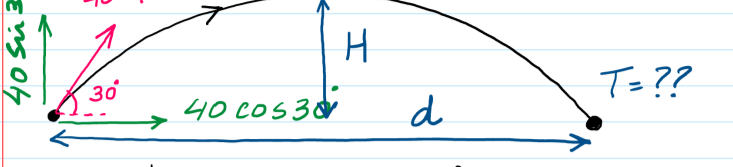


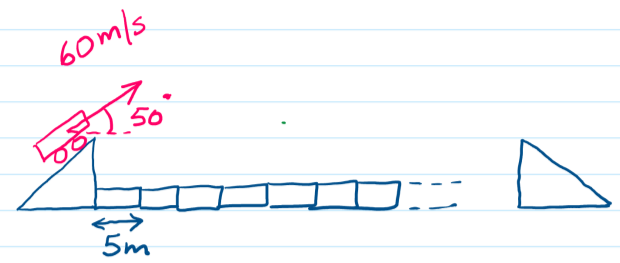
$v = u + at$   
 $v^2 = u^2 + 2as$   
 $s = ut + \frac{1}{2}at^2$   
 $s = \left(\frac{u+v}{2}\right) \times t$

$S = \sqrt{t} \quad | \quad V = u + at$   
 $V^2 = u^2 + 2as$   
 $S = \frac{1}{2}ut + \frac{1}{2}at^2$



- Initial horizontal component of velocity =  $40 \cos 30 = 34.6 \text{ m/s}$
- Initial vertical component of velocity =  $40 \sin 30 = 20 \text{ m/s}$
- Cal max height reached (H)  
 $\uparrow u = 20 \quad v = 0 \quad a = -9.81 \quad s = ??$   
 $v^2 = u^2 + 2as$   
 $0 = 20^2 + 2(-9.81)s \quad s = 20.4 \text{ m}$
- Cal time taken (t) to reach max height.  
 $\uparrow u = 20 \quad v = 0 \quad a = -9.81 \quad s = 20.4 \quad t = ??$   
 $v = u + at$  OR  $s = ut + \frac{1}{2}at^2$   
 $0 = 20 + (-9.81)t$   
 $t = 2.04 \text{ s}$
- Cal the total time (T) for entire journey  $T = 2 \times t = 2 \times 2.04 = 4.08 \text{ s}$ .
- Cal the total horizontal distance (d) covered by projectile.  
 $\rightarrow d = s \times t$  OR  $\rightarrow s = ut + \frac{1}{2}at^2$   
 $d = 34.6 \times 4.08$   
 $d = 141 \text{ m}$        $s = 34.6 \times 4.08$   
 $s = 141 \text{ m}$

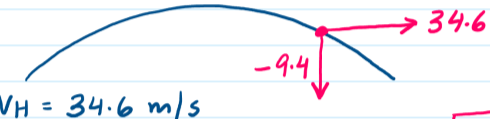
side note



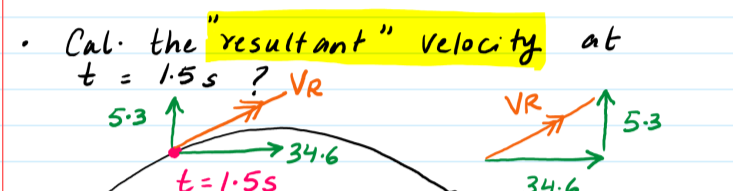
- Cal. max # of blocks which can be crossed by the car in the given diagram?
- $\uparrow v = u + at$  (t to reach highest pt).  
 $0 = 60 \sin 50 - 9.81t$   
 $t = 4.7 \text{ s}$
  - $T = 2 \times t = 2 \times 4.7 = 9.4 \text{ s}$
  - total horizontal distance  
 $\rightarrow d = s \times t$   
 $d = (60 \cos 50) \times 9.4$   
 $d = 362.5 \text{ m}$
  - max # of cars.  
 $\frac{362.5}{5} = 72.5 \approx 72 \text{ cars}$

side note.

