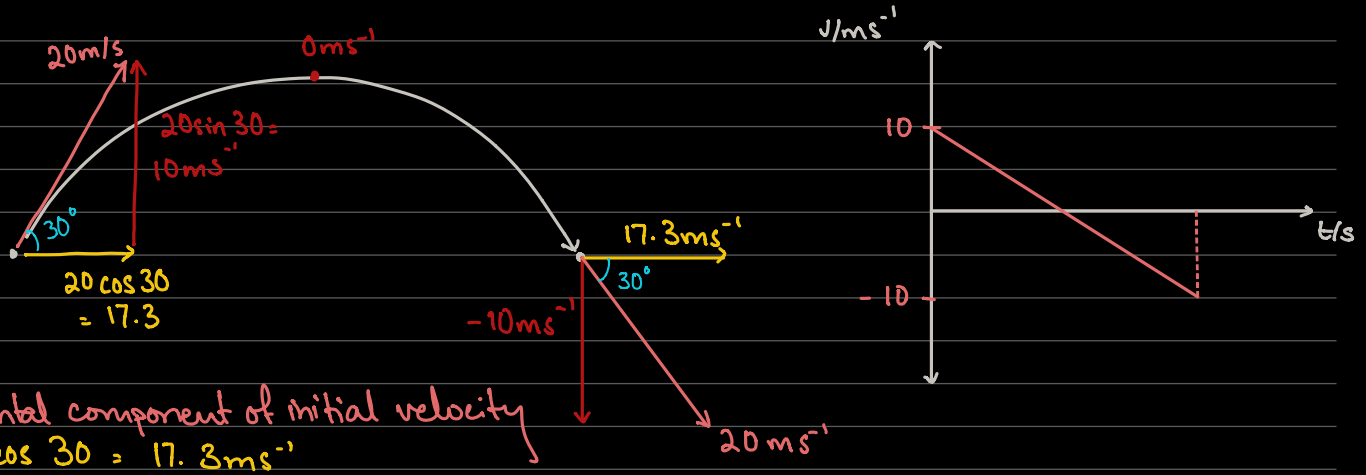
PROJECTILE MOTION : PART OF KINEMATICS

- Motion in which an object performs "two dimensional motion" ie. it moves in the horizontal as well as in the vertical plane, as shown.



Q1. find horizontal component of initial velocity

$20\cos 30 = 17.3 ms^{-1}$

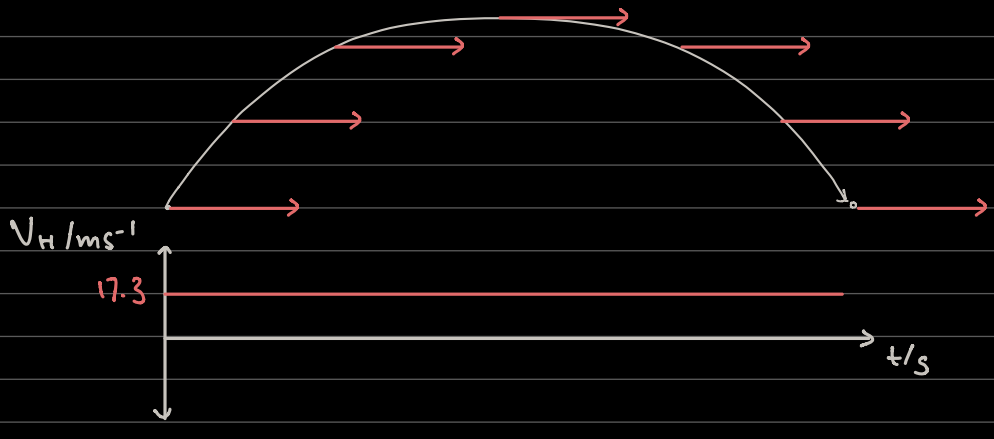
Q2. Find the vertical component of initial velocity

$20\sin 30 = 10 ms^{-1}$

Note: the vertical component of velocity gets influenced by the pull of gravity, therefore, the vertical component becomes 0 as you reach the highest point, and then, it again increases in the opposite direction

"Teacher's Notes"

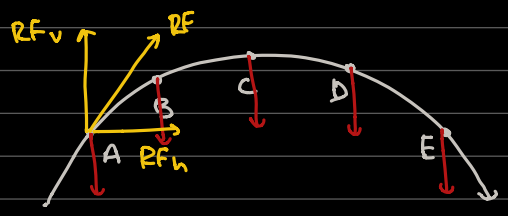
- Since acceleration due to gravity acts in the vertical plane, therefore it does not affect the horizontal motion. Therefore the horizontal vector will remain unchanged.



Important Points:

1. Vertical velocity changes continuously
2. Horizontal velocity remains constant
3. Acceleration acts only in the vertical plane
4. If AR is negligible, then we can separately apply equations of motion for

the vertical and horizontal motion.



Q1. At which point is the velocity going to be 0?
No point; only the vertical component of the velocity becomes constant

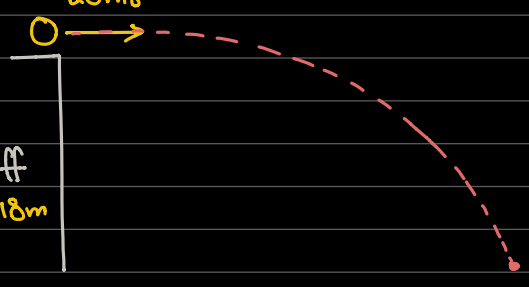
Q2. Mark the direction of acc. on all five points.
Done.; Arrows pointing downwards. (of equal length at all points)

Q3. Mark the direction of force at all five points.
According to F=ma, the force and acceleration follow the same direction, thus the answer is the same as part (2).

Q. How to mark the direction of the resultant velocity on point A?
By constructing a tangent at the relevant points as shown.

"HALF" PROJECTILE MOTION

- A particle is projected horizontally from the top of the cliff as shown:



- Horizontal velocity will remain constant
- Since it is projected horizontally, it's initial vertical velocity will be zero.
  - However, as it moves, the vertical velocity starts to increase (downwards)

i) Calculate time taken to reach the ground.

$s = 18$
$u = 0$
$a = 9.81$
$t = ?$

$s = ut + \frac{1}{2}at^2$

$s = 0 + \frac{1}{2}(9.81)t^2$

$18 = \frac{1}{2}(9.81)t^2$

$1.9s = t \rightarrow \therefore$, 1.9s taken to reach the ground.

General formula for calculating time taken.

$$y = 0 + \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2y}{g}}$$

i) Calculate horizonal displacement

$$s = \frac{d}{t}$$

$$20 = \frac{d}{1.9}$$

$$20 \times 1.9 = d$$

$38m = d \rightarrow \therefore$, horizontal displacement = 38m

General formula for calculating horizontal displacement

distance = speed x time $\Rightarrow$ $x = u \times \sqrt{\frac{2y}{g}}$

where...

x = horizontal displacement
u = (initial) horizontal velocity
y = vertical displacement
g = gravitational acceleration