Question

The maximum and minimum magnitudes of the resultant of two forces are 35 N and 5 N respectively. Find the magnitude of resultant force when act orthogonally(Perpendicularly) to each other.

$$\begin{aligned} A+B &= 35 \\ A-B &= 5 \\ \hline A &= 20 \\ B &= 15 \end{aligned}$$

$$\underline{\text{Ans}} = \sqrt{20^2+(15)^2} = 5\times5 = \underline{25}$$

Ans : 25

Question

Two equal forces (P each) act at a point inclined to each other at an angle of $120°$. The magnitude of their resultant is

$$= \sqrt{P^2 + P^2 + 2 \cdot P \cdot P \cdot \cos 120^\circ}$$

A $\frac{P}{2}$

B $\frac{P}{4}$

C P

D $2P$

Ans : (C)

Question

Maximum and minimum magnitudes of the resultant of two vectors of magnitudes P and Q are in the ratio 3 : 1. Which of the following relations is true?

A $P = 2Q$

B $P = Q$

C $PQ = 1$

D None of these

$$\frac{P+Q}{P-Q} = \frac{3}{1}$$

$$P+Q = 3P-3Q$$

$$4Q = 2P$$

$$\boxed{P = 2Q}$$

Ans : (A)

Question

For the resultant of the two vectors to be maximum, what must be the angle between them

A) $0°$

B) $60°$

C) $90°$

D) $180°$

Ans : (A)

Question

Two forces, each numerically equal to 5 N, are acting as shown in the figure. Then the resultant is

$$\cancel{F_{net} = \sqrt{5^2 + 5^2 + 2\times5\times5\cos60^\circ}}$$

$$\cancel{= \sqrt{25 + 25 + 25}} = 5\sqrt{3}$$

A 2.5 N

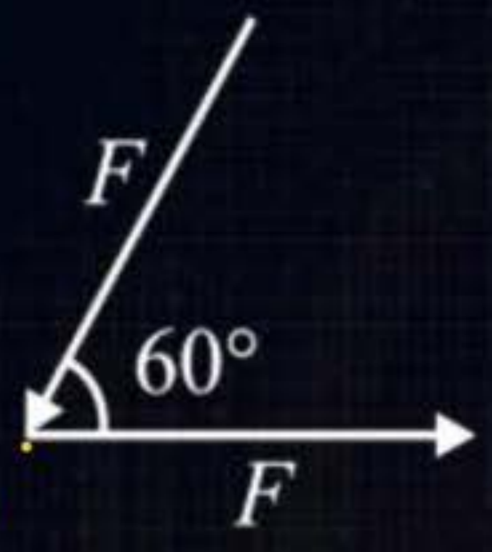
B 5 N

C $5\sqrt{3}\,N$ X

D 10 N

$$F_{net} = \sqrt{5^2 + 5^2 + 2\times5\times5\cos120^\circ}$$

$$= \underline{5}$$

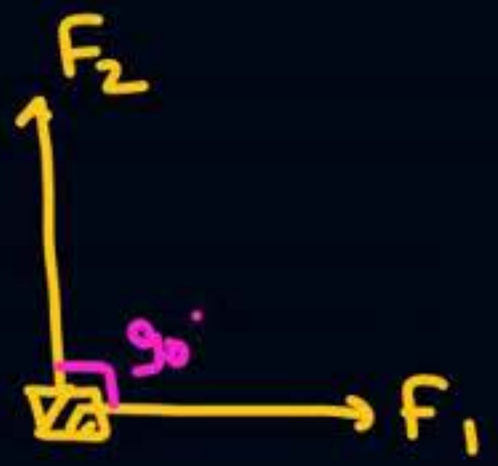


B

Ans : ~~(C)~~

Question

Force F_1 and F_2 act on a point mass in two mutually perpendicular directions. The resultant force on the point mass will be



A $F_1 + F_2$

B $F_1 - F_2$

C $\sqrt{F_1^2 + F_2^2}$

D $F_1^2 + F_2^2$

Ans : (C)

Question

Class Notes

The sum of magnitude of two force $\vec{A}$ and $\vec{B}$ acting at a point is 16 N. If their resultant has magnitude 8 N and direction of resultant is perpendicular to $\vec{A}$. Find Magnitude of $\vec{A}$ and $\vec{B}$.

A 6 N and 10 N

B 8 N and 8 N

C 4 N and 12 N

D 2 N and 14 N

Ans : (A)

Question

The vector sum of the forces of 10 newton and 6 newton can be:

A 2 N

B 8 N

C 18 N

D 20 N

$C_{max} = 10 + 6 = 16$

$C_{min} = 10 - 6 = 4$

$\boxed{4 \leq C \leq 16}$

Ans : (B)

Question

बाद में

Which of the following pair of forces will never give a resultant force of 2 N?

A 2 N and 2 N ≡ $0 \le C \le 4$

B 1 N and 1 N $\boxed{0 \le C \le 2}$

C 1 N and 3 N = $2 \le C \le 4$

D $\boxed{\text{1 N and 4 N}}$

$3 \le C \le 5$

Ans D

Ans : (D)

Question

If three forces $\overrightarrow{F_1} = \underline{3i} - 4\hat{j} + 5\hat{k}$, $\overrightarrow{F_2} = \underline{-3\hat{\imath}} + 4\hat{j}$.and $\overrightarrow{F_3} = 5\hat{k}$ are acted on a body, then the direction of resultant force on the body is:

$$\overrightarrow{F_{net}} = 0\hat{i} + 0\hat{j} + 10\hat{k}$$

$$\overrightarrow{F_{net}} = 10\hat{k}$$

A Along x-axis

B Along y-axis

C Along z-axis

D In indeterminate form

Ans. (C)

Question

A vector lying in x-y plane has a magnitude 3, and makes an angle 30° with the x-axis. Find its components along X axis and Y axis respectively.

A $\frac{3}{2}, \frac{\sqrt{3}}{2}$

B $\frac{3}{2}, \frac{3\sqrt{3}}{2}$

C $\frac{\sqrt{3}}{2}, \frac{3}{2}$

D $\frac{3\sqrt{3}}{2}, \frac{3}{2}$

$$\vec{A} = 3\cos 30\,\hat{i} + 3\sin 30\,\hat{j}$$
$$= 3\frac{\sqrt{3}}{2}\,\hat{i} + \frac{3}{2}\,\hat{j}$$

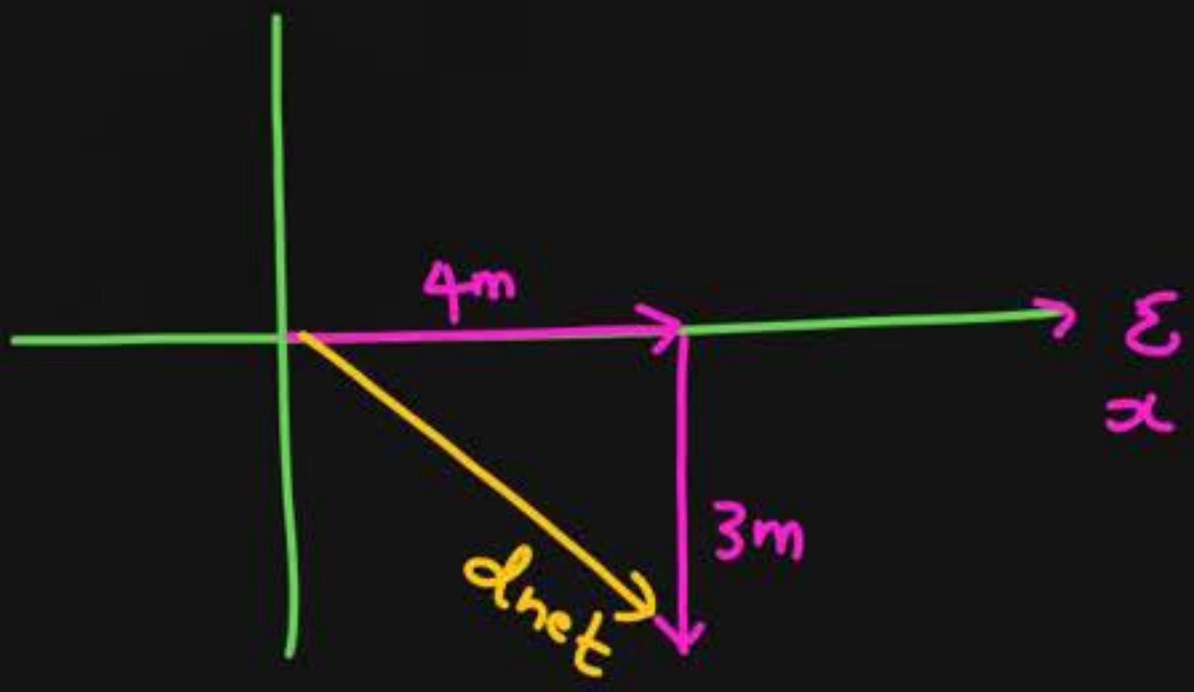
Ans. (D)

Question

$d_1 =$

A boy walks 4 m east and then 3 m south. Find the resultant displacement of the boy.

$d_1 = 4\hat{i}$ $\quad \vec{d_2} = -3\hat{j}$ $\quad \vec{d} = 4\hat{i} - 3\hat{j}$



A 4 m

B 5 m

C 7 m

D 3 m

Ans. (B)

Question

If a particle moves from point $P\,(2, 3, 5)$ to point $Q\,(3, 4, 5)$. Its displacement vector be

$\overrightarrow{PQ} = \hat{i} + \hat{j}$

A $\hat{\imath} + \hat{\jmath} + 10\hat{k}$

B $\hat{\imath} + \hat{\jmath} + 5\hat{k}$

C $\hat{\imath} + \hat{\jmath}$

D $2\hat{\imath} + 4\hat{\jmath} + 6\hat{k}$

Ans. (C)

Question

$\vec{A} = 2\hat{\imath} + \hat{\jmath}$, $B = 3\hat{\jmath} - \hat{k}$ and $\vec{C} = 6i - 2\hat{k}$. Value of $\vec{A} - 2\vec{B} + 3\vec{C}$ would be

$-2\vec{B} = -6\hat{j} + 2\hat{k}$ $\quad$ $3\vec{C} = 18\hat{i} + 0\hat{j} - 6\hat{k}$

A $20\hat{\imath} + 5\hat{\jmath} + 4\hat{k}$

B $20\hat{\imath} - 5\hat{\jmath} - 4\hat{k}$

C $4\hat{\imath} + 5\hat{\jmath} + 20\hat{k}$

D $5\hat{\imath} + 4\hat{\jmath} + 10\hat{k}$

Ans $\Rightarrow$ $20\hat{i} - 5\hat{j} - 4\hat{k}$

Ans. (B)

Question

Two force $F_1 = 1$ N and $F_2 = 2$ N act along the lines $x = 0$ and $y = 0$ respectively. Then the resultant of forces would be

y Axis

x-Axis

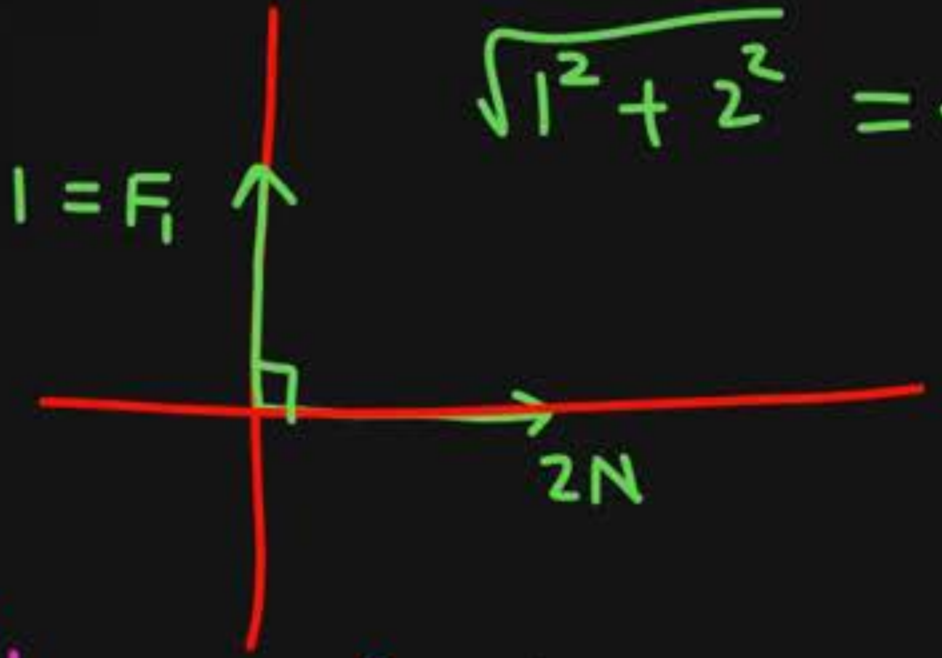
A $\hat{\imath} + 2\hat{\jmath}$

B $\hat{\imath} + \hat{\jmath}$

C $3\hat{\imath} + 3\hat{\jmath}$

D $2\hat{\imath} + \hat{\jmath}$

$\sqrt{1^2 + 2^2} = \sqrt{5}$



$\vec{F}_{net} = 2\hat{i} + \hat{j}$

Ans. (D)

Question

Following forces starts acting on a particle at rest at the origin of the co-ordinate system simultaneously

$$\overrightarrow{F_1} = -4\hat{\imath} - 5\hat{\jmath} + 5\hat{k},\ \overrightarrow{F_2} = 5\hat{\imath} + 8\hat{\jmath} + 6\hat{k},$$
$$\overrightarrow{F_3} = -3\hat{\imath} + 4\hat{\jmath} - 7\hat{k} \text{ and } \overrightarrow{F_4} = 2\hat{\imath} - 3\hat{\jmath} - 2\hat{k}$$

$$\boxed{\vec{F}_{net} = 0\hat{i} + 4\hat{j} + 2\hat{k}}$$

y, z

then the particle will move

A In x–y plane

B In y–z plane

C In x–z plane

D Along x-axis

Ans. (B)

Question

The vector sum of the forces of 10 newton and 6 newton can be:

A 2 N

B 8 N

C 18 N

D 20 N

$10-6 \leq C \leq 10+6$

$4 \leq C \leq 16$

Ans. (B)

Question

The unit vector along $\hat{\imath} + \hat{\jmath}$ is :

A $\hat{k}$

B $\hat{\imath} + \hat{\jmath}$

C $\frac{\hat{\imath} + \hat{\jmath}}{\sqrt{2}}$

D $\frac{\hat{\imath} + \hat{\jmath}}{2}$

Ans. (C)

Question

The unit vector parallel to the resultant of the vectors $\vec{A} = 4\hat{\imath} + 3\hat{\jmath} + 6\hat{k}$ and $\vec{B} = -\hat{\imath} + 3\hat{\jmath} - 8\hat{k}$ is:

$$\vec{A} + \vec{B} = 3\hat{i} + 6\hat{j} - 2\hat{k} = \vec{C}$$

A $\frac{1}{7}[3\hat{\imath} + 6\hat{\jmath} - 2\hat{k}]$

B $\frac{1}{7}[3\hat{\imath} + 6\hat{\jmath} + 2\hat{k}]$

C $\frac{1}{49}[3\hat{\imath} + 6\hat{\jmath} + 2\hat{k}]$

D $\frac{1}{49}[3\hat{\imath} + 6\hat{\jmath} - 2\hat{k}]$

$$\hat{C} = \frac{3\hat{i} + 6\hat{j} - 2\hat{k}}{\sqrt{3^2 + 6^2 + 2^2}}$$

Ans. (A)

Question

$\hat{i}$

If $\vec{A}+\vec{B}$ is a unit vector along x-axis and $\vec{A}=\hat{\imath}-\hat{\jmath}+\hat{k}$, then what is $\vec{B}$?

A $\hat{\jmath}+\hat{k}$

B $\hat{\jmath}-\hat{k}$

C $\hat{\imath}+\hat{\jmath}+\hat{k}$

D $\hat{\imath}+\hat{\jmath}-\hat{k}$

$$\vec{A}+\vec{B}=\hat{i}$$

$$\cancel{\hat{i}}-\hat{j}+\hat{k}+\vec{B}=\cancel{\hat{i}}$$

$$\vec{B}=\hat{j}-\hat{k}$$

Ans. (B)

Question

The vectors $5i + 8j$ and $2i + 7j$ are added. The magnitude of the sum of these vector is

A $\sqrt{274}$

B 38

C 238

D 560

$7\hat{i} + 15\hat{j}$

$\sqrt{7^2 + (15)^2}$

$$\begin{array}{r} 49 \\ 225 \\ \hline 274 \\ \hline \end{array}$$

Ans. (A)

Question ①

A particle is in a unidirectional potential field where the potential energy (U) of a particle depends on the x-coordinate given by $Ux = k(1 - \cos ax)$ & k and 'a' are constants. Find the physical dimensions of 'a' & k.

$U(x)$

$\boxed{U(x)} = k - k\cos ax$

Pot. Energy

$\parallel$

ML^2T^{-2}

ML^2T^{-2}

$aL = 1$

$\boxed{a = L^{-1}}$

Ans - L^{-1}

ML^2T^{-2}

Question (2)

The time period (T) of a spring mass system depends upon mass (m) and spring constant (k) and length of the spring (l) $\left[k = \frac{\text{Force}}{\text{Length}}\right]$. Find the relation among T, m, l and k using dimensional method.

$$T \propto m^x k^y l^z$$

$$K \equiv \frac{MLT^{-2}}{L}$$

$$K \equiv M L^0 T^{-2}$$

$$\boxed{\text{Ans} \quad T = a\sqrt{\frac{m}{k}}}$$

$$M^0 L^0 T^1 = M^x (M T^{-2})^y L^z$$

$$M^0 L^0 T^1 = M^{x+y} L^z T^{-2y}$$

$$z = 0$$

$$x + y = 0$$

$$x - \frac{1}{2} = 0$$

$$x = \frac{1}{2}$$

$$-2y = 1$$

$$\boxed{y = -\frac{1}{2}}$$

Ans

$$T = k' m^{\frac{1}{2}} k^{-\frac{1}{2}} l^0$$

$$T = k' \frac{\sqrt{m}}{\sqrt{k}} = k' \sqrt{\frac{m}{k}}$$

Question (3)

A satellite is orbiting around a planet. It orbital velocity (v_0) is found to depend upon

Class Notes Check

(A) Radius of orbit (R)

(B) Mass of planet (M)

(C) Universal gravitational constant (G)

$$V_0 = K\sqrt{\frac{GM}{R}}$$

$$V_0 \propto R^x M^y G^z$$

Question (4)

A assume that the largest stone of mass '*m*' that can be moved by a flowing river depends upon the velocity of flow *v*, the density *d* and the acceleration due to gravity *g*. If '*m*' varies as the K^{th} power of the velocity of flow, then find the value of *K*.

$$m \propto v^K d^l g^m$$

$$(LT^{-1})^K (ML^{-3})^l (LT^{-2})^m$$

$$M^1 L^0 T^0 = M^l L^{K-3l+m} T^{-K-2m}$$

compare

$l = 1$

$K = 6$

$-K-2m = 0 \Rightarrow -K = 2m$

$K - 3l + m = 0$ $\quad m = -\frac{K}{2}$

$K - 3\times1 + m = 0$

$K + m = 3$

$K - \frac{K}{2} = 3$

$\frac{K}{2} = 3$ $\quad K = 6$

Question (5)

Which of the following functions of A and B may be performed if A and B possess different dimensions?

A $\frac{A}{B}$ ✓

B $A + B$ ✗

C $A - B$ ✗

D None of these

Ans (A)

Question (6)

The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are respectively:-

A LT^{-2}, L and T

B L^2, T and LT^2

C LT^2, LT and L

D L, LT and T^2

velocity

$\frac{b}{t+c}$

Ans (A)

$at \longrightarrow$ velocity

$aT = LT^{-1}$

$a = LT^{-2}$

$\boxed{c = T}$

$\frac{b}{t+c} \longrightarrow$ velocity

$\frac{b}{T} = LT^{-1}$

$\boxed{b = L}$

Question (7)

If area (A), velocity (v), and density (ρ) are base units, then the dimensional formula of force can be represented as:-

$\rightarrow MLT^{-2}$

A $Av\rho$ $\rightarrow L^2 \cdot LT^{-1} \cdot \frac{M}{L^3} = MLT^{-1}$

Ans (B)

B $Av^2\rho$ $\rightarrow L^2 \cdot (LT^{-1})^2 ML^{-3} = MLT^{-2} \equiv$ Force

C $Av\rho^2$

D $A^2v\rho$

Question (8)

If force, acceleration and time are taken as fundamental quantities, then the dimensions of length will be:

F A T

L

Ans ~~(C)~~ (D)

A) FT^2 $\longrightarrow MLT^{-2} \cdot T^2 = ML$

B) $F^{-1}A^{-2}T^{-1} = \frac{1}{FA^2T} = \frac{1}{MLT^{-2} \cdot (LT^{-2})^2 \cdot T} = \frac{1}{ML^3T^{-5}}$

C) FA^2T

D) AT^2 $\longrightarrow LT^{-2} \cdot T^2 = L$

Question

Find the value of

(i) $\cos(-60°)$ $= \cos 60 = \frac{1}{2}$

(ii) $\tan 210°$ $= \tan(180+30) = +\frac{1}{\sqrt{3}}$

(iii) $\sin 300°$ $\rightarrow \sin(360-60) = -\frac{\sqrt{3}}{2}$

(iv) $\boxed{\cos 120°}$ $= -\frac{1}{2}$

Ans. (i) $\frac{1}{2}$, (ii) $\frac{1}{\sqrt{3}}$, (iii) $-\frac{\sqrt{3}}{2}$, (iv) $-\frac{1}{2}$

Question

Use the approximation $(1+x)^n \approx 1+nx$, $|x| << 1$, to find approxima

(i) $\sqrt{99}$

(ii) $\frac{1}{1.01}$

$\sqrt{100-1} = (100-1)^{\frac{1}{2}} = \left[100(1-.01)\right]^{\frac{1}{2}} = 10(1-.01)^{\frac{1}{2}}$

$= 10\left(1-\frac{1}{2}\times .01\right)$

$= 10(1-.005)$

$= 10\times .995$

$= \underline{9.95}$

$(1.01)^{-1} = (1+.01)^{-1} = 1-.01$

$= .99$

Ans. (i) 9.95, (ii) 0.99

Question

ML^2T^{-2}

In system called the star system we have 1 star kilogram = 10^{20} kg. 1 starmeter = 10^{8} m, 1 starsecond = 10^{3} s then calculate the value of 1 joule in this system.

$$1\,J' = \frac{10^{20}\,kg \cdot (10^{8}\,m)^2}{(10^{3}\,s)^2}$$

$$1\,J' = 10^{30}\,\frac{kg\,m^2}{sec^2} = 10^{30}\,J$$

$$\frac{1\,J'}{10^{30}} = 1\,J = 10^{-30}\,J'$$

Ans. (10^{-30} star joule)

Question

Find the approximate value of

(i) $(1.003)^3$ $= (1+.003)^3 = 1.009$

(ii) $(1.003)^{-3}$ $\rightarrow (1+.003)^{-3} = 1-.009 = .991$

(iii) $\left(\frac{1}{1.005}\right)^3$ $\rightarrow (1.005)^{-3} = (1+.005)^{-3} = 1-.015 = .985$

(iv) $\sqrt{98}$

$\rightarrow$ Clas $(100-2)^{\frac{1}{2}} = 10(1-.02)^{\frac{1}{2}} = 10(1-.01) = \underline{9.9}$

Ans. (i) 1.009, (ii) .991, (iii) .985, (iv) 9.9

Question

Convert following into radian

(i) 45°

(ii) 60°

(iii) 90°

(iv) 120°

(v) 150°

$\frac{\pi}{180}$

Class

$45 \times \frac{\pi}{180} = \frac{\pi}{4}$

Ans. (i) $\pi/4$, (ii) $\pi/3$, (iii) $\pi/2$, (iv) $2\pi/3$, (v) $5\pi/6$

Question

Convert following into degree

$\pi \equiv 180$ ✓

(i) $\frac{4\pi}{3}$

(ii) $\frac{8\pi}{3}$ $\rightarrow$ $\frac{8\times180}{3} = \underline{480^\circ}$

(iii) 4π

Ans. (i) 240°, (ii) 480°, (iii) 720°

H/W

(1) $U = \dfrac{A\sqrt{x}}{B + x^2}$ P.E.

$B = L^2$

$\boxed{\text{D.F. of } A \cdot B \text{ is}}$

$ML^2T^{-2} = \dfrac{A\,L^{\frac{1}{2}}}{L^2} = A\,L^{3/2}$

$\boxed{A = M L^{7/2} T^{-2}}$

$\rightarrow ML^{7/2}T^{-2}L^2 = \checkmark$

(2)

$$P = \frac{\alpha}{\beta} e^{-\frac{\alpha x}{KT}}$$

KT की dim put कर रहा हूँ

JEE mains 2021, 22,

*** $\boxed{\text{JEE mains 2025}}$

K ⟶ Bolzman const

T ⟶ temp.

P ⟶ pressure

dim. of $\frac{\alpha x}{KT} = 1$

$\frac{\alpha L}{ML^2T^{-2}} = 1 \Rightarrow \boxed{\alpha = MLT^{-2}}$

DF of KT

Internal Energy

K.E.

$U = \frac{3}{2} KT$

$KT \equiv ML^2T^{-2}$

$\frac{\cancel{M}\cancel{L}T^{-2}}{L^2} = \frac{\alpha}{\beta} = \frac{\cancel{M}\cancel{L}T^{-2}}{\beta}$

$\beta = L^2$

Check the following equation dimensionally

(a) $h = \frac{2s\cos\theta}{r\rho g} \equiv \frac{MLT^{-2}}{L\,L\,\frac{M}{L^3}\,LT^{-2}} = L$

$h \to$ height $s \to$ surface tension $= \frac{F}{l}$

$r \to$ radius $\rho \to$ density

$g \to$ acc due to gravi

wrong (b) $\nu = \sqrt{\frac{P}{\rho}}$

frequency $P \to$ pressure $\rho \to$ density

$\sqrt{\frac{MLT^{-2}}{L^2 \cdot \frac{M}{L^3}}} = \sqrt{L^2T^{-2}}$

$T^{-1} \neq LT^{-1}$

अब Last pages जरूर देखना

Q. Time period (T) of a simple pendulum depends on 'm' of block length of string (l) & acc due to gravity 'g'. Derived the formula for time period.

$$\left.\begin{matrix} T \propto m^x \\ T \propto l^y \\ T \propto g^z \end{matrix}\right\} \text{ यहा तक गया ?}$$

$$T \propto m^x l^y g^z$$

$$T = K m^x l^y g^z$$

dimensionless const होना जरूरी है

$$\boxed{T = K\, m^x\, l^y\, g^z}$$

$$M^0 L^0 T^1 = M^x\, L^y\, (LT^{-2})^z$$

$$= M^x\, L^y\, L^z\, T^{-2z}$$

$$\boxed{M^0 L^0 T^1 = M^x\, L^{y+z}\, T^{-2z}}$$

Compare

$x = 0,$

$y + z = 0$

$-2z = 1 \Rightarrow z = -\frac{1}{2}$

$y = -z = -\left(-\frac{1}{2}\right) = \frac{1}{2}$

$$T = K\, m^0\, l^{\frac{1}{2}} \cdot g^{-\frac{1}{2}} = \frac{K\sqrt{l}}{\sqrt{g}}$$

$$\boxed{T = K\sqrt{\frac{l}{g}}}$$

करदू

(E)

Q Energy of a particle performing SHM depends on mass (m) of object, Amplitude (A), frequency 'f' of motion. Derive the relation b/w them.

$A \equiv$ Distance

ये ऐसा कददू है जो Dimensionless है

$$E \propto m^x A^y f^z$$

$$\boxed{E = K m^x A^y f^z}$$

$$M L^2 T^{-2} = M^x L^y (T^{-1})^z$$

$$M^1 L^2 T^{-2} = M^x L^y T^{-z}$$

Compare.

$x = 1$

$y = 2$

$-z = -2$

$z = 2$

$$\boxed{E = K M A^2 f^2}$$

Suppose

Q Force depends on mass(m), speed(v), and radius 'r'
Derive the relation b/w them

$$F = k\, m^x v^y r^z$$

$$MLT^{-2} = M^x (LT^{-1})^y L^z$$

$$M^1 L T^{-2} = M^x L^{y+z} T^{-y}$$

Compare (power)

$x = 1$,

$-y = -2 \quad y = 2$

$y + z = 1$

$2 + z = 1 \quad z = -1$

पता नहीं

$$F = K\, m^1 . v^2 . r^{-1}$$

$$\boxed{F = K \frac{mv^2}{r}}$$

इसे अभी कुछ नहीं पता

Q. A sattellit is revolving around the earth such that time period T of sattellite depends on M (mass of earth), gravitational cons. (G), and radius of orbit r, Derive the formula for time period of sattellite

$$\boxed{G = M^{-1} L^{3} T^{-2}}$$

$$T = K M^{-\frac{1}{2}} G^{-\frac{1}{2}} r^{+3/2}$$

1 ✓

2 X

3 → इसका नहीं लगी

$$T = K M^{x} G^{y} r^{z}$$

$$T = M^{x} (M^{-1} L^{3} T^{-2})^{y} L^{z}$$

$$M^{0} L^{0} T^{1} = M^{x-y} L^{3y+z} T^{-2y}$$

$$\boxed{\begin{aligned} -2y &= 1 \\ y &= -\frac{1}{2} \end{aligned}}$$

$$x - y = 0$$

$$x = y \Rightarrow x = -\frac{1}{2}$$

$$3y + z = 0$$

$$z = -3y = +3/2$$

H/W

Q A sattellit is revolving around the earth such that orbital velocity V_0 of sattellite depends on M (mass of earth), gravitational cons. (G), and radius of orbit r, Derive the formula for orbital velocity of sattellite

$G = M^{-1}L^{3}T^{-2}$.

$$\boxed{G = M^{-1}L^{3}T^{-2}}$$

Q.

A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of:

(JEE Main-2020)

A Momentum

B Area

C Energy

D Volume

Ans : (C)

Q.

Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is: **(JEE Main-2020)**

A $ML^2 T^{-2}$

B MLT^{-2}

C $M^2L^0T^{-1}$

D $ML^0 T^{-3}$

Ans : (D)

Q. Tough. Go.... gently

In a typical combustion engine the work done by a gas molecule is given $W = \alpha^2 \beta e^{\frac{-\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be:

(JEE Main-2021)

A $[MLT^{-2}]$

B $[M^0LT^0]$

C $[M^2LT^{-2}]$

D $[MLT^{-1}]$

Ans : (B)

Q.

The force is given in terms of time t and displacement x by the equation $F = A\cos Bx + C\sin Dt$. The dimensional formula of AD/B is: **(JEE Main-2021)**

A $[M^0 L T^{-1}]$

B $[M L^2 T^{-3}]$

C $[M^1 L^1 T^{-2}]$

D $[M^2 L^2 T^{-3}]$

Ans : (B)

Q.

Match List-I with List-II. (JEE Main-2021)

List-I		List-II	
(a)	Torque	(i)	MLT^{-1}
(b)	Impulse	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

Choose the most appropriate answer from the option given below :

A (a)–(iii), (b)–(i), (c)–(iv), (d)–(ii)

B (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

C (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii)

D (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

Ans : (A)

Q.

An expression of energy density is given by $u = \frac{\alpha}{\beta}\sin\left(\frac{\alpha x}{kt}\right)$, where α, β are constants, x is displacement, k is Boltzmann constant and t is the temperature. The dimensions of β will be: (JEE Main-2022)

A $[ML^2 T^{-2} \theta^{-1}]$

B $[M^0 L^2 T^{-2}]$

C $[M^0 L^0 T^0]$

D $[M^0 L^2 T^0]$

Ans : (D)

Q.

Match the list-I with List -II.

	List I		List II
A.	Torque	I.	Nms^{-1}
B.	Stress	II.	$J\,kg^{-1}$
C.	Latent Heat	III.	Nm
D.	Power	IV.	Nm^{-2}

Choose the correct answer from the options given below: **(JEE Main-2022)**

A. A-III, B-II, C-I, D-IV

B. A-III, B-IV, C-II, D-I

C. A-IV, B-I, C-III, D-II

D. A-II, B-III, C-I, D-IV

Ans : (B)

Q.

In Vander Waals equation $\left[P+\frac{a}{V^2}\right][V-b]=RT$; P is pressure, V is volume, R is universal gas constant and T is temperature. The ratio of constants a/b is dimensionally equal to:

(JEE Main-2022)

A P/V

B V/P

C PV

D PV^3

Ans : (C)

(18) $E = \dfrac{B^2 - x^2}{At}$ Energy

find D.F of A & B

$B^2 = L^2$

$\boxed{B = L}$

$\dfrac{ML^2T^{-2}}{} = \dfrac{L^2}{A \cdot T}$

$A = \dfrac{L^2}{T(ML^2T^{-2})}$

$\boxed{A = M^{-1}L^0T^{+1}}$

H/W

(19) $P = \dfrac{A - t^2}{B + x^2} \cdot C$

(momentum)

(20) $P = \dfrac{A + t^2}{B - x^2} \cdot C$

$A - t^2$

pressure का

$B + x^2$

tough

(21) $F = \dfrac{A - x^2}{B} + Ct + Dx$

find D.F of $\dfrac{A \cdot B}{C \cdot D}$

HCV H.W

physics Introduction to

obj II page → 9, (1,2)

Exercise 1, 2, 5, 8,

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H/W

Calculation OP है

(let)

$$y = \sin\theta$$

angle $\Rightarrow$ Dimensionless.

Dimensionless, number $[-1, 1]$

(1) $y = \sin A \Rightarrow A = [M^0 L^0 T^0]$

(2) $y = \sin(Ax)$

$Ax = 1$ (dimensionless)

$A.L = 1$

$\boxed{A = L^{-1}}$

(3) $y = \sin(\underline{At})$

$AT = 1$

$\boxed{A = T^{-1}}$

(4) $y = \sin\left(\frac{A}{x^2}\right)$

$\frac{A}{L^2} = 1$

$\boxed{A = L^2}$

(5) $y = \sin\left(\underline{A}x^2 + \underline{B}t^3\right)$ → ये एक Number है b/w $[-1, 1]$

y = Number → Dimensionless

Dimensionally

$$\begin{cases} Ax^2 = 1 & Bt^3 = 1 \\ AL^2 = 1 & BT^3 = 1 \\ A = L^{-2} & B = T^{-3} \end{cases}$$

(6) $y = \sin\left(\frac{A}{x^2} + Bt^2 + Ct\right)$

$\frac{A}{x^2} = 1$ (dimensionally) $= BT^2 = 1$

$\boxed{B = T^{-2}}$

$\frac{A}{L^2} = 1$ $\boxed{A = L^2}$

$CT = 1$

$\boxed{C = T^{-1}}$

$y = M^0L^0T^0$

$$\boxed{\frac{AB}{C} = \frac{L^2 \cdot T^{-2}}{T^{-1}} = L^2T^{-1}}$$

Q $y = v \sin\left(Ax^2 + \frac{B}{t}\right)$

$v \to$ velocity

$AL^2 = 1$ $A = L^{-2}$

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

$y \equiv \text{Velocity} \equiv LT^{-1}$

(8) $y = A \sin\left(Px^2 + \frac{Q}{t} + R \cdot v\right)$

A → Amplitude (meter)

v → velocity

$\boxed{y = L}$

1. -2
2. -3
3. -4
4. None

D.F. of $\frac{PQ}{y \cdot R}$ is given by $M^{\alpha} L^{\beta} T^{\gamma}$

find $\alpha + \beta + \gamma$

$\frac{PQ}{yR}$

$P = L^{-2}$ $\quad Q = T$

$Rv = 1$

$R L T^{-1} = 1$

$\boxed{R = L^{-1} T}$

$\frac{L^{-2} \cdot T}{L \cdot L^{-1} T} = L^{-2}$

$\alpha = 0$

$\beta = -2$

$\gamma = 0$

$\text{Log}(x)$

$x \equiv$ dimensionless $\cos(x)$

e^x

$\tan(x)$

$\sin(x)$

$y = \log(x)$ dimensionless

$y = \sin\left(Ax^2 + \frac{B}{t}\right)$

Q $y = \log\left(Ax^2 + \frac{B}{t}\right)$

$AL^2 = 1$

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

$A = L^{-2}$

$B = T$

Q $q = Q_0 e^{-t/\tau}$

find D.F. of τ

$\boxed{e = 2.718 \text{ maths}}$

$\boxed{\pi = 3.14}$

$\frac{t}{\tau} = 1$ (dimensionally)

$t \equiv \tau$

$\tau = T^1$

Q $y = \log\left(\frac{A}{t^2} - Bv\right)$

find D.F. of A.B

$A = T^2$

$B.LT^{-1} = 1$

$B = L^{-1}T$

Ans $\rightarrow T^2 . L^{-1}T$

$= L^{-1}T^3$

Q $y = v e^{\left(Ax^2 + \frac{B}{t^2} - Ct\right)}$

$\left(Ax^2 + B/t^2 - 1.Ct\right)$

find D.F. of A.B.C.

$A = L^{-2}, \quad B = T^2, \quad C = T^{-1}$

$L^{-2} . T^2 . T^{-1} \equiv L^{-2}T^{+1}$

Amplitude (m)

Q $y = A \log\left(Bx^2 + \frac{C}{t^3} - 5Dt^3 + \frac{E}{F+t} - \frac{G}{x^2} \right)$

find D.F. of A.B.C.D.E.F.G. = ?

$A = L$, $B = L^{-2}$, $C = T^3$, $D = T^{-3}$, $F = T$, $E = T$, $G = L^2$

$a \cdot x = 1$ (dimensionally)

Q $U = K(1 - \sin(ax))$

Potential Energy

find D.F. of K & a

$\boxed{a = L^{-1}}$

DF of U = D.F of K

$\boxed{ML^2T^{-2} \equiv K}$

(meter)

Q $y = A \sin\left(\dfrac{Bx}{C+t}\right)$

find D.F of B & C

$C = T$, $A = L$,

$\dfrac{Bx}{C+t} \longrightarrow$ dimensionless

$\dfrac{BL}{T} = 1$, $B = L^{-1}T$

$q = Q_0 e^{-t/\tau}$

$-\frac{t}{\tau} \longrightarrow$ dimensionless

$(-1)\left(\frac{t}{\tau}\right) \Rightarrow 1$

$\frac{t}{\tau} = 1$

$\tau = T$

$p = P_0 e^{5\alpha t^2}$

$\alpha t^2 \longrightarrow$ dimension

$\alpha = T^{-2}$

$A = A_0 e^{2t/\tau}$

$\frac{2t}{\tau} \longrightarrow$ dimensionless

$\frac{t}{\tau} \longrightarrow 1$

$\tau = T$

H/W

(1) $U = \frac{A\sqrt{x}}{B+x^2}$

D.F. of A.B is

(2)

$$P = \frac{\alpha}{\beta} e^{-\frac{\alpha x}{KT}}$$

JEE mains 2021, 22,

*
*
$\boxed{\text{JEE mains 2025}}$

$K \longrightarrow$ Bolzman const

$T \longrightarrow$ temp.

Check the following equation dimentionally

(a) $h = \dfrac{2S\cos\theta}{r\rho g}$

$h \rightarrow$ height $\quad S \rightarrow$ surface tension

$r \rightarrow$ radius $\quad \rho \rightarrow$ density

$g \rightarrow$ acc due to gravi

(b) $\nu = \sqrt{\dfrac{P}{\rho}}$

$\nu \rightarrow$ frequency

$P \rightarrow$ pressure

$\rho \rightarrow$ density

अबे Last pages जरूर देखना

$$F = \frac{A - x^2}{B} + Ct + Dx$$

$$\boxed{\begin{aligned} C &\equiv MLT^{-3} \\ D &= MT^{-2} \\ A &= L^2 \\ B &= M^{-1}LT^{+2} \end{aligned}}$$

$$\frac{M^{-1}L^3T^{+2}}{M^2LT^{-5}} \equiv M^{-3}L^2T^{+7}$$

(1) momentum

$$P = \frac{A+t^2}{B+x^2} \cdot C$$

$B = L^2$

$A = T^2$

$$MLT^{-1} = \frac{T^2}{L^2} \cdot C$$

$$\boxed{C = ML^3T^{-3}}$$

Pressure

$$P = \frac{A+t^2}{B-x^2} \cdot C$$

$A \equiv T^2$
$B \equiv L^2$

$$\frac{MLT^{-2}}{\cancel{L^2}} = \frac{T^2}{\cancel{L^2}} \cdot C$$

$$\boxed{C = MLT^{-4}}$$

3. Suppose you are told that the linear size of everything in the universe has been doubled overnight. Can you test this statement by measuring sizes with a metre stick ? Can you test it by using the fact that the speed of light is a universal constant and has not changed ? What will happen if all the clocks in the universe also start running at half the speed ?
4. If all the terms in an equation have same units, is it necessary that they have same dimensions ? If all the terms in an equation have same dimensions, is it necessary that they have same units ?
5. If two quantities have same dimensions, do they represent same physical content ?
6. It is desirable that the standards of units be easily available, invariable, indestructible and easily reproducible. If we use foot of a person as a standard unit of length, which of the above features are present and which are not ?
7. Suggest a way to measure :
   (a) the thickness of a sheet of paper,
   (b) the distance between the sun and the moon.

OBJECTIVE I

1. Which of the following sets cannot enter into the list of fundamental quantities in any system of units ?
   (a) length, mass and velocity,
   (b) length, time and velocity,
   (c) mass, time and velocity,
   (d) length, time and mass.
2. A physical quantity is measured and the result is expressed as nu where u is the unit used and n is the numerical value. If the result is expressed in various units then
   (a) $n \propto$ size of u (b) $n \propto u^2$
   (c) $n \propto \sqrt{u}$ (d) $n \propto \frac{1}{u}$.
3. Suppose a quantity x can be dimensionally represented in terms of M, L and T, that is, $[x] = M^a L^b T^c$. The quantity mass
   (a) can always be dimensionally represented in terms of L, T and x,
   (b) can never be dimensoinally represented in terms of L, T and x,
   (c) may be represented in terms of L, T and x if $a = 0$,
   (d) may be represented in terms of L, T and x if $a \neq 0$.
4. A dimensionless quantity
   (a) never has a unit, (b) always has a unit,
   (c) may have a unit, (d) does not exist.
5. A unitless quantity
   (a) never has a nonzero dimension,
   (b) always has a nonzero dimension,
   (c) may have a nonzero dimension,
   (d) does not exist.
6. $\int \frac{dx}{\sqrt{2ax - x^2}} = a^n \sin^{-1}\left[\frac{x}{a} - 1\right]$.
   The value of n is
   (a) 0 (b) -1
   (c) 1 (d) none of these.
   You may use dimensional analysis to solve the problem.

OBJECTIVE II

1. The dimensions $ML^{-1}T^{-2}$ may correspond to
   (a) work done by a force
   (b) linear momentum
   (c) pressure
   (d) energy per unit volume.
2. Choose the correct statement(s) :
   (a) A dimensionally correct equation may be correct.
   (b) A dimensionally correct equation may be incorrect.
   (c) A dimensionally incorrect equation may be correct.
   (d) A dimensionally incorrect equation may be incorrect.
3. Choose the correct statement(s) :
   (a) All quantities may be represented dimensionally in terms of the base quantities.
   (b) A base quantity cannot be represented dimensionally in terms of the rest of the base quantities.
   (c) The dimension of a base quantity in other base quantities is always zero.
   (d) The dimension of a derived quantity is never zero in any base quantity.

EXERCISES

1. Find the dimensions of
   (a) linear momentum,
   (b) frequency and
   (c) pressure.
2. Find the dimensions of
   (a) angular speed ω, (b) angular acceleration α,
   (c) torque Γ and (d) moment of interia I.
   Some of the equations involving these quantities are

$\omega = \frac{\theta_2 - \theta_1}{t_2 - t_1}$, $\alpha = \frac{\omega_2 - \omega_1}{t_2 - t_1}$, $\Gamma = Fr$ and $I = mr^2$.

The symbols have standard meanings.

3. Find the dimensions of
   (a) electric field E, (b) magnetic field B and
   (c) magnetic permeability μ_0.
   The relevant equations are
   $F = qE$, $F = qvB$, and $B = \frac{\mu_0 I}{2\pi a}$;
   where F is force, q is charge, v is speed, I is current, and a is distance.

4. Find the dimensions of
   (a) electric dipole moment p and
   (b) magnetic dipole moment M.
   The defining equations are $p = q.d$ and $M = IA$;
   where d is distance, A is area, q is charge and I is current.

5. Find the dimensions of Planck's constant h from the equation $E = h\nu$ where E is the energy and ν is the frequency.

6. Find the dimensions of
   (a) the specific heat capacity c,
   (b) the coefficient of linear expansion α and
   (c) the gas constant R.
   Some of the equations involving these quantities are $Q = mc(T_2 - T_1)$, $l_t = l_0[1 + \alpha(T_2 - T_1)]$ and $PV = nRT$.

7. Taking force, length and time to be the fundamental quantities find the dimensions of
   (a) density, (b) pressure,
   (c) momentum and (d) energy.

8. Suppose the acceleration due to gravity at a place is 10 m/s^2. Find its value in cm/(minute)^2.

9. The average speed of a snail is 0·020 miles/hour and that of a leopard is 70 miles/hour. Convert these speeds in SI units.

10. The height of mercury column in a barometer in a Calcutta laboratory was recorded to be 75 cm. Calculate this pressure in SI and CGS units using the following data : Specific gravity of mercury = 13·6, Density of water = 10^3 kg/m^3, g = 9·8 m/s^2 at Calcutta. Pressure = $h\rho g$ in usual symbols.

11. Express the power of a 100 watt bulb in CGS unit.

12. The normal duration of I.Sc. Physics practical period in Indian colleges is 100 minutes. Express this period in microcenturies. 1 microcentury = $10^{-6} \times 100$ years. How many microcenturies did you sleep yesterday?

13. The surface tension of water is 72 dyne/cm. Convert it in SI unit.

14. The kinetic energy K of a rotating body depends on its moment of inertia I and its angular speed ω. Assuming the relation to be $K = kI^a\omega^b$ where k is a dimensionless constant, find a and b. Moment of inertia of a sphere about its diameter is $\frac{2}{5}Mr^2$.

15. Theory of relativity reveals that mass can be converted into energy. The energy E so obtained is proportional to certain powers of mass m and the speed c of light. Guess a relation among the quantities using the method of dimensions.

16. Let I = current through a conductor, R = its resistance and V = potential difference across its ends. According to Ohm's law, product of two of these quantities equals the third. Obtain Ohm's law from dimensional analysis. Dimensional formulae for R and V are $ML^2I^{-2}T^{-3}$ and $ML^2T^{-3}I^{-1}$ respectively.

17. The frequency of vibration of a string depends on the length L between the nodes, the tension F in the string and its mass per unit length m. Guess the expression for its frequency from dimensional analysis.

18. Test if the following equations are dimensionally correct :
    (a) $h = \frac{2S\cos\theta}{\rho r g}$, (b) $v = \sqrt{\frac{P}{\rho}}$,
    (c) $V = \frac{\pi P r^4 t}{8\eta l}$, (d) $\nu = \frac{1}{2\pi}\sqrt{\frac{mgl}{I}}$;
    where h = height, S = surface tension, ρ = density, P = pressure, V = volume, η = coefficient of viscosity, ν = frequency and I = moment of inertia.

19. Let x and a stand for distance. Is $\int \frac{dx}{\sqrt{a^2 - x^2}} = \frac{1}{a}\sin^{-1}\frac{a}{x}$ dimensionally correct?

□

ANSWERS

OBJECTIVE I

1. (b) 2. (d) 3. (d) 4. (c) 5. (a) 6. (a)

OBJECTIVE II

1. (c), (d) 2. (a), (b), (d) 3. (a), (b), (c)

EXERCISES

1. (a) MLT^{-1} (b) T^{-1} (c) $ML^{-1}T^{-2}$
2. (a) T^{-1} (b) T^{-2} (c) ML^2T^{-2} (d) ML^2
3. (a) $MLT^{-3}I^{-1}$ (b) $MT^{-2}I^{-1}$ (c) $MLT^{-2}I^{-2}$
4. (a) LTI (b) L^2I
5. ML^2T^{-1}
6. (a) $L^2T^{-2}K^{-1}$ (b) K^{-1} (c) $ML^2T^{-2}K^{-1}(mol)^{-1}$

7. (a) $FL^{-4}T^{2}$ (b) FL^{-3} (c) FT (d) FL
8. 36×10^{4} cm/(minute)^{2}
9. 0·0089 m/s, 31 m/s
10. 10×10^{4} N/m^{2}, 10×10^{5} dyne/cm^{2}
11. 10^{7} erg/s
12. 1·9 microcenturies
13. 0·072 N/m
14. $a = 1$, $b = 2$
15. $E = kmc^{2}$
16. $V = IR$
17. $\frac{k}{L}\sqrt{\frac{F}{m}}$
18. all are dimensionally correct
19. no

□

Application of dimension Analysis

(1) Correctness of formula

(2) We can find D.F. of unknown phy. quantity.

Q $F = \frac{G m_1 m_2}{r^2}$

D.F. of $G = ?$

$G = \frac{F r^2}{m_1 m_2} \Rightarrow \frac{MLT^{-2} \cdot L^2}{MM} = [M^{-1} L^3 T^{-2}]$

Q $F = 6\pi r \eta v$

$\eta \longrightarrow$ coff. of viscosity

D.F of η

$\eta = \frac{F}{6\pi r v}$

$\eta \Rightarrow \frac{MLT^{-2}}{L\,LT^{-1}} = [ML^{-1}T^{-1}]$

Q Find DF of specific heat const.

$$\Delta Q = m s \Delta T$$

heat energy given

Change in temp

$$S = \frac{\Delta Q}{m \Delta T} \equiv \frac{\cancel{M}L^2T^{-2}}{\cancel{M}\ K}$$

DF $\Rightarrow$ K $= [M^0 L^2 T^{-2} K^{-1}]$

D

$$\Delta Q = m S \Delta T$$

$$S = \frac{\Delta Q}{m \Delta T}$$

Q $Q = mL$

heat given / Energy

mass

Latent heat of fusion

D.f of L $\Rightarrow$

(A) mL^2T^{-2}

(B) $m^0L^2T^{-2}$

(C) m^0LT^{-2}

(D) other

$Q = mL$

$L = \frac{Q}{m} \Rightarrow \frac{mL^2T^{-2}}{M}$

$[m^0L^2T^{-2}]$

PW

Q Bolzman Const (K)

find the DF of bolzman Const.

$U = \frac{3}{2} K T$

internal Energy (kinetic Energy)

temp.

$K = \frac{2U}{3T}$

$K \Rightarrow \cancel{\frac{ML^2T^{-2}}{T} = ML^2T^{-3}}$

$K \Rightarrow \frac{ML^2T^{-2}}{K} \equiv [ML^2T^{-2}K^{-1}]$

(4) $v = \frac{A}{B+t}$ find D.F of 'B'

B में t जुड़ रहा है $B \Rightarrow$ time $\Rightarrow B = M^0 L^0 T^1$

(5) $v = A \sin[B(C+t)]$ find D.F. of 'C'

$t \rightarrow$ time

$C \equiv [M^0 L^0 T^1]$

(6) $x = At$

time

Displacement

D.F of $A = ?$

$At \longrightarrow$ Displacement

$AT = L$

$A = \frac{L}{T} = LT^{-1}$

$t \longrightarrow$ time

(7) $x = At + Bt^2 + Ct^3$

Displacement

$Ct^3 \longrightarrow$ Displacement

$CT^3 = L$

$\boxed{C = LT^{-3}}$

$At \longrightarrow$ Displacement

$AT = L$

$A \Rightarrow \frac{L}{T} = LT^{-1}$

$Bt^2 \longrightarrow$ Displacement

$BT^2 = L$

$\boxed{B \Rightarrow LT^{-2}}$

(8) $v = At + Bx$

$v \rightarrow$ velocity

$t \rightarrow$ time

$x \rightarrow$ Displacement

find D.F. of A & B

(b) find D.F of $\frac{A}{B}$

$$\frac{LT^{-2}}{T^{-1}} \equiv LT^{-1}$$

$At \longrightarrow$ velocity

$$AT = LT^{-1}$$

$$A = \frac{LT^{-1}}{T} = LT^{-2}$$

$Bx \longrightarrow$ velocity

$$B\cancel{L} = \cancel{L}T^{-1}$$

$$\boxed{B \Rightarrow T^{-1}}$$

(9) $v = At^2 + Bx^2 + Ct^3$

find D.F. of A, B, C

$v \rightarrow$ velocity
$t \rightarrow$ time
$x \rightarrow$ displacement

$AT^2 = LT^{-1}$

$\boxed{A \Rightarrow LT^{-3}}$

$BL^2 = LT^{-1}$

$\boxed{B \Rightarrow L^{-1}T^{-1}}$

$CT^3 = LT^{-1}$

$\boxed{C = LT^{-4}}$

$x \longrightarrow$ Displacement
$t \longrightarrow$ time
$v \longrightarrow$ velocity, speed
$F \longrightarrow$ force

(10) $x = At + \frac{B}{t} + Cx$

find D.F. of A, B, C

इसको Notes में देख
हाथों हाथ solve करे

$At \longrightarrow$ Displacement

$A.T = L \Rightarrow \boxed{A = LT^{-1}}$

$\frac{B}{t} \longrightarrow$ Displacement

$\frac{B}{T} = L \quad \boxed{B = LT}$

$Cx \longrightarrow$ displacement

$CL = L$

$C = 1 \rightarrow$ dimensionless

$C \equiv [M^0 L^0 T^0]$

(11) $v = At + \frac{B}{t} + Cx$

$AT = LT^{-1}$

$\boxed{A = LT^{-2}}$

$\frac{B}{T} = LT^{-1}$

$\boxed{B = LT^{-1}\cdot T = L}$

$CL = LT^{-1}$

$\boxed{C = T^{-1}}$

(12) $v = Ax^2 + Bx + \frac{C}{t^2}$

$AL^2 = LT^{-1}$

$\boxed{A = L^{-1}T^{-1}}$

$BL = LT^{-1}$

$\boxed{B = T^{-1}}$

$\frac{C}{T^2} = LT^{-1}$

$\boxed{C = LT}$

(13) $F = At + Bx$

$AT = MLT^{-2}$

$\boxed{A \Rightarrow MLT^{-3}}$

$B.L = MLT^{-2}$

$\boxed{B \equiv ML^{0}T^{-2}}$

(14) $F = \frac{A}{t} + Bx^2$

$MLT^{-2} = \frac{A}{T}$

$\boxed{A = MLT^{-1}}$

$BL^2 = MLT^{-2}$

$\boxed{B = ML^{-1}T^{-2}}$

(15) $F = Av + \frac{B}{x^2}$

$F = Av$

$A \equiv \frac{F}{v} \equiv \frac{MLT^{-2}}{LT^{-1}}$

$\equiv ML^{0}T^{-1}$

$MLT^{-2} = \frac{B}{L^2}$

$\boxed{B = ML^{3}T^{-2}}$

(16) $v = \dfrac{A}{B+t}$ find D.F of A & B

$B + t \Rightarrow \boxed{B \Rightarrow T}$

$v \Rightarrow \dfrac{A}{\text{time} + \text{time}} = \dfrac{A}{\text{time}}$

$$\boxed{\begin{array}{l} B \longrightarrow T \\ A \longrightarrow L \end{array}}$$

$v \Rightarrow \dfrac{A}{\text{time}}$

$LT^{-1} = \dfrac{A}{T}$

$\boxed{A = LT^{-1} \cdot T = L}$

(17) $v = \frac{At}{B^2 - x^2}$ $\rightarrow$ $v = \frac{At}{L^2}$

B^2 से x^2 घट रहा है

DF of B^2 = DF of x^2

$B^2 = L^2$

$\boxed{B = L}$

$LT^{-1} = \frac{AT}{L^2}$

$A = \frac{LT^{-1}L^2}{T} = L^3T^{-2}$

$\boxed{A = L^3T^{-2}}$

style find DF of A·B

$= L^3T^{-2} \cdot L$

$= L^4T^{-2}$

Exam

(18) $E = \dfrac{B^2 - x^2}{At}$

$E \to$ Energy

find D.F of A & B

$B^2 = L^2$

$\boxed{B = L}$

$ML^2T^{-2} = \dfrac{L^2}{A \cdot T}$

$A = \dfrac{L^2}{T(ML^2T^{-2})}$

$\boxed{A = M^{-1}L^{0}T^{+1}}$

H/W

(19) $P = \dfrac{A - t^2}{B + x^2} \cdot C$

$P \to$ (momentum)

(20) $P = \dfrac{A + t^2}{B - x^2} \cdot C$

$P \to$ pressure

tough

(21) $F = \dfrac{A - x^2}{B} + Ct + Dx$

find D.F of $\dfrac{A \cdot B}{C \cdot D}$

H/W

HCV ~~H.W~~

physics Introduction to

obj II page → 9, (1,2)

Exercise

1, 2, 5, 8,

HCV pdf download google

Calculation OP है

Q.

Match List-I with List-II :

List-I	List-II
(a) h (Planck's constant) ✓	(i) $[M\ L\ T^{-1}]$
(b) E (kinetic energy) ✓	(ii) $[M\ L^2\ T^{-1}]$
(c) V (electric potential) ✓	(iii) $[M\ L^2\ T^{-2}]$
(d) P (linear momentum) ✓ MLT^{-1}	(iv) $[M\ L^2\ I^{-1}\ T^{-3}]$

Notes में नही लिखना है

Choose the correct answer from the options given below: **(JEE Main-2021)**

A (a)→(iii), (b)→(iv), (c)→(ii), (d)→(i) ✗

B (a)→(ii), (b)→(iii), (c)→(iv), (d)→(i) ✓

C (a)→(i), (b)→(ii), (c)→(iv), (d)→(iii) ✗

D (a)→(iii), (b)→(ii), (c)→(iv), (d)→(i) ✗

Ans : (B)

Q.

H/W Match List-I with List-II. (JEE Main-2021)

List-I		List-II	
(a)	Torque	(i)	MLT^{-1}
(b)	Impulse	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

Choose the most appropriate answer from the option given below :

A (a)–(iii), (b)–(i), (c)–(iv), (d)–(ii)

B (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

C (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii)

D (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

Ans : (A)

Q find dimentional formula of plank const.

$E = h\nu$ — ν: frequency; h: plank const; E: Energy of one photon

$h = \dfrac{E}{\nu} \rightarrow \dfrac{ML^2T^{-2}}{T^{-1}}$

$= [ML^2T^{-1}]$

$\boxed{\text{frequency} = \dfrac{1}{T} \Rightarrow T^{-1}}$

ML^2T^{-2+1} solve

$$\text{Angular velocity} = \frac{\Delta\theta}{\text{time}} = \frac{1}{T} = T^{-1}$$

$$= [M^0 L^0 T^{-1}]$$

स्वरकुला

$$\text{Velocity} \rightarrow [M^0 L T^{-1}]$$

$$\text{Angular velocity} \rightarrow [M^0 L^0 T^{-1}]$$

Circular motion में पढ़ेंगे

Q. Resistance = ?

$V = iR$ (current, pot-difference)

$R = \frac{V}{i} \Rightarrow \frac{ML^2T^{-3}A^{-1}}{A}$

$= [ML^2T^{-3}A^{-2}]$

रटना नहीं है

Q. Check the correctness of following formula

(a) $F = \frac{mv^2}{r^2} \Rightarrow$?

$F \rightarrow$ force
$m \rightarrow$ mass
$v \rightarrow$ speed
$r \rightarrow$ radius

Dimension of LHS $\Rightarrow [MLT^{-2}]$

Dimension of RHS $\Rightarrow \frac{M(LT^{-1})^2}{L^2}$

$= \frac{M\cancel{L^2}T^{-2}}{\cancel{L^2}} = [ML^0T^{-2}]$

Dimension of LHS $\neq$ dimension of RHS

Relation गलत है, formula is incorrect

Correct

Q A planet is orbiting around earth with orbital velocity V

$$V = \sqrt{\frac{GM}{r}} \equiv \text{Check ?}$$

M ⟶ mass of earth

r ⟶ radius of orbit

G ⟶ gravitational const

$G \Rightarrow [M^{-1} L^{3} T^{-2}]$

RHS.

$$\sqrt{\frac{M^{-1} L^{3} T^{-2}\, M}{L}} = \sqrt{L^{2} T^{-2}} = LT^{-1}$$

Dimentional formula

$LT^{-1} \equiv$ LHS

LHS = RHS

Q Timeperiod of simple pendulum is given by

$$T = 2\pi\sqrt{\frac{l}{g}} \quad ?$$

$T \longrightarrow$ time period

$l \longrightarrow$ length of pendulum

$g \longrightarrow$ Acc. due to gravity

RHS. $2\pi\sqrt{\frac{l}{g}}$

$$\sqrt{\frac{L}{LT^{-2}}} = \sqrt{T^2} = T$$

LHS = RHS

Dimensionally correct

Q Time period of spring block system is given by

$$T = 2\pi\sqrt{\frac{m}{K}}$$

time period

$m \longrightarrow$ mass of block

$K \longrightarrow$ spring const

$$\left(K = \frac{\text{Force}}{\text{length}}\right) \equiv \frac{MLT^{-2}}{L} = MT^{-2}$$

RHS $\sqrt{\frac{M}{MT^{-2}}} = \sqrt{T^2}$

$= T \Rightarrow$

LHS = RHS

Correct

Kinetic Energy $= \frac{1}{3}mv^2$ (किसी ने कहा let)

Correct = ?
Incorrect = ?

RHS → $m(LT^{-1})^2 = [ML^2T^{-2}]$

$\|\|\|$ Dimensionally correct

But numerically wrong

Overall formula is wrong

दूसरे ने बोला

$K.E. = \frac{1}{2}mv^2$ है

Check = ?

RHS → $M(LT^{-1})^2$

$[ML^2T^{-2}]$

$\|\|\|$ Dimensionally Correct ✓

Numerically correct ✓

Overall correct ✓

$G = ?$

$$F = \frac{G m_1 m_2}{r^2}$$

$$G = \frac{F r^2}{m_1 m_2} \Rightarrow \frac{MLT^{-2} \cdot L^2}{M M}$$

$$[M^{-1} L^3 T^{-2}]$$

$$U_1 + U_2 = U_3 \Longrightarrow$$

Same Unit
Same dimentional (D.F.) formula
Same physical Quan.

$$U_f - U_i = \Delta U = \text{Change in } U$$

Q particle initial speed $= 10\, m/s$

final speed $= 15\, m/s$

Change in speed $= \Delta v$

$$\Delta V = V_f - V_i$$

$$5\, m/s = 15\, m/s - 10\, m/s$$

Derived Physical Quantity	Unit (MKS)	Unit CGS	Dimensional formula
① Speed = $\frac{\text{Distance}}{\text{time}}$	m/sec	cm/sec	$\frac{L}{T} = LT^{-1}$ $[M^0 L T^{-1}]$
② Velocity = $\frac{\text{Displacement}}{\text{time}}$	m/sec	cm/sec	$[M^0 L T^{-1}]$
③ momentum $p = m \times v$	Kg m/sec	gm cm/sec	$[M L T^{-1}]$
④ Density = $\frac{\text{mass}}{\text{Vol}^n}$	Kg/m^3	gm/cm^3	$[M L^{-3} T^0]$

$[MLT^{-1}] \equiv MLT^{-1}K^0A^0$

mass

momentum $P = mv$

velocity $= \frac{\text{Displacement}}{\text{time}}$

D.F. of 'P' $\equiv M\frac{L}{T} = [M^{1}LT^{-1}]$

" dimension of mass $\longrightarrow$ 1

" " Length $\longrightarrow$ 1

" " time $\longrightarrow$ -1

Next Class

Dimension of Length in Area = 2

Area = Lenght × width $\Rightarrow$ $L.L = L^{2} \Longrightarrow [M^0 L^2 T^0]$ — Dimentional formula

Vol^n $\longrightarrow$ $L.L.L \Rightarrow L^3 \Longrightarrow [M^0 L^3 T^0]$

Density = $\dfrac{\text{mass}}{\text{Vol}^n}$ $\longrightarrow$ $\dfrac{M}{L^3} \Rightarrow M^1 L^{-3} \Longrightarrow [M L^{-3} T^0]$

speed = $\dfrac{\text{Distance}}{\text{time}}$ $\longrightarrow$ $\dfrac{L}{T} \Rightarrow L^1 T^{-1}$

velocity = $\dfrac{\text{Displacement}}{\text{time}}$ $\longrightarrow$ $\dfrac{L}{T} \Rightarrow L T^{-1}$

Area $\longrightarrow$ Length × width	$L \cdot L \Rightarrow [M^0 L^2 T^0]$
Volume $\longrightarrow$ $L \times B \times H$	$L \cdot L \cdot L \Rightarrow [M^0 L^3 T^0]$
Density $= \dfrac{\text{mass}}{\text{Vol}^n}$	$\dfrac{M}{L^3} \Rightarrow [M L^{-3} T^0]$
Distance $\longrightarrow$	$[M^0 L^1 T^0]$
Displacement $\longrightarrow$	$[M^0 L^1 T^0]$
Speed $= \dfrac{\text{Distance}}{\text{time}}$	$\dfrac{L}{T} \longrightarrow [M^0 L T^{-1}]$
Velocity $= \dfrac{\text{Displacent}}{\text{time}}$	$\dfrac{L}{T} \longrightarrow [M^0 L T^{-1}]$

D.F

Same

** Velocity $\longrightarrow LT^{-1} \equiv [M^0LT^{-1}]$

* acceleration (a) $= \frac{\text{Velocity}}{\text{time}} \longrightarrow \frac{LT^{-1}}{T} = LT^{-2} \Rightarrow [M^0LT^{-2}]$

Force $(F = ma) \longrightarrow [MLT^{-2}]$

momentum 'p' $= mv \longrightarrow [MLT^{-1}]$

Impulse 'J' $= F \times t \longrightarrow [MLT^{-2} \cdot T] = [MLT^{-1}]$

D.F same But ?

1" imp **

पेपर

speed, velocity $\longrightarrow LT^{-1}$

Acc $\longrightarrow LT^{-2}$

Force $\longrightarrow MLT^{-2}$

P.E., Work done $\longrightarrow ML^2T^{-2}$

K.E, heat Energy

Surface Energy

- Pressure = $\frac{\text{Force}}{\text{Area}} \Rightarrow \frac{MLT^{-2}}{L^2} \Rightarrow [ML^{-1}T^{-2}]$

- Work done

$W = F \times \text{displacement} \Rightarrow MLT^{-2}\,L \Rightarrow [ML^2T^{-2}]$

- Torque = Force × (perpendicular Distance) $\Rightarrow [MLT^{-2}\,L] = [ML^2T^{-2}]$

- moment of inertia $= \underbrace{m}_{\text{mass}}\underbrace{R^2}_{\text{Distance from axis}} \Longrightarrow [ML^2]$ ✓

$[ML^2T^0]$ ✓

रटना नहीं है

Ques $G \equiv [M^{-1}L^{3}T^{-2}]$

$\alpha = -1$

$\beta = 3$

$\gamma = -2$

If Dimentional formula of G is given by $M^{\alpha}L^{\beta}T^{\gamma}$

find value of $|\alpha| + |\beta| + |\gamma| = 1 + 3 + 2 = 6$

find "

$\alpha + \beta + \gamma = -1 + 3 - 2 = 0$

find

$$\frac{\beta\gamma}{\alpha} \Rightarrow \frac{3 \times (-2)}{-1} \Rightarrow 6$$

$$U_1 + U_2 = U_3 \implies$$

Same Unit
Same dimentional (D.F.) formula
Same physical Quan.

$$U_f - U_i = \Delta U = \text{Change in } U$$

Q particle initial speed $= 10\, m/s$

final speed $= 15\, m/s$

Change in speed $= \Delta v$

$$\Delta V = V_f - V_i$$

$$5\, m/s = 15\, m/s - 10\, m/s$$

find momentum in MKS & CGS system if a particle of mass 10 kg is moving with velocity 5 m/s (east).

Q

5 m/s

10 kg

$$\text{momentum} = P = m \times u$$

$$= 10\,\text{kg} \times 5\,\text{m/s}$$

$$= 50\ \frac{\text{kg m}}{\text{sec}} \equiv \text{mks syst}$$

Convert into CGS

$$5 \times 10^{6}\ \frac{\text{gm cm}}{\text{sec}} = \frac{50 \times 1000\,\text{gm} \times 100\,\text{cm}}{\text{sec}}$$

momentum (CGS) system

ρ

Q Density $= 6\ kg/m^3 = 6\ \frac{kg}{m^3}$

Convert into CGS system

$$\text{Density} = 6 \times \frac{1000\ gm}{(100\ cm)^3} = \frac{6 \times 1000\ gm}{10^6\ cm^3} = 6 \times 10^{-3}\ gm/cm^3$$

Q Convert into MKS system

$$\text{Density} = .6\ gm/cc = \frac{.6\ gm}{(cm)^3}$$

$$= \frac{.6 \times \left(\frac{1\ kg}{1000}\right)}{\left(\frac{1m}{100}\right)^3}$$

$$= \frac{.6 \times 10^6}{1000} = 600\ kg/m^3$$

$1\ kg = 1000\ gm$

$1\ gm = \frac{1\ kg}{1000}$

Derived Physical Quantity	Unit (MKS)	Unit CGS	Dimensional formula
(1) Speed $= \frac{\text{Distance}}{\text{time}}$	m/sec	cm/sec	$\frac{L}{T} = LT^{-1}$ $[M^0LT^{-1}]$
(2) Velocity $= \frac{\text{Displacement}}{\text{time}}$	m/sec	cm/sec	$[M^0LT^{-1}]$
(3) momentum $p = m \times v$	Kg m/sec	gm cm/sec	$[MLT^{-1}]$
(4) Density $= \frac{\text{mass}}{\text{Vol}^n}$	Kg/m^3	gm/cm^3	$[ML^{-3}T^0]$

Density $= \dfrac{\text{mass}}{\text{Vol}^n} \Rightarrow \dfrac{M}{L \cdot L \cdot L} = \dfrac{M}{L^3} \Rightarrow \left[M L^{-3} T^0\right]$ Dimensional formula of Density

→ में mass की Dimension क्या है ⇒ power ⇒ 1

→ " Length " " ⇒ −3

→ time " " ⇒ 0

→ temp " " ⇒ 0

Dimension of Length in Area = 2

Area = Lenght × width $\Rightarrow$ L.L $= L^2 \Longrightarrow [M^0 L^2 T^0]$

Vol^n $\longrightarrow$ L.L.L $\Rightarrow L^3 \Longrightarrow [M^0 L^3 T^0]$

Dimentional formula

Density $= \frac{\text{mass}}{\text{Vol}^n} \longrightarrow \frac{M}{L^3} \Rightarrow M^1 L^{-3} \Longrightarrow [M L^{-3} T^0]$

speed $= \frac{\text{Distance}}{\text{time}} \longrightarrow \frac{L}{T} \Rightarrow L^1 T^{-1}$

velocity $= \frac{\text{Displacement}}{\text{time}} \longrightarrow \frac{L}{T} \Rightarrow L T^{-1}$

Q.

H/W

If E, L, M and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of P in the formula $P = EL^2M^{-5}G^{-2}$ are :- (JEE Main-2021)

mvr

$$\frac{EL^2}{m^5 G^2} = \frac{mL^2T^{-2}\cdot(mL^2T^{-1})^2}{m^5(m^{-1}L^3T^{-2})^2}$$

$$\frac{m^3L^6T^{-4}}{m^3L^6T^{-4}} = 1$$

A. $[M^0 L^1 T^0]$

B. $[M^{-1} L^{-1} T^2]$

C. $[M^1 L^1 T^{-2}]$

D. $[M^0 L^0 T^0]$

Ans : (D)

Q.

H/W If force (F), length (L) and time (T) are taken as the fundamental quantities. Then what will be the dimension of density: $\boxed{ML^{-3}}$ (JEE Main-2021)

A $\boxed{[FL^{-4}T^{2}]}$ = इज्जत के साथ

B $[FL^{-3}T^{2}]$

C $[FL^{-5}T^{2}]$

D $[FL^{-3}T^{3}]$

$$\frac{FT^2}{L^4} = \frac{MLT^{-2}T^2}{L^4} = \frac{M}{L^3}$$

Ans : (A)

Q.

H/W If momentum [P], area [A] and time [T] are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is : (JEE Main-2022)

$F = 6\pi r \eta v$

A $\boxed{[P\,A^{-1}\,T^{0}]}$

डायरेक्ट

B $[P\,A\,T^{-1}]$

C $[P\,A^{-1}\,T]$

D $[P\,A^{-1}\,T^{-1}]$

$$\frac{P}{A} = \frac{MLT^{-1}}{L^2} = ML^{-1}T^{-1}$$

$$\eta = \frac{F}{6\pi r v} = \frac{MLT^{-2}}{L\,LT^{-1}}$$

$$\boxed{\eta = ML^{-1}T^{-1}}$$

Class

Ans : (A)

Question star level ques शानदार Next Class में

इतना मतलब

The gas equation for n moles of a real gas is: $\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$ where P is the pressure, V is the volume, T is the absolute temperature, R is the molar gas constant and a, b are arbitrary constants. Which of the following have the same dimensions as those of PV?

dimentionally $P = \frac{n^2a}{V^2}$ $\qquad$ $V = nb$ (dimentionally)

$PV = \frac{n^2a}{V}$ $\qquad$ $b = \frac{V}{n}$

A nRT

B n^2a/V

C $Pb \longrightarrow P\frac{V}{n} = \frac{PV}{n} = \frac{PV}{mol}$

D ab/V^2 = तू try करना

Question

ML^2T^{-2}

In a new unit system, 1 unit of time is equal to 10 second, 1 unit of mass is 5 kg and 1 unit of length is 20 m. In this new system of units, 1 unit of energy is equal to

$$= \frac{5\,kg \times (20\,m)^2}{(10\,sec)^2}$$

$$= 20\,J$$

A 20 Joule

B 1/20 Joule

C 4 Joule

D 16 Joule

(A)

Question

Which of the following statements is correct about conversion of units, for example $\boxed{1\ m = 100\ cm}$

A. Conversion of units have identical dimensions on each side of the equal sign but not the same units.

B. Conversion of units have different dimensions on each side of the equal sign but have same unit

C. If a larger unit is used then numerical value of physical quantity is large.

D. Due to conversion of units physical quantity to be measured will change.

(A)

Question

Class

(c) $-\frac{5}{6}+\frac{1}{2}+\frac{1}{3}=\frac{-5+3+2}{6}=0$

A gas bubble oscillates with a time period T proportional to $P^a d^b E^c$ where P is pressure, d is the density and E is the energy. The values of a, b & c are

$\frac{F}{A}$

A $a=\frac{3}{2}, b=-\frac{1}{3}, c=\frac{1}{2}$

B $a=-\frac{5}{6}, b=\frac{1}{3}, c=\frac{1}{2}$

C $a=-\frac{5}{6}, b=\frac{1}{2}, c=\frac{1}{3}$

D $a=\frac{3}{2}, b=-\frac{1}{3}, c=\frac{1}{2}$

$$T = K P^a d^b E^c$$
$$= (ML^{-1}T^{-2})^a (ML^{-3})^b (ML^2T^{-2})^c$$

$$M^0 L^0 T^1 = M^{a+b+c} L^{-a-3b+2c} T^{-2a-2c}$$

$a+b+c=0$ ✓
$-a-3b+2c=0$
$\boxed{-2a-2c=1}$

$-2a-2c=$

$2\times\frac{5}{6}-\frac{2}{3}=\frac{5}{3}-\frac{2}{3}=1$

(c)

Question

Class

(c) $-\frac{5}{6}+\frac{1}{2}+\frac{1}{3}=\frac{-5+3+2}{6}=0$

A gas bubble oscillates with a time period T proportional to $P^a d^b E^c$ where P is pressure, d is the density and E is the energy. The values of a, b & c are

& momentum

$\frac{F}{A}$

(A) $a=\frac{3}{2}, b=-\frac{1}{3}, c=\frac{1}{2}$

(B) $a=-\frac{5}{6}, b=\frac{1}{3}, c=\frac{1}{2}$

(C) $a=-\frac{5}{6}, b=\frac{1}{2}, c=\frac{1}{3}$

(D) $a=\frac{3}{2}, b=-\frac{1}{3}, c=\frac{1}{2}$

$T = K P^a d^b E^c p'^d$

$M^0L^0T^1 = (ML^{-1}T^{-2})^a (ML^{-3})^b (ML^2T^{-2})^c (MLT^{-1})^d$

variable

Unknown a, b, c, d = चार variable ?c

तीन equa

Question

The energy E of an oscillating body in simple harmonic motion depends on its mass m, frequency n and amplitude A as $E = k(m)^x(n)^y(A)^z$. Find the value of $(2x + y + z)$.

T^{-1}

L

Class

6

Question

$1m = 100cm$

$1cm = \frac{1m}{100}$

The value of $\boxed{\text{Stefan's constant}}$ in CGS system is $\sigma = 5.67 \times 10^{-5}$ erg s^{-1} cm^{-2} K^{-4}. Its value in SI units is

Ans- 5.67×10^{-8} J $\cdot s^{-1} m^{-2} K^{-4}$

$$\sigma = \frac{5.67 \times 10^{-5} \times \frac{1J}{10^7}}{s.\left(\frac{1}{100}m\right)^2 K^4}$$

$1J = 10^7$ erg

$1 \text{ erg} = \frac{1J}{10^7}$

$$= 5.67 \times 10^{-5+4-7} \left(\frac{J}{sec.m^2.K^4}\right)$$

$$= 5.67 \times 10^{-8}$$

Question

$xy = \overline{\text{कद्दू}}$ $\quad x^2 = \overline{\text{कद्दू}}$

$x \cdot x = \overline{\text{कद्दू}}$ $\quad x = \sqrt{\text{कद्दू}} \equiv y = z$

Consider three physical quantities x, y and z. Operations $x + y$ and $y - z$ are valid with these physical quantities. Which of the following conclusions can you make?

$\boxed{x, y, z} \equiv$ same D.F होगा

कद्दू

A The operation $x \pm z$ is also valid

B If dimension of any of the three is known, dimension of other two can be predicted.

C If dimension of product of any two of them is known, dimension of all of them can be predicted.

$x \cdot y = L^2$ (let) $\quad x = L$

$x \cdot x = x^2 = L^2$

D If dimension of quotient of any two of them is known, dimension of all of them can be predicted.

1, dimension

A, B, C

Question

Viscous force acting on a spherical ball is given by $F = 6\pi\eta rv$, where r is radius of the ball, v is the velocity of the ball & η is coefficient of viscosity. Dimension formula of η is given by $[\eta] = M^aL^{-b}T^{-c}$. Find the value of $a + b + c$

Class

$$\eta = \frac{F}{6\pi r v}$$

3

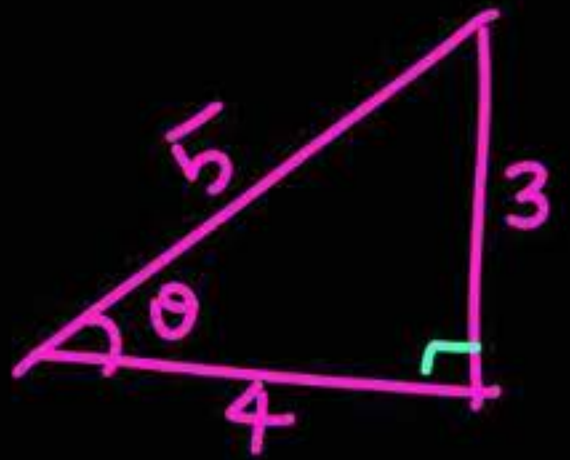
Q $\cos\theta = \frac{4}{5}$

find $\sin\theta = \frac{3}{5}$

$\tan\theta = \frac{3}{4}$

$\cot\theta = \frac{4}{3}$

$\sec\theta = \frac{5}{4}$



KPP discussion
Class के Last 20min
में करूंगा

Q. In a hypothetical system

1 unit of mass = 10 kg
1 unit of length = 4 m
1 unit of sec = 2 sec

(1) Find value of 1 unit of force $\rightarrow MLT^{-2}$

$$1 \text{ Unit of force} = 10\,\text{kg} \cdot 4\,\text{m} \cdot (2\,\text{sec})^{-2} = \frac{10 \times 4}{4} \frac{\text{kg m}}{\text{sec}^2}$$

$$= 10\,\text{N}$$

(2) Find value of 5 Unit of force in newton $= 5 \times 10\,\text{N} = 50\,\text{N}$

(3) what is numerical value of 1 Newton in this new system.

In a hypothetical system (Alien system)

1 Unit of mass = 10 kg

" " length = 4 m

" " time = 2 sec

① ✓

② ✗

(1) 1 Unit of force = 10 N

(2) Numerical value of 1 N in this system.

$$10\,N = 1 \text{ Unit of force in new system}$$

$$10\,N = 1\,N' = 1 \text{ कद्दू}$$

$$\boxed{1\,N = \frac{1}{10}\,N'}$$

Q In a alien system

1 Unit of mass $= 5\,kg$
1 Unit of length $= \frac{1}{2}\,m$
1 Unit of time $= 10\,sec.$

---

① 1 Unit of force in new system in terms of newton. $= \dfrac{5\times\frac{1}{2}}{100}\,\dfrac{kg\,m}{sec^2}$
(1N')

$= \frac{1}{40}\,N$

② Numerical value of 1N in this system.

$1N' = \frac{1}{40}N$

$$\boxed{1N = 40\,N'}$$

tough ⓒ value of 20N in newsystem

$1N = 40N'$

$20N = 20\times40N' = 800N'$

Q In a alien system

1 Unit of mass = 5 kg

1 Unit of length = $\frac{1}{2}$ m

1 Unit of time = 10 sec.

ML^2T^{-2}

(4) 1 Unit of Energy in new system in terms of Joule $= \dfrac{5\,kg\cdot\left(\frac{1}{2}m\right)^2}{(10\,sec)^2}$

$1J' = \frac{5}{400}\frac{kg\,m^2}{sec^2} = \frac{1}{80}J$

(5) Numerical value of 1J in this system.

$1J' = \frac{1}{80}J$ $\boxed{1J = 80J'}$

(6) Value of 20 J in this system.

$= 1600J'$

Q Convert 1N in dyne

Value of 1N in dyne

S.I., हमारा	उनका (CGS)
$m_1 = 1kg$	$m_2 = 1gm = \frac{1}{1000} kg$
$L_1 = 1m$	$L_2 = 1m = \frac{1}{100} m$
$T_1 = 1sec$	$T_2 = 1sec$
1N	
$n_1 = 1$	$n_2 = x$

MLT^{-2}

$$n_1 u_1 = n_2 u_2$$

$$1 \times \frac{\cancel{kg}\,\cancel{m}}{\cancel{sec^2}} = x \frac{\frac{\cancel{kg}}{1000} \cdot \frac{1}{100} \cancel{m}}{\cancel{sec^2}}$$

$$1 = \frac{x}{100000}$$

$$x = 10^5$$

ये सभी के लिए है

ये method हम जल्दी से Apply नहीं करेंगे

Q ***** In a hypothetical system

1 unit of mass = 20 kg
" length = 2 m
" time = 2 sec.

Find the numerical value of 40N in this system

हमारा

$$1N' = \frac{20kg \cdot 2m}{(2sec)^2} = 10\ \frac{kg\ m}{sec^2}$$

$1N' = 10N$

$4N' = 40N$

$10N = 1N'$

$1N = \frac{1}{10}N'$

$40N = \frac{40}{10}N' = 4N'$

Ans 4

Book $40N = x\ N'$

हमारा	उनका
$m_1 = 1kg$	$m_2 = 20kg$
$L_1 = 1m$	$L_2 = 2m$
$T_1 = 1sec$	$T_2 = 2sec$
$n_1 = 40$	$N_2 = ?$

$$n_1 U_1 = n_2 U_2$$

$$40 \times \frac{kg\,m}{sec^2} = n_2 \cdot \frac{20kg \cdot 2m}{(2sec)^2}$$

$$n_2 = \frac{40 \times 4}{40}$$

$$\boxed{n_2 = 4}$$

Q In a hypothetical system

ML^2T^{-2}

1 Unit of mass = 10 kg

" " Lenght = 2 m

" " time = 2 sec

(1) 1 Unit of energy in this system

$$1J' = \frac{10\,kg\,(2m)^2}{(2\,sec)^2} = 10\,\frac{kg\,m^2}{sec^2}$$

$$\boxed{1J' = 10J}$$

Numerical value

(2) Value of 20J in this system

$$10J = 1J'$$

$$20J = 2J'$$

Ans 2.

$$20 = n_2 \times \frac{10 \times \cancel{2^2}}{\cancel{2^2}}$$

$$n_2 = 2$$

Q. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is: (JEE Main-2020)

सूत्र

(A) $[PA^{-1}T^{-2}]$

(B) $[PA^{1/2}T^{-1}]$

(C) $[P^2AT^{-2}]$

(D) $[P^{1/2}AT^{-1}]$

(M1) $\boxed{E = P^x A^y T^z}$ ***

$= (MLT^{-1})^x (L^2)^y T^z$

$ML^2T^{-2} = M^x L^{x+2y} T^{-x+z}$

Compare

$x = 1$, $x + 2y = 2$, $-x + z = -2$

$1 + 2y = 2$, $-1 + z = -2$

$\boxed{y = \frac{1}{2}}$ $\boxed{z = -1}$

$\boxed{E = P^1 A^{\frac{1}{2}} T^{-1}}$

Ans : (B)

Q. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is: (JEE Main-2020)

मूल

ML^2T^{-2}

M-2 = option check करो

A $[PA^{-1}T^{-2}]$

B $[PA^{1/2}T^{-1}]$

C $[P^2AT^{-2}]$

D $[P^{1/2}AT^{-1}]$

(A) $\frac{P}{AT^2} = \frac{MLT^{-1}}{L^2T^2} = ML^{-1}T^{-3}$ ✗

(B) $\frac{P \cdot A^{\frac{1}{2}}}{T} \equiv \frac{MLT^{-1} \cdot \sqrt{L^2}}{T} = ML^2T^{-2}$

match

Ans : (B)

Q.

$mvr \Rightarrow ML^2T^{-1}$

H/W If time (t), velocity (v), and angular momentum (ℓ) are taken as the fundamental units. Then the dimension of mass (m) in terms of t, v and l is :

(JEE Main-2021)

A $[t^{-1} v^1 \ell^{-2}]$

B $[t^1 v^2 \ell^{-1}]$

C $[t^{-2} v^{-1} \ell^1]$

D $[t^{-1} v^{-2} \ell^1]$

$$m = t^x v^y \ell^z$$

$$= T^x (LT^{-1})^y (ML^2T^{-1})^z$$

$$M^1L^0T^0 = M^z L^{y+2z} T^{x-y-z}$$

$$\boxed{z = 1}$$

$$y + 2z = 0$$

$$\boxed{y = -2}$$

$$x - y - z = 0$$

$$x + 2 - 1 = 0$$

$$\boxed{x = -1}$$

Ans : (D)

Q.

H/W If E, L, M and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of P in the formula $P = EL^2M^{-5}G^{-2}$ are :- **(JEE Main-2021)**

A $[M^0 L^1 T^0]$

B $[M^{-1} L^{-1} T^2]$

C $[M^1 L^1 T^{-2}]$

D $[M^0 L^0 T^0]$

Ans : (D)

Q.

If force (F), length (L) and time (T) are taken as the fundamental quantities.

H/W Then what will be the dimension of density: **(JEE Main-2021)**

A $[FL^{-4}T^{2}]$

B $[FL^{-3}T^{2}]$

C $[FL^{-5}T^{2}]$

D $[FL^{-3}T^{3}]$

Ans : (A)

Q.

H/W If momentum $[P]$, area $[A]$ and time $[T]$ are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is : **(JEE Main-2022)**

$F = 6\pi \lambda \eta v$

A $[P\,A^{-1}\,T^{0}]$

B $[PA\,T^{-1}]$

C $[P\,A^{-1}\,T]$

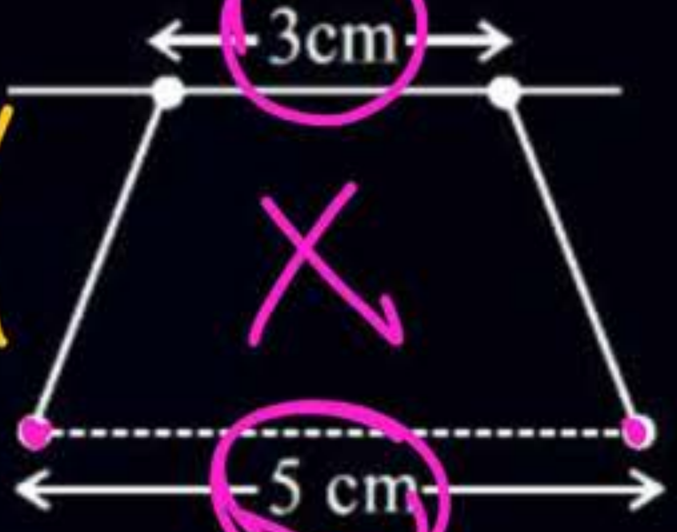
D $[P\,A^{-1}\,T^{-1}]$

Ans : (A)

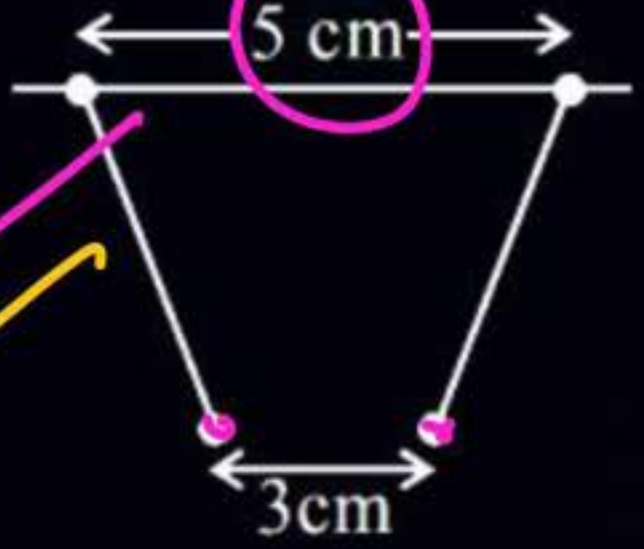
Question

Two oppositely charge particles attract to each other. Two charge particles having equal and opposite charge are suspended from a horizontal rod through two string of same length the separation between the suspension points being 5 cm. In equilibrium, the separation between the particles is 3 cm. Choose the correct diagram.

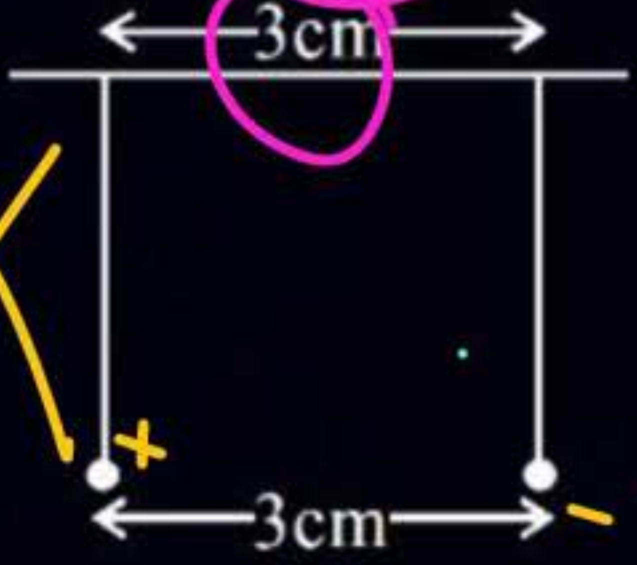
A



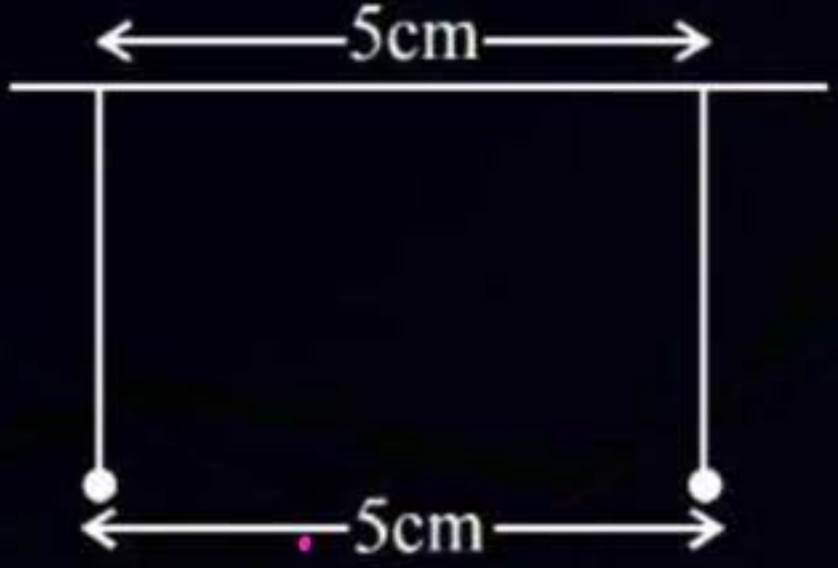
B



C



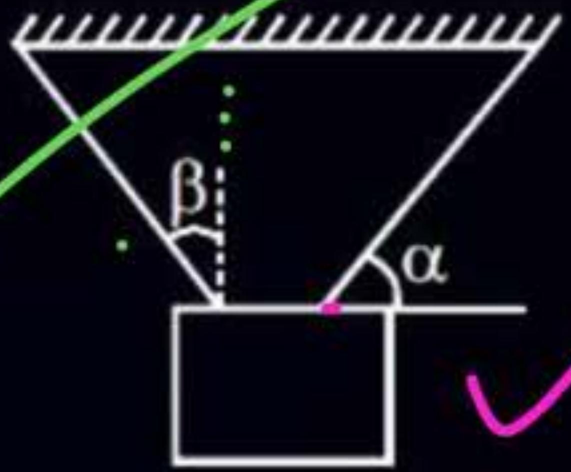
D



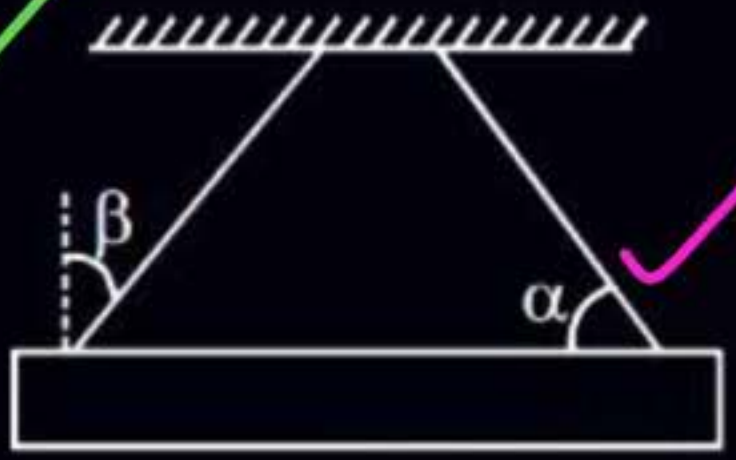
Question

A body of mass m is suspended by two strings (right string equals an angle α with horizontal & left an angle β with vertical). Choose the correct diagrams showing the situation.

