Lecture Kinematics

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- "objects in motion"

distance d
displacement s
speed S
velocity v
acc a

Equations of motion

- acc = rate of change of velocity

$a = \frac{\text{change in velo}}{\text{time}}$

$a = \frac{v-u}{t}$ $\quad \boxed{v = u + at}$ (1)

- distance = Speed x time

$d = S \times t$ (speed is CONSTANT)

if speed is NOT constant

distance = Average Speed x time
displacement = Average velo. x time

$\boxed{s = \left(\frac{u+v}{2}\right) \times t}$ (2)

- 3rd Eq $s = ut + \frac{1}{2}at^2$ derive.

Subs. 'v' from eq (1) into eq (2)

$v = u + at$

$s = \left(\frac{u+v}{2}\right) \times t$

$s = \left(\frac{u+(u+at)}{2}\right) \times t$

$\boxed{s = ut + \frac{1}{2}at^2}$ (3)

- 4th Eq $v^2 = u^2 + 2as$ derive

make "t" the subject from eq (1) & replace it in eq (2)

$v = u + at$

$t = \frac{v-u}{a}$

$s = \left(\frac{u+v}{2}\right) \times t$

$s = \left(\frac{u+v}{2}\right) \times \left(\frac{v-u}{a}\right)$

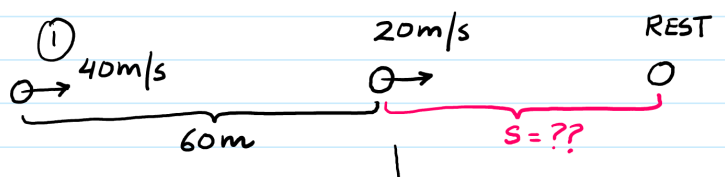
simplify $\boxed{v^2 = u^2 + 2as}$ (4)

These equations are to be used under the following conditions.

(1) object must be moving in a straight Line. (Linear motion)

(2) The acceleration of the object must be constant.

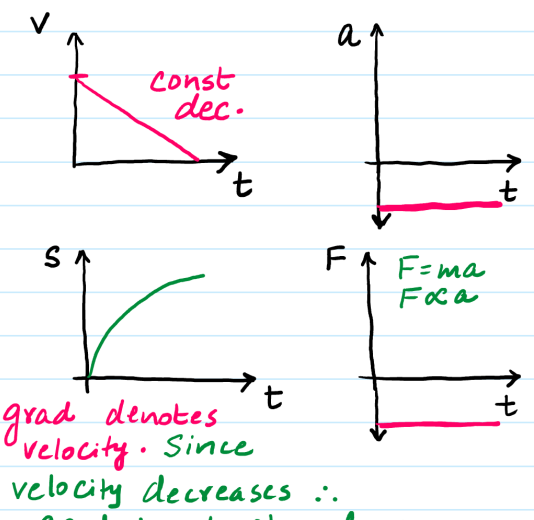
example (1)



$v^2 = u^2 + 2as$
$20^2 = 40^2 + 2a(60)$
$\boxed{a = -10}$
const. dec

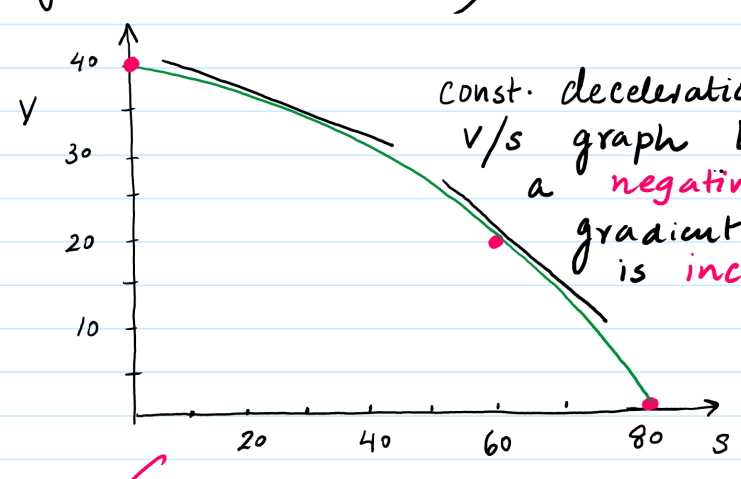
$v^2 = u^2 + 2as$
$0^2 = 20^2 + 2(-10)s$
$\boxed{s = 20m}$

