must equal the velocity of the aircraft for their positions to coincide. Thus:

$$\vec{v}_{plane} = \vec{v}_{shell} \cos \theta$$

$$\theta = \cos^{-1} \left( \frac{\vec{v}_{plane}}{\vec{v}_{shell}} \right)$$