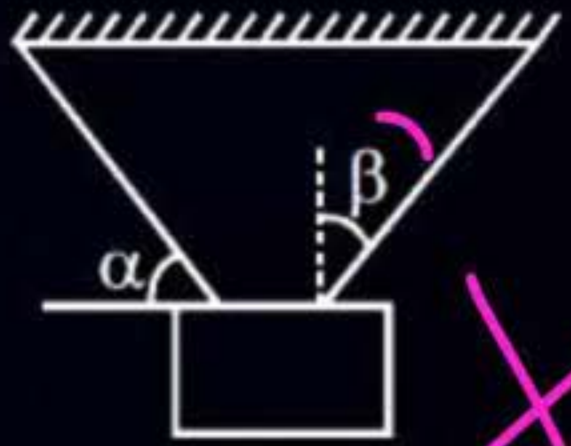
A



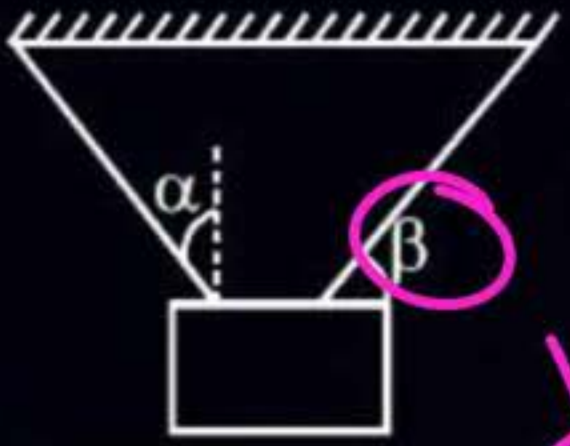
B



C



D



Question

Two objects are said to approach each other if separation between them is decreasing and recede if separation between them is increasing with time. The following diagrams show location and direction of velocity of the two objects. Choose the situation in which they are approaching

A 

B 

C 

D 

Question

MLT^{-2} ... ML^2T^{-2}

E, m, L, G denote energy, mass, angular momentum & gravitation constant respectively.

The dimensions of $\frac{EL^2}{m^5G^2}$ will be that of :

Class

(A) angle

(B) length

(C) mass

(D) time

$$\frac{ML^2T^{-2}\cdot(ML^2T^{-1})^2}{M^5(M^{-1}L^3T^{-2})^2} = 1$$

Dimensionless

Question

Which of the following combinations of three dimensionally different physical quantities P, Q, R can never be a meaningful quantity?

A $PQ - R$

B PQ/R

~~C~~ $(P - Q)/R$

D $(PR - Q^2)/QR$

Ans C

Question

शानदार Next class में

The gas equation for n moles of a real gas is: $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$ where P is the pressure, V is the volume, T is the absolute temperature, R is the molar gas constant and a, b are arbitrary constants. Which of the following have the same dimensions as those of PV?

A nRT

B $n^2 a/V$

C Pb

D ab/V^2

Question

The answer to Q.5.226 of I.E. Irodov is $\Delta\lambda = -\lambda\sqrt{\dfrac{2\Psi}{mv^2}}\cos\theta$. Here symbols have their usual notations. Ψ can represent

A kinetic energy

B power

C force

D pressure

wavelen

$\sqrt{\dfrac{\Psi}{\frac{1}{2}mv^2}}$

change in wavelength

dimensionless

$L = L$

dimensionless

$\Psi \equiv mv^2$

Question

Class Notes

$a = T^2$

The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$ where P is pressure, x is distance and t is time, are

Solⁿ

$$a = T^2$$

$$M L^{-1} T^{-2} = \frac{T^2}{b \cdot L}$$

$$b = M^{-1} L^0 T^4$$

$$\frac{a}{b} = \frac{T^2}{M^{-1} L^0 T^4} = M^1 L^0 T^{-2}$$

A. $[M^2 L T^{-3}]$

B. $[MT^{-2}]$

C. $[LT^{-3}]$

D. $[ML^3 T^{-1}]$

Question

Clan

Which of the following physical quantities represents the dimensional formula $[M^1 L^{-2} T^{-2}]$

$\frac{ML^2T^{-2}}{L^2} = \frac{ML^0T^{-2}}{}$

A Energy/Area

B Pressure

C Force × length

D $\boxed{\text{Pressure per unit length}}$

$\frac{MLT^{-2}}{L^2 \cdot L} = ML^{-2}T^{-2}$

Question

The time dependence of a physical quantity p is given by $p = p_0\, e^{(-\alpha t^2)}$ where α is constant and t is time. The constant α

A is dimensionless

B has dimensions T^{-2}

C has dimensions T^2

D has dimensions of p

$$\alpha t^2 = 1$$

$$\alpha T^2 = 1$$

$$\alpha = T^{-2}$$

Conversion of Unit

(1) $P = 20 \frac{kg\,m}{sec} \xrightarrow{\text{convert into CGS}} \frac{20 \times 1000\,gm \times 100\,cm}{sec}$

$= 2 \times 10^{6}\ \frac{gm\ cm}{sec}$

force → MLT^{-2}

Q. Convert 1N into dyne

Convert 1N into CGS system

dyne → Unit of force in CGS system.

Sol^n

$$1\,N = \frac{1\,kg\ m}{sec^2} \xrightarrow[\text{into CGS system}]{\text{convert}} \frac{1 \times 1000\,gm \times 100\,cm}{sec^2}$$

$$= 10^5 \ \frac{gm.\ cm}{sec^2}$$

Unit of force CGS system

$$= 10^5 \text{ dyne}$$

Q

$375\ N \xrightarrow[\text{CGS}]{\text{convert into}}$

$375\ \frac{kg\ m}{sec^2} \xrightarrow[\text{CGS ✓}]{} \frac{375 \times 1000\ gm \times 100\ c.m}{sec^2}$

$= 37500000\ \frac{gm\ c.m}{sec^2}$

$= 375 \times 10^5$

dyne

Q Convert 1 Joule into CGS system

" " " erg (erg → Unit of energy in CGS system)

$$1\,J = 1\,\frac{kg\,m^2}{sec^2} \xrightarrow[\text{into CGS}]{\text{convert}} \frac{1 \times 1000\,gm \times (100\,cm)^2}{sec^2}$$

$$= 10^7\,\underbrace{\frac{gm\ cm^2}{sec^2}}_{\text{ध}}$$

$$= 10^7\ \text{erg.}$$

MLT^{-2}

SKC

Q $m = 5\,kg$, $a = 3\, m/sec^2$

$$F = m.a$$
$$= 5\,kg . 3\, m/sec^2$$
$$= 15\ \boxed{kg\, m/sec^2}$$
$$= 15\ N$$

$$1\,N = \frac{1\,kg\,m}{sec^2}$$

$$1\,dyne = 1\,\frac{gm\ c.m}{sec^2}$$

$$1\,Joule = \frac{1\,kg\,m^2}{sec^2}$$

$$1\,erg = \frac{1\,gm.\,c.m^2}{sec^2}$$

$1\,m = 100\,c.m$

कल्पद्

Q. In a hypothetical system

हमारा Method

1 unit of mass = 20 kg
1 Unit of length = 5 m
1 Unit of time = 2 sec.

(a) Find value of 1 unit of force

$$1 \text{ Unit of force} = 20\,kg \cdot 5\,m\,(2\,sec)^{-2}$$

$$= \frac{20 \times 5}{4} \frac{kg \cdot m}{sec^2}$$

$$= 25\,N$$

(b) find the value of 1 unit of Energy

$$20\,kg \cdot (5m)^2 (2\,sec)^{-2}$$

$$= \frac{20 \times 25}{4} \frac{kg \cdot m^2}{sec^2}$$

$$= 125 \text{ Joule.}$$

Q. In a hypothetical system

1 unit of mass = 20 kg
1 Unit of length = 5 m
1 Unit of sec = 2 sec.

(1) Find value of 1 unit of force

M-2 Book वाला methode.

Q. In a hypothetical system

1 unit of mass = 5 Kg
1 Unit of length = 2 m
1 Unit of sec = 2 sec.

(1) Find value of 1 unit of force

$5\,Kg \cdot 2\,m\,(2\,sec)^{-2}$

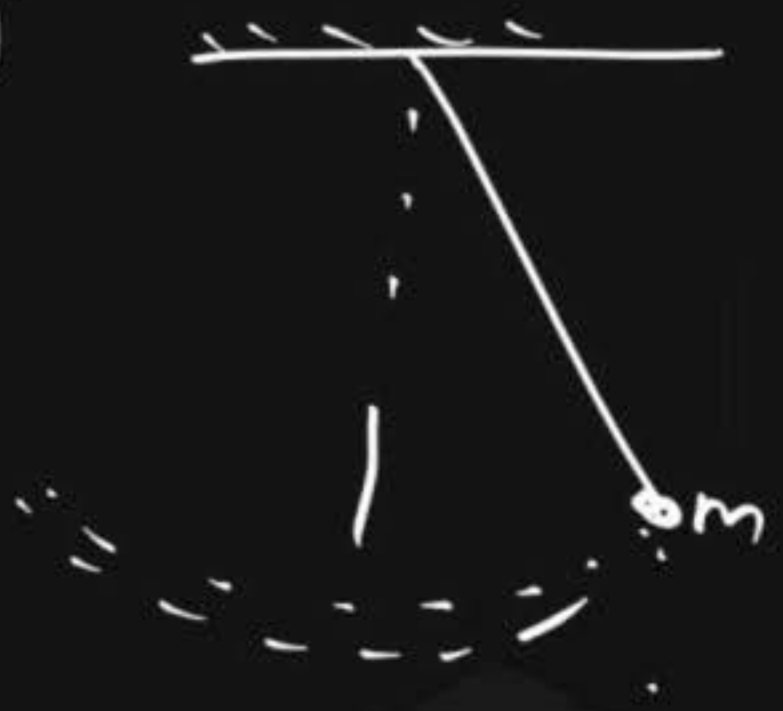
$= \frac{10}{4}\,Kg\,m/sec^2 = 2.5\,N$

(2) Find the value of 1 Unit of energy

$\frac{5\,Kg \cdot (2m)^2}{(2\,sec)^2} = 5\,\frac{Kg\,m^2}{sec^2}$

$= 5$ Joule.

Q. Time period (T) of a simple pendulum depends on 'm' of block length of string (l) & acc due to gravity 'g'. Derived the formula for time period.



$$T = K m^x l^y g^z$$

$$m^0 L^0 T^1 = [redacted] m^x L^y (LT^{-2})^z$$

[redacted]

$$\boxed{T = k\, m^x \ell^y g^z}$$

$$M^0 L^0 T^1 = M^x L^y (LT^{-2})^z$$

$$= M^x L^y L^z T^{-2z}$$

$$\boxed{M^0 L^0 T^1 = M^x L^{y+z} T^{-2z}}$$

Compare

$x = 0,$

$y + z = 0$

$-2z = 1 \Rightarrow z = -\frac{1}{2}$

$y = -z = -\left(-\frac{1}{2}\right) = \frac{1}{2}$

$$T = K M^0 \ell^{\frac{1}{2}} \cdot g^{-\frac{1}{2}} = \frac{K\sqrt{\ell}}{\sqrt{g}}$$

$$\boxed{T = K\sqrt{\frac{\ell}{g}}}$$

(E) $E = K m^x A^y f^3$

Q Energy of a particle performing SHM depends on mass (m) of object, Amplitude (A), frequency 'f' of motion. Derive the relation b/w them.

$A \equiv$ Distance

ये ऐसा कददू है जो Dimensionless है

$$E \propto m^x A^y f^3$$

$$\boxed{E = K m^x A^y f^3}$$

$$ML^2T^{-2} = M^x L^y (T^{-1})^3$$

$$M^1L^2T^{-2} = M^x L^y T^{-3}$$

Compare.

$x = 1$

$y = 2$

$-3 = -2$

$3 = 2$

$$\boxed{E = KMA^2f^2}$$

Suppose

Q Force depends on mass(m), speed(v), and radius 'r'
Derive the relation b/w them

$$F = K\, m^x v^y r^z$$

$$MLT^{-2} = M^x (LT^{-1})^y L^z$$

$$M^1 L T^{-2} = M^x L^{y+z} T^{-y}$$

Compare (power)

$x = 1$,

$-y = -2$ $\quad y = 2$

$y + z = 1$

$2 + z = 1$ $\quad z = -1$

पता नहीं

$$F = K\, M^1 \cdot v^2 \cdot r^{-1}$$

$$\boxed{F = K \frac{mv^2}{r}}$$

इसे अभी कुछ नहीं पता

Q A sattellite is revolving around the earth such that $\boxed{\text{time period } T \text{ of}}$ sattellite depends on M (mass of earth), gravitational cons (G), and radius of orbit r, Derive the formula for time period of sattellite

$$\boxed{G = M^{-1} L^{3} T^{-2}}$$

$T = K M^{-\frac{1}{2}} G^{-\frac{1}{2}} r^{+3/2}$

1 ✓

2 X

3 → इसका नहीं लगी

$T = K M^{x} G^{y} r^{z}$

$T = M^{x} (M^{-1} L^{3} T^{-2})^{y} L^{z}$

$M^{0} L^{0} T^{1} = M^{x-y} L^{3y+z} T^{-2y}$

$$\boxed{\begin{aligned} -2y &= 1 \\ y &= -\frac{1}{2} \end{aligned}}$$

$x - y = 0$

$x = y \Rightarrow x = -\frac{1}{2}$

$3y + z = 0$

$z = -3y = +3/2$

H/W

Q. A sattellite is revolving around the earth such that $\boxed{\text{orbital velocity } V_0}$ of sattellite depends on M (mass of earth), gravitational cons. (G), and radius of orbit r,
Derive the formula for orbital velocity of sattellite

$$\boxed{V_0 = K\, m^{\frac{1}{2}}\, G^{\frac{1}{2}}\, r^{-\frac{1}{2}}}$$

$$V_0 = K\, M^x\, G^y\, r^z$$

$$LT^{-1} = M^x\,(M^{-1}L^3T^{-2})^y\, L^z$$

$$M^0LT^{-1} = M^{x-y}\, L^{3y+z}\, T^{-2y}$$

(1) ✓

(2) X

(3) try नहीं किया

$$\boxed{G = M^{-1}L^3T^{-2}}$$

$y = \frac{1}{2}$, $x - y = 0$

$x = y = \frac{1}{2}$

$3y + z = 1$

$\frac{3}{2} + z = 1 \Rightarrow z = -\frac{1}{2}$

Q. $E = h\nu \quad h = \frac{E}{\nu}$

A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of:

(JEE Main-2020)

A Momentum

B Area

C Energy

D Volume

$$\sqrt{\frac{ML^2T^{-2}}{T^{-1}} \times \frac{(LT^{-1})^5}{M^{-1}L^3T^{-2}}} = \sqrt{M^2L^4T^{-4}}$$

$$= ML^2T^{-2}$$

Ans : (C)

Q.

Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is: **(JEE Main-2020)**

A $ML^2 T^{-2}$

B MLT^{-2}

C $M^2L^0T^{-1}$

D $ML^0 T^{-3}$

Solar const $= \frac{E}{\text{Area.time}} = \frac{ML^2T^{-2}}{L^2 . T} \quad -1$

$\Rightarrow M^1 L^0 T^{-3}$

Ans : (D)

Q. Tough. Go.... gently

In a typical combustion engine the work done by a gas molecule is given $W = \alpha^2 \beta e^{\frac{-\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be:

(JEE Main-2021)

A. $[MLT^{-2}]$

B. $[M^0LT^0]$

C. $[M^2LT^{-2}]$

D. $[MLT^{-1}]$

$$\frac{\beta L^2}{ML^2T^{-2}} = 1$$

$$\boxed{\beta = MT^{-2}}$$

$$W = \alpha^2 \beta e^{(\ )}$$

$$\cancel{M}L^2\cancel{T^{-2}} = \alpha^2 \cancel{M}\cancel{T^{-2}}$$

$$\alpha^2 = L^2$$

$$\alpha = L$$

Ans : (B)

Q.

The force is given in terms of time t and displacement x by the equation $F = A\cos Bx + C\sin Dt$. The dimensional formula of AD/B is: **(JEE Main-2021)**

$D = T^{-1}$

$B = L^{-1}$

$\frac{AD}{B} \equiv \frac{MLT^{-2} \cdot T^{-1}}{L^{-1}}$

A → force

ML^2T^{-3}

A. $[M^0 L T^{-1}]$

B. $[M L^2 T^{-3}]$

C. $[M^1 L^1 T^{-2}]$

D. $[M^2 L^2 T^{-3}]$

Ans : (B)

Q.

Match List-I with List-II. (JEE Main-2021)

List-I		List-II	
(a)	Torque	(i)	MLT^{-1}
(b)	Impulse	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

class Notes

Choose the most appropriate answer from the option given below :

A (a)–(iii), (b)–(i), (c)–(iv), (d)–(ii)

B (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

C (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii)

D (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

Ans : (A)

Q $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$\vec{B} = 2\hat{i} + 3\hat{j} - 2\hat{k}$

$\vec{A} + \vec{B} = 5\hat{i} + 7\hat{j} + 3\hat{k}$

Q $\vec{A} = 3\hat{i} + 4\hat{j} + 6\hat{k}$

$2\vec{A} = 6\hat{i} + 8\hat{j} + 12\hat{k}$

$= 2(3\hat{i} + 4\hat{j} + 6\hat{k})$

$-3\vec{A} = -9\hat{i} - 12\hat{j} - 18\hat{k}$

Q $\vec{A} = 6\hat{i} + 3\hat{j} + 2\hat{k}$

$\vec{B} = \hat{i} + 6\hat{j} + 5\hat{k}$

$\vec{A} + \vec{B} = 7\hat{i} + 9\hat{j} + 7\hat{k}$

Q $\vec{A} = 7\hat{i} + 3\hat{j} + 8\hat{k}$

$\vec{B} = 5\hat{i} + \hat{j} + 2\hat{k}$

$\vec{A} - \vec{B} = 2\hat{i} + 2\hat{j} + 6\hat{k}$

Q $\vec{A} = 3\hat{i} + 2\hat{j} + 5\hat{k}$

$\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

(1) $\vec{A} + \vec{B} = 5\hat{i} + 5\hat{j} + 9\hat{k}$

(2) $\vec{A} - \vec{B} = \hat{i} - \hat{j} + \hat{k}$

(3) $|\vec{A} + \vec{B}| = \sqrt{5^2 + 5^2 + 9^2}$

(4) $|\vec{A} - \vec{B}| = \sqrt{3}$

(5) $2\vec{A} + 3\vec{B} = 12\hat{i} + 13\hat{j} + 22\hat{k}$

(6) $|2\vec{A} + 3\vec{B}| = \sqrt{(12)^2 + (13)^2 + (22)^2}$

(7) $2\vec{A} - 3\vec{B} = 0\hat{i} + (4-9)\hat{j} + (10-12)\hat{k}$

$= -5\hat{j} - 2\hat{k}$

Q $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$

$\vec{B} = 4\hat{i} + \hat{j} + 4\hat{k}$

find a vector $\vec{C}$ whose magnitude is 20 and dir^n is opposite to $4\vec{A} + \vec{B}$

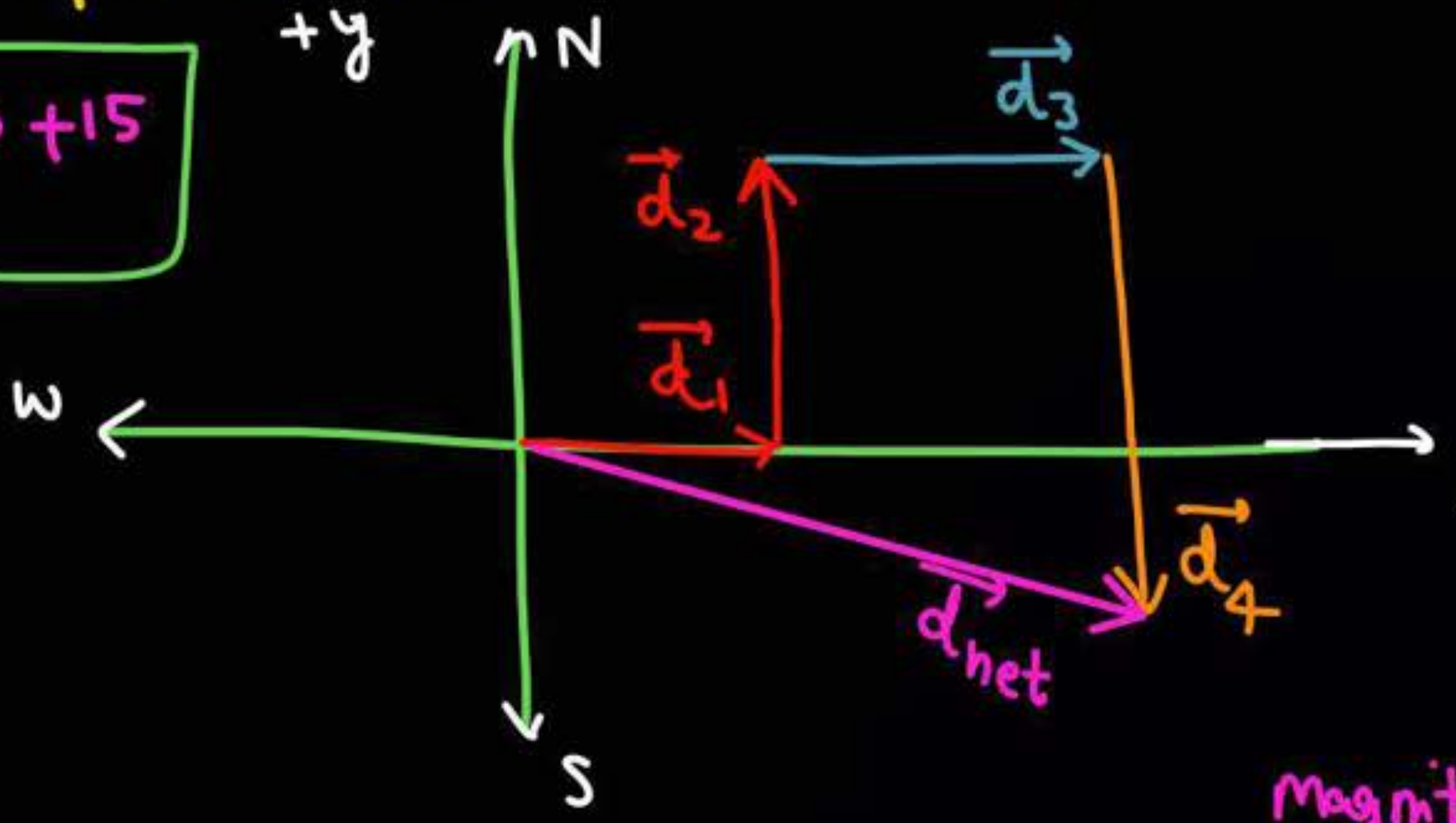
$4\vec{A} + \vec{B} = 12\hat{i} + 5\hat{j} + 8\hat{k}$

Ans $\Rightarrow \underbrace{-}_{\text{minus}} 20 \times \left(\dfrac{12\hat{i} + 5\hat{j} + 8\hat{k}}{\sqrt{12^2 + 5^2 + 8^2}} \right)$

Kinematics

Q. A man move 5m along east, then turn left & move 10m along north, then turn right and move 20m east & then turn right to south & move 15m. find net displacement, Distance travel

$$\text{Distance} = 5+10+20+15 = 50$$



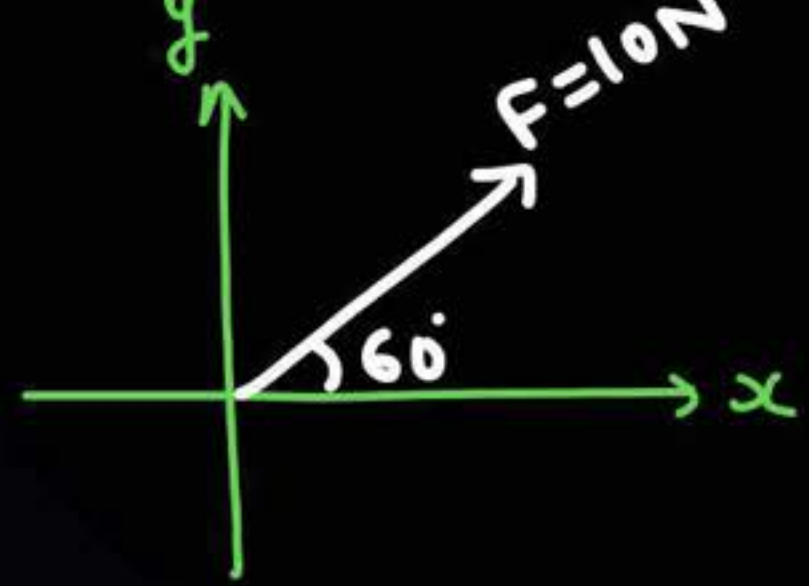
$$\vec{d_1} = 5\hat{i}$$
$$\vec{d_2} = 10\hat{j}$$
$$\vec{d_3} = 20\hat{i}$$
$$\vec{d_4} = -15\hat{j}$$

$$\vec{d}_{net} = 25\hat{i} - 5\hat{j}$$

$$\text{magnitude} = \sqrt{(25)^2 + 5^2} = \sqrt{\ }$$

Q Resolve the vector into $\hat{i}$ & $\hat{j}$

(1)

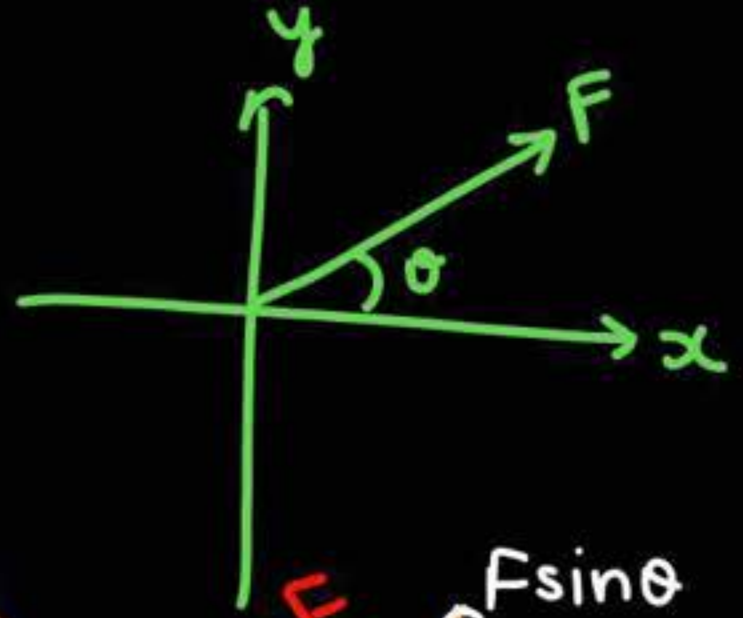


$$\vec{F} = 10\cos 60^\circ\,\hat{i} + 10\sin 60\,\hat{j}$$

$$= 10\times\frac{1}{2}\hat{i} + 10\frac{\sqrt{3}}{2}\hat{j}$$

$$\boxed{\vec{F} = 5\hat{i} + 5\sqrt{3}\hat{j}}$$

(2)

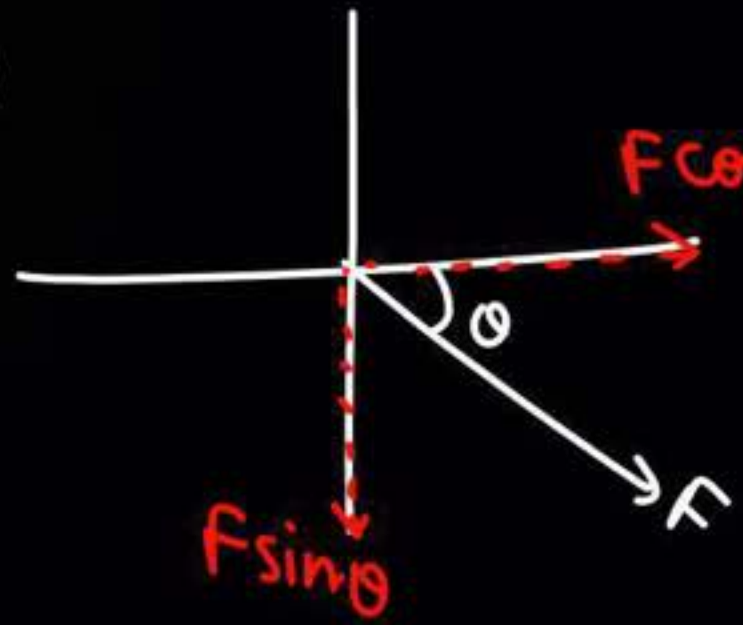


$$\vec{F} = F\cos\theta\,\hat{i} + F\sin\theta\,\hat{j}$$

(3)

$$\vec{F} = -F\cos\theta\,\hat{i} + F\sin\theta\,\hat{j}$$

(4)



$$\vec{F} = F\cos\theta\,\hat{i} - F\sin\theta\,\hat{j}$$

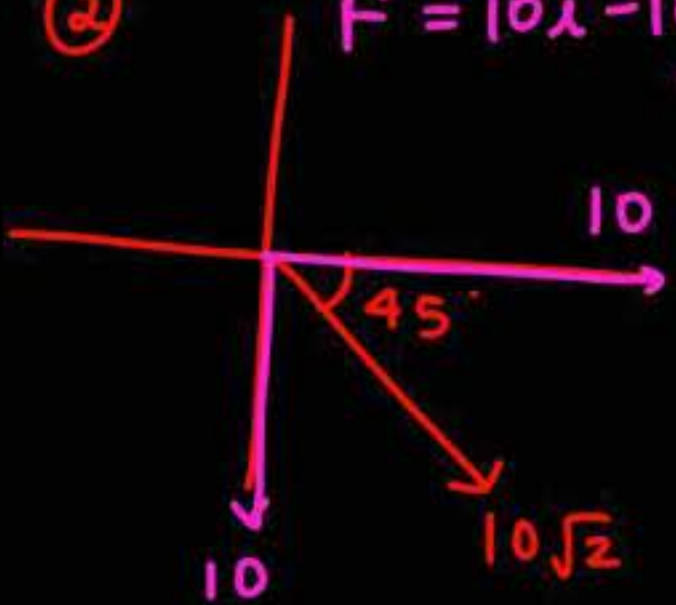
Do तोड़ा ताड़ी

(1)

$\vec{F} = 10\cos 30\,\hat{i} + 10\sin 30\,\hat{j}$

$\vec{F} = 5\sqrt{3}\,\hat{i} + 5\hat{j}$

(2) $\vec{F} = 10\hat{i} - 10\hat{j}$



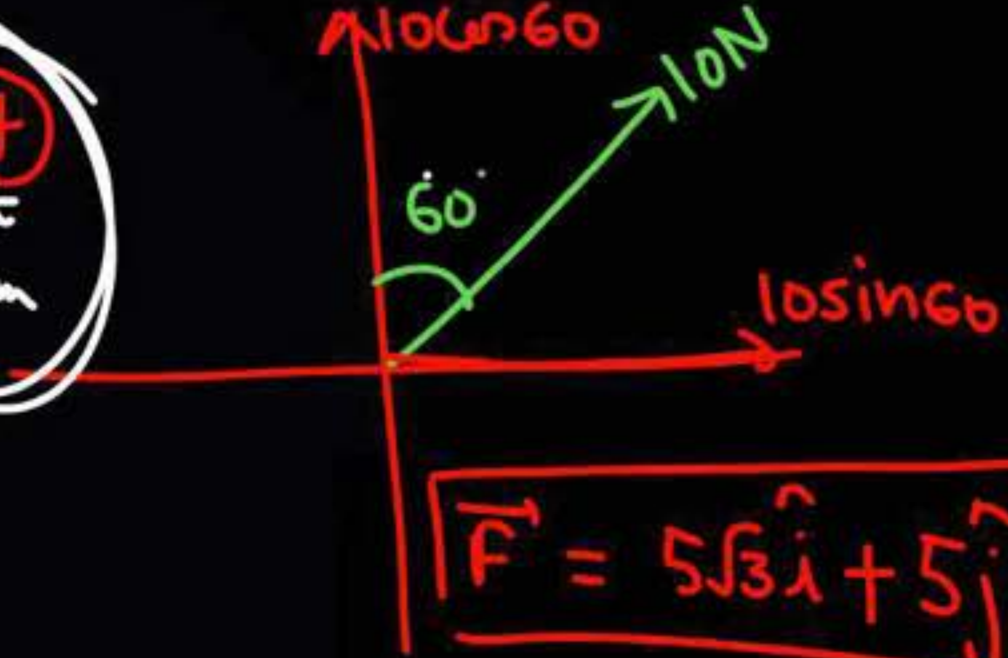
(3)

$\vec{F} = 10\cos 37\,\hat{i} + 10\sin 37\,\hat{j}$

$= 10 \times \frac{4}{5}\,\hat{i} + 10 \times \frac{3}{5}\,\hat{j}$

$\boxed{\vec{F} = 8\hat{i} + 6\hat{j}}$

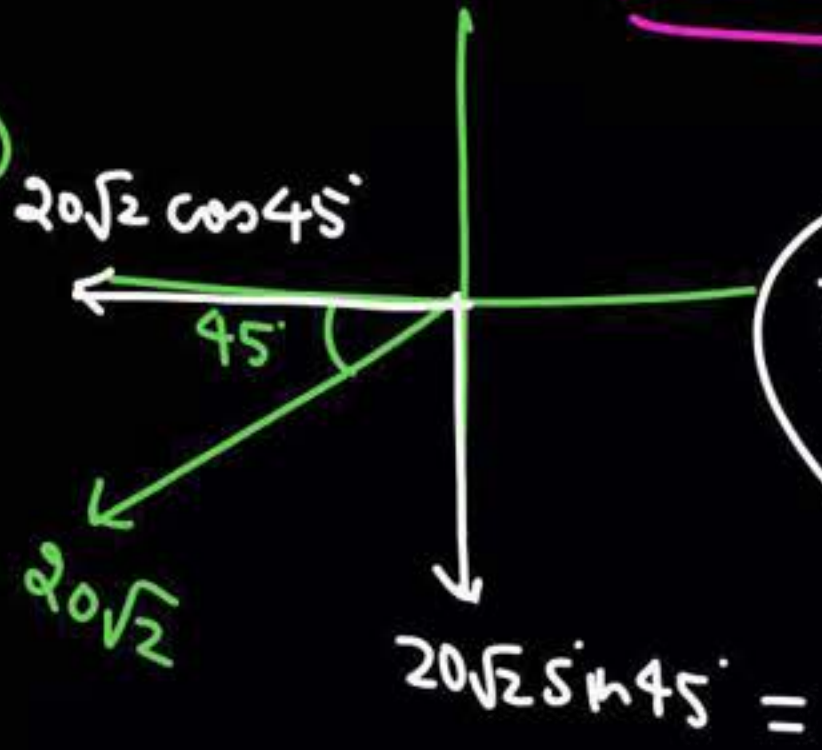
(4) next class



$\boxed{\vec{F} = 5\sqrt{3}\,\hat{i} + 5\hat{j}}$

$= \checkmark$

(5)



$\vec{F} = -20\hat{i} - 20\hat{j}$

Q If angle b/w $\vec{A}$ & $\vec{B}$ is 30°.

$A = 10$ find $|\vec{A}-\vec{B}|$ = magnitude of $\vec{A}-\vec{B}$

$B = 20$

(1) m_1 direct $D = \sqrt{A^2+B^2-2AB\cos\theta}$ → $\vec{A}$ और $\vec{B}$ के बीच angle

$D = \sqrt{100+400-2\times10\times20\frac{\sqrt{3}}{2}}$

$= \sqrt{500-200\sqrt{3}}$

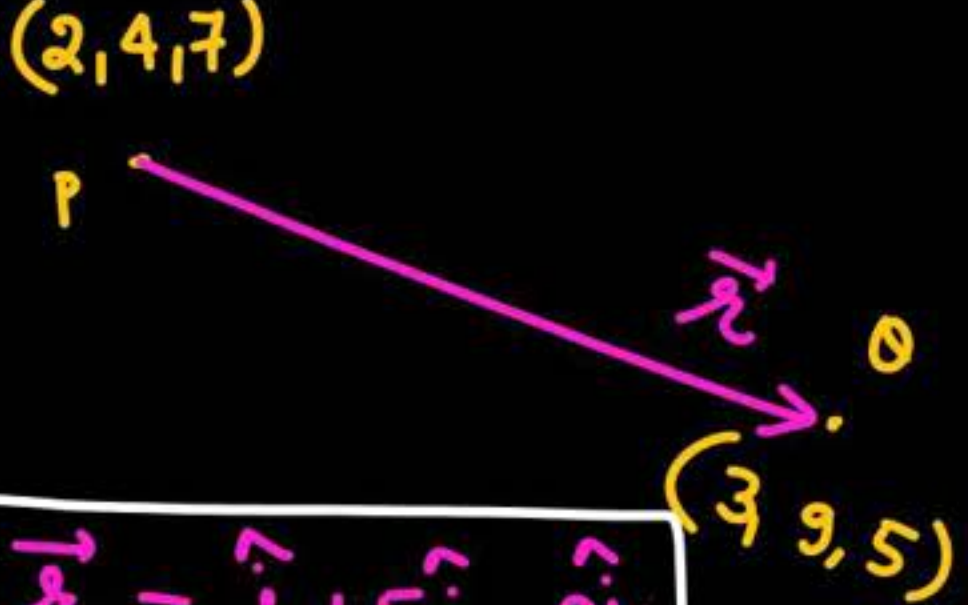
(m_2) $D = \sqrt{A^2+B^2+2AB\cos(180-\theta)}$

$= \sqrt{100+400+2\times10\times20\cos 150^\circ}$

$= \sqrt{500+2\times10\times20\left(-\frac{\sqrt{3}}{2}\right)}$

$= \sqrt{500-200\sqrt{3}}$

$$\overrightarrow{AB} = \text{P.V. of } B - \text{P.V. of } A$$
$$= (7-2)\hat{i} + (8-3)\hat{j} + (9-4)\hat{k}$$
$$= 5\hat{i} + 5\hat{j} + 5\hat{k}$$



$$\boxed{\vec{r} = \hat{i} + 5\hat{j} - 2\hat{k}}$$

magnitude of a vector.

$\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

magnitude of $A = \sqrt{2^2 + 3^2 + 4^2}$

$= \sqrt{4 + 9 + 16}$

$= \sqrt{29}$

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

mag. of $\vec{A} = \sqrt{A_x^2 + A_y^2 + A_z^2}$

Q $\vec{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

mag. of $\vec{A} = \sqrt{2^2 - 3^2 + 4^2}$ ✗

$= \sqrt{2^2 + 3^2 + 4^2}$ ✓

find magnitude of $\vec{A}$ in following cases

① $\vec{A} = 3\hat{i} + 4\hat{j}$

$A = \sqrt{3^2 + 4^2} = 5$

② $\vec{A} = -3\hat{i} + 4\hat{j}$

$A = \sqrt{3^2 + 4^2} = 5$

③ $\vec{A} = 3\hat{i} - 4\hat{j}$

$A = 5$

④ $\vec{A} = -3\hat{i} - 4\hat{j}$

$A = 5$

⑤ $\vec{A} = 6\hat{i} + 2\hat{j} + 3\hat{k}$

$A = \sqrt{6^2 + 2^2 + 3^2} = 7$

⑥ $\vec{A} = 5\hat{i} - 12\hat{j} + 13\hat{k}$

$A = \sqrt{5^2 + 12^2 + 13^2} = 13\sqrt{2}$

⑦ $\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$A = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{3}$

⑧ $\vec{A} = \hat{i} - \hat{j} + \hat{k}$

$A = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{3}$

Find magnitude of $\vec{A}$ in following cases

① $\vec{A} = 3\hat{i} + 4\hat{j}$

$A = \sqrt{3^2 + 4^2} = 5$

② $\vec{A} = -3\hat{i} + 4\hat{j}$

$A = \sqrt{3^2 + 4^2} = 5$

③ $\vec{A} = 3\hat{i} - 4\hat{j}$

$A = 5$

④ $\vec{A} = -3\hat{i} - 4\hat{j}$

$A = 5$

⑤ $\vec{A} = 6\hat{i} + 2\hat{j} + 3\hat{k}$

$A = \sqrt{6^2 + 2^2 + 3^2} = 7$

$\hat{A} = \frac{6\hat{i} + 2\hat{j} + 3\hat{k}}{7}$

⑥ $\vec{A} = 5\hat{i} - 12\hat{j} + 13\hat{k}$

$A = \sqrt{5^2 + 12^2 + 13^2} = 13\sqrt{2}$

⑦ $\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$A = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{3}$

⑧ $\vec{A} = \hat{i} - \hat{j} + \hat{k}$

$A = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{3}$

(9) $\vec{A} = \hat{i} - \hat{j}$

$A = \sqrt{1^2 + 1^2} = \sqrt{2}$

(10) $\vec{A} = \hat{i} - \hat{k}$

$A = \sqrt{1^2 + 0^2 + 1^2} = \sqrt{2}$

$$\left.\begin{array}{l} (11)\quad \vec{A} = \hat{i} \\ \qquad A = 1 \\ (12)\quad \vec{A} = \hat{k} \\ \qquad A = 1 \end{array}\right\} \text{Unit vector}$$

(13) $\vec{A} = \hat{j} - \hat{k}$

$A = \sqrt{1^2 + 1^2} = \sqrt{2}$

(14) $\vec{A} = \frac{\hat{i}}{\sqrt{2}} + \frac{\hat{j}}{\sqrt{2}}$

$A = \sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = \sqrt{\frac{1}{2} + \frac{1}{2}} = 1$

(15) $\vec{A} = \frac{\hat{i}}{\sqrt{3}} - \frac{\hat{j}}{\sqrt{3}} - \frac{\hat{k}}{\sqrt{3}}$

$A = \sqrt{\left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2} = 1$

Unit vector ≡ ऐसा vector whose magnitude is '1'

$$\vec{A} = |\vec{A}| . \hat{A}$$

$\hat{A}$ → dirⁿ
→ unit vector

$|\vec{A}|$ → magnitude

Q $\vec{A} = 3\hat{i} + 4\hat{j}$

mag. of $\vec{A} = \sqrt{3^2 + 4^2} = 5$

$$\hat{A} = \frac{\vec{A}}{|A|}$$

Unit vector along $\vec{A}$
or
$\hat{A}$

$$\hat{A} = \frac{\vec{A}}{|A|} = \frac{3\hat{i} + 4\hat{j}}{5} = \frac{3}{5}\hat{i} + \frac{4}{5}\hat{j}$$

Q $\vec{A} = 3\hat{i} - 4\hat{j}$

$$\hat{A} = \frac{\vec{A}}{|A|} = \frac{3\hat{i} - 4\hat{j}}{5}$$

Q $\vec{A} = \hat{i} + \hat{j}$

$$\hat{A} = \frac{\hat{i} + \hat{j}}{\sqrt{2}}$$

Q $\vec{A} = \hat{i} - \hat{j} - \hat{k}$

$$\hat{A} = \frac{\hat{i} - \hat{j} - \hat{k}}{\sqrt{3}}$$

Q $\vec{A} = 2\hat{i} + 6\hat{j} - 3\hat{k}$

$$\hat{A} = \frac{2\hat{i} + 6\hat{j} - 3\hat{k}}{7} = \frac{2}{7}\hat{i} + \frac{6}{7}\hat{j} - \frac{3}{7}\hat{k}$$

Q $\vec{A} = 5\hat{i} + 5\hat{j}$

$$\hat{A} = \frac{5\hat{i} + 5\hat{j}}{5\sqrt{2}} = \frac{5(\hat{i} + \hat{j})}{5\sqrt{2}} = \frac{\hat{i} + \hat{j}}{\sqrt{2}}$$

Q A bird is flying with speed 10 m/s in the direction of a vector $\vec{A} = 3\hat{i} + 4\hat{j}$. Find velocity of bird.

$\boxed{v = 10\ m/s}$

$\vec{v} = (\text{magnitude})(\text{direction})$

$\vec{v} = 10 . \hat{A} = 10 \times \left(\frac{3\hat{i}+4\hat{j}}{5}\right) = 2(3\hat{i} + 4\hat{j})$

$\hat{A} = \frac{3\hat{i}+4\hat{j}}{5}$

$\boxed{\vec{v} = 6\hat{i} + 8\hat{j}\ (m/s)}$

Q Find a vector whose magnitude is 20 and dir^n is parallel to (or along or towards) $\vec{A} = 6\hat{i} - 8\hat{j}$

<u>Ans</u> $20\hat{A} = 20 \dfrac{6\hat{i} - 8\hat{j}}{\sqrt{6^2 + 8^2}} = 20\left(\dfrac{6\hat{i} - 8\hat{j}}{10}\right)$

$= 12\hat{i} - 16\hat{j}$

Q Find force F in vector form if its magnitude is 21 N and direction is (a) parallel to $6\hat{i}-3\hat{j}+2\hat{k}=\vec{A}$

(b) opposite to $6\hat{i}-3\hat{j}+2\hat{k}=\vec{A}$

(a) $\vec{F}=21.\hat{A}=21\left(\frac{6\hat{i}-3\hat{j}+2\hat{k}}{7}\right)=18\hat{i}-9\hat{j}+6\hat{k}$

(b) $\vec{F}=21(-\hat{A})=-21\hat{A}=-(18\hat{i}-9\hat{j}+6\hat{k})$

$=-18\hat{i}+9\hat{j}-6\hat{k}$

Q A bird is flying with speed 10 m/s from point A to directly point $\vec{B}$. find Velocity of bird.

$$\vec{AB} = 4\hat{i} + 0\hat{j} - 3\hat{k} = 4\hat{i} - 3\hat{k}$$

$$\vec{v} = 10 \times \hat{AB} = 10 \times \left(\frac{4\hat{i} - 3\hat{k}}{5}\right) = 8\hat{i} - 6\hat{k}$$

घास्ड 9 ws

Q Initial speed of चिड़िया is 10 m/s alon $\vec{A} = 3\hat{i} - 4\hat{j}$

and net force on the चिड़िया is 50 N in the Dir^n of $\vec{B}$

mass of चिड़िया is 2 Kg

$\vec{B} = \boxed{6\hat{i} + 8\hat{j}}$

(1) find velocity of चिड़िया at t = 14 sec

$u_i = 10\,\hat{A} = 10\left(\frac{3\hat{i} - 4\hat{j}}{5}\right)$

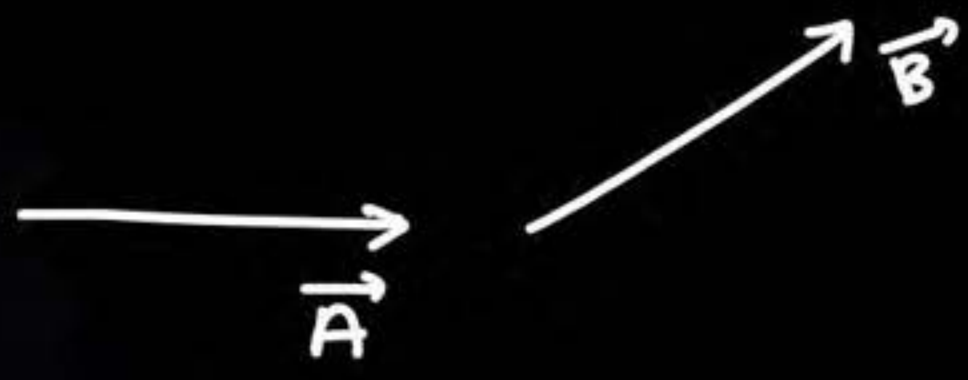
$\vec{v} = \vec{u} + \vec{a}t$

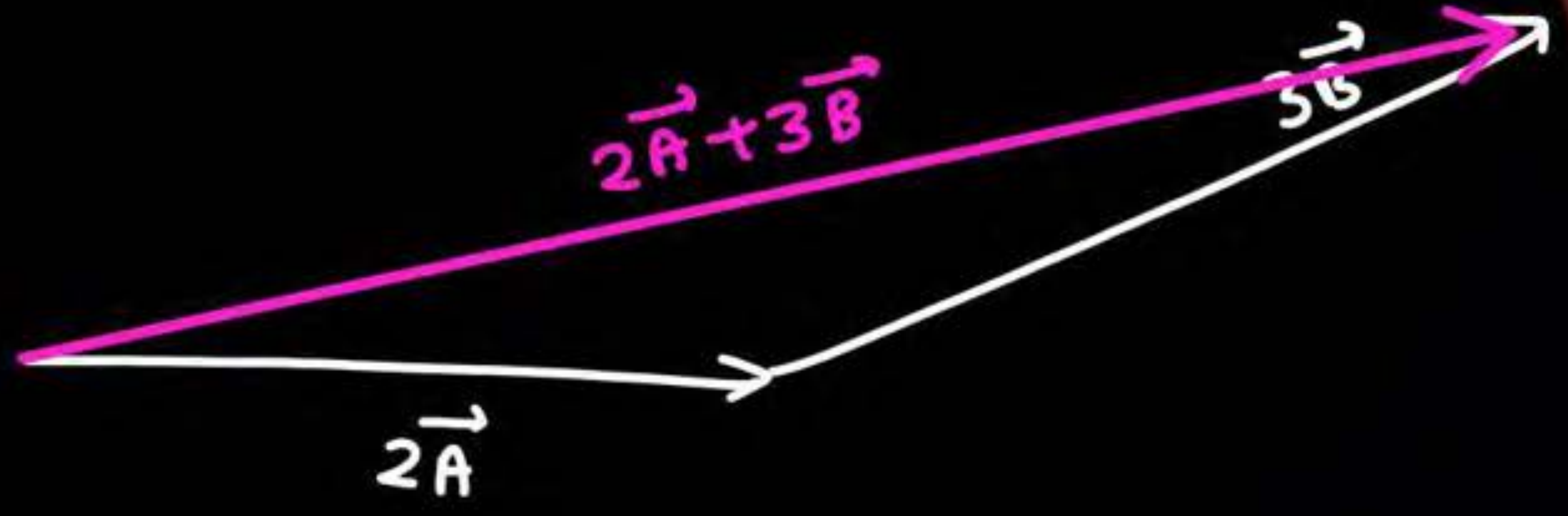
$\vec{F} = 50\,\hat{B} = 50 \times \left(\frac{6\hat{i} + 8\hat{j}}{10}\right)$

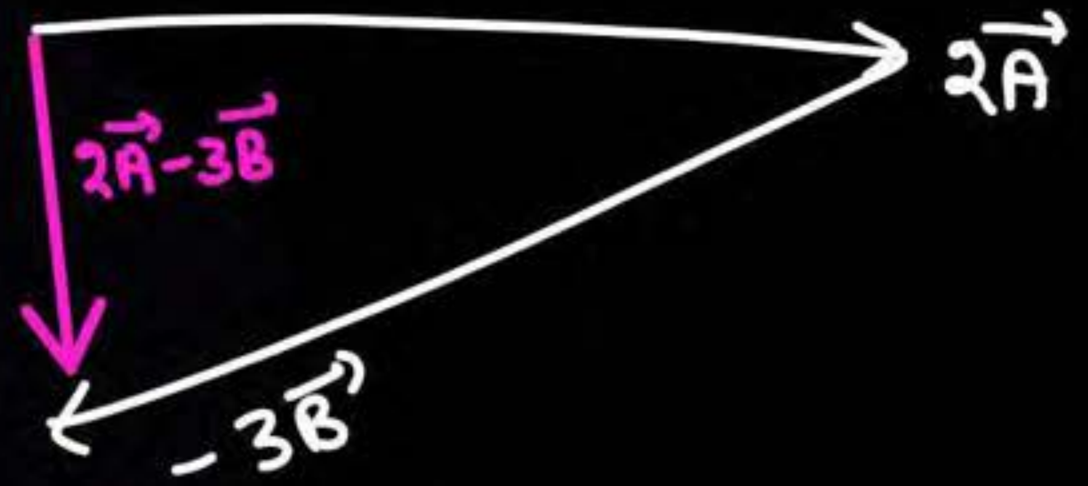
$\vec{F} = 30\hat{i} + 40\hat{j}$

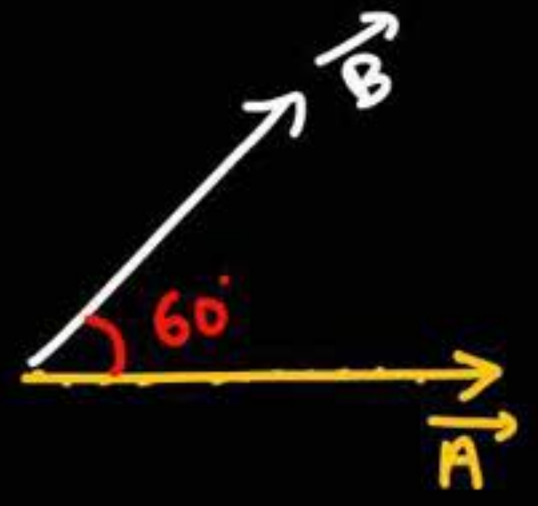
$\vec{a} = \frac{\vec{F}}{m} = 15\hat{i} + 20\hat{j}$

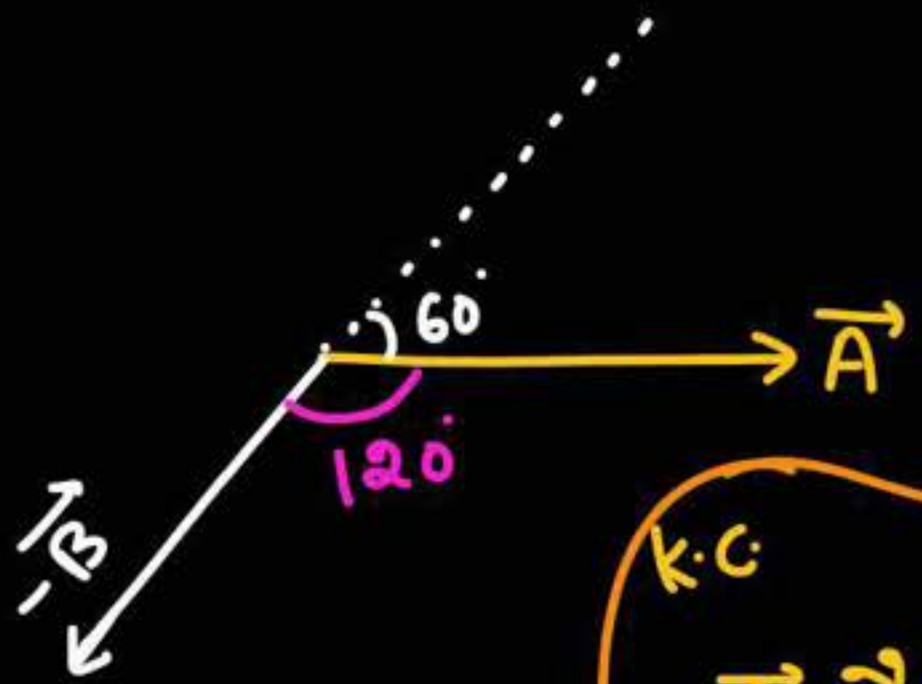
Q Draw rough daigram of (1) $2\vec{A}+3\vec{B}$ & (2) $2\vec{A}-3\vec{B}$











Angle between $\vec{A}$ & $\vec{B}$ = 60°

Angle between $\vec{A}$ & $-\vec{B}$ = 180 − 60
= 120°

K.C.

$\vec{A}$ और $\vec{B}$ के बीच
अगर angle θ है
तो $\vec{A}$ और $-\vec{B}$ के
बीच $180-\theta$ होगा।

Q magnitude of $\vec{A}$ & $\vec{B}$ is 10 & 20 Unit, angle between $\vec{A}$ & $\vec{B}$ is $60°$

(A) find mag. of resultant of $\vec{A}$ & $\vec{B}$ and angle made by this resultant with $\vec{A}$

$\vec{C} = \vec{A} + \vec{B}$

$$C = \sqrt{10^2 + 20^2 + 2\times10\times20\cos60°} = 10\sqrt{7}$$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta} = \frac{20\sin60}{10 + 20\cos60°}$$

(B) If vector $\vec{B}$ is reversed and added to $\vec{A}$, find mag. of new resultant and angle made by this with $\vec{A}$

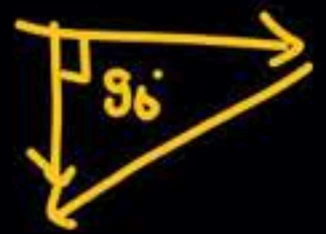
$$\vec{D} = \vec{A} - \vec{B} = \vec{A} + (-\vec{B})$$

$$C = \sqrt{10^2 + 20^2 - 2\times10\times20\times\cos60°}$$

$$= \sqrt{300}$$

$$\tan\alpha = \frac{B\sin\theta}{A - B\cos\theta} = \frac{20\sin60°}{10 - 20\cos60°} = \frac{10\sqrt{3}}{0}$$

$$\alpha = 90°$$



(B) $\vec{A}$ व $\vec{B}$ के बीच angle $= 60^\circ$

$\vec{A}$ व $-\vec{B}$ 〃 〃 $= 120^\circ$

$$\vec{D} = \vec{A} - \vec{B}$$

$$D = \sqrt{10^2 + (20)^2 + 2 \times 10 \times 20 \times \cos 120^\circ}$$

$$D = \sqrt{10^2 + 20^2 + 2 \times 10 \times 20 \cos(180 - 60)}$$

$$= \sqrt{10^2 + 20^2 + 2 \times 10 \times 20 \left(-\frac{1}{2}\right)}$$

$$= \sqrt{100 + 400 - 200}$$

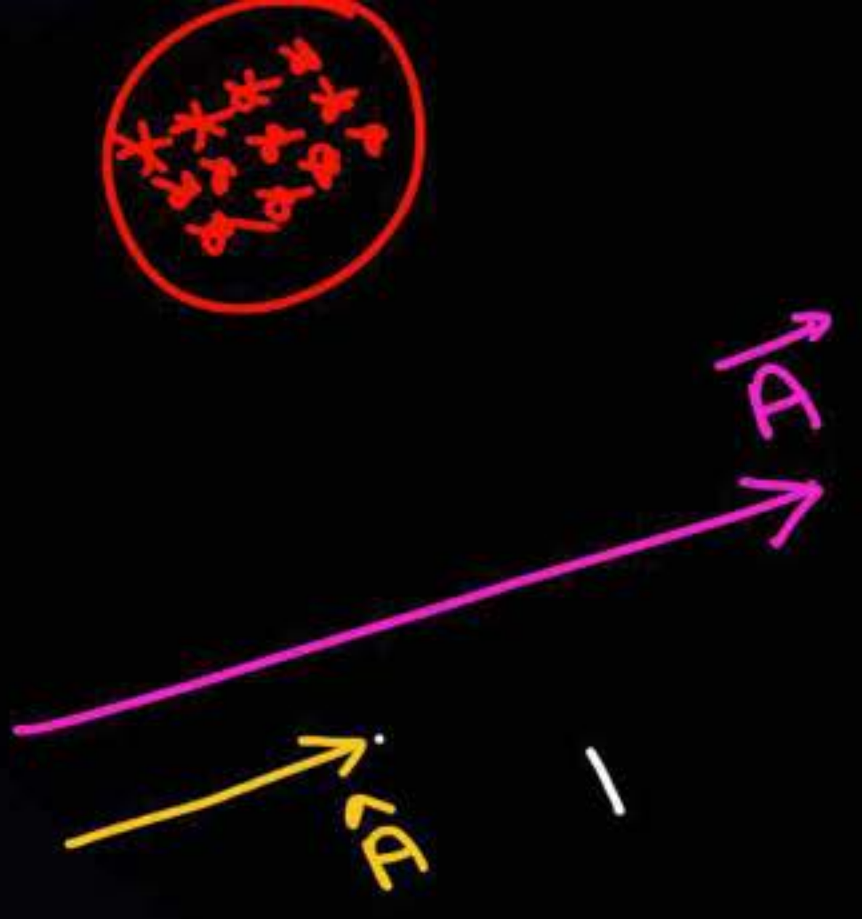
$$= \sqrt{300}$$

$$, \tan\alpha = \frac{20 \sin 120^\circ}{10 + 20 \cos 120}$$

$$= \frac{20 \times \sin(180-60)}{10 + 20 \cos(180-60)}$$

$$= \frac{20 \sqrt{3}/2}{10 + 20\left(-\frac{1}{2}\right)} = \frac{10\sqrt{3}}{0}$$

$$\alpha = 90^\circ$$



*** K.C.

$\vec{A}, \hat{A} \equiv$ parallel vector

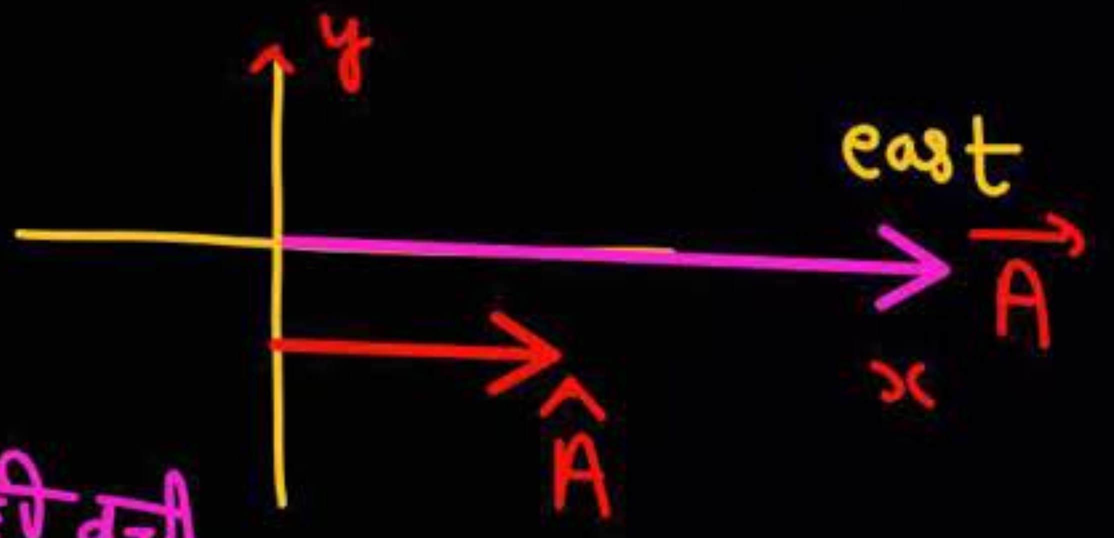
$\hat{A} \longrightarrow$ Unit vector

→ ये ऐसा vector है जिसका magnitude '1' और dir^n $\vec{A}$ की तरफ को है

Q $\vec{A} = 5\,N$ east

$\hat{A} =$ east

→ dir^n ही बची



Q A particle is moving with speed 10 m/s along +x Axis

find velocity $\vec{v} = 10\,\text{m/s}\ \hat{i}$

Dir^n

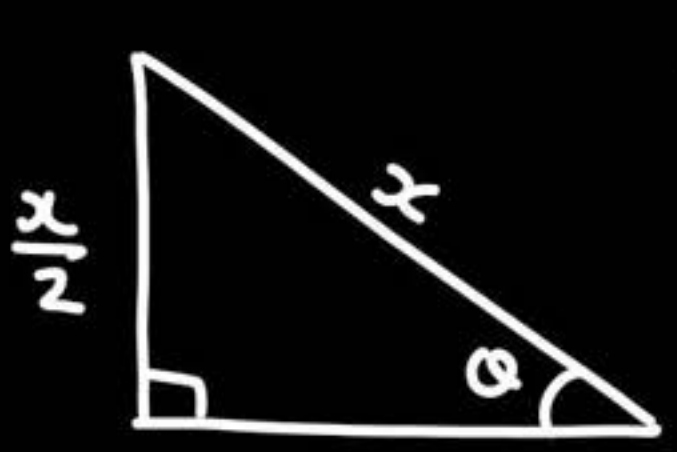
Q A particle is moving with speed 20 m/s along −y Axis

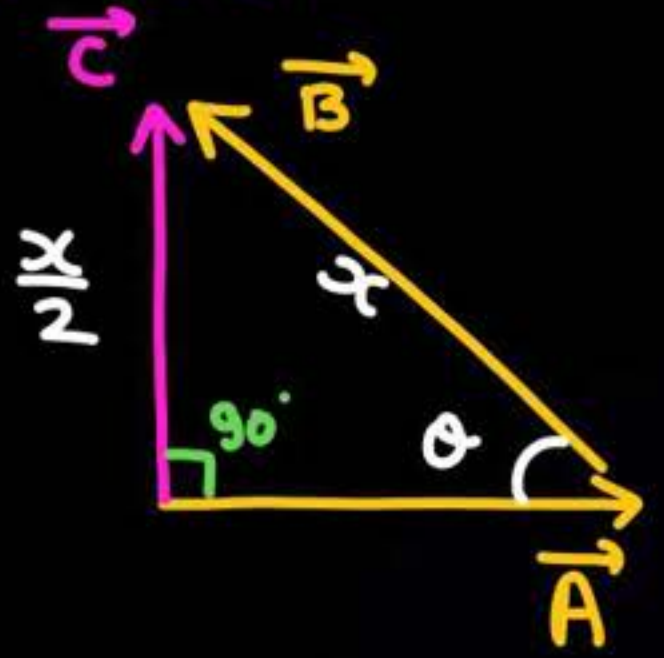
$$\vec{V} = 20\,\text{m/s}(-\hat{j}) = -20\hat{j}$$

Q Resultant of $\vec{A}$ & $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is equal to half of magnitude of $\vec{B}$. Find the angle between $\vec{A}$ & $\vec{B}$.

M-2

$$\vec{A} + \vec{B} = \vec{C}$$





~~Ans → 30°~~

Ans → $180 - 30°$

$= 150°$

$$\sin\theta = \frac{x/2}{x} = \frac{1}{2}$$

$$\boxed{\theta = 30°}$$

Q Two vector $\vec{A}$ & $\vec{B}$ have same magnitude 'a' and resultant has magnitude R. Now $\vec{B}$ is doubled and added to $\vec{A}$ and now new resultant become $a\sqrt{3}$. Find angle between $\vec{A}$ & $\vec{B}$

$$\vec{A}+\vec{B}=\vec{R}$$

$$R=\sqrt{a^2+a^2+2\cdot a\cdot a\cdot \cos\theta}$$

2B + A ✗

$2\vec{B}+\vec{A}$ ✓

$$R_{\text{नया}}=\sqrt{a^2+(2a)^2+2\cdot a\cdot 2a\cdot \cos\theta}$$

$$a\sqrt{3}=\sqrt{a^2+4a^2+4a^2\cos\theta}$$

$$3a^2=5a^2+4a^2\cos\theta$$

$$-2a^2=4a^2\cos\theta$$

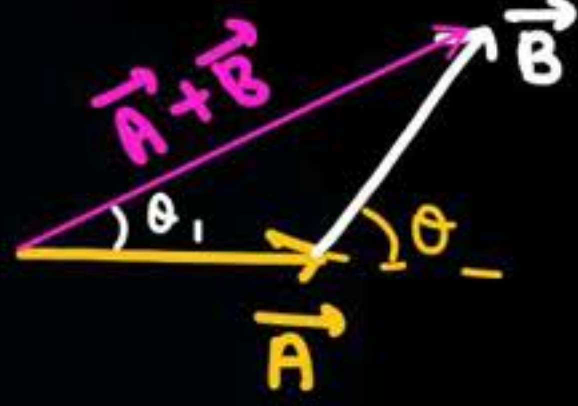
$$\boxed{\begin{gathered}\cos\theta=-\frac{1}{2}\\ \theta=120^\circ\ \checkmark\end{gathered}}$$

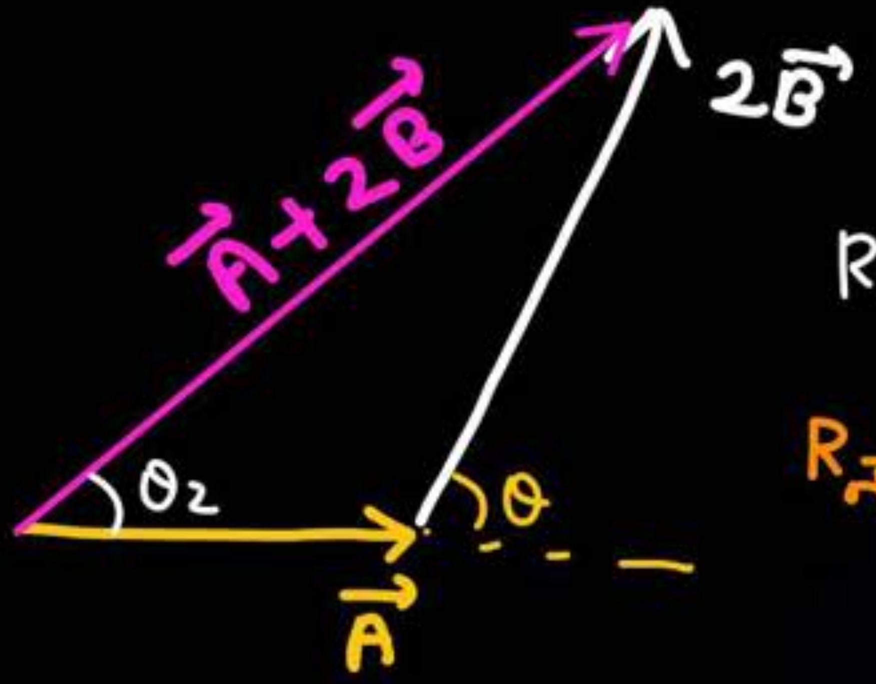
Q $\vec{A}$ has magnitude 10N, $\vec{B}$ has magnitude 20N

पहले

अब = 40

angle between $\vec{A}$ & $\vec{B}$ is 60°. If $\vec{B}$ is doubled and added to $\vec{A}$ find new resultant.





$R_{नया} = \sqrt{10^2 + (40)^2 + 2\times10\times40\cos60}$

$R_{नया} = \sqrt{100 + 1600 + 800\times\frac{1}{2}}$

$= \sqrt{2100}$

$= 10\sqrt{21}$ (N)

$C_{max} = A + B$

$C_{min} = A - B$

Q. $\vec{A}$ has magnitude 10 N

$\vec{B}$ " " 6 N

find Range of magnitude of resultant of $\vec{A}$ & $\vec{B}$

$C_{max} = A + B = 10 + 6 = 16$

$C_{min} = |A - B| = 10 - 6 = 4$

$\boxed{4 \leq C \leq 16} \Rightarrow [4, 16]$

Q. magnitude of $\vec{A}$ is 8 N (angle not given)

" " $\vec{B}$ is 6 N

which of the following can be the magnitude of $\vec{A}+\vec{B}$

(A) 10 N ✓

(B) 12 N ✓

(C) 4 N ✓

(D) 2 N ✓

(F) 2.0001 ✓

(F) 1.9999 ✗

(G) 13 N ✓

(H) 14 N ✓

(I) 13.999 N ✓

(J) 14.0001 N ✗

(K) 16 N ✗

$C_{max} = A + B = 14$

$C_{min} = A - B = 2$

$2 \le C \le 14$

Q If magnitude of resultant of $\vec{A}$ & $\vec{B}$ has max value 30 N and has min value 20 N. Find $\frac{A}{B}$ (Ratio of magnitu

$$\vec{C} = \vec{A} + \vec{B}$$

$$C_{max} = A + B = 30$$

$$C_{min} = A - B = 20$$

$$\boxed{\begin{aligned} A &= 25 \\ B &= 5 \end{aligned}}$$

Q. magnitude of resultant of $\vec{A}$ & $\vec{B}$ is 5 Unit. Where magnitude of $\vec{A}$ is $5\sqrt{3}$ Unit & magnitude of $\vec{B}$ is 5 Unit.

Find angle between $\vec{A}$ & $\vec{B}$.

(A) 60° (B) 150° (C) 120°

(D) -30°

$$\vec{C} = \vec{A} + \vec{B}$$

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$5 = \sqrt{(5\sqrt{3})^2 + 5^2 + 2 \times 5\sqrt{3} \times 5\cos\theta}$$

$$\cancel{25} = 75 + \cancel{25} + 50\sqrt{3}\cos\theta$$

$$50\sqrt{3}\cos\theta = -75$$

$$\cos\theta = \frac{-75}{50\sqrt{3}} = -\frac{\sqrt{3}}{2}$$

$$\cos\theta = -\frac{\sqrt{3}}{2}$$

Basic maths पढ़ो

$$\boxed{\theta = 150^\circ}$$

$$\boxed{\theta = 210^\circ}$$

Q magnitude of $\vec{A}$ is 10
" " $\vec{B}$ is 20
angle between $\vec{A}$ & $\vec{B}$ is 60°.

(1) find magnitude of resultant of $\vec{A}$ & $\vec{B}$

$$C = \sqrt{(10)^2 + (20)^2 + 2 \times 10 \times 20 \times \cos 60^\circ} = \sqrt{700}$$

(2) find angle made by resultant of $\vec{A}$ & $\vec{B}$ with $\vec{A}$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta} = \frac{20\sin 60^\circ}{10 + 20\cos 60} = \frac{20\frac{\sqrt{3}}{2}}{10 + 20 \times \frac{1}{2}}$$

$$\tan\alpha = \frac{\sqrt{3}}{2}$$

Q Two vector $\vec{A}$ & $\vec{B}$ having equal magnitude 'a' are at angle 60°. find magnitude of $\vec{A}+\vec{B}$ and angle made by resultant of $\vec{A}+\vec{B}$ with $\vec{A}$

$$C = \sqrt{A^2+B^2+2AB\cos\theta}$$

$$C = \sqrt{a^2+a^2+2aa\cos 60^\circ}$$

$$= a\sqrt{3}$$

$$\tan\alpha = \frac{B\sin\theta}{A+B\cos\theta} = \frac{a\sin 60}{a+a\cos 60^\circ}$$

$$\tan\alpha = \frac{\sqrt{3}/2}{1+\frac{1}{2}} = \frac{\sqrt{3}}{3} = \frac{1}{\sqrt{3}}$$

$$\boxed{\alpha = 30^\circ}$$

tough/tricky ⇒ 2 बार solve

Q Sum of magnitude of $\vec{A}$ & $\vec{B}$ is 16N. Magnitude of resultant of $\vec{A}$ & $\vec{B}$ is 8N when resultant is perpendicular to the $\vec{A}$. Find magnitude of $\vec{A}$ & $\vec{B}$.

$\theta \rightarrow$ नही पता

$\cancel{\vec{A}+\vec{B}=16}$

$$\boxed{A+B=16}$$

$$\vec{A}+\vec{B}=\vec{C}$$

mag. of $\vec{C}=8$

$$C=\sqrt{A^2+B^2+2AB\cos\theta}$$

$$64=A^2+B^2+2AB\cos\theta$$

$\vec{C}$ ने $\vec{A}$ के साथ 90° Angle बनाया

$$\alpha=90^\circ$$

$$\tan\alpha=\frac{B\sin\theta}{A+B\cos\theta}$$

$$\tan 90^\circ=\frac{B\sin\theta}{A+B\cos\theta}$$

$\tan 90^\circ \rightarrow \infty$, $A+B\cos\theta \rightarrow 0$

$$\boxed{A+B\cos\theta=0}$$

$A + B = 16$

$A + B\cos\theta = 0 \Rightarrow B\cos\theta = -A$

$64 = A^2 + B^2 + 2AB\cos\theta$

$64 = A^2 + B^2 + 2A(-A)$

$64 = A^2 + B^2 - 2A^2$

$64 = B^2 - A^2 = (B+A)(B-A)$

$64 = (B+A)(B-A)$

$64 = 16(B-A)$

$4 = B - A$

$B - A = 4$

$B + A = 16$

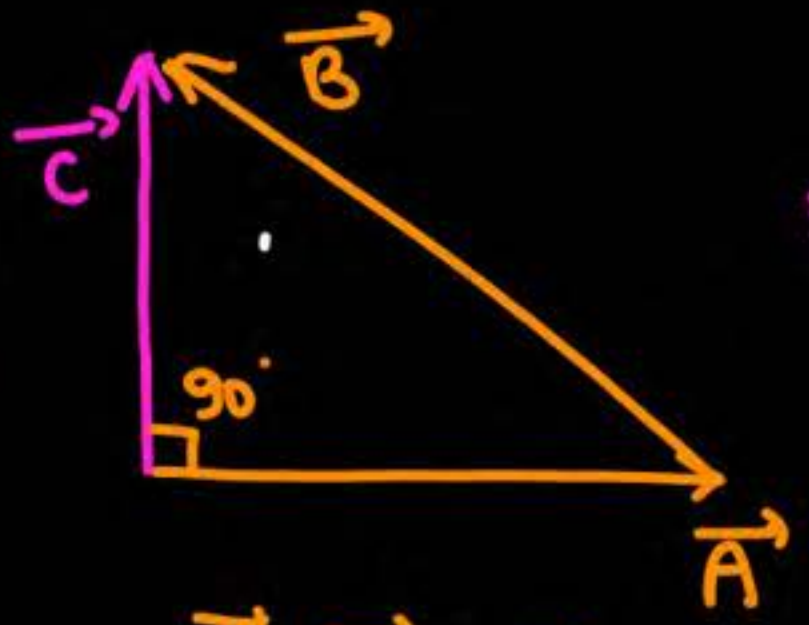
$\boxed{B = 10 \quad A = 6} \rightarrow$ Ans tough

Q2 Sum of magnitude of $\vec{A}$ & $\vec{B}$ is 16N. Magnitude of resultant of $\vec{A}$ & $\vec{B}$ is 8N when resultant is perpendicular to the $\vec{A}$. find magnitude of $\vec{A}$ & $\vec{B}$.

अच्छा method

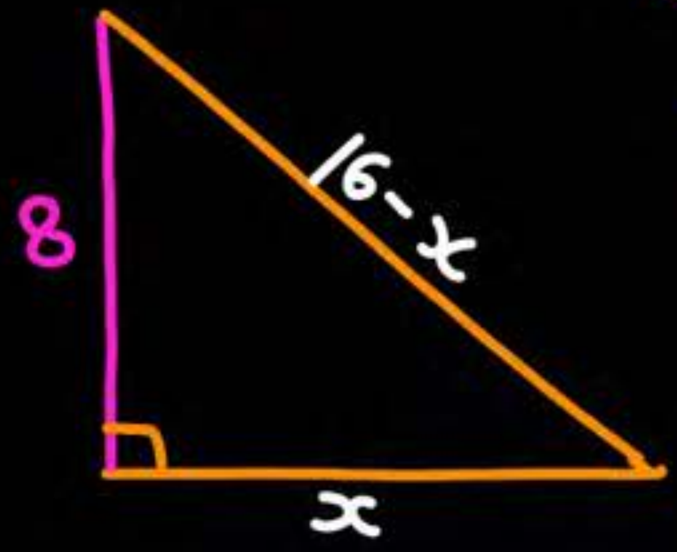
Δ बनानि की कोशिश करो

Method 2



$\vec{A} + \vec{B} = \vec{C}$

$\equiv$



$$8^2 + x^2 = (16-x)^2$$

Solve

$$\boxed{x = 6}$$

$$\begin{cases} A = 6 \\ B = 16 - x = 16 - 6 \\ B = 10 \end{cases}$$

Q Two vector $\vec{A}$ & $\vec{B}$ having same magnitude x (given)
Find magnitude of resultant of $\vec{A}$ & $\vec{B}$ if angle between them is 60°.

$A = x$
$B = x$

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$= \sqrt{x^2 + x^2 + 2 \cdot x \cdot x \cos 60^\circ}$$

$$= \sqrt{x^2 + x^2 + 2x^2 \frac{1}{2}}$$

$$\boxed{C = x\sqrt{3}}$$

Q Two vector $\vec{A}$ & $\vec{B}$ having same magnitude x.

Find magnitude of resultant of $\vec{A}$ & $\vec{B}$ if angle between them is 120°.

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$C = \sqrt{x^2 + x^2 + 2 \cdot x \cdot x \cdot \cos 120^\circ}$$

$$= \sqrt{2x^2 + 2x^2\left(-\frac{1}{2}\right)}$$

$$\boxed{C = x}$$

Q Two vector $\vec{A}$ & $\vec{B}$ having same magnitude x.

Find magnitude of resultant of $\vec{A}$ & $\vec{B}$ if angle between them is $90°$

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$C = \sqrt{x^2 + x^2 + 2 \cdot x \cdot x \cdot \cos 90°}$$

$$= \sqrt{x^2 + x^2 + 0}$$

$$\boxed{C = x\sqrt{2}}$$

Q If magnitude of $\vec{A}$ is 10N
and magnitude of $\vec{B}$ is 6N $\quad \vec{A}+\vec{B}=\vec{C}$

(1) If angle between $\vec{A}$ & $\vec{B}$ is 60° find magnitude of resultant of $\vec{A}$ & $\vec{B}$

$$C=\sqrt{100+36+2\times10\times6\cos60}=\sqrt{136+60}=\sqrt{196}=14$$

(2) If angle between $\vec{A}$ & $\vec{B}$ is 90° find magnitude of resultant of $\vec{A}$ & $\vec{B}$

$$C=\sqrt{10^2+6^2+2\times10\times6\cos90}=\sqrt{10^2+6^2}=\sqrt{136}$$

(3) If angle between $\vec{A}$ & $\vec{B}$ is 60° and $\vec{B}$ become twice to its initial value & added to $\vec{A}$ find magnitude of new resultant.

Q If magnitude of $\vec{A}$ is 10N and magnitude of $\vec{B}$ is 6N $\vec{A}+\vec{B}=\vec{C}$

(3) If angle between $\vec{A}$ & $\vec{B}$ is 60° and $\vec{B}$ become twice to its initial value & added to $\vec{A}$ find magnitude of new resultant

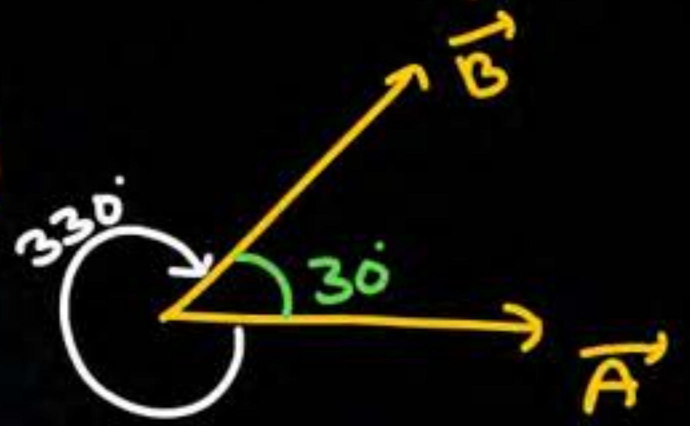
$C = \sqrt{100+144+120}$

$= \sqrt{364}$

$C_{\text{नया}} = \sqrt{10^2+(12)^2+2\times10\times12\cos60^\circ}$

find angle b/w $\vec{A}$ & $\vec{B}$

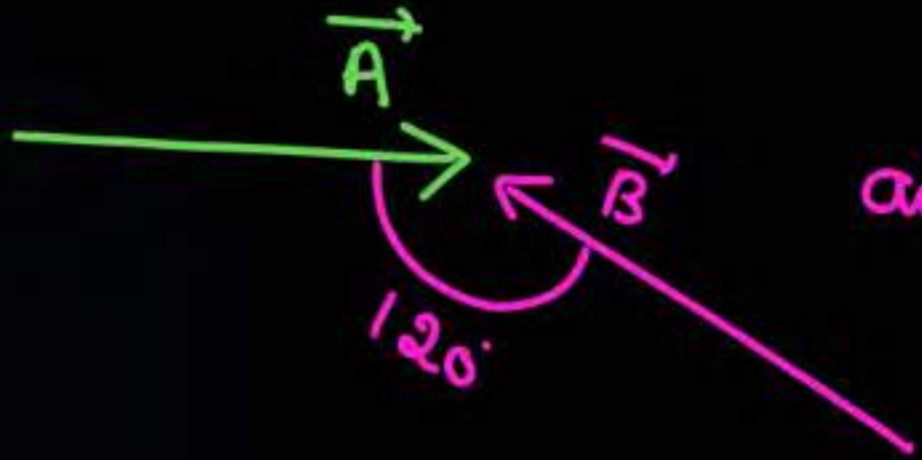
(1)



angle b/w vecter $= 30°$ ✓

$= 330°$ ✗

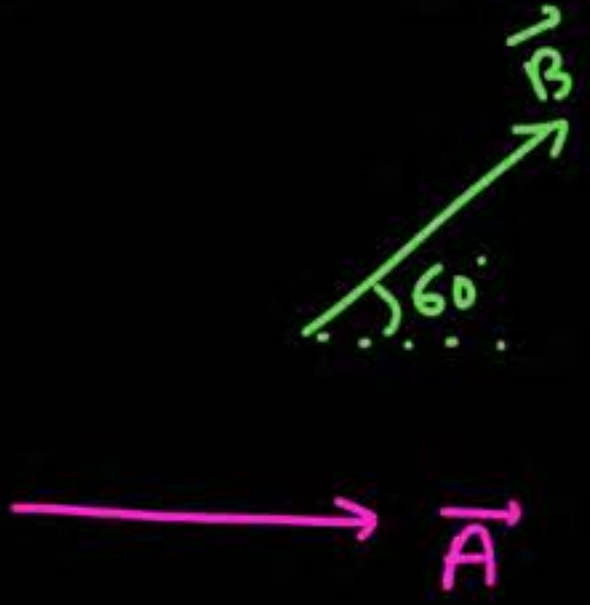
(2)



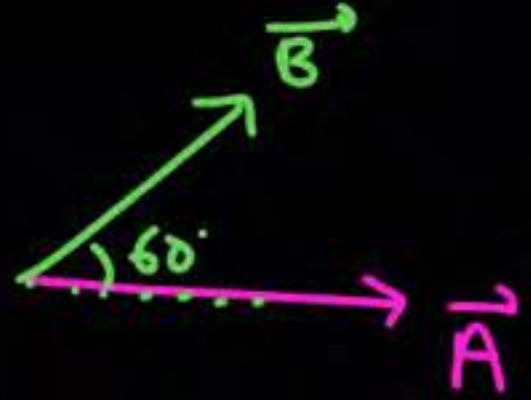
angle between vector

$= 120°$

(3)



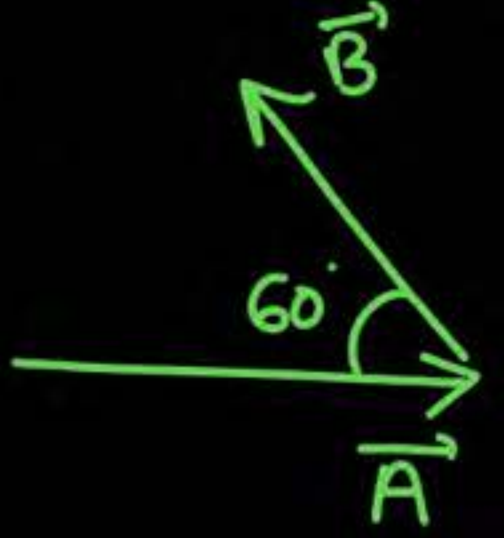
Sol^n

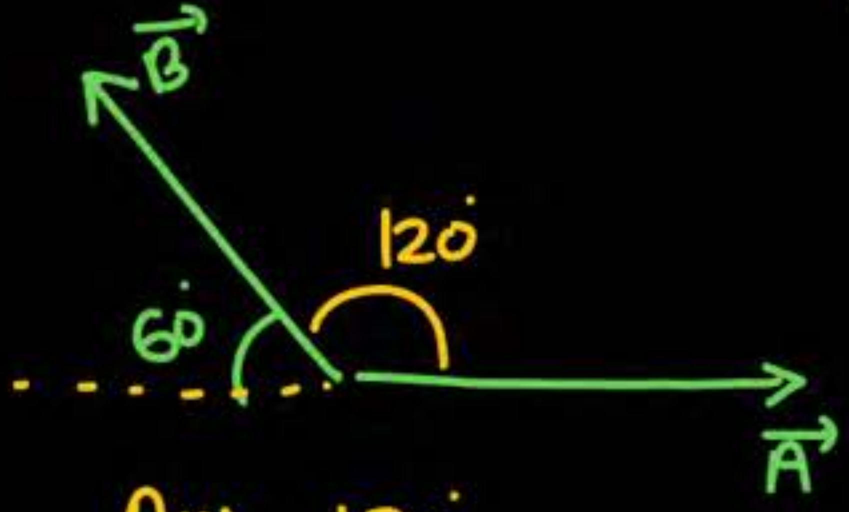


60° ✓

***

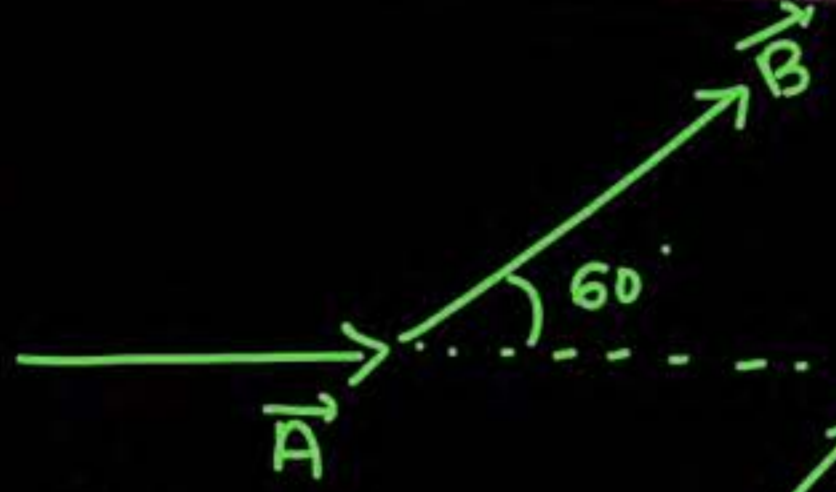
(4)



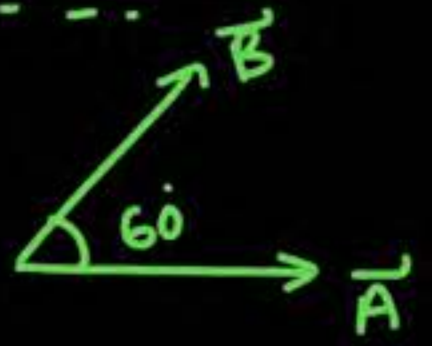


<u>Ans</u> 120°

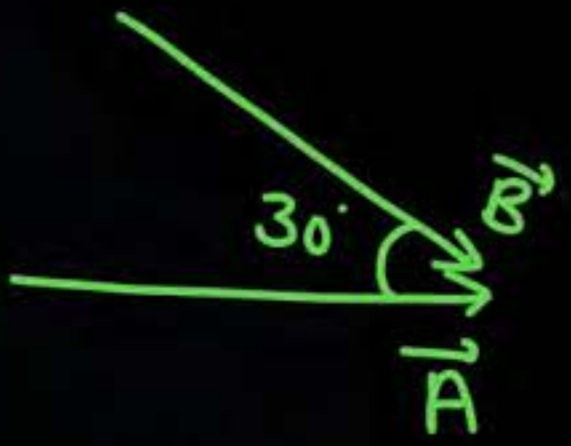
(6)



<u>Ans</u> 60°

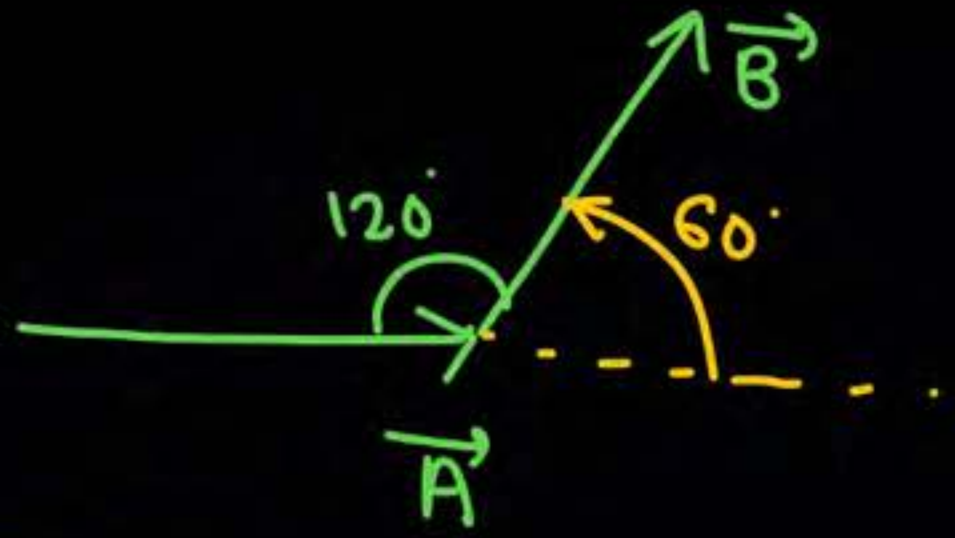


(5)



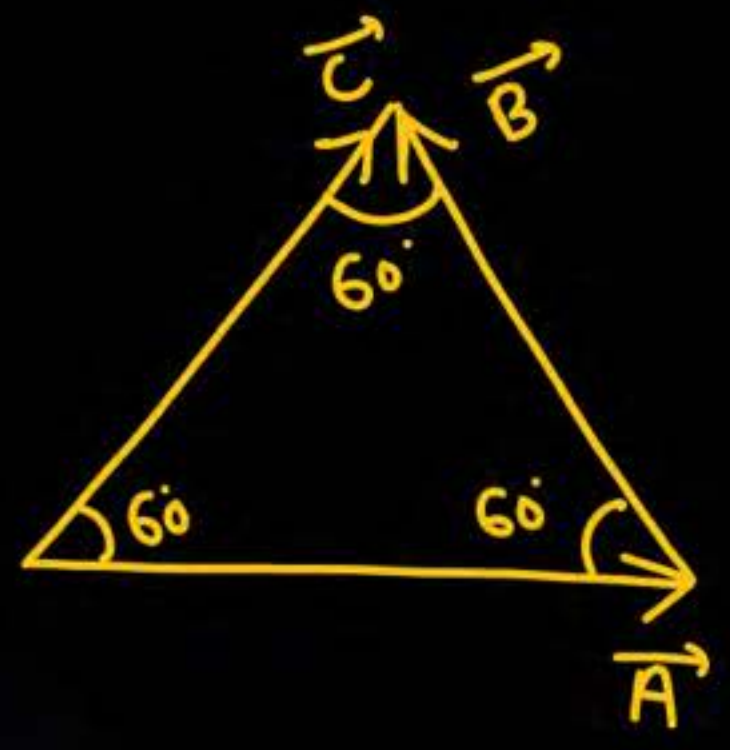
<u>Ans</u> <u>30°</u>

(7)



<u>Ans</u> = 60°

(8)

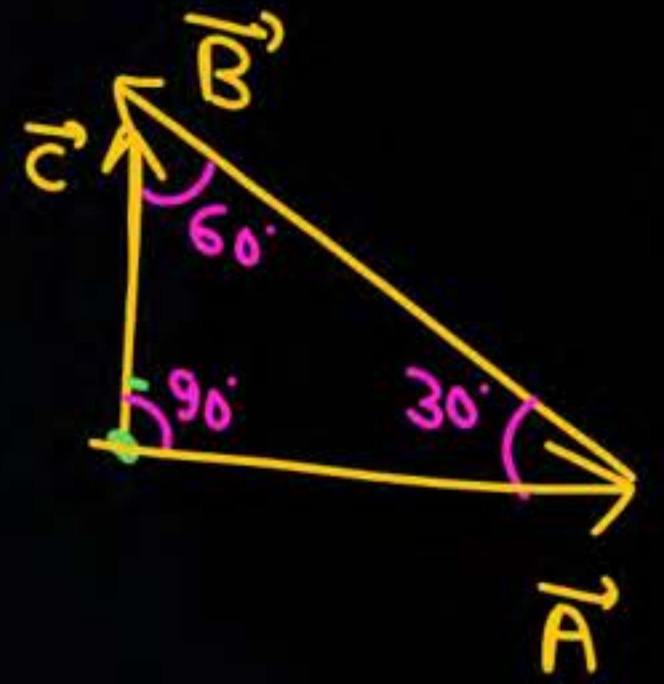


Angle between $\vec{A}$ & $\vec{B}$ = 120°

" " $\vec{B}$ & $\vec{C}$ = 60°

" " $\vec{A}$ & $\vec{C}$ = 60°

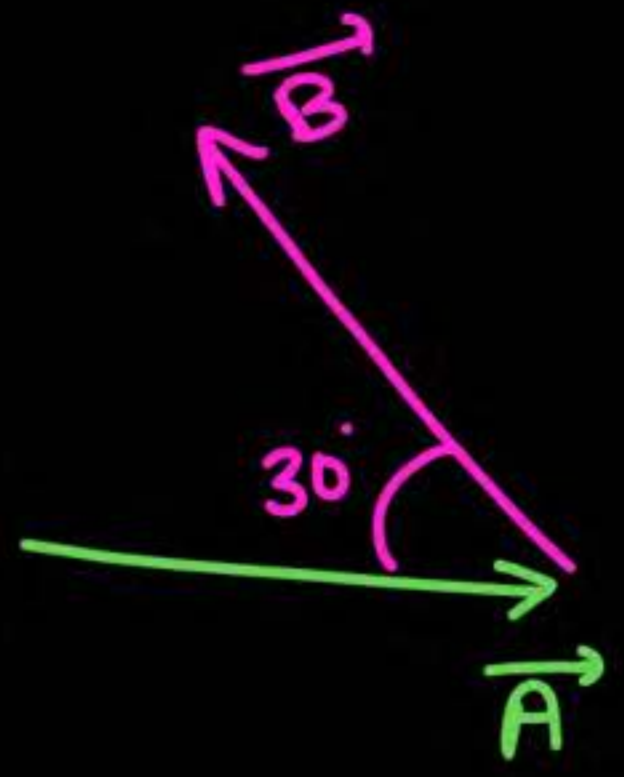
(9)



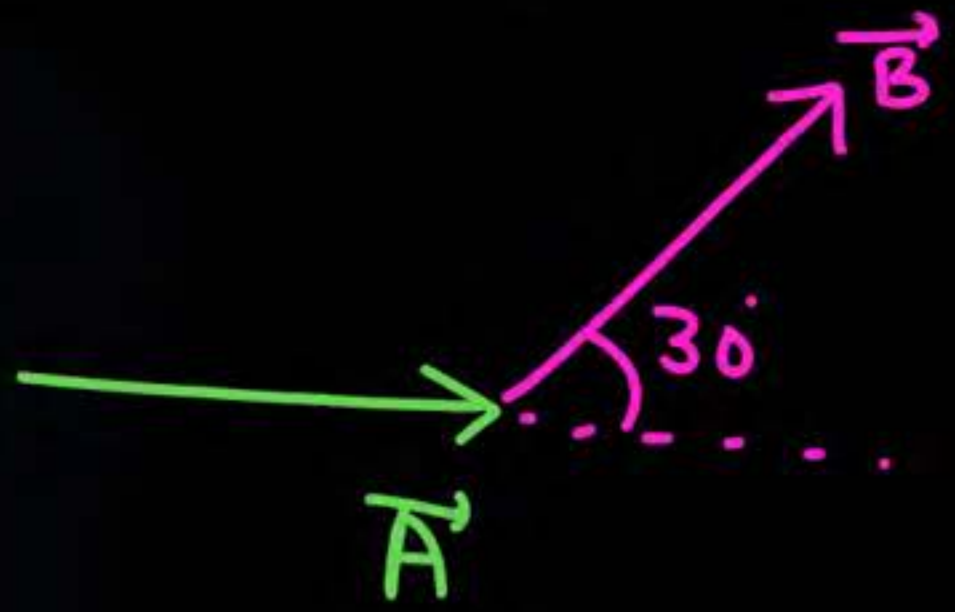
Angle between $\vec{A}$ & $\vec{B}$ = 180 - 30 = 150°

" " $\vec{B}$ & $\vec{C}$ = 60

" " $\vec{A}$ & $\vec{C}$ = 90°



Angle b/w $\vec{A}$ & $\vec{B}$ $= 180 - 30 = 150^\circ$



Angle b/w $\vec{A}$ & $\vec{B}$ $= 30^\circ$

$\vec{A} + \vec{B}$ → Addition of $\vec{A}$ & $\vec{B}$ = ?

