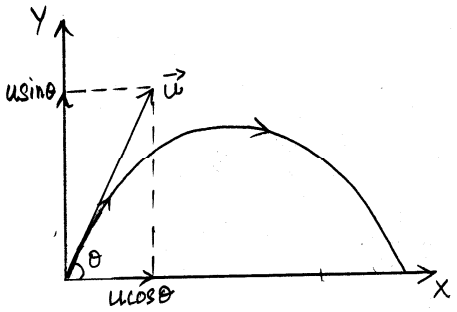
31. What are the components of initial velocity of the projectile?

Ans:



Horizontal component,

$$u_x = u\cos\theta$$

Vertical component,

$$u_y = u\sin\theta$$

32. What is the force on the projectile?

Ans: F=-mg (downwards**)**

33. What is the acceleration of the projectile?

Ans: a=-g (downwards**)**

34. What is the acceleration of the projectile at the highest position?

Ans: a=-g (downwards**)**

35. How the initial velocity changes during the motion of the projectile?

Ans: During the motion of a projectile, the horizontal component of velocity ($v_x = u\cos\theta$) remains same but the vertical component decreases first, reaches zero value and then increases in the downward direction.

36. What is the velocity of the projectile at its highest position?

Ans: ucosθ

Explanation

At the highest position,

Horizontal component,

$$v_x = u\cos\theta$$

Vertical component,

$$v_y = 0$$

Resultant velocity,

$$v = \sqrt{v_x^2 + v_y^2}$$

$$= \sqrt{(u\cos\theta)^2 + 0^2}$$

$$= u\cos\theta$$

37. What will be the magnitude and direction of velocity,'**t**' time after projection?

Ans:

Horizontal component of velocity,

$$v_x = u\cos\theta$$

Vertical component,

$$v_y = u_y + at$$

$$= u\sin\theta - gt$$

Resultant velocity

$$v = \sqrt{v_x^2 + v_y^2}$$

$$= \sqrt{(u\cos\theta)^2 + (u\sin\theta - gt)^2}$$

Direction of resultant velocity,

$$\tan\theta = \frac{v_y}{v_x} = \frac{u\sin\theta - gt}{u\cos\theta}$$

38. Derive expressions for (i) Time of flight (ii) Maximum Height (iii) Horizontal range of a projectile.

Ans:

Time of flight (t_f)

It is the time taken by the projectile to reach back to the horizontal plane of the point of projection.

To derive the expression for time of flight we must consider the **vertical motion** of the projectile.

ΔS is the linear displacement and $\Delta\theta$ is the angular displacement.

47. Derive the relation between linear velocity and angular velocity.

Ans: From the above figure,

$$\Delta\theta = \frac{\Delta S}{r} \text{ (for small } \Delta\theta)$$

$$\Delta S = r\,\Delta\theta$$

Dividing by Δt

$$\frac{\Delta S}{\Delta t} = r\,\frac{\Delta\theta}{\Delta t}$$

Taking limit $\Delta t \to 0$ on both sides

$$\lim_{\Delta t\to 0}\frac{\Delta S}{\Delta t} = r\lim_{\Delta t\to 0}\frac{\Delta\theta}{\Delta t}$$

$$\Rightarrow v = r\omega$$

$$\boxed{v = r\omega}$$

48. Define time period.

Ans: The time taken by a particle to complete one circular path is called its time period of revolution.

49. Define frequency of revolution.

Ans: The no. of revolutions completed by the particle in one second is called the frequency.

$$\upsilon = \frac{1}{T}$$

50. Give the relations between **ω, v** and **T.**

Ans: When a particle completes one circular path,

angular velocity, ω

$$= \frac{\text{Angular displacement}}{\text{Time}}$$

$$\boxed{\omega = \frac{2\pi}{T}} \Rightarrow \boxed{\omega = 2\pi\upsilon}$$

51P. Calculate the angular speed of

(i) Second hand

(ii) Minute hand and

(iii) Hour hand of a watch.

Ans:

52P. An insect travels in a circle. It travels 6 revolutions in an anticlockwise direction for a time of 31.4 sec.

a) Find the angular velocity of the insect.

b) If the insect travels another 4 revolutions in the clockwise direction for a time of 8.6 sec, what will be the **angular speed** averaged over the total time?

Ans: