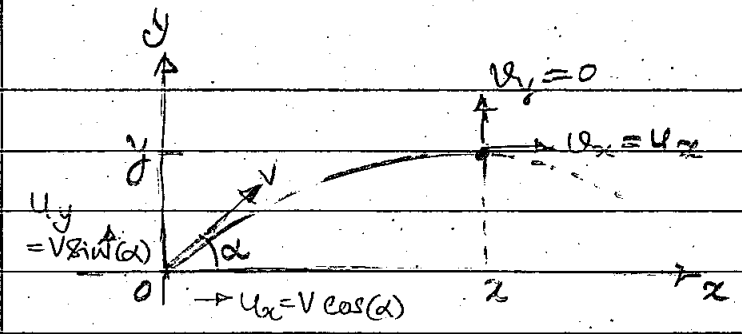
U3A Maths.

01-Jun-2026 Term 2 / Week 7

Projectile Motion (Cont'd)

Let us continue the example from last week.

Ex.1 A golfer hits the ball with a velocity of 45 m/s at an angle of 20° to the horizontal.
(a) What is the maximum height reached by the ball?
(b) What is the horizontal distance to the maximum height.



we have $V = 45$ m/s & $\alpha = 20°$
and $a = -g = -9.81$ m/s²

Initial velocity in 'x' direction
$= u_x = V\cos(\alpha)$
$= 45 \times \cos(20°) = 42.286$ m/s

Initial velocity in 'y' direction
$= u_y = V\sin(\alpha)$
$= 45 \times \sin(20°) = 15.391$ m/s

(a) When the ball reaches maximum height, the final vertical velocity $v_y = 0$

We have
$$v_y = u_y + at$$

$\therefore \quad 0 = 15.391 - 9.81 \times t$

$\therefore$ time to reach max. height
$$t = \frac{-15.391}{-9.81} = +1.569 \text{ s}$$

we have, Vertical dist ≡ Max. height
$$y = u_y t + \frac{1}{2} a t^2$$
$$= 15.391 \times 1.569 - \tfrac{1}{2} \times 9.81 \times (1.569)^2$$
$$= 12.074 \text{ m}$$

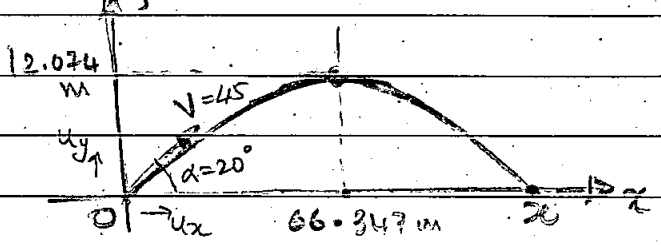
For horizontal distance,
$$x = u_x \cdot t$$

Note; there is no acceleration in the horizontal direction.

$\therefore \quad x = 42.286 \times 1.569$
$= 66.347$ m

Ex.2

For the golf ball in Ex.1,
(a) how long will the ball be in air
(b) how far it will travel before hitting the ground.



we have,
$u_x = V\cos(\alpha) = 42.286$ m/s
$u_y = V\sin(\alpha) = 15.391$ m/s.

(a) Time taken to reach half the horizontal distance = 1.569s

Since, hor. velocity (u_x) is constant total time $T = 2 \times 1.569$
$= 3.1388$

∴ Ball is in the air for 3.1388

(b) Horizontal distance travelled for time $T = 3.138$ sec

$x = u_x \times T$

$= 42.286 \times 3.138 = 132.69$ m

Alternative Soln

- We got the above results using results from Ex. 1
- But we can can calculate it directly

When the ball reaches the ground, we have $y = 0$!

We have

$y = u_y t + \frac{1}{2} a t^2$

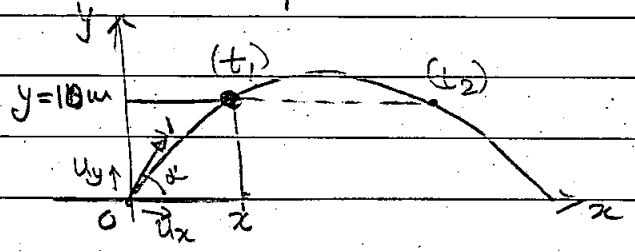
∴ $0 = 15.391 \times t + \frac{1}{2}(-9.81) t^2$

∴ $t = \frac{15.391}{(\frac{1}{2} \times 9.81)} = 3.138$ s

(Same results as above!)

Ex. 3

In Ex. 1, how long does the golf ball take to reach a height of 10 m. And, what is the horizontal distance.



Given: $u_y = V \sin\alpha$

$y = 10$ m, $= 45.81 \sin(20°)$

$a = -9.81$ m/s^2 $= 15.391$ m/s

We have,

$y = u_y t + \frac{1}{2} a t^2$

$10 = 15.391 t + \frac{1}{2}(-9.81) t^2$

Rearranging,

$4.905 t^2 - 15.391 t + 10 = 0$

We need to solve the quadratic equation!

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Solving we get

$t = 2.219$ s or 0.919 s
(t_2) (t_1)

Note that the ball is at a height 10 m at 0.919 s & 2.219 s !!

Home Work

In Ex. 1, will the golf ball clear a 12 m high tree at a distance of 80 m.