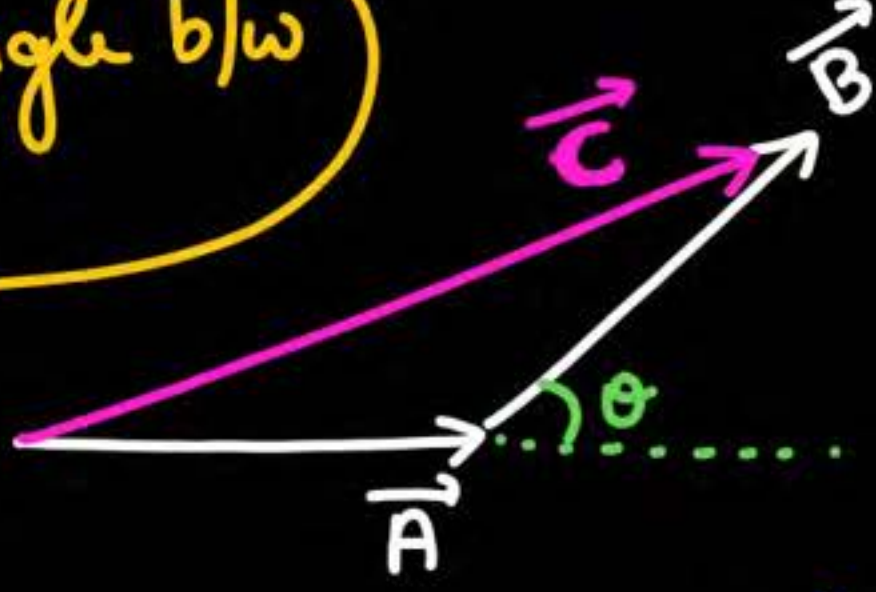
→ Resultant of $\vec{A}$ & $\vec{B}$ = ?

$\vec{A} + \vec{B}$ और $A + B$ ≡ दोनो अलग-अलग चीज है

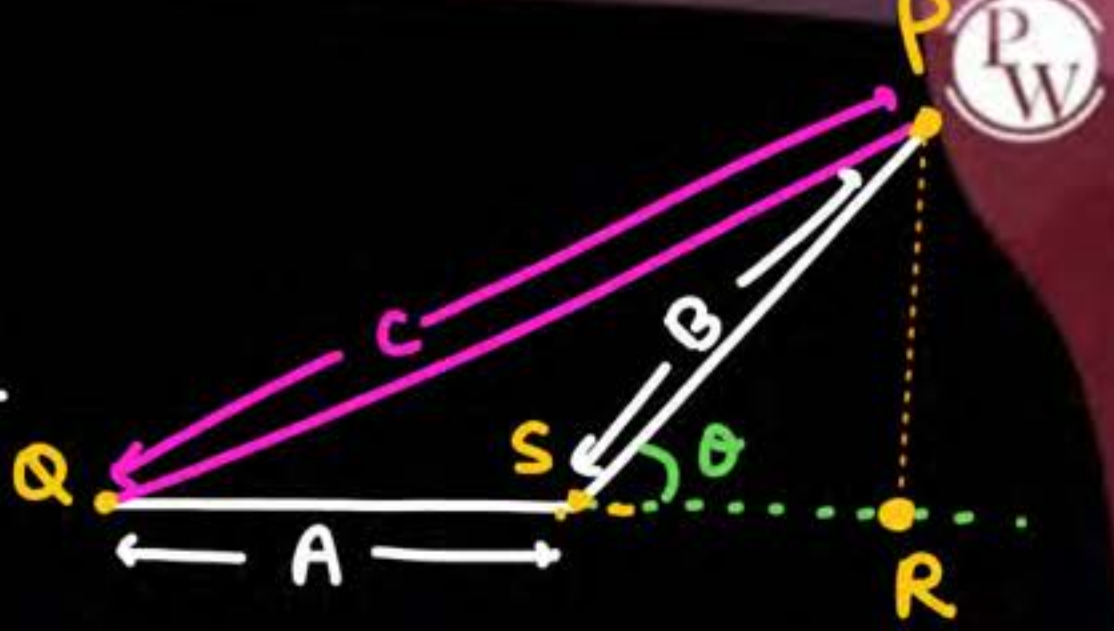
ये Derivation काम का नहीं है इसे भूल जाओ

$\theta \longrightarrow$ angle b/w $\vec{A}$ & $\vec{B}$

$\vec{A} + \vec{B} = \vec{C}$



$\equiv$



magnitude of $\vec{A} = A$

" " $\vec{B} = B$

" " $\vec{C} = C$

lenght of $\vec{C}$ = mag. of $\vec{C}$

$$(PR)^2 + (QR)^2 = (PQ)^2$$

$$(B\sin\theta)^2 + (A + B\cos\theta)^2 = C^2$$

$$B^2\sin^2\theta + A^2 + B^2\cos^2\theta + 2AB\cos\theta = C^2$$

$$A^2 + B^2(\sin^2\theta + \cos^2\theta) + 2AB\cos\theta = C^2$$

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$\cos\theta = \frac{SR}{B}$

$SR = B\cos\theta$

$\sin\theta = \frac{PR}{B}$

$PR = B\sin\theta$

Q Two forces 10 N and 20 N are acting on a block having 60° angle between them. Find magnitude of resultant of them

$$C = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$= \sqrt{(10)^2 + (20)^2 + 2 \times 10 \times 20 \times \cos 60^\circ}$$

$$= \sqrt{500 + 200} = \sqrt{700}$$ Ans

Q

$\vec{v} \rightarrow$ ऊपर

$\vec{a} \rightarrow$ नीचे

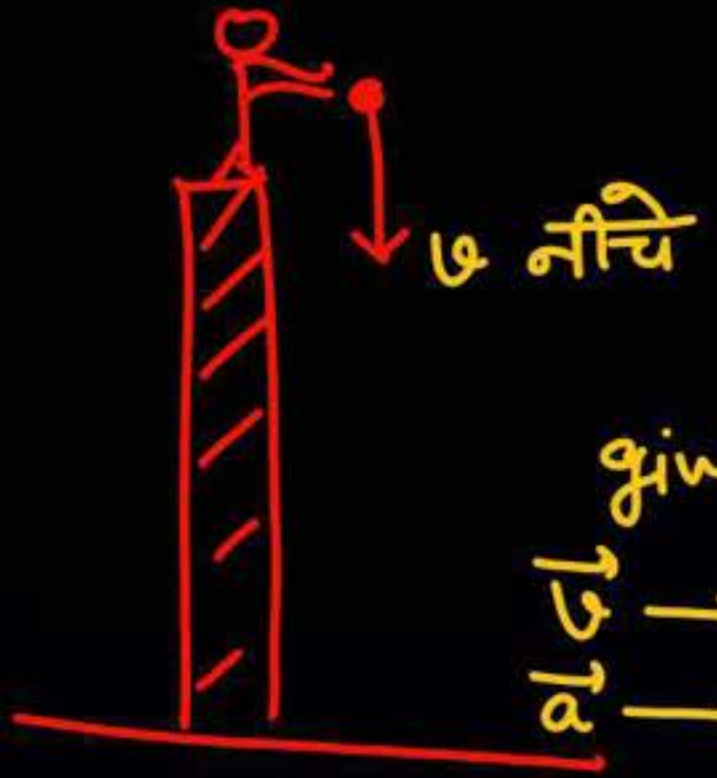
} kinamatics

$\vec{v}, \vec{a}$ are antiparallel.

No lag ≡ thumb up

lag ≡ " down

②



given

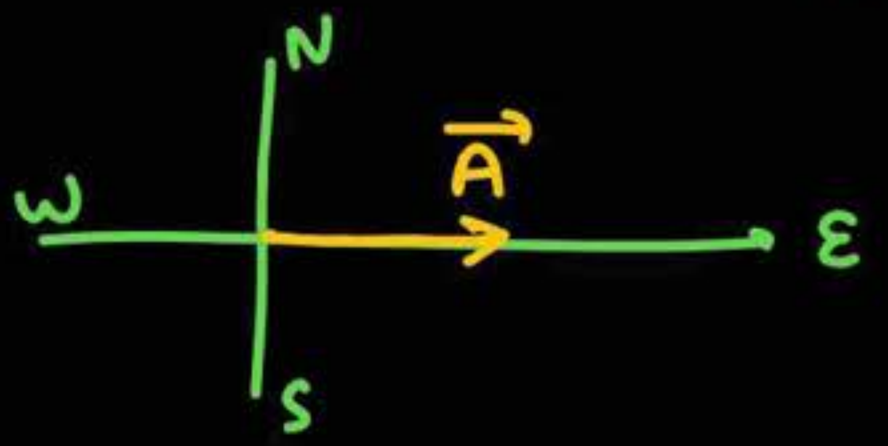
$\vec{v} \rightarrow$ नीचे

$\vec{a} \rightarrow$ नीचे

$\vec{v}, \vec{a}$ are parallel vector

Q $\quad \vec{A} = 10\,N$ (along east)

$N \rightarrow$ newton (force)



find, Draw

$2\vec{A} = 20\,N$ (along east)

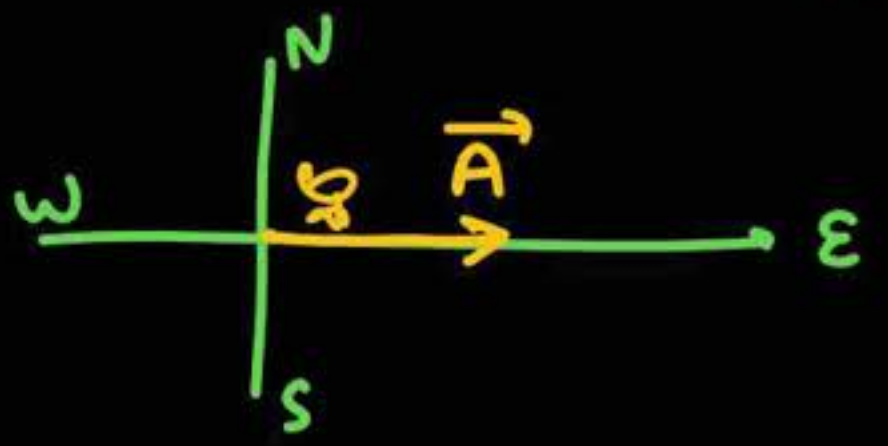
$3\vec{A} = 30\,N$ (" ")

$\frac{\vec{A}}{2} = \frac{1}{2}\vec{A} = 5\,N$ (")

$-2\vec{A} = 20\,N$ (west)

$-5\vec{A} = 50\,N$ (west)

Q $\quad \vec{v} = 10\, m/s$ (along east)



find, Draw

$2\vec{v} = 20\, m/s$ (along east)

$3\vec{v} = 30\, m/s$ (" ")

$\frac{\vec{v}}{2} = \frac{1}{2}\vec{A} = 5\, m/s$ (")

Q $t^2 - 3t + 2 = 0$

find t_1 & t_2

$$t_1 = \frac{3 + \sqrt{9 - 4 \times 2 \times 1}}{2} = \frac{3+1}{2} = 2$$

$$t_2 = \frac{3 - \sqrt{9 - 4 \times 2 \times 1}}{2} = \frac{3-1}{2} = 1$$

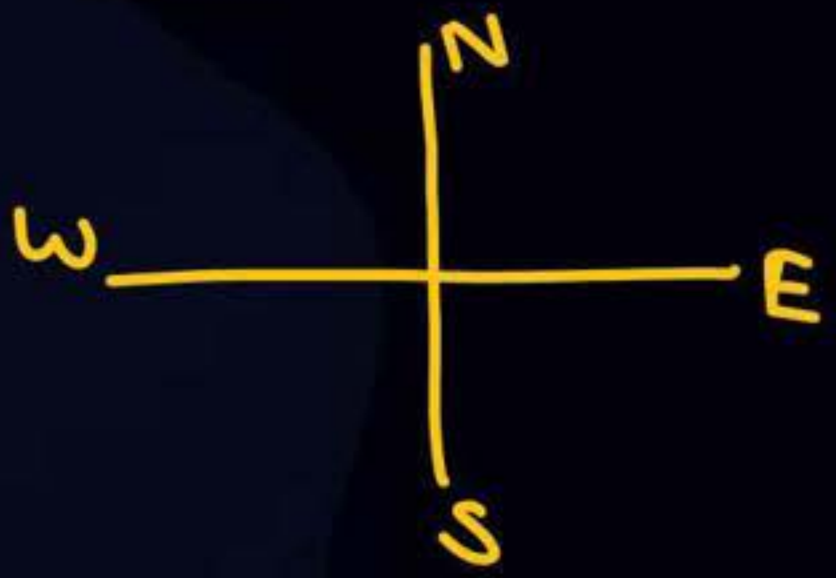
$ax^2+bx+c=0$

- $b^2-4ac>0 \longrightarrow$ two root
- $b^2-4ac=0 \longrightarrow$ 1 root
- $b^2-4ac<0 \longrightarrow$ No real root
  imaginary root

Q Represent vector $\vec{P}$ & vector $\vec{Q}$

$\vec{P} = 20\,N$ along east

$\vec{Q} = 40\,N$ along North

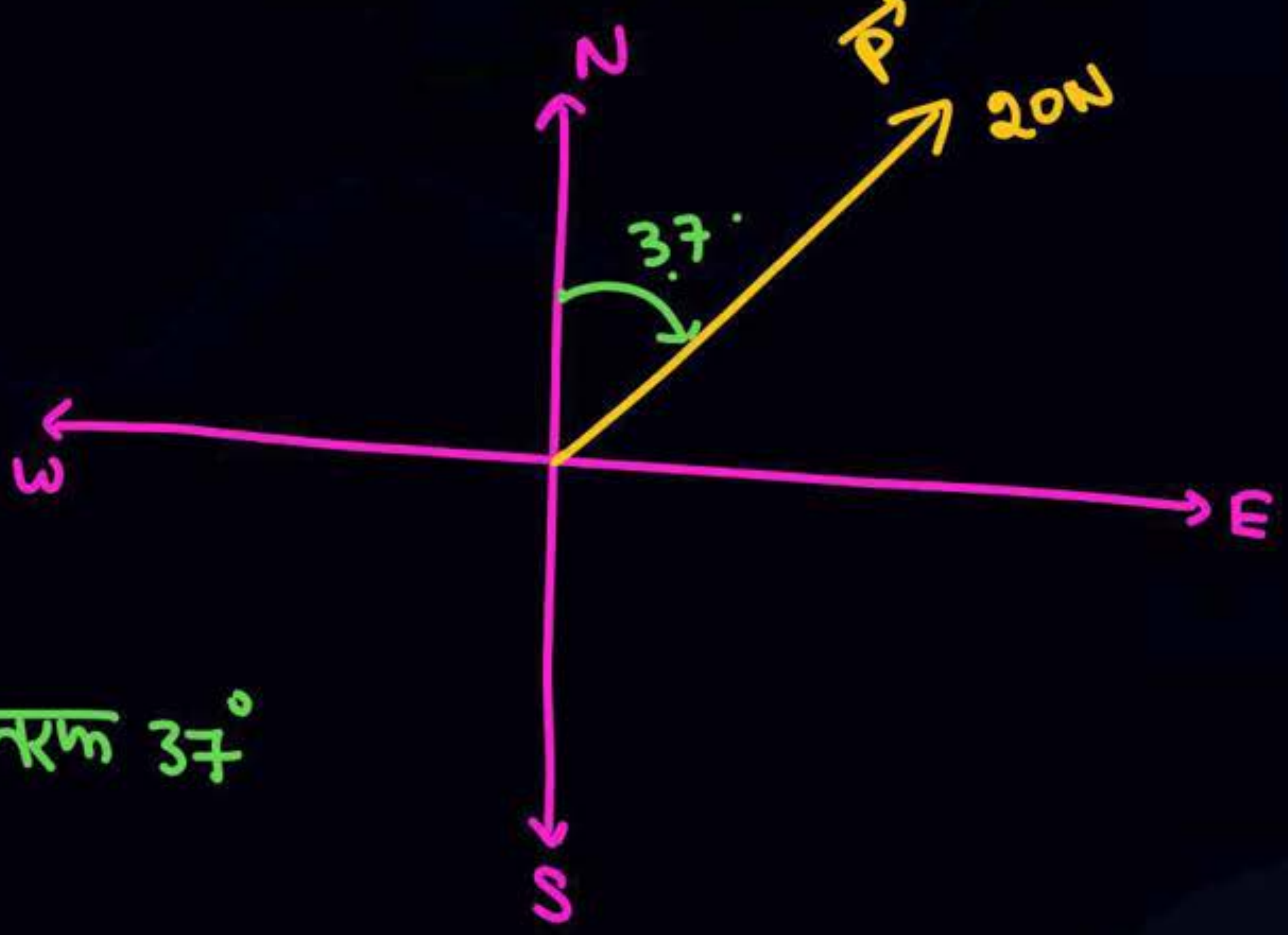


Q Represent $\vec{P}$ of magnitude 20N in direction of 37° east of north.

Q Represent $\vec{P}$ of magnitude 20N in direction of 37° east of north

|||

North से east की तरफ 37°



(2) <u>parallel vector</u> → Two vectors are said to be parallel if they have same direction.

<u>Q</u> Block is moving with velocity 10 m/s along east dir^n

here

$\vec{F_1}$ & $\vec{F_2}$ are parallel vector ✓

" " " equal vector ✗

$\vec{F_1}$ & $\vec{v}$ are parallel vector ✓

$\vec{F_2}$ & $\vec{v}$ " " " ✓

$\vec{F_1}$ & $\vec{F_3}$ are antiparallel ✓

$\vec{v}$ & $\vec{F_3}$ " " " ✓

Q $\vec{A} = 4\hat{i} - 2\hat{j}$

$\vec{B} = 3\hat{i} + 4\hat{j}$

$264 - 264 = 0$

(1) Component of $\vec{A}$ parallel to $\vec{B}$ $= A\cos\theta = \dfrac{\vec{A}\cdot\vec{B}}{B} = \dfrac{12-8}{5} = \dfrac{4}{5}$

" " " vector form $= \dfrac{4}{5}\cdot\hat{B} = \dfrac{4}{5}\left(\dfrac{3\hat{i}+4\hat{j}}{5}\right) = \dfrac{12\hat{i}+16\hat{j}}{25}$

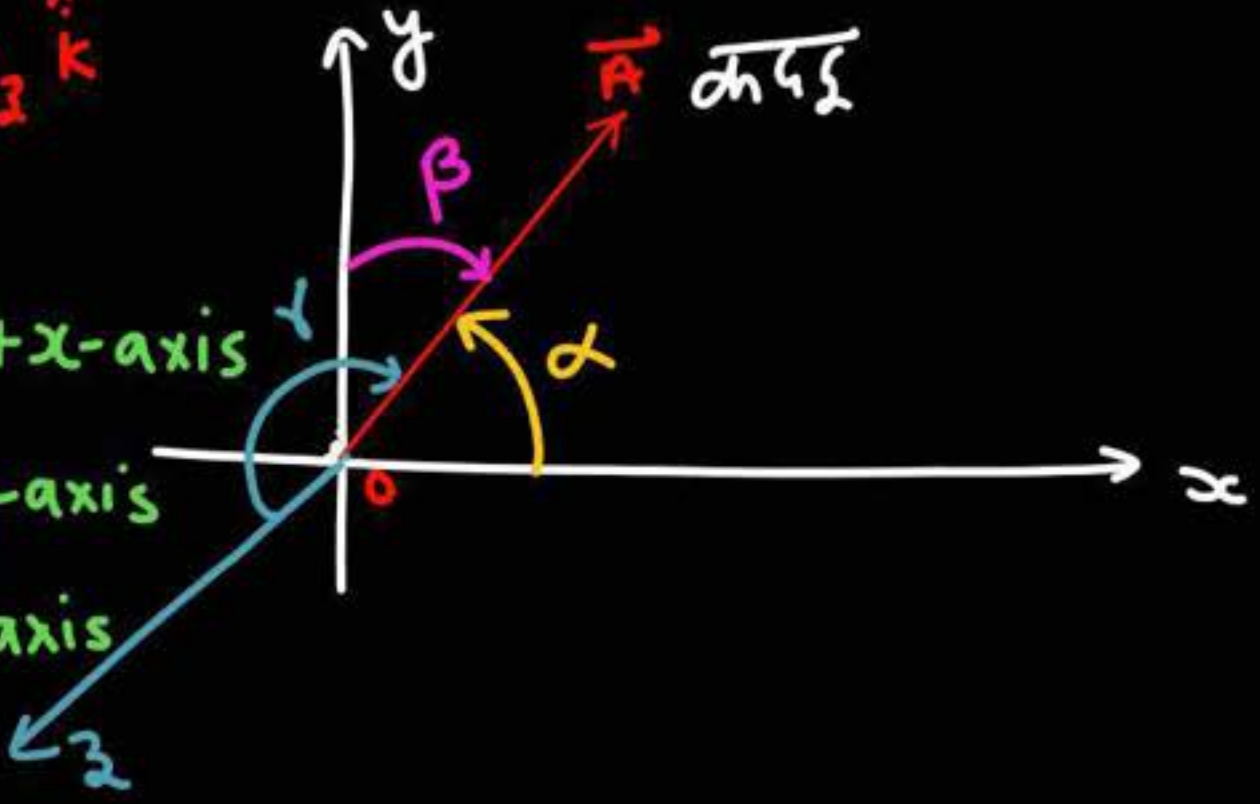
(2) Component of $\vec{A}$ perpendicular to $\vec{B}$ $= \vec{A} - \vec{A}_{\parallel}$

$= (4\hat{i} - 2\hat{j}) - \dfrac{12\hat{i}+16\hat{j}}{25}$

$= \dfrac{88\hat{i} - 66\hat{j}}{25}$

Direction Cosine.

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$



If $\vec{A}$ makes angle α with $+x$-axis

" " β " $+y$-axis

" " γ " $+z$-axis

$\cos\alpha = \dfrac{A_x}{A}$

$\cos\beta = \dfrac{A_y}{A}$

$\cos\gamma = \dfrac{A_z}{A}$

Component of $\vec{A}$ along x-Axis $= A\cos\alpha = A_x$

" " " y " $= A\cos\beta = A_y$

" " " z " $= A\cos\gamma = A_z$

Q $\vec{A} = 2\hat{i} + 3\hat{j} + 6\hat{k}$

$A = |\vec{A}| = \sqrt{2^2 + 3^2 + 6^2} = 7$

$$\left.\begin{aligned} \cos\alpha &= \frac{A_x}{A} = \frac{2}{7} \\ \cos\beta &= \frac{A_y}{A} = \frac{3}{7} \\ \cos\gamma &= \frac{A_z}{A} = \frac{6}{7} \end{aligned}\right\} \text{direction cosine}$$

Silly

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$\sin^2\alpha + \sin^2\beta + \sin^2\gamma = \cancel{1}$

$= 2$ ✓

$\rightarrow 1 - \sin^2\alpha + 1 - \sin^2\beta + 1 - \sin^2\gamma = 1$

$\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2.$

***

Q $\vec{A} = 3\hat{i} + 4\hat{j} + 5K$ $\quad A = \sqrt{3^2 + 4^2 + 5^2} = 5\sqrt{2}$

(1) Direction cosine

$\cos\alpha = \frac{3}{5\sqrt{2}}$

$\cos\beta = \frac{4}{5\sqrt{2}}$

$\cos\gamma = \frac{5}{5\sqrt{2}} = \frac{1}{\sqrt{2}}$, $\gamma = 45^\circ$

(2) Component of $\vec{A}$ along x-axis $= 3\hat{i}$

(3) " " " y " $= 4\hat{j}$

(4) " " " z " $= 5\hat{k}$

*(5) " " on x-y plane $= 3\hat{i} + 4\hat{j}$

*(6) " " on y-z plane $= 4\hat{j} + 5\hat{k}$

$$\hat{i}\cdot\hat{j}\,\hat{k}\,\hat{i}\,\hat{j}\,\hat{k}\,\hat{i}\,\hat{j}\,\hat{k} \longrightarrow K\cdot C\cdot$$

Same seq ≡ + Remaining

उल्टा seq = − Reman

**

Q $\vec{a} = 3\hat{i} + 4\hat{j}$

$\vec{b} = 2\hat{i} + 5\hat{j}$

$\hat{i} \times \hat{i} = 0$

$\hat{j} \times \hat{j} = 0$

$$\vec{a} \times \vec{b} = (3\hat{i} + 4\hat{j}) \times (2\hat{i} + 5\hat{j})$$

$$= 6\,\hat{i}\times\hat{i} + 15\,\hat{i}\times\hat{j} + 8\,\hat{j}\times\hat{i} + 20\,\hat{j}\times\hat{j}$$

$$= 0 + 15\hat{k} - 8\hat{k} + 0$$

$$= 7\hat{k} = \vec{C}$$

$\vec{C} \perp \vec{A}$, $\vec{C} \perp \vec{B}$

Q $\vec{a} = 4\hat{i} + 7\hat{j}$

$\vec{b} = 2\hat{i} + 3\hat{j}$

① $\vec{a} \times \vec{b} = ?$

② $\vec{b} \times \vec{a} = ?$

Q $\vec{a} = 4\hat{i} + 7\hat{j}$

$\vec{b} = 2\hat{i} + 3\hat{j}$

$\vec{a} \times \vec{b} = (4\hat{i} + 7\hat{j}) \times (2\hat{i} + 3\hat{j})$

$= 0 + 12\hat{k} - 14\hat{k} + 0$

$= -2\hat{k}$

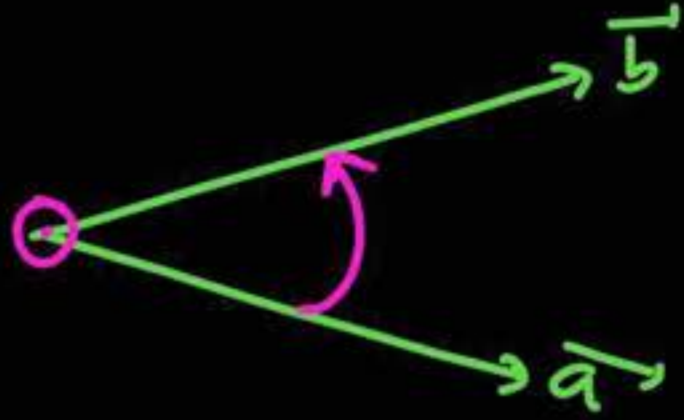
$\vec{b} \times \vec{a} = (2\hat{i} + 3\hat{j}) \times (4\hat{i} + 7\hat{j})$

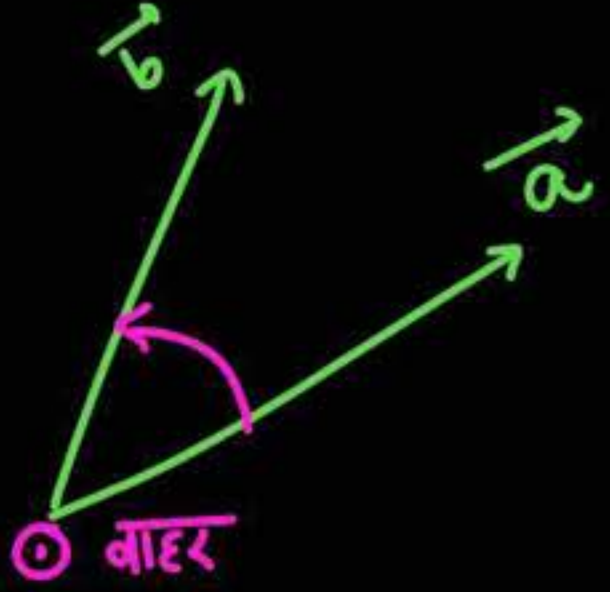
$= 0 + 14\hat{k} - 12\hat{k} + 0$

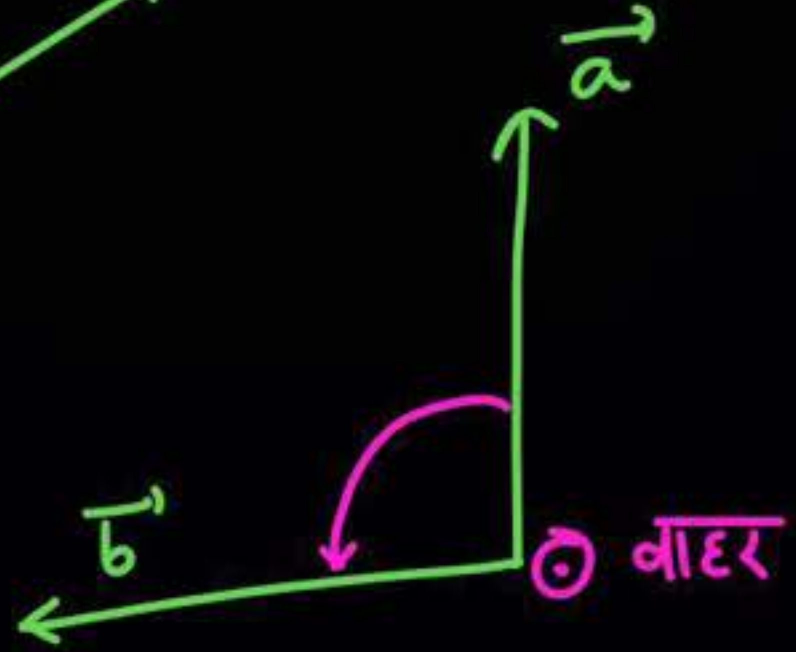
$\boxed{\vec{b} \times \vec{a} = +2\hat{k}}$

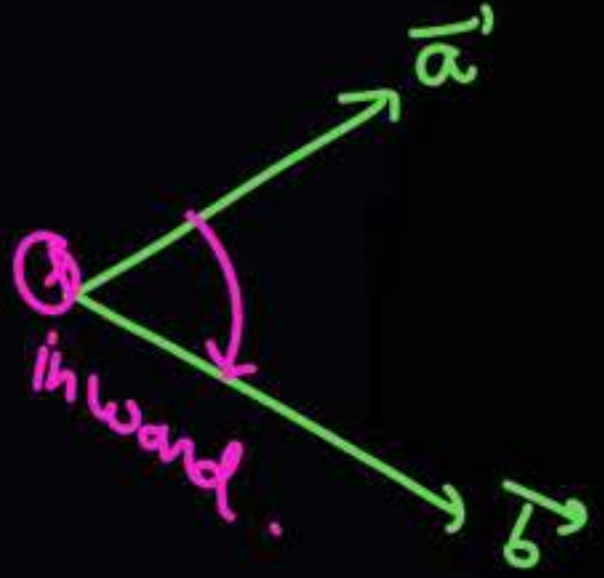
$\boxed{\vec{a} \times \vec{b} = -\vec{b} \times \vec{a}}$

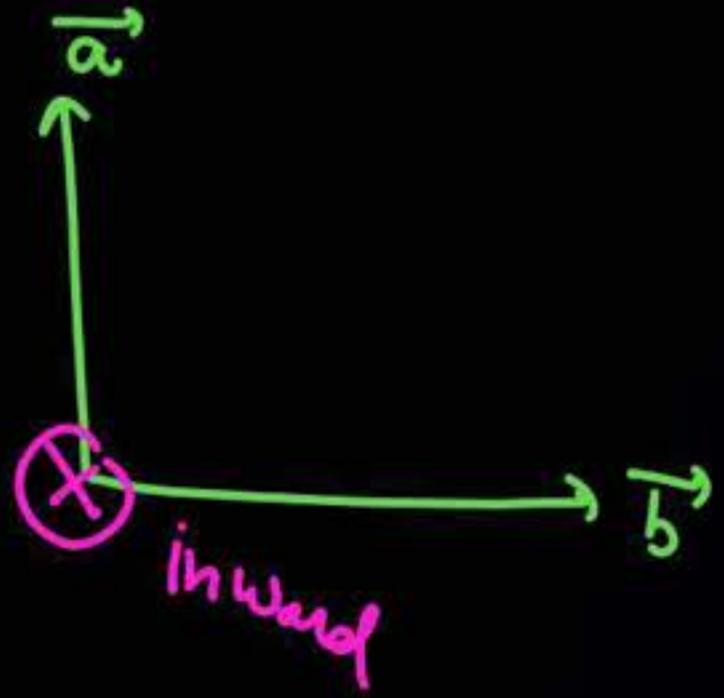
Q Find dir^n of $\vec{a} \times \vec{b}$

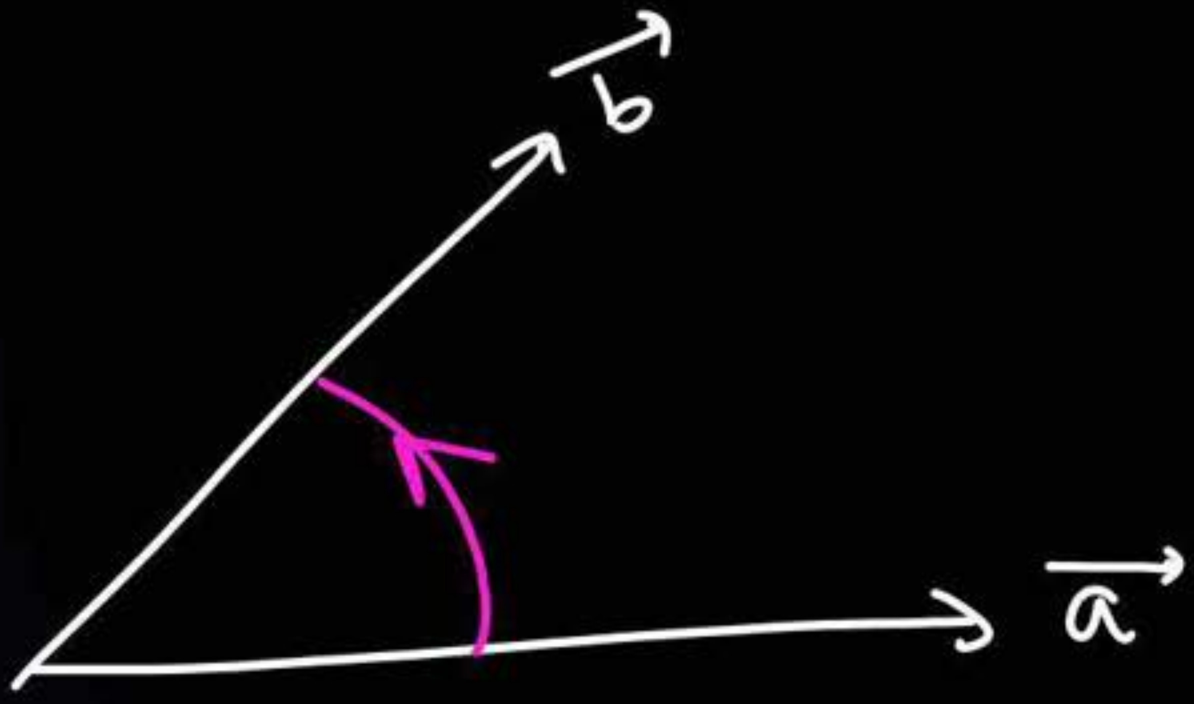






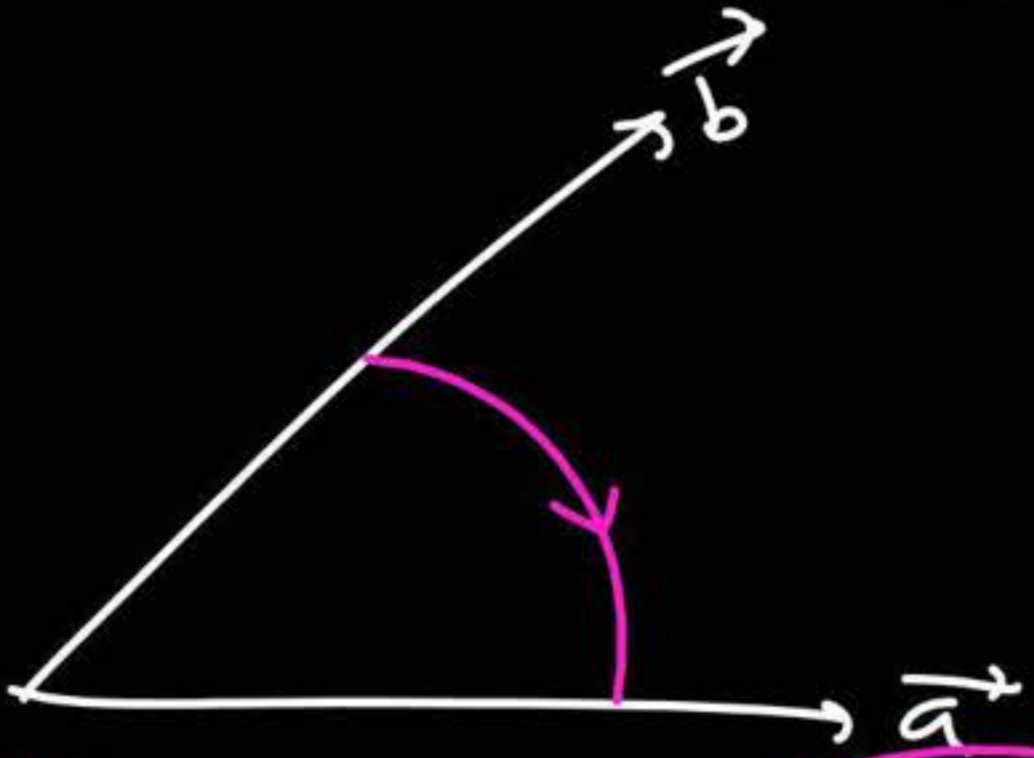




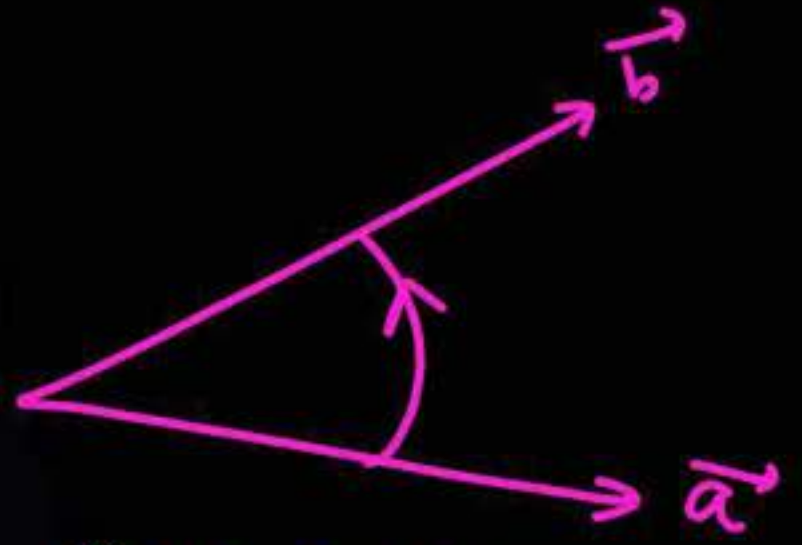


$\vec{a}\times\vec{b} \equiv dir^n$

ACW $\equiv$ बाहर



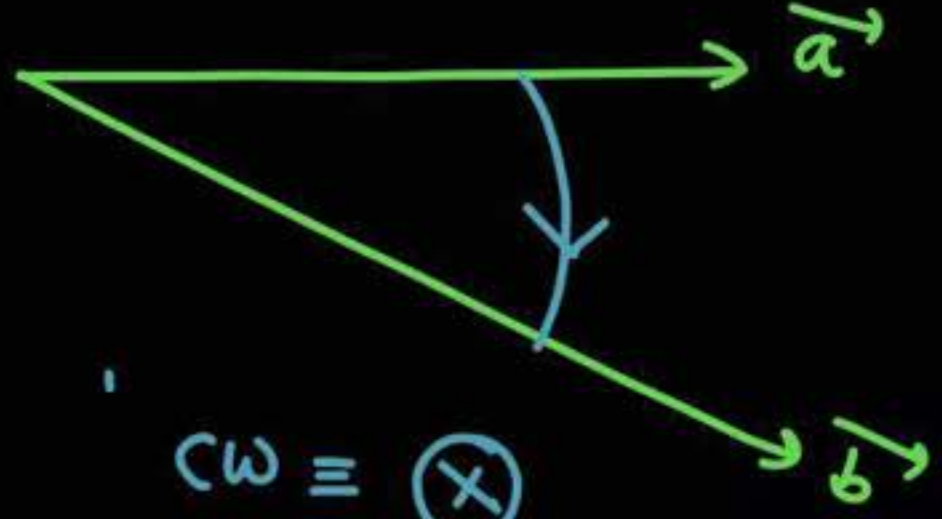
$\vec{b}\times\vec{a}$ CW $\perp$ inward



ACW sense

$\equiv$

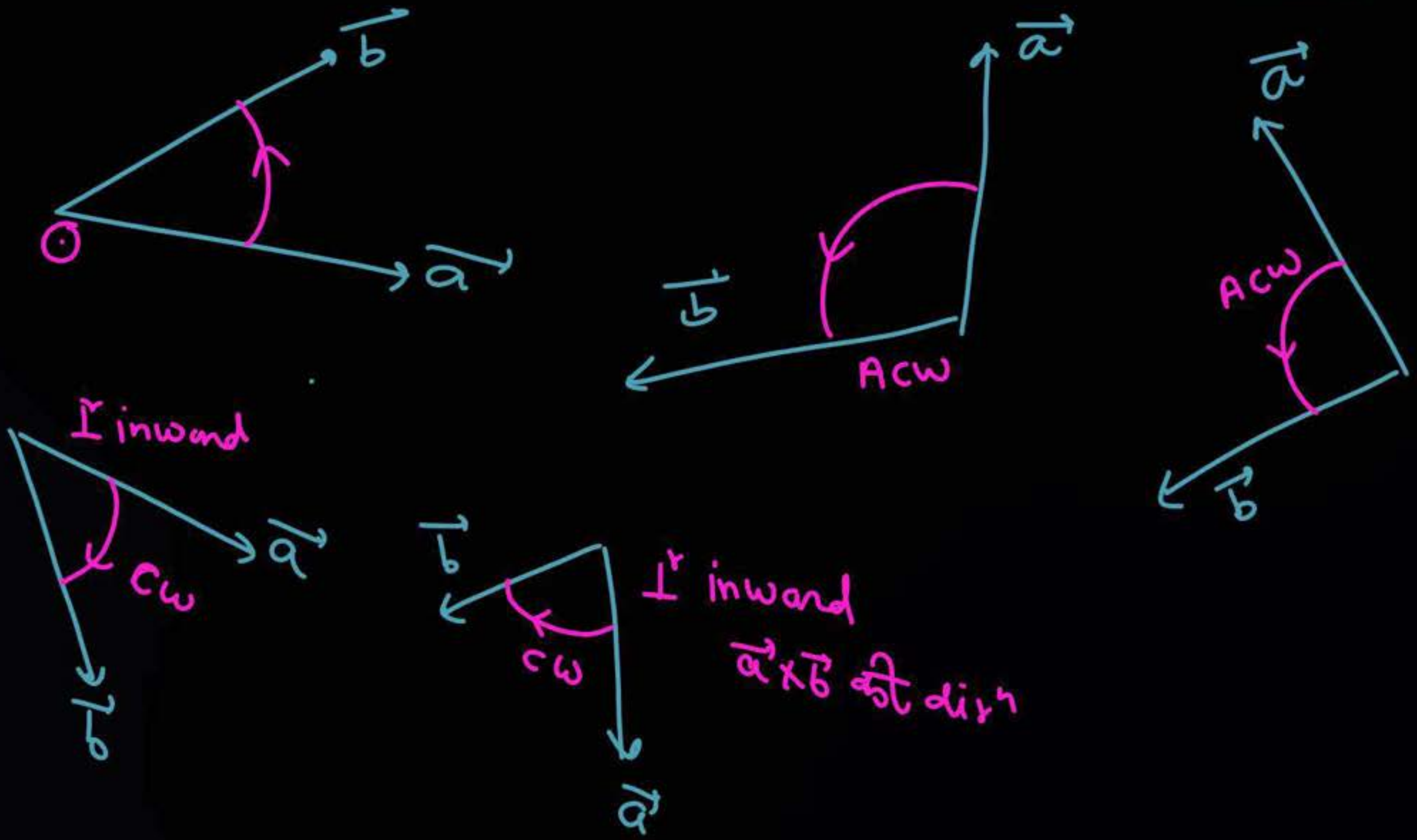
$\odot \equiv (\perp^{r} \text{ outward})$



CW $\equiv \otimes$

$\perp^{r}$ inward

Q.



$\vec{b}$
O
$\vec{a}$
$\vec{a}$
$\vec{b}$
ACW
$\vec{a}$
ACW
$\vec{b}$
$\perp^r$ inward
$\vec{a}$
CW
$\vec{b}$
$\vec{b}$
CW
$\perp^r$ inward
$\vec{a} \times \vec{b}$ की dirn
$\vec{a}$

imp. points

$\hat{i}\cdot\hat{i} = 1$

$\hat{j}\cdot\hat{j} = 1$

$\hat{k}\cdot\hat{k} = 1$

$\hat{i}\cdot\hat{j} = \hat{j}\cdot\hat{k} = \hat{i}\cdot\hat{k} = 0$

If $\vec{A} \perp \vec{B} \Rightarrow \vec{A}\cdot\vec{B} = 0$

zero

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$\vec{A}\cdot\vec{A} = A^2$

$(\vec{A}+\vec{B})\cdot(\vec{C}+\vec{D}) = \vec{A}\cdot\vec{C} + \vec{A}\cdot\vec{D} + \vec{B}\cdot\vec{C} + \vec{B}\cdot\vec{D} = 0$

$\vec{A}\cdot\vec{B} = \vec{B}\cdot\vec{A} = AB\cos\theta$

$\vec{A} = 2\hat{i} - 5\hat{j} + 7\hat{k}$

$\vec{B} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$\vec{A}\cdot\vec{B} = 6 - 20 + 35 = 21$

Q find $\vec{A}\cdot\vec{B}$

(1) $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$\vec{B} = 2\hat{i} - 3\hat{j} - 4\hat{k}$

$\vec{A}\cdot\vec{B} = 6 - 12 - 20 = -26$

(2) $\vec{A} = \hat{i} - \hat{k}$

$\vec{B} = \hat{j} + \hat{k}$

$\vec{A} = \hat{i} + 0\hat{j} - \hat{k}$

$\vec{B} = 0\hat{i} + \hat{j} + \hat{k}$

$\vec{A}\cdot\vec{B} = 0 + 0 - 1 = -1$

(3) $\left.\begin{aligned}\vec{A} &= \hat{i} - \hat{j} + 2\hat{k}\\ \vec{B} &= 4\hat{i} + 8\hat{j} + 2\hat{k}\end{aligned}\right\}\ \vec{A} \perp \vec{B}$

$\vec{A}\cdot\vec{B} = 4 - 8 + 4 = 0$

(4) $\vec{A} = \hat{i} - \hat{j} = \hat{i} - \hat{j} + 0\hat{k}$

$\vec{B} = \hat{i} + \hat{k} = \hat{i} + 0\hat{j} + \hat{k}$

$\vec{A}\cdot\vec{B} = 1 + 0 + 0 = 1$

अगर दो vector $\perp^r$ हैं तो उनका dot product zero होगा

JEE main मे स्कूप =

Q $\vec{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

$\vec{B} = \alpha\hat{i} + 2\hat{j} + 5\hat{k}$

If $\vec{A} \perp \vec{B}$ find α

$$\vec{A} \cdot \vec{B} = 0$$

$$2\alpha - 6 + 20 = 0$$

$$2\alpha + 14 = 0$$

$$\boxed{\alpha = -7}$$

Q. Find angle b/w $\vec{A}$ & $\vec{B}$

$$\vec{A} = \hat{i} + \hat{j}$$
$$\vec{B} = 3\hat{i} + 4\hat{j}$$

$$\vec{A}\cdot\vec{B} = 3+4$$
$$= 7$$

$$\vec{A}\cdot\vec{B} = AB\cos\theta$$
$$7 = \sqrt{2}\,5\cos\theta$$

डरना मत

$$\cos\theta = \frac{7}{5\sqrt{2}}$$
$$\theta = \cos^{-1}\left(\frac{7}{5\sqrt{2}}\right)$$

***

$$\vec{A}\cdot\vec{B} = AB\cos\theta$$
$$\cos\theta = \frac{\vec{A}\cdot\vec{B}}{AB}$$

Q. $$\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$$
$$\vec{B} = 2\hat{i} + 3\hat{j} + 6\hat{k}$$

$$A = \sqrt{3^2+4^2+5^2} = 5\sqrt{2}$$
$$B = \sqrt{2^2+3^2+6^2} = 7$$

$$\vec{A}\cdot\vec{B} = 6+12+30 = 48$$
$$\vec{A}\cdot\vec{B} = AB\cos\theta$$
$$48 = 5\sqrt{2}\,7\cos\theta$$
$$\cos\theta = \frac{48}{35\sqrt{2}}$$

Q Find the angle between $\vec{A}$ & $\vec{B}$

$\vec{A}\cdot\vec{B} = AB\cos\theta$

? ?

① $\vec{A} = \hat{i} + \hat{j} + \hat{k}$

$\vec{B} = \hat{i} - \hat{j} + \hat{k}$

$\vec{A}\cdot\vec{B} = 1 - 1 + 1 = 1$

$1 = \sqrt{3}\sqrt{3}\cos\theta$

$\boxed{\cos\theta = \frac{1}{3}}$ $\theta = \cos^{-1}\left(\frac{1}{3}\right)$

② $\vec{A} = \hat{i} + \hat{j}$

$\vec{B} = \hat{i} - \hat{j}$

$\vec{A}\cdot\vec{B} = 1 - 1 = 0$

$\theta = 90^\circ$

③ $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$\vec{B} = 2\hat{i} - 4\hat{j} + 2\hat{k}$

$\vec{A}\cdot\vec{B} = 6 - 16 + 10 = 0$

$\theta = 90^\circ$

④ $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$\vec{B} = 6\hat{i} + 8\hat{j} + 10\hat{k}$

$A = 5\sqrt{2}$

$B = 10\sqrt{2}$

$\vec{A}\cdot\vec{B} = 18 + 32 + 50 = 100$

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$100 = 5\sqrt{2}\,10\sqrt{2}\cos\theta$

$\cos\theta = 1$

$\theta = 0^\circ$

$\vec{A}$ & $\vec{B}$ are parallel

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$
$$\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$$

Q $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$
$\vec{B} = 6\hat{i} + 8\hat{j} + 10\hat{k} = 2[3\hat{i} + 4\hat{j} + 5\hat{k}]$

$\frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{1}{2}$ $\vec{B} = 2\vec{A}$

$\vec{A} \uparrow\uparrow$ to $\vec{B}$

If

$$\frac{A_x}{B_x} = \frac{A_y}{B_y} = \frac{A_z}{B_z} = n$$

$\rightarrow n > 0 \Rightarrow \vec{A}$ is parallel to $\vec{B}$

$\rightarrow n < 0 \Rightarrow \vec{A}$ is antiparallel to $\vec{B}$

Q $\vec{A} = 4\hat{i} + 6\hat{j}$
$\vec{B} = 12\hat{i} + 18\hat{j}$ $\frac{4}{12} = \frac{6}{18}$

$\vec{A} \uparrow\uparrow \vec{B}$

Q $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$

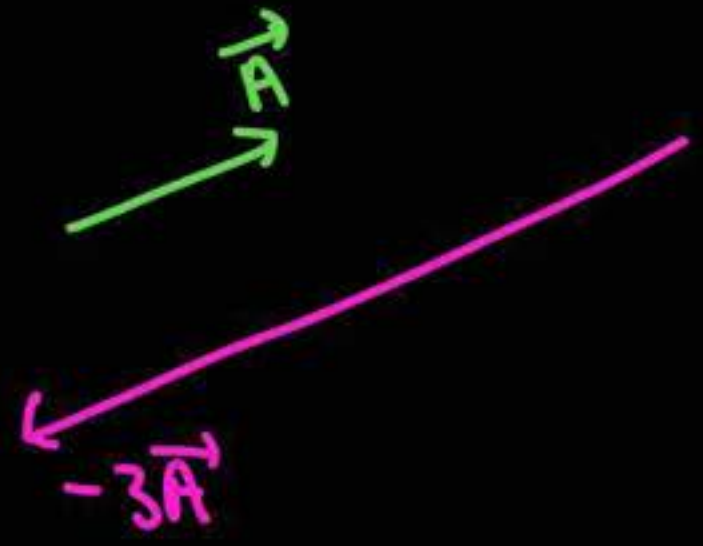
$\vec{B} = -9\hat{i} + 12\hat{j} - 15\hat{k}$

$= -3(3\hat{i} - 4\hat{j} + 5\hat{k})$

$$\boxed{\frac{3}{-9} = \frac{-4}{12} = \frac{5}{-15} = -\frac{1}{3}}$$

Antiparallel

$\vec{B} = -3\vec{A}$



Q $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

$\vec{B} = 4\hat{i} + 6\hat{j} - 8\hat{k}$

~~(a)~~ $\vec{A}$ is parallel to $\vec{B}$

~~(b)~~ " antiparallel "

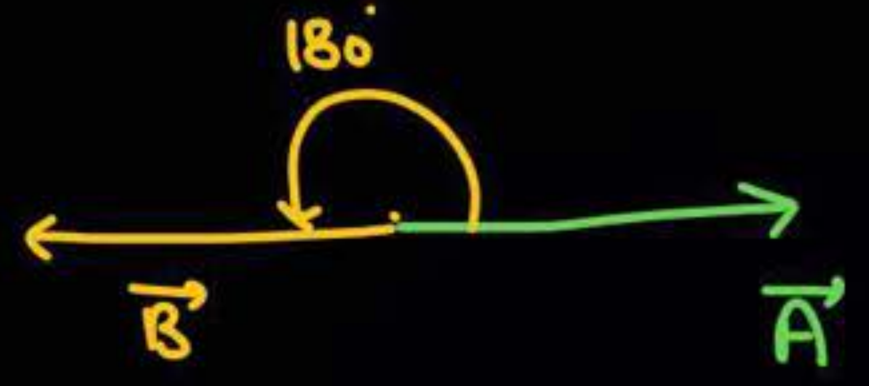
(c) कुछ भी नहीं है, कद्दू है

$\vec{A}, \vec{B}$ $\parallel^{r}$ हैं antiparallel हैं या $\perp^{r}$ हैं, या कद्दू है

$\cos\theta = \frac{\vec{A}\cdot\vec{B}}{AB}$ = निकाल लो।

If

$\theta = 0$	parallel
$\theta = 180$	Antiparallel
$\theta = 90$	$\perp$

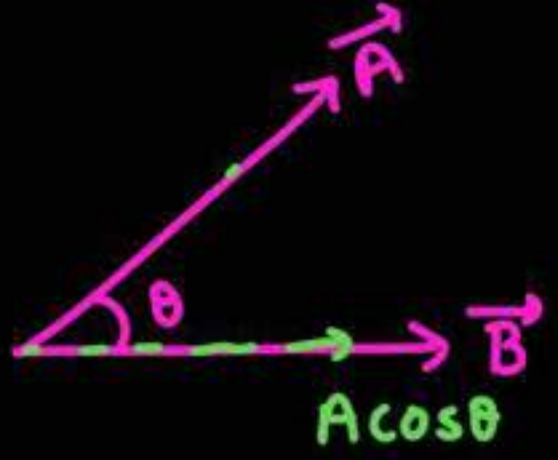


Q $\vec{A} = 3\hat{i} + 4\hat{j}$

$\vec{B} = \hat{i} + \hat{j}$

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$A\cos\theta = \dfrac{\vec{A}\cdot\vec{B}}{B}$



Component of $\vec{A}$ along $\vec{B}$ = $A\cos\theta$

towards
parallel to $= \dfrac{\vec{A}\cdot\vec{B}}{B} = \dfrac{3+4}{\sqrt{2}} = \dfrac{7}{\sqrt{2}}$ (scalar)

Component of $\vec{A}$ along $\vec{B}$ (in vector form)

$$= \frac{7}{\sqrt{2}}\cdot\hat{B} = \frac{7}{\sqrt{2}}\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right) = \frac{7}{2}(\hat{i}+\hat{j}) = \frac{7}{2}\vec{B}$$

Q $\vec{A} = \hat{i} + 3\hat{j}$

$\vec{B} = 3\hat{i} + 4\hat{j}$

Component of $\vec{A}$ along $\vec{B}$ = $A\cos\theta = \frac{\vec{A}\cdot\vec{B}}{B} = \frac{3+12}{5} = 3$

Vector form $\Rightarrow 3\hat{B} = 3\cdot\left(\frac{3\hat{i}+4\hat{j}}{5}\right) = \frac{3}{5}(3\hat{i}+4\hat{j})$

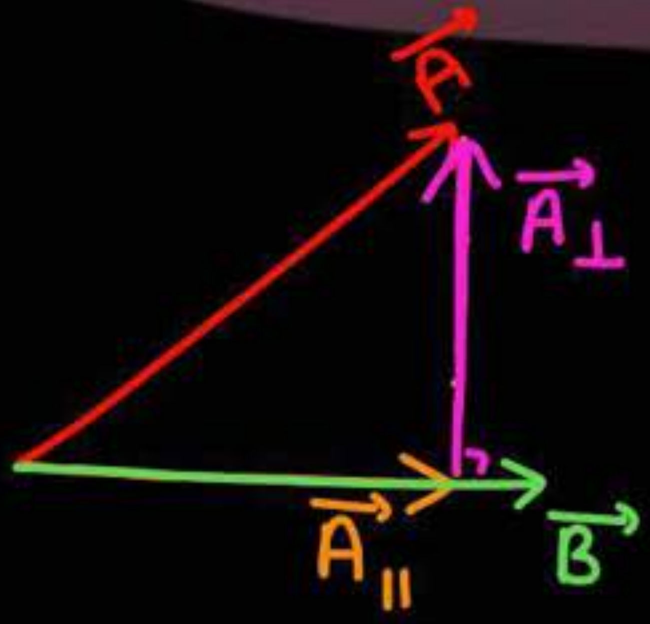
ऐसा vector बताओ whose magnitude is 3 & dir^n is along $\vec{B}$

Component of $\vec{A}$ along $\vec{B} = \dfrac{\vec{A}\cdot\vec{B}}{B}$

Vector form $\equiv \left(\dfrac{\vec{A}\cdot\vec{B}}{B}\right)\cdot\hat{B}$

Q $\quad \vec{A} = \hat{i} + 3\hat{j}$

$\vec{B} = 3\hat{i} + 4\hat{j}$



Component of $\vec{A}$ parallel to $\vec{B}$ $= \frac{3}{5}(3\hat{i} + 4\hat{j}) = \vec{A}_\parallel$
or along

$\vec{A}_\parallel + \vec{A}_\perp = \vec{A}$

$$\boxed{\vec{A}_\perp = \vec{A} - \vec{A}_\parallel}$$

Component of $\vec{A}$ perpendicular to $\vec{B}$ =

Vector form = ?

$$\vec{A}_\perp = \vec{A} - \vec{A}_\parallel = (\hat{i} + 3\hat{j}) - \frac{3}{5}(3\hat{i} + 4\hat{j})$$

$$= \frac{-4\hat{i} + 3\hat{j}}{5}$$

Q $\vec{A} = 2\hat{i} + 3\hat{j}$

$\vec{B} = \hat{i} + \hat{j}$

(1) Component of $\vec{A}$ along $\vec{B} = \frac{\vec{A}\cdot\vec{B}}{B} = \frac{2+3}{\sqrt{2}} = \frac{5}{\sqrt{2}}$

" " Vector $= \frac{5}{\sqrt{2}}\cdot\hat{B} = \frac{5}{\sqrt{2}}\,\frac{\hat{i}+\hat{j}}{\sqrt{2}} = \frac{5}{2}(\hat{i}+\hat{j}) =$

$$\boxed{\vec{A}_{11} = \frac{5\hat{i}+5\hat{j}}{2}}$$

(2) Component of $\vec{A}$ perpendicular to $\vec{B} = \vec{A} - \vec{A}_{11} = 2\hat{i}+3\hat{j} - \frac{5\hat{i}+5\hat{j}}{2}$

$$= \frac{-\hat{i}+\hat{j}}{2}$$

Q which of the following vector is must be Unit vector

① $\vec{A} = \hat{i} + \hat{j}$

$|\vec{A}| = \sqrt{1^2+1^2} = \sqrt{2}$ $\quad \vec{A} \longrightarrow$ not Unit vector.

② $\vec{A} = \frac{\hat{i}}{\sqrt{2}} - \frac{\hat{j}}{\sqrt{2}}$ $\quad |\vec{A}| = \sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2}$

$= \sqrt{\frac{1}{2}+\frac{1}{2}} = 1$

③ $\vec{A} = \frac{\hat{j}}{\sqrt{2}} + \frac{\hat{k}}{\sqrt{2}}$

④ $\vec{A} = \frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$

$|\vec{A}| = \sqrt{\left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2}$

$= \sqrt{\frac{1}{3}+\frac{1}{3}+\frac{1}{3}} = 1$

(5) $\vec{A} = \dfrac{\vec{P}+\vec{Q}+\vec{R}}{|\vec{P}+\vec{Q}+\vec{R}|}$

$\vec{P}+\vec{Q}+\vec{R} = \vec{S}$ (let)

$\vec{A} = \dfrac{\vec{S}}{|\vec{S}|}$

(6) $\vec{A} = \dfrac{\vec{P}+\vec{Q}-\vec{R}}{|\vec{P}+\vec{Q}-\vec{R}|} = \dfrac{\vec{S}}{|\vec{S}|}$ (let)

(7) $\vec{A} = \dfrac{\vec{P}+\vec{Q}+\vec{R}}{|\vec{P}+\vec{Q}-\vec{R}|}$

$\vec{A}$ must be unit vector $\equiv$ wrong

⑦ $\vec{A} = \dfrac{\vec{P}+\vec{Q}+\vec{R}}{|\vec{P}+\vec{Q}-\vec{R}|} = \dfrac{9\hat{i}+14\hat{j}}{\sqrt{5}}$ = magnitude $\sqrt{\left(\frac{9}{\sqrt{5}}\right)^2+\left(\frac{14}{\sqrt{5}}\right)^2}$

$\neq 1$

let
$$\begin{cases} \vec{P} = 2\hat{i}+3\hat{j} \\ \vec{Q} = 3\hat{i}+5\hat{j} \\ \vec{R} = 4\hat{i}+6\hat{j} \end{cases}$$

$\vec{P}+\vec{Q}+\vec{R} = 9\hat{i}+14\hat{j}$

$\vec{P}+\vec{Q}-\vec{R} = \hat{i}+2\hat{j}$

$|\vec{P}+\vec{Q}-\vec{R}| = \sqrt{1^2+2^2} = \sqrt{5}$

Q If $\vec{A}$ is Unit vector find value of α

$$\vec{A} = .6\hat{i} + \alpha\hat{j}$$

$$|\vec{A}| = 1$$

$$\sqrt{(.6)^2 + \alpha^2} = 1$$

$$.36 + \alpha^2 = 1$$

$$\alpha^2 = 1 - .36$$

$$\alpha^2 = .64$$

$$\boxed{\alpha = \pm .8}$$

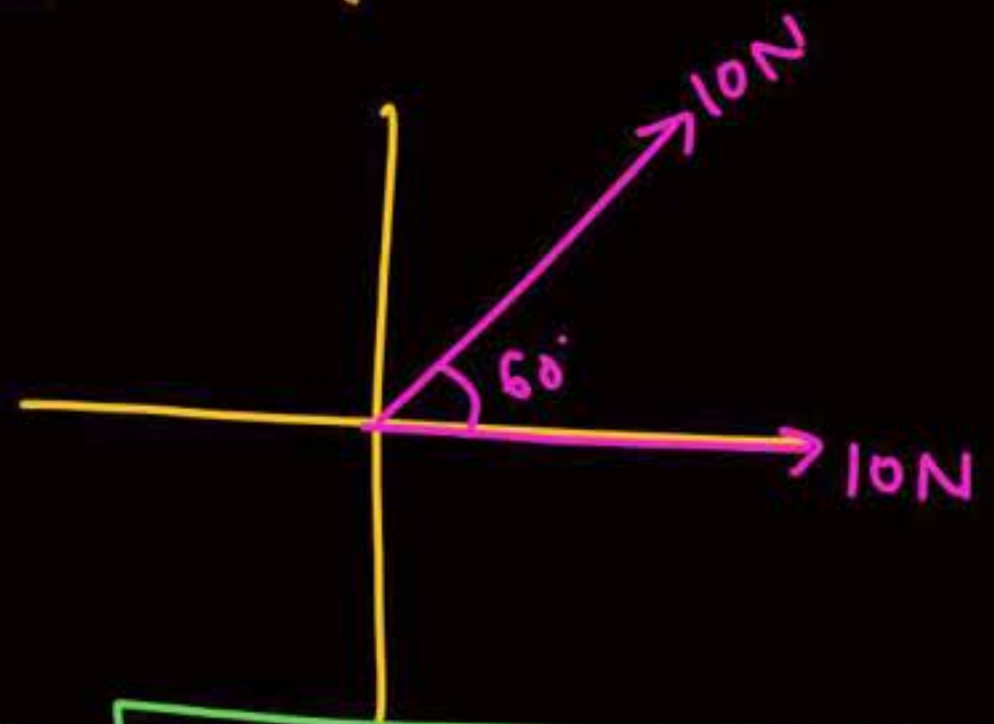
$\alpha = .8$ ✓

$\alpha = -.8$ ✓

$\vec{A} = .6\hat{i} + .8\hat{j}$ ✓

$\vec{A} = .6\hat{i} - .8\hat{j}$ ✓

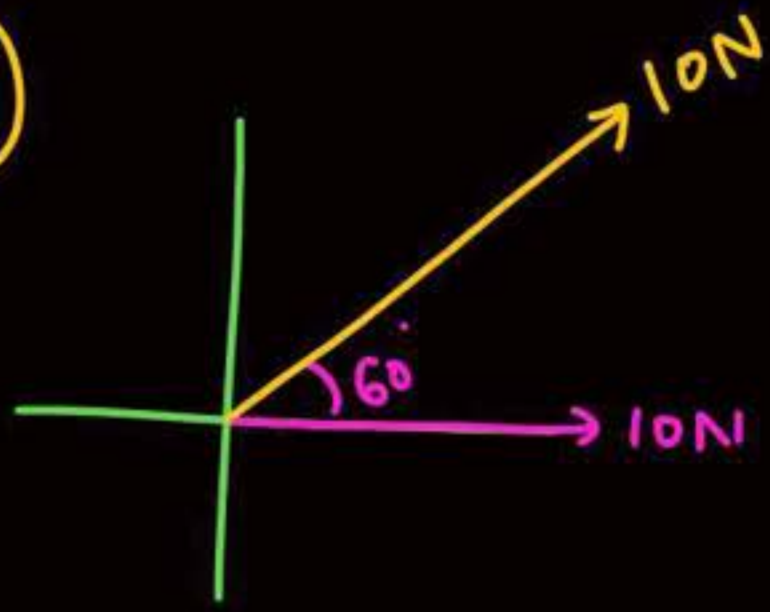
Q Find net force



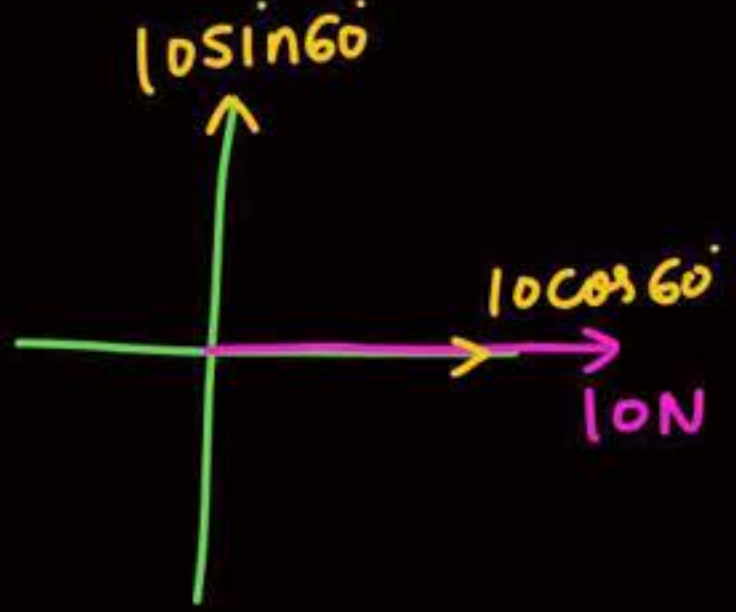
$$c = \sqrt{10^2 + 10^2 + 2\times10\times10\cos 60}$$

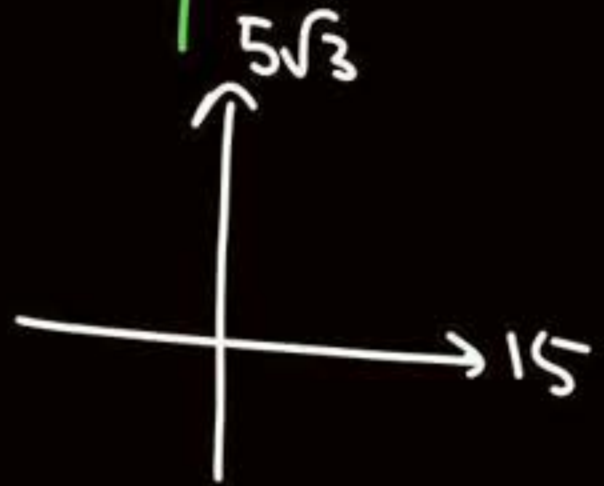
$$= 10\sqrt{3}$$

M-2



$\equiv$





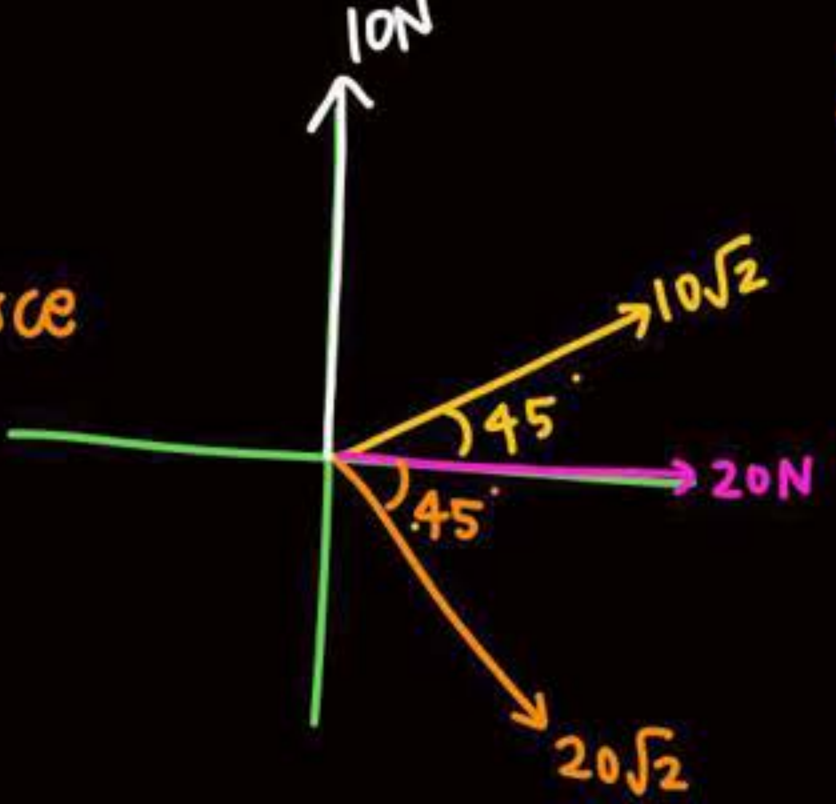
$$\vec{F}_{net} = 15\hat{i} + 5\sqrt{3}\,\hat{j}$$

$$|\vec{F}_{net}| = \sqrt{15^2 + (5\sqrt{3})^2}$$

$$= \sqrt{225 + 75}$$

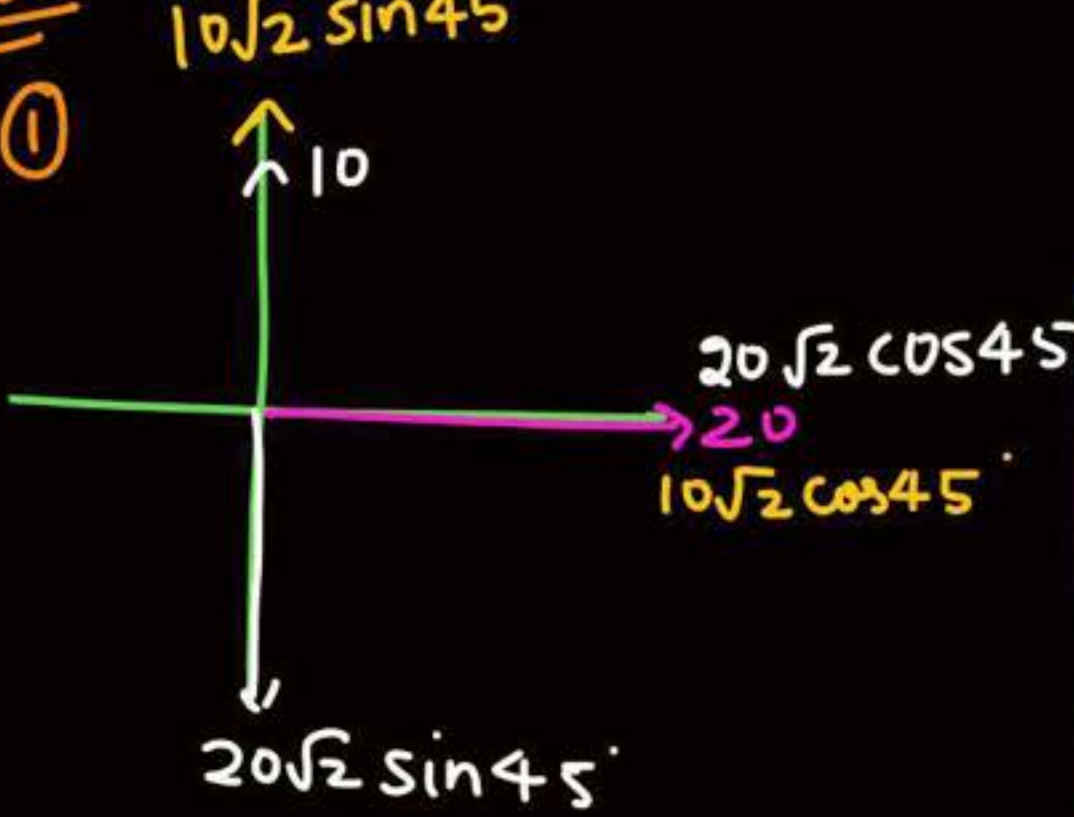
$$= 10\sqrt{3}$$

Q. find net force



Sol^n

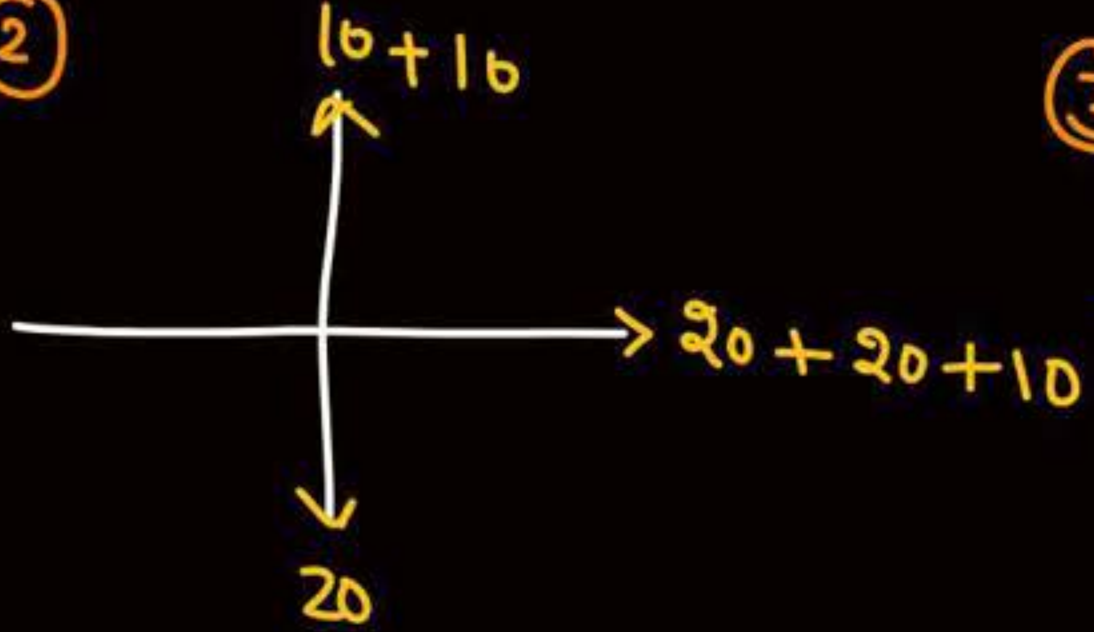
(1)



K.C.