sketch



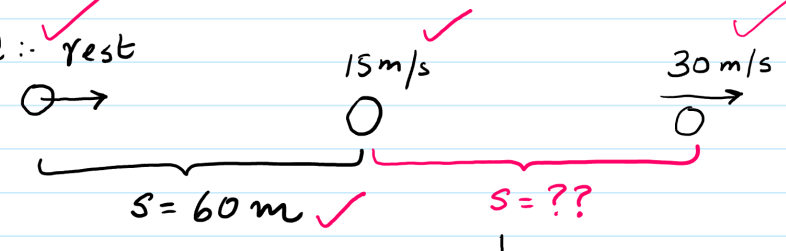
grad denotes velocity. Since velocity decreases ∴ grad must also decrease

(b) Sketch a velocity against displ graph (v vs s)



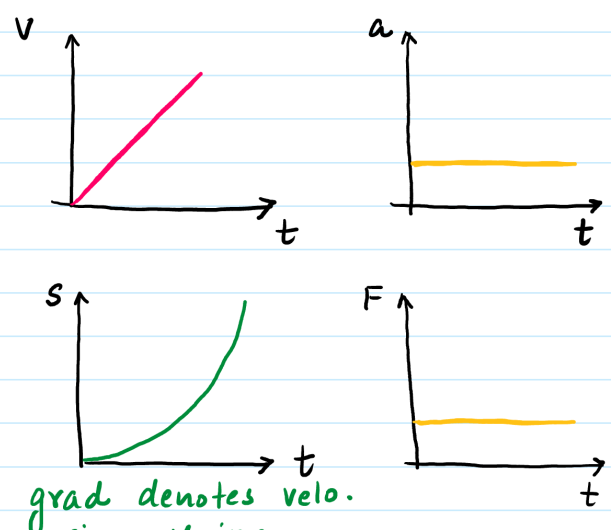
const. deceleration v/s graph has a negative. gradient which is increasing

Q :- rest

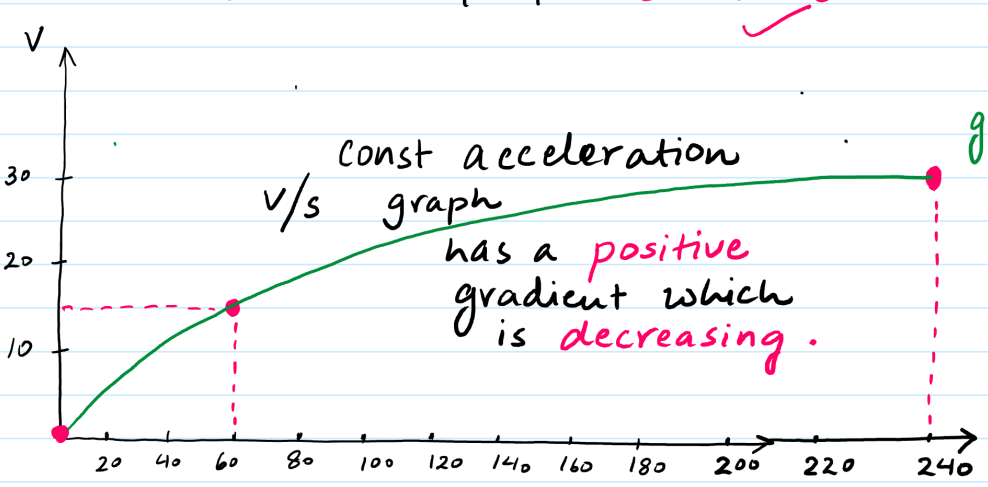


$v^2 = u^2 + 2as$
$15^2 = 0^2 + 2a(60)$
$a = 1.875\ m/s^2$

$v^2 = u^2 + 2as$
$30^2 = 15^2 + 2(1.875)s$
$s = 180\ m$



grad denotes velo. since v inc. ∴ grad also inc.



const acceleration v/s graph has a positive gradient which is decreasing.