Q: Cal  $V_R$  at  $t = 3 \text{ sec}$

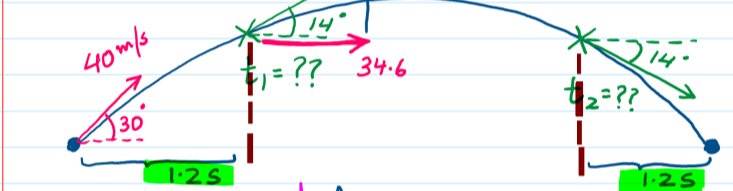


- $V_H = 34.6 \text{ m/s}$
- Find  $V_V$  at  $t = 3 \text{ s}$   
 $V_R = \sqrt{(-9.4)^2 + (34.6)^2}$
- $\uparrow v = u + at$   
 $v = 20 + (-9.81)(3)$   
 $v = -9.4 \text{ m/s}$   
 $V_R = 36 \text{ m/s}$



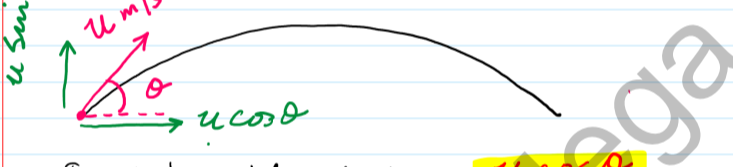
- Cal. the "resultant" velocity at  $t = 1.5 \text{ s}$
- $V_H$  remains constant throughout  $V_H = 34.6 \text{ m/s}$
- find  $V_V$  at  $1.5 \text{ sec}$   
 $\uparrow u = 20 \quad v = ?? \quad a = -9.81 \quad t = 1.5$   
 $\uparrow v = u + at$   
 $v = 20 + (-9.81)(1.5)$   
 $v = 5.3 \text{ m/s}$

Cal. the 2 times  $t_1$  &  $t_2$  when ball makes an angle of  $14^\circ$  with the horizontal?



- Use trig  $V_V$   
 $\tan 14 = \frac{V_V}{34.6}$   
 $V_V = 8.63 \text{ m/s}$   
 $\uparrow u = 20 \quad v = 8.63$   
 $a = -9.81 \quad t = t_1$   
 $\uparrow v = u + at$   
 $8.63 = 20 + (-9.81)t_1$   
 $t_1 = 1.2 \text{ s}$   
 $t_2 = 4.08 - 1.2 \text{ s} = 2.88 \text{ s}$

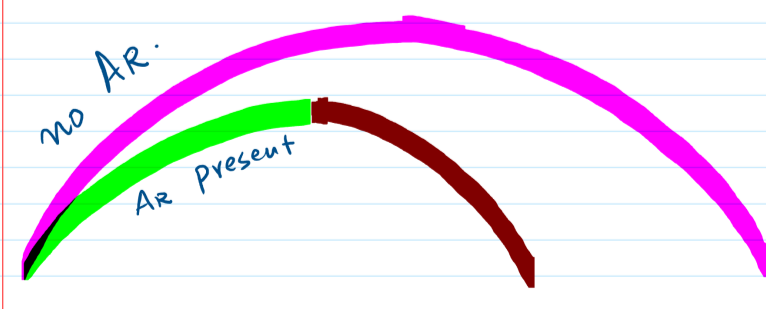
Example Question using Variables rather than absolute numbers.



- Initial horizontal velocity =  $u \cos \theta$
- Initial vertical velocity =  $u \sin \theta$
- Expression for vertical velocity after t sec  
 $\uparrow v = u + at$   
 $v = u \sin \theta + (-g)t$   
 $v = u \sin \theta - gt$
- Expression for horizontal velocity after t sec  
 $u \cos \theta$
- Expression for calculating horizontal distance after t sec?  
 $\rightarrow d = s \times t$   
 $d = u \cos \theta \times t$
- Expression for calculating vertical distance after t sec.  
 $\uparrow s = ut + \frac{1}{2}at^2$   
 $s = (u \sin \theta)t + \frac{1}{2}(-g)t^2$   
 $s = u \sin \theta \cdot t - \frac{1}{2}gt^2$
- Expression for time taken (t) to reach max height.  
 $\uparrow v = u + at$   
 $0 = u \sin \theta + (-g)t$   
 $t = \frac{u \sin \theta}{g}$
- Expression for total time (T) for the journey.  
 $T = 2 \times t$   
 $T = \frac{2u \sin \theta}{g}$

NOTE: Above expressions/general formula used in mcqs.

How to construct path of projectile if air resistance is present



- due to AR
    - vertical height will reduce.
    - horizontal range/distance will reduce.
    - Since AR is present  $\therefore$  horizontal component of velocity will keep decreasing  $\therefore$  dist covered in 2nd half (brown) will be less than dist covered in the first half (green).
- NOT symmetrical.