* सारे forces को x-y में तोड़ लो
* (x-y) में collect ✓

(2)



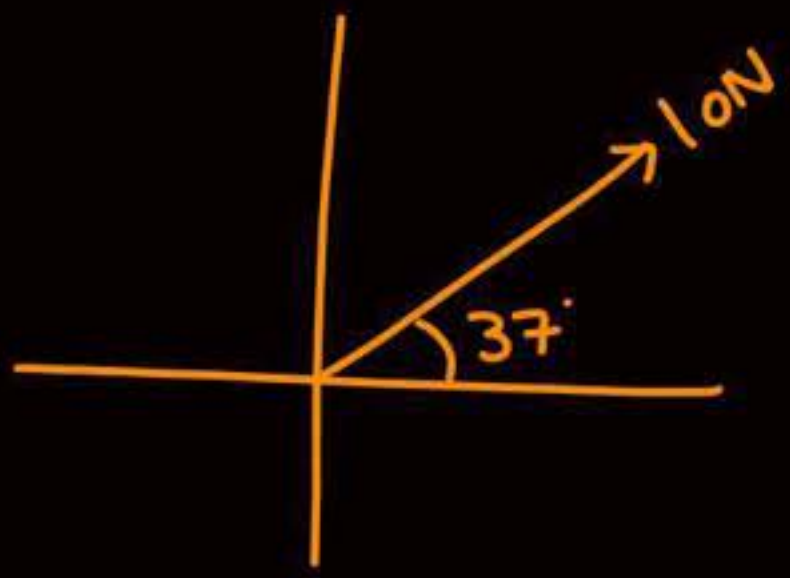
⇒

(3)

(4)

$$\vec{F}_{net} = 50\hat{i}$$

#



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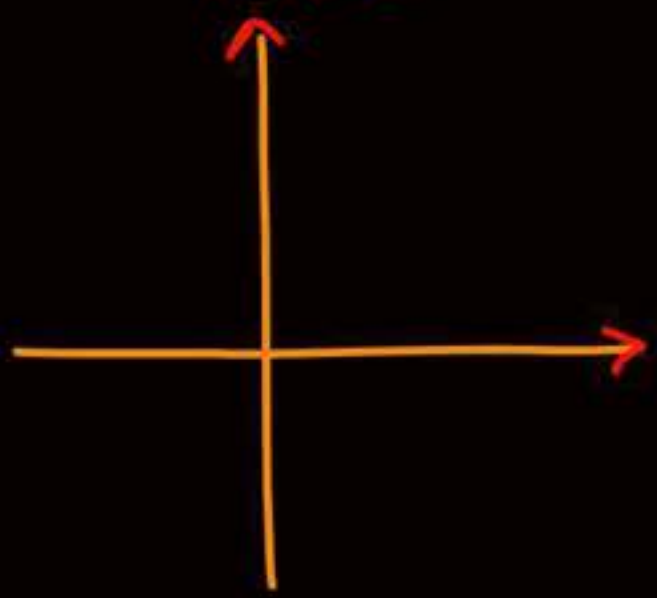
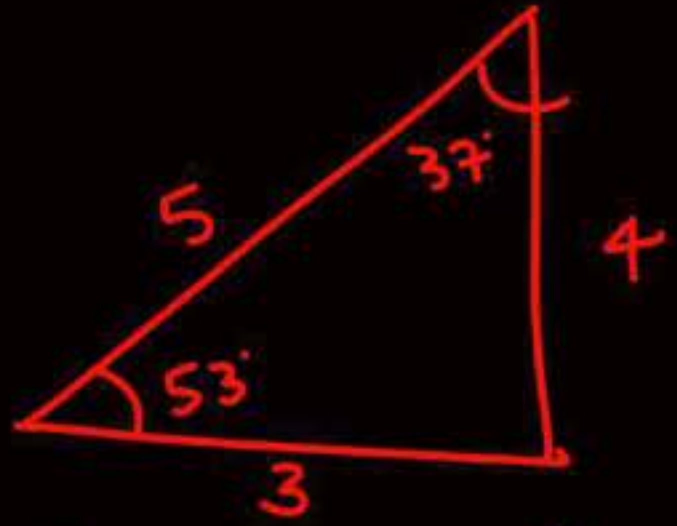
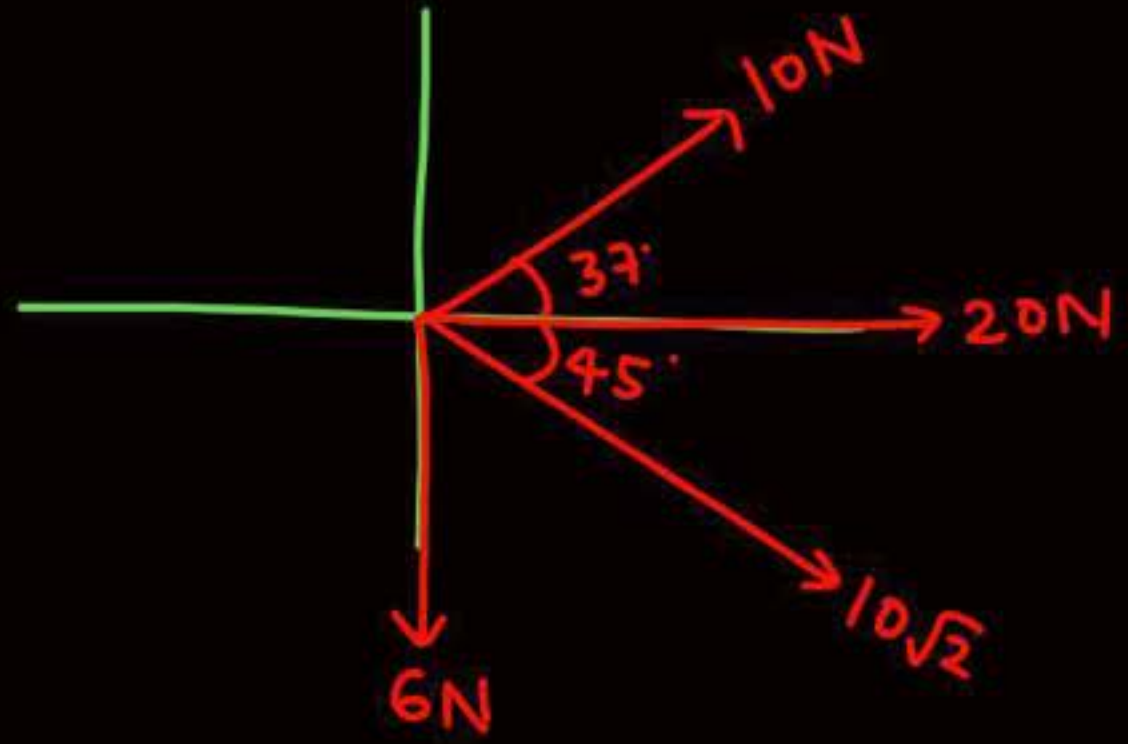




$$\sin 37 = \frac{3}{5} = \cos 53$$

$$\cos 37 = \frac{4}{5} = \sin 53$$

Q Find net force



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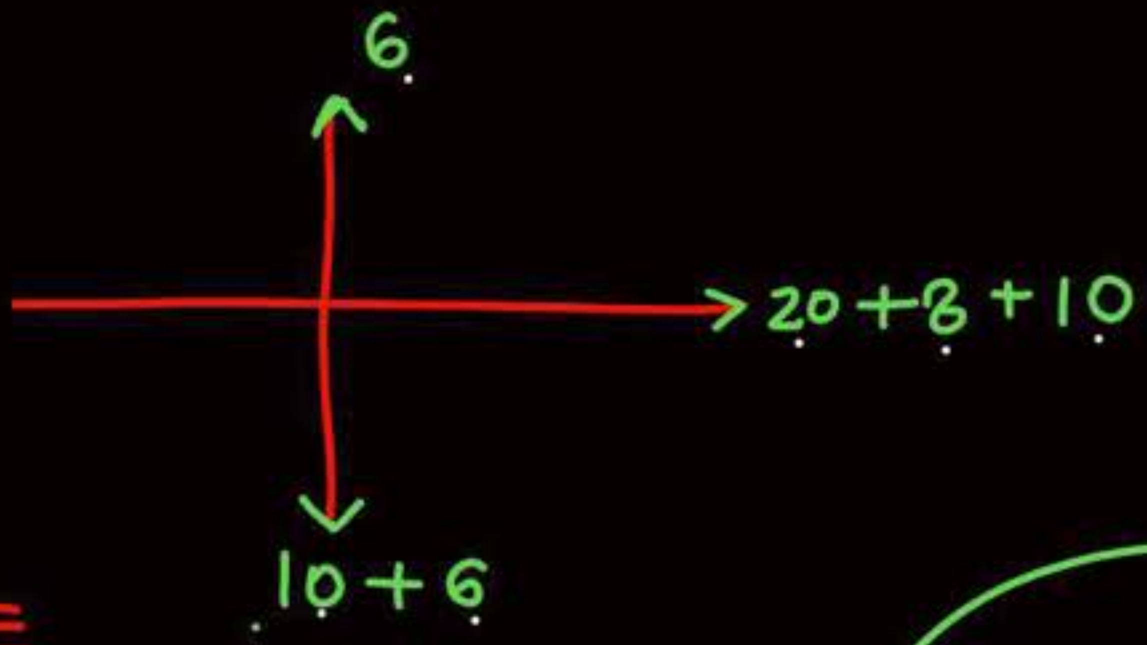
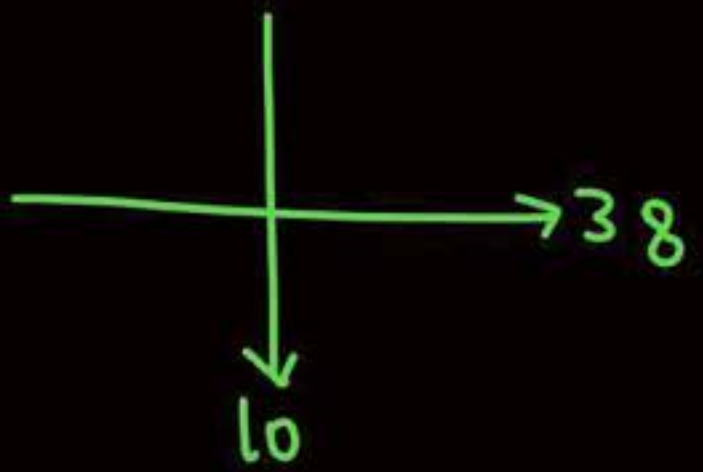
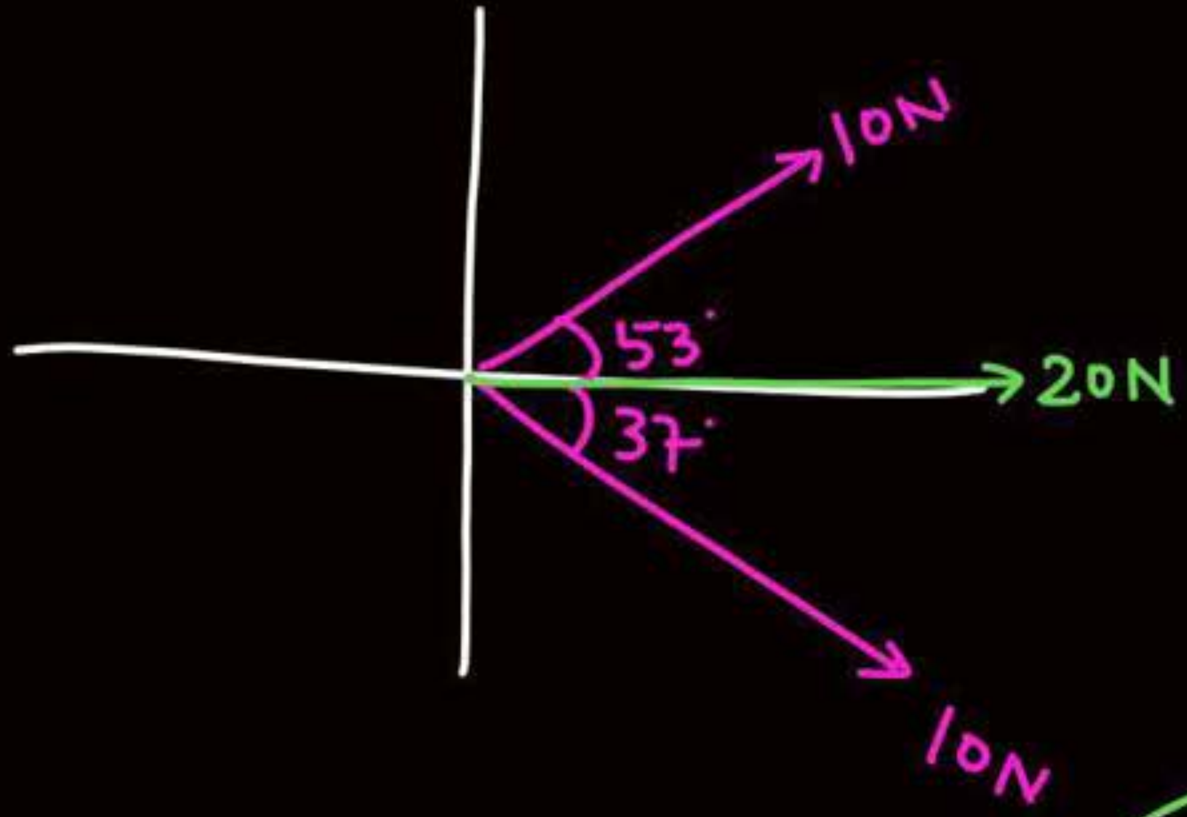
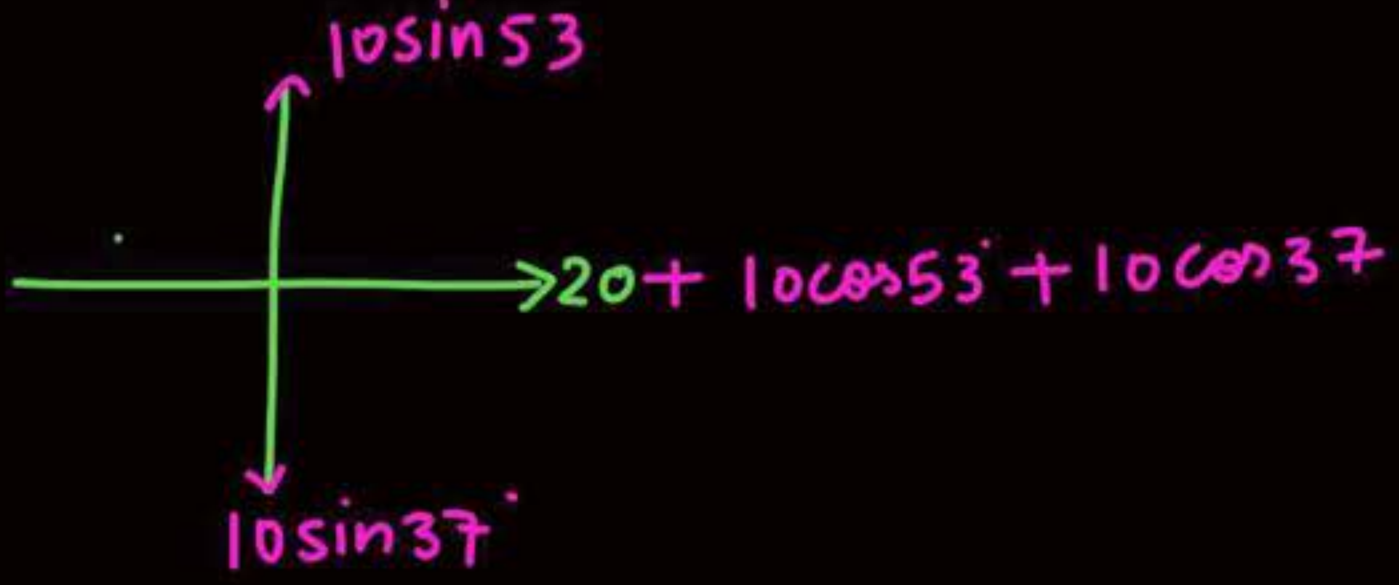


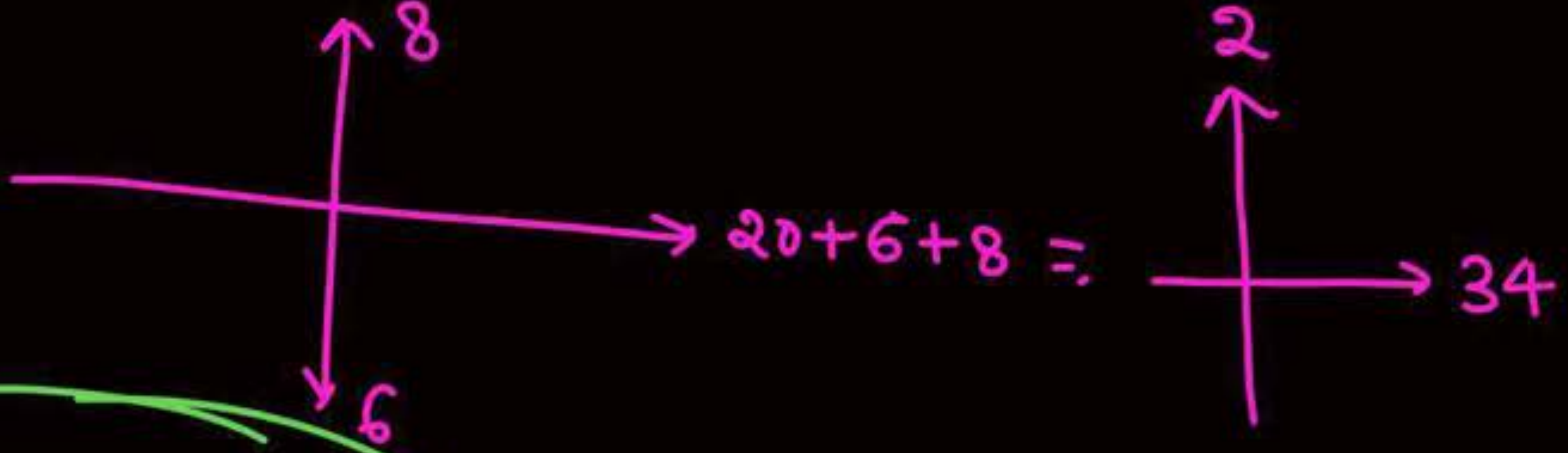


$$\vec{F}_{net} = 38\hat{i} - 10\hat{j}$$

Q Find net force

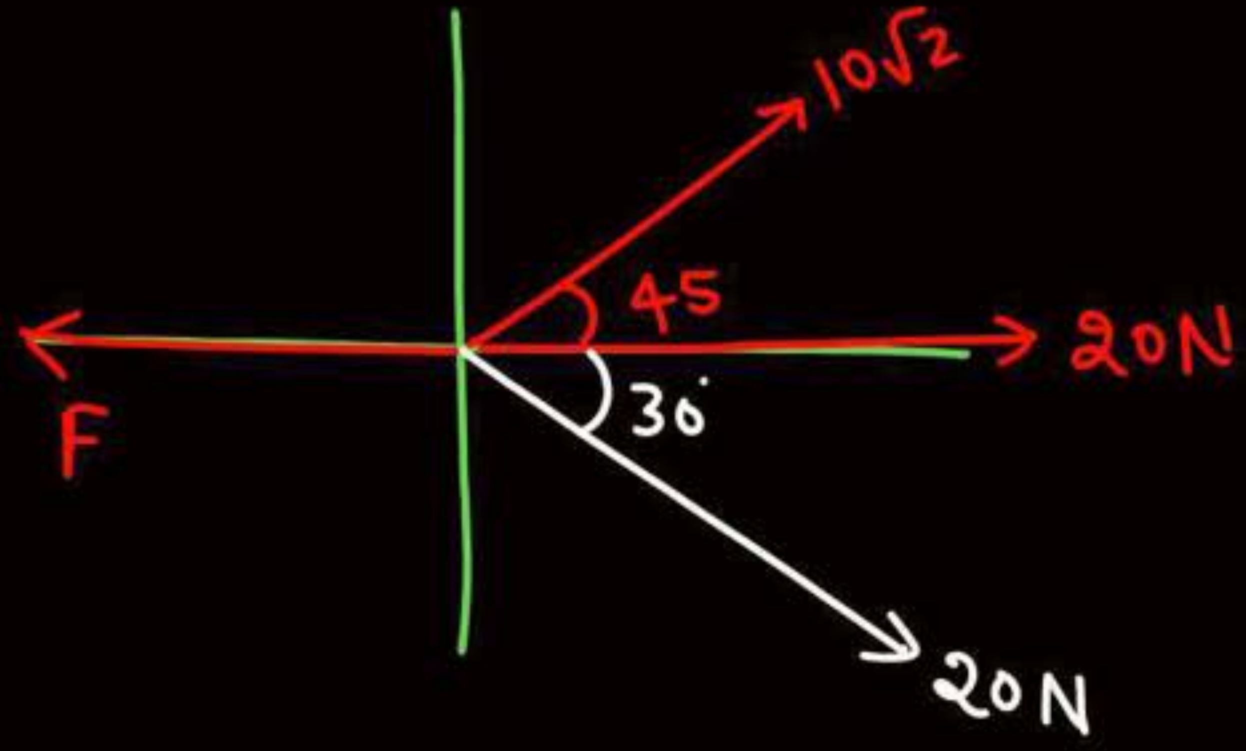


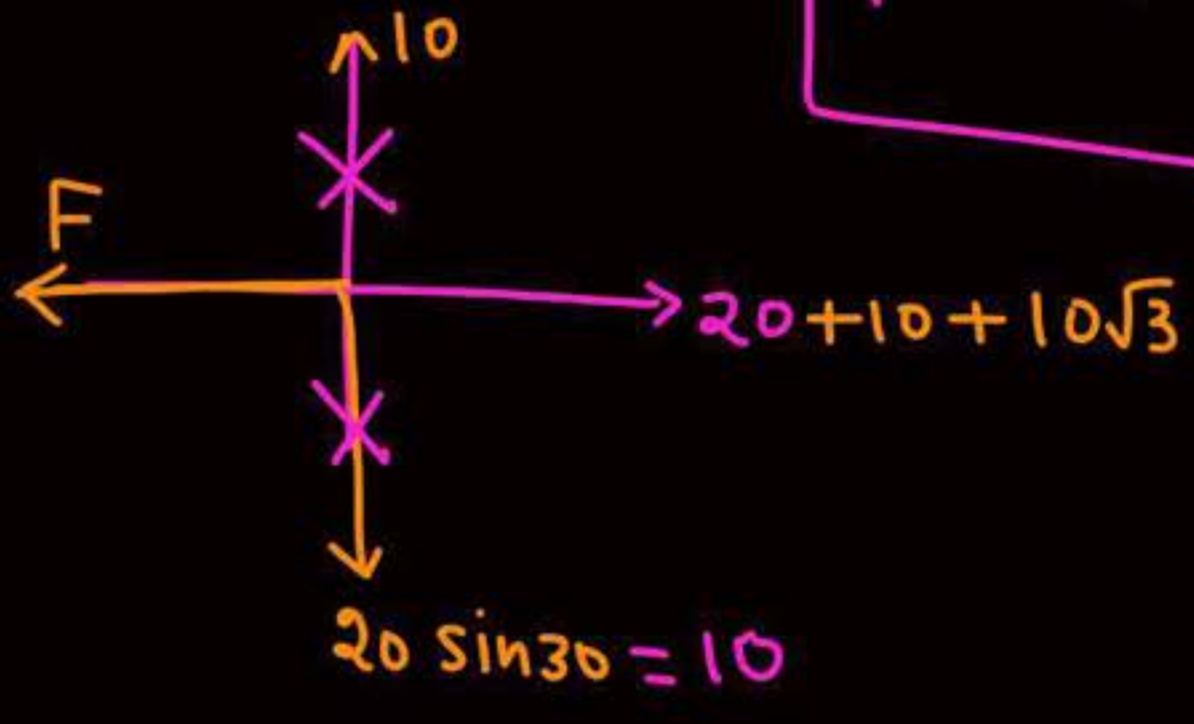




$$\vec{F}_{net} = 34\hat{i} + 2\hat{j}$$

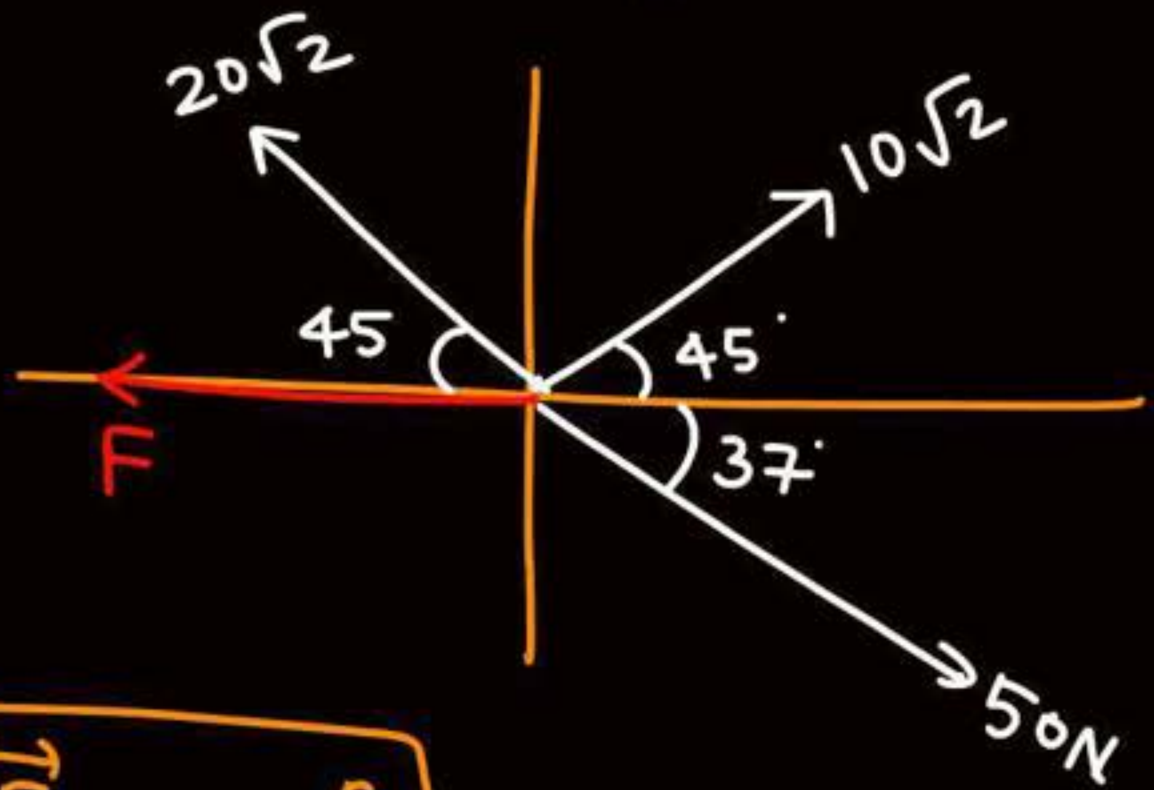
Q Find the value of F so that net force is zero.

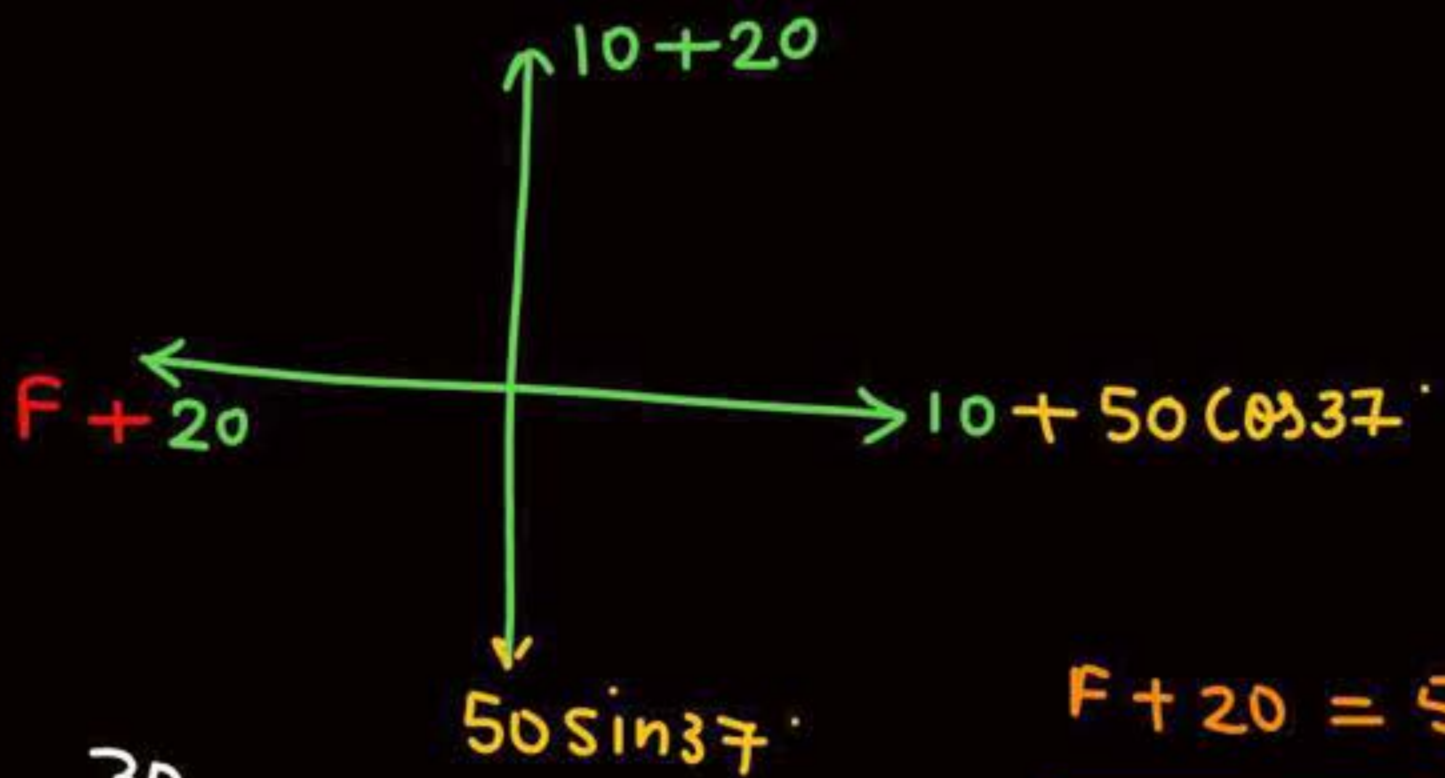




$$\boxed{F = 30 + 10\sqrt{3} \quad \text{Ans}}$$

Q Find value of F if $\vec{F}_{net} = 0$

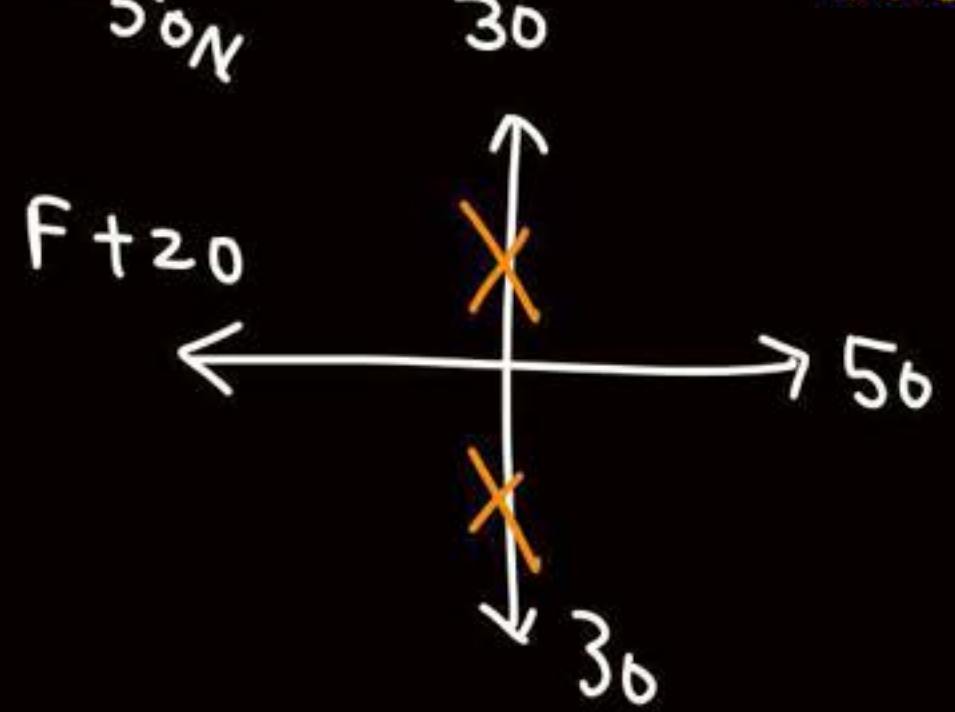




$F + 20 = 50$

$\boxed{F = 30}$

$\boxed{\vec{F} = -30\hat{i}}$



(1)

$$\vec{A} = 2\hat{i} + 3\hat{j}$$
$$\vec{B} = 4\hat{i} + 5\hat{j}$$

$$\vec{A}\cdot\vec{B} = 8 + 15 = 23$$

(2)

$$\vec{A} = 5\hat{i} + 3\hat{j}$$
$$\vec{B} = 4\hat{i} + 10\hat{j}$$

$$\vec{A}\cdot\vec{B} = 20 + 30 = 50$$

Q

3

$$\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$$
$$\vec{B} = 3\hat{i} + 4\hat{j} + 5\hat{k}$$

$$\vec{A}\cdot\vec{B} = 6 + 12 + 20$$
$$= 38$$

4

Q

$$\vec{A} = 3\hat{i} + 2\hat{j} + 3\hat{k}$$
$$\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$$

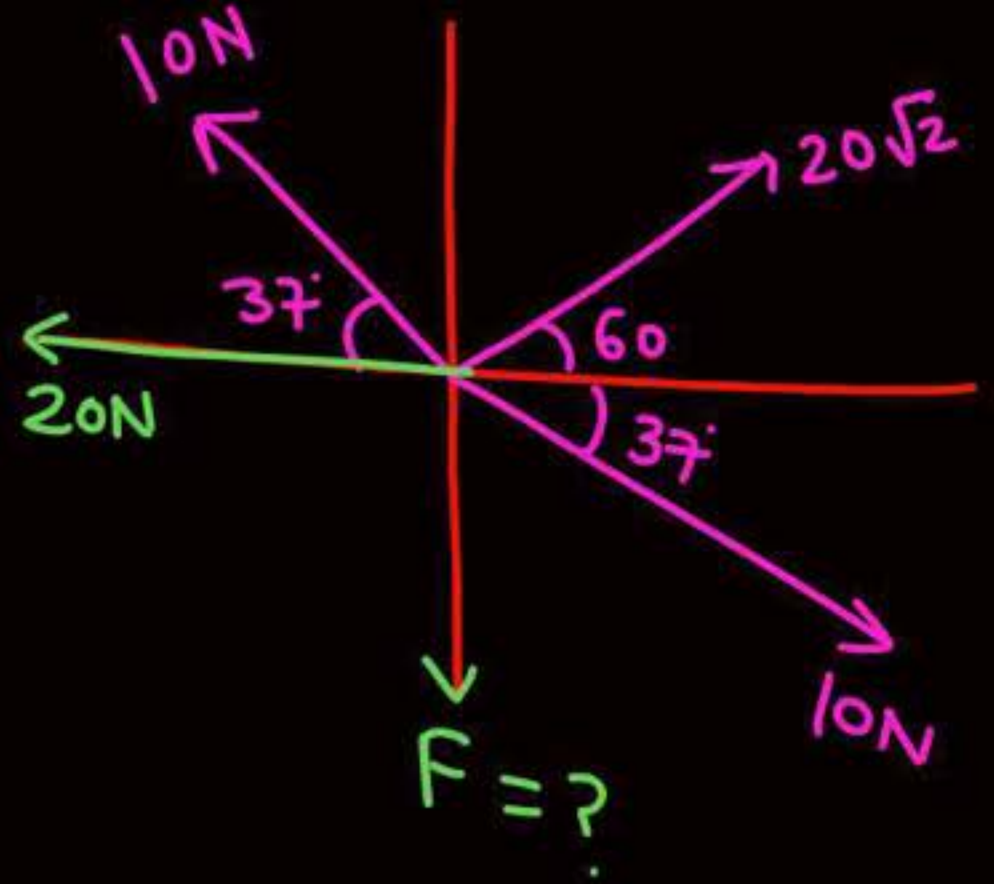
$$\vec{A}\cdot\vec{B} = 6 + 6 + 12 = 24$$

5

$$\vec{A} = 2\hat{i} - 3\hat{j}$$
$$\vec{B} = 5\hat{i} + 2\hat{j}$$

$$\vec{A}\cdot\vec{B} = 10 - 6 = 4$$

Q Find the value of F so that $\vec{F}_{net}$ is zero



Ans → 20

Q Find value of a & b so that $\vec{F}_{net} = 0$

$$\vec{F_1} = a\hat{i} + 5\hat{j} + 3\hat{k}$$

$$\vec{F_2} = (b-3)\hat{i} - b\hat{j} - 3\hat{k}$$

$\underline{\text{sol}^n \text{ next page}}$

But पहले solve करो

Sol^n

$$\vec{F_1} = a\hat{i} + 5\hat{j} + 3\hat{k}$$

$$\vec{F_2} = (b-3)\hat{i} - b\hat{j} - 3\hat{k}$$

$$\vec{F}_{net} = \vec{F_1} + \vec{F_2} = (a+b-3)\hat{i} + (5-b)\hat{j} + (3-3)\hat{k}$$

$$\vec{F}_{net} = 0 \Rightarrow \quad a+b-3=0 \quad , \quad 5-b=0$$

$$a+b=3 \qquad b=5$$

$$b=5, \quad a+b=3$$

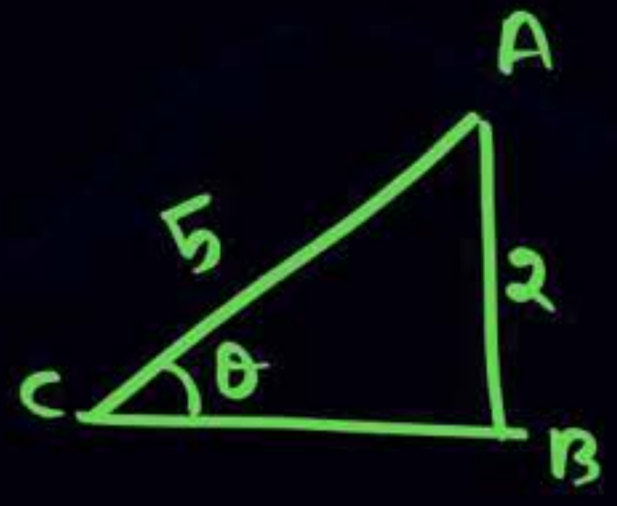
$$a+5=3$$

$$a=-2$$

Trigonometry

Q $\sin\theta = \frac{2}{5}$

$\tan\theta = \frac{2}{\sqrt{21}}$

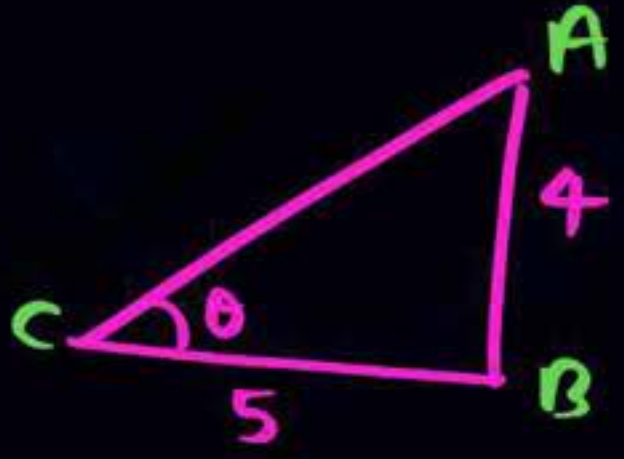


$CB = \sqrt{25-4} = \sqrt{21}$

Vectors में जरूरत पड़ेगी

Q $\tan\theta = \frac{4}{5}$

$\cancel{\sin\theta = \frac{3}{5}}$



$\sin\theta = \frac{AB}{AC} = \frac{4}{\sqrt{41}}$

$AC = \sqrt{25+16}$

$= \sqrt{41}$

$\cos 120^\circ = \cos(180-60) = -\frac{1}{2}$

$\cos 150^\circ = \cos(180-30) = -\frac{\sqrt{3}}{2}$

$\cos 210^\circ = \cos(180+30) = -\frac{\sqrt{3}}{2}$

$\cos 240 = \cos(180+60) = -\frac{1}{2}$

$\sin 120^\circ = \sin(180-60) = +\frac{\sqrt{3}}{2}$

$\sin 240^\circ = \sin(180+60) = -\frac{\sqrt{3}}{2}$

$\sin 150^\circ = \sin(180-30) = +\frac{1}{2}$

$\tan 150 = \tan(180-30) = -\frac{1}{\sqrt{3}}$

$\tan 210 = \tan(180+30) = +\frac{1}{\sqrt{3}}$

$\tan 300 = \tan(360-60) = -\sqrt{3}$

$\sin 300 = \sin(360-60) = -\frac{\sqrt{3}}{2}$

$\cos 300 = \cos(360-60) = +\frac{1}{2}$

***

* $\cos 0^\circ = 1$

$\cos 180^\circ = -1$

$\sin 0^\circ = \sin 180^\circ = \sin 360^\circ = 0$

$\sin 270^\circ = \sin(180 + 90) = -1$

$\sin 270 = -1$

$\cos 270 = 0$

***

$\cos 0 = 1$

$\left.\begin{aligned} \cos 120^\circ &= -\frac{1}{2} \\ \cos 150^\circ &= -\frac{\sqrt{3}}{2} \\ \cos 135^\circ &= -\frac{1}{\sqrt{2}} \end{aligned}\right\}$

$\cos 180 = -1$

Homework

$\cos 330^\circ =$

$\cos 300 =$

$\tan 240 =$

$\tan 210^\circ =$

$\sin 210^\circ =$

$\sin 135^\circ =$

$\cos 150 =$

$\cos 180 =$

$\sin 180 =$

$\tan 180 =$

$\tan 0^\circ =$

$\sin 150^\circ =$

$\sin 127^\circ =$

$\cos 127^\circ =$

$\sin 143^\circ =$

$\cos 143^\circ =$

$\tan 143^\circ =$

$\sin 217^\circ =$

$\cos 217^\circ =$

$\tan 217^\circ =$

Basic maths =

(1) —→ ये physics का chapter नहीं है

(2) यहाँ हम maths के only वो only topic पढ़ेंगे/Revise करें जिनकी जरूरत होगी 11th class की phy. में पढ़ने वाली है

(3) ये है तो maths ही . . . Detail में पढ़ेगा तो 1 साल भी कम है

Conversion of rad into degree.

(1) $\frac{\pi}{2}$ rad. $\xrightarrow[\text{into degree}]{\text{convert}}$ $\frac{180}{2} = 90^\circ$

π की जगह 180° रख दो

(2) $\frac{\pi}{3}$ rad. $\xrightarrow{\text{"}}$ $\frac{180}{3} = 60^\circ$

(3) $\frac{\pi}{6}$ rad $\longrightarrow$ $\frac{180}{6} = 30^\circ$

(4) $\frac{2\pi}{3}$ rad $\xrightarrow[\text{degree}]{\text{convert into}}$ $\frac{2\times180}{3} = 120^\circ$

(5) $\frac{5\pi}{6}$ rad $\xrightarrow{\text{"}}$ $\frac{5\times180}{6} = 150^\circ$

(6) 2π rad. $\xrightarrow{\text{"}}$ $2\times180^\circ = 360^\circ$

(7) $\frac{2\pi}{3}$ rad $\xrightarrow{\text{"}}$ $\frac{2\times180}{3} = 120^\circ$

(8) $\frac{7\pi}{6}$ rad $\xrightarrow{\text{"}}$ 210°

Conversion of degre into radian

$90^\circ \xrightarrow[\text{radian}]{\text{convert into}} 90 \times \frac{\pi}{180} = \frac{\pi}{2}$ rad

$60^\circ \xrightarrow{\text{"}} 60 \frac{\pi}{180} = \frac{\pi}{3}$ rad

$45^\circ \longrightarrow 45 \times \frac{\pi}{180} = \frac{\pi}{4}$ rad

$\frac{\pi}{180}$ से multiply कर दो

$\boxed{\pi \text{ rad} \equiv 180^\circ \quad 1^\circ = \frac{\pi}{180} \text{ rad.}}$

$120^\circ \xrightarrow[\text{radian}]{\text{Convert into}} \frac{120\pi}{180} = \frac{2\pi}{3}$ rad

$240^\circ \xrightarrow{\text{"}} \frac{4\pi}{3}$ rad

$210^\circ \xrightarrow{\text{"}} \frac{210.\pi}{180} = \frac{7\pi}{6}$ rad

$720 \xrightarrow{\text{"}} 4\pi$ rad

$750^\circ \xrightarrow{\text{"}} \frac{750.\pi}{180} = \frac{25\pi}{6}$ rad

$150^\circ \longrightarrow \frac{5\pi}{6}$ rad

**

rad

$2^\circ \longrightarrow \frac{2.\pi}{180} = \frac{\pi}{90}$

$4^\circ \longrightarrow \frac{\pi}{45}$

$3^\circ \longrightarrow \frac{3.\pi}{180} = \frac{\pi}{60}$

$5^\circ \longrightarrow \frac{5.\pi}{180} = \frac{\pi}{36}$

Q ① $\sin 2^\circ \approx 2\times\frac{\pi}{180} \approx \frac{\pi}{90} = \frac{3.14}{90} \simeq .03488$

② $\sin 3^\circ \simeq 3\frac{\pi}{180} = \frac{\pi}{60} = \frac{3.14}{60}$

③ $\sin 4^\circ = 4\frac{\pi}{180} = \frac{\pi}{45}$

④ $\sin 8^\circ \simeq \frac{8\pi}{180}$

** Small angle approximation

if θ is very small

$\theta < 5^\circ$

$\cos\theta \longrightarrow 1$

* $\sin\theta \simeq \theta$ $\quad \theta < 10^\circ$ (Best)

* $\tan\theta \simeq \theta$ $\quad (\theta < 10^\circ$ Best)

* $\sin\theta \simeq \tan\theta \simeq \theta$ (if θ is very small, $\theta < 10^\circ$ Best)

$\sin 2^\circ \simeq \tan 2^\circ$

$\sin 5^\circ \simeq \tan 5^\circ$

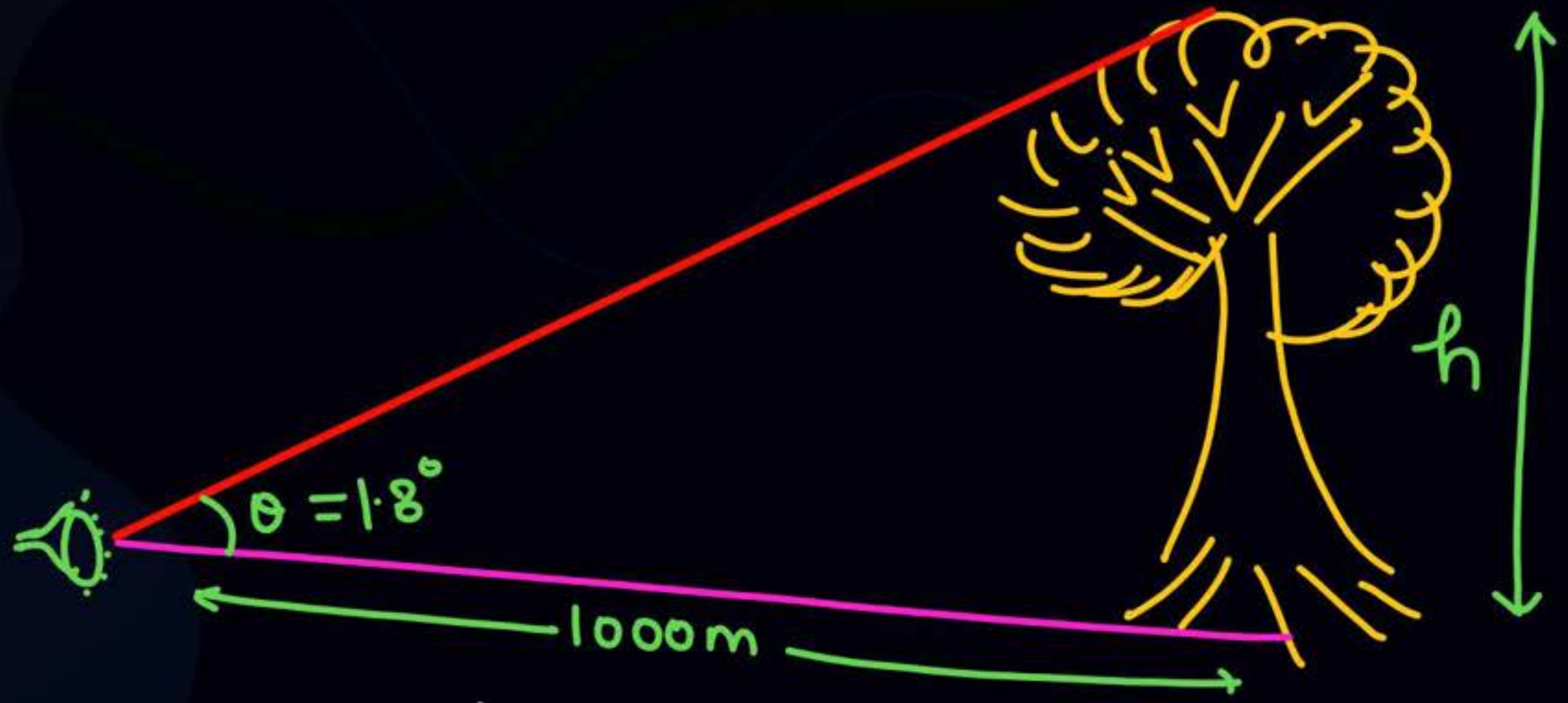
① $\tan 8^\circ = \frac{8\pi}{180}$

② $\sin 8^\circ = \frac{8\pi}{180}$

③ $\sin 10^\circ = \frac{10\pi}{180}$

④ $\tan 5^\circ = \frac{5\pi}{180}$

Q



$$\tan 1.8^\circ = \frac{h}{1000}$$

$$h = 1000 \cdot \tan 1.8^\circ = 1000 \times 1.8 \times \frac{\pi}{180}$$

$$= 10\pi = \underline{31.4}\ m$$

$\sin 2^\circ \simeq .034899$ (calc)

$\tan 2^\circ \simeq .0349$

$\sin 2^\circ \simeq 2 \cdot \frac{\pi}{180} = \frac{\pi}{90} = \frac{3.14}{90} = .0348$

$(\sin\theta \simeq \theta)$

$\sin 5^\circ \simeq .0871$

$\tan 5^\circ = .0874$

$\parallel$

Approx equal

$$\sin\theta \simeq \theta \xrightarrow{} \text{rad}$$

$$\sin 2^\circ \approx 2\cdot\frac{\pi}{180} = \frac{\pi}{90} = \frac{3.14}{90} = .03488$$

$$\sin 3^\circ \simeq 3 \cdot \frac{\pi}{180} = \frac{\pi}{60} = \frac{3.14}{60} = .0523$$

* π rad $= 180^\circ$

* $1^\circ = 60'$ (minute)

Bionomial Expansion.

अभी
हमारे काम का नही है

$$(1+x)^n = 1 + nx + \frac{n.(n-1)}{1\times 2}x^2 + \frac{n(n-1)(n-2)x^3}{1\times 2\times 3} + \cdots$$

$n = 2$ put

$$(1+x)^2 = 1 + 2x + \frac{2\cdot 1\cdot x^2}{1\cdot 2} + \cdots$$

$$= 1 + 2x + x^2$$

$$= x^2 + 1 + 2x$$

$$(1+x)^n = 1 + nx + \frac{n.(n-1)x^2}{1\times 2} + \cdots$$

Neglect

$$\boxed{\begin{array}{l}\text{If } x \ll 1 \\ (1+x)^n \simeq 1+nx\end{array}}$$

Q $(1.0003)^5 = (1 + .0003)^5$

$= 1 + 5 \times .0003$

$= 1.0015$

Q $(1.004)^2 \simeq (1+.004)^2 = 1.008$

Q $(1.006)^3 \simeq 1.018$

Calc $\equiv 1.01810$

→ Approimat.

Q $(1.007)^4 \simeq \underline{1.028}$

Q $\sqrt{1.008}$

$= (1+.008)^{\frac{1}{2}}$

$= \left(1+\frac{1}{2}\times .008\right)$

$= \underline{1.004}$

Q $\sqrt{1.00} \simeq \underline{1.003}$

Revision

θ is very small

$\cos\theta \longrightarrow 1$

(1) $\frac{3\pi}{2} \longrightarrow \frac{3\times 180}{2} = 270^\circ$

(2) $210^\circ \longrightarrow 2\cancel{10} \times \frac{\pi}{18\cancel{0}} = \frac{7\pi}{6}$

(3) $\left.\begin{array}{l} \sin\theta \simeq \theta \\ \tan\theta \simeq \theta \\ \sin\theta \simeq \theta = \tan\theta \end{array}\right\} \therefore \theta < 10$

Best ✓

$$(1+x)^n \simeq 1+nx \quad \boxed{(\text{If } x<<1)}$$

$$(1-x)^n = 1-nx \quad (\text{if } x<<1)$$

Q $(1+.003)^4 \simeq 1+4\times.003 = \underline{1.012}$

$\xrightarrow{\text{calc}}$ $\underline{1.012}05$

$(1+.003)^{-3} = 1+(-3)\times .003 = 1-3\times .003 = 1-.009 = .991$

$(1+.004)^{-2} = 1-.008 = .992$

$$\boxed{(1\pm x)^n = 1\pm nx \quad \text{if } x \ll 1}$$

$(1.007)^{-2} = 1-.014 = .986$

$(1-.002)^3 = 1-3\times .002 = 1-.006 = .994$

$(.996)^3 = (1-.004)^3 = 1-.012 = \underline{.988}$

$(1.007)^3 \simeq 1.021$

$(1.009)^{\frac{1}{3}} \simeq 1 + \frac{1}{3} \times .009 \simeq 1.003$

$(1.008)^{\frac{1}{2}} = (1 + .008)^{\frac{1}{2}} = 1.004$

$\sqrt{1.006} = (1 + .006)^{\frac{1}{2}}$

$= 1 + \frac{1}{2} \times .006$

$= \underline{1.003}$

$\frac{1}{1.006} = (1.006)^{-1}$

$= (1 + .006)^{-1}$

$= 1 - .006 = .994$

$\frac{1}{.998} \simeq (.998)^{-1} = (1 - .002)^{-1}$

$= 1 + .002 = 1.002$

$\left(\frac{1}{.997}\right)^2 \simeq (.997)^{-2} = (1 - .003)^{-2}$

$= 1 + .006$

$= \underline{\underline{1.006}}$

find

$$\tan 5^\circ = \frac{5\cdot\pi}{180}$$ ✓

$$\tan 8^\circ = 8\cdot\frac{\pi}{180}$$ ✓

S.K.C

$$\boxed{\begin{aligned} &\pi = 180^\circ \quad \times \\ &\pi \text{ rad} = 180^\circ \\ &\pi = \frac{22}{7} = 3.14 \end{aligned}}$$

$$\tan 4^\circ = \frac{4\cdot\pi}{180}$$

$\sin 120^\circ = \sin(180-60) = +\frac{\sqrt{3}}{2}$

हमारा ✓
हम इसे follow करेंगे.

$\sin(\underline{90}+30) = +\cos 30^\circ = +\frac{\sqrt{3}}{2}$ = दूर रहो

$90^\circ, 270^\circ$ में तोड़े तो

$\sin \rightleftharpoons \cos$

$\tan \rightleftharpoons \cot$

$180, 360^\circ$ में तोड़ रहे हो तो मत change करो

(1) $\sin 150^\circ = \sin(180-30) = +\sin 30 = +\frac{1}{2}$

$\hookrightarrow \sin(90+60) = +\cos 60 = +\frac{1}{2}$

(2) $\sin 210^\circ = \sin(180+30) = -\sin 30 = -\frac{1}{2}$

$\hookrightarrow \sin(270-60) = -\cos 60 = -\frac{1}{2}$

$\sin(90-\theta) = \cos\theta$
$\cos(90-\theta) = \sin\theta$
$\tan(90-\theta) = \cot\theta$
$\cot(90-\theta) = \tan\theta$

10th class

(3) $\sin 240^\circ = \sin(180+60) = -\sin 60 = -\frac{\sqrt{3}}{2}$

$\hookrightarrow \sin(270-30) = -\cos 30 = -\frac{\sqrt{3}}{2}$

(4) $\cos 240^\circ = \cos(180+60) = -\cos 60 = -\frac{1}{2}$

$\hookrightarrow \cos(270-30) = -\sin 30 = -\frac{1}{2}$

(3) $\tan 240^\circ = \tan(180+60) = +\tan 60 = \sqrt{3}$

$\hookrightarrow \tan(270-30) = +\cot 30^\circ = \sqrt{3}$

(4) $\cos 300^\circ = \cos(360-60) = +\cos 60 = \frac{1}{2}$

$\hookrightarrow \cos(270+30) = +\sin 30 = \frac{1}{2}$

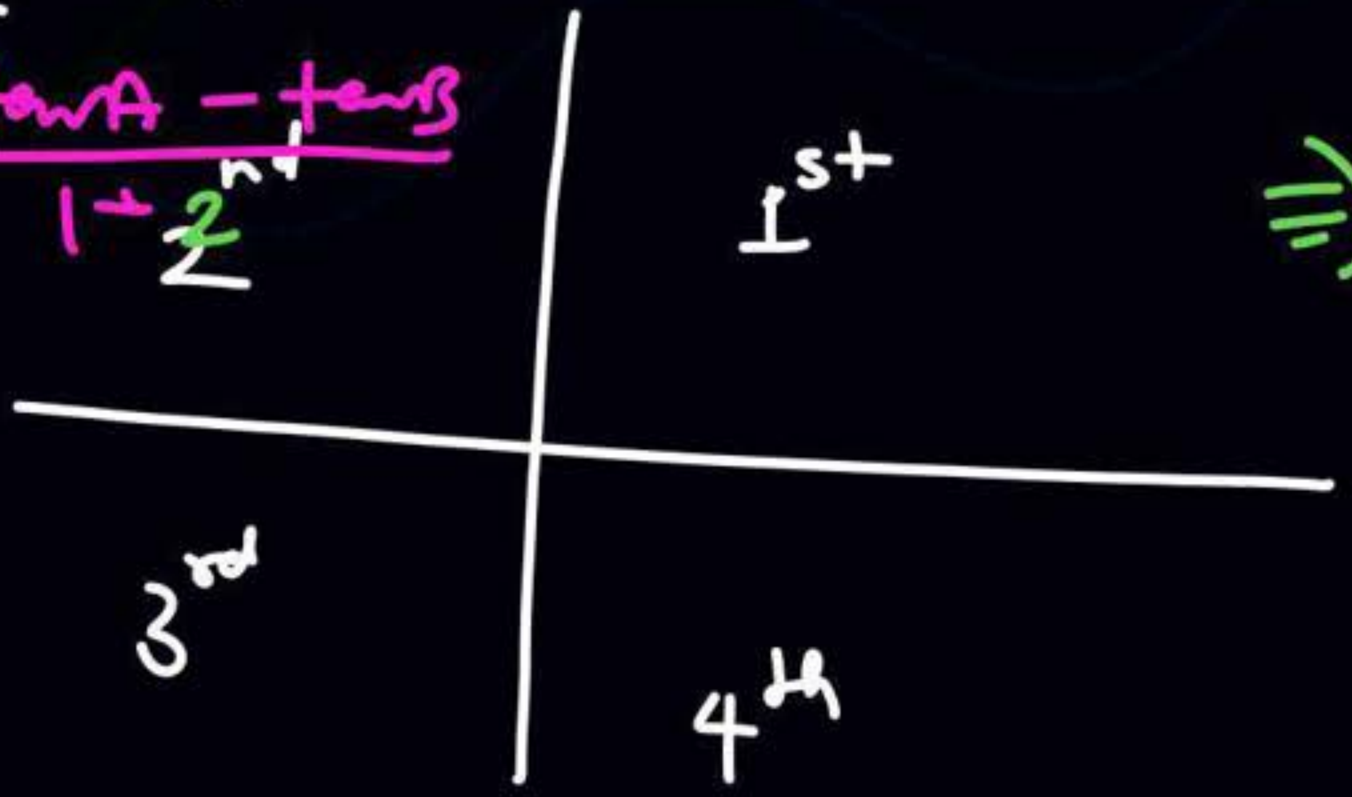
(5) $\sin 300 = \sin(360-60) = -\frac{\sqrt{3}}{2}$

$\hookrightarrow \sin(270+30) = -\cos 30 = -\frac{\sqrt{3}}{2}$

$\tan 15^\circ = \tan(45-30)$

$\tan(A-B) = \dfrac{\tan A - \tan B}{1+}$

$\tan 45^\circ = 1$



$\Rightarrow$ आती है ↑

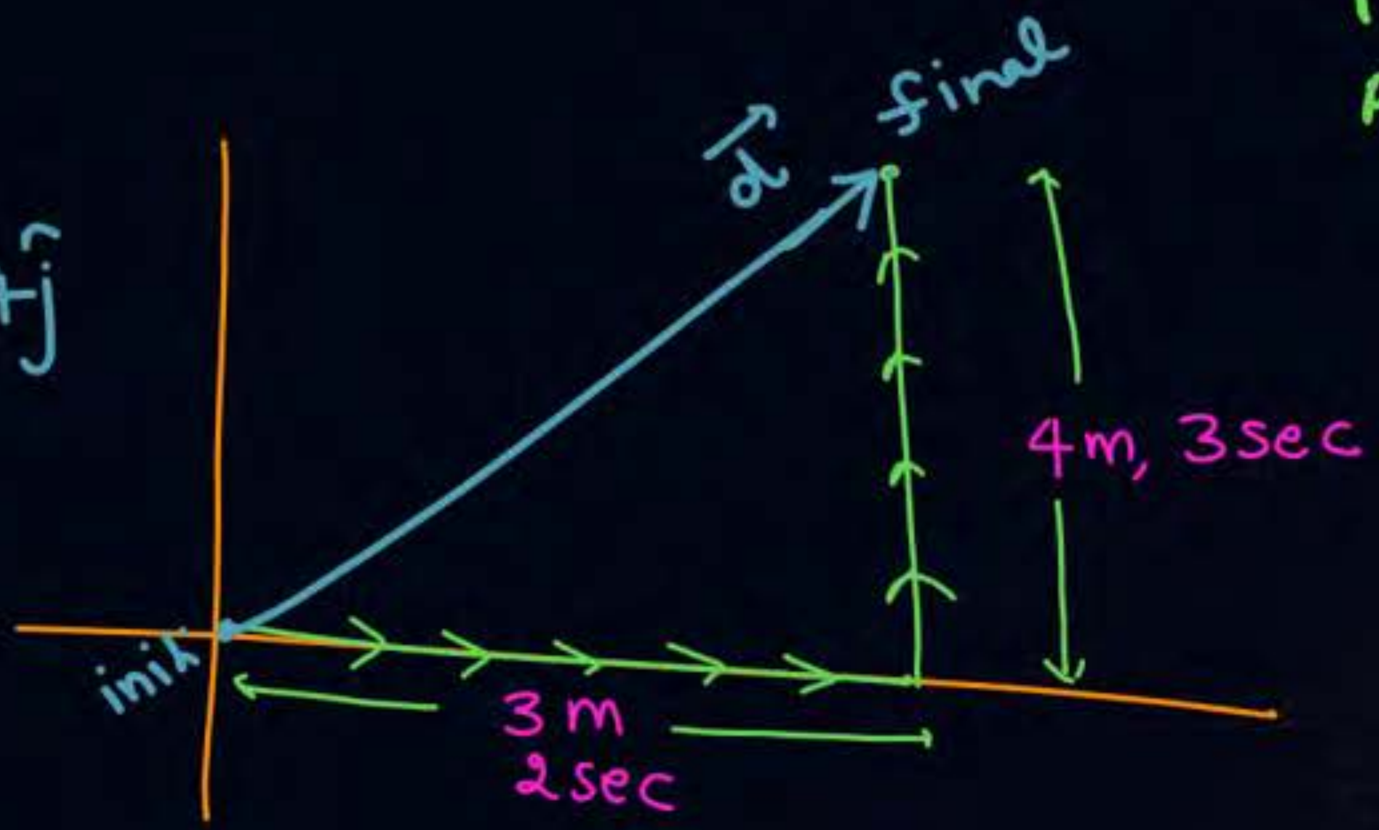
Sign

Q

Displacement $= \vec{d} = 3\hat{i} + 4\hat{j}$

Avrage Velocity $= \dfrac{3\hat{i}+4\hat{j}}{2+3}$

$= \dfrac{3\hat{i}+4\hat{j}}{5}$



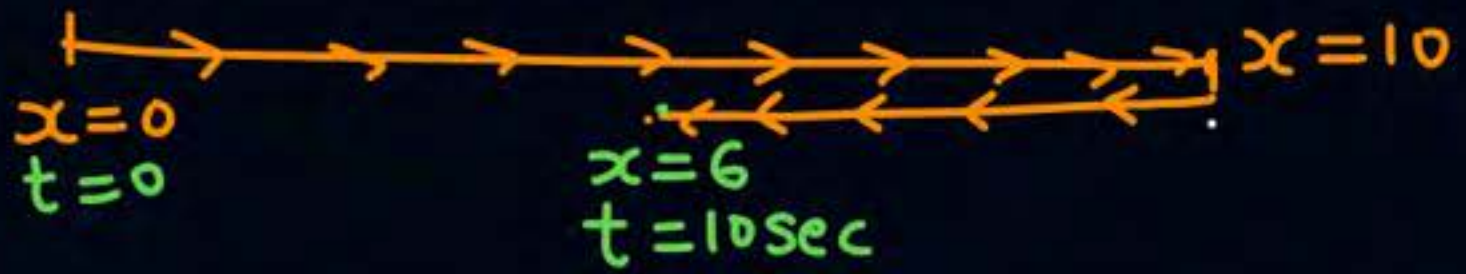
if displacement = 0
Avg velocity = 0

magnitude $\Rightarrow$ Displacement $= 5$

time $= 2+3 = 5$ sec

Avg velocity $= \dfrac{5}{5} = 1$ m/s

Q



Displacement $= 6$

Avrg Velocity $= \frac{6}{10}$

Distance $= 10 + 4$
$= 14$

Avrg speed $= \frac{14}{10}$

Q

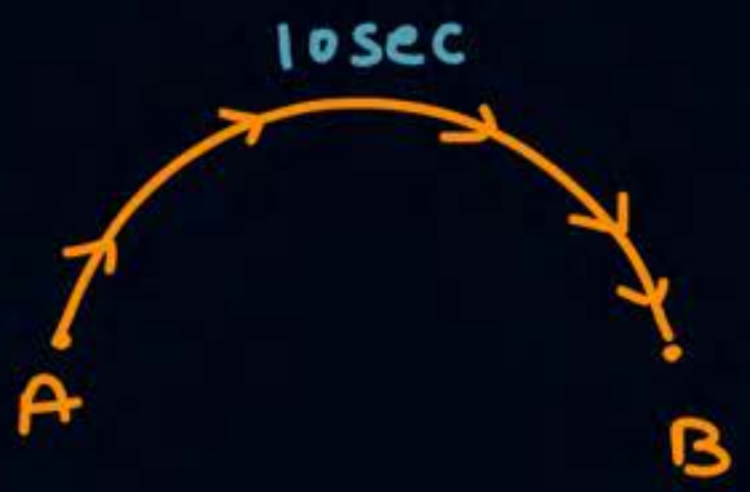
distance $= 10$

displacement $= 10$ (magnitude)

Avrg velocity $= \frac{10}{5}$ (magnit)

Avrg speed $= \frac{10}{5}$

Q

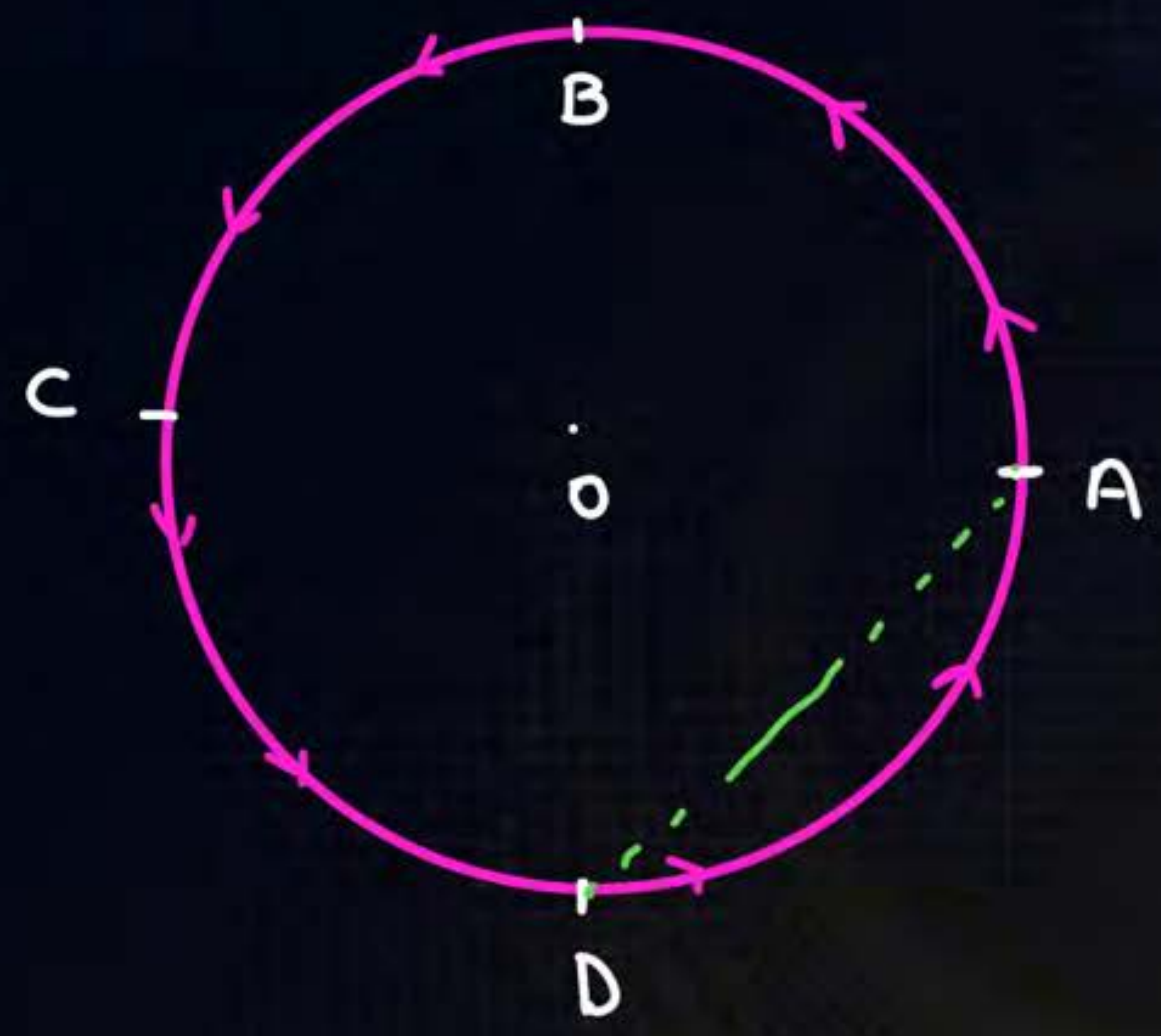


Avg. speed = $\frac{\pi R}{10}$

Avrg Velocity (magnitude) = $\frac{2R}{10} = \frac{R}{5}$

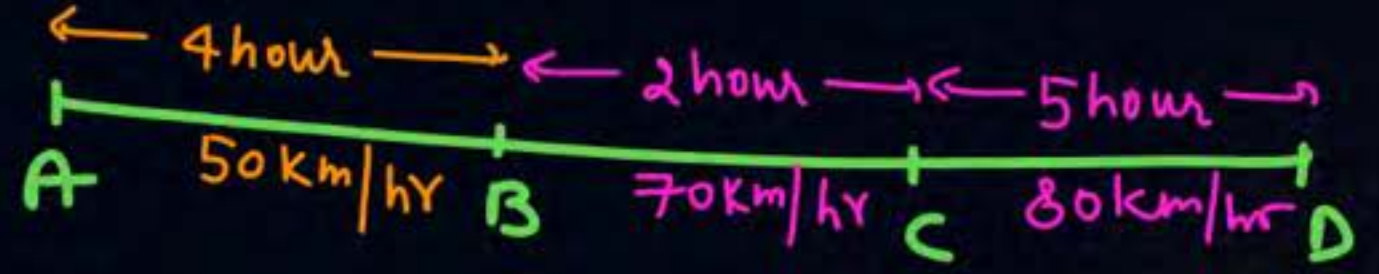
Q A particle is performing uniform circular motion with $\boxed{\text{const speed } v}$, having time period T anticlockwise.

	Avrg speed	|Avrg velocity|
$A \to B$	$\frac{2\pi R/4}{T/4} = \frac{2\pi R}{T}$	$\frac{R\sqrt{2}}{T/4}$
$A \to B \to C$	$\frac{\pi R}{T/2} = \frac{2\pi R}{T}$	$2R/T/2$
$A \to B \to C \to D$	$\frac{\frac{3}{4} 2\pi R}{3T/4} = \frac{2\pi R}{T}$	$\frac{R\sqrt{2}}{3T/4}$
$A \to B \to C \to D \to A$	$\frac{2\pi R}{T}$	0



9th class

Q A car is moving along $+x$ axis, in 1st four hour it travel with speed 50 km/hr, in next 2 hour it move with 70 km/hr and in last part of journey it travel for 5 hour with 80 km/hr find Avrg speed.



$$\text{Avrg Speed} = \frac{50\times4 + 70\times2 + 80\times5}{4+2+5} = \frac{200+140+400}{11} = ✓$$

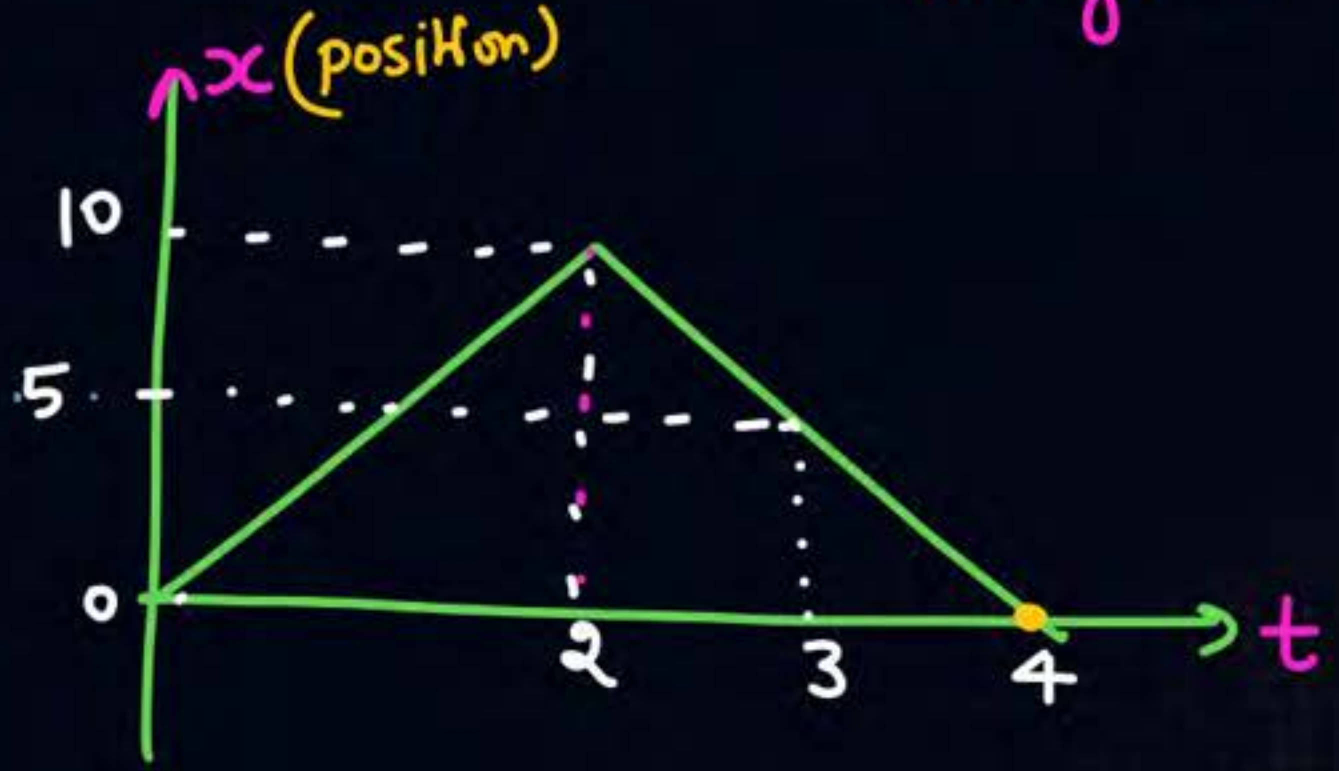
$$\text{Avrg velocity} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\vec{r}_f - \vec{r}_i}{\underbrace{\Delta t}_{\text{time interval.}}}$$

1 D motion.

If a particle is moving on x-axis only

$$\text{Avrg Velocity} = \frac{\vec{x}_f - \vec{x}_i}{\text{time}} = \frac{\Delta \vec{x}}{\Delta t}$$

Q A particle is moving on the x-axis s.t its x-co-ordinate w.r.t time changes as



(1) $t=0 \longrightarrow t=2$ sec

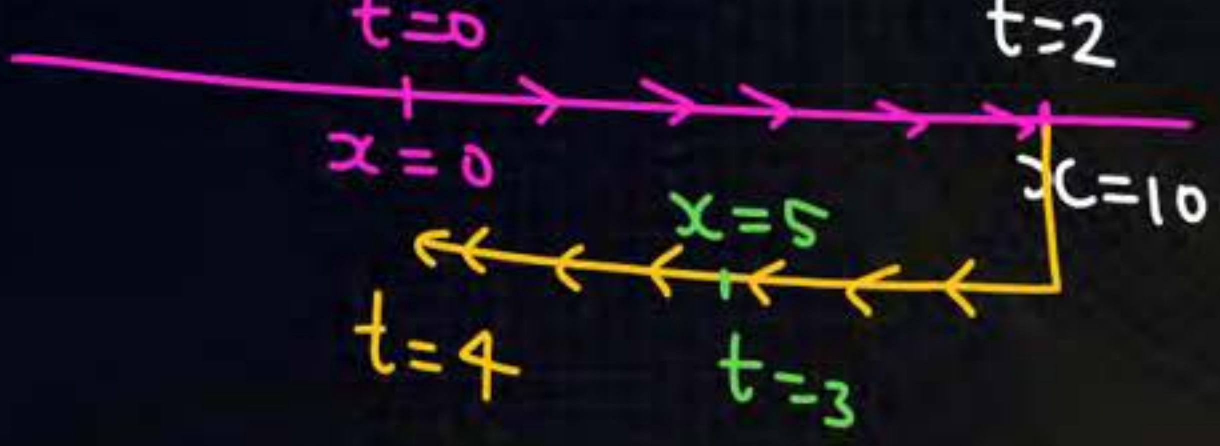
Avrg velocity $= \frac{10}{2} = 5$

Avrg velocity $= \frac{x_f - x_i}{\text{time}} = \frac{10-0}{2}$

(2) $t=0 \longrightarrow t=3$

Avrg velocity $= \frac{x_f - x_i}{\text{time}} = \frac{5-0}{3}$

Avrg speed $= \frac{15}{3} = 5$



Q $t=0 \longrightarrow t=5$

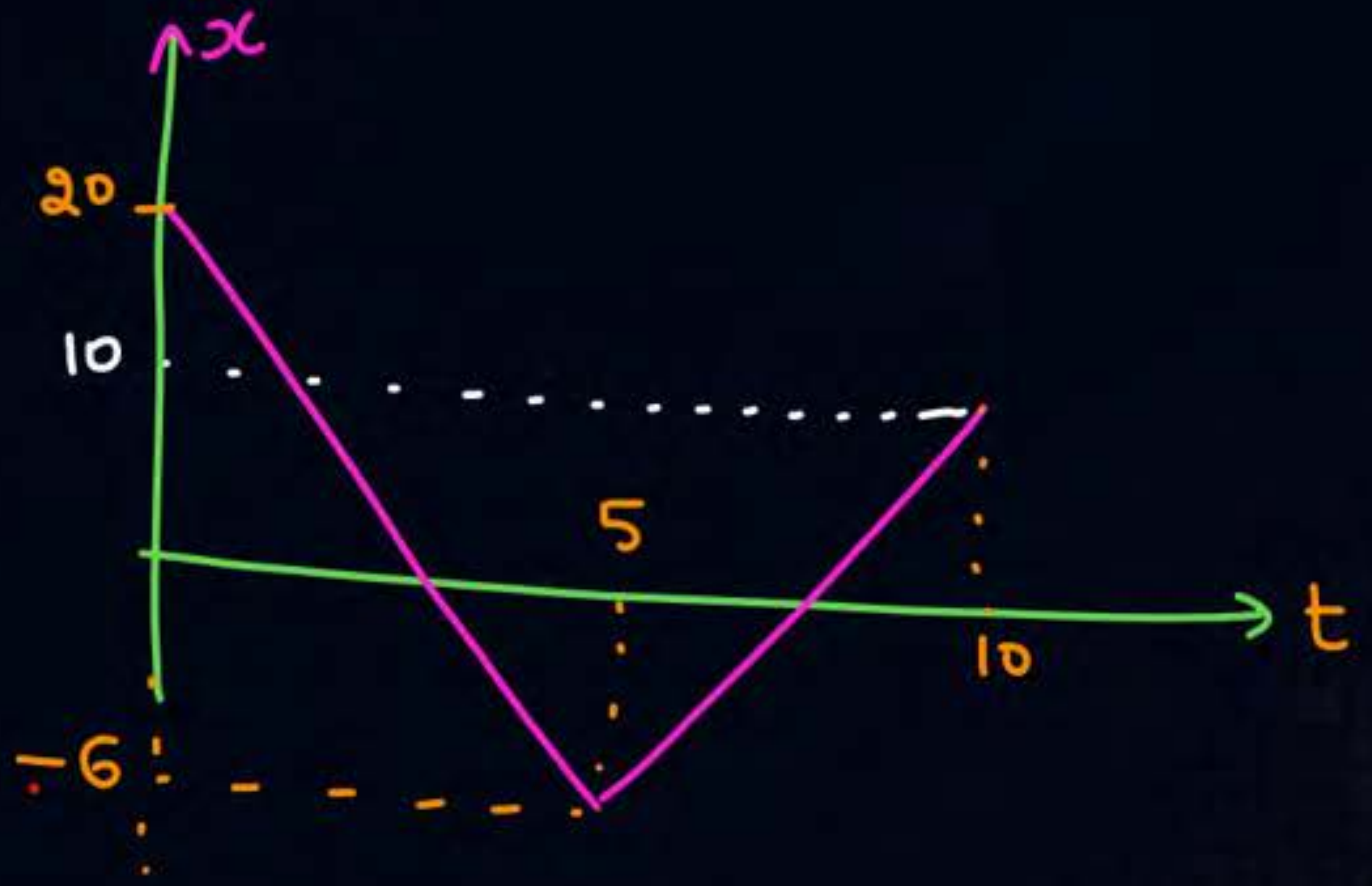
Avg velocity $= \dfrac{x_f - x_i}{\text{time}}$

$= \dfrac{(-6)-(+20)}{5}$

$= -\dfrac{26}{5}$

Q② $t=0 \longrightarrow t=10$

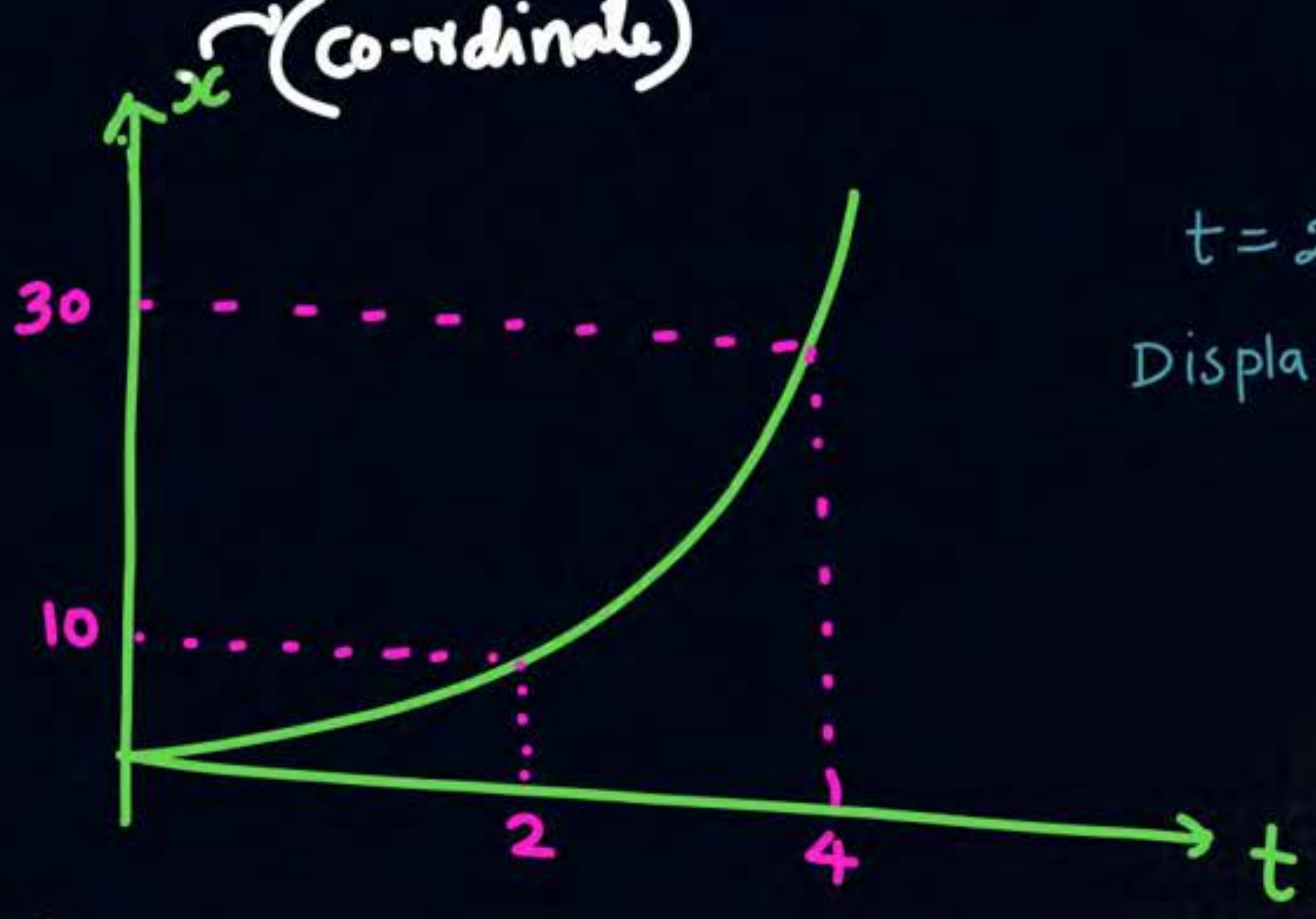
Avg velocity $= \dfrac{10-20}{10}$



Q

find average velocity from

$t = 2 \longrightarrow t = 4\,sec$



$t = 2 \longrightarrow t = 4$

Displacement $= 20$

$= 30 - 10 = 20$

Avg velocity $= \dfrac{x_f - x_i}{\text{total time}}$

$$\boxed{= \frac{30-10}{4-2} = \frac{20}{2} = 10}$$


thank you

Q

initial $(2,3,4)$ final $(7,5,9)$

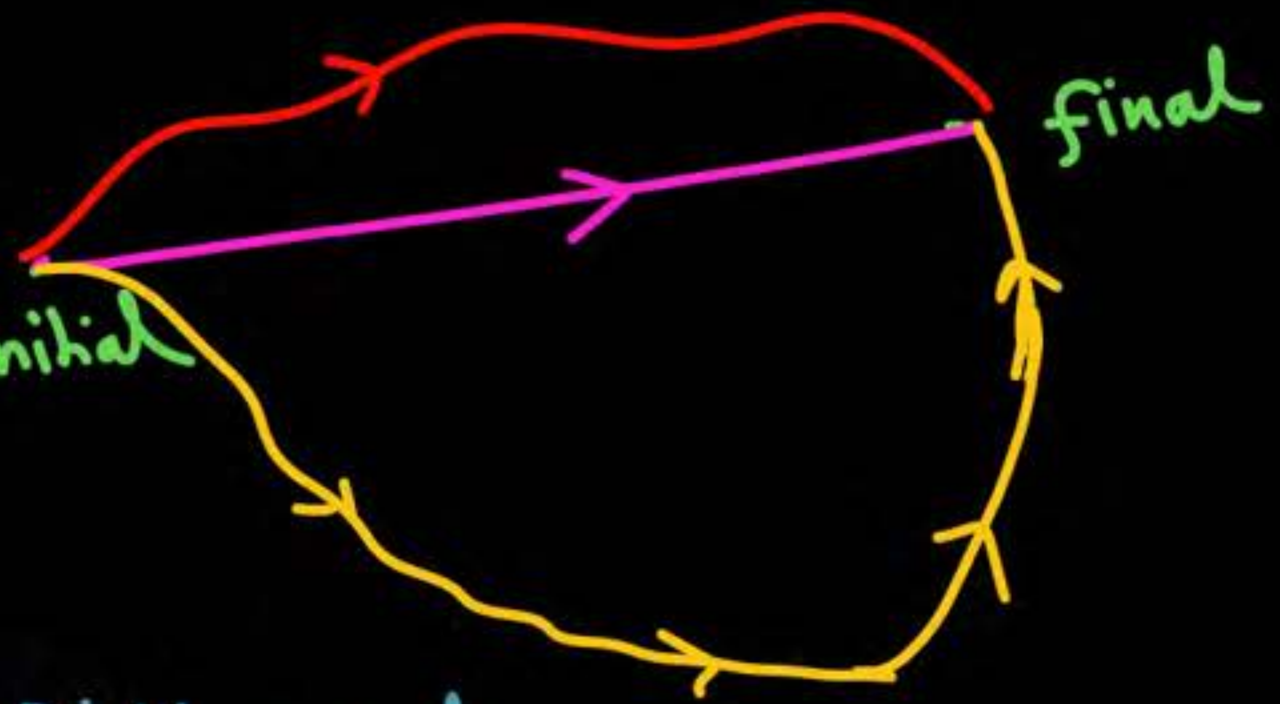
$\vec{d}$ = displacement $= \vec{r}_f - \vec{r}_i = 5\hat{i} + 2\hat{j} + 5\hat{k}$

Q.

final $(-5,0,0) \longleftarrow$ initial $(0,0,0)$

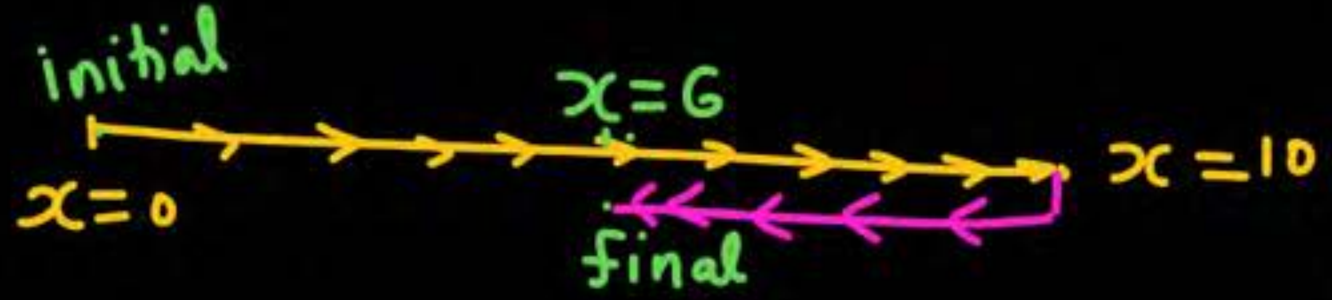
Displacement $= -5\hat{i}$

Q



- Displacement $\longrightarrow$ same
- Distance $\longrightarrow$ अलग $\equiv$ diff ✓ = depends on path.

** Q

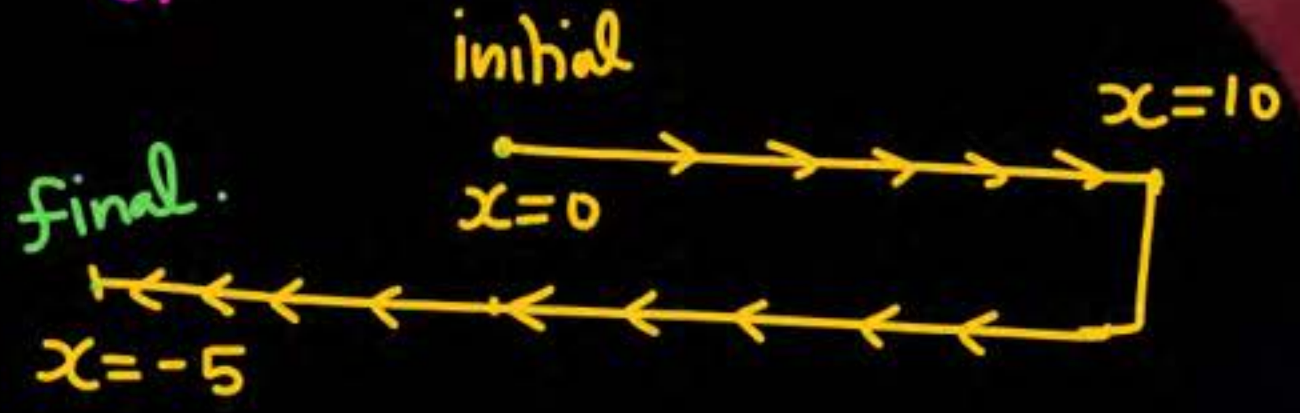


Distance travelled $= 10 + 4 = 14$

Displacement $= 6$ (magnitude)

Displacement (vector) $= 6\hat{i}$

Q

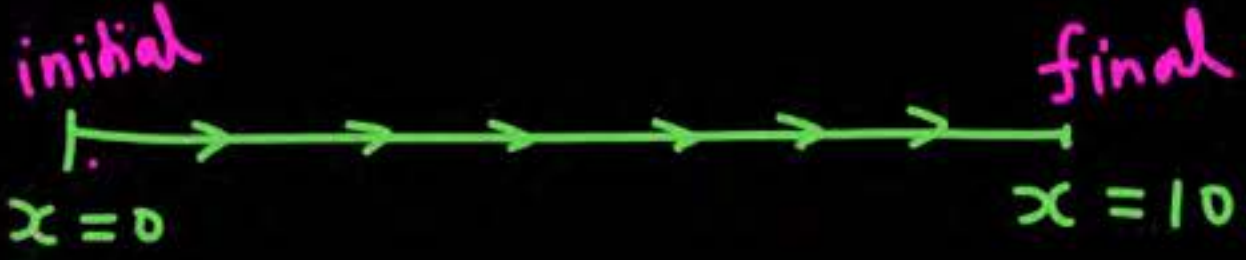


Distance $= 10 + 10 + 5$

$= 25$

Displacement $= -5\hat{i}$

Q



distance = 10

Displacement = $10\hat{i}$

Distance = |Displacement|

Q.

