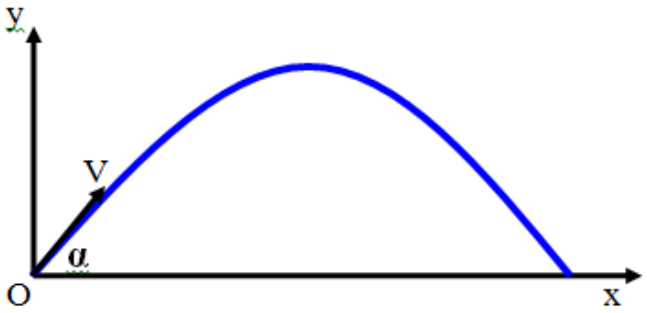
How can there be TWO angles of projection which will result in the same range for a projectile?

The range is given by:

$$R = \frac{V^2 \sin(2\alpha)}{g}$$

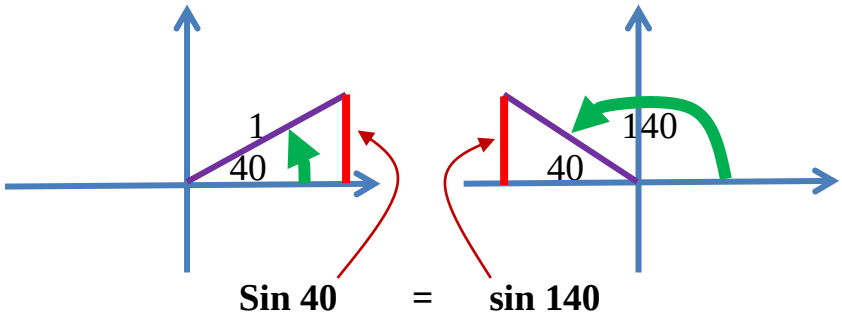


If the initial velocity, V is a constant then the only variable is the angle of projection α.

So let us concentrate on the term **sin(2α)**

Consider these pairs of angles:

The vertical red lines are the **sine values** of the marked angles when the hypotenuse is 1 unit.



If **2α = 40** or **140** then **sin40 = sin140**
This means if α = 20 or 70 then the ranges R will be the same

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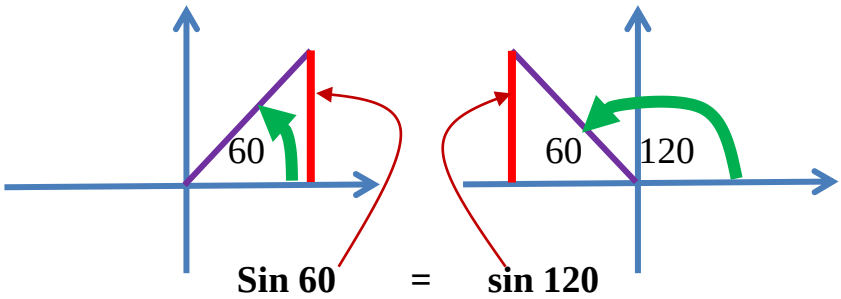

If **2α = 60** or **120** then **sin 60 = sin 120**
This means if α = 30 or 60 then the ranges R will be the same

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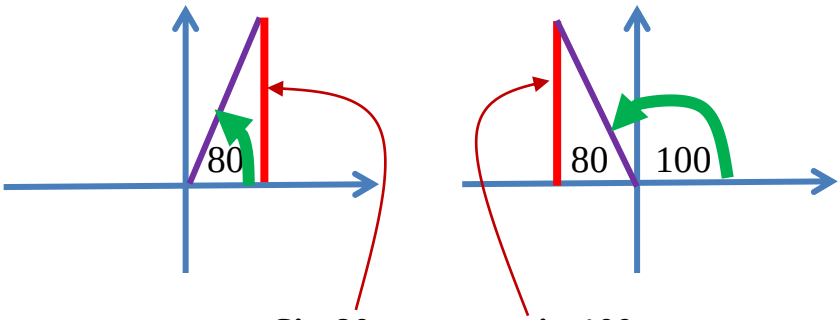

If **2α = 80** or **100** then **sin80 = sin100**
This means if α = 40 or 50 then the ranges R will be the same

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The general result here is that the ranges will be equal for any two angles of projection which **add to 90.**

The following diagram gives the maximum range when the **initial velocity is 20 m/s** when the angle of projection is **45 degrees**.

MAX RANGE when V = 20 m/s and $\alpha = 45^0$

The following diagrams show that when the angle of projection is either 60 degrees or 30 degrees, the range is the same in both cases.

RANGE when V = 20 m/s and $\boldsymbol{\alpha = 60^0}$

RANGE when V = 20 m/s and $\boldsymbol{\alpha = 30^0}$