

KINEMATICS

more...

FISIKA DASAR 1

More complicated situations

Special Case

Summary



wore complicated situations

More Objects

Write an additional set of equations

> More Dimensions

Write an additional set of equations

$$V_{x} = \frac{dx}{dt}$$

$$a_{\chi} = \frac{dv_{\chi}}{dt} = \frac{d^2\chi}{dt^2}$$

$$V_{y} = \frac{dy}{dt}$$

$$a_y = \frac{dv_y}{dt} = \frac{d^2y}{dt^2}$$

Vector Connections

$$\vec{v} = \frac{d\vec{r}}{dt} \quad \vec{a} = \frac{d\vec{v}}{dt} = \frac{d^2\vec{r}}{dt^2}$$

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

$$|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$$

Special Case of Constant Acceleration

Kinematics

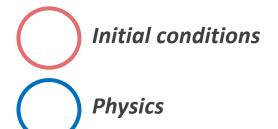
Extra Special Case

$$x = (x_o) + (v_{ox}t) + \frac{1}{2}(a_xt^2)$$

$$v_x = (v_{ox}) + (a_xt)$$

$$y = v_0 + v_{oy}t + \frac{1}{2}a_yt^2$$

$$v_y = v_{oy} + a_yt$$



Trajectories with gravity near the surface of the Earth and no air resistance or other drag forces

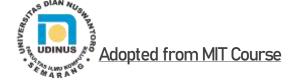


$$a_{x} = 0$$

$$v_{0x} = v_{0}\cos(\theta)$$

$$a_{y} = -g$$

$$v_{0y} = v_{0}\sin(\theta)$$



Super Special Case

Range of a projectile near the surface of the Earth and no air resistance or other drag forces

$$x_0 = 0$$
 $y_0 = 0$ $y_{final} = 0$ $x_{final} = Range$

$$Range = \frac{v_o^2 \sin(2\theta)}{g}$$

You should immediately forget you ever saw this formula but remember the technique used to find it.

Quadratic Equations

$$ax^2 + bx + c = 0$$

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

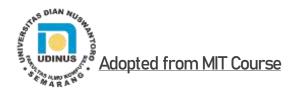
Important property:

Such equations can have 0, 1, or 2 solutions depending on the value of b2-4ac.

Negative: 0 solutions Zero: 1 solution

Positive: 2 solutions

Warning: Only one of the 2 solutions may be physical!







The bullet is fired from point O (ground) with initial velocity $v_0 = 60m/s$ and the elevation angle from the ground is 60 degrees. $g = 10m/s^2$ Calculate:

- a. When will the bullet hit the ground?
- b. Where the bullets will fall on the ground?
- c. What is the velocity of the bullet when it hits the ground?

Example

Example 1

Answer

$$y_{final} = 0$$

$$y = v_o Sin\theta.t + \frac{1}{2}(-g)t^2$$

$$0 = 60Sin60^o.t - \frac{1}{2}10t^2$$

$$0 = 30\sqrt{3}.t - 5t^2$$

$$t=6\sqrt{3}s$$



$$x = v_o \cos \theta . t$$
$$x = 60 \sin 60^o . 6\sqrt{3}$$



$$x = 180\sqrt{3}m$$

Bullet coordinates on the ground is (180 $\sqrt{3}$, 0)



$$v_y = v_o Sin\theta - gt$$

$$v_y = 60Sin60^o - 10.6\sqrt{3}$$

$$v_y = -30\sqrt{3}m/s$$

$$v_x = v_o cos\theta$$

 $v_x = 60Sin60^o$
 $v_x = 30m/s$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{30^2 + (-30\sqrt{3})^2}$$

$$v = 60m/s$$

SUMMARY

- 1. Study special cases (like range of a projectile) but understand the assumptions that go into all formulas
- 2. Position, velocity, and acceleration are ALL vectors and need to be manipulated using either arrows (qualitative) or components (quantitative)
- 3. Directions (or signs in 1D) of position, velocity, and acceleration can all be different

THANK YOU