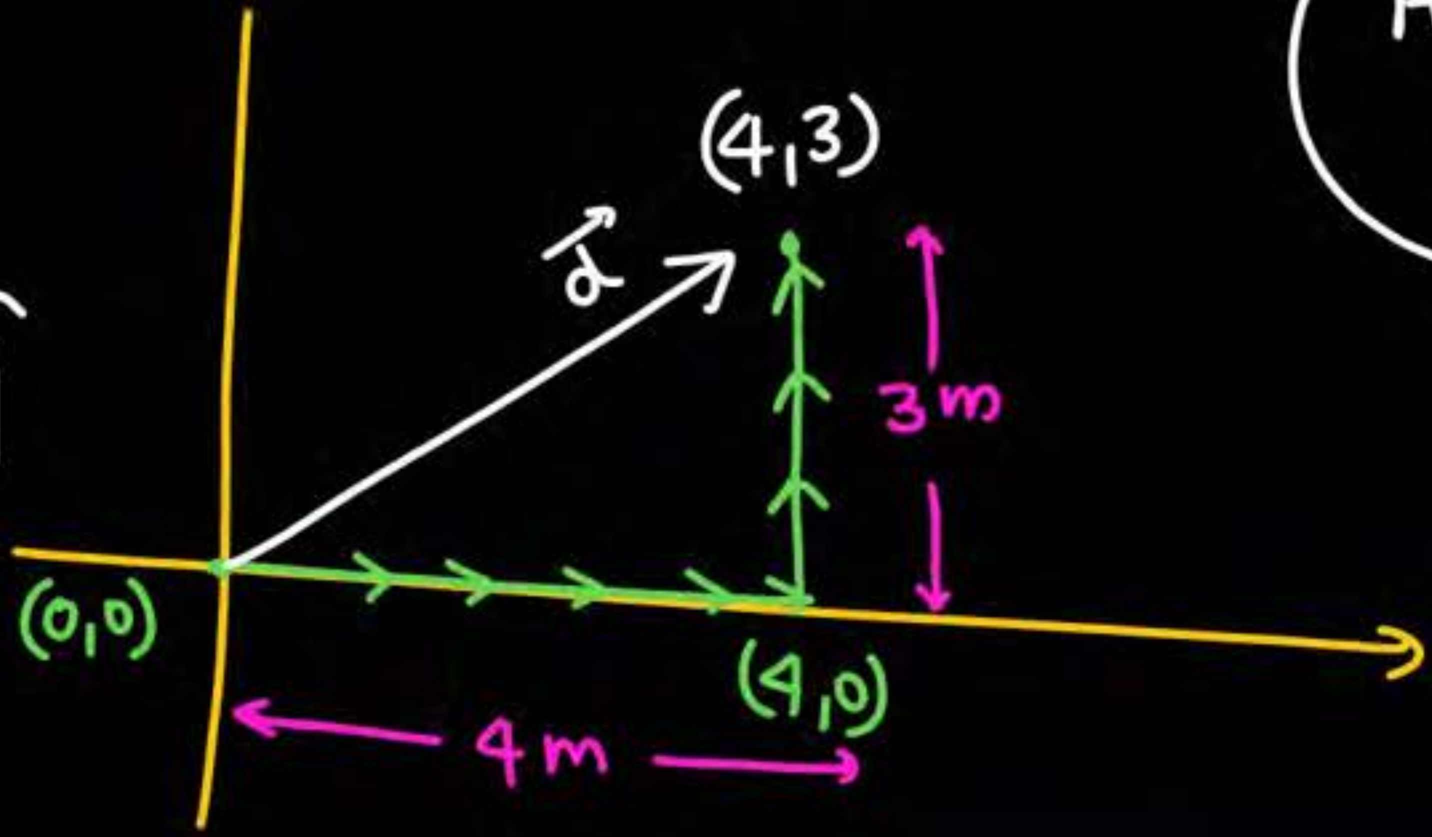
Distance $= 4 + 3 = 7\,m$

Displacement $= \vec{d} = 4\hat{i} + 3\hat{j}$

magnitude of displacement $= \sqrt{4^2 + 3^2}$

$= 5$

here Distance $>$ |Displacement|



$\vec{d_1} = 4\hat{i}$

$\vec{d_2} = 3\hat{j}$

$\vec{d}_{net} = 4\hat{i} + 3\hat{j}$

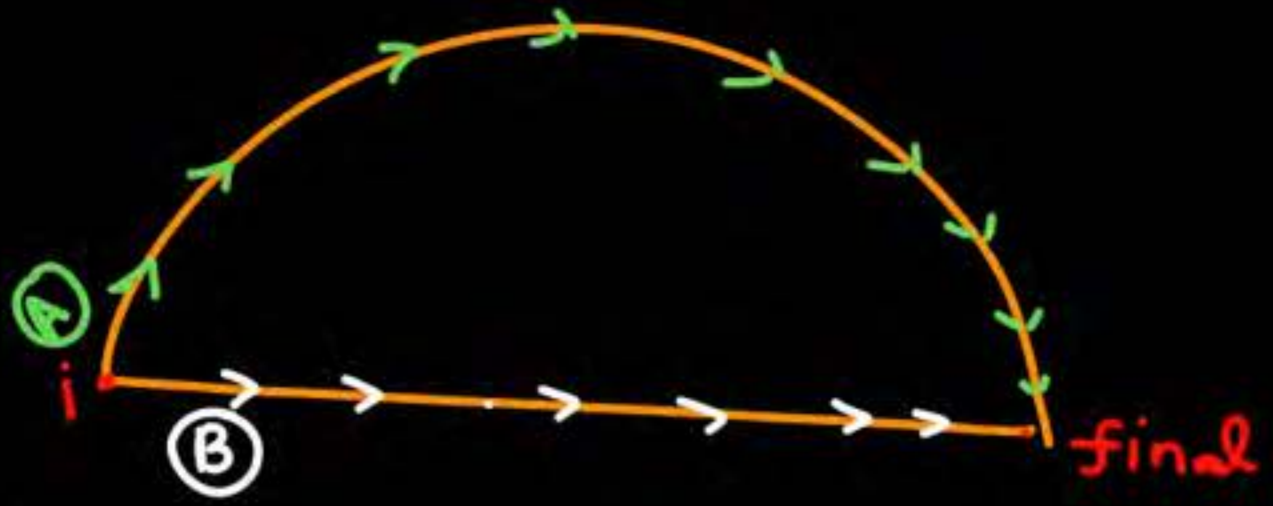
$\vec{A} + \vec{B}$

$A + B$

Q

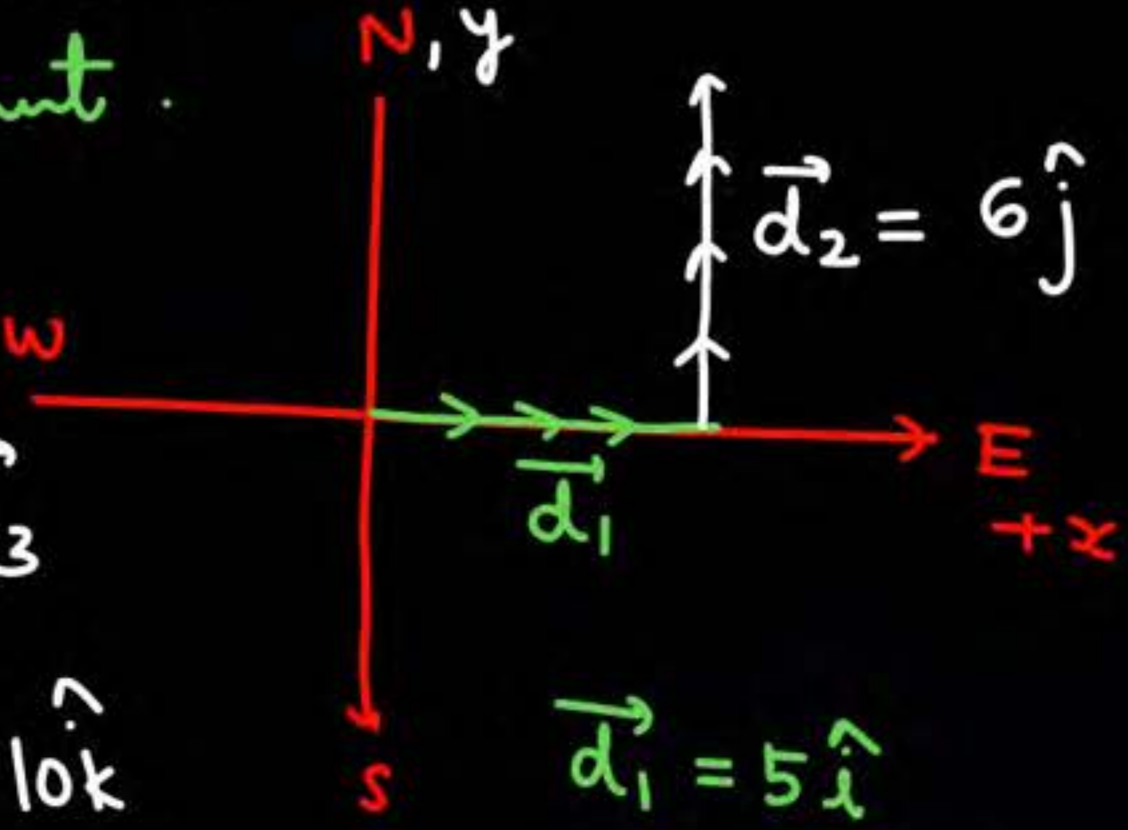
(A) → semicircle

(B) → st. line



	A	B
Distance	πR	$2R$
|Displacent|	$2R$	$2R$

Q A particle move 5m along east, then 6m along north and 10 m in upward direction. find distance & displacement.



Distance = 5 + 6 + 10 = 21

Displacement $= \vec{d}_{net} = \vec{d}_1 + \vec{d}_2 + \vec{d}_3$

$$= 5\hat{i} + 6\hat{j} + 10\hat{k}$$

Magnitude $= \sqrt{5^2 + 6^2 + 10^2}$

$\vec{d}_1 = 5\hat{i}$

$\vec{d}_3 = 10\hat{k}$

Q A particle move

10m east $= \vec{d_1} = 10\hat{i}$

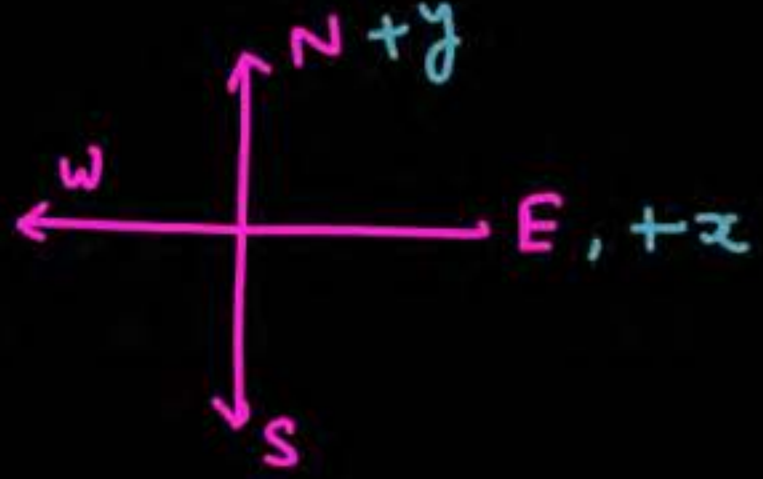
5m north $= \vec{d_2} = 5\hat{j}$

6m south $= \vec{d_3} = -6\hat{j}$

8m west $= \vec{d_4} = -8\hat{i}$

15m east $= \vec{d_5} = 15\hat{i}$

20m north $= \vec{d_6} = 20\hat{j}$



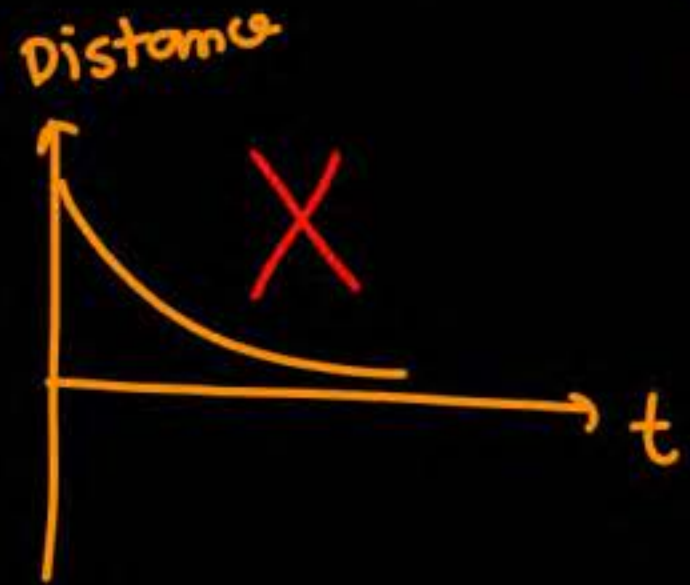
$\vec{d}_{net} =$ (Add) $= (10-8+15)\hat{i} + (5-6+20)\hat{j}$

$= 17\hat{i} + 19\hat{j}$

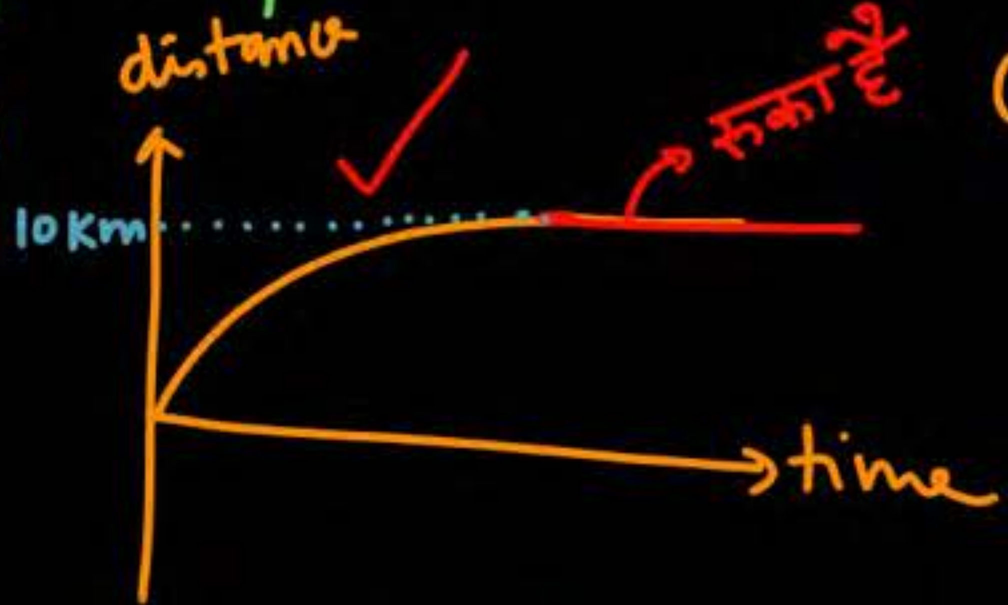
distance $= 10+5+6+8+15+20$

Q which of the graph is possible.

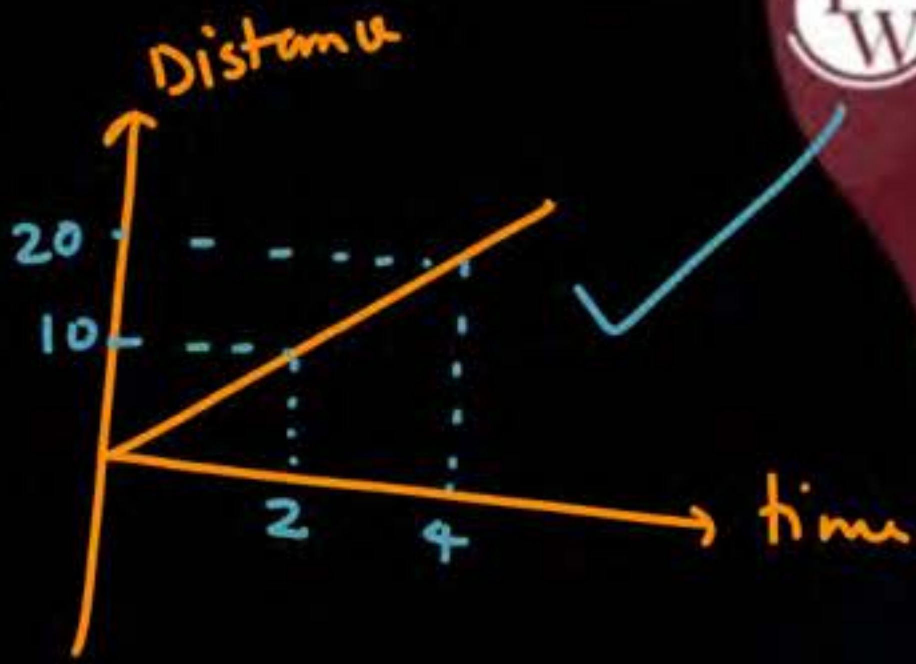
(1)



(2)



(3)



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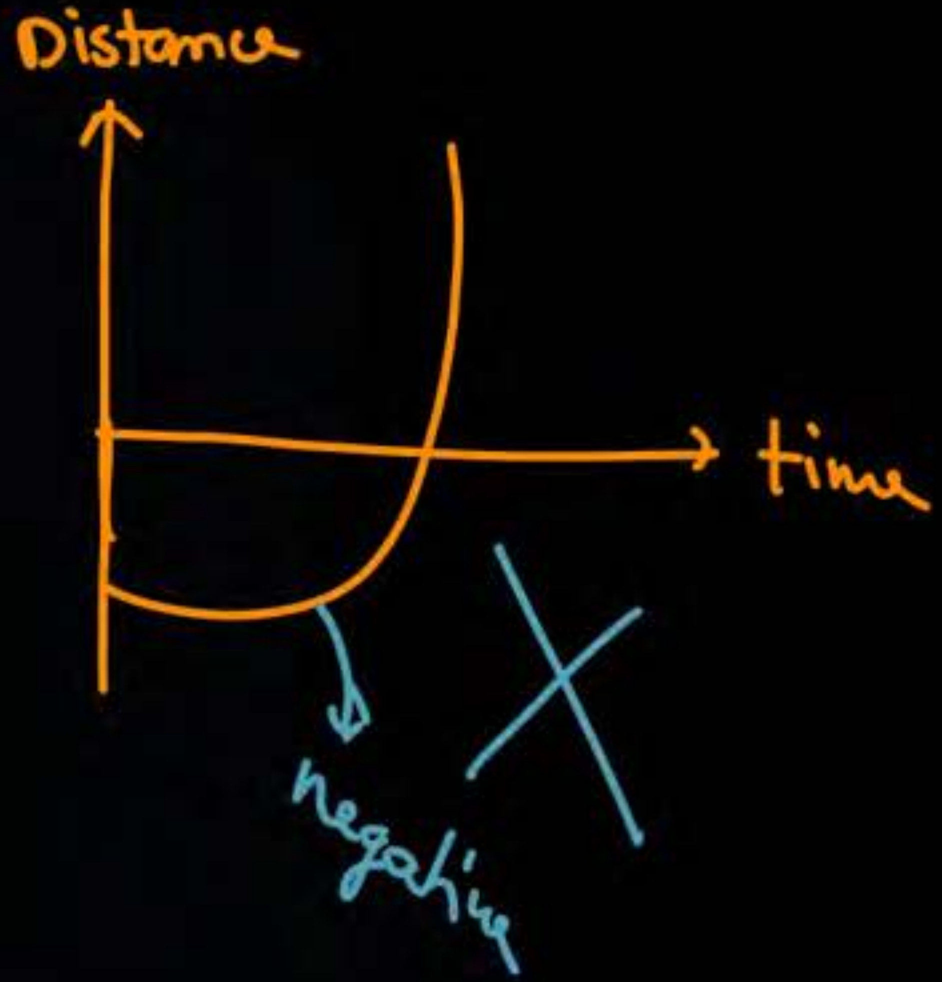
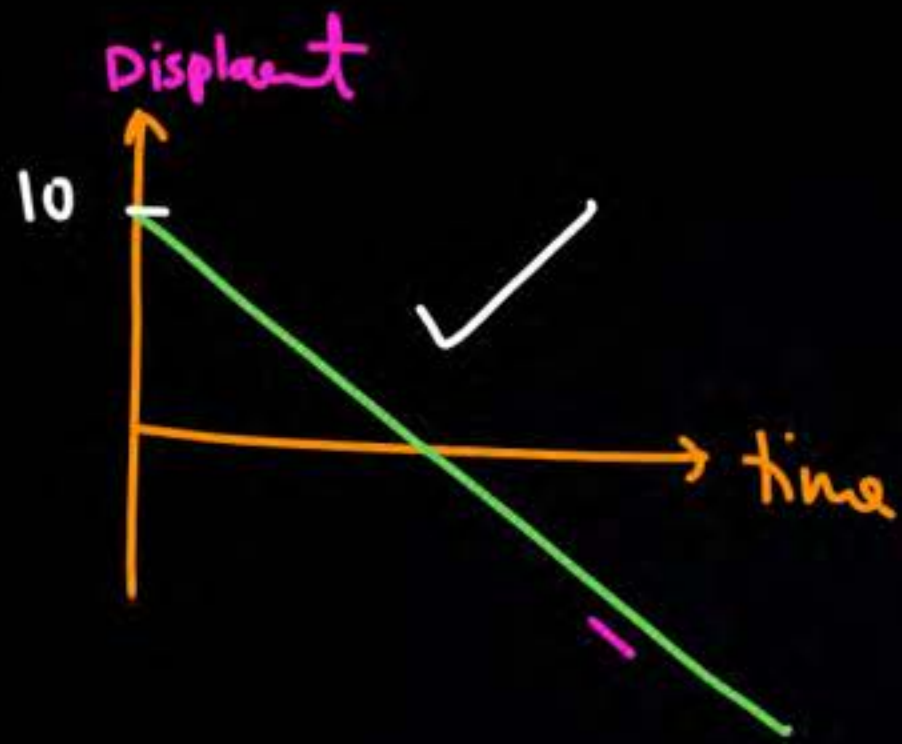
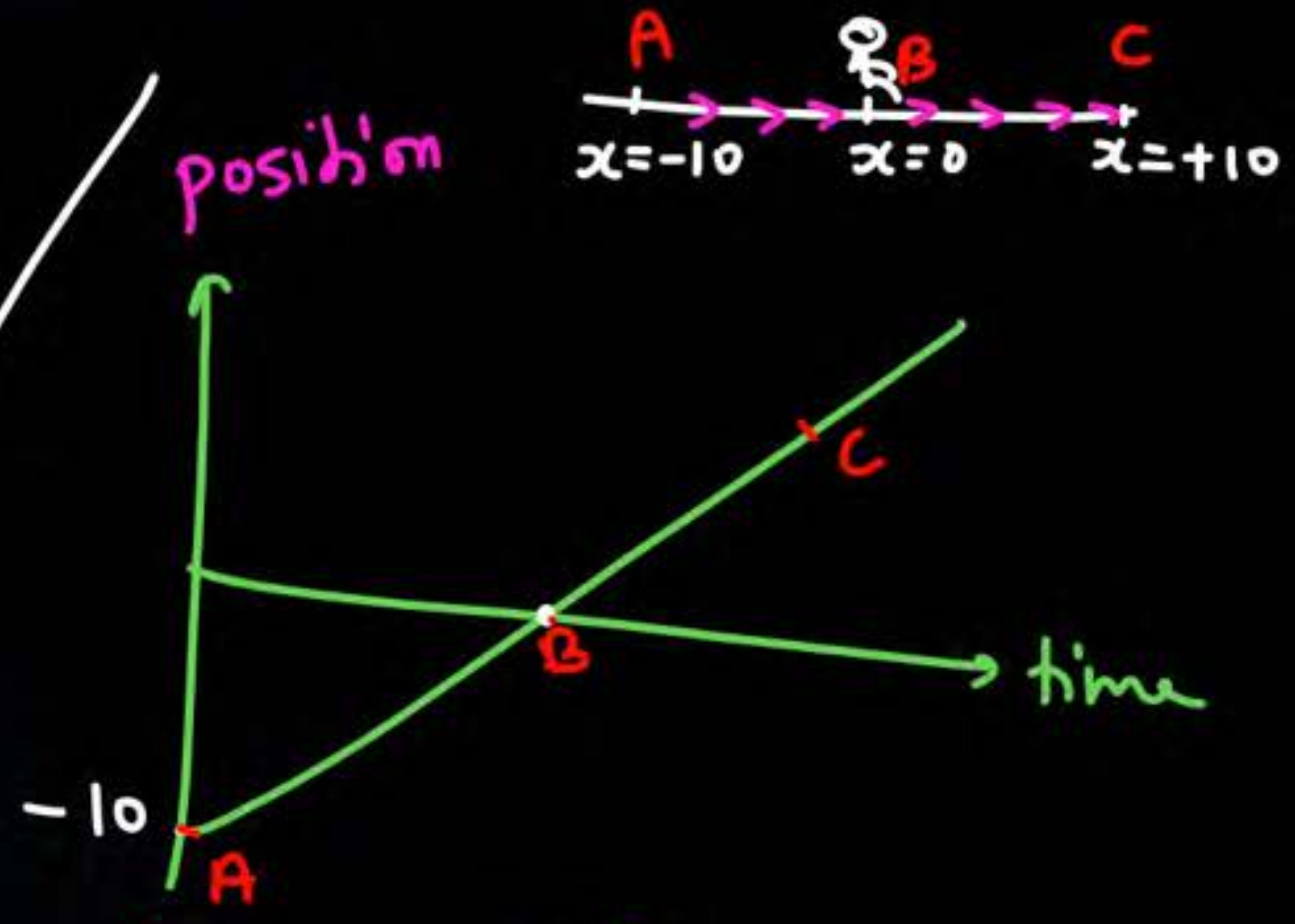


(5)



6



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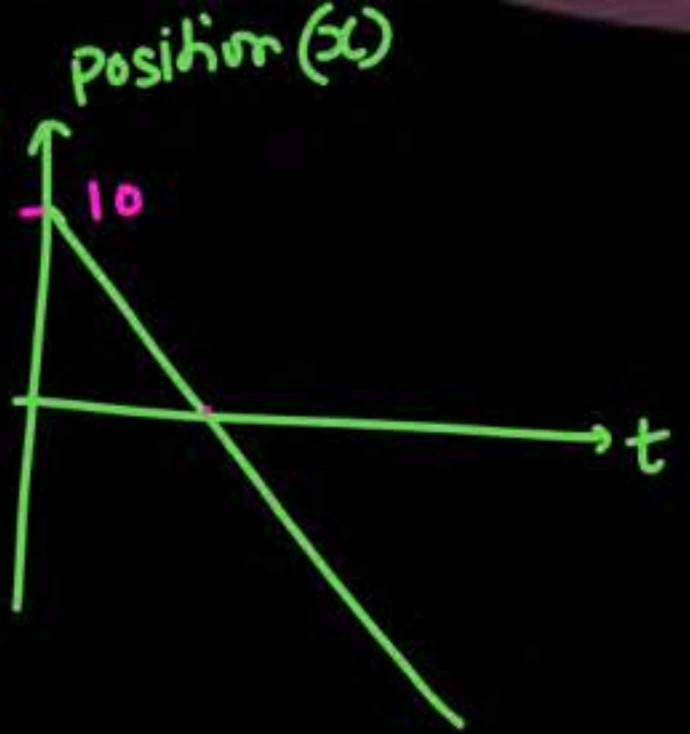

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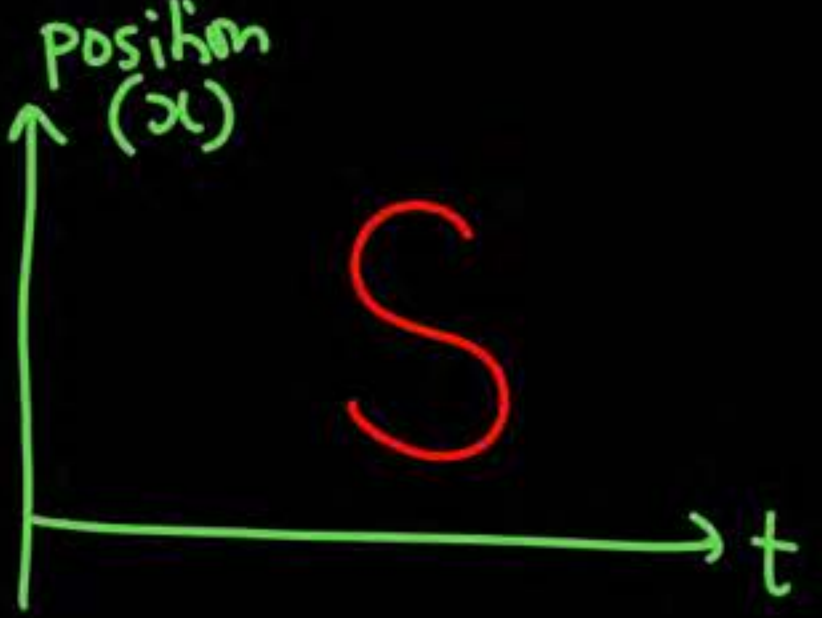


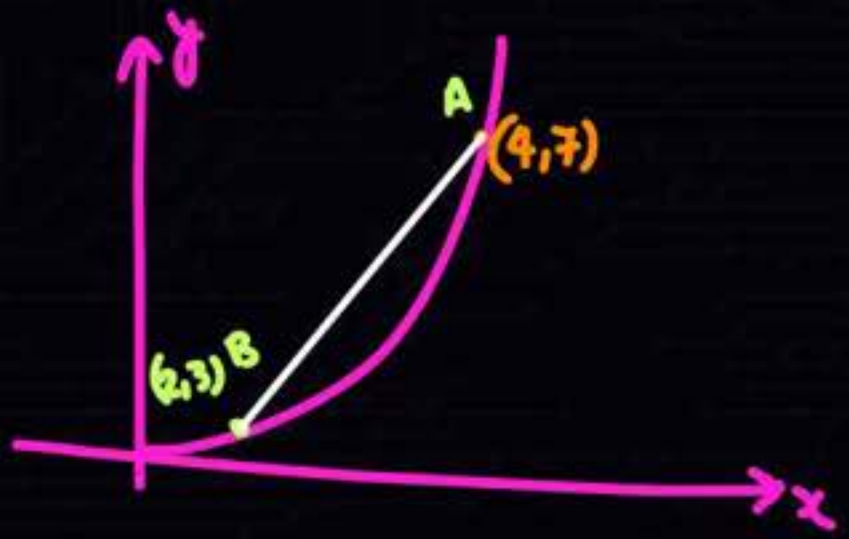
displacement = chge in positi

$$\vec{d} = \vec{x}_f - \vec{x}_i$$

Slope.

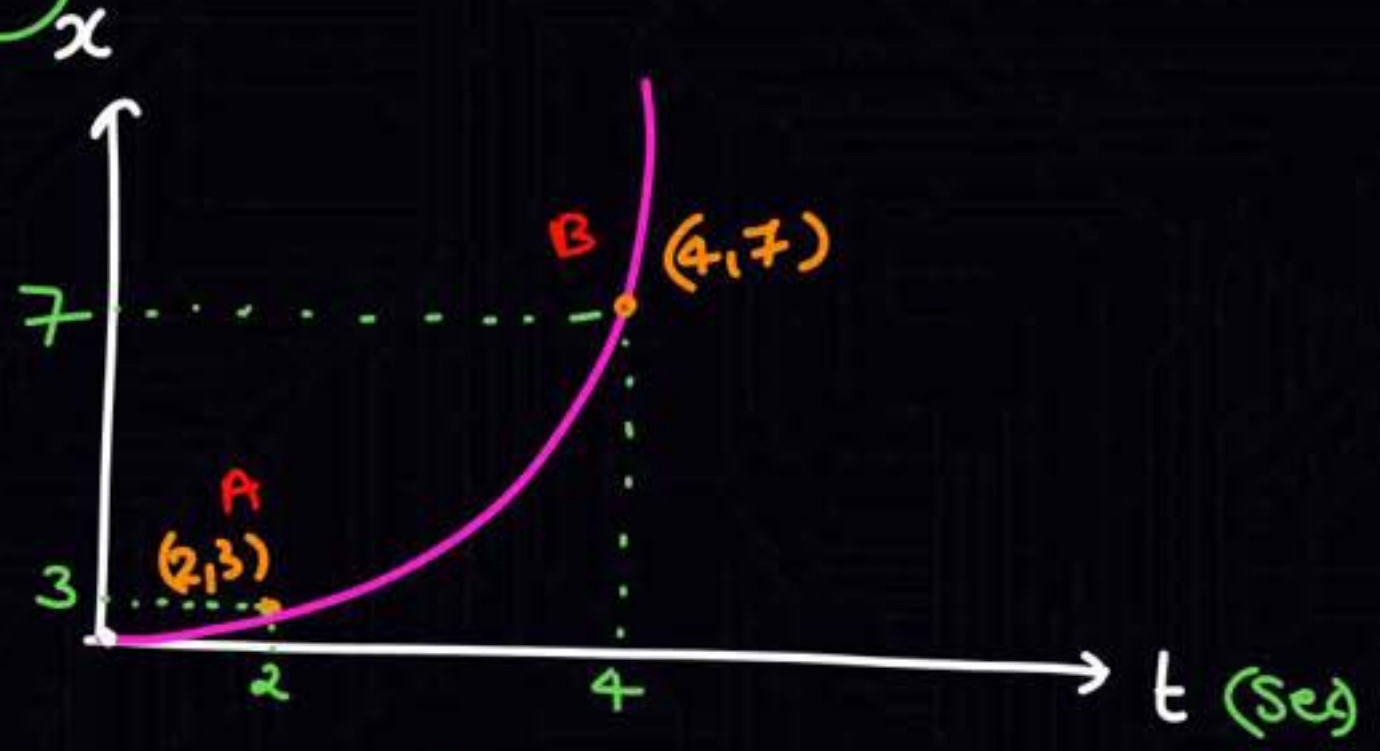
$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Slope} = \frac{7-3}{4-2} = 2$$

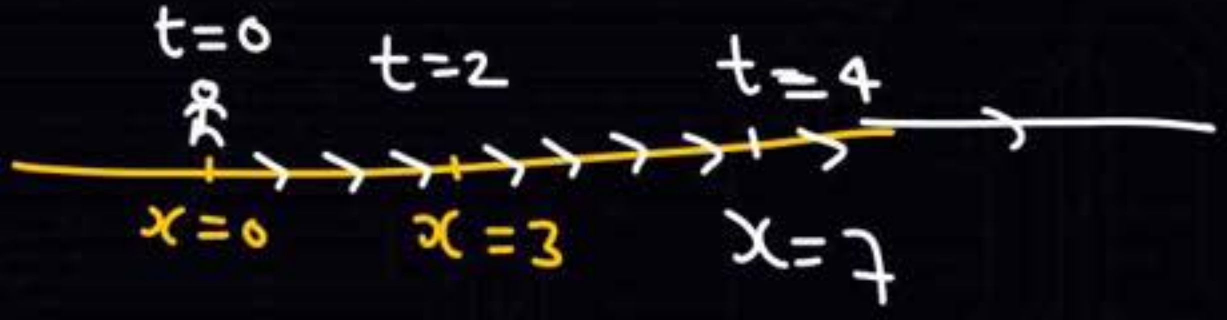


$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_2} = \frac{\text{change in } y}{\text{change in } x}$$

phy



$$\underset{(A \to B)}{\text{Avrg velocity}} = \frac{x_f - x_i}{t_2 - t_1} = \frac{7-3}{4-2} = 2$$



(1)

slope = $\tan\theta$

$$y = mx + c$$

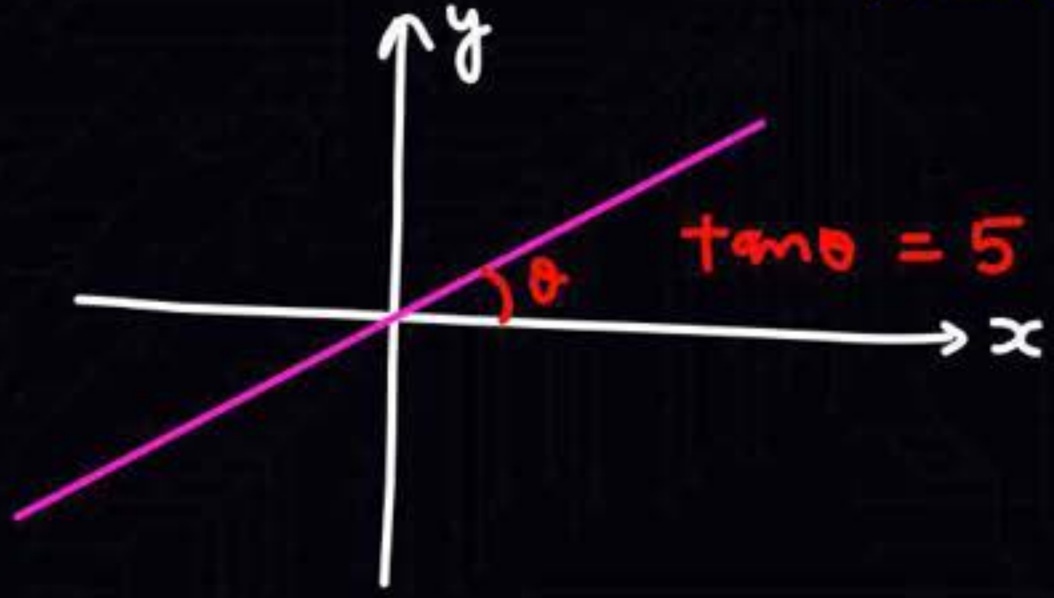
$m \downarrow$ slope = $\tan\theta$

(2)

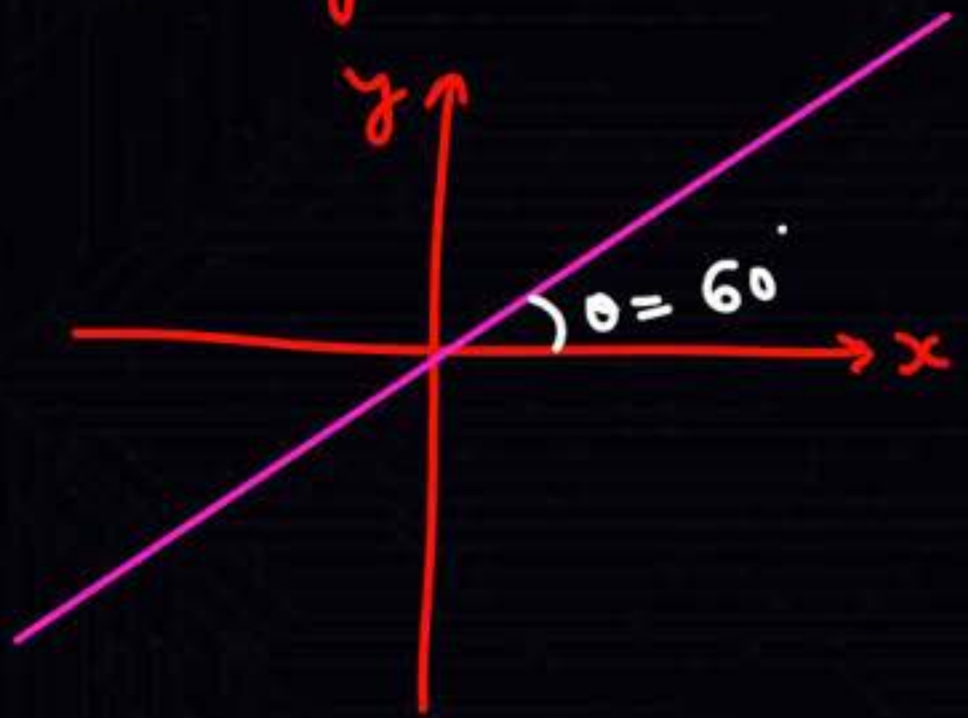
$$y = 5x$$

$$y = mx + c$$

$$m = 5 = \text{slope}$$



③ $y = x\sqrt{3}$



slope $= \sqrt{3} = \tan\theta$

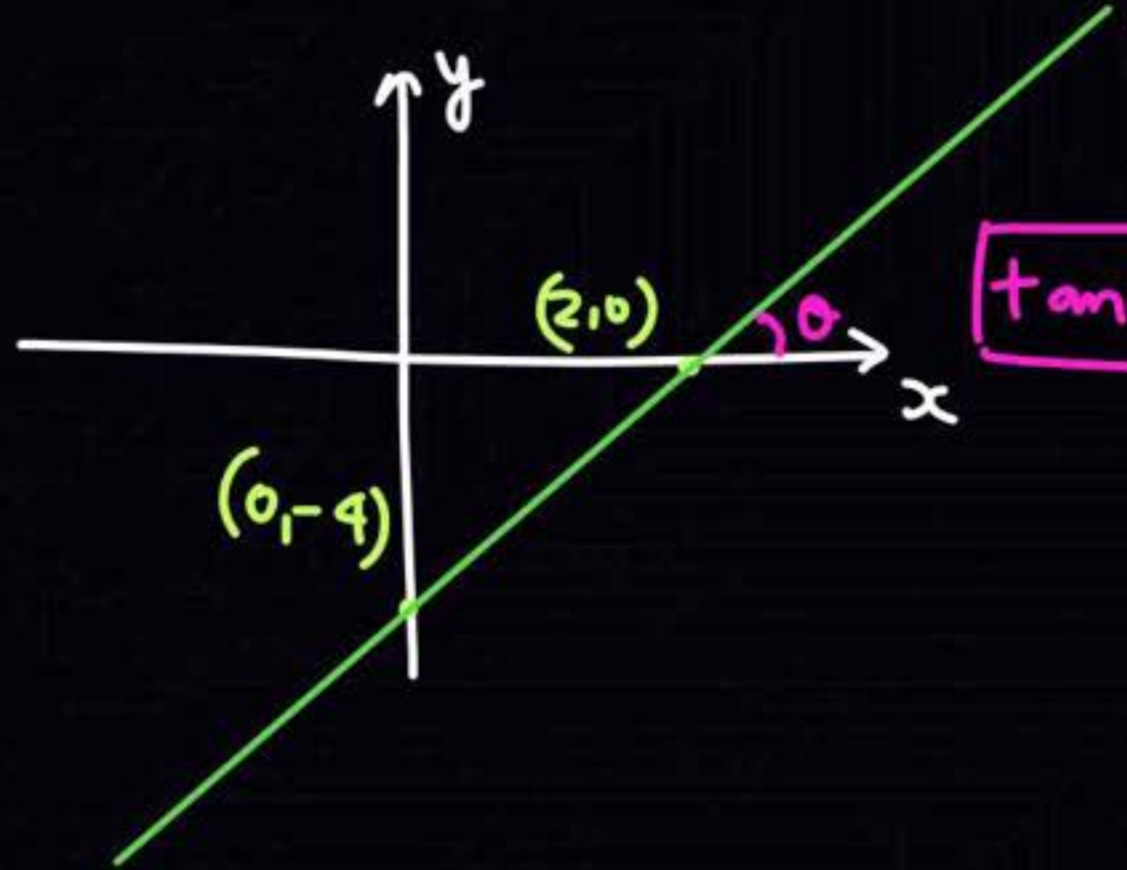
$\theta = 60°$

$y = 2x - 4$ (draw) → (not imp in physics)

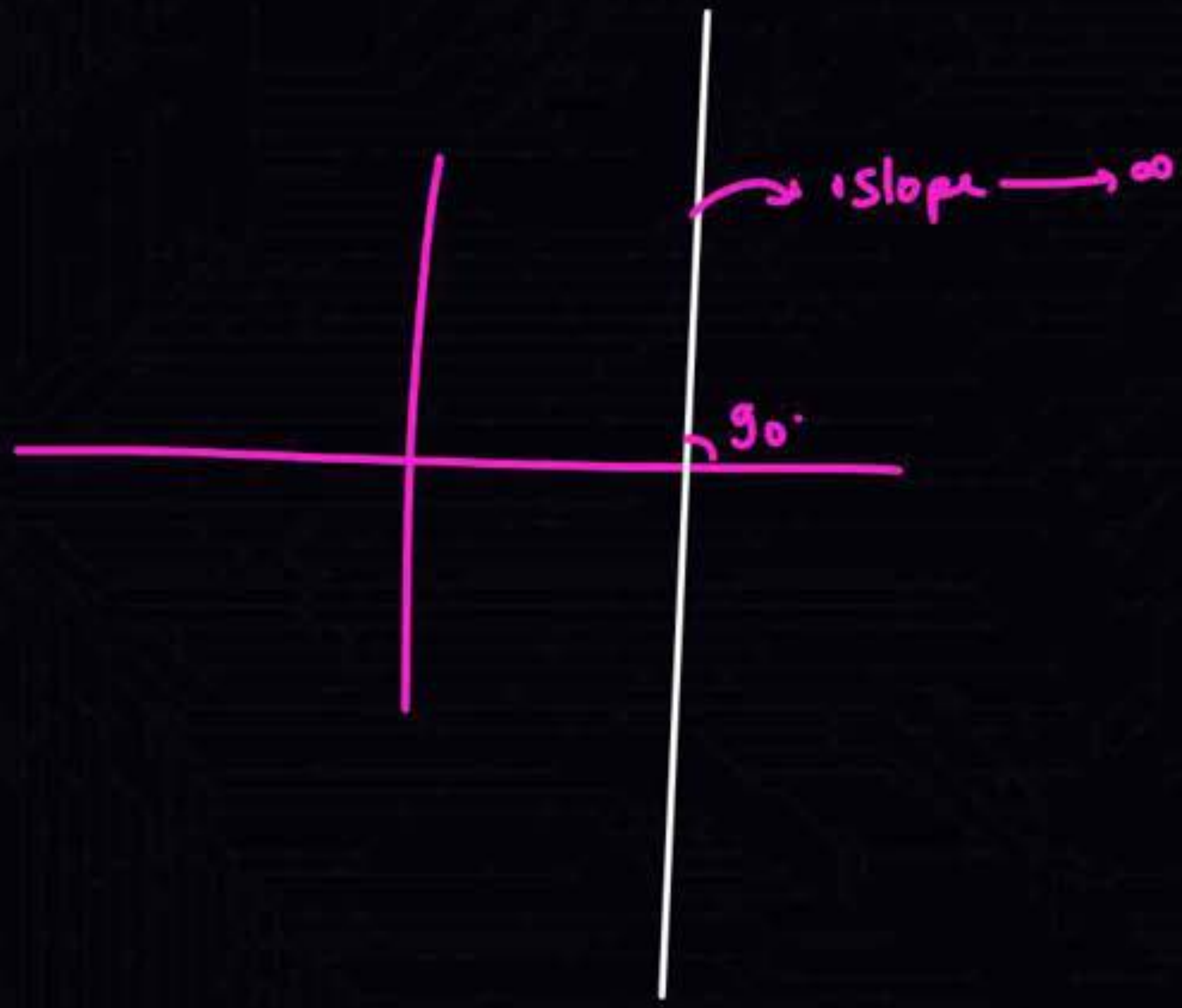
$(x=0,\ y=-4) \equiv (0,-4)$

$(y=0,\ x=2) = (2,0)$

slope $= 2 \Rightarrow +ve$



$\boxed{\tan\theta = \text{slope} = 2}$

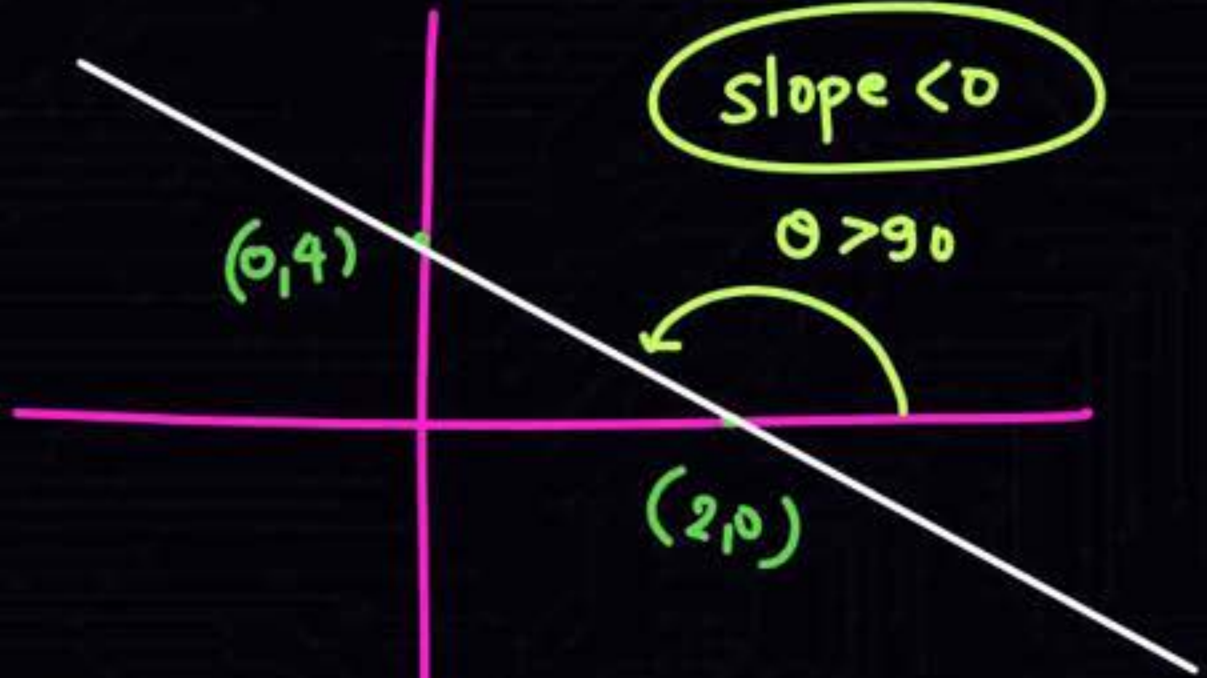

slope → ∞
90°

$y = -2x + 4$

$$\left(\begin{matrix} x=0, & y=4 \\ y=0, & x=2 \end{matrix}\right) \begin{matrix} (0,4) \\ (2,0) \end{matrix}$$

Slope $= -2$

$\tan\theta = -2$

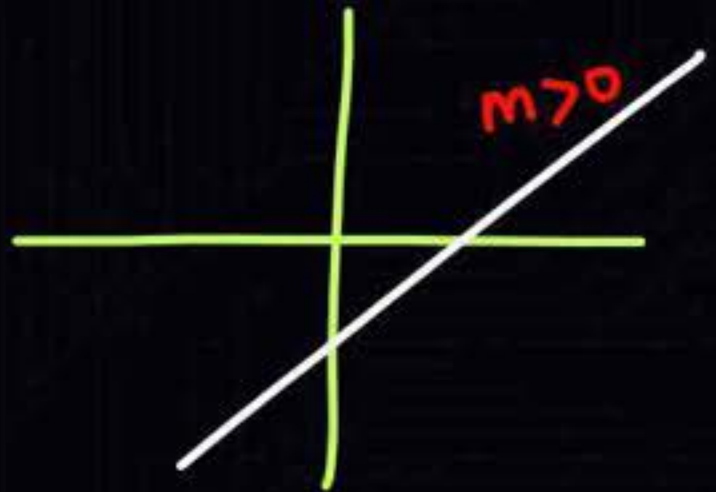


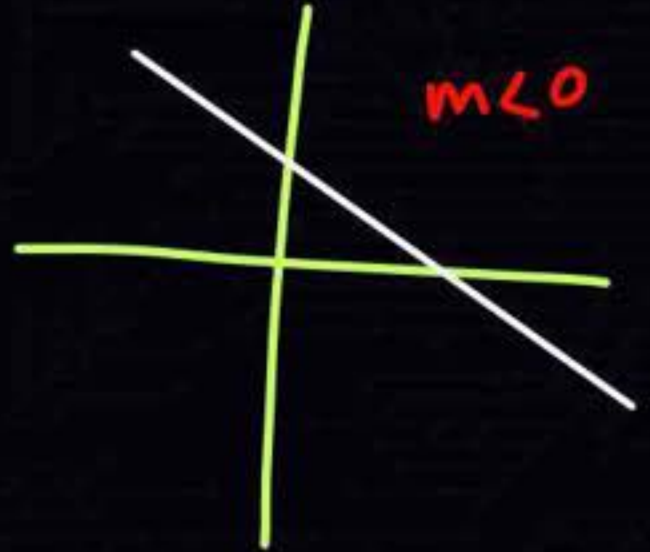
$y = mx + c$

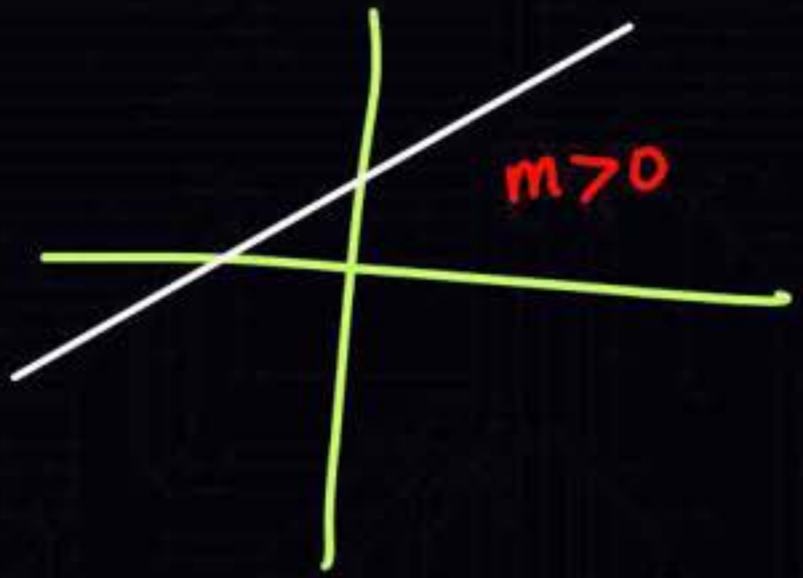
$2y = 8x + 16$

$\boxed{\text{Slope} = 8x}$

$$\boxed{\begin{matrix} y = 4x + 8 \\ \text{slope} = 4 \end{matrix}}$$


m>0


m<0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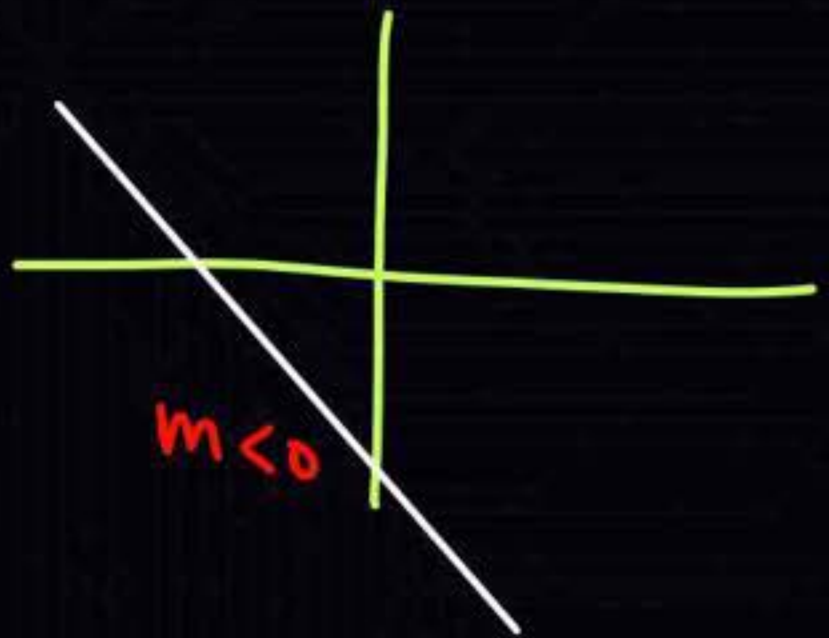
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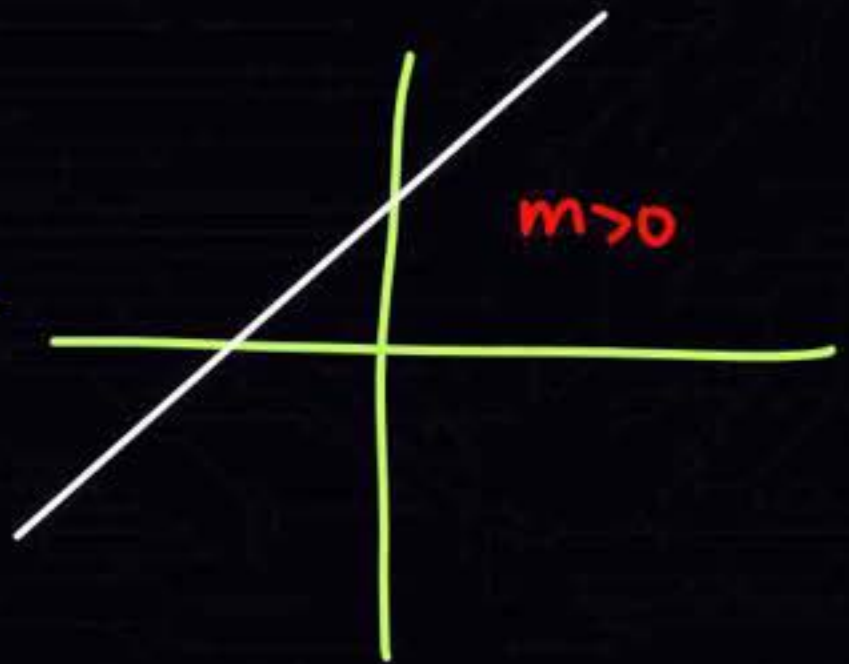
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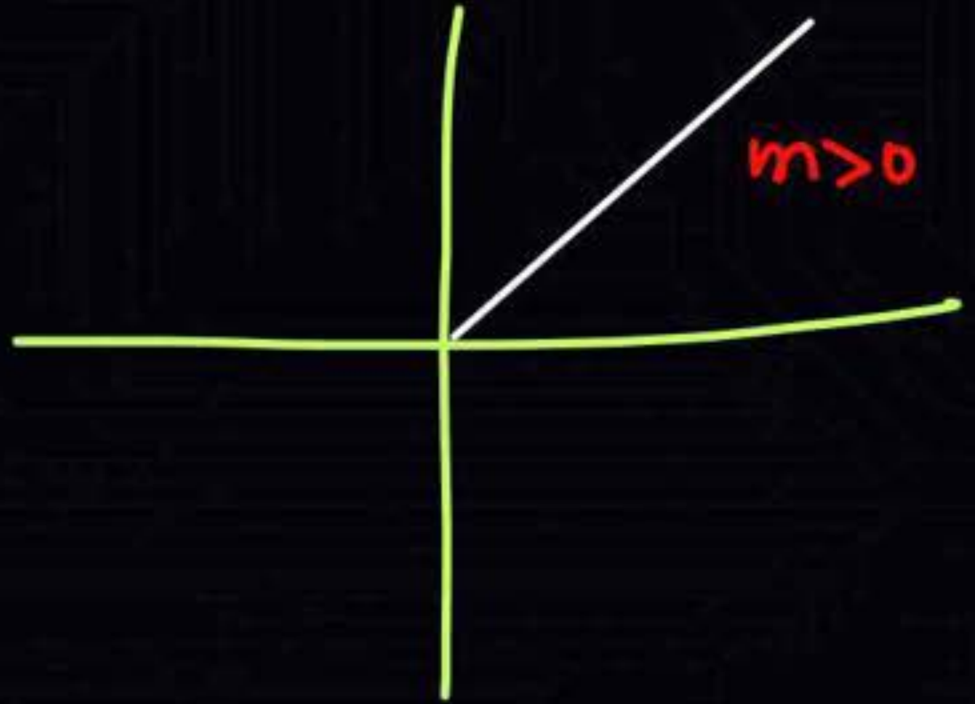

m>0

$$y = x^n$$

$$\frac{dy}{dx} = n x^{n-1}$$

1. $y = x^3$

$$\frac{dy}{dx} = 3x^{3-1} = 3x^2$$

2. $y = x^5$

$$\frac{dy}{dx} = 5x^4$$

3. $y = x^7$

$$\frac{dy}{dx} = 7x^6$$

4. $y = x^9$

$$\frac{dy}{dx} = 9x^8$$

5. $y = 2x^5$

$$\frac{dy}{dx} = 2 \times 5x^4$$

$$= 10x^4$$

(6) $y = x^3$

$\frac{dy}{dx} = 3x^2$

(7) $y = t^3$

$\frac{dy}{dt} = 3t^2$

(8) $x = t^3$

$\frac{dx}{dt} = 3t^2$

(9) $x = t^5$

$\frac{dx}{dt} = 5t^4$

(10) $x = t^7$

$\frac{dx}{dt} = 7t^6$

(1) $y = x^n$

$\frac{dy}{dx} = nx^{n-1}$

(2) $y = \sin x$

$\frac{dy}{dx} = \frac{d}{dx}(\sin x) = \cos x$

$\Downarrow$

means

differentiation of $\sin x$ w.r.t. x is $\cos x$

(3) $y = \cos x$

$\frac{dy}{dx} = \frac{d}{dx}\cos x = -\sin x$

(4) $y = \tan x$

$\frac{dy}{dx} = \frac{d}{dx}(\tan x) = \sec^2 x$

(5) $y = \cot x$

$\frac{dy}{dx} = \frac{d(\cot x)}{dt} = -\operatorname{cosec}^2 x$

* $\frac{d}{dx}(x^n) = nx^{n-1}$
* $\frac{d}{dx}\sin x = \cos x$
* $\frac{d}{dx}(\cos x) = -\sin x$
* $\frac{d}{dx}(\tan x) = \sec^2 x$
* $\frac{d}{dx}(\sec x) = \sec x . \tan x$
* $\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$
* $\frac{d}{dx}\cot x = -\operatorname{cosec}^2 x$
* $\frac{d}{dx}e^x = e^x$
* $\frac{d}{dx}(\ln x) = \frac{1}{x}$

Q

$$x = \frac{t^3}{3} - 3t^2 + 9t + 21$$

$$v = t^2 - 6t + 9 + 0 = (t-3)^2$$

$v = 0$

$t^2 - 6t + 9 = 0$

$t = 3$ sec

~~$t = 3$ is turning point~~

$v = (t-3)^2 > 0$

$v \longrightarrow$ always +ve

No turning point

Q $x = 3t^2 - 12t + 10$

$\rightarrow v = 6t - 12$

$\rightarrow a = 6 = \text{Const}$

① $t=0$, $t=2$, $t=3$,

	x	v	a
$t=0$	10	-12	6
$t=2$	-2	0	6
$t=3$	$+1$	6	6

② find x & a when particle comes to at rest

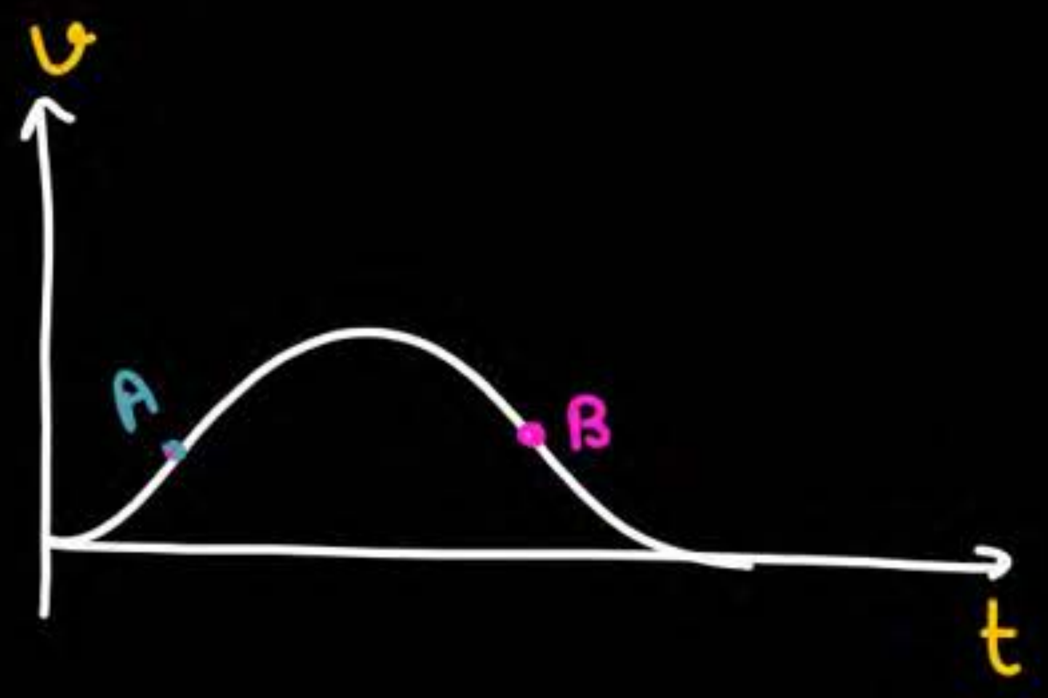
$v=0$, $v = 6t - 12 = 0$

$t=2$

$t=2$, $x = -2$

$a = 6$

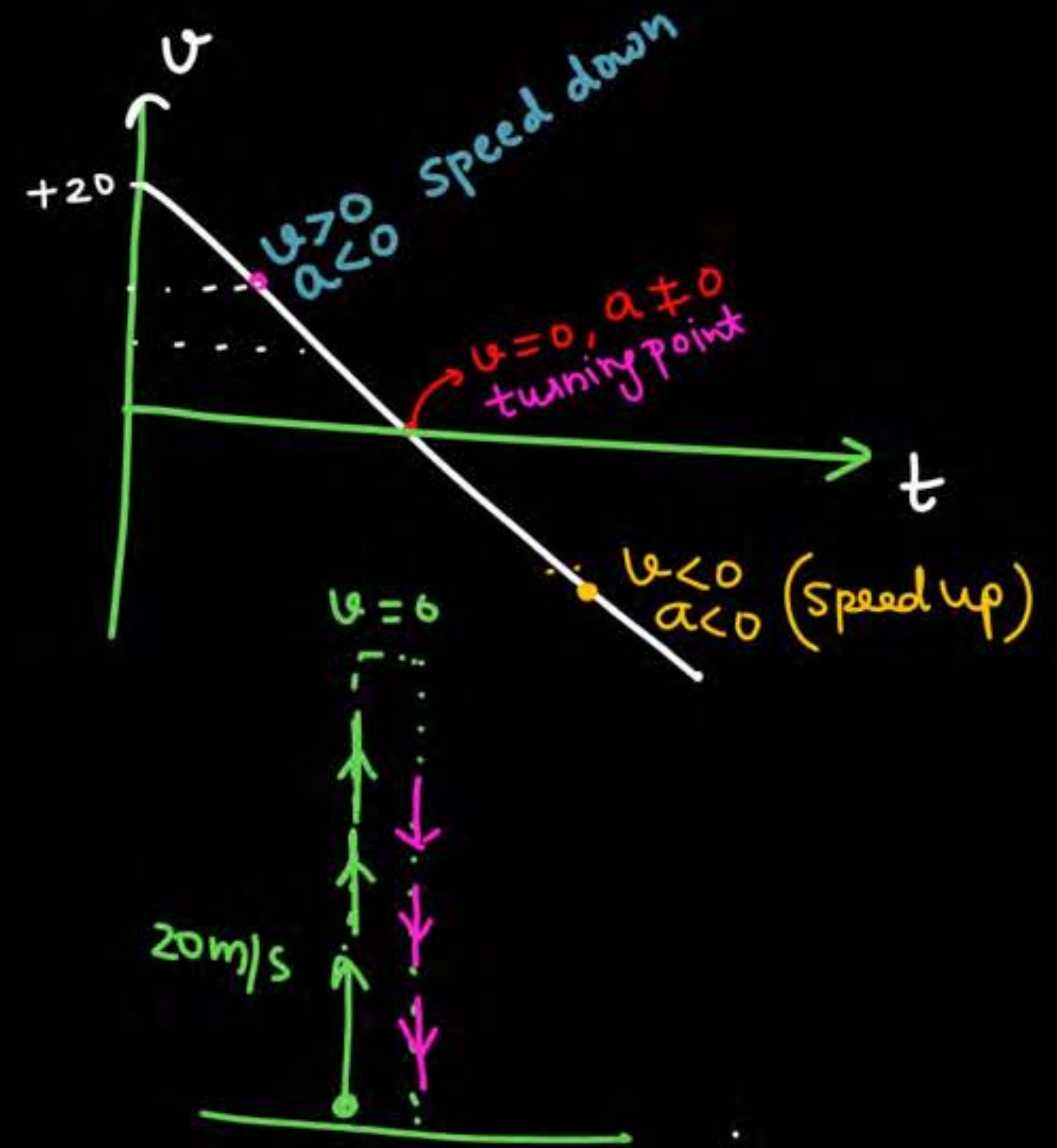
Q



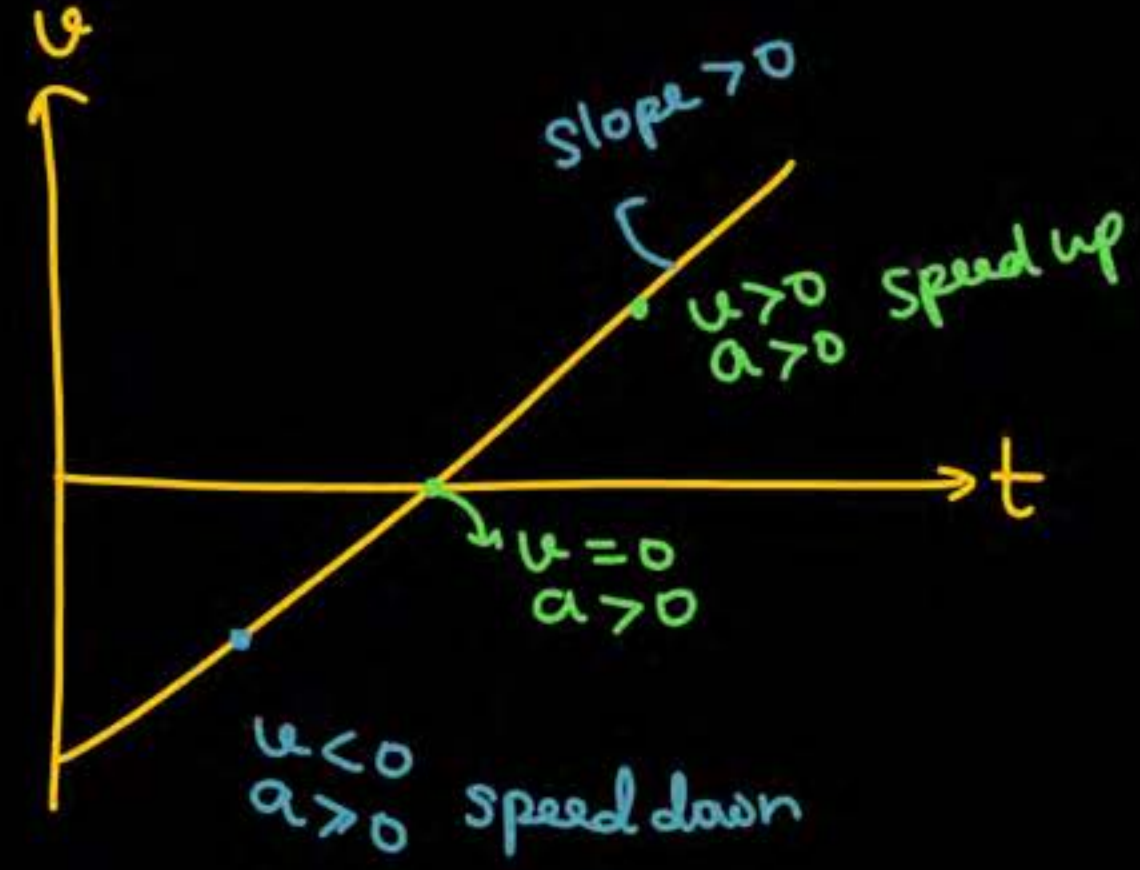
$v_A > 0$, $a_A > 0$ ⇒ speed up

$v_B > 0$, $a_B < 0$ ⇒ speed down

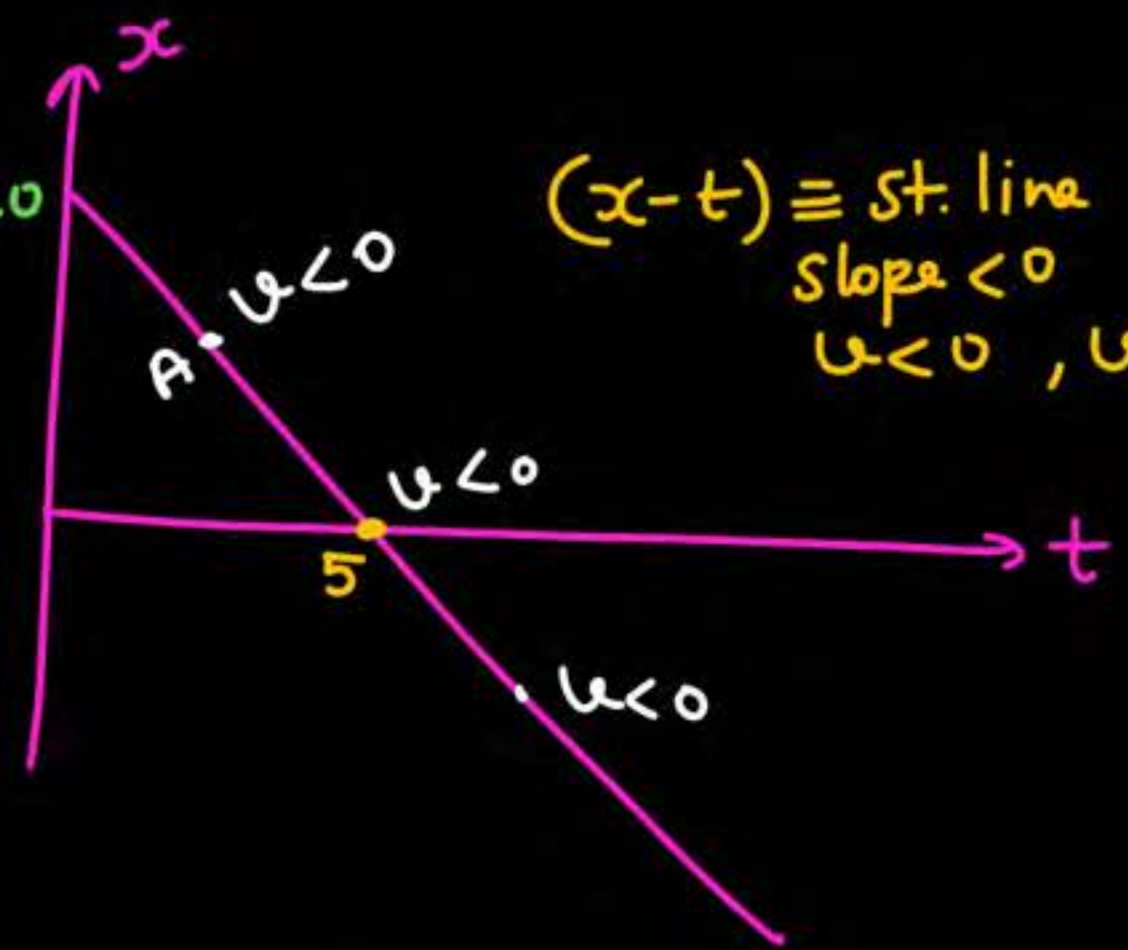
Q



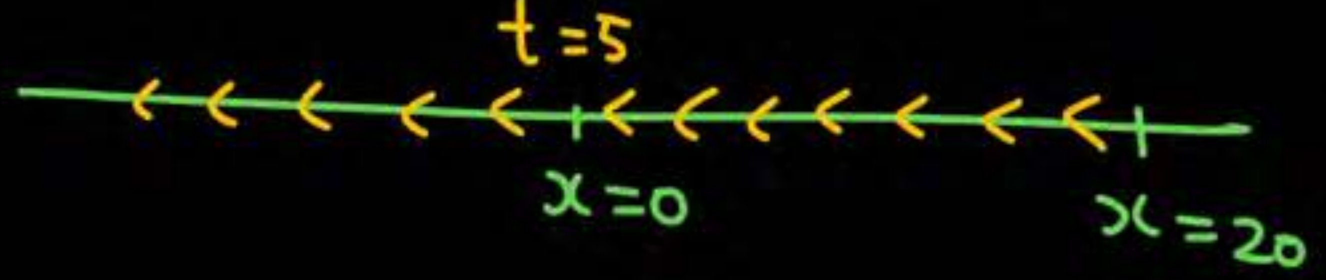
Q



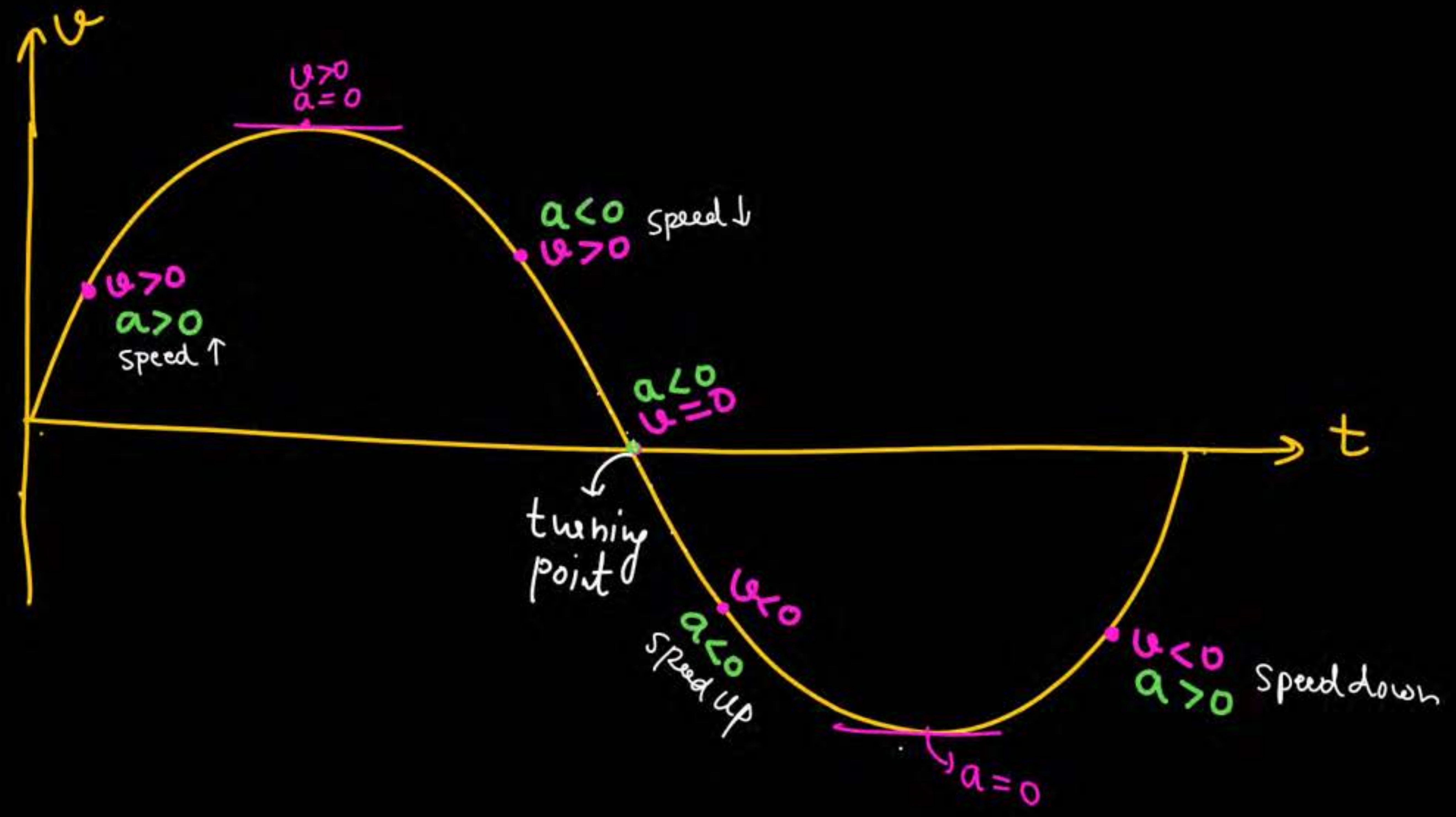
Q



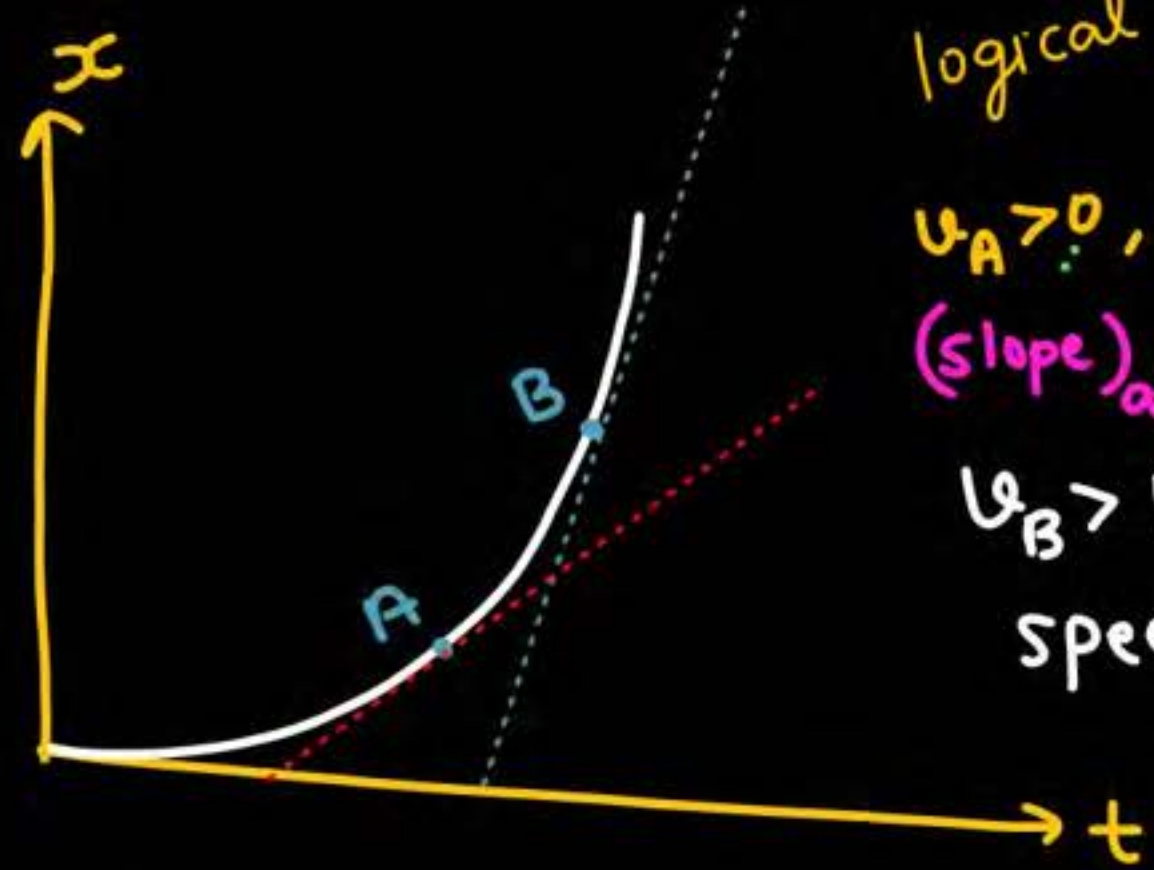
$(x-t) \equiv$ st. line
slope < 0
$v < 0$, $v =$ const



Q


v
t
v>0
a=0
a<0 speed↓
v>0
v>0
a>0
speed ↑
a<0
v=0
turning point
v<0
a<0
speed up
v<0
a>0 speed down
a=0

Q



logical तरीका

$v_A > 0$, $v_B > 0$

$(\text{slope})_{\text{at } B} > (\text{slope})_{\text{at } A}$

$v_B > v_A$

speed up

$v > 0$

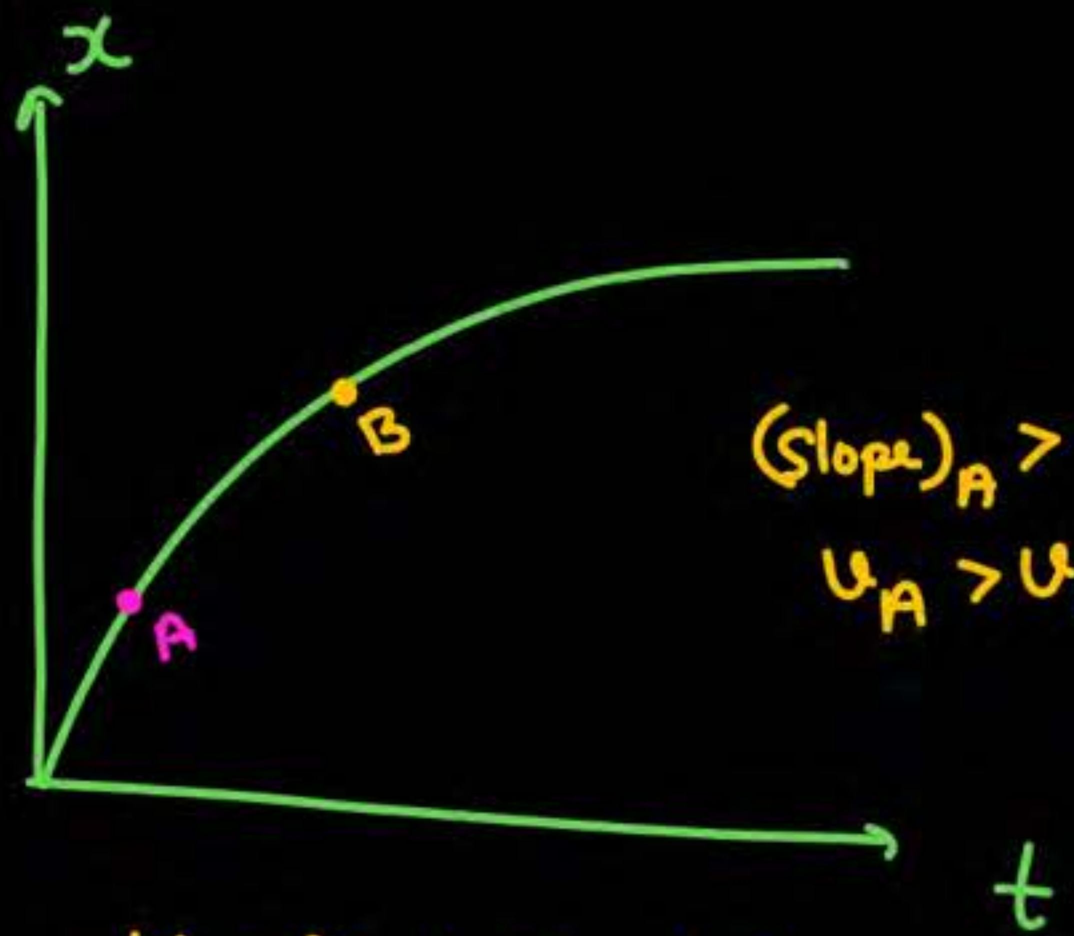
$a > 0$

$v > 0$

speed up

$a > 0$

Q



$(\text{Slope})_A > (\text{Slope})_B$

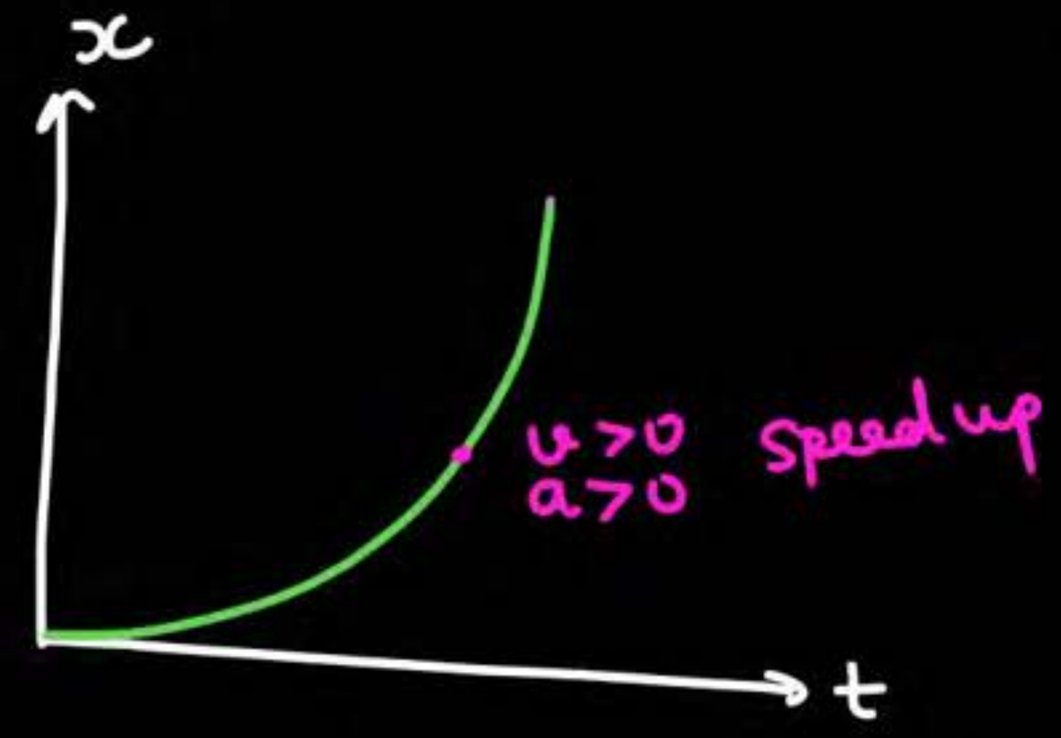
$v_A > v_B$

time ↑ ⇒ speed ↓

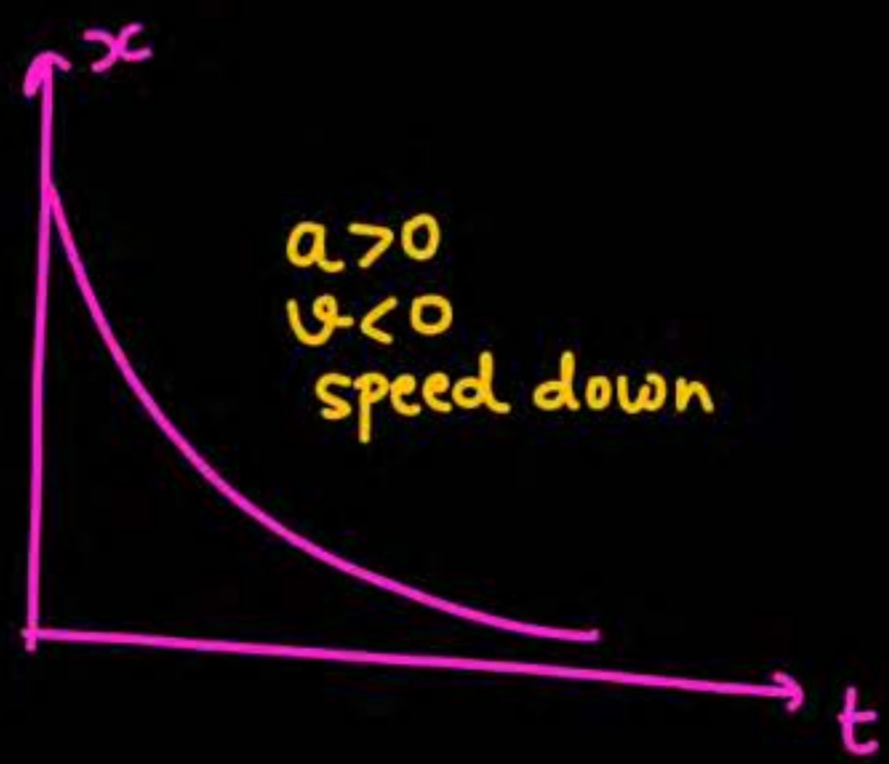
$v > 0$, $a < 0$

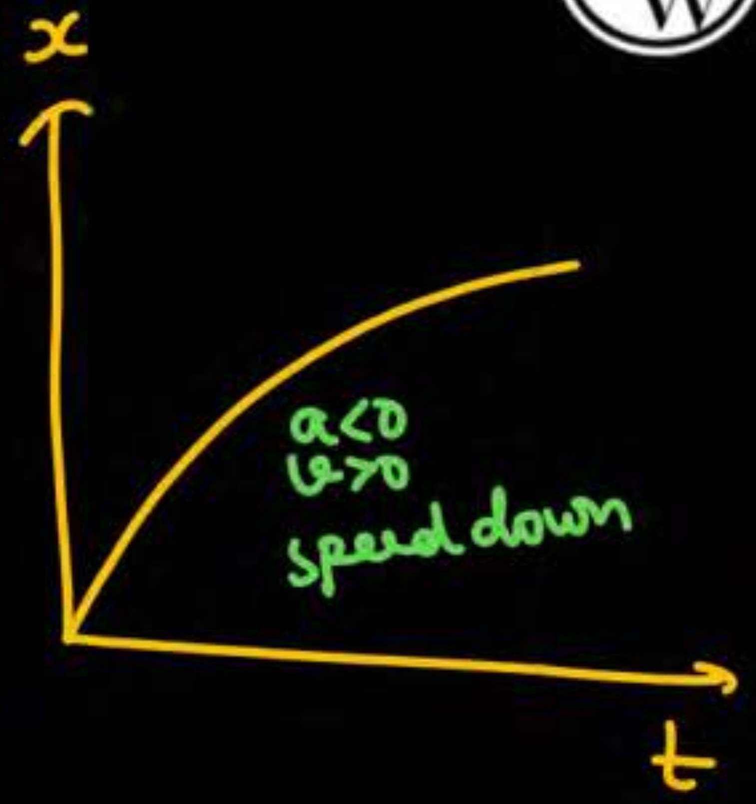
t

Q

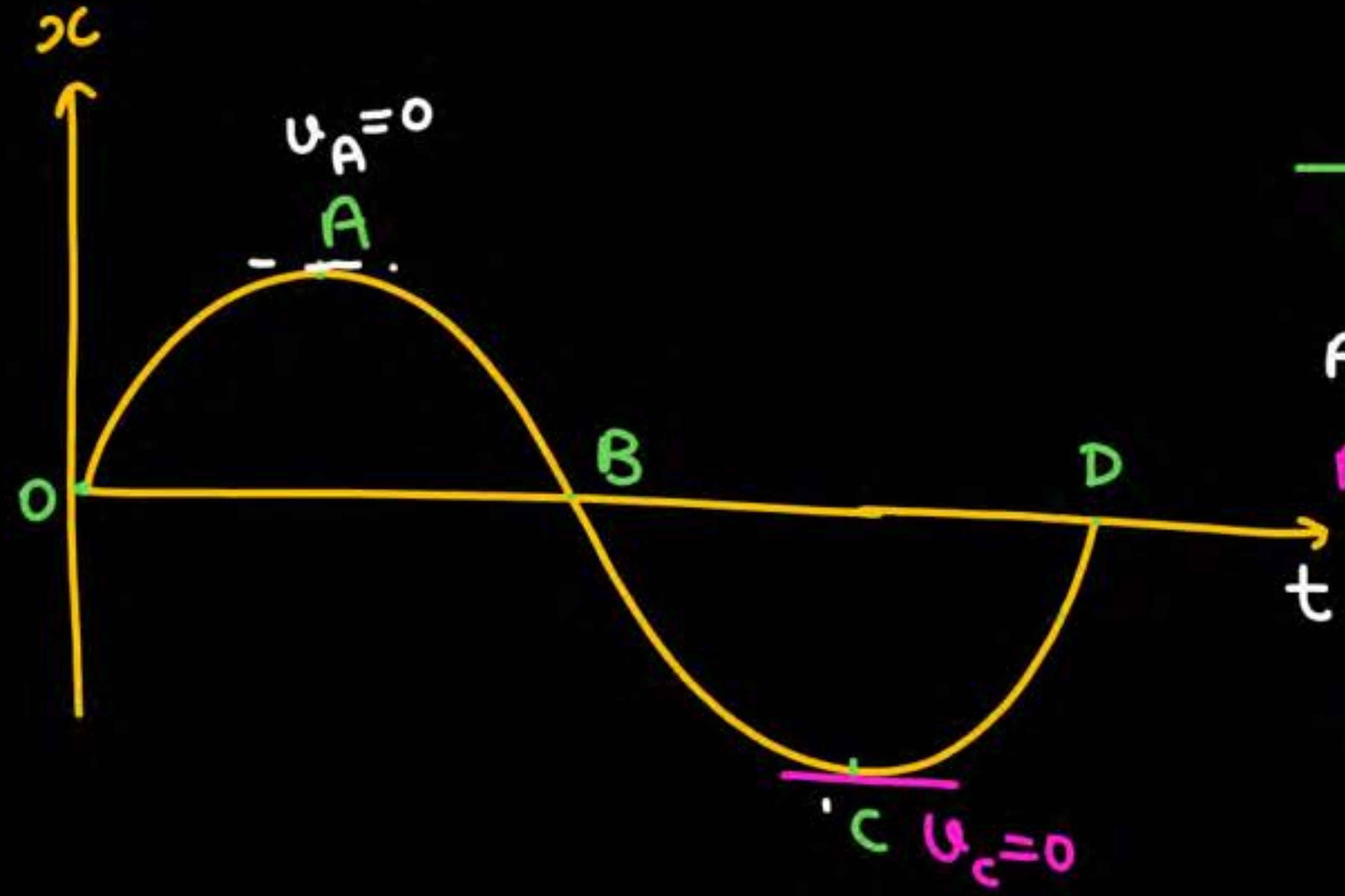


Q



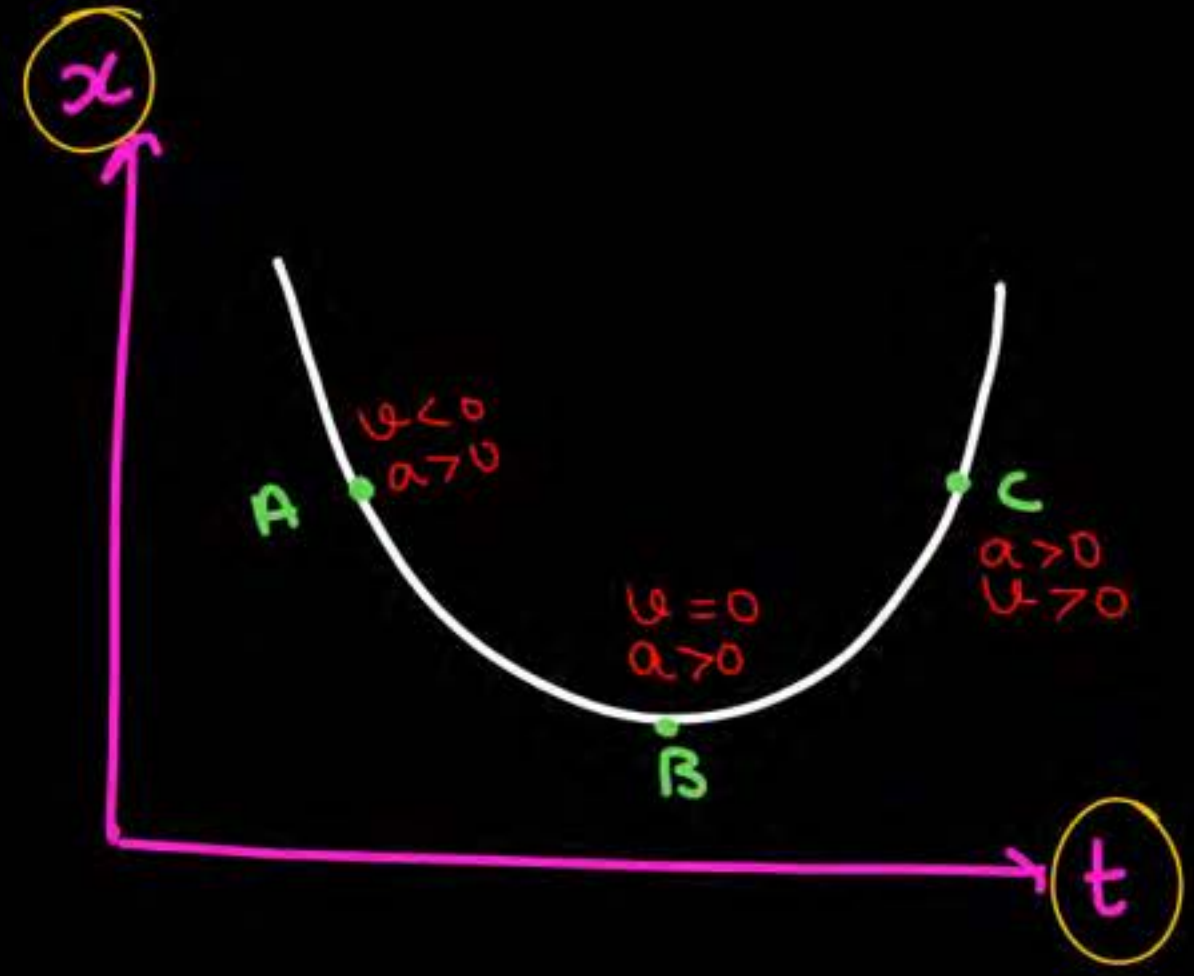


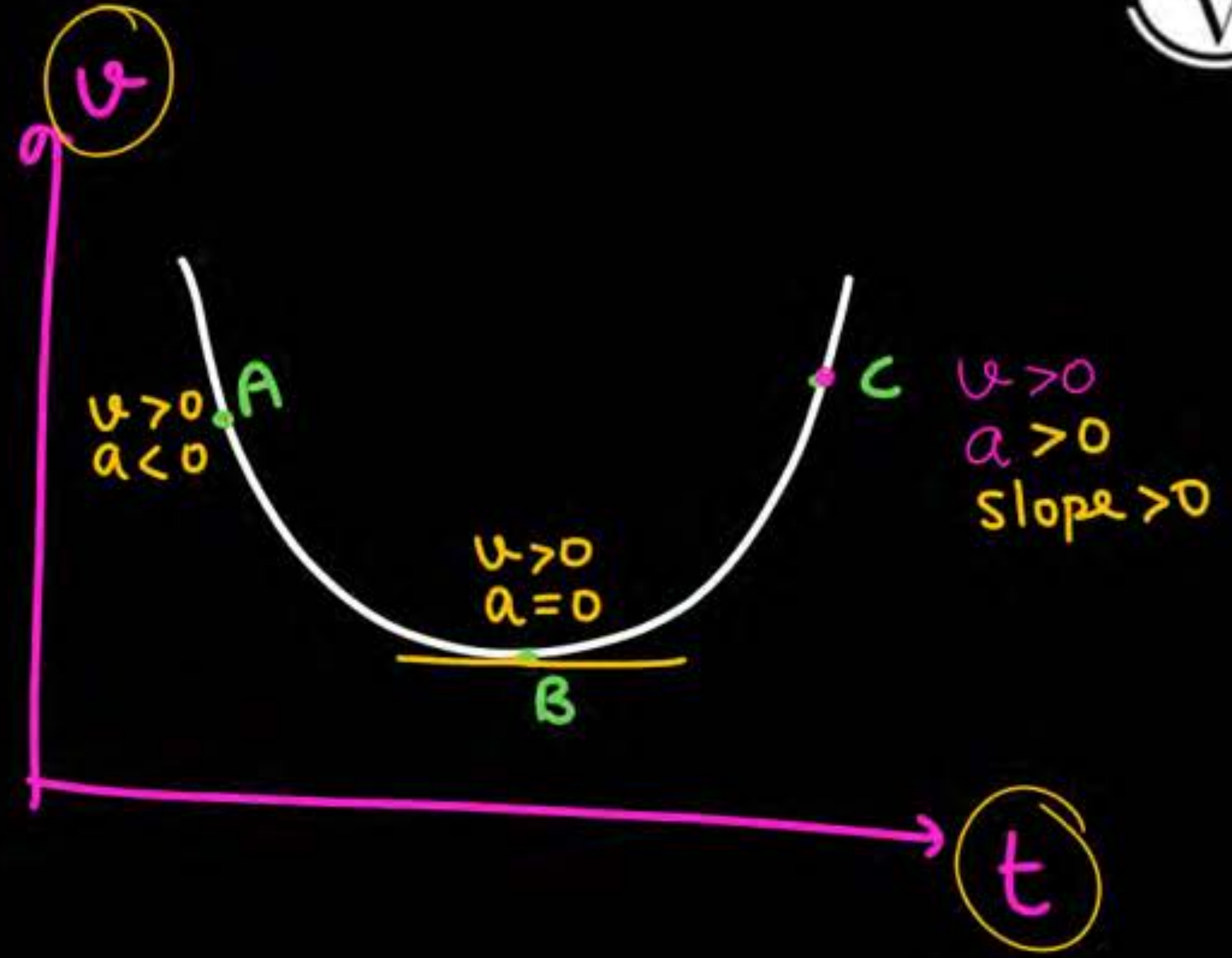
Q



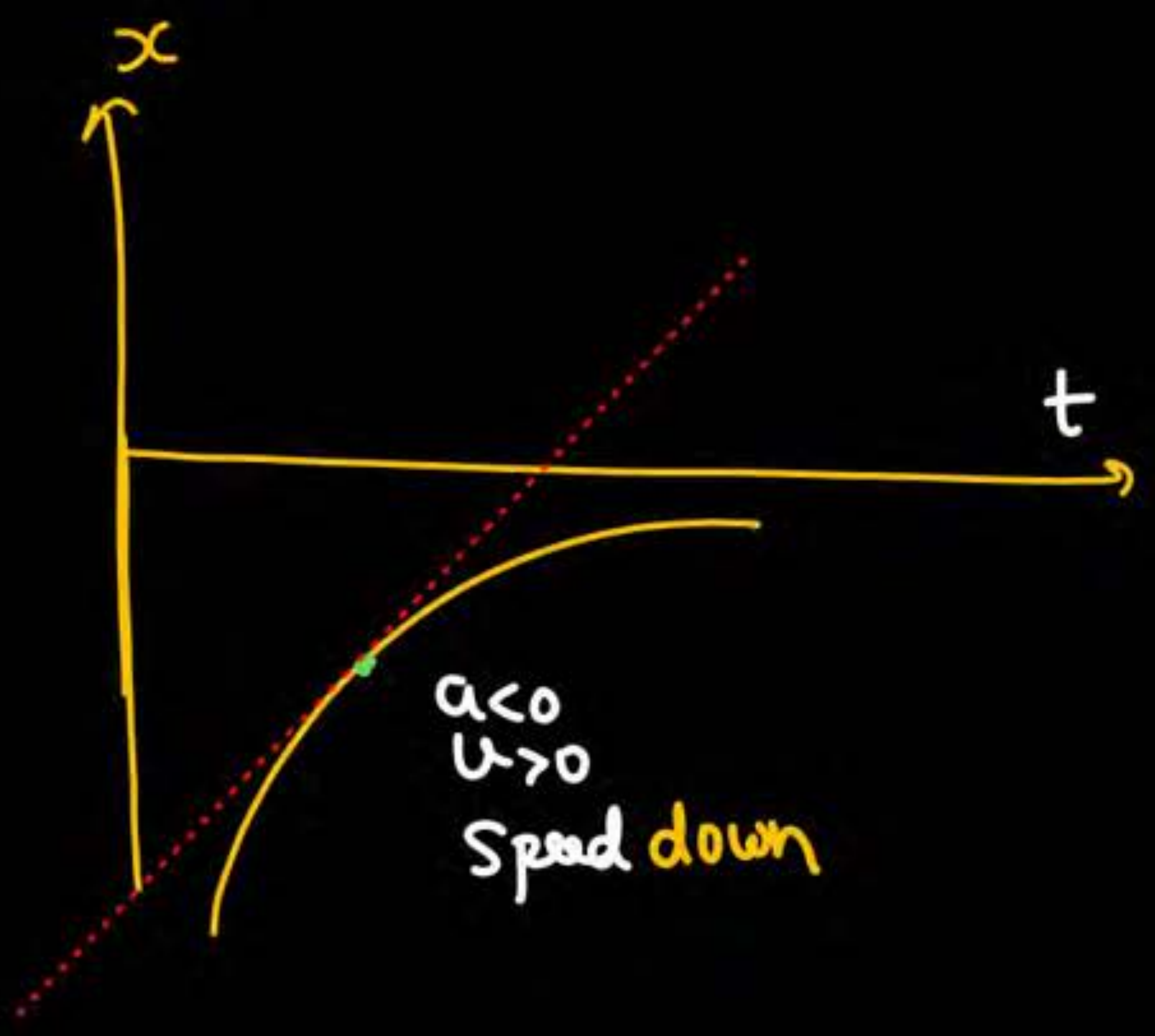
	v	a	speed ↑↓
$O \to A$	+	−	speed ↓
$A \to B$	−	−	speed ↑
$B \to C$	−	+	speed ↓
$C \to D$	+	+	speed up

