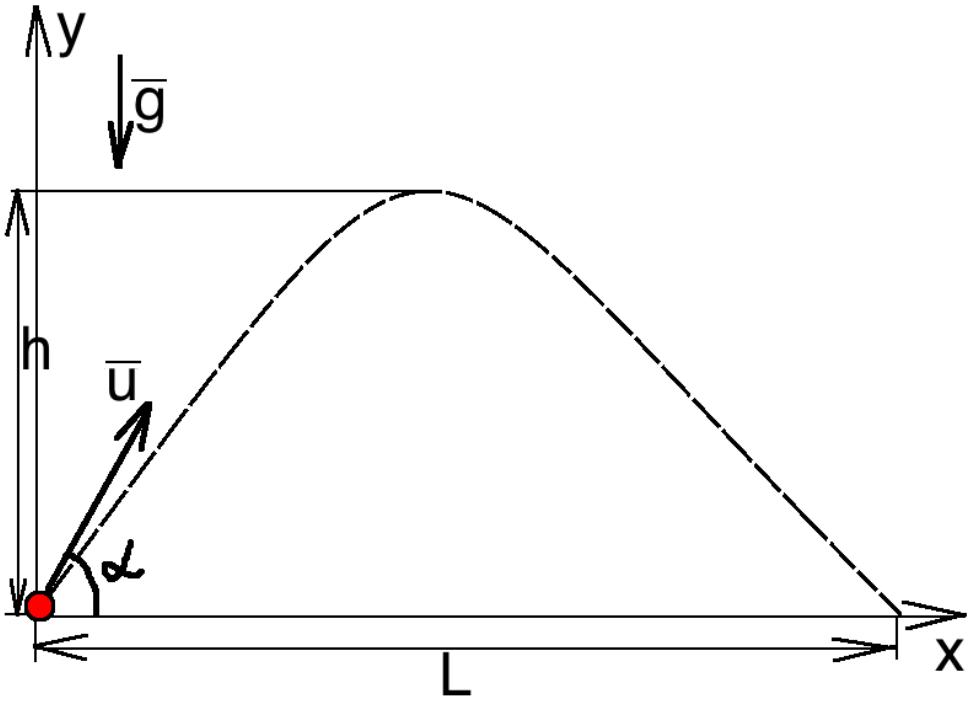
Answer on Question #43993 – Physics - Mechanics | Kinematics | Dynamics

body projected at such an angle that horizontal range is 3 times greatest height.find angle of projection

Solution:



Equation of the motion for body, thrown at angle α: (L - maximum horizontal range of this body) (t – time of the flight)

$u_x = u\cos\alpha;\ u_y = u\sin\alpha;$

x: $L = ut\cos\alpha$ (1)

y: $0 = ut\sin\alpha - \frac{gt^2}{2}$

$u\sin\alpha = \frac{gt}{2}$

$t = \frac{2u\sin\alpha}{g}$ (2)

(2) in (1):

$L = u\frac{2u\sin\alpha}{g}\cos\alpha = \frac{2u^2\sin\alpha\cos\alpha}{g}$ (3)

Maximum height: the time taken to reach the maximum height is equal to half of the time of flight:

$t_1 = \frac{t}{2} = \frac{u\sin\alpha}{g}$

y: (half of the flight): $h_1 = ut_1\sin\alpha - \frac{gt_1{}^2}{2}$

$$h = ut_1 \sin\alpha - \frac{gt_1{}^2}{2}$$

$$h = u\frac{u\sin\alpha}{g}\sin\alpha - \frac{g\left(\frac{u\sin\alpha}{g}\right)^2}{2} = \frac{u^2\sin^2\alpha}{2g} \qquad (4)$$

From the problem statement:

$$L = 3 \cdot h \qquad (5)$$

(4) and (3)in(5):

$$\frac{2u^2\sin\alpha\cos\alpha}{g} = \frac{3 \cdot u^2\sin^2\alpha}{2g}$$

$$4\cos\alpha = 3\sin\alpha$$

$$\frac{4}{3} = \tan\alpha \Rightarrow \alpha = \arctan\left(\frac{4}{3}\right) = 53°$$

Answer: angle of projection if equal to 53°.