Q

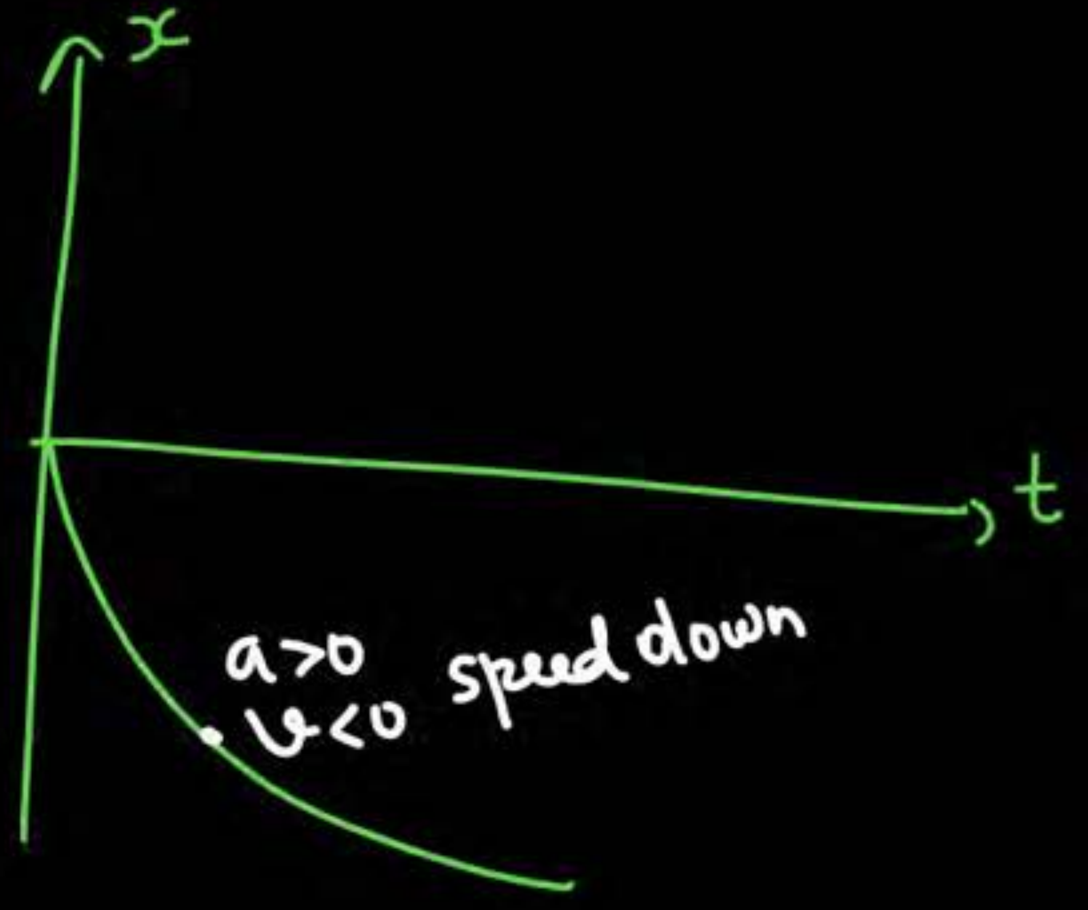




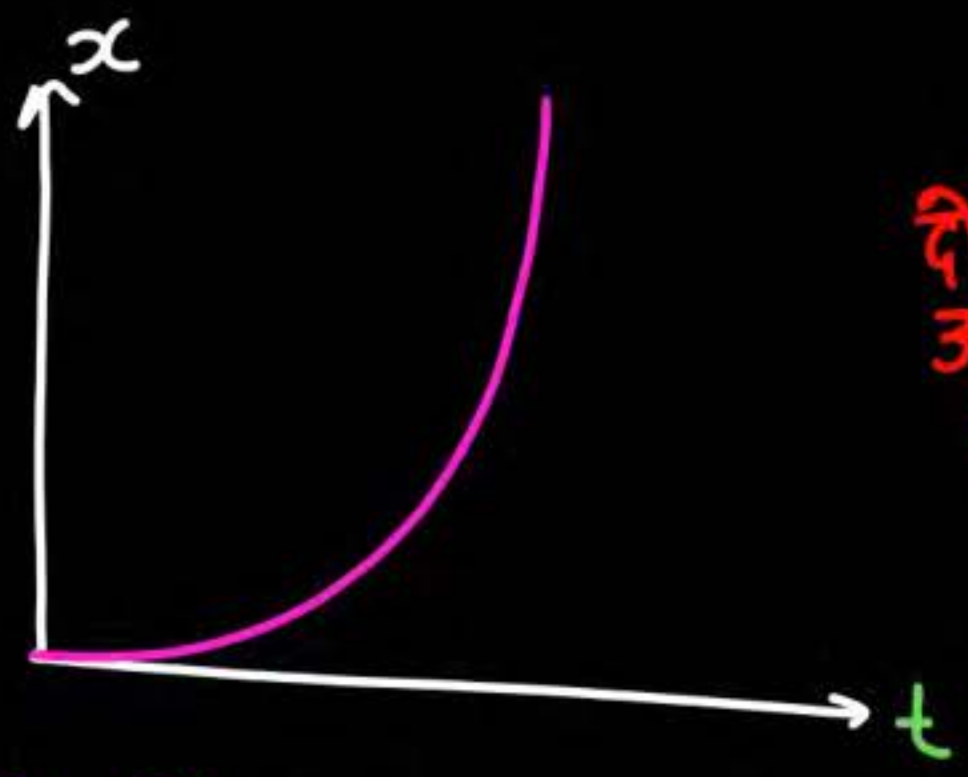
Q



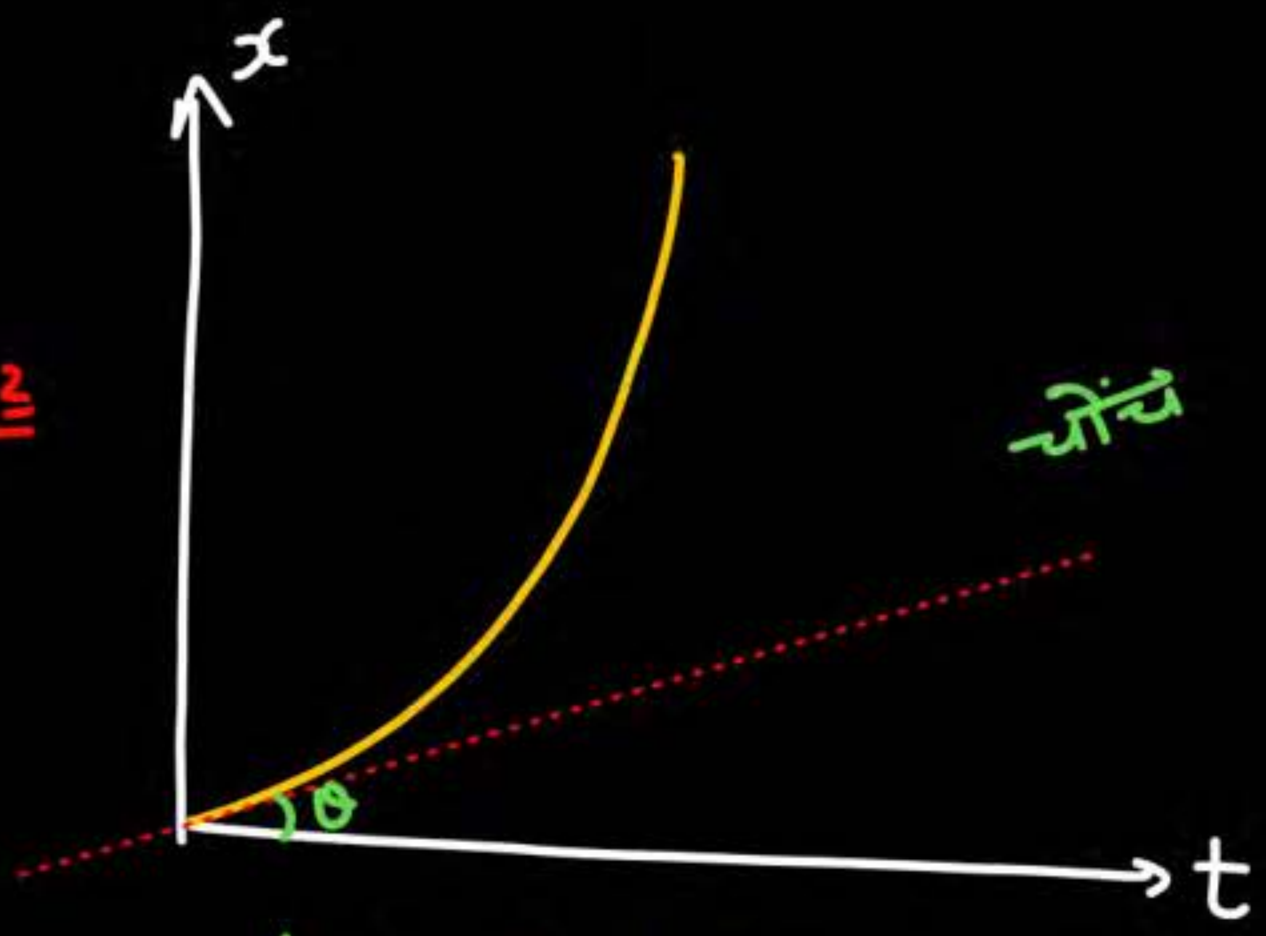
Q



Q



दोनो अलग-2 हैं



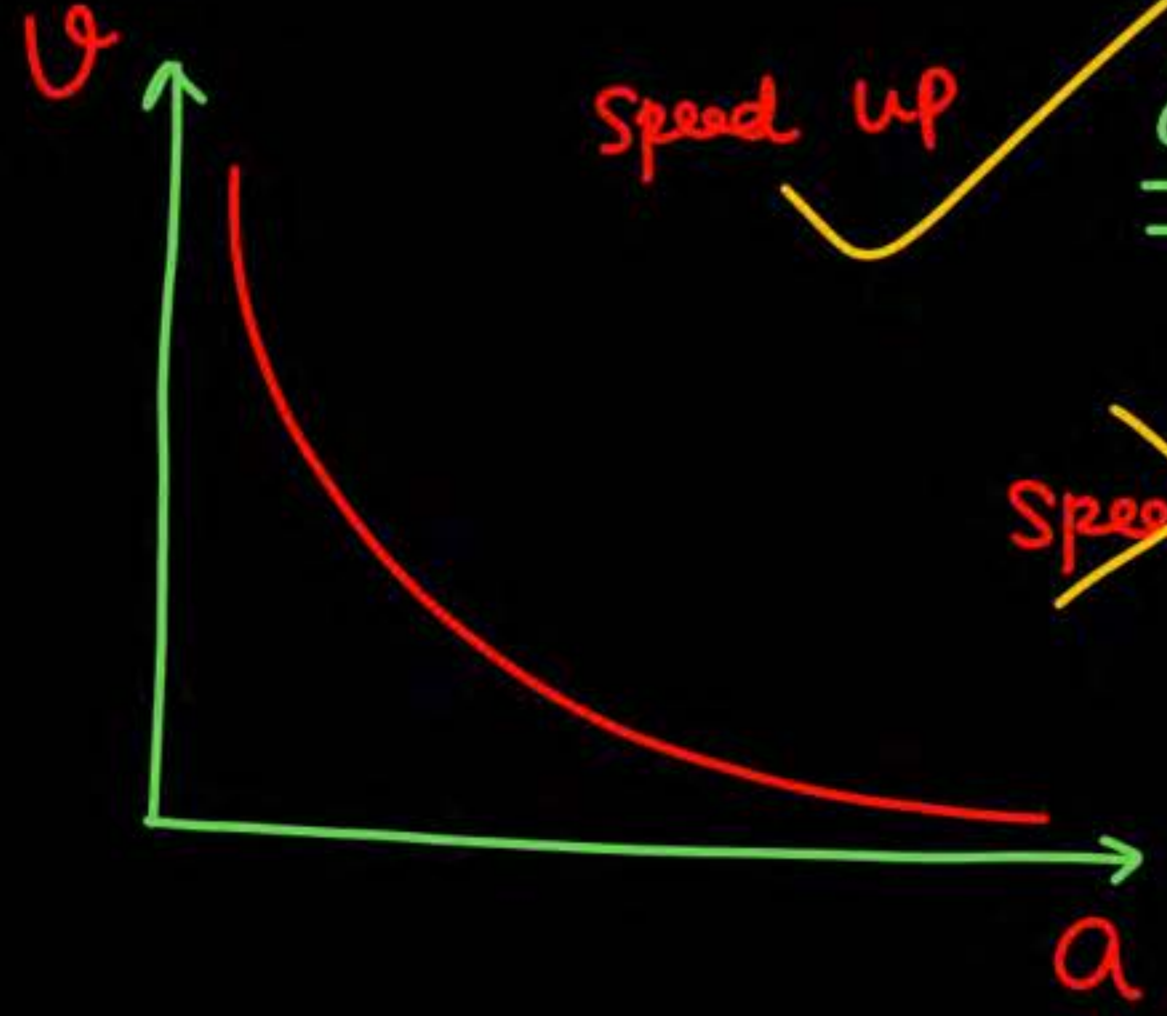
$t = 0$, Slope $= 0$

$v = 0$

particle start motion from rest.

$t = 0$, $u_i \neq 0$

Q



speed up

क्यों ≡ हा हा हा

~~speed down~~

Q $x = t^2 - 4t + 5$ Find average speed from $t=0 \longrightarrow t=4$

Sol^n

① $t=0, \; x_i = 5$

$t=4, \; x_f = 5$

② turning point = ?

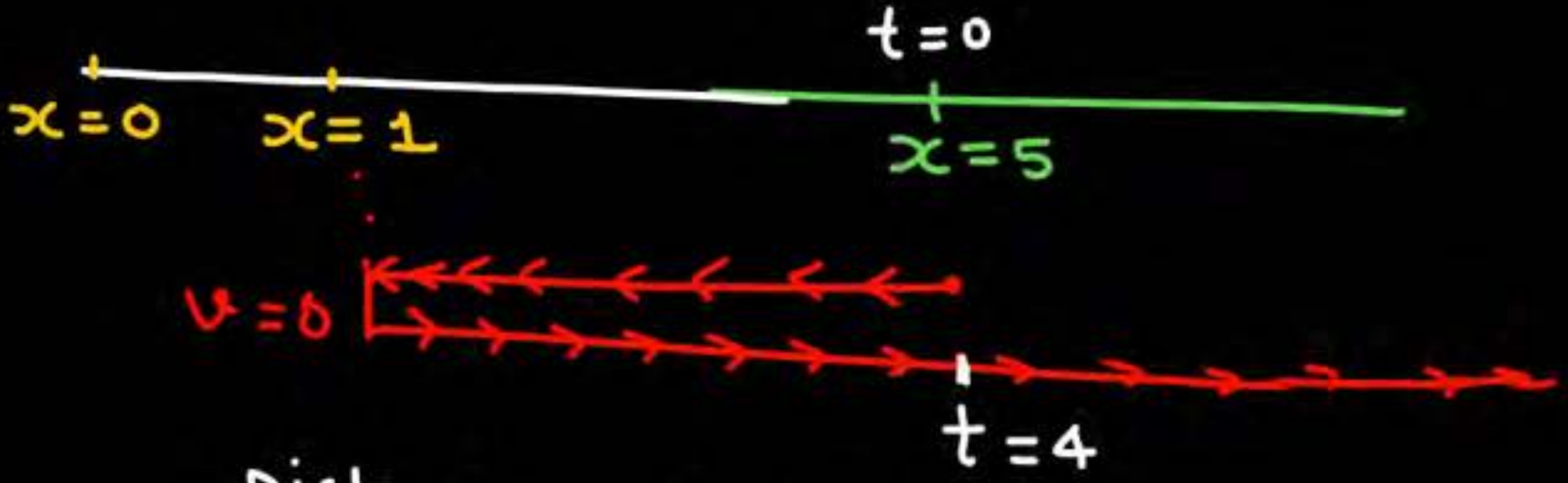
$\rightarrow v = 0$

$v = 2t - 4 = 0$

$\boxed{t = 2\,\text{sec}}$

$t=2, \; x = 2^2 - 4\times 2 + 5$

$= 1.$



Distance $t=0 \longrightarrow t=4 = 4+4$

Average speed $= \frac{8}{4} = 2$

Q $x = t^2 - 2t + 10$

find average speed from $t=0 \longrightarrow t=3$ sec

Sol^n $t=0,\ x_i = 10$

$t=3,\ x_f = 9-6+10 = 13$

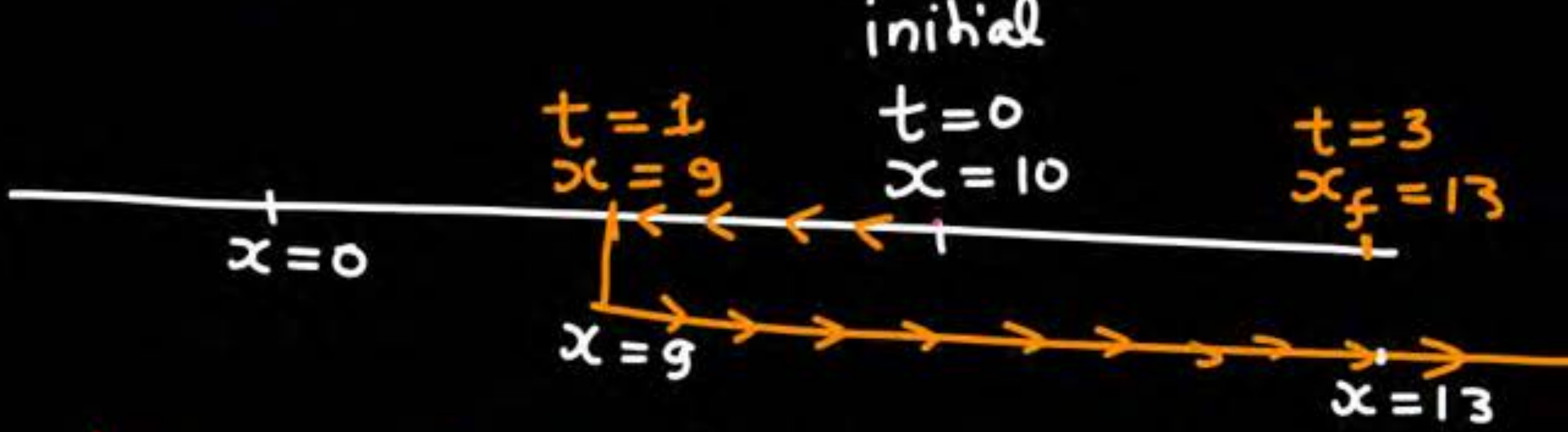
$v = 2t-2 = 0$

$2t = 2$

$\boxed{t=1}$ = turning point

$t=1,\ x = 1^2 - 2\times1 + 10$

$x = 9$



Averge speed $= \dfrac{1+4}{3} = \dfrac{5}{3}$

Q. $x = 2t^2 - 4t + 5$

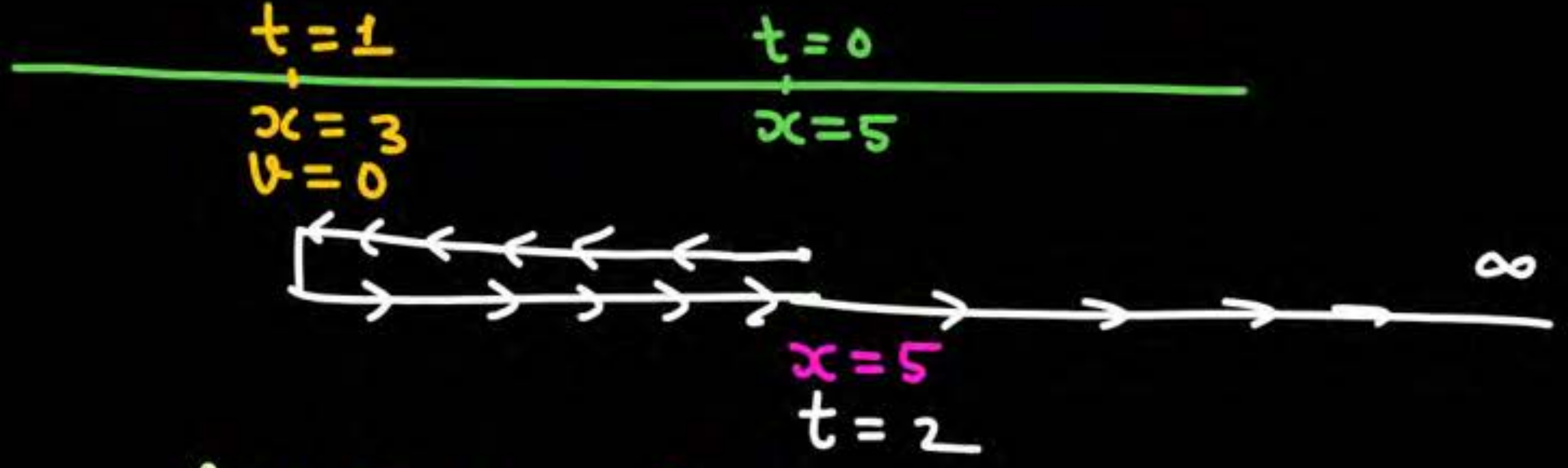
$t = 0 \longrightarrow t = 2$ average speed = ?

(1) $t = 2,\ x_f = 8 - 8 + 5$
$= 5$

(2) $v = 4t - 4 = 0$

$\boxed{t = 1}$

$t = 1,\ x = 2 - 4 + 5 = 3$



$$\text{Avg Speed} = \frac{2+2}{2} = 2$$

Q $x = t^2 - 2t + 4$

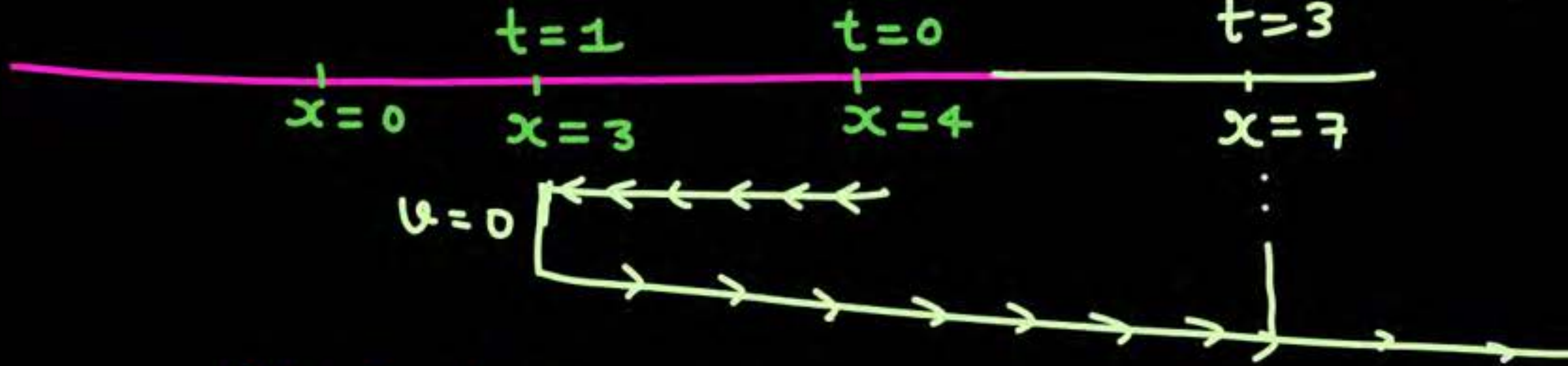
find average speed $t = 0 \longrightarrow t = 3$ sec.

$x = 9 - 6 + 4 = 7$

$v = 2t - 2 = 0$

$\boxed{t = 1 \text{ sec}}$

$x = 1 - 2 + 4 = 3$



Average velocity $= \frac{1+4}{3} = 5/3$

$v = 4t - 4$

Q $\quad x = 2t^2 - 4t + 2$

$t=0 \longrightarrow t=3$

Averge speed $= \dfrac{2+8}{3} = \dfrac{10}{3}$

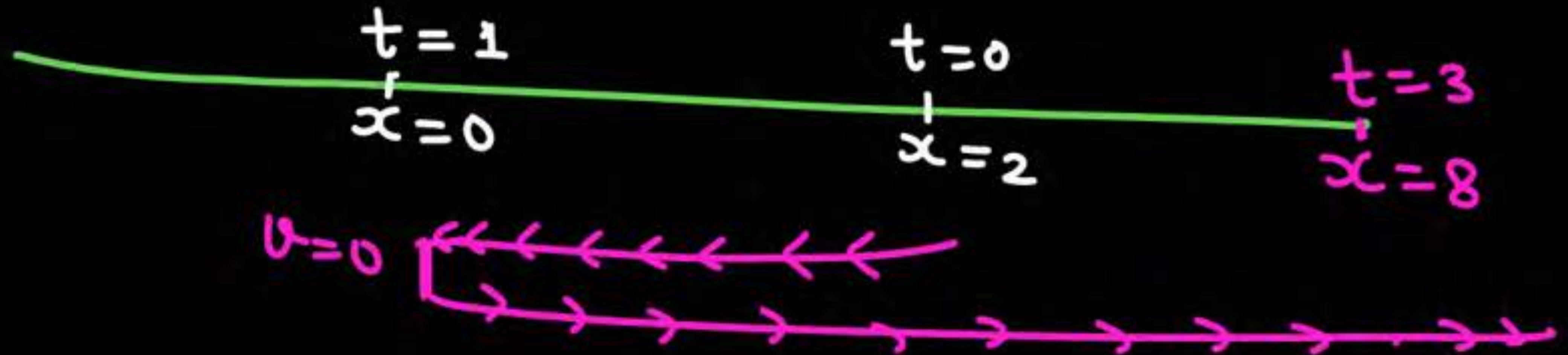
$\boxed{t=0,\ x=2}$

$v = 4t - 4 = 0 \quad (t=1)$

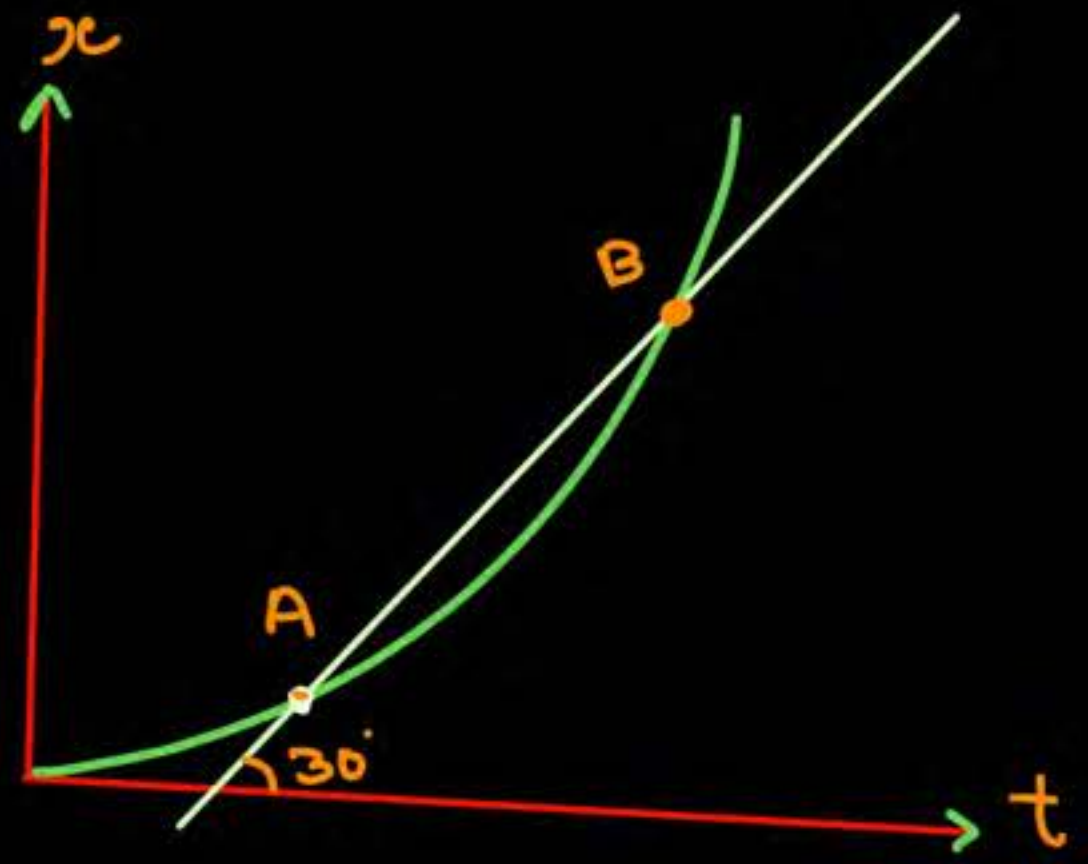
$\Downarrow$

$x = 2 - 4 + 2 = 0$

$t=3 \quad x = 18 - 12 + 2 = 8$

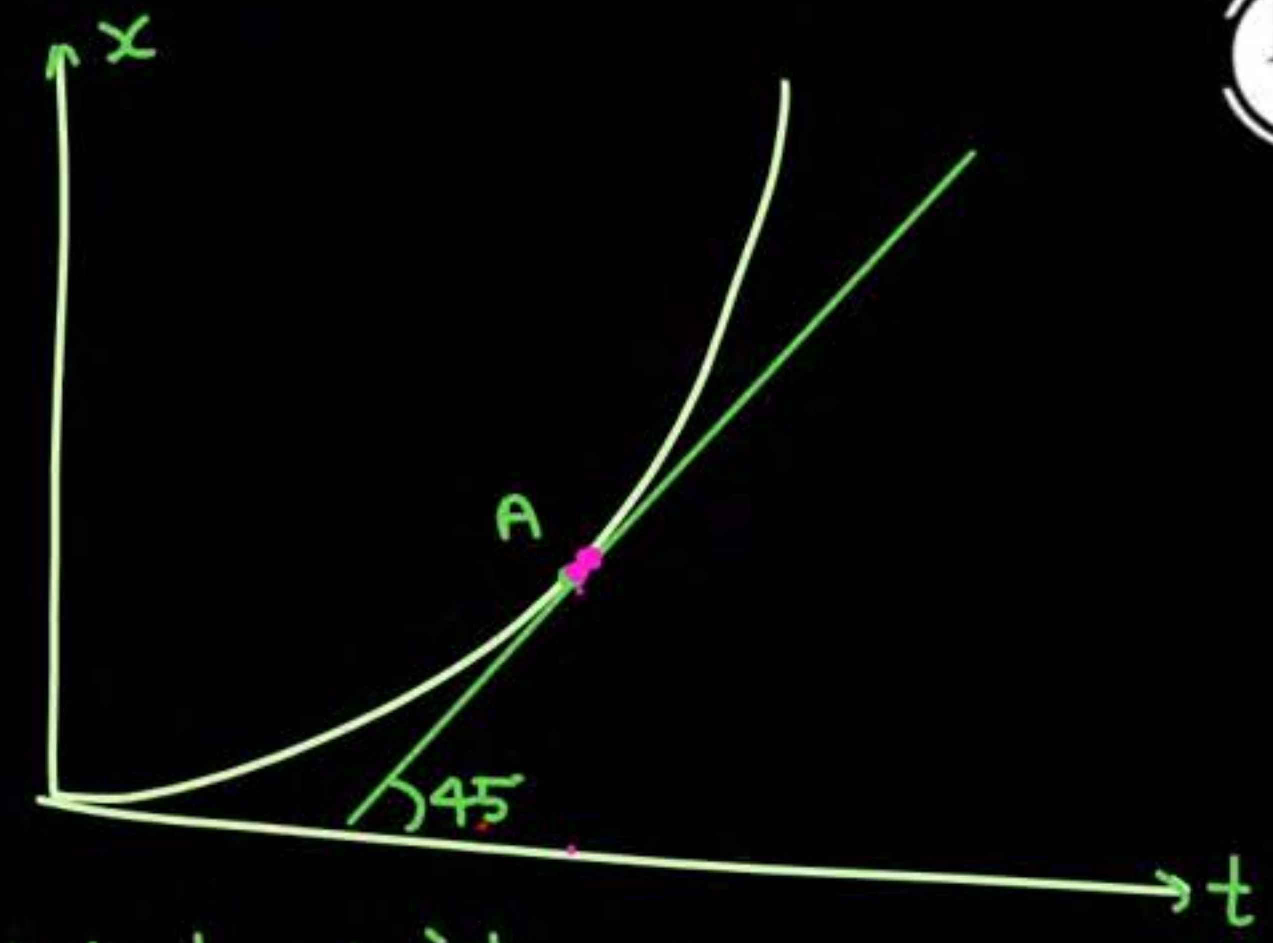


Q



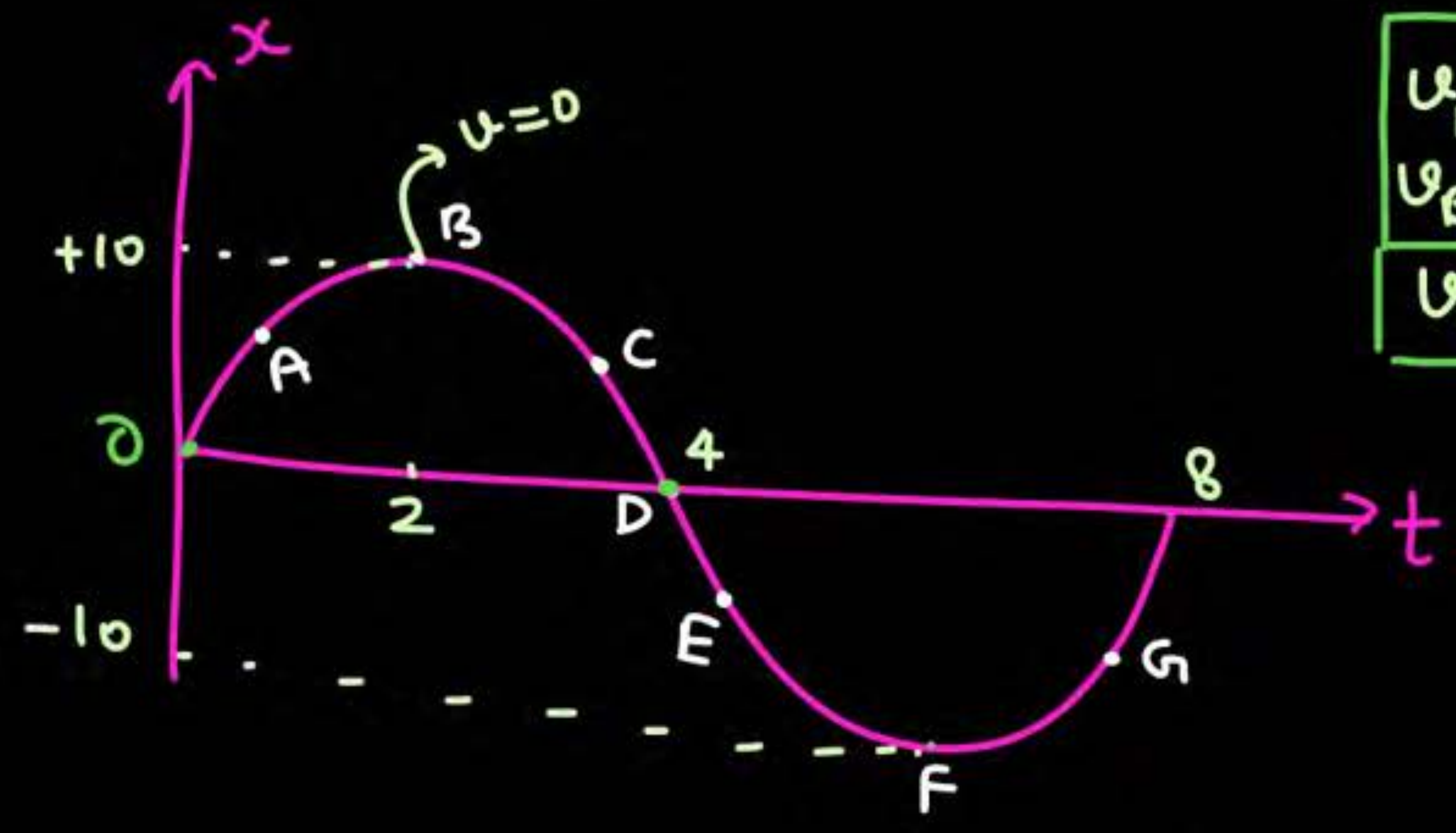
Averge velocity $\equiv$ slope of line AB
b/w A & B $=$ $\tan 30°$

Q₂



Velocity at 'A' $\equiv \tan 45° = \underline{1}$

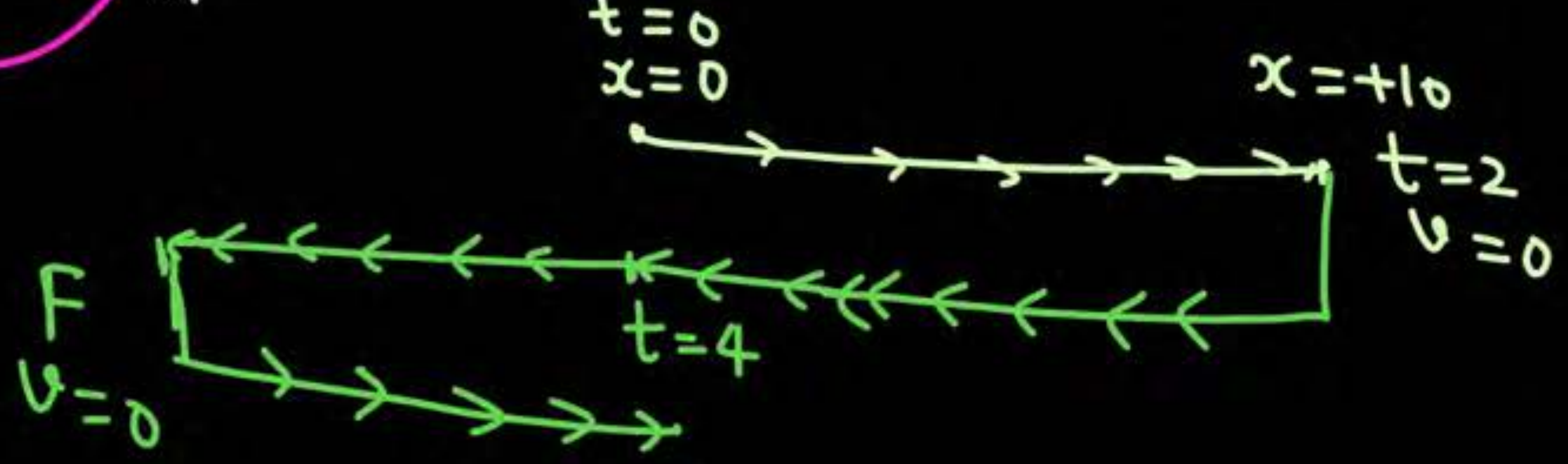
4



$v_A > 0$, $v_G > 0$

$v_B = 0$, $v_F = 0$

$\boxed{v_C ,\ v_D ,\ v_E \equiv -ve}$



Q $v = t^2 + 4t + 10$

(1) find acc at $t = 1$ sec

$$a = \frac{dv}{dt} = 2t + 4$$

$t = 1$, $a = 2 + 4 = 6$

(2) $t = 0 \longrightarrow t = 3$

$$\text{Averge acc} = \frac{\vec{V}_f - \vec{V}_i}{\text{total time}}$$

$t = 3$, $V_f = 9 + 12 + 10 = 31$

$t = 0$ $v_i = 10$

$$\text{Avg acc} = \frac{31 - 10}{3 - 0} = 7$$

Q $x = t^3 + 2t^2 + 5t$

find velocity & acc at $t = 2$ sec.

$v = \frac{dx}{dt} = 3t^2 + 4t + 5$, $t = 2$, $v = 12 + 8 + 5 = 25$

$a = \frac{dv}{dt} = 6t + 4$

$t = 2$, $a = 12 + 4 = 16$

$$\boxed{\vec{a} = \frac{d\vec{v}}{dt} = \frac{d^2\vec{x}}{dt}}$$

Q $x = 4t^2 - 16t + 20$

find turning point

$v = 0$

$v = \frac{dx}{dt} = 8t - 16$

$$\boxed{v = 0, \quad t = 2\,sec}$$

Chocklate ques

Q

$$x = \frac{t^3}{3} - 3t^2 + 9t + 21$$

find turning point

21

Ans ~~$t = 3$ turning point~~

Q H.W 2 page छोड़ दो

Q $x = 3t^2 - 12t + 10$

find (1) x, v, a at $t = 0$, $t = 2$, $t = 3$ sec

(2) find value of x & a when particle comes to at rest.

(3) find average velocity, average speed, average acc from $t = 0 \longrightarrow t = 3$ sec

Homework

Q $y = \pi x^2$

$$\frac{dy}{dx} = \pi 2x$$

Q $A = \pi r^2$

$$\frac{dA}{dr} = \pi 2r$$

Q $y = \pi x^3$

$$\frac{dy}{dx} = \pi 3x^2$$

Q $V = \frac{4}{3}\pi r^3$

$$\frac{dV}{dr} = \frac{4\pi}{3} 3r^2$$

Q $y = t^2 - 4t + 10$

$$\frac{dy}{dt} = 2t - 4$$

$$\frac{d^2y}{dt^2} = 2 - 0$$

Q $x = t^2 - 4t + 10$

$$\frac{dx}{dt} = 2t - 4 + 0$$

$$\frac{d^2x}{dt^2} = 2 - 0$$

Q $y = t^3 - 4t^2 + 10$

$$\frac{dy}{dt} = 3t^2 - 8t + 0$$

$$\frac{d^2y}{dt^2} = 6t - 8$$

Q $x = t^3 - 4t^2 + 10$

$$v = \frac{dx}{dt} = 3t^2 - 8t + 0$$

$$\frac{d^2x}{dt^2} = 6t - 8 + 0$$

Q $y = \sin x$

$$\frac{dy}{dx} = \cos x$$

$$\frac{d^2y}{dx^2} = -\sin x$$

Q $P = \ln t$

find $\frac{dP}{dt}$ at $t = 10$ sec

$$\frac{dP}{dt} = \frac{1}{t}$$

$$= \frac{1}{10}$$

Q $y = x^2 + 3x$

find $\frac{dy}{dx}$ at $x = 4$

$\cancel{y = 16 + 12 = 28}$

$\cancel{\frac{dy}{dx} = 0}$

$\frac{dy}{dx} = 2x + 3 \longrightarrow x = 4$

Put

$= 2 \times 4 + 3$

$\boxed{\frac{dy}{dx} = 11}$

Q $y = x^3$

find $\frac{dy}{dx}$, at $x = 2$

Sol^n $y = x^3$

$$\frac{dy}{dx} = 3x^2$$

at $x = 2$, $\frac{dy}{dx} = 3 \times 2^2$

$= 12$ Ans

Similarly find $\Rightarrow$

Q $y = t^2$

find $\frac{dy}{dt}$ at $t = 10$ sec

$\frac{dy}{dt} = 2t \Rightarrow \frac{dy}{dt} = 2 \times 10 = 20$ ✓

** Q $x = t^2 + 2t$

find $\frac{dx}{dt}$ at $t = 3$ sec

$\frac{dx}{dt} = 2t + 2$

$\frac{dx}{dt} = 8$

Q $x = t^3 - 2t^2 + 5$

find $\frac{dx}{dt}$ and $\frac{d^2x}{dt^2}$ at $t = 2$ sec

Q

$x = t^3 - 2t^2 + 5$ $\quad t = 2,\ \frac{dx}{dt} = ?$

$\frac{dx}{dt} = 3t^2 - 4t + 0$ put

$\frac{dx}{dt} = 3 \times 2^2 - 4 \times 2 = 12 - 8 = 4$

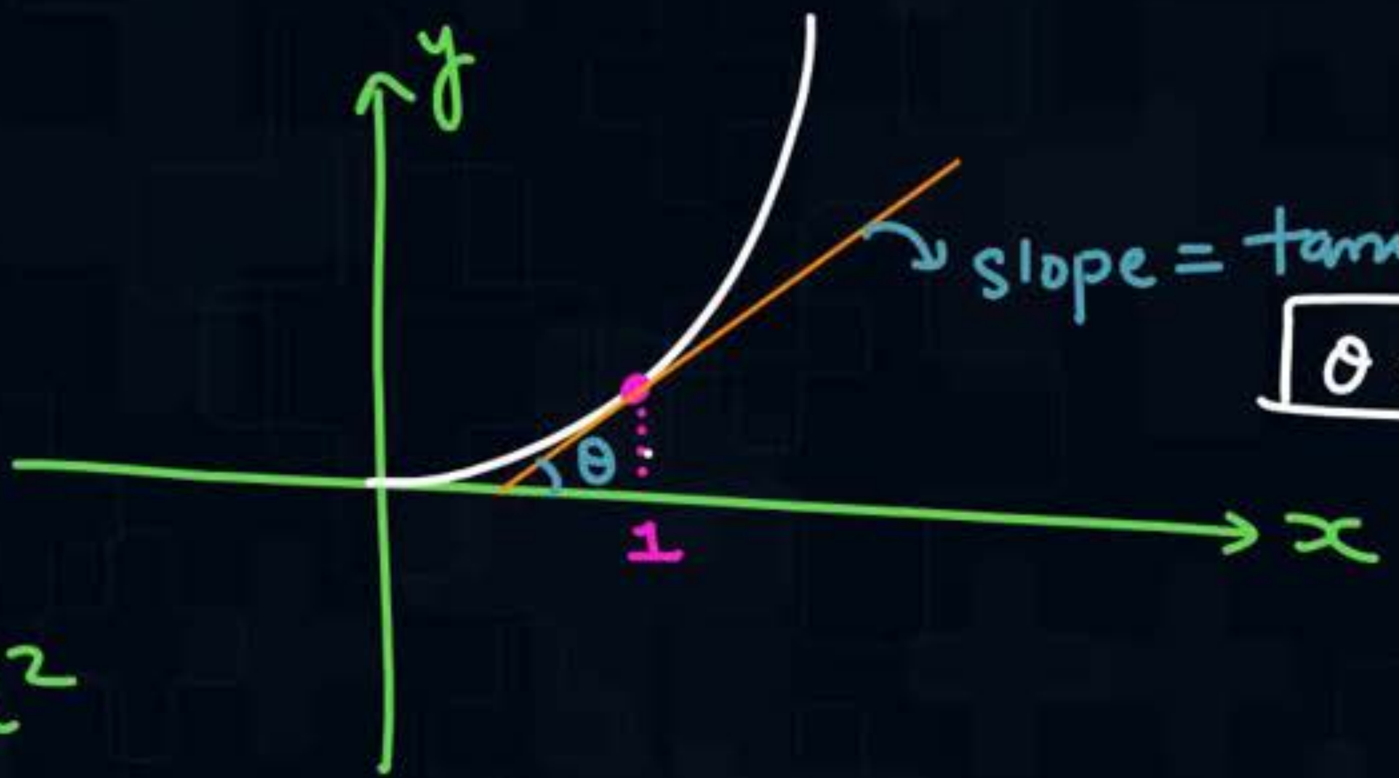
$\frac{d^2x}{dt} = 6t - 4$ $\quad t = 2$ $\quad \frac{d^2x}{dt^2} = 6 \times 2 - 4 = 8$

put

Q $y = \frac{x^3}{\sqrt{3}}$

find $\frac{dy}{dx}$ at $x = 1$

$$\frac{dy}{dx} = \frac{1}{\sqrt{3}} 3x^2 = \sqrt{3}x^2$$



slope = $\tan\theta = \sqrt{3}$

$\boxed{\theta = 60^\circ}$

At $x=1 \Rightarrow \frac{dy}{dx} = \frac{3}{\sqrt{3}} \cdot 1^2 = \sqrt{3}$ = slope

$\frac{dy}{dx}$ = slope of tangent at that point

Q

$x = t^3 - 4t^2 + 5$

$\frac{dx}{dt}$ at $t = 2$ sec $\rightarrow 12 - 16 = -4$

$\frac{d^2x}{dt^2}$ at $t = 2$ sec. $\rightarrow 4$

$\frac{dx}{dt} = 3t^2 - 8t + 0$

$\frac{d^2x}{dt^2} = 6t - 8$

Q

$x = t^2 - 4t + 20$

find Value of x, $\frac{dx}{dt}$, $\frac{d^2x}{dt^2}$

at $t = 2$ sec

① $y = 5x^3$

$$\frac{dy}{dx} = 5\left(\frac{d}{dx}x^3\right)$$

$$= 5 \times 3x^2$$

$$= 15x^2$$

② $y = Kx^3$

$K \longrightarrow$ const

$$y = K\frac{d}{dx}(x^3)$$

$$y = K \times (3x^2)$$

③ $y = \pi x^3$

$$\frac{dy}{dx} = \pi \; 3x^2$$

④ $y = \pi + x^3$

$$\frac{dy}{dx} = 0 + 3x^2$$

Q $y = \dfrac{x^3}{\sqrt{3}}$

find $\dfrac{dy}{dx}$ at $x=1$?

इस graph में $x=1$ पर tangent बनाओ

उस tangent का slope $= \dfrac{dy}{dx}$

#

$$y = x^3$$

$$\frac{dy}{dx} = 3x^2$$

differentiation of y wrt x

$\Rightarrow$

(1) $y = x^3$

$\frac{dy}{dt} \rightarrow$ diff. of y wrt time

$$\frac{dy}{dt} = 3x^2 \cdot \frac{dx}{dt}$$

(2) $y = x^5$

$$\frac{dy}{dt} = 5x^4 \frac{dx}{dt}$$

(3) $y = x^7$

$$\frac{dy}{dt} = 7x^6 \frac{dx}{dt}$$

(4) $y = 5x^2$

$$\frac{dy}{dt} = 10x\left(\frac{dx}{dt}\right)$$

(5) $y = \pi x^2$

$\frac{dy}{dt} = \pi 2x \cdot \frac{dx}{dt}$

(6) $A = \pi r^2$

$\frac{dA}{dr} = \pi 2r$

(7) $A = \pi r^2$

$\frac{dA}{dt} = \pi 2r \cdot \frac{dr}{dt}$

(8) $y = \pi x^2$

$\frac{dy}{dx} = \pi 2x$

(9) $y = \frac{4}{3}\pi x^3$

$\frac{dy}{dx} = \frac{4}{3}\pi 3x^2$

$\frac{dy}{dt} = \frac{4}{3}\pi 3x^2\left(\frac{dx}{dt}\right)$

(10) $y = \sin x$

$\frac{dy}{dx} = \cos x$

$\frac{dy}{dt} = \cos x \frac{dx}{dt}$

Q Radius of a circle increases wrt time with the rate of +5 m/sec. find rate of change of area wrt time when radius is 10m.

$$A = \pi r^2$$

$$? = \frac{dA}{dt} = \pi \, 2r \frac{dr}{dt}$$

$$\frac{dr}{dt} = 5 \quad , \; r = 10$$

$$\frac{dA}{dt} = \pi . 2 . \times 10 \times 5 = 100\pi$$

$\frac{dy}{dx} \longrightarrow$ Rate of change of y wrt x

$\frac{dA}{dt} \longrightarrow$ Rate of change of Area wrt time

$\frac{dr}{dt} \longrightarrow$ Rate of change of radius wrt time

Q If radius of a sphere is increasing at the rate of 10 m/sec at what rate vol^n of sphere will change, when radius is 3 m.

$V = \frac{4}{3}\pi r^3$

$\frac{dV}{dt} = \frac{4\pi}{3} 3r^2 \frac{dr}{dt}$

$\frac{dV}{dt} = \frac{4\pi}{3} \cdot 3 \cdot (3)^2 \cdot \times 10 = \underline{360\pi}$.

Q A particle is moving on x-axis such that its x-coordinate wrt time changes as

$$x = t^2 - 4t + 10$$

(1) find velocity at $t = 3$ sec

$$v = \frac{dx}{dt} = 2t - 4 + 0$$

$t=3$, $v = 2\times3-4 = 2$

$v = 2\,m/s$

(2) find velocity at $t = 4$ sec

$v = 2t - 4$ ← put

$v = 2\times4 - 4$

$v = 4$

(3) find initial velocity ≡ at $t=0$

$v = 2t - 4$

$t=0$, $v = 0 - 4 = -4$

Q $x = t^2 - 6t + 10$

(1) find velocity at $t=0$, $t=3$, $t=6$ sec $\equiv$ Inst. velocity

$v = 2t - 6$

$t=0$, $v = -6$

$t=3$, $v = 0$

$t=6$ $v = 2\times6-6$

$v = +6$.

(2) find average velocity $t=0 \longrightarrow t=3$

$$\text{Avg velocity} = \frac{x_f - x_i}{t_2 - t_1}$$

$t=0$, $x_i = 0 - 0 + 10$

$\longrightarrow x_i = 10$

$t=3$, $x_f = 3^2 - 6\times3 + 10 = 1$

$$\text{Avg velocity} = \frac{1-10}{3-0} = -3$$

H/W

(3) find average speed from $t=0 \longrightarrow t=4$

Q $x = t^2 - 4t + 5$

(1) find velocity at $t=0$, $t=2$, $t=4$ sec

$v = \frac{dx}{dt}$ $v = 2t-4$

$\boxed{t=0, \quad v=-4}$

$\boxed{t=2, v=0}$

$\boxed{t=4, v=4}$

(2) find avenge velocity from $t=0$ to $t=4$ sec

$t=0, x_i = 5$

$t=4, x_f = \cancel{4}^2 - \cancel{4} \times 4 + 5 = 5$

Avg velocity $= \frac{x_f - x_i}{\text{total time}} = \frac{5-5}{4} = 0$

④ $y = x^n$

$$\frac{dy}{dx} = \frac{d\,x^n}{dx} = n x^{n-1}$$

① $y = x^5$

$$\frac{dy}{dx} = 5x^{5-1} = 5x^4$$

② $y = x^7$

$$\frac{dy}{dx} = 7x^6$$

③ $y = x^{-5}$

$$\frac{dy}{dx} = -5\,x^{-5-1} = -5 \cdot x^{-6}$$

$$\frac{dy}{dx} = \frac{-5}{x^6}$$

PW

(4) $y = \frac{1}{x^2} = x^{-2}$

$\frac{dy}{dx} = -2x^{-2-1} = \frac{-2}{x^3}$

$f(x) = g(x) \pm h(x)$

$\frac{d}{dx}f(x) = \frac{d}{dx}g(x) \pm \frac{d}{dx}h(x)$

(5) $y = x^2 + x^5$

$\frac{dy}{dx} = 2x + 5x^4$

(7) $y = x^7 + x^8$

$\frac{dy}{dx} = 7x^6 + 8x^7$

(6) $y = x^3 - x^4$

$\frac{dy}{dx} = 3x^2 - 4x^3$

(8) $y = x^9 + \frac{1}{x^5}$

$\frac{dy}{dx} = 9x^8 - \frac{5}{x^6}$

$y = x^6$

$$\frac{dy}{dx} = 6x^5$$

y'

$$y = x^8$$

$$y' = \frac{dy}{dx} = 8x^7$$

$$\boxed{\begin{aligned} y &= u \pm v \\ y' &= u' \pm v' \end{aligned}}$$

Q $y = x^3 + x^8$

$$\frac{dy}{dx} = 3x^2 + 8x^7$$

diff. of y wrt x

Q $y = t^3 + t^8$

$$\frac{dy}{dt} = 3t^2 + 8t^7$$

diff. of y wrt 't'

Q $y = 5.x^3$

$\frac{dy}{dx} = 5 \times 3x^2 = 15x^2$

Q $y = 4x^2$

$y' = 8x$

Q $y = 3x^7$

$y' = \frac{dy}{dx} = 21x^6$

Q $y = 2x^2 + 4x^3 + 6x^7$

$y' = 4x + 12x^2 + 42x^6$

Q $y = x = x^1$

$\frac{dy}{dx} = 1\,x^{1-1} = 1$

$y = x$

$\frac{dy}{dx} = 1$

Q $y = 4x$

$\frac{dy}{dx} = 4 \times 1 = 4$

#. $y = 5$

$$\frac{dy}{dx} = 0$$

$$\boxed{\begin{array}{l} y = C \quad \text{const} \\ \dfrac{dy}{dx} = 0 \quad , \quad \dfrac{d}{dx}(\text{const}) = 0 \end{array}}$$

Q $y = x^3 + 2x^5 + 7$

$$\frac{dy}{dx} = 3x^2 + 10x^4 + 0$$

Q $y = x^5 - x^4 + 2$

$$\frac{dy}{dx} = 5x^4 - 4x^3 + 0$$

All differentiation formula Notes + (एक अलग page पर)

*** $\frac{d}{dx}(x^n) = n\, x^{n-1}$

*** $\frac{d}{dx}(\text{const}) = 0$

*** $\frac{d}{dx}(\sin x) = \cos x$

*** $\frac{d}{dx}(\cos x) = -\sin x$

* $\frac{d}{dx}\tan x = \sec^2 x$

* $\frac{d}{dx}\sec x = \sec x \tan x$

* $\frac{d}{dx}\cot x = -\operatorname{cosec}^2 x$

* $\frac{d}{dx}\operatorname{cosec} x = -\operatorname{cosec} x \cdot \cot x$

*** $\frac{d}{dx}e^x = e^x$

* $\frac{d}{dx}(\ln x) = \frac{1}{x}$

$\ln x \equiv \log_e x$

Q $y = x^3 + \sin x$

$\frac{dy}{dx} = 3x^2 + \cos x$

Q $y = x^7 + \tan x + 10$

$\frac{dy}{dx} = 7x^6 + \sec^2 x + 0$

Q $y = \sin 30^\circ = \frac{1}{2} = \text{const}$

$\cancel{\frac{dy}{dx} = \cos 30 = \frac{\sqrt{3}}{2}}$

$\frac{dy}{dx} = 0$

Q $y = 3x^3 + \sin x + \tan x$

$\frac{dy}{dx} = 9x^2 + \cos x + \sec^2 x$

$$\boxed{\begin{aligned} y &= \tan 45^\circ = 1 \\ \frac{dy}{dx} &= 0 \end{aligned}}$$

Q $y = 2x^2 + \cos x + 5$

$\frac{dy}{dx} = 4x - \sin x + 0$

Q $y = 3x^2 + \cos x + e^x - \sin x + 10$

$\frac{dy}{dx} = 6x - \sin x + e^x - \cos x + 0$

Q $y = x^3 + \sin x$

$$\frac{dy}{dx} = 3x^2 + \cos x$$

$y = u.v$

$y' = uv' + vu'$

Q $y = x^3 . \sin x$

$$\frac{dy}{dx} = x^3\left(\frac{d}{dx}\sin x\right) + \sin x\left(\frac{d}{dx}x^3\right)$$

$$\frac{dy}{dx} = x^3 \cos x + [\sin x] . 3x^2$$

Q $y = x^5 \tan x$

$$\frac{dy}{dx} = x^5 \sec^2 x + [\tan x].(5x^4)$$

Q $y = x^3 e^x$

$$\frac{dy}{dx} = x^3 e^x + e^x \cdot 3x^2$$

Q $y = e^x \cdot \sin x$

$$\frac{dy}{dx} = e^x \cos x + \sin x \cdot e^x$$

Q $y = x^4 \ln x$

$$\frac{dy}{dx} = x^4 \cdot \frac{1}{x} + (\ln x)(4x^3)$$

Q $y = e^x \cdot \cos x$

$$\frac{dy}{dx} = e^x(-\sin x) + (\cos x)(e^x)$$

imp नहीं है phy के point of view से (skip)
may ✓

$\frac{10}{2} = 10 \times \left(\frac{1}{2}\right)$

$$y = \frac{u}{v}$$

$$y' = \frac{vu' - uv'}{v^2}$$

Q $y = \frac{x^5}{\sin x}$

$$y' = \frac{(\sin x) . 5x^4 - x^5 . \cos x}{(\sin x)^2}$$

Q (m-2) product के form में ले जाकर diff कर दो

$$y = x^5 . \operatorname{cosec} x$$

$$y' = x^5 . (-\operatorname{cosec} x . \cot x) + \operatorname{cosec} x \; 5x^4$$

$$= \frac{\sin x}{\sin x} \frac{5x^4}{\sin x} - \frac{x^5}{\sin x} . \frac{\cos x}{\sin x} = \frac{\sin x \, 5x^4 - x^5 \cos x}{\sin^2 x}$$

same

Chain rule

Book

$$y = f(g(x))$$

$$y' = f'(g(x)) \cdot g'(x)$$

$$y = f(\text{कद्दू})$$

$$y' = f'(\text{कद्दू}) \cdot (\text{कद्दू})'$$

Q $y = \sin(x^2 + x^7)$

$$\frac{dy}{dx} = \cos(x^2 + x^7) \times (2x + 7x^6)$$

Q $y = \cos(x^3)$

$$\frac{dy}{dx} = -\sin(x^3) \cdot 3x^2$$

Q $y = \ln x^5$

$$\frac{dy}{dx} = \frac{1}{x^5} \cdot 5x^4$$

Q $y = \ln x^4$

$$\frac{dy}{dx} = \frac{1}{x^4} \cdot 4x^3$$

Q $y = \ln(\sin x)$

$$\frac{dy}{dx} = \frac{1}{\sin x} \cdot \cos x$$

Q $y = \tan^2 x = (\tan x)^2$

$$y = (2\tan x) \cdot \sec^2 x$$

Q $y = \cos^5 x$

$$\frac{dy}{dx} = 5\cos^4 x \times (-\sin x)$$

(1) $y = \sin^3 x = (\sin x)^3$

$\frac{dy}{dx} = 3(\sin x)^2 \cdot \cos x.$

(2) $y = \sin^4 x = (\sin x)^4$

$\frac{dy}{dx} = 4(\sin x)^3 \cdot \cos x$

$y = x^3$

$\frac{dy}{dx} = 3x^2$

(3) $y = \ln(\overline{\text{कद्दू}})$

$\frac{dy}{dx} = \frac{1}{\text{कद्दू}} \cdot$ (कद्दू का differentiation)

$y = f(\text{कद्दू}) \Rightarrow y' = f'(\text{कद्दू}) \cdot (\text{कद्दू})'$

$\boxed{\text{पहले अंदर वाले को कद्दू मानकर बाहर वाले का differentiation करो।}}$

Q $y = \ln(x^2+x^3)$

$$\frac{dy}{dx} = \frac{1}{x^2+x^3} \times \left[2x+3x^2\right]$$

Q $y = \sin(x^2+x^3)$

$$\frac{dy}{dx} = \cos(x^2+x^3)(2x+3x^2)$$

Q $y = \tan x^3$

$$\frac{dy}{dx} = \sec^2(x^3) \times 3x^2$$

Q $y = \ln(\sin x^3)$

$$\frac{dy}{dx} = \frac{1}{\sin x^3} \times \cos(x^3) \times [3x^2]$$

Q $y = e^{x^3}$

$$y = e^{x^3} \times 3x^2$$

Q $y = \sin(e^x)$

$$y = \cos(e^x) \cdot e^x$$

Q Imp. for physics

$$y = \sin\left(5x + \frac{\pi}{3}\right)$$

$$\frac{dy}{dx} = \cos\left(5x + \pi/3\right)\left(5 + 0\right)$$

SHM ≡ (5-6) month बाद

Q $y = A.\sin(\omega t + \phi)$

$(A, \omega, \phi \longrightarrow \text{const})$

$$\frac{dy}{dx} = A\left[\cos(\omega t + \phi)\right]\left[\omega + 0\right]$$

Q $y = 5 + x$ | $y = 5x$

$\frac{dy}{dx} = 0 + 1$ | $\frac{dy}{dx} = 5 \times 1$

Q $y = \underbrace{k}_{\text{const}} + x$ | $y = \underbrace{k}_{\text{const}} x$

$y' = 0 + 1$ | $y' = k$

Kinematics

Q $y = x^2 + 4x + 10$

$$\frac{dy}{dx} = 2x + 4 + 0$$

Q $y = x^2 - 6x + 5$

$$\frac{dy}{dx} = 2x - 6 + 0$$

Q $y = x^3 + x^2 - 2x$

$$\frac{dy}{dx} = 3x^2 + 2x - 2$$

Q $y = t^2 - 2t + 10$

$$\frac{dy}{dt} = 2t - 2 + 0$$

Q $y = t^3 - t^2 + 10t + 5$

$$\frac{dy}{dt} = 3t^2 - 2t + 10$$

Q $y = x^6$

$\dfrac{dy}{dx} = 6x^5$

और differentiate करो

double differentiation of y wrt x $\equiv \dfrac{d^2y}{dx^2} \equiv y''$

diff of $\left(\dfrac{dy}{dx}\right)$ wrt x

$y = x^6$ diff

$\dfrac{dy}{dx} = y' = 6x^5$ diff

$\dfrac{d^2y}{dx^2} = y'' = 30x^4$

Q $y = x^3 + x^5 + x^4$

$y' = 3x^2 + 5x^4 + 4x^3$

$\dfrac{d^2y}{dt^2} = y'' = 6x + 20x^3 + 12x^2$

Homework

Q $y = \pi x^2$

$\frac{dy}{dx} =$

Q $A = \pi r^2$

$\frac{dA}{dr} =$

Q $y = \pi x^3$

$\frac{dy}{dx} =$

Q $V = \frac{4}{3}\pi r^3$

$\frac{dV}{dr} =$

Q $y = t^2 - 4t + 10$

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

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

Q $x = t^2 - 4t + 10$

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

$$\frac{d^2x}{dt^2} =$$

Q $y = t^3 - 4t^2 + 10$

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

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

Q $x = t^3 - 4t^2 + 10$

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

$$\frac{d^2x}{dt^2} =$$

Q $y = \sin x$

$\frac{dy}{dx} =$

$\frac{d^2y}{dx^2} =$

Q $P = \ln t$

find $\frac{dP}{dt}$ at $t = 10$ sec

Q $y = x^3$

find $\frac{dy}{dx}$, at $x=2$

Soln $y = x^3$

$$\frac{dy}{dx} = 3x^2$$

at $x=2$, $\frac{dy}{dx} = 3\times2^2$

$= 12$ Ans

Similarly find $\Rightarrow$

Q $y = t^2$

find $\frac{dy}{dt}$ at $t=10$ sec

Q $x = t^2 + 2t$

find $\frac{dx}{dt}$ at $t=3$ sec

Q $x = t^3 - 2t^2 + 5$

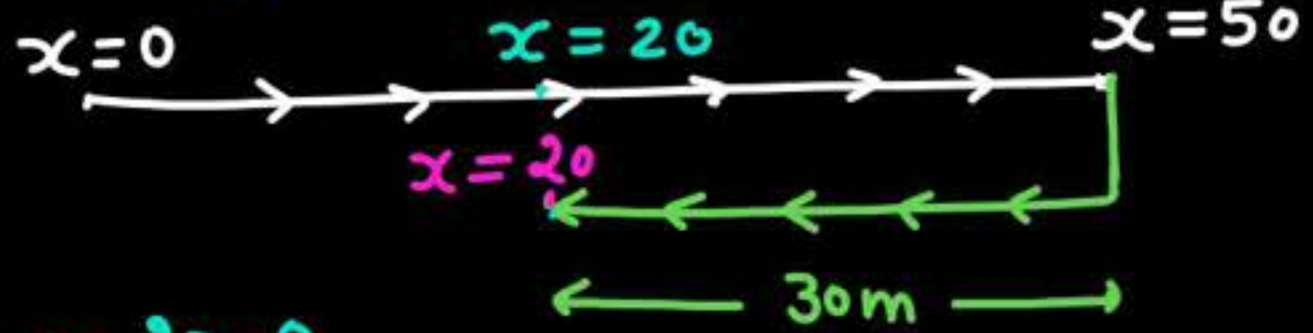
find $\frac{dx}{dt}$ and $\frac{d^2x}{dt^2}$ at $t=2$ sec

Q A particle is moving with velocity +10 m/s for 5 sec. along +x-dir than it reversed its direction and move with velocity −10 m/s for three second.

find (1) displacement

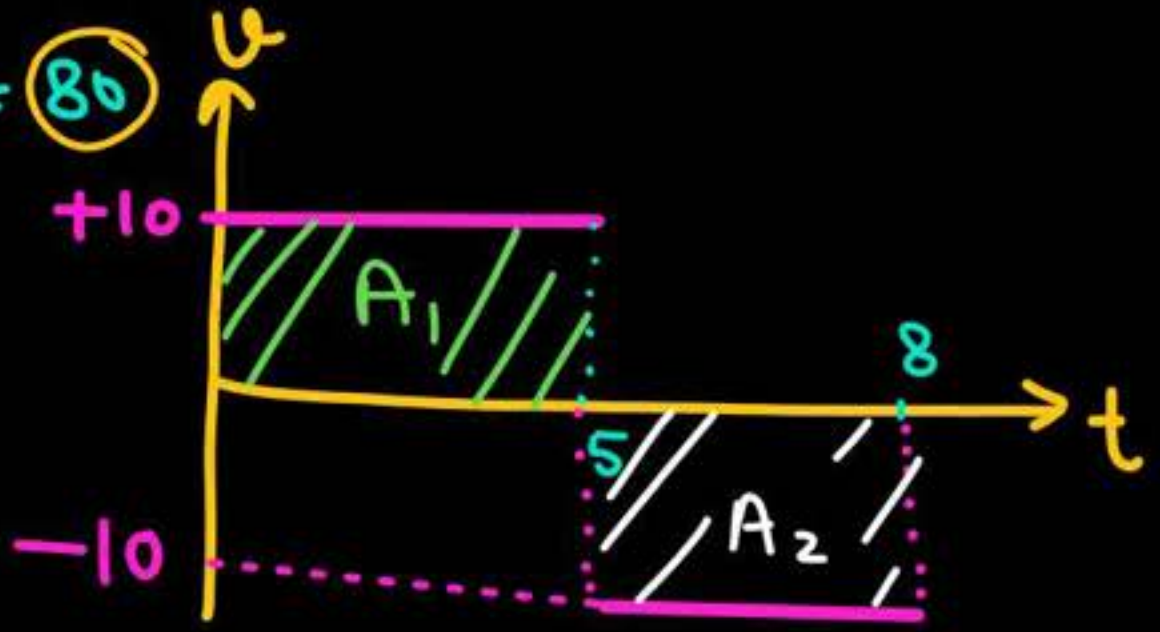
(2) Distance

$Sol^n \Rightarrow$



Displacement $= 20 - 0$
$= 20$

Distance $= 50 + 30 = 80$



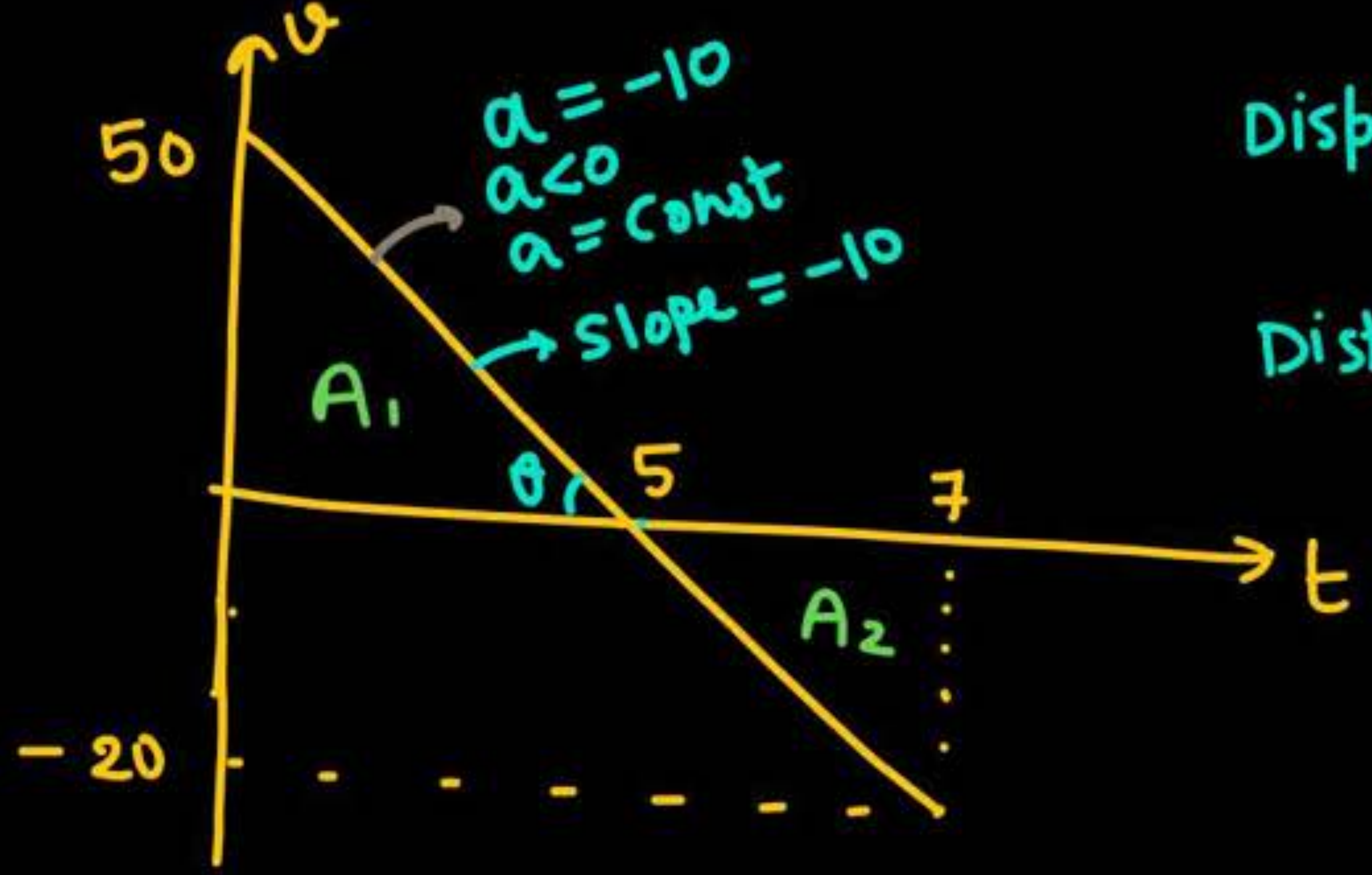
$A_1 = 5 \times 10 = 50$

$A_2 = 3 \times 10 = 30$

Displacement $= A_1 - A_2$
$= 50 - 30 = 20$

Distance $= A_1 + A_2 = 50 + 30 = 80$

Q



Displacement $= 125 - 20 = 105$

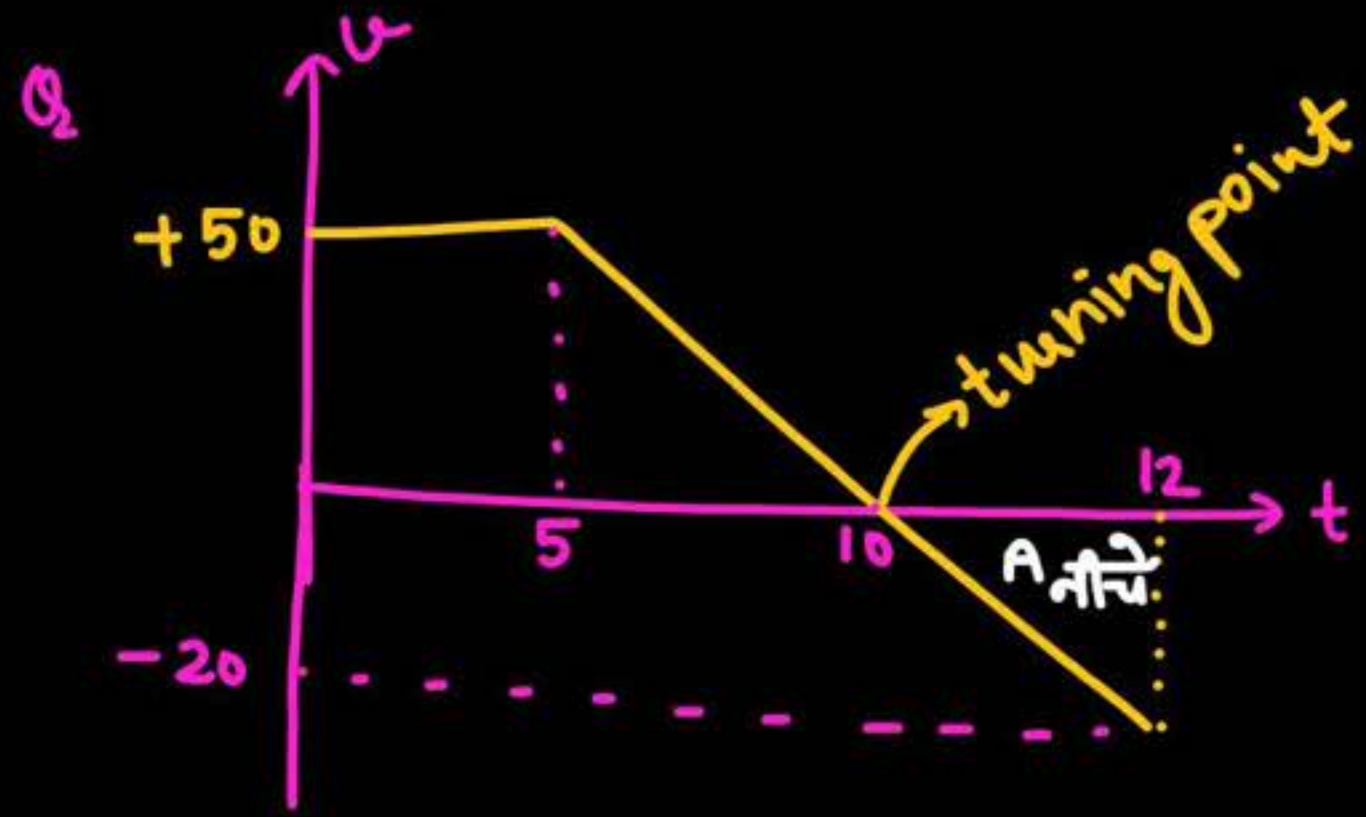
Distance $= 125 + 20 = 145$

Averge velocity $= \frac{105}{7}$

Avg. speed $= \frac{145}{7}$

$A_1 = \frac{1}{2} \times 5 \times 50 = 125$

$A_2 = \frac{1}{2} \times 2 \times 20 = 20$



Displacement $= A_{upper} - A_{\text{नीचे वाला}}$

$= \frac{1}{2}(5+10)\times 50 - \frac{1}{2}\times 2\times 20$

$= \frac{750}{2} - \frac{40}{2} = 375 - 20 = 355$

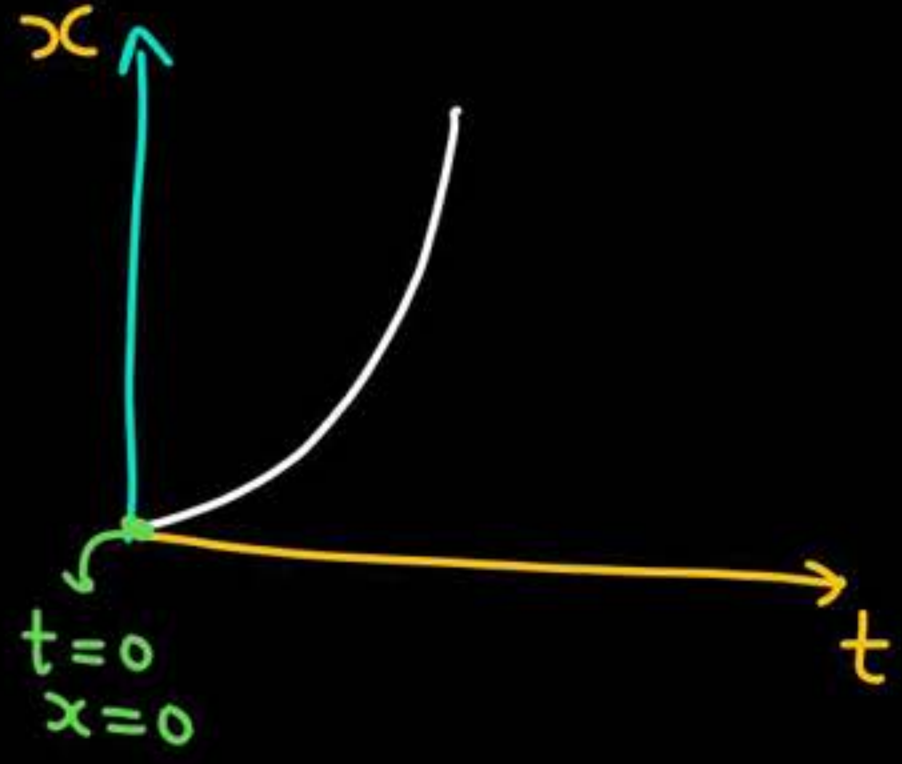
Distance $= 375 + 20 = 395$

Q $V = 10t + 20$

$$\boxed{\begin{array}{c}\text{Slope} = 10 = \text{const} \\ a = 10\end{array}}$$

$$a = \frac{dv}{dt} = 10 + 0$$

Q Draw x-t graph if at $t=0$ particle is at origin $(x=0)$



$V = 10t + 20$

$a = +10 > 0$

खुशी

घर पर note करना

Q A particle start motion from rest from origin such that its acc is +10. Draw v-t, x-t graph

$t=0,\ x=0$
$v=0$

$a=+10$

$\frac{dv}{dt}=10$

$\int dv=\int 10\,dt$

$v=10t+c$ $\quad \boxed{v=10t} \equiv$ St. line

at $t=0$, $0=0+c$

$\boxed{c=0}$

$v=10t$

$\frac{dx}{dt}=10t$

$\int dx=\int 10t\,dt$

$x=10\frac{t^2}{2}+c$

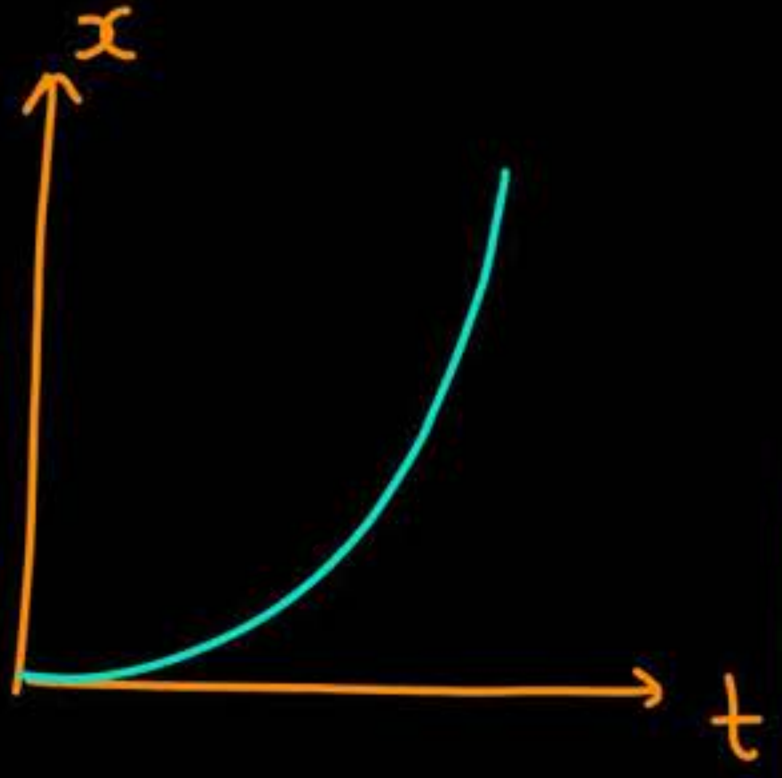
$x=5t^2+c$

$t=0, x=0 \Rightarrow 0=0+c$ $\quad c=0$
given

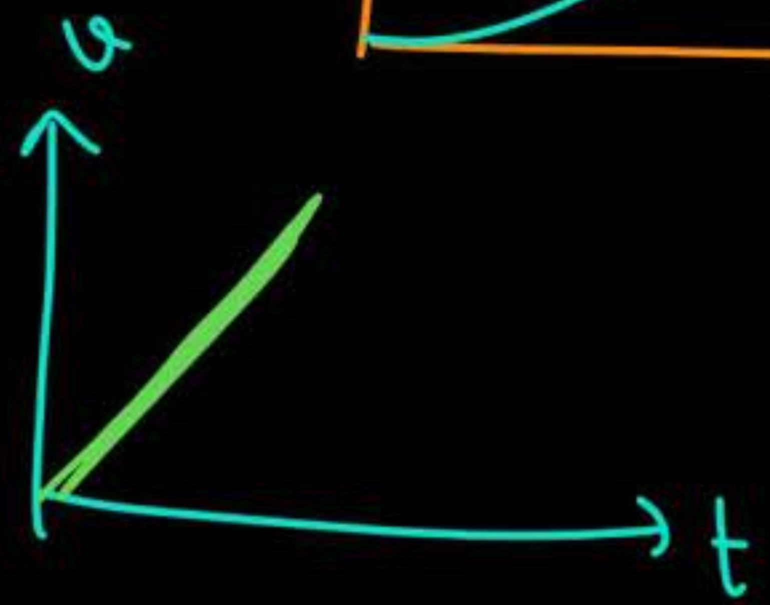
$x=5t^2$
$\parallel$
(parabola)

ग्राफ

$x = 5t^2$

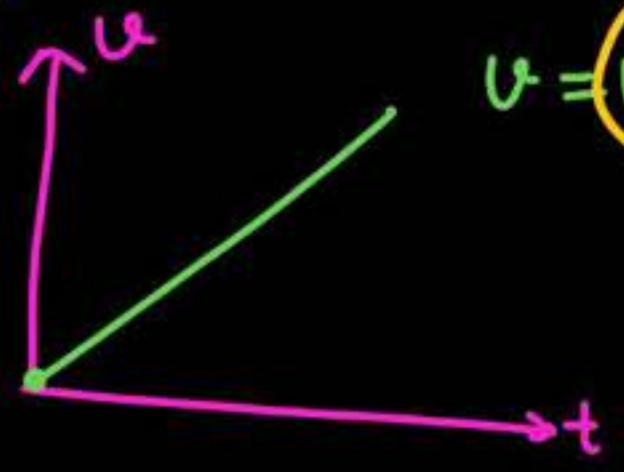


$v = 10t$

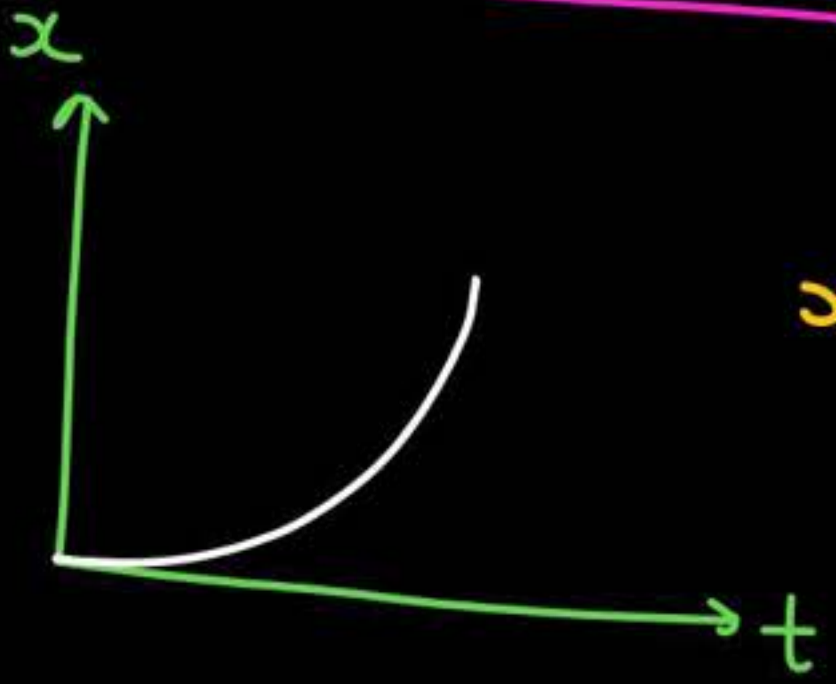


Q particle start from rest from origin at $t=0$, having acc $+10\,m/s^2$.

$a \rightarrow$ const

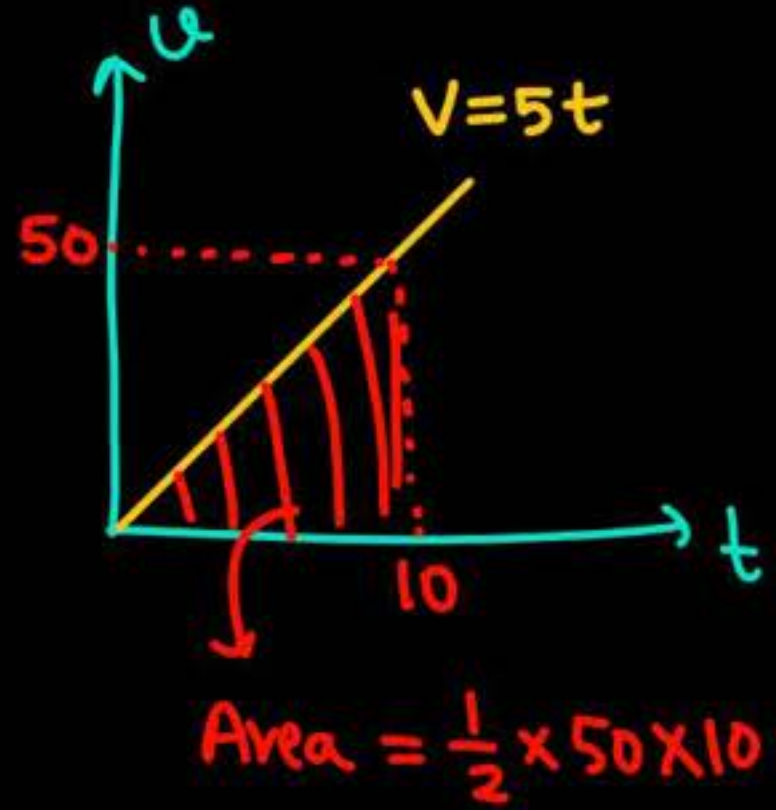


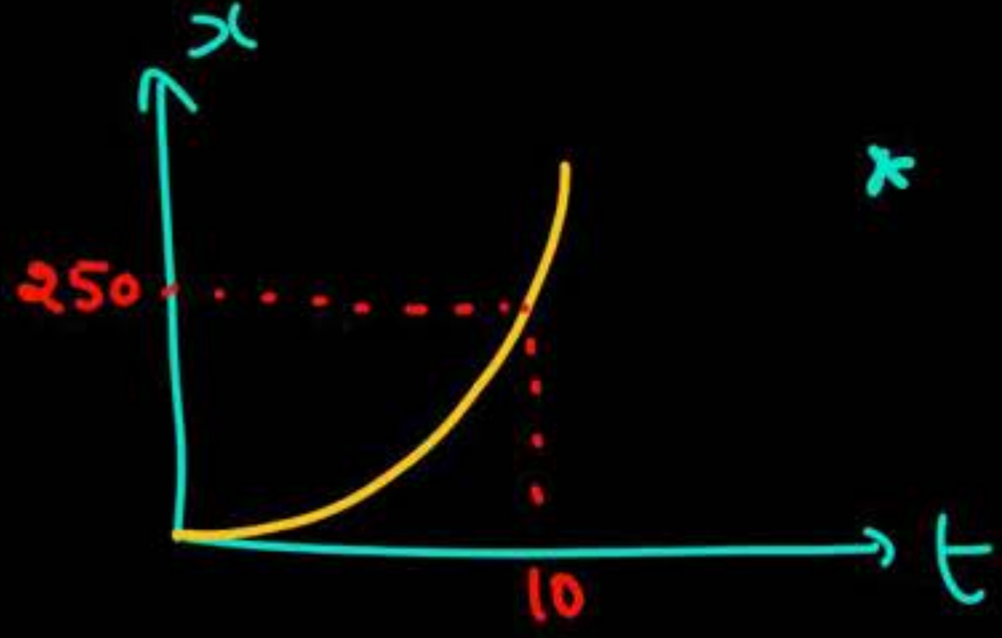
$v = 10t$



$x = \frac{10t^2}{2}$

Q particle start from rest from origin having acc $a = +5 = \text{Const}$





* $v = u + at$

$= 0 + 5 \times 10$

$v = 50$

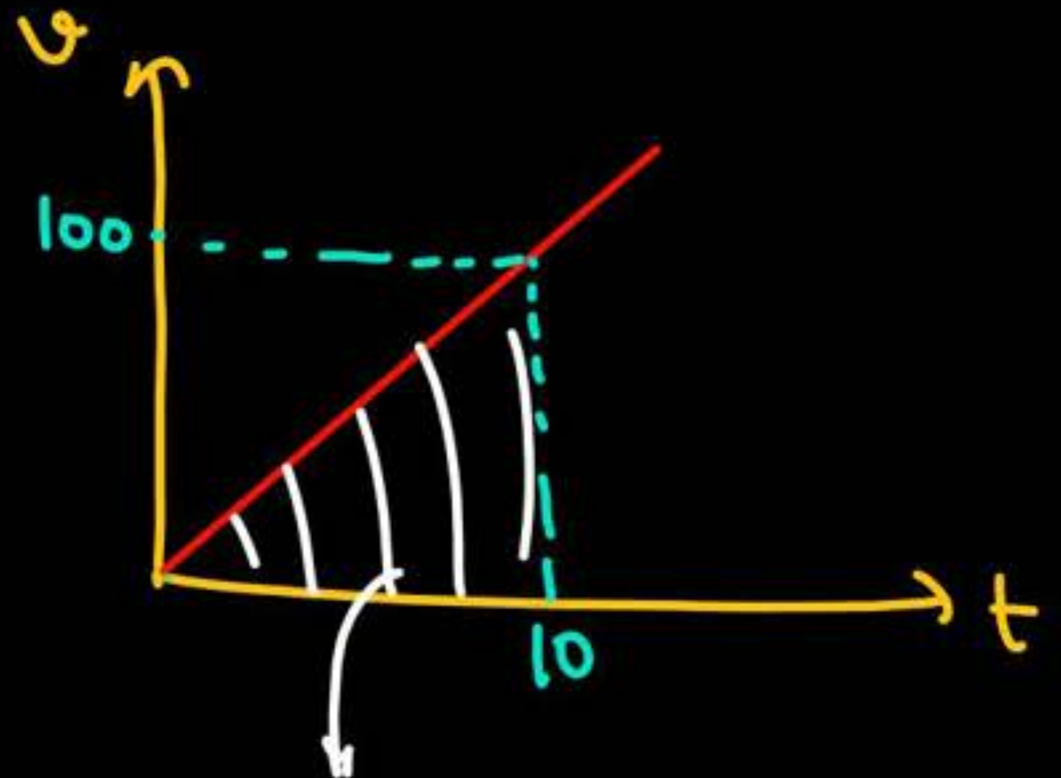
* $S = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 5 \times 10^2$

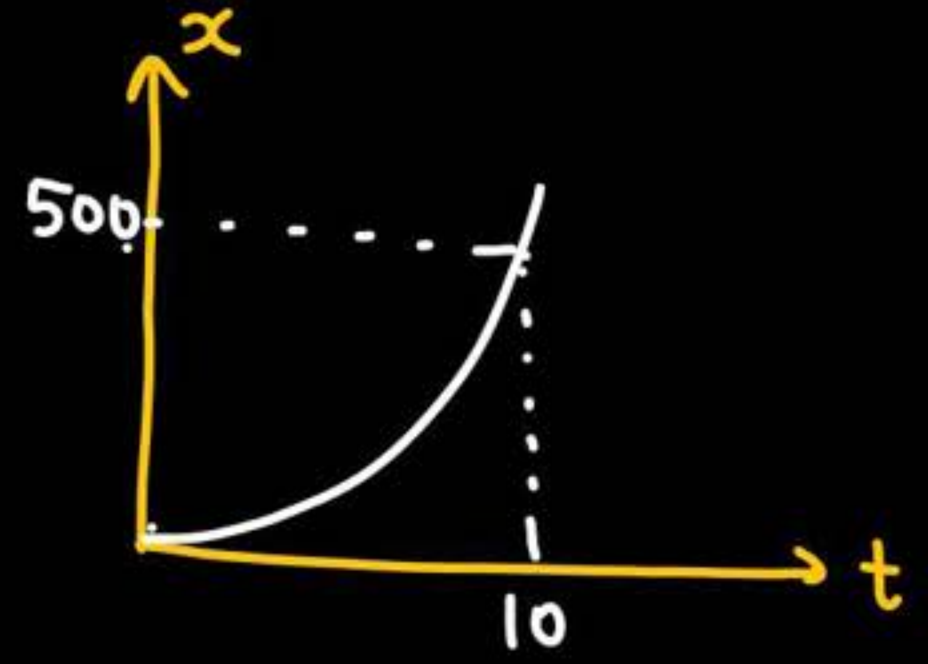
$= 250$

Q particle start from rest from origin having acc = +10 m/s.

$t=0 \longrightarrow t=10$ तक (v-t), (x-t) draw



Area $= \frac{1}{2} \times 10 \times 100 = 500$

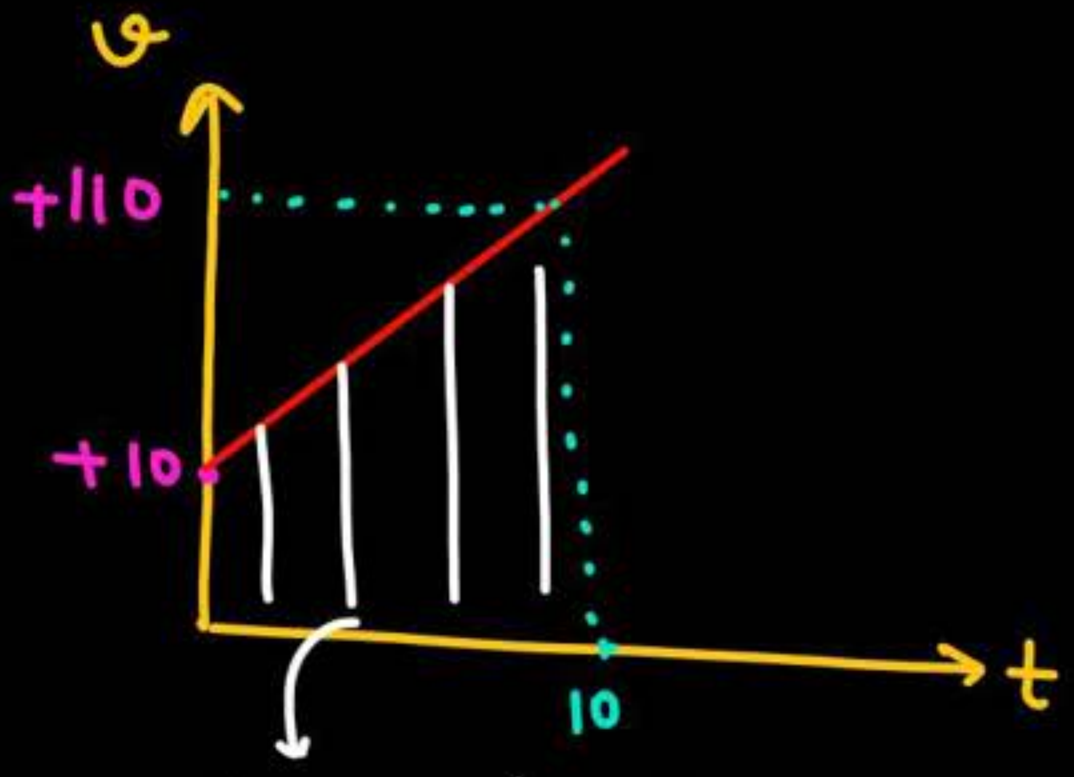


$u = 0$
$a = +10$
$t = 10$

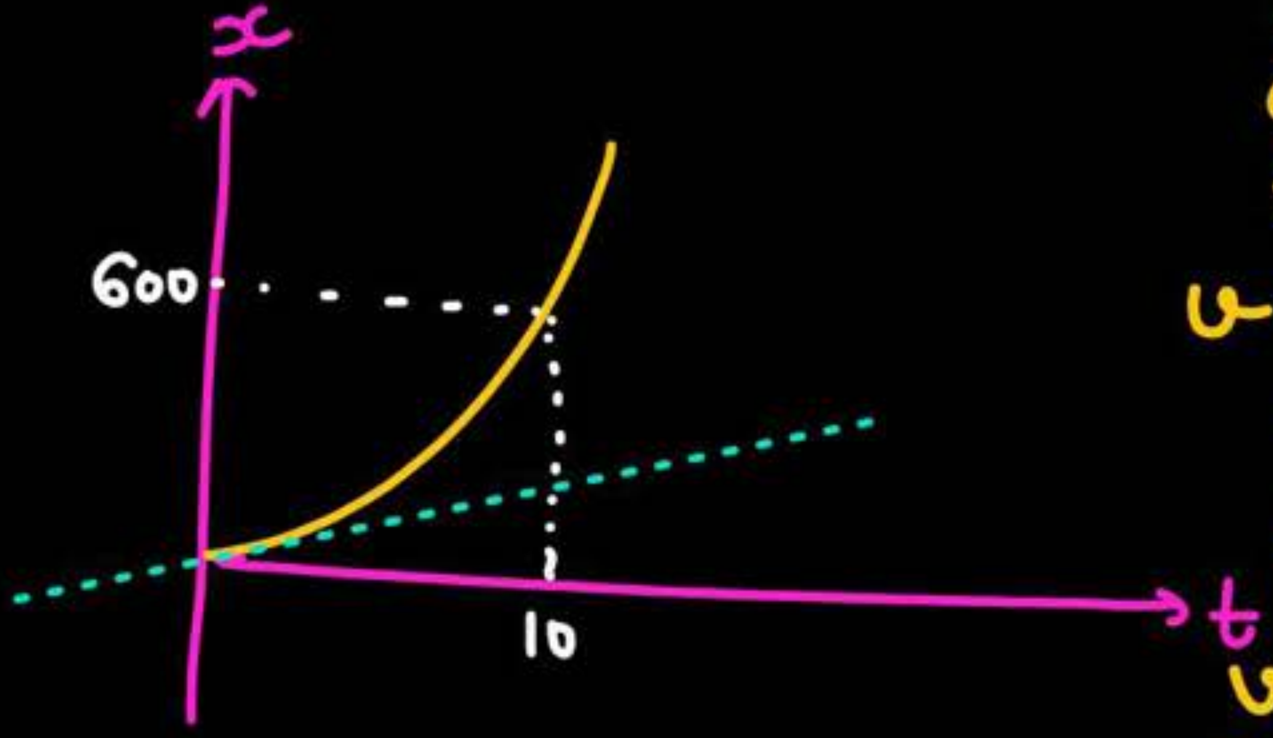
$v = u + at$
$v = 0 + 10 \times 10$
$v = 100$

$S = ut + \frac{1}{2}at^2$
$= 0 + \frac{1}{2} \times 10 \times 10^2$
$= 500$

Q A particle start motion having initial velocity $+10\,m/s$ and $acc = +10\,m/s^2$.



$$\text{Area} = \frac{1}{2}\times(10+110)\times 10$$
$$= 600$$



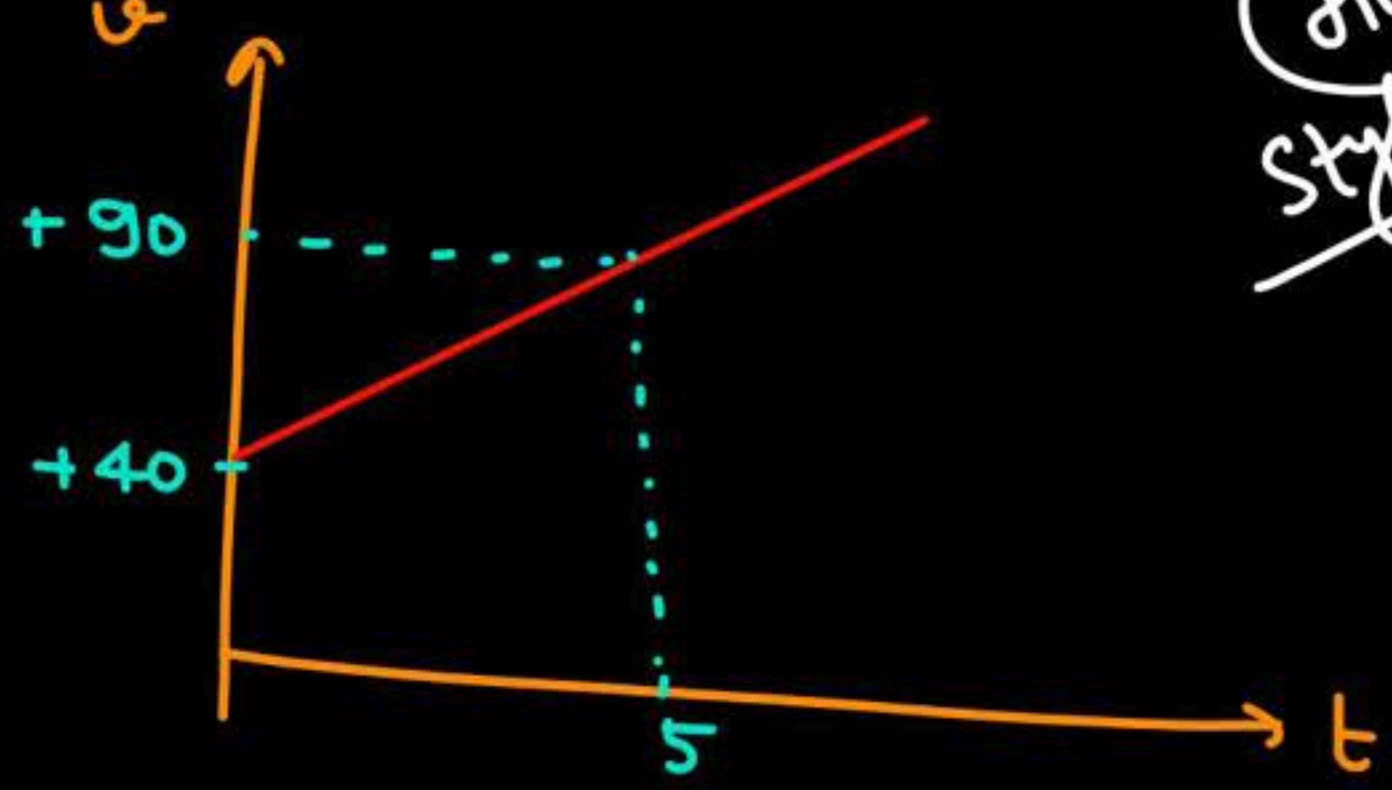
$u = +10$
$a = +10$
$t = 10\,sec$

$$v = u + at$$
$$= 10 + 10\times 10$$
$$= 10 + 100$$
$$v = 110$$

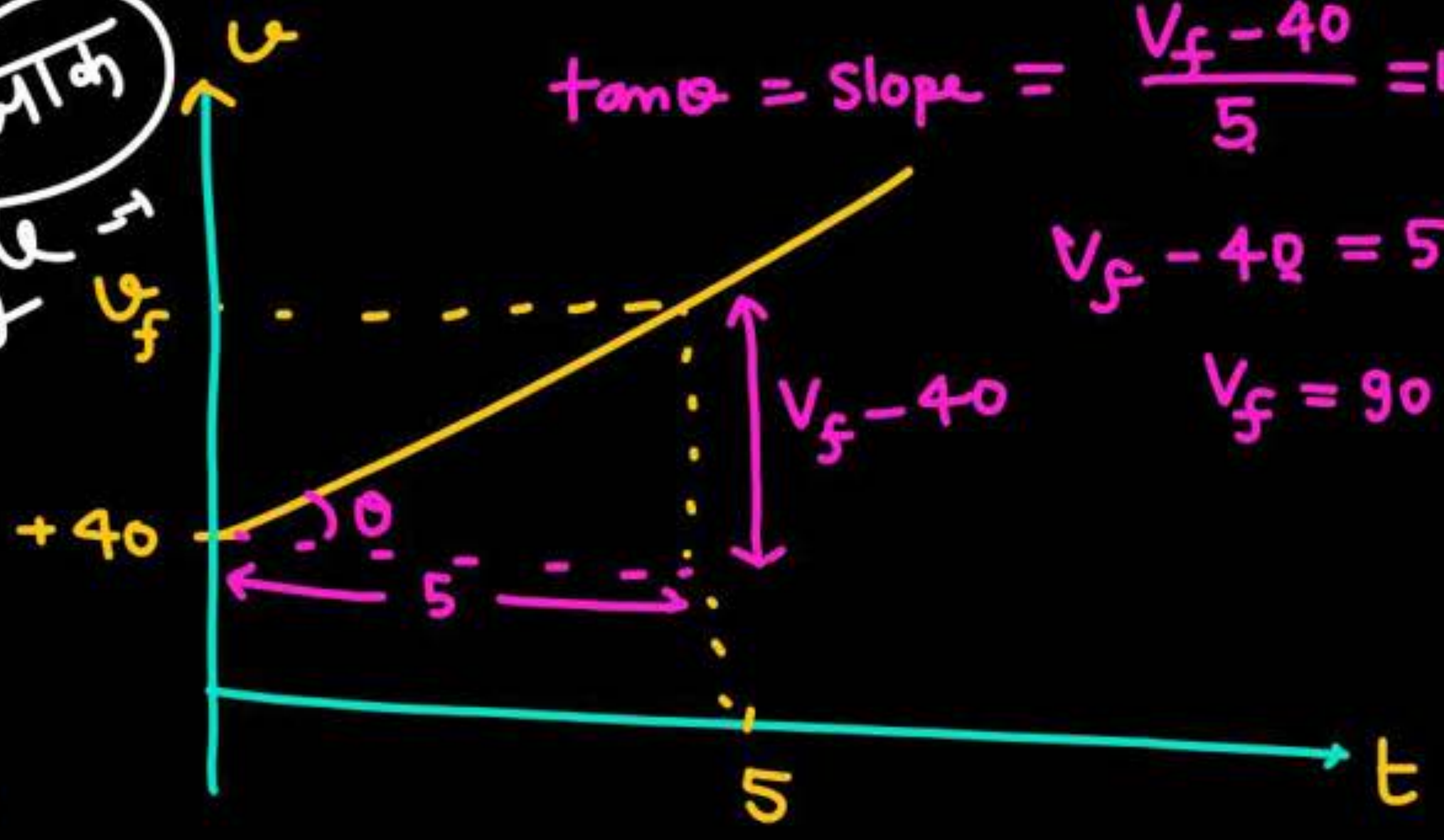
$$S = ut + \frac{1}{2}at^2$$
$$= 10\times 10 + \frac{1}{2}\times 10\times 10^2$$
$$= 100 + 500 = 600$$

Q A particle start motion having initial velocity $+40\,m/s^2$ and acc $= +10\,m/s^2$.

(*)



गणित style →



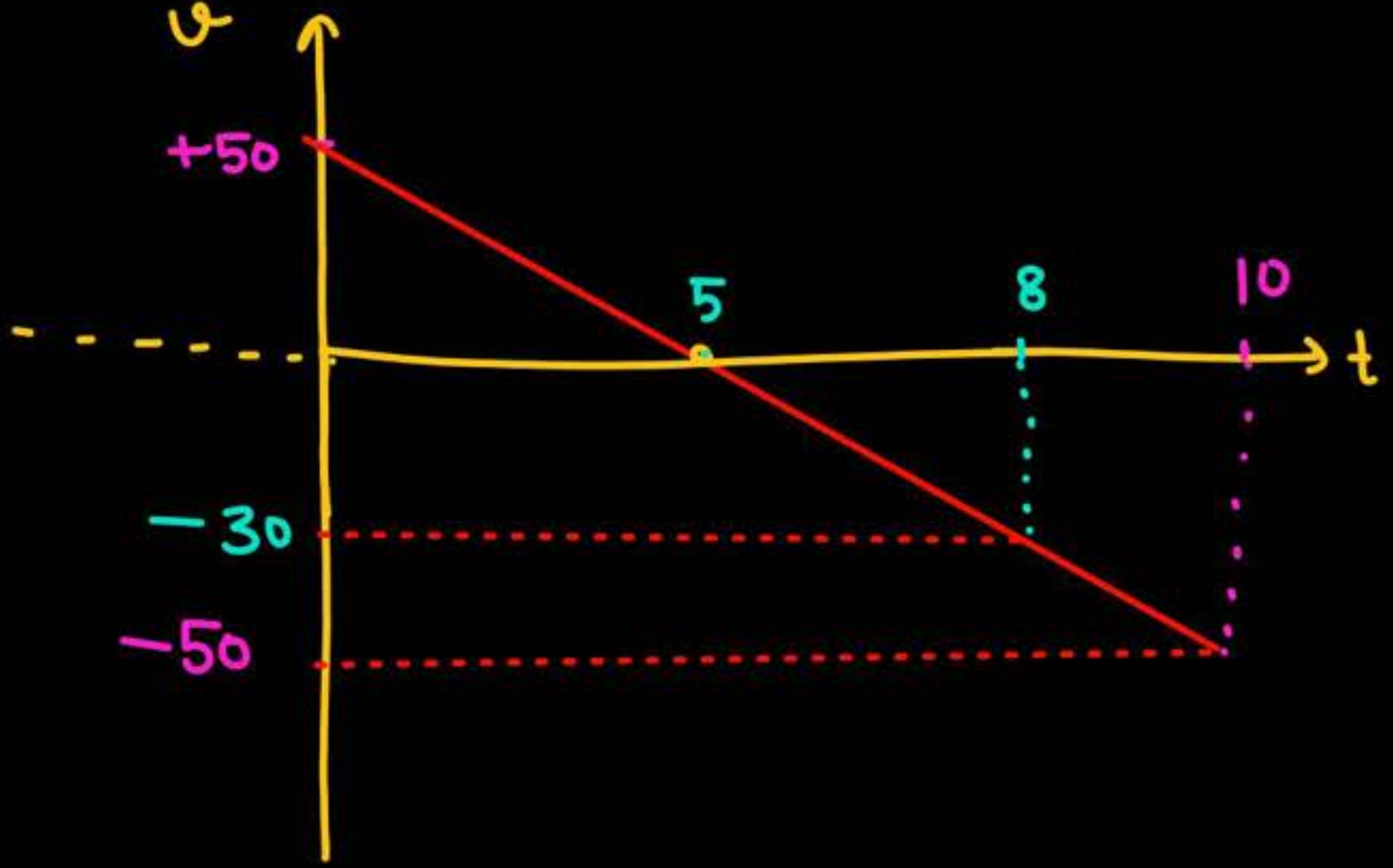
$\tan\theta = \text{Slope} = \dfrac{V_f - 40}{5} = 10$

$V_f - 40 = 50$

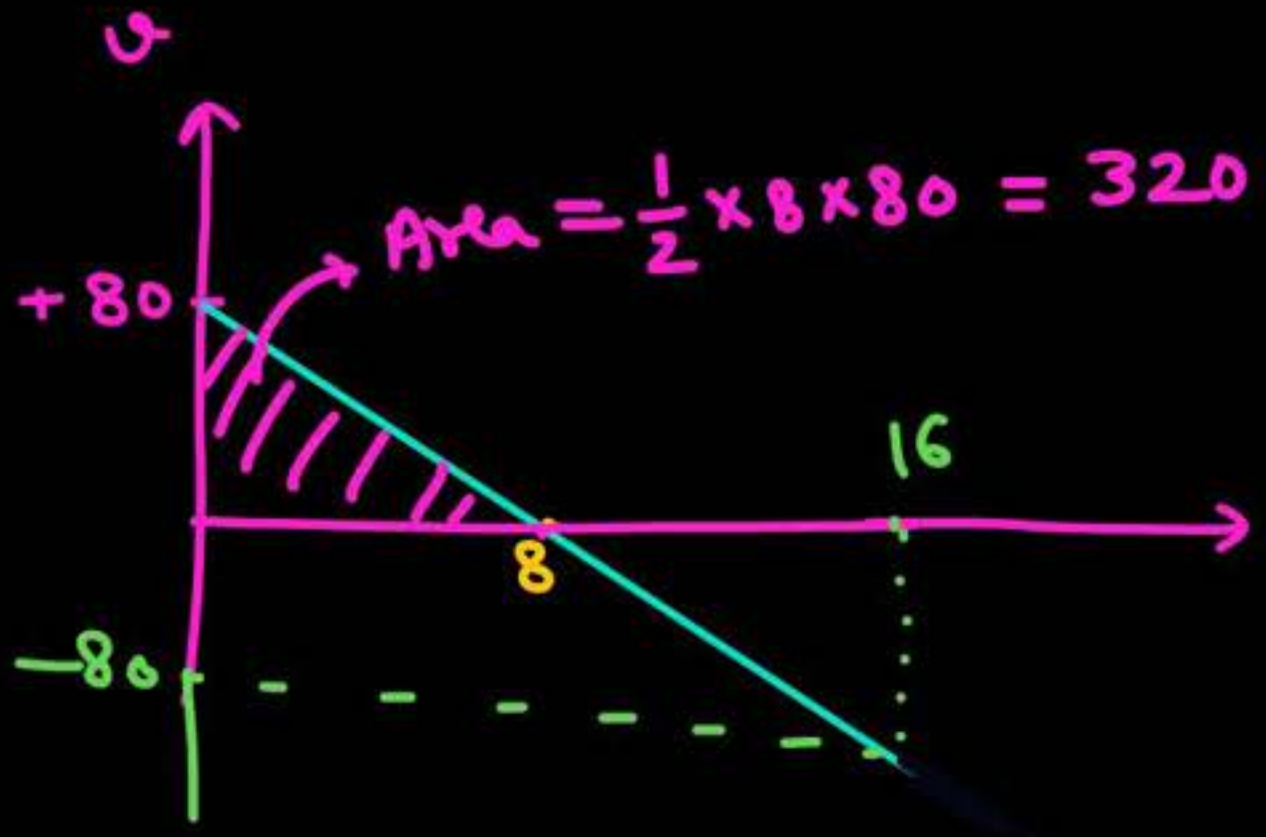
$V_f = 90$

Q A particle start motion having initial velocity +50m/s and acc = -10 m/s². $a<0$

$50-80=-30$ 10

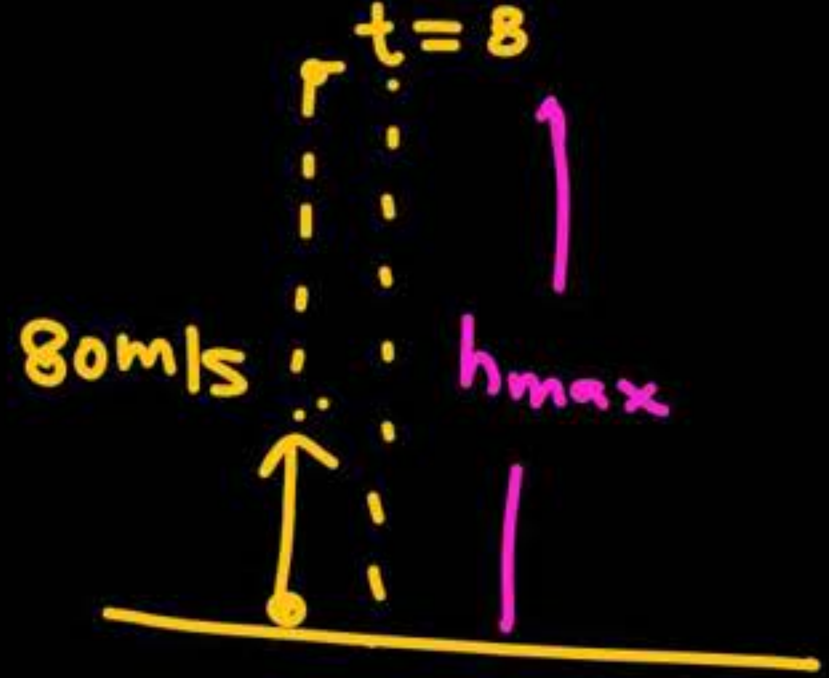


Q A particle start motion having initial veloci $+80\,m/s$ and acc $= -10\,m/s^2$



$t = 10$ sec $\quad v = 80 - 100 = -20 \quad 10$

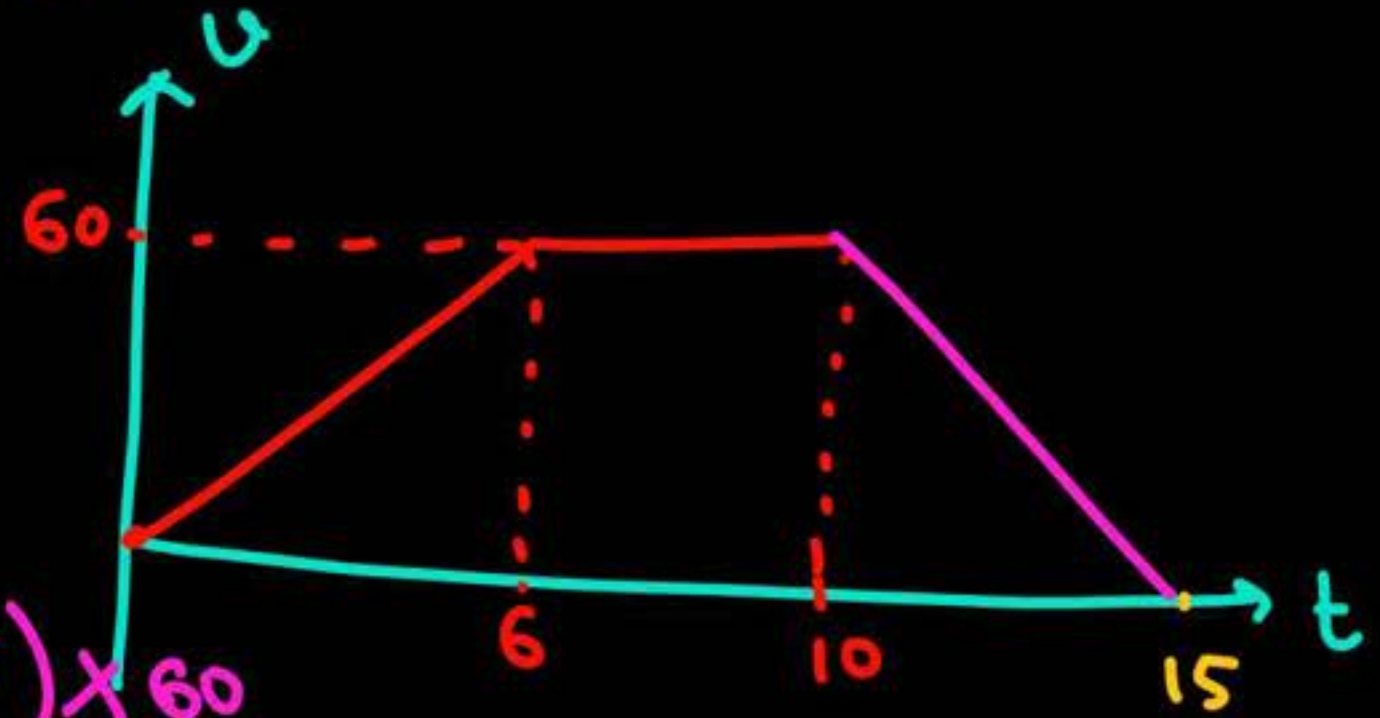
$v = u + at = 80 + (-10)10$
$= -20$



Q A particle start motion from rest, having acc $+10\,m/s^2$ for 6 sec. after that it move with constant velocity for next four second In last part of journey particle comes to at rest & took 5 sec. having const acc.

(1) find acc in last part of journey

(2) Distance travelled, Displacement



$$\text{Displ.} = \text{Area} = \frac{1}{2} \times (4+15) \times 60$$

Chocolate qn

Q particle is moving with initial velocity $+20\,m/s$ having acceleration $-5\,m/s^2$. find distance travelled by particle in 10 sec.

$u = +20$

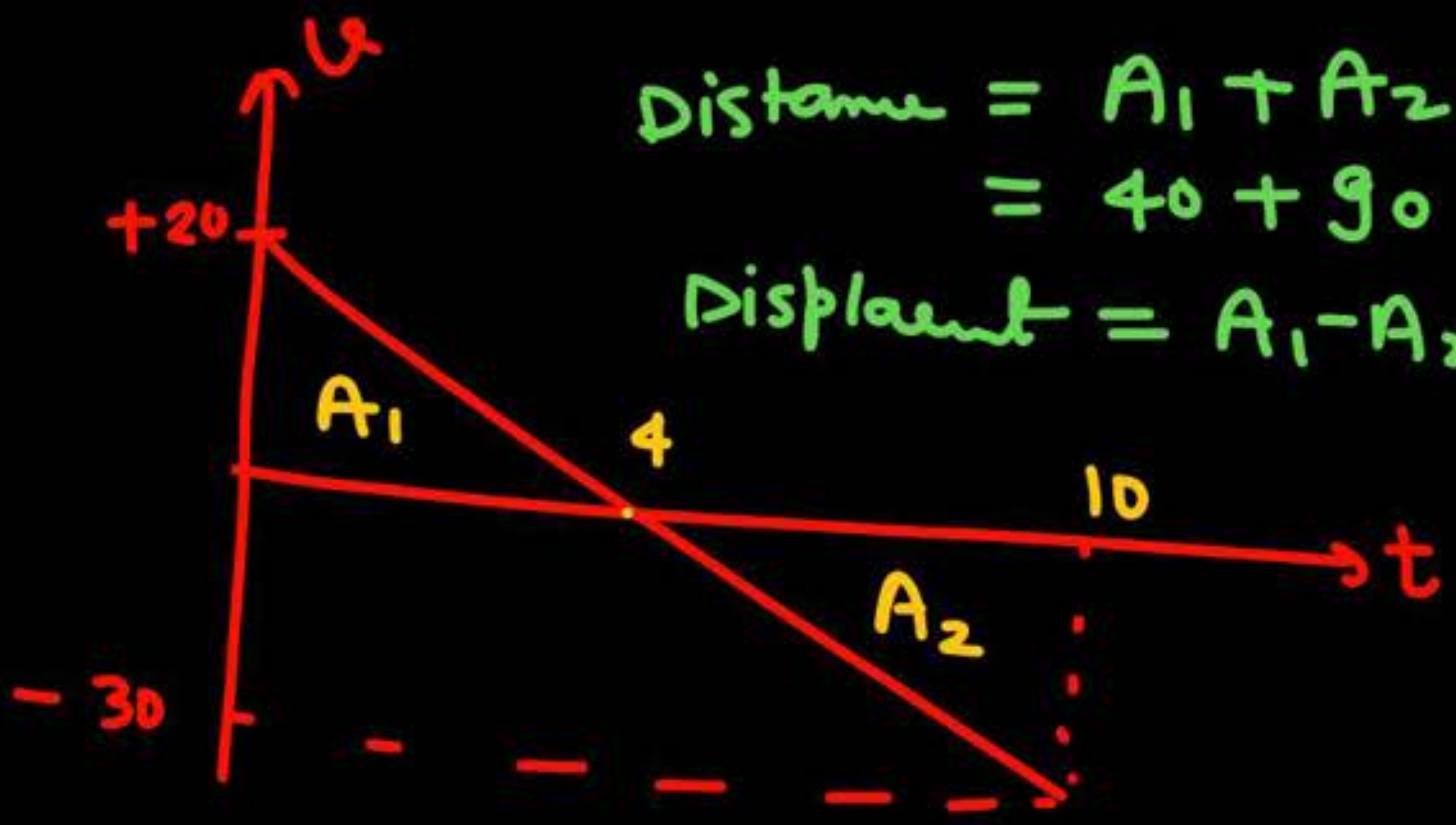
$a = -5$

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

Disp $= 20\times10 - \frac{1}{2}\times5\times10^2$

$= 200 - 250$

$= -50$



Distance $= A_1 + A_2$

$= 40 + 90 = 130$

Displacement $= A_1 - A_2 = 40 - 90$

$= -50$

H/W

Q A particle start motion from rest, having acc $+10 m/s^2$ for 6 sec. after that it move with constant velocity for next four second. After that particle move with const acc of $-20 m/s^2$ for five second. find

Distance travelled.

$$\int \sin(ax+b)\,dx = -\frac{1}{a}\cos(ax+b) + c$$

$$\int e^{x}\,dx = e^{x} + c$$

$$\int e^{ax+b}\,dx = \frac{1}{a}e^{ax+b} + c$$

* $\int \frac{1}{x}\,dx = \ln x + c$

$$\int \frac{1}{3x}\,dx = \frac{1}{3}\int \frac{1}{x}\,dx$$
$$= \frac{1}{3}\ln x + c$$

* $\int \frac{1}{3x+4}\,dx = \frac{1}{3}\ln(3x+4) + c$

याद कर लो

**

$$\int \frac{1}{ax+b}\cdot dx = \frac{1}{a}\ln(ax+b)+c$$

$$\int \frac{1}{4x+5}dx = \frac{1}{4}\ln(4x+5)+c$$

मन करें लिखो वरना मत लिखो

$$\int \frac{1}{4x+5}dx = ?$$

$$4x+5 = t \text{ (let)}$$

differentiate

$$4\,dx = 1\,dt$$

$$dx = \frac{1}{4}dt$$

$$\int \frac{1}{4x+5}dx = \int \frac{1}{t}\,\frac{1}{4}dt$$

$$= \frac{1}{4}\int \frac{1}{t}dt = \frac{1}{4}\ln t$$

$$= \frac{1}{4}\ln(4x+5)$$

Defenite Integration

upper limit of x

$$\int_{x_i = a}^{x_f = b} f(x)\cdot dx = g(x)\Big|_{x_i = a}^{x_f = b} = g(b) - g(a)$$

lower limit of x

Q $$\int_{x_i = 0}^{x_f = 3} x^2\, dx = \int_0^3 x^2\, dx = \frac{x^3}{3}\Big|_0^3 = \left(\frac{3^3}{3}\right) - \left(\frac{0^3}{3}\right)$$

$$= 9 \quad \text{Ans}$$

Q $\int_{2}^{3} 4x^3 dx = 4 \cdot \frac{x^4}{4} \Big|_{x=2}^{x=3} = x^4 \Big|_{x=2}^{x=3} = 3^4 - 2^4 = 81 - 16 = \checkmark$

Q $\int_{0}^{\pi/2} \cos x \, dx = \sin x \Big|_{0}^{\pi/2} = \left(\sin \pi/2\right) - \sin 0 = 1 - 0 = 1$

Q $\displaystyle\int_{x=1}^{x=4} 2x\,dx = 2\cdot\frac{x^2}{2}\Big|_1^4 = x^2\Big|_{x=1}^{x=4} = 4^2 - 1^2 = 15$

Q $\displaystyle\int_0^1 7x^6\,dx = x^7\Big|_0^1 = 1^7 - 0^7 = 1$

Q $\displaystyle\int_2^3 e^x\,dx = e^x\Big|_2^3 = e^3 - e^2$

Q $$\int_0^{10} 2x\,dx = x^2\Big|_{x=0}^{x=10} = 100-0 = 100$$

Q $$\int_0^{1} (3x^2+2x)\,dx = \left(3\frac{x^3}{3} + 2\frac{x^2}{2}\right)\Big|_{x=0}^{x=1} = (x^3+x^2)\Big|_{x=0}^{x=1}$$

$$= (1^3+1^2) - (0^3+0^2)$$

$$= 2$$

imp
12th class math

Q $y = x^3$

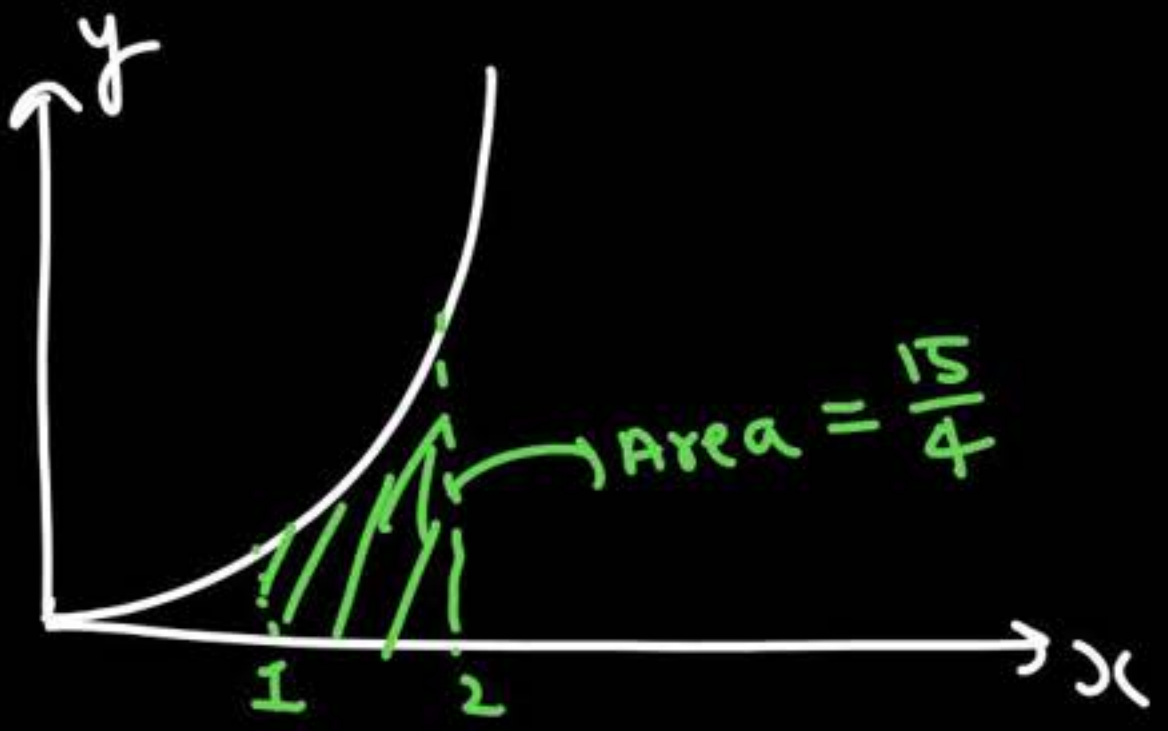
find area under curve (b/w curve & x-axis) from $x = 1$ to $x = 2$

Sol^n

$$\text{Area} = \int y\,dx = \int_1^2 x^3\,dx$$

$$\text{Area} = \frac{x^4}{4}\Bigg|_{x=1}^{x=2}$$

$$= \frac{1}{4}\left[2^4 - 1\right] = \frac{15}{4}$$



$$x \xrightarrow{\text{differentiate}} v \xrightarrow{\text{differentiate}} a$$

$$x \xleftarrow{\text{Integrate}} v \xleftarrow{\text{integrate}} a$$

Q at $t=0$, particle is at $x=10$
particle is moving such that its v vs time relation is given as

$V = 3t^2 + 2t$

find ① location of particle at $t = 1$ sec

② $x = f(t)$

$$x = \int v\,dt = \int (3t^2+2t)\,dt = t^3 + t^2 + c$$

$$\boxed{x = t^3 + t^2 + c}$$

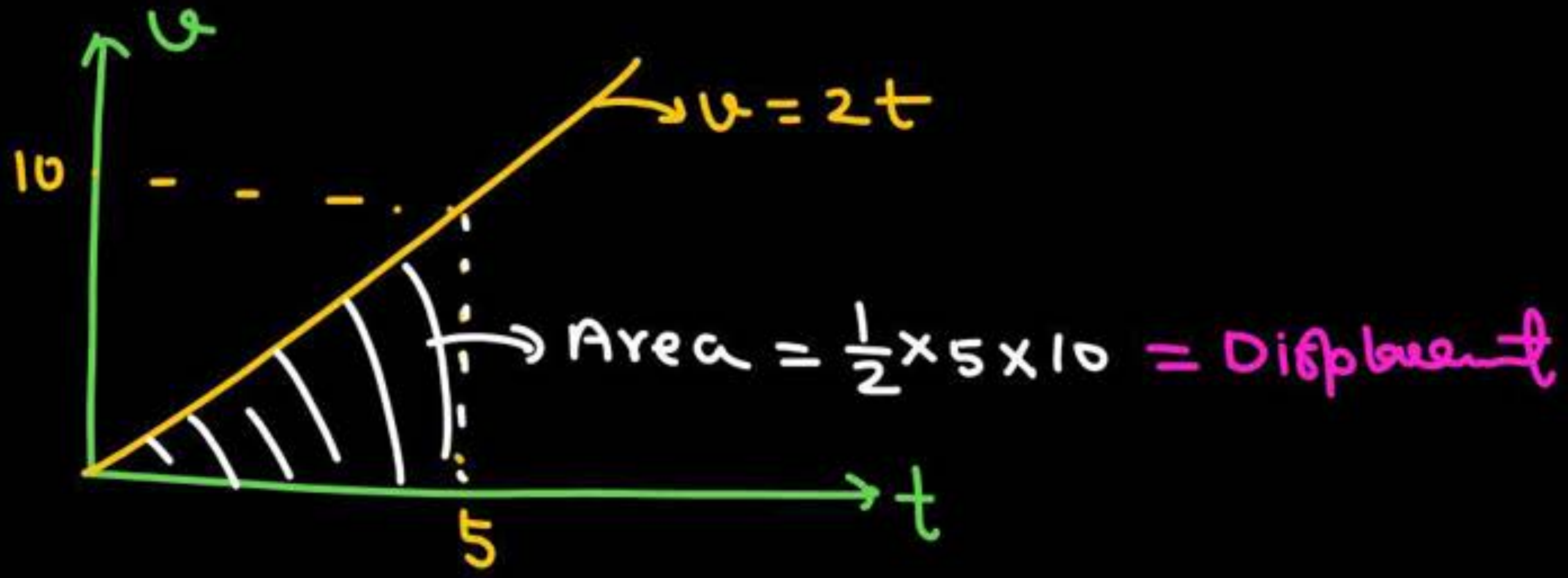
at $t=0$, $x=10$

$10 = 0 + 0 + c \Rightarrow C = 10$

$$\boxed{x = t^3 + t^2 + 10}$$

Q A particle is moving along x-axis s.t its velocity Vs time relation is given as

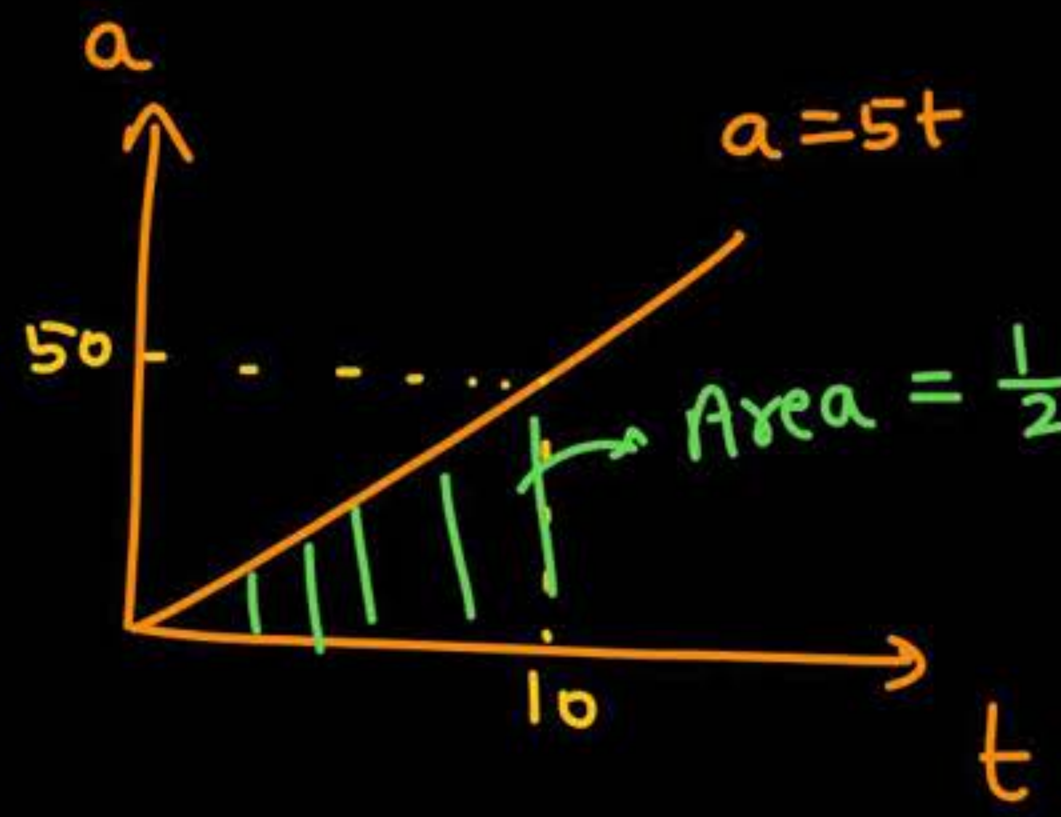
Displacement from $t=0 \longrightarrow t=5$



$\underline{\underline{Sol^n}}$ $\text{Area} = \frac{1}{2} \times 5 \times 10$

$= \underline{\underline{25}}$

Q A particle start motion from rest such that its a-t graph is given as



find velocity at $t = 10\,sec$,

Area $= \frac{1}{2} \times 10 \times 50 =$ change in velo[city]

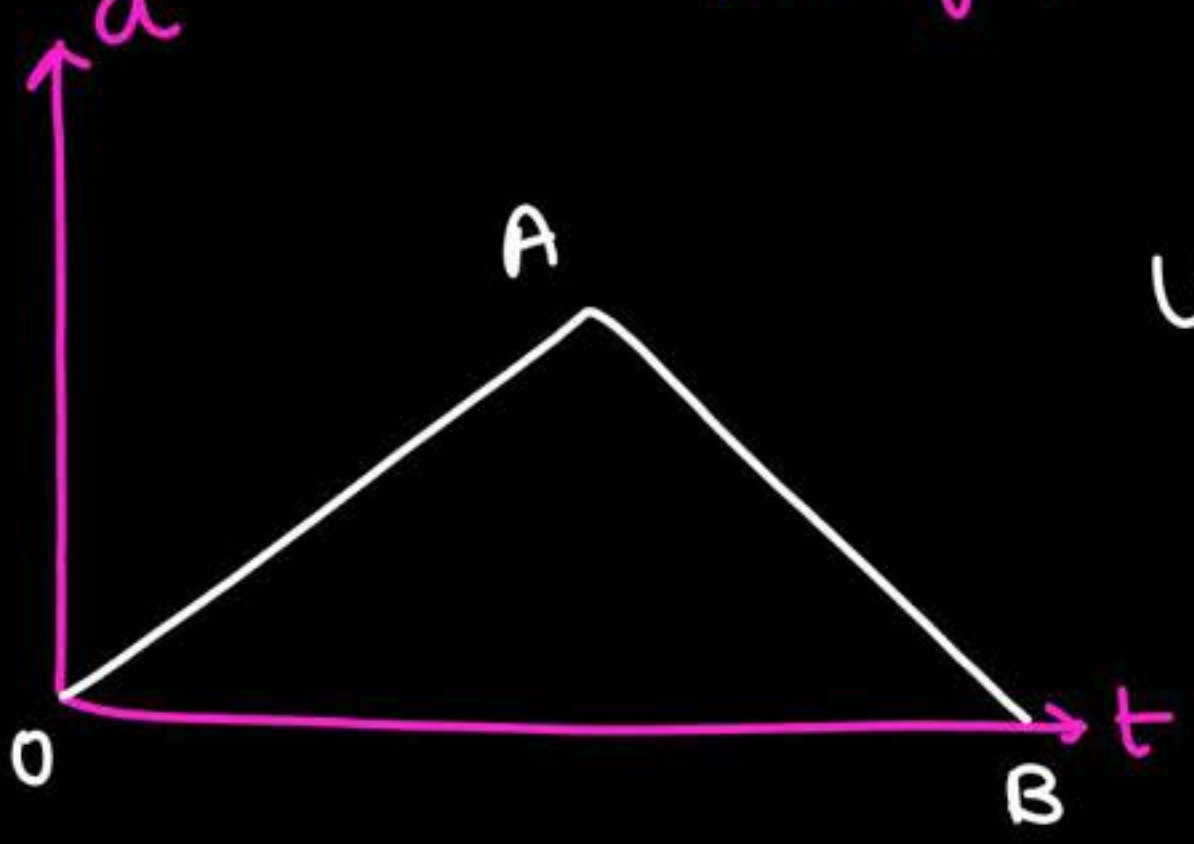
$= V_f - V_i$

Area $= \vec{V_f} - \vec{V_i}$

$\frac{1}{2} \times 10 \times 50 = V_f - 0$

$V_f = 250$

initially particle is at rest



v_{max} कहाँ होगी

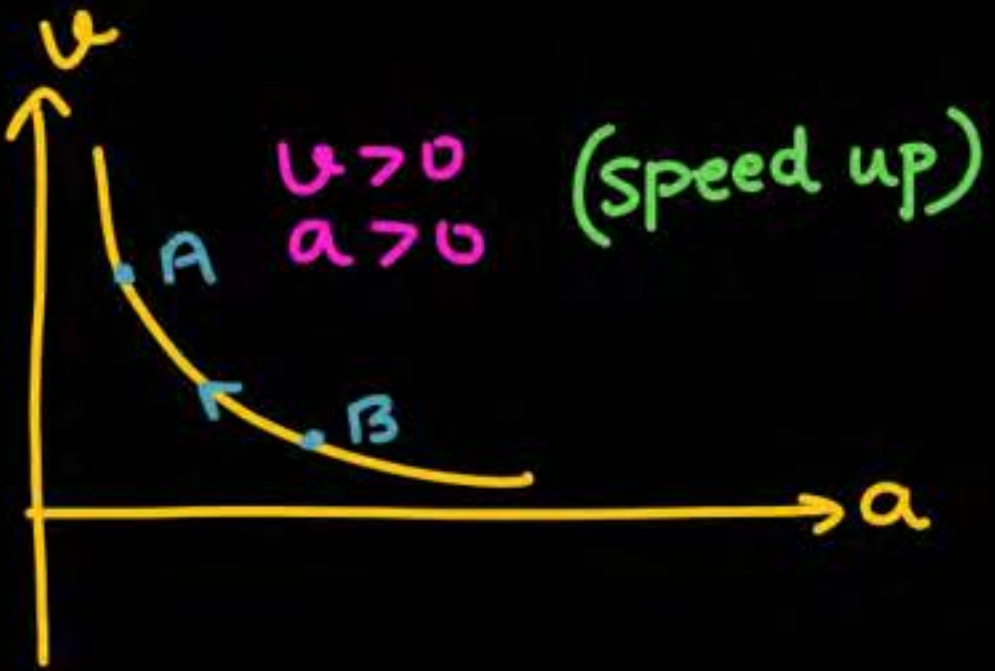
~~A~~ ≡ 35%

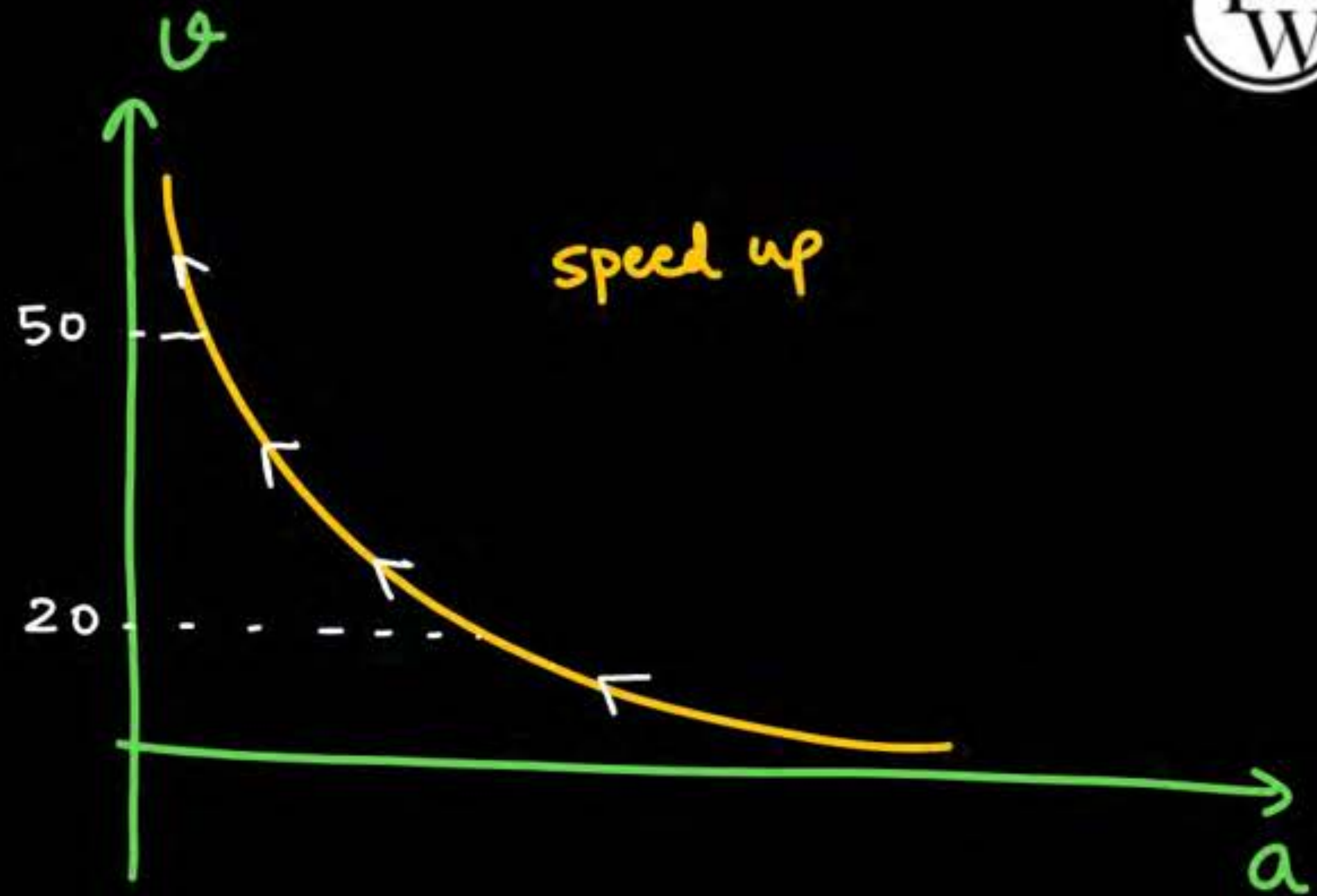
B ≡ 45%

(C) ≡ O 12%

(D) ≡ हमारा छूटना नहीं चल रहा

7%





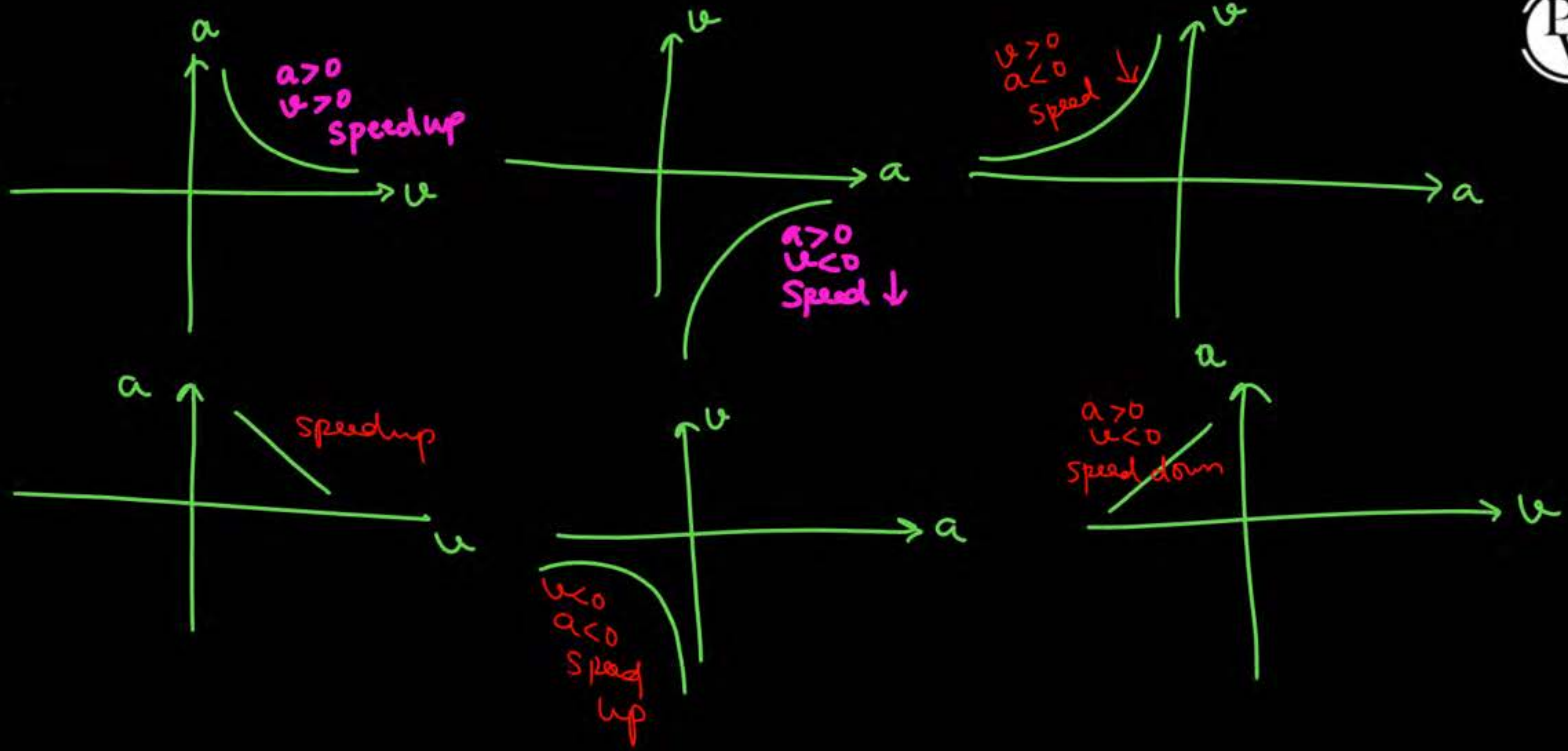
① velocity is decreasing ✗

② " " increasing ✓

③ acc is increasing ✗

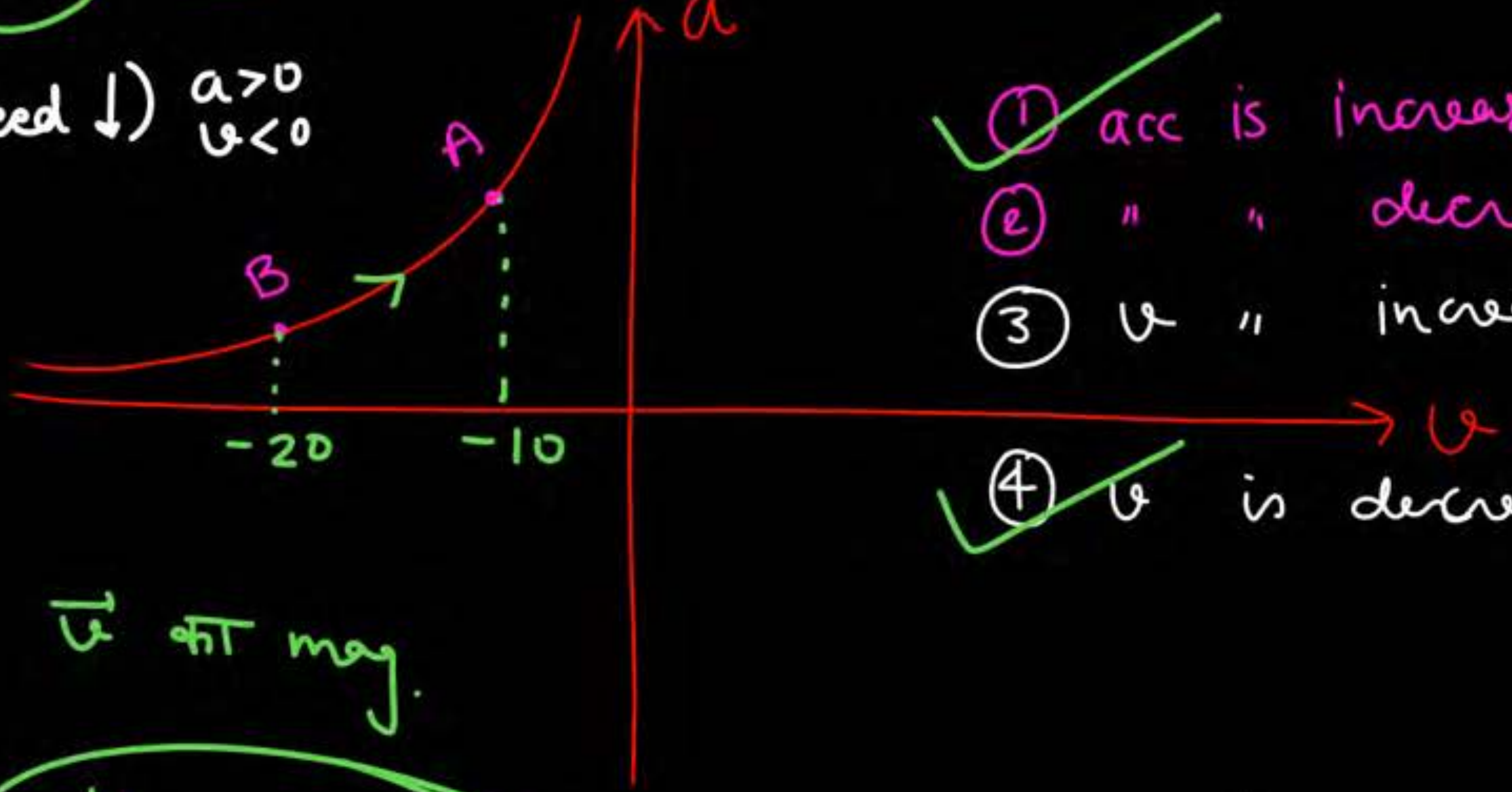
④ acc is decreasing ✓

Q


a
v
a>0
v>0
speedup
v
a
a>0
v<0
Speed ↓
v
a
v>0
a<0
Speed ↓
a
v
speedup
v
a
v<0
a<0
Speed up
a
v
a>0
v<0
speed down

Q H/W next class $\equiv$ Dis

(Speed ↓) $a>0$
$v<0$



① acc is increasing
② " " decreasing $\equiv$?
③ v " increasing
④ v is decreasing

$\vec{v}$ का mag.

B ⟶ A

③ $\int x^7 \cdot dx = \frac{x^8}{8} + C$ → const

⇓

differentiate wrt 'x'

$\frac{8x^7}{8} + 0 = x^7$

K.C.

$f(x) \xrightarrow{\text{differentiate}} g(x)$

↓ integrate

$f(x) + C$ → नहीं भूलना है

Q

① x^3 का diff. wrt x $\Rightarrow 3x^2 \Rightarrow \int 3x^2 dx = 3\int x^2 dx$

$= 3\,\frac{x^3}{3} + c$

$= x^3 + c$

② x^3+5 का differentiation wrt x $\Rightarrow 3x^2+0$

$\int 3x^2 \cdot dx = x^3 + c$

③ x^3+25 का diff बताओ wrt x $\Rightarrow 3x^2+0$

$\int 3x^2 dx = x^3 + c$

(4) $\int x^{10}\,dx = \dfrac{x^{11}}{11} + c$

(5) $\int x^{50}\,dx = \dfrac{x^{51}}{51} + c$

(6) $\int x^{25}\,dx = \dfrac{x^{26}}{26} + c$

(7) $\int x^{-5}\,dx = \dfrac{x^{-5+1}}{-5+1} + c$

(8) $$\int x^2\,dx = \frac{x^3}{3} + c$$

(9) $$\int x^7\,dx = \frac{x^8}{8} + c$$

(10) $$\int (x^2 + x^3)\,dx = \frac{x^3}{3} + \frac{x^4}{4} + c$$

$$= \int x^2\,dx + \int x^3\,dx$$

(11) $$\int 5x^4\,dx = 5\int x^4\,dx$$

$$= 5\,\frac{x^5}{5} + c$$

$$= x^5 + c$$

(12) $$\int 6x^5\,dx = x^6 + c$$

(13) $\int (3x^2 + 7x^6)\,dx$

$= 3\frac{x^3}{3} + 7\frac{x^7}{7} + c = x^3 + x^7 + c$

(14) $\int x^{-3}\,dx = \frac{x^{-3+1}}{-3+1} + c$

दिमाग मत लगाना

$= -\frac{1}{2x^2} + c$

(15) $\int \frac{1}{x^3}\,dx = \int x^{-3}\,dx$

$= -\frac{1}{2x^2} + c$

(16) $\int \left(\frac{1}{x^2} + \frac{1}{x^3}\right)dx = \int (x^{-2} + x^{-3})\,dx$

$= -\frac{1}{x} - \frac{1}{2x^2} + c$

(17) $\int \left(\frac{1}{x^9} + \frac{1}{x^{10}}\right)dx = \int (x^{-9} + x^{-10})\,dx$

$= \frac{x^{-9+1}}{-9+1} + \frac{x^{-10+1}}{-10+1} + c = \boxed{-\frac{x^{-8}}{8} - \frac{x^{-9}}{9} + c}$

(18) $\int (3x^2 - 4x^3)\,dx = x^3 - x^4 + c$

***

(19) $\int dx = \int 1 \cdot dx = \int x^0\,dx = \frac{x^{0+1}}{0+1} + c$

$= x$

$$\boxed{\int dx = x + C}$$

$$\int 5\,dx = 5\int dx = 5x + C$$

$$\int 7\,dx = 7x + C$$

Q. $\int (3x^2 + 4x^3 + 5)\,dx$

$$= 3\cdot\frac{x^3}{3} + 4\frac{x^4}{4} + 5x + C$$

$$= x^3 + x^4 + 5x + C$$

सही लेगा ✓

Q

$$\int \boxed{(2x + 7x^6 + 10)}\, dx = \boxed{x^2 + x^7 + 10x + C}$$

$\equiv$ differentiate wrt x

same

$$\boxed{2x + 7x^6 + 10 + 0}$$

$$\int (2t + 7t^6 + 10)\, dt = t^2 + t^7 + 10t + c$$

** very very imp

Q

$$\frac{d}{dx}\sin(2x+3) = \cos(2x+3).[2+0] = 2\cos(2x+3)$$

$$\frac{d}{dx}\sin(ax+b) = a\cos(ax+b)$$

$$\frac{d}{dx}e^{2x+3} = e^{2x+3}.(2+0) = 2e^{2x+3}$$

$$\frac{d}{dx}\sin(2x+3) = 2\cos(2x+3)$$

$$\int 2\cos(2x+3) = \sin(2x+3) + c$$

$$\int \cos(2x+3) = \frac{1}{2}\sin(2x+3) + c'$$

$$\int \cos x \, dx = \sin x + c$$

$$\int \cos(ax+b)\,dx = \frac{1}{a}\sin(ax+b) + c$$

$$\int e^{2x}\,dx = \frac{1}{2}e^{2x} + c$$

$$\frac{d}{dx}\sin(2x) = 2.\cos 2x$$

diff

integ.

$$\int 2\cos 2x \cdot dx = \sin 2x + c$$

$$\int \cos 2x \, dx = \frac{1}{2}\sin 2x + \frac{c}{2}$$

$$\sin x \xrightarrow{\text{diff}} \cos x$$

$$\int \cos x \, dx = \sin x + c$$

$$\int \boxed{\cos 2x} dx = \sin 2x + c$$ ✗

$\equiv$ differentiate

$$\boxed{2(\cos 2x)} + 0$$

$$\int \cos 2x \, dx = \boxed{\frac{1}{2}\sin 2x + c}$$

$\equiv$ differentiate

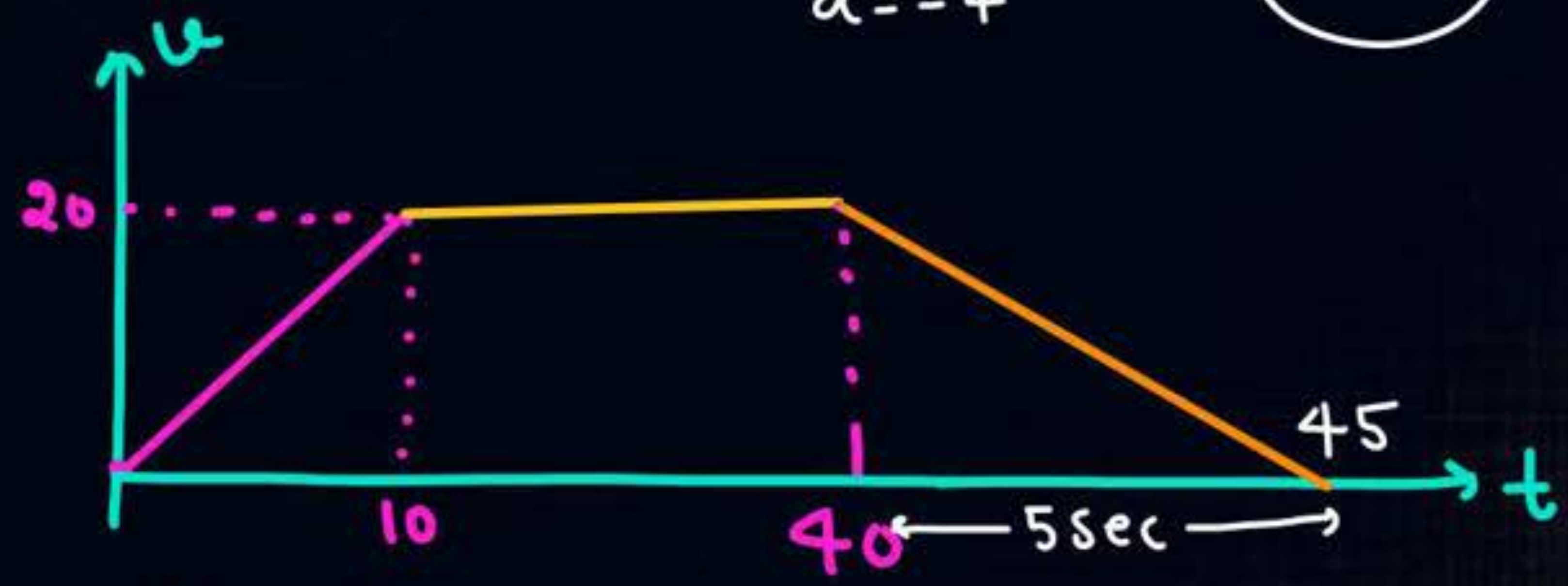
$$\cos 2x = \frac{1}{\cancel{2}}(\cos 2x) \times \cancel{2}$$

Question

Note

A particle starts from rest, accelerates at $2\ m/s^2$ for 10 s and then goes at constant speed for 30 s and then decelerates at $4\ m/s^2$ till it stops. What is the distance travelled by it:

$a = -4$



A 750 m

B 800 m

C 700 m

D 850 m

$$\text{Area} = \frac{1}{2} \times (30 + 45) \times 20 = \underline{\underline{750}}$$

Ans : (A)

Question

note ×

The driver of a car which is moving on a straight horizontal road with a speed of $72\ \text{kmh}^{-1}$ applies brakes. If the retardation produced is $20\ \text{ms}^{-2}$, the distance moved by the car before coming to rest will be

$u = 72\,\dfrac{km}{hr} = 72 \times \dfrac{5}{18}\ m/s = 20\ m/s$

A. 10 m

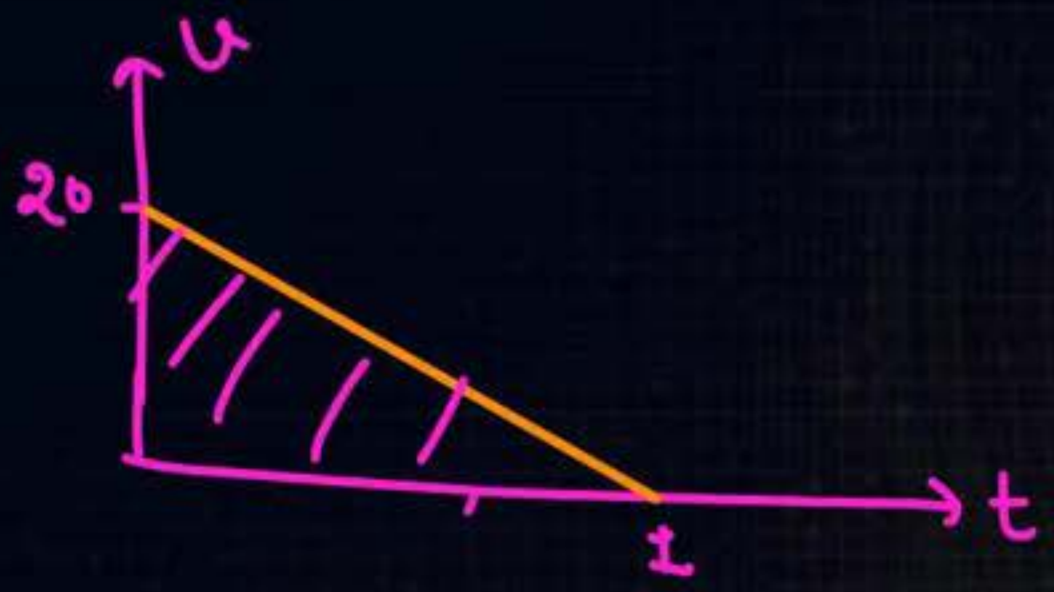
B. 8 m

C. 6 m

D. 2 m

Area $= \frac{1}{2} \times 20 \times 1$

$= 10$



Ans : (A)

Q A particle start motion having initial velocity 20 m/s and it moves with const acc of $10 m/s^2$.

① find velocity at $t = 4$ sec

② find displacement of particle from $t=0 \longrightarrow t=4$ sec

③ Find displacement in 4^{th} sec

$u = 20$

$a = 10$

① $t = 4$, $\Rightarrow v = u + at$

$= 20 + 10 \times 4$

$v = 60$

② $s = ut + \frac{1}{2}at^2$

$= 20 \times 4 + \frac{1}{2} \times 10 \times 4^2 = 160$

$S_n = u + \frac{1}{2}(2n-1)a$

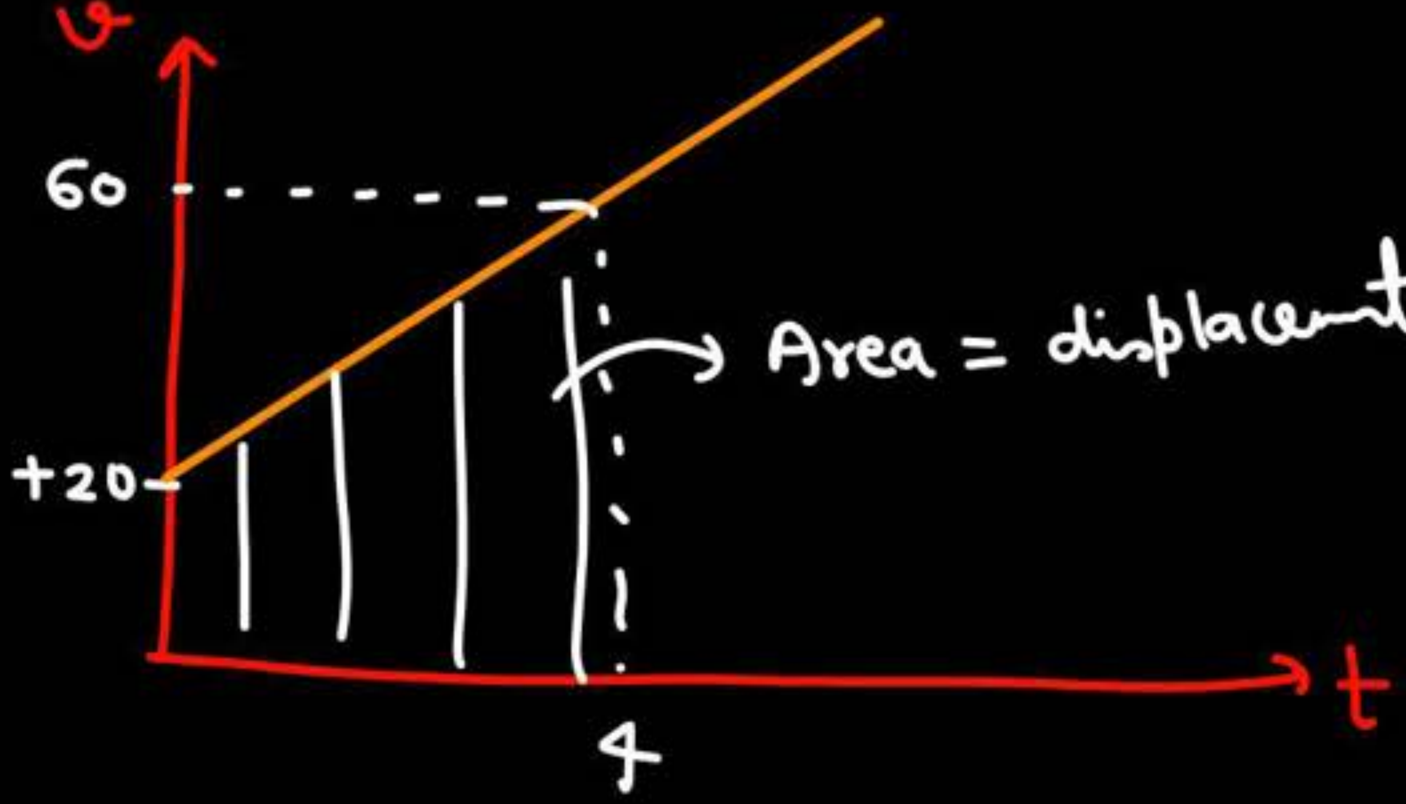
$S_n = 20 + \frac{1}{2} \cdot (2 \times 4 - 1) \times 10$

$= 20 + 35 = 55$

Q A particle start motion having initial velocity 20 m/s and it moves with const acc of $10\,m/s^2$.

M-2

graph से



Area = displacement $= \frac{1}{2} \times (20+60) \times 4$

$= 160$

HCV note

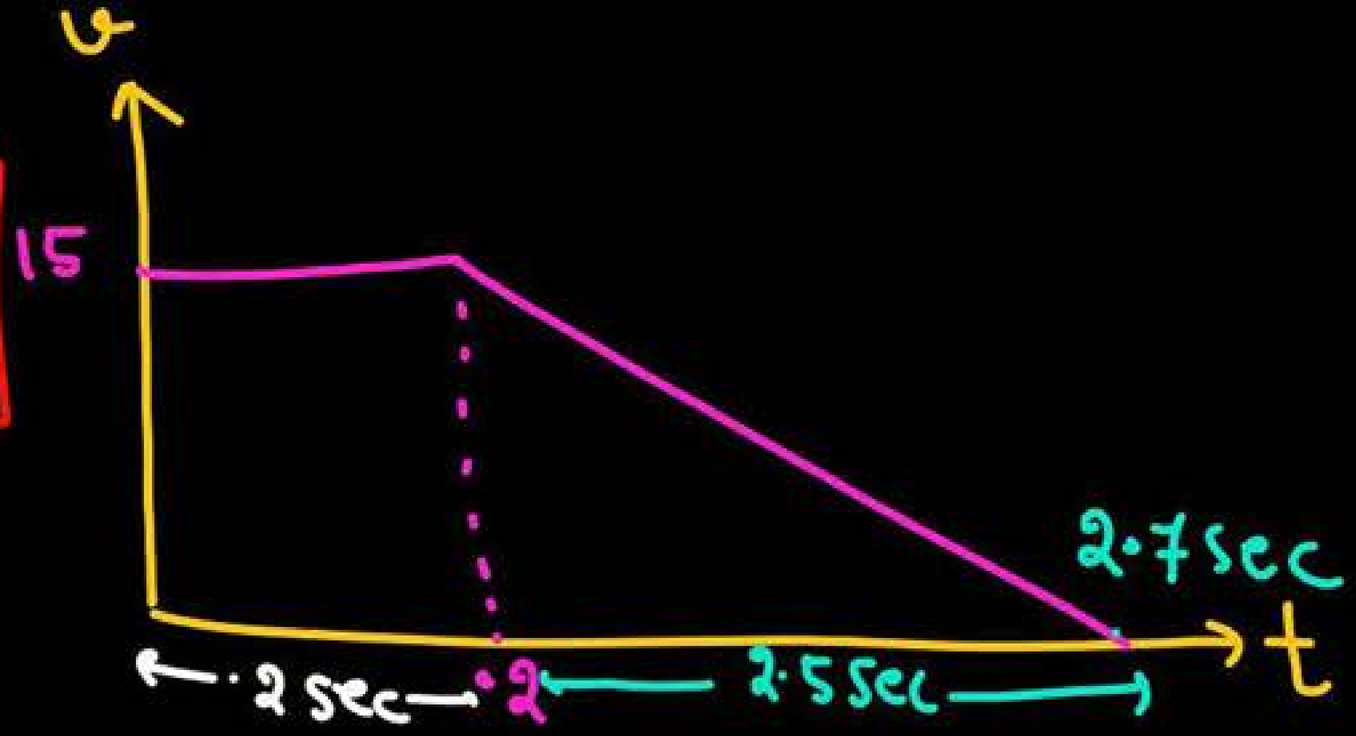
19. A driver takes 0·20 s to apply the brakes after he sees a need for it. This is called the reaction time of the driver. If he is driving a car at a speed of 54 km/h and the brakes cause a deceleration of 6·0 m/s², find the distance travelled by the car after he sees the need to put the brakes on.

$54\ km/hr = 54 \times \frac{5}{18} = 15\ m/s$

find stopping distama.

$\boxed{\text{Area} = \frac{1}{2} \times (.2 + 2.7) \times 15}$

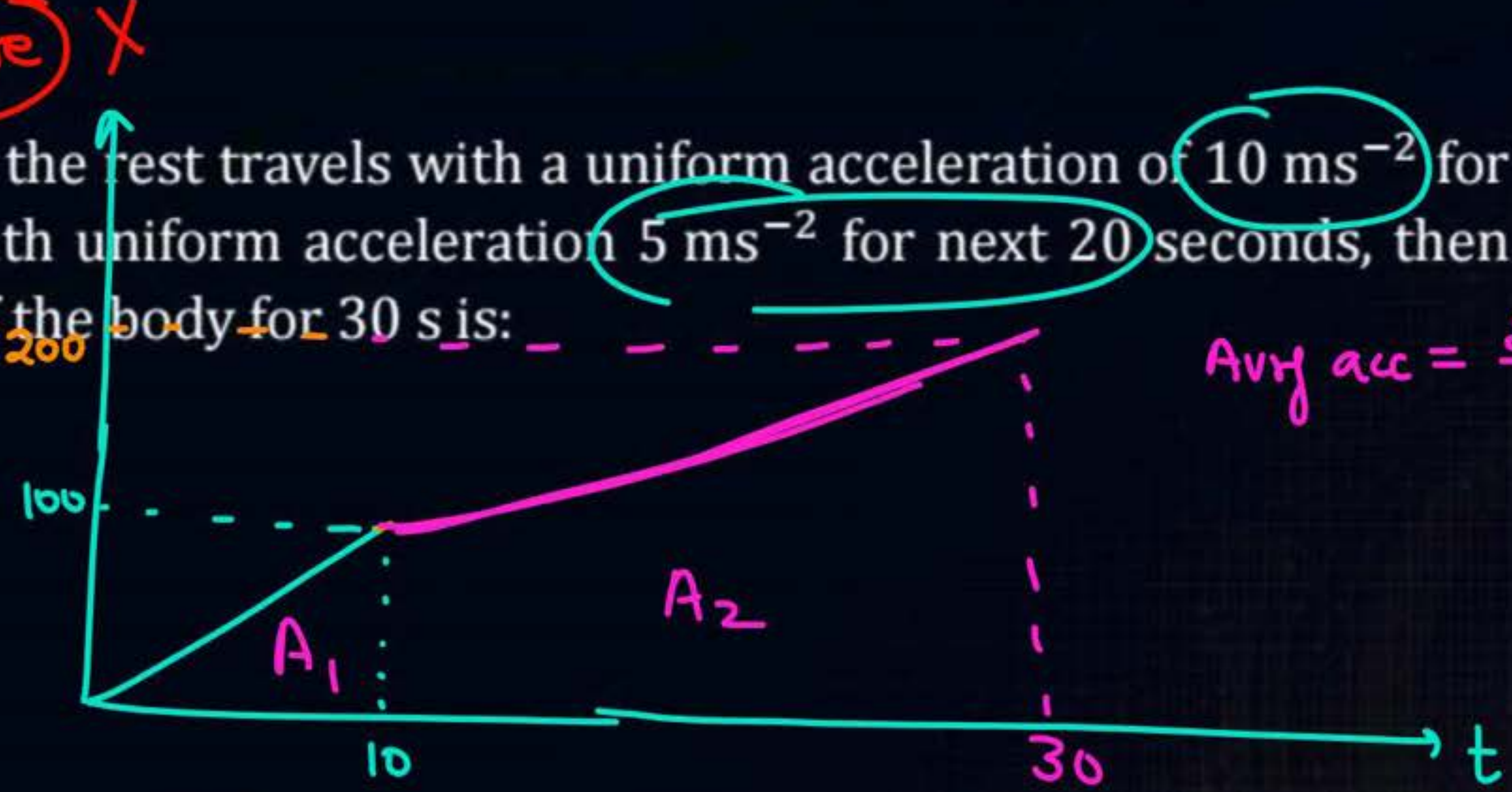
$= 21.75$



Question

Note

If a body starting from the rest travels with a uniform acceleration of $10\ ms^{-2}$ for first 10 second and with uniform acceleration $5\ ms^{-2}$ for next 20 seconds, then average acceleration of the body for 30 s is:



Avg acc $= \frac{200-0}{30}$

Displacement $= A_1 + A_2$

A $15\ ms^{-2}$

B $10\ ms^{-2}$

C $20\ ms^{-2}$

D $20/3\ ms^{-2}$

Ans : (D)

Question

notex

Rough copy

A car is moving with a velocity of 30 m/s. The driver applied brake for 5 seconds to bring it down to zero. What is the average acceleration? $= \frac{v_f - v_i}{\text{total time}} = \frac{0-30}{5}$

$= -6$

A $-5\ m/s^2$

B $6\ m/s^2$

C $-6\ m/s^2$

D ZERO

Ans : (C)

Question

Notes ✓

A truck travelling with uniform acceleration crosses two points A and B with velocities 60 m/s and 40 m/s respectively. The speed of the body at the midpoint of A and B is nearest to:

A 17 m/s

B 20 m/s

C 19.49 m/s

D 50.9 m/s

A → 60   C mid $v_c = ?$ B → 40

$\longleftarrow x \longrightarrow$

$40^2 = 1600$
$60^2 = 3600$
-2000

(A→B) $40^2 = 60^2 + 2ax \Rightarrow 2ax = -2000$

$ax = -1000$

(A→C) $v_c^2 = 60^2 + \cancel{2}a\frac{x}{\cancel{2}}$

$v_c^2 = 3600 - 1000 = 2600$

$v_c = 10\sqrt{26}$

Ans : (A)

Question Notes Both

A particle having initial velocity 10 m/s moves with a constant acceleration $5\ ms^{-2}$, for a time 15 second along a straight line, what is the displacement of the particle in the last 2 second?

A 160 m

$t=0 \longrightarrow t=15$

B 200 m

$S_{15} = 10\times15 + \frac{1}{2}5(15)^2$

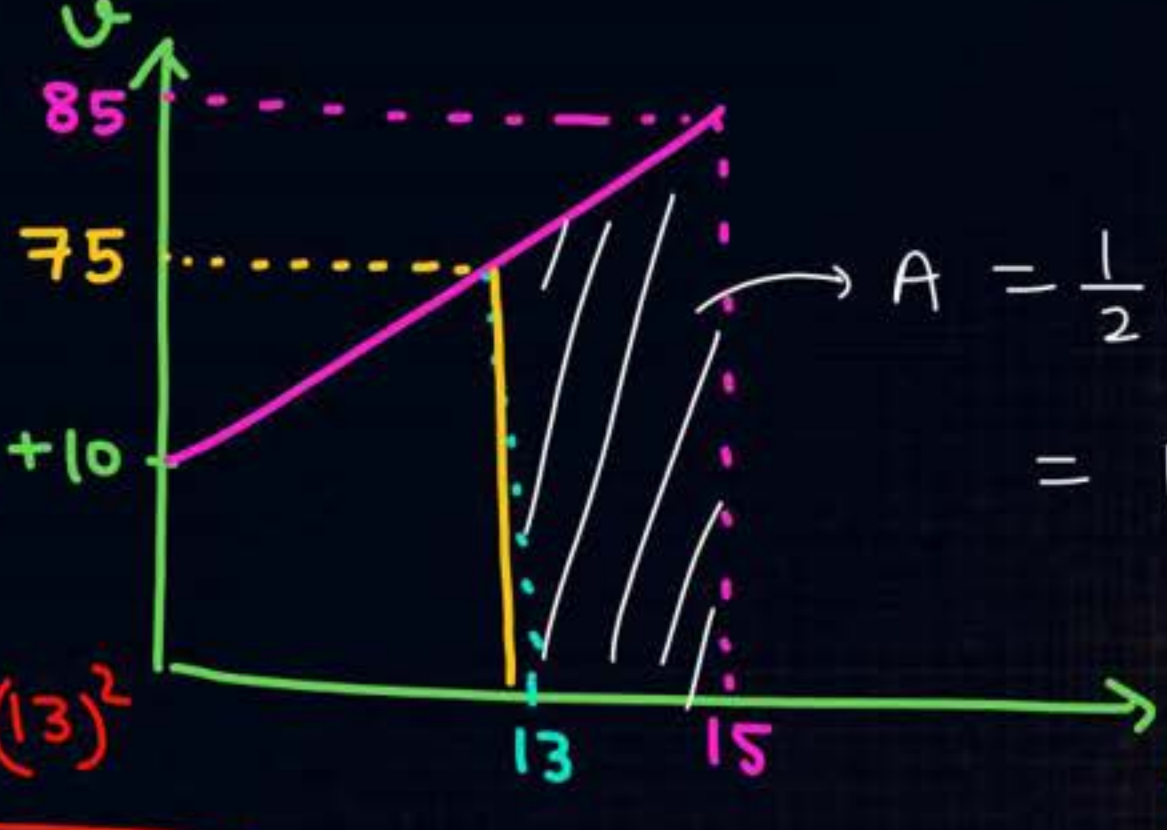
C 210 m

$S_{13} = 10\times13 + \frac{1}{2}\times5\times(13)^2$

D 230 m

Ans $S_{15}-S_{13} = 20 + \frac{5}{2}\left[15^2-13^2\right]$

$= 20+\frac{5}{2}\times28\times2 = 20+140 = 160$



$\longrightarrow A = \frac{1}{2}(75+85)2$

$= 160$

Ans : (A)

Question

Class notes

2 m/s

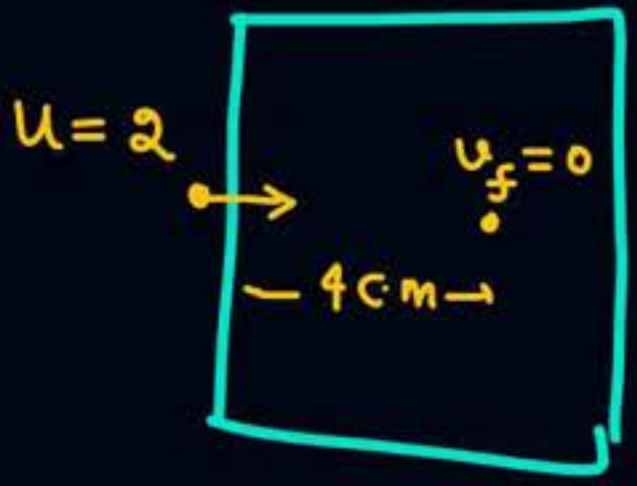
A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after travelling 4 cm inside it. What velocity is needed for travelling distance of 9 cm in same block?

A 100 cm/s

B 136.2 cm/s

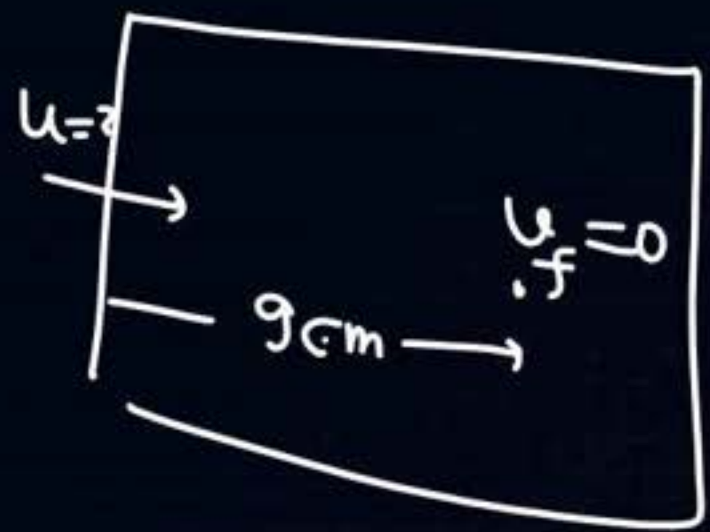
C 300 cm/s

D 250 cm/s



$$0^2 = 2^2 + 2a \times \frac{4}{100}$$

$$-4 = \frac{8}{100} a \qquad \boxed{a = -50}$$



$$0^2 = u^2 + 2as$$

$$0 = u^2 + 2 \times (-50)\left(\frac{9}{100}\right)$$

$$u^2 = 9$$

$$u = 3$$

Ans : (C)

Question

note X

$F = ma$ $\quad u = 10 \quad v_f = 0$

A car moving with a velocity of 10 m/s can be stopped by the application of a constant force F in a distance of 20m. If the velocity of the car is 30 m/s. It can be stopped by this force in

$\rightarrow a = \text{Const}$ $\quad \rightarrow S = 20$

A 20/3 m

B 20 m

C 60 m

D 180 m

$$v^2 = u^2 + 2as$$
$$0 = 10^2 + 2a \cdot 20$$
$$a = -\frac{100}{40} = -\frac{5}{2}$$

$$0^2 = 30^2 + 2 \times a \times x$$
$$0 = 900 + 2\left(-\frac{5}{2}\right)x$$
$$5x = 900$$
$$\boxed{x = 180}$$

Ans : (D)

Note

$u =$

17. A bullet going with speed 350 m/s enters a concrete wall and penetrates a distance of 5·0 cm before coming to rest. Find the deceleration.

HCV

Rough

$v_f = 0$ $a = ?$

1 min

$$0^2 = (350)^2 + 2 \times a \times \frac{5}{100}$$

$$a = -(350)^2 \times 10$$

$$\boxed{a = -1225000}$$

$$\begin{array}{r} 35 \\ 35 \\ \hline 1225 \end{array}$$

Q A particle covered 100m distance in first 10 sec. and in next 10 sec it travel 200m. find distance travel in next 10 sec. (acc is const)

300 ×

400 ×

$t=0 \longrightarrow t=10 \Rightarrow 100 = u \times 10 + \frac{1}{2} a\, 10^2$

$$\boxed{100 = 10u + 50a} \quad \text{—— (1)}$$

$t=0 \longrightarrow t=20 \Rightarrow 300 = u\,20 + \frac{1}{2} \cdot a \cdot (20)^2$

$300 = 20u + 200a$

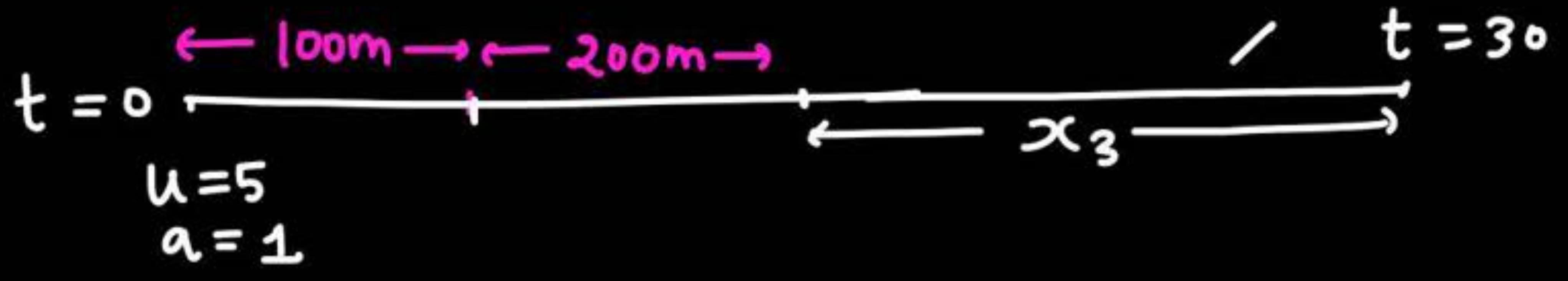
$$\boxed{150 = 10u + 100a} \quad \text{— (2)}$$

(1) − (2)

$-50 = -50a$

$$\boxed{a = 1}$$

$$\boxed{u = 5}$$



$$\boxed{t=0 \longrightarrow t=30}$$

$$300 + x_3 = ut + \frac{1}{2}at^2$$

$$300 + x_3 = 5 \times 30 + \frac{1}{2} \times 1 \times (30)^2$$

$$300 + x_3 = 150 + 450$$

$$\boxed{x_3 = 300}$$

$u=0$

A particle, after starting from rest, experiences, constant acceleration for 20 seconds. If it covers a distance of S_1, in first 10 seconds and distance S_2 in next 10 sec, then

(a) $S_2 = S_1/2$

(b) $S_2 = S_1$

(c) $S_2 = 2S_1$

(d) $S_2 = 3S_1$

$$S_1 = 0 + \frac{1}{2} \cdot a \cdot 10^2$$

$$S_1 + S_2 = 0 + \frac{1}{2} \cdot a \cdot (20)^2$$

$$\frac{S_1 + S_2}{S_1} = \frac{400}{100}$$

$$1 + \frac{S_2}{S_1} = 4$$

$$\frac{S_2}{S_1} = 3 \qquad S_2 = 3S_1$$

Q A particle travels x_1 in 1st 10 sec & x_2 in next 10 sec find distance travelled in next 10 sec. ($a \longrightarrow$ const)

$$x_1 = u \times 10 + \frac{1}{2} \cdot a \cdot 10^2$$

$$x_1 + x_2 = u \times 20 + \frac{1}{2} \cdot a \cdot 20^2$$

$\longrightarrow$ $a = \checkmark$

$u = \checkmark$

$$x_1 + x_2 + x_3 = u \times 30 + \frac{1}{2} \cdot a \cdot 30^2$$

Q A particle start motion from origin towards $+x$-axis with initial velocity $60\,m/s$ and const acc $= -10\,m/s^2$

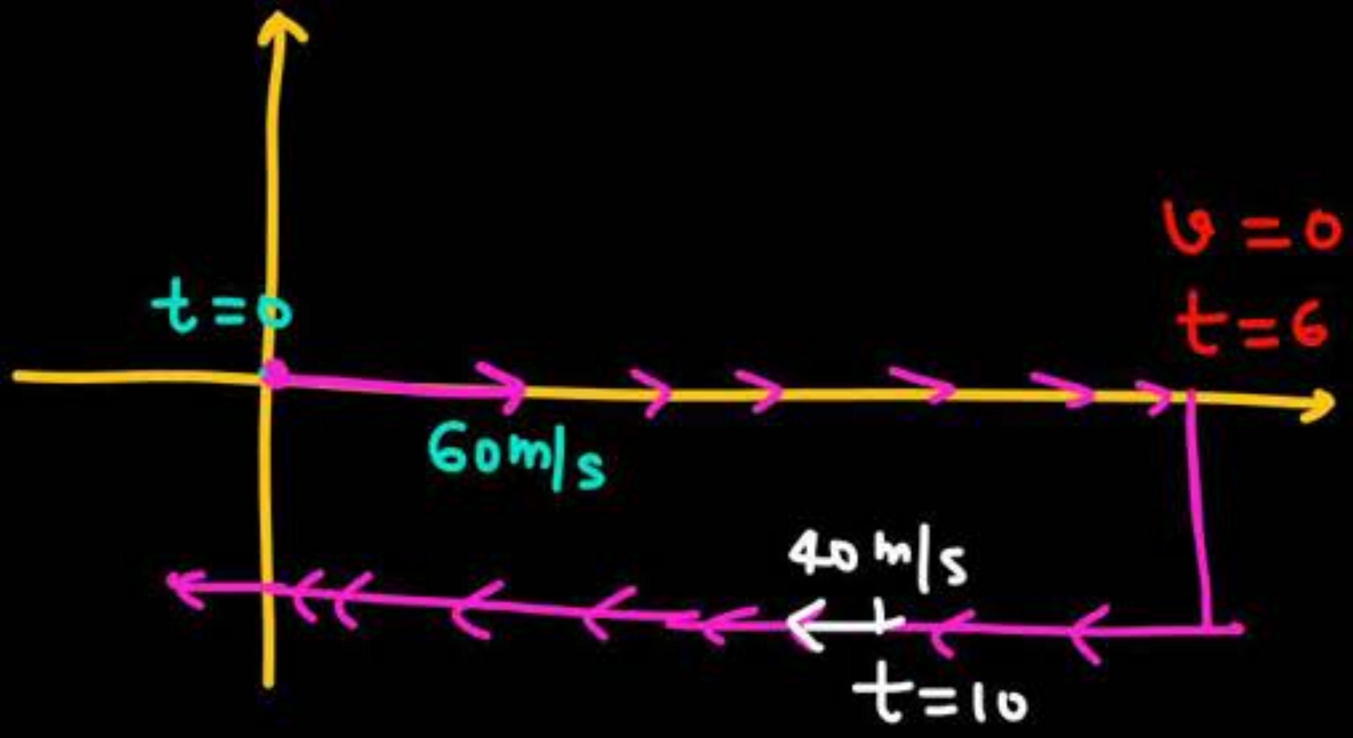
① When particle will come to at rest

$t = 6$

② find v at $t = 2$. $v = 40$

" v at $t = 10\,sec$

$v = -40$



③ Displacement in 10 sec

$$S = 60 \times 10 + \frac{1}{2} \times (-10) \times 10^2 = 600 - 500 = 100$$

A particle starts from rest at $t = 0$ and $x = 0$ to move with a constant acceleration $= +2\ m/s^2$, for 20 seconds. After that, it moves with $-4\ m/s^2$ for the next 20 seconds. Finally, it moves with positive acceleration for 10 seconds until its velocity becomes zero.

(a) What is the value of the acceleration in the last phase of motion?

(b) What is the final x-coordinate of the particle?

(c) Find the total distance covered by the particle during the whole motion.

H/W

Ans

(a) $4\ m/s^2$

(b) 200 m

(c) 1000 m

A car accelerates with uniform rate from rest on a straight road. The distance travelled in the last second of a three second interval from the start is 15 m then find the distance travelled in first second in m.

H/W

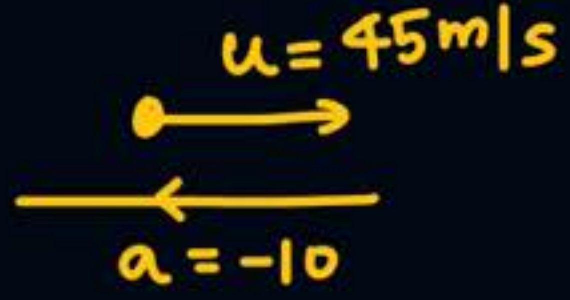
Ans → 3

A particle moving in one-dimension with constant acceleration of 10 m/s^2 is observed to cover a distance of 100 m during a 4s interval. How far will the particle move in the next 4s?

H/W

Ans 260

Q



distance travelled in 5^{th} sec.

Displacement $= A_{\text{ऊपर}} - A_{\text{नीचे}} = 0$

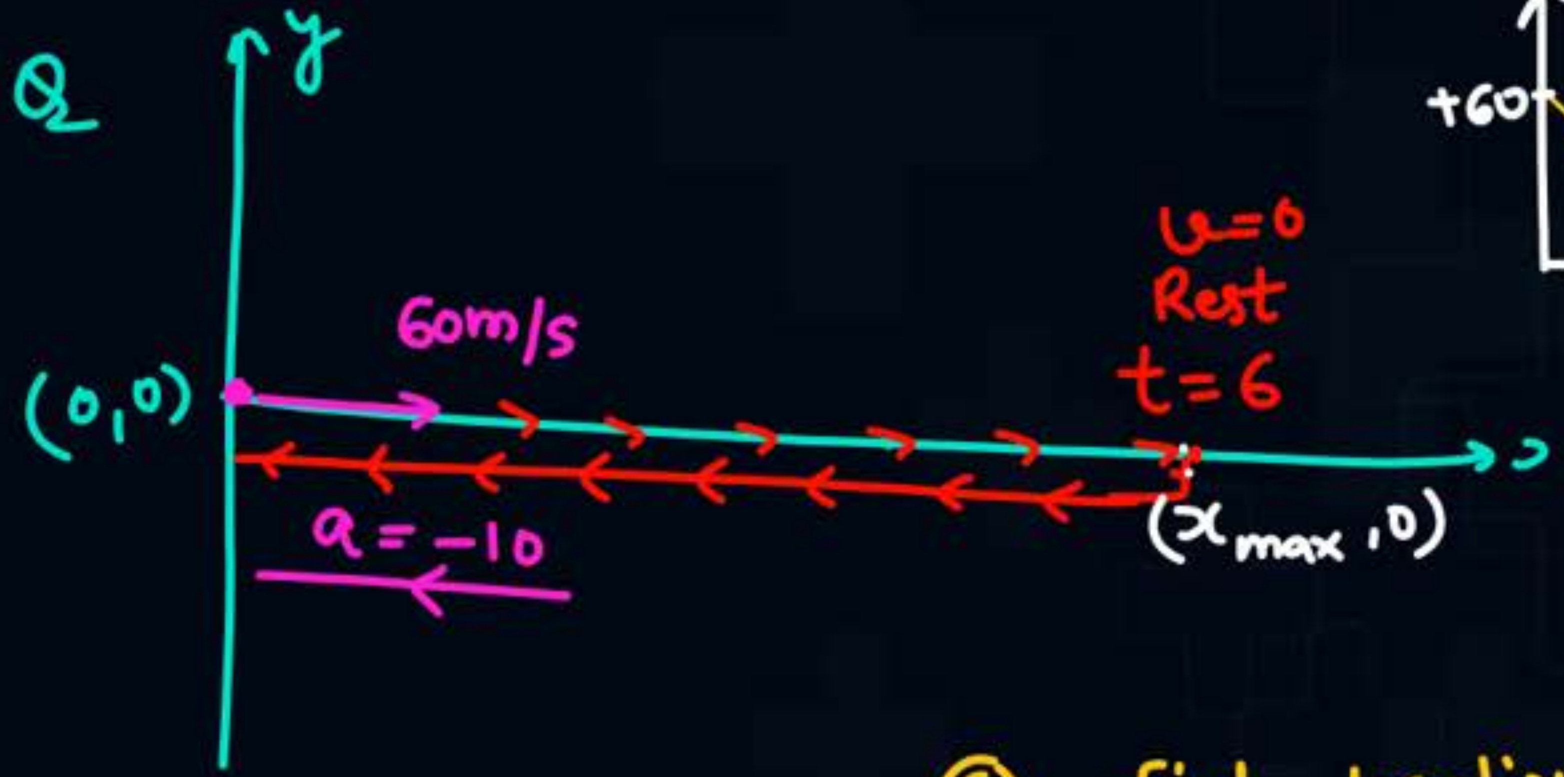
Distance $= A_{\text{ऊपर}} + A_{\text{नीचे}}$

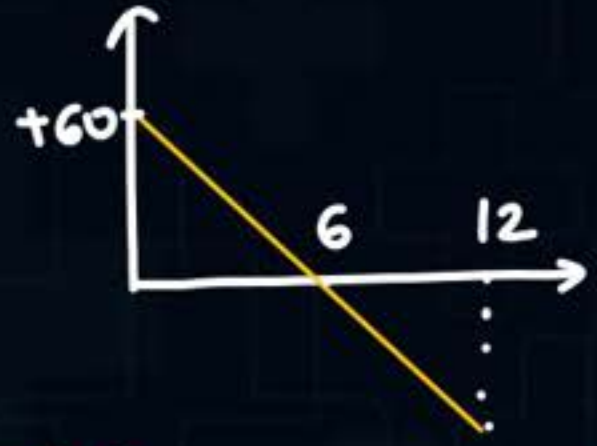
$= \frac{25}{20} + \frac{25}{20} = \frac{50}{20} = \underline{2.5}$

$A_{\text{ऊपर}} = \frac{1}{2} \times .5 \times 5 = \frac{25}{20}$

$A_{\text{नीचे}} = \frac{1}{2} \times .5 \times 5 = \frac{25}{20}$

Q





① $t=4,\ v=20$

② $t=6,\ v=0$

③ $t=8,\ v=-20$

④ $t=10,\ v=-40$

⑤ $t=12,\ v=-60$

पीछे

⑥ find location of particle at $t=4$ sec

$u=+60,\quad a=-10$

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

$x=60\times4-\frac{1}{2}\times10\times4^2$

$x=240-80=\underline{160}$

⑦ find location of particle $t=8$ sec

$x=60\times8-\frac{1}{2}\times10\times8^2$

$x=480-320=160$

⑧ find where particle comes to at rest

$x_{max}=?\qquad v_f=0$

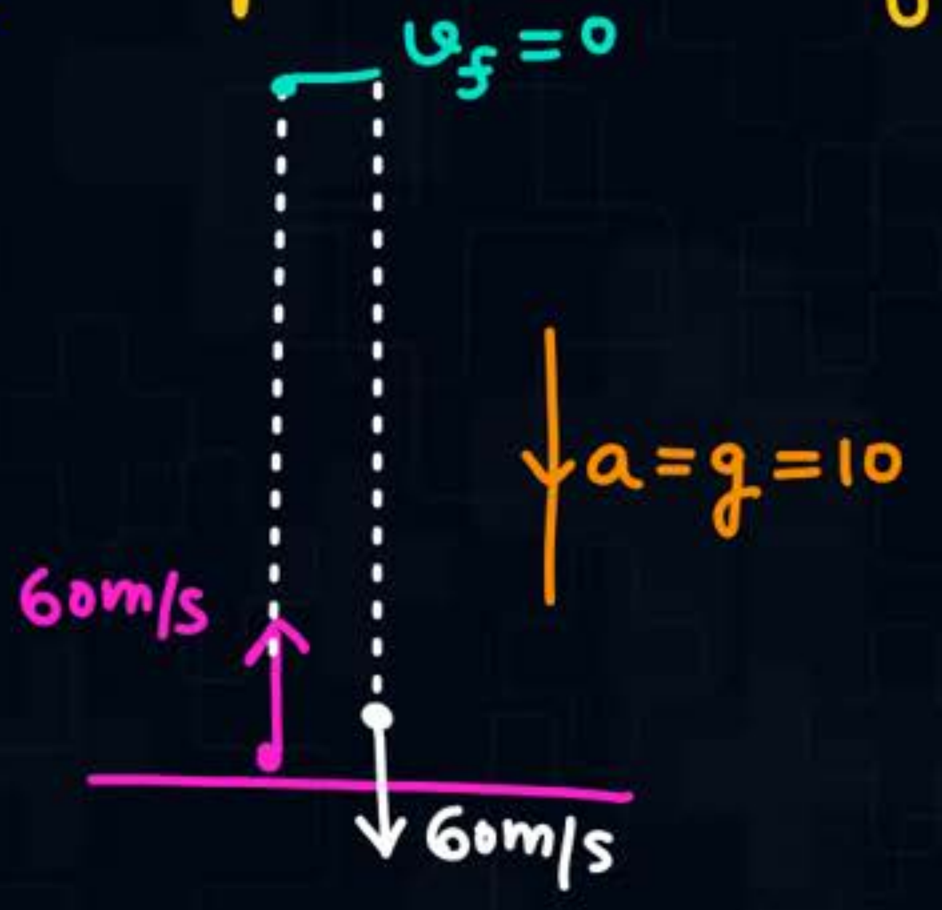
$v^2=u^2+2as$

$0=(60)^2+2(-10)x_{max}$

$\boxed{x_{max}=180}$

Q A particle is projected from ground vertically upward with velocity 60 m/s. find

(1) find velocity at $t=10$



Sign Convension

Consider Upward dir^n (+ve)

$u = 60$ ऊपर $= +60$

$a = 10$ नीचे $= -10$

(1) $t=10,\quad v = u + at = 60 + (-10)(10)$

$v = -40$

नीचे

location

$t=10$

ऊपर

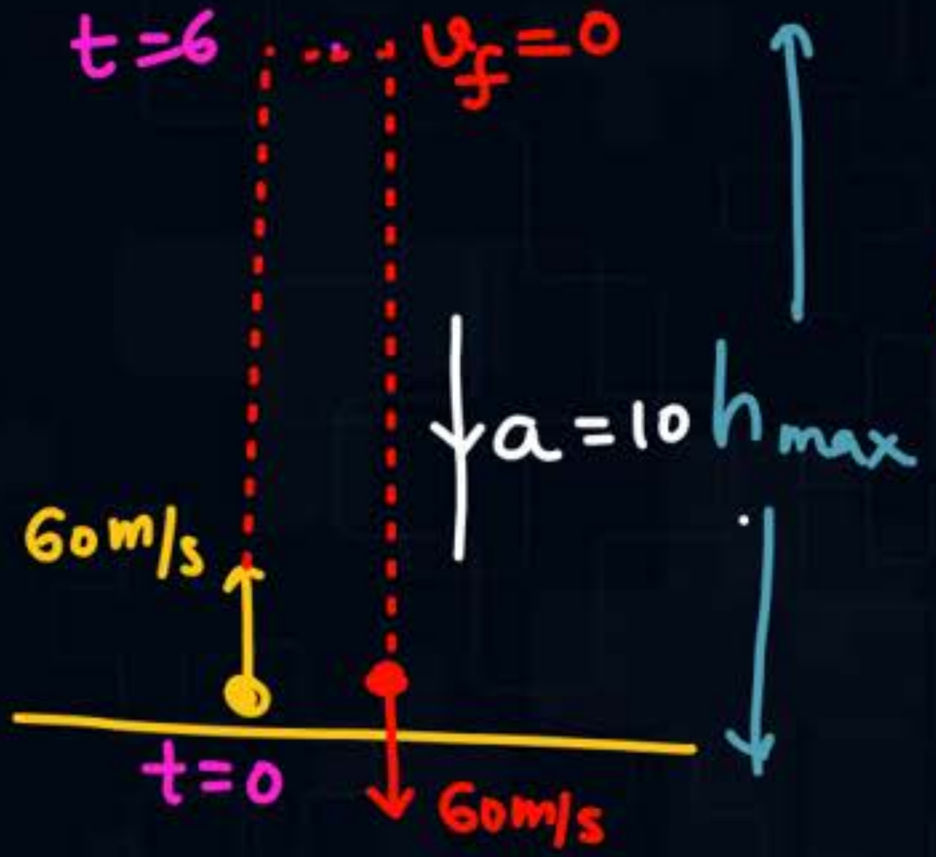
$y = 60 \times 10 + \frac{1}{2}(-10)(10)^2 = +100$

Q

① find v at

$t = 4, \quad v = 20$

$t = 11, \quad v = -50$



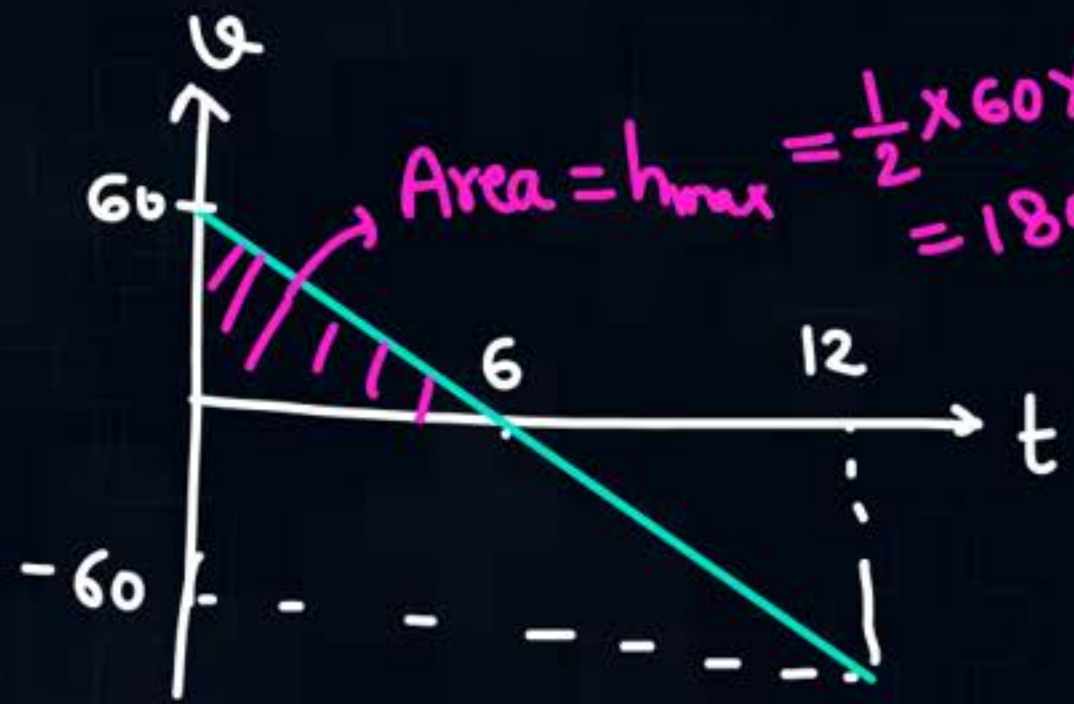
② when particle will comes to at rest $t = 6$

③ find time of flight $\Rightarrow 6 + 6 = 12$ sec

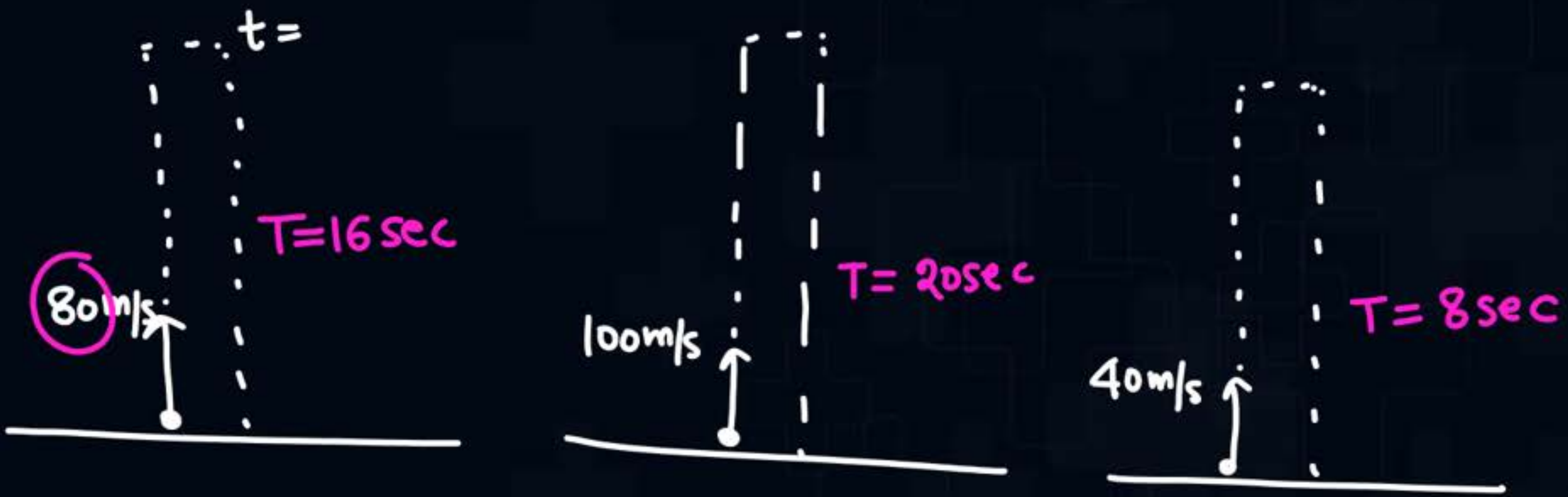
④ max height

$$0^2 = 60^2 + 2 \times (-10) h_{max}$$

$$\boxed{h_{max} = 180}$$

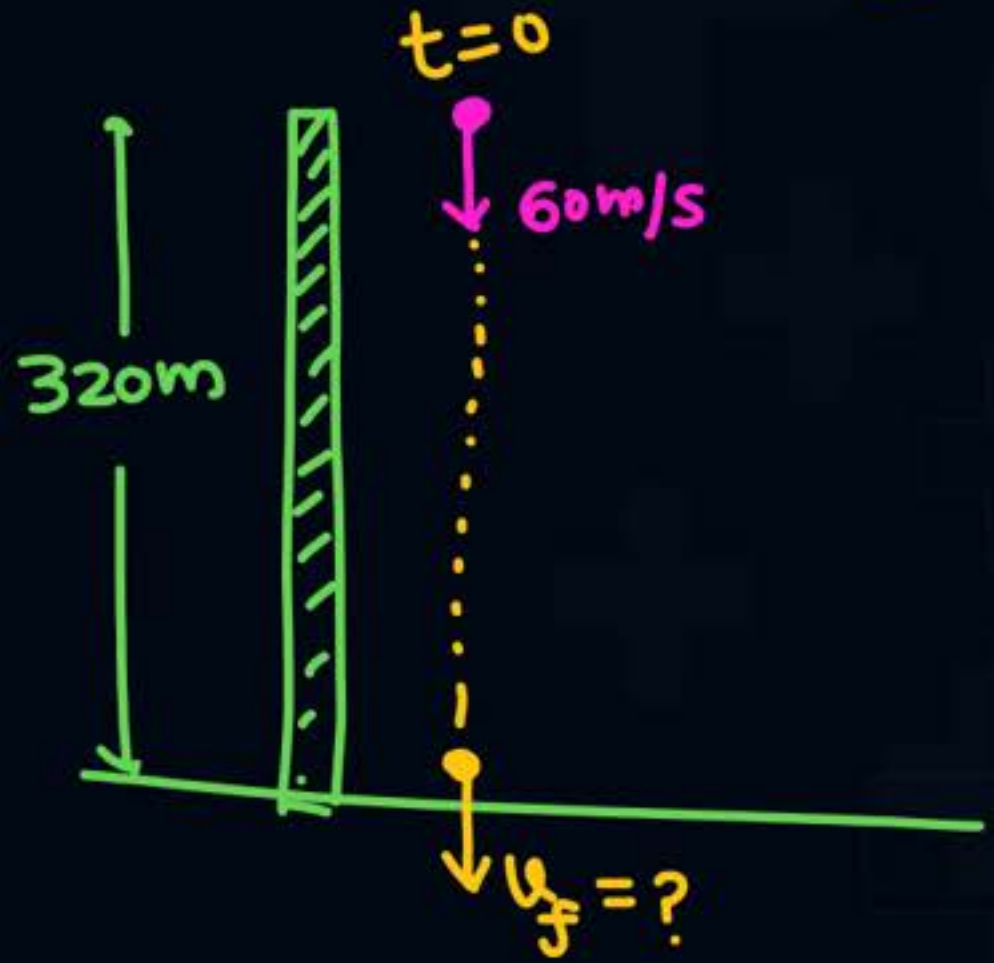


$\text{Area} = h_{max} = \frac{1}{2} \times 60 \times 6$
$= 180$



time of flight

Q



Q when particle will hit the ground & with what velocity.

नीचे ⇒ +ve (downward)

$u = +60$ $\quad a = +10$

displacement = S = नीचे 320

$S = +320$

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

$$+320 = 60t + \frac{1}{2}\times 10\times t^2$$

$$\boxed{t^2 + 12t - 64 = 0}$$

$$(t+16)(t-4) = 0$$

$$\boxed{t = 4 \text{ sec}}$$

$$v^2 = u^2 + 2as$$

$$v^2 = 60^2 + 2\times 10\times 320$$

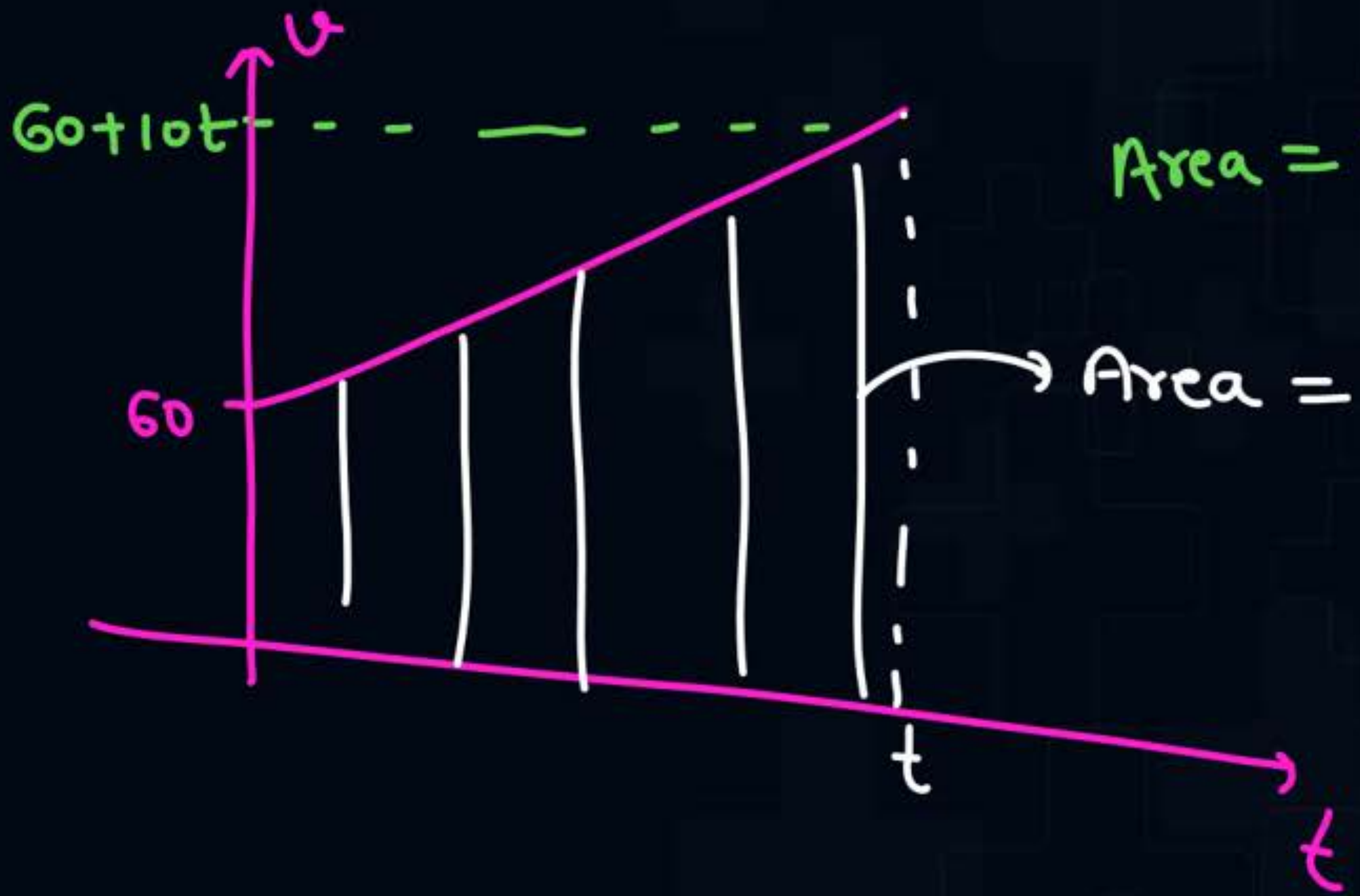
$$v^2 = 3600 + 6400$$

$$v^2 = 10000$$

$v = 100$ (नीचे)

|||

(common sense)



Area = 320

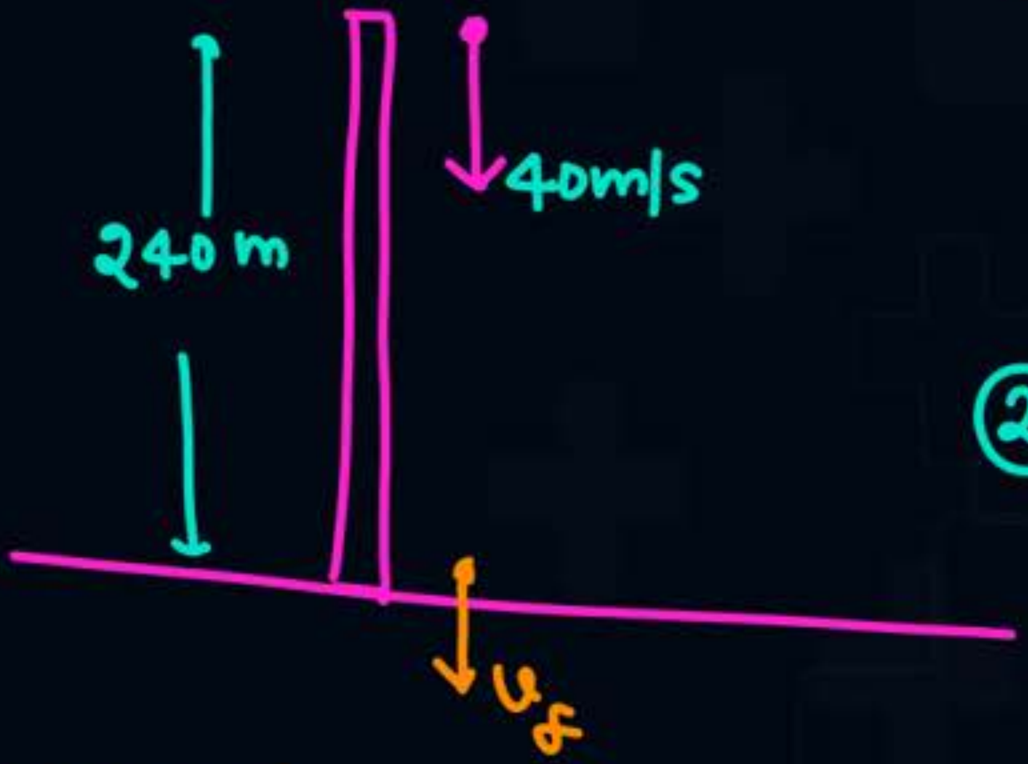
$$\text{Area} = \frac{1}{2}(60 + 60 + 10t) \times t = 320$$

$$(120 + 10t)t = 640$$

$$10t^2 + 120t = 640$$

$$t^2 + 12t - 64 = 0$$

Q



downward ≡ +ve

$u = +40$

$a = +10$

$S = +240$

① velocity of particle before it hit the ground

$v^2 = (40)^2 + 2 \times 10 \times 240$

$v = 80$ (नीचे)

② when particle will hit the ground.

$S = ut + \frac{1}{2} a t^2$

$240 = 40t + \frac{1}{2} \times 10 \times t^2$

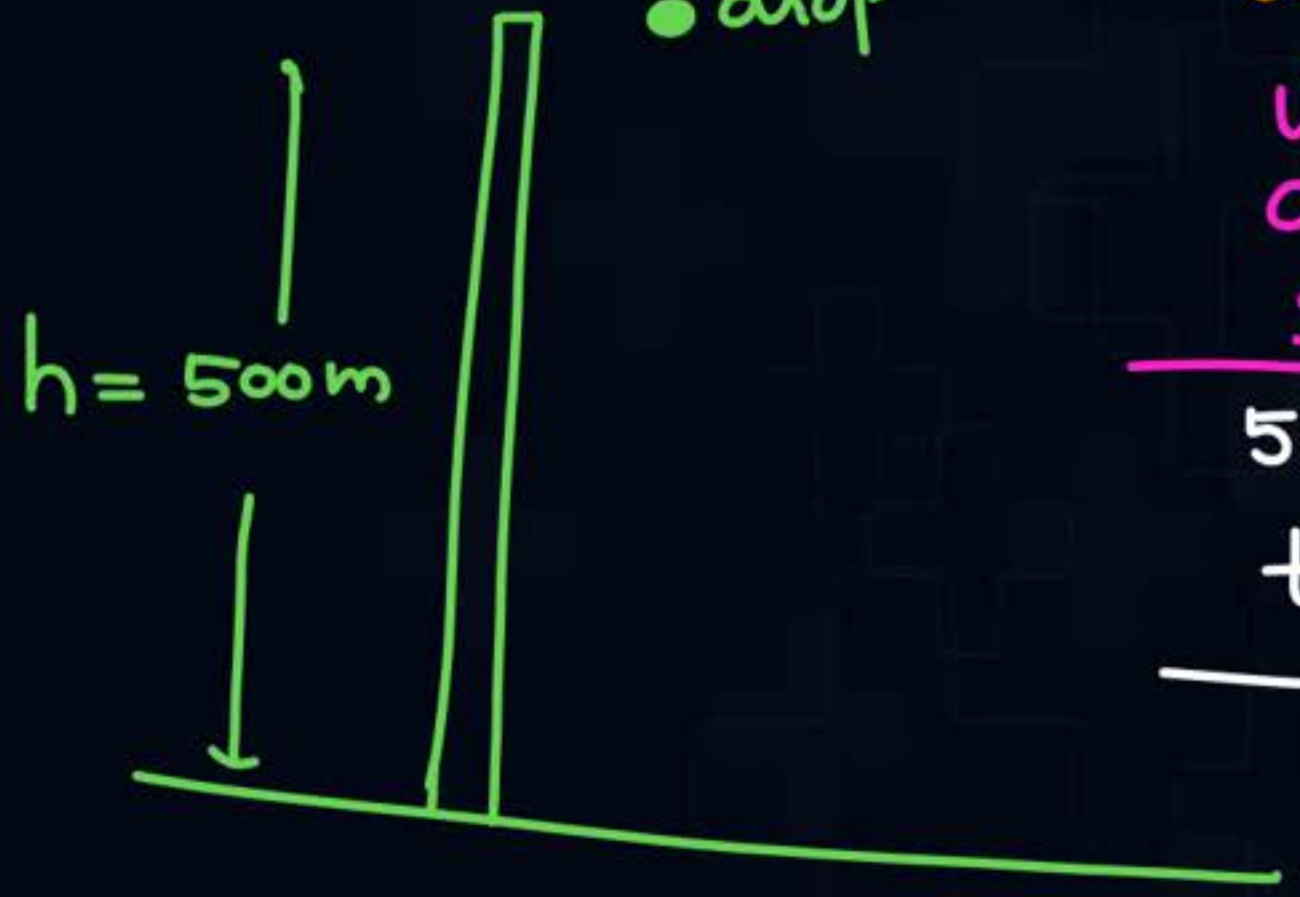
$5t^2 + 40t - 240 = 0$

$t^2 + 8t - 48 = 0$

$(t+12)(t-4) = 0$

$\boxed{t = 4}$ ✓

Q note ✓



When it will hit the ground

$u = 0$
$a = +10$ (downward $\longrightarrow$ +ve)
$S = +500$

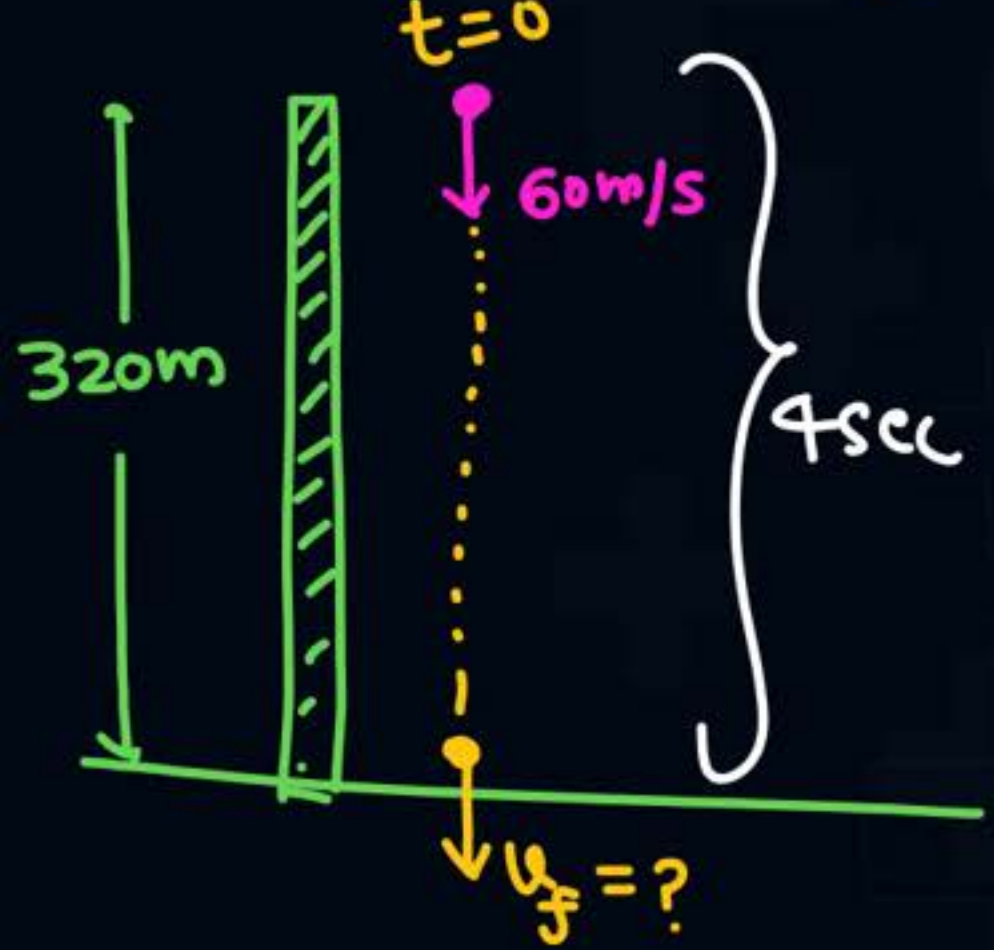
$500 = 0 + \frac{1}{2} \times 10 \times t^2$

$t = \sqrt{\frac{1000}{10}} = 10\,\text{sec}$

$v_f^2 = 0^2 + 2 \times 10 \times 500$

$\boxed{v_f = 100}$

Q



Q when particle will hit the ground & with what velocity.

नीचे ⇒ +ve (downward)

$u = +60 \qquad a = +10$

displacement = S = नीचे 320

$S = +320$

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

$+320 = 60t + \frac{1}{2} \times 10 \times t^2$

$$\boxed{t^2 + 12t - 64 = 0}$$

$(t+16)(t-4) = 0$

$$\boxed{t = 4 \text{ sec}}$$

$v^2 = u^2 + 2as$

$v^2 = 60^2 + 2 \times 10 \times 320$

$v^2 = 3600 + 6400$

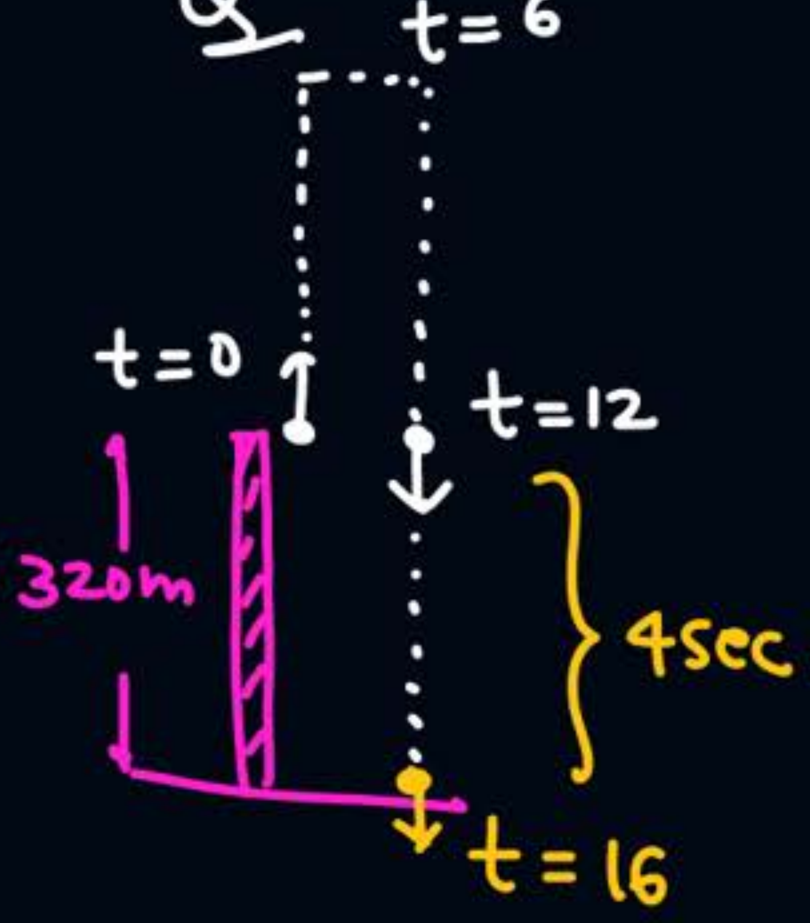
$v^2 = 10000$

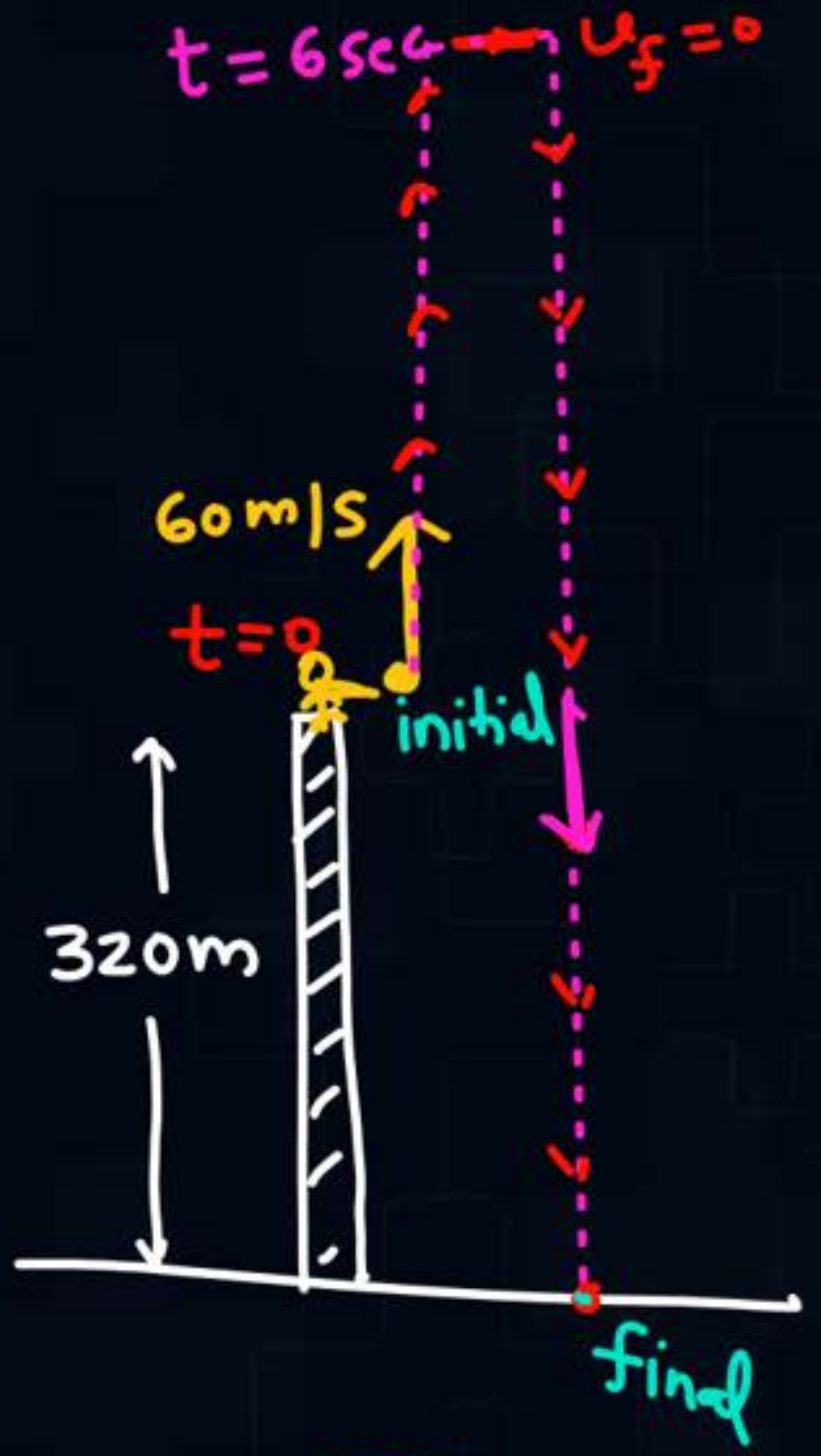
$v = 100$ (नीचे)

|||

(Common sense)

Q





$$\boxed{t = 16 \text{ sec}}$$

when it will hit the ground.

ऊपर → +ve

$u =$ ऊपर $60 = +60$

$a =$ नीचे $g = -10$

$S =$ नीचे $320 = -320$

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

$$-320 = 60t - \frac{1}{2}\times 10 \times t^2$$

$$5t^2 - 60t - 320 = 0$$

$$t^2 - 12t - 64 = 0$$

$$(t-16)(t+4) = 0$$

कल practice

Q

① find the time when particle will hit the ground

② " " velocity just before particle hit the ground

upward (positive) ऊपर +ve

$u = +40$

$a = -10$

$s = -240$

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

$-240 = 40t + \frac{1}{2}\cdot(-10)t^2$

$5t^2 - 40t - 240 = 0$

$t^2 - 8t - 48 = 0$

$(t-12)(t+4) = 0$

$\boxed{t = 12 \text{ Ans}}$

$v^2 = u^2 + 2as$

$= (40)^2 + 2\times(-10)(-240)$

$\boxed{v = 80}$

Q

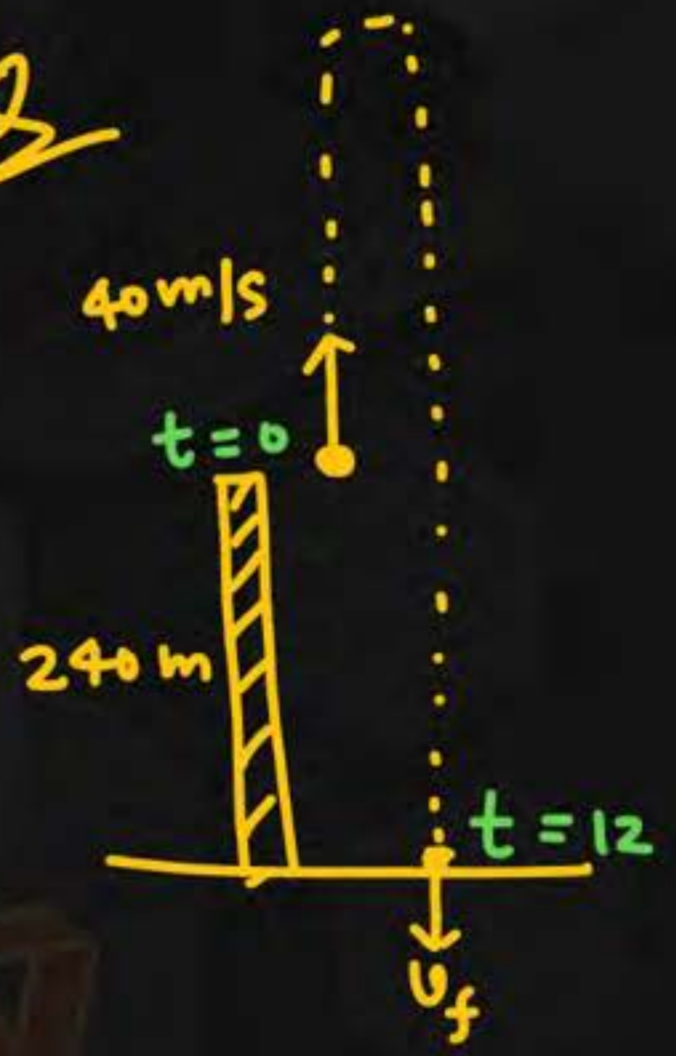
$$s = ut + \frac{1}{2}at^2$$

$$-270 = 50t - \frac{1}{2}\times 10\times t^2$$

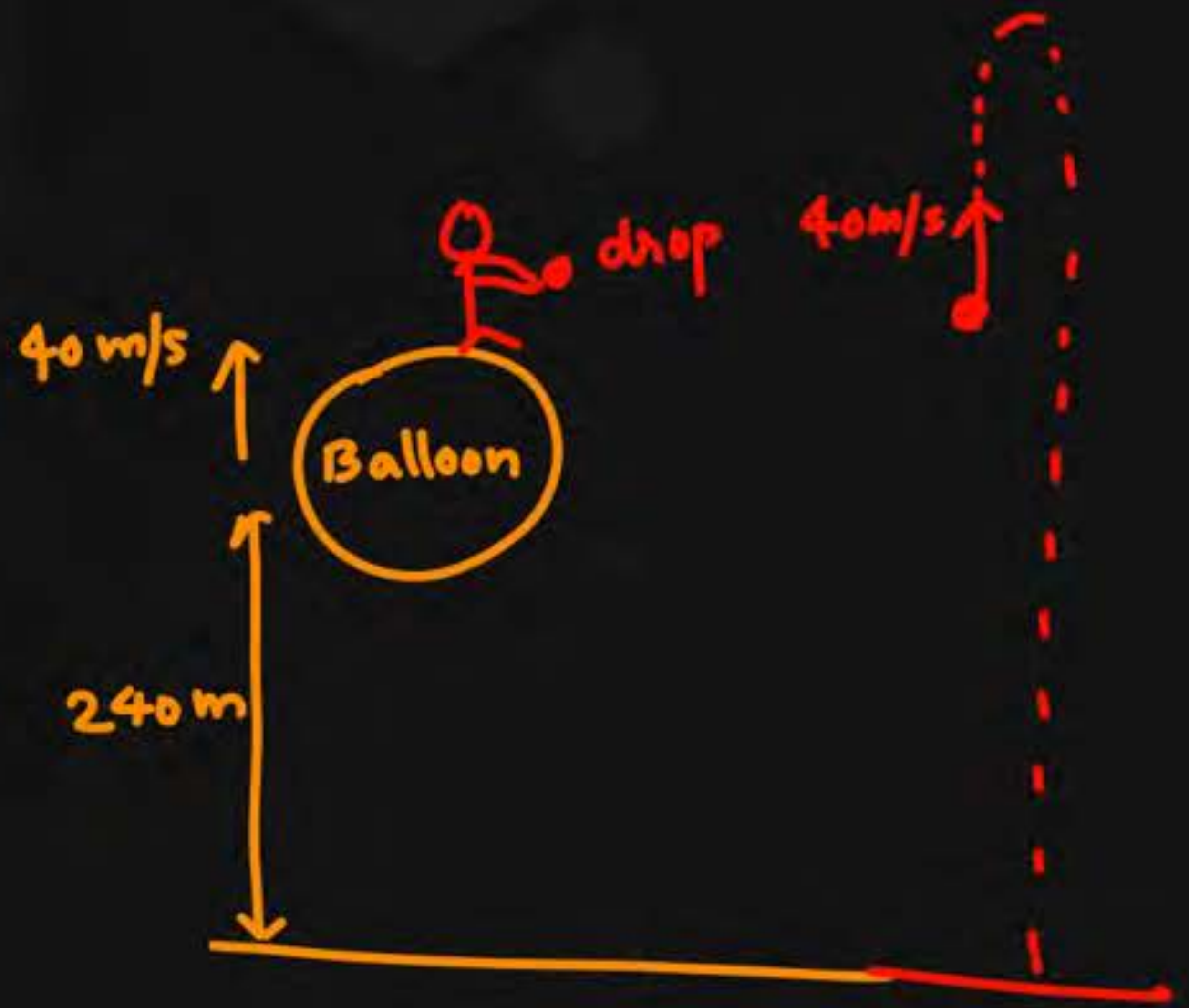
solve quadratic

$$v_f^2 = (50)^2 + 2(-10)(-270)$$

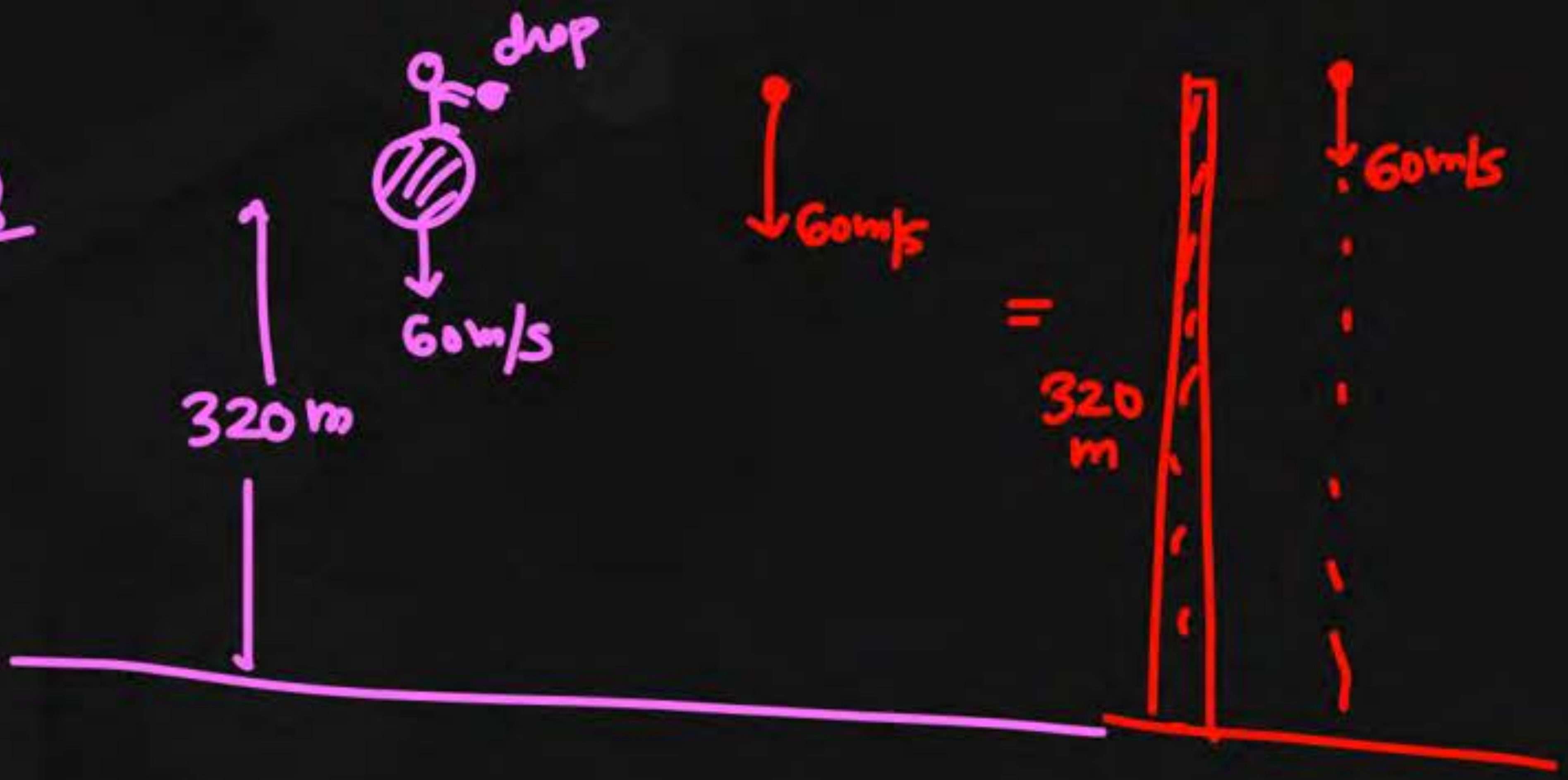
Q



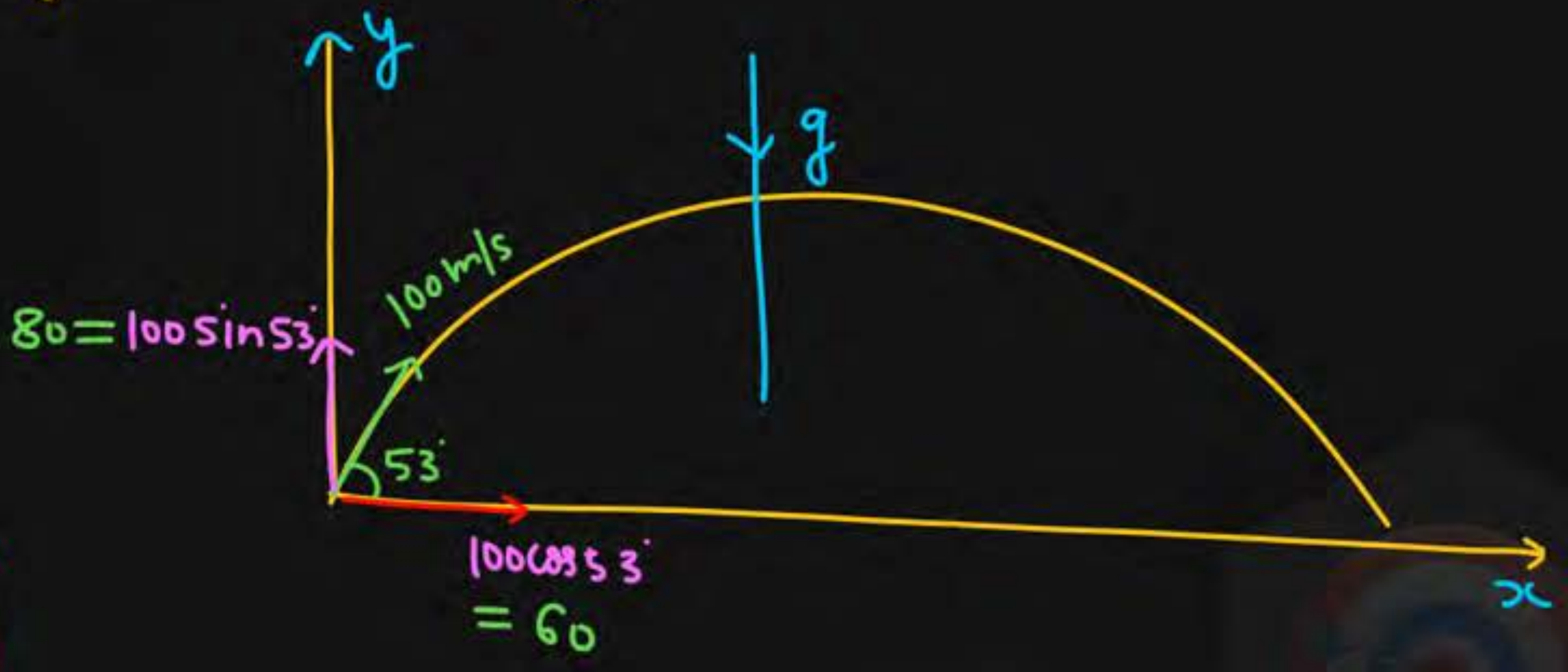
⇛



Q



Q A particle is projected with velocity 100 m/s at angle of 53° with the horizonal.



(a) Find initial velocity

$$\vec{u} = 60\hat{i} + 80\hat{j}$$

(b) $\vec{a} = g$ नीचे

$$\vec{a} = -g\hat{j} = -10\hat{j}$$

$$\vec{a} = 0\hat{i} - 10\hat{j}$$

$$\vec{a}_x = 0$$

(c) Find time of flight

$T = 8 + 8 = 16$ sec

(d) Range $= 60 \times 16 = 960$

(e) find velocity at

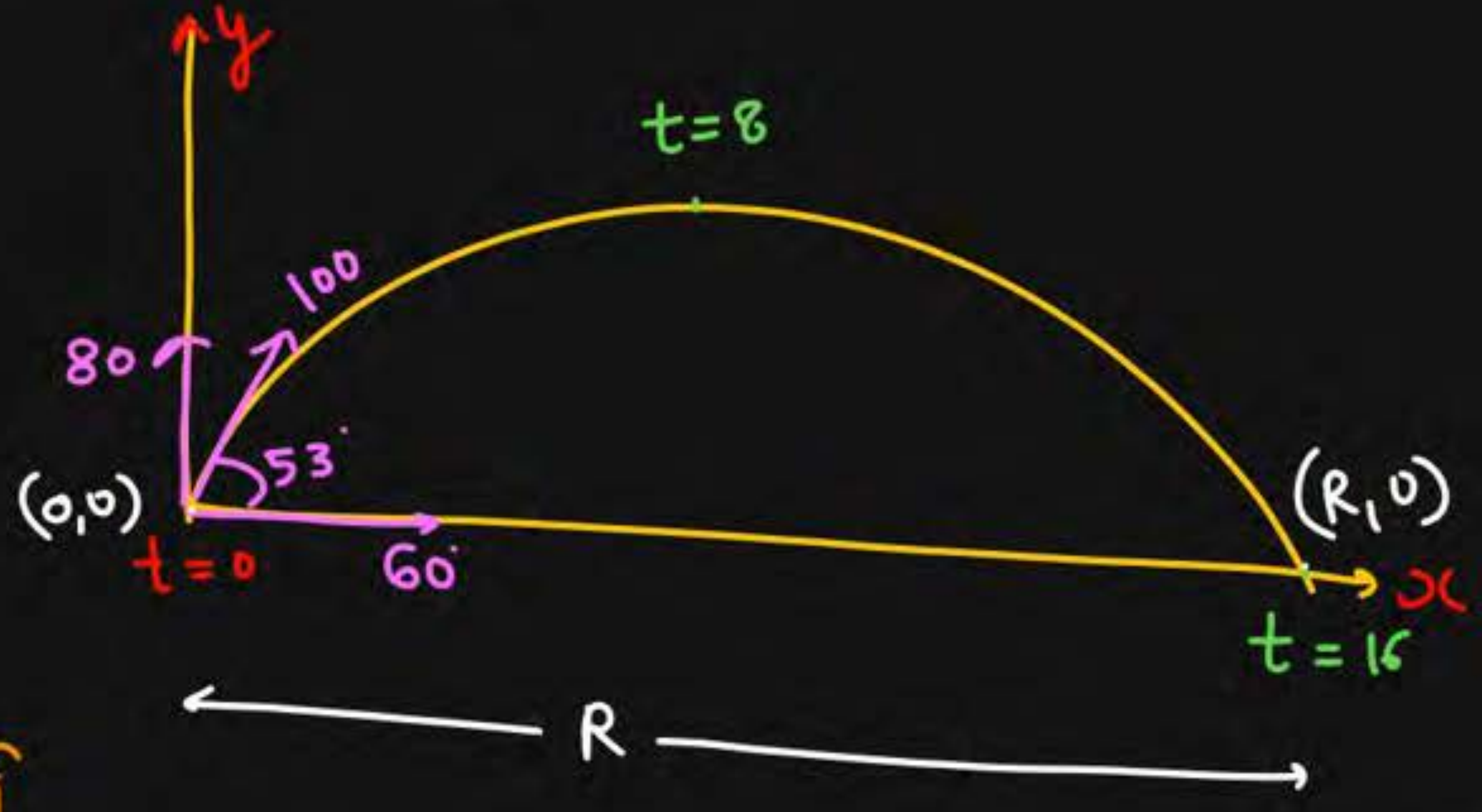
$t = 2 \quad \vec{v} = 60\hat{i} + 60\hat{j}$

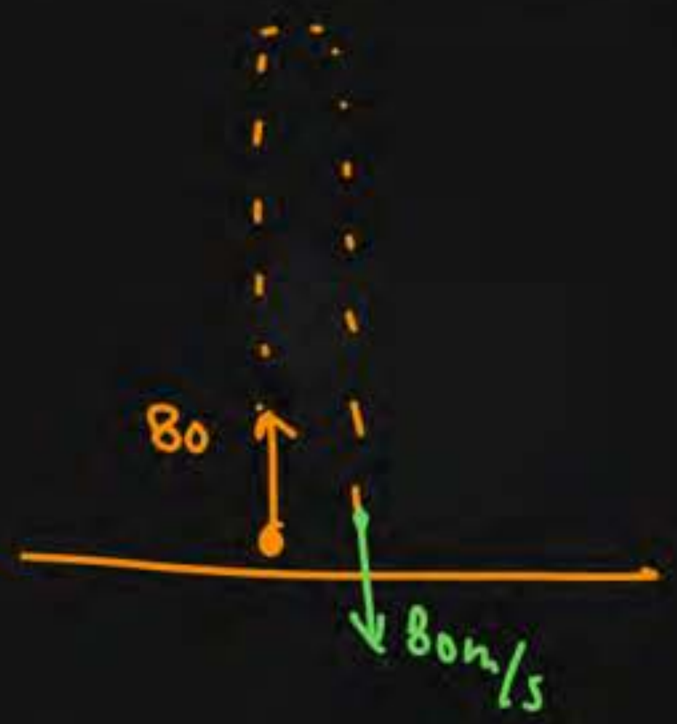
$t = 8 \quad \vec{v} = 60\hat{i} + 0\hat{j}$

$t = 10 \quad \vec{v} = 60\hat{i} - 20\hat{j}$

$t = 16^{-} \quad \vec{v} = 60\hat{i} - 80\hat{j}$

just before it hit the gr





$\vec{P} = \text{momentum} = m\vec{v}$

(f) find change in momentum for entire motion ($m = 1\,kg$)

$$\Delta\vec{P} = \vec{P_f} - \vec{P_i}$$

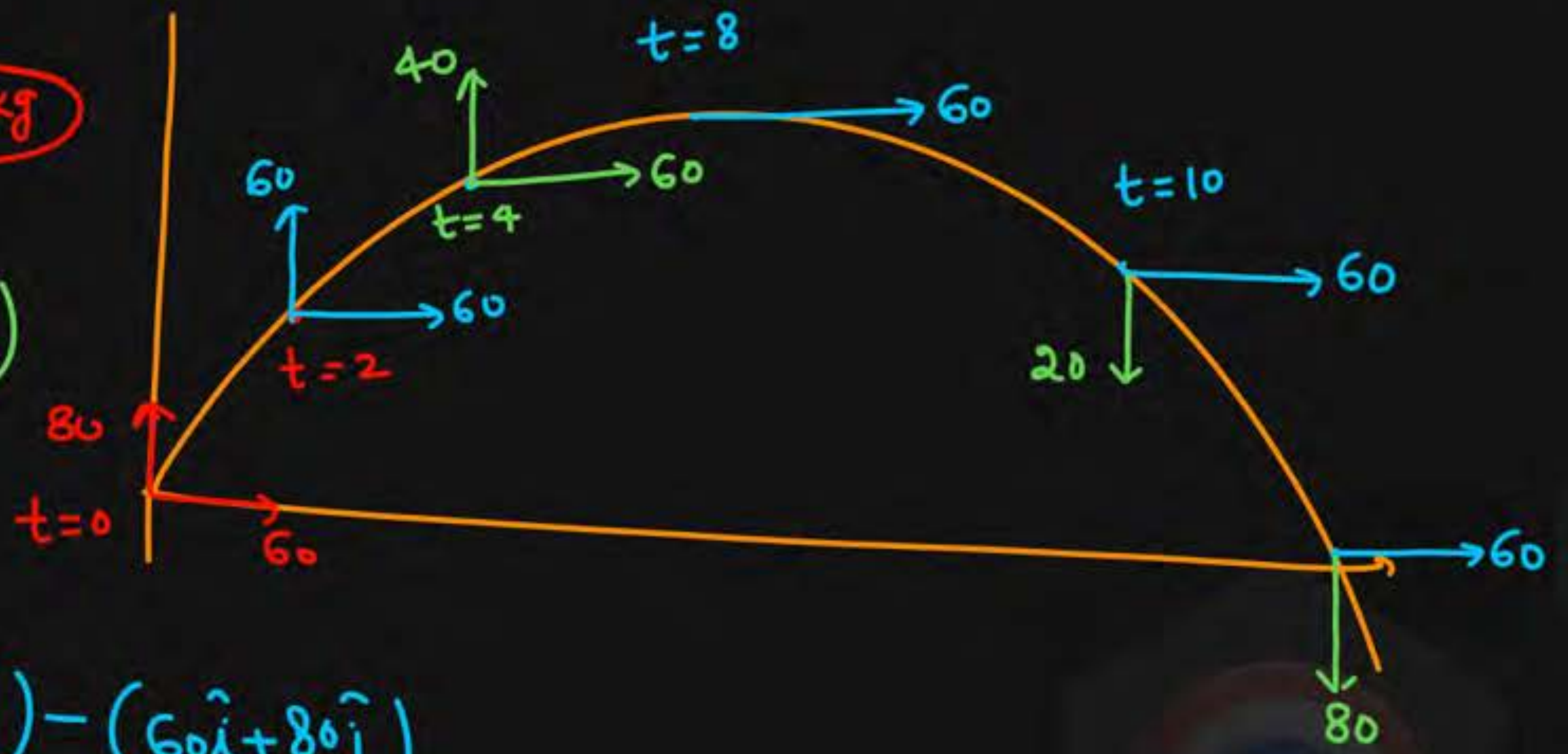
$$\vec{P_i} = m\vec{v_i} = 1(60\hat{i} + 80\hat{j})$$

$$= 60\hat{i} + 80\hat{j}$$

$$\vec{P_f} = 60\hat{i} - 80\hat{j}$$

$$\Delta\vec{P} = \vec{P_f} - \vec{P_i} = (60\hat{i} - 80\hat{j}) - (60\hat{i} + 80\hat{j})$$

$$= -160\hat{j}$$

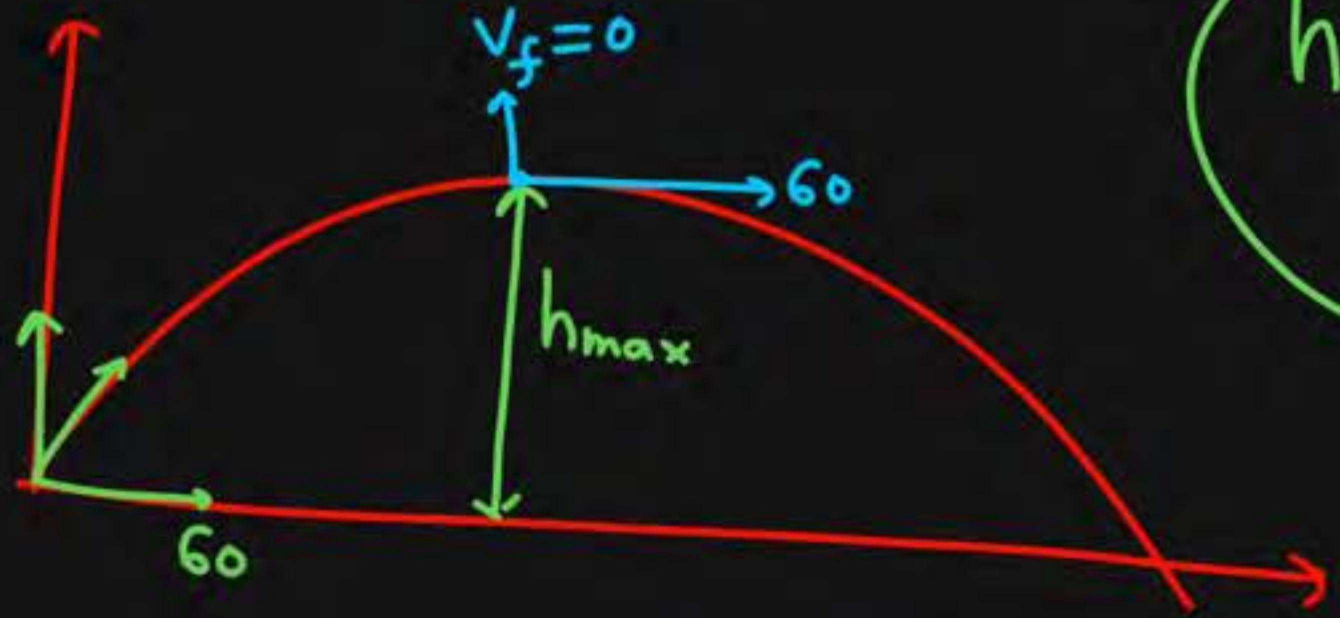


(g) find h_{max}

(y) $v^2 = u^2 + 2as$

$0^2 = (80)^2 + 2(-10)(h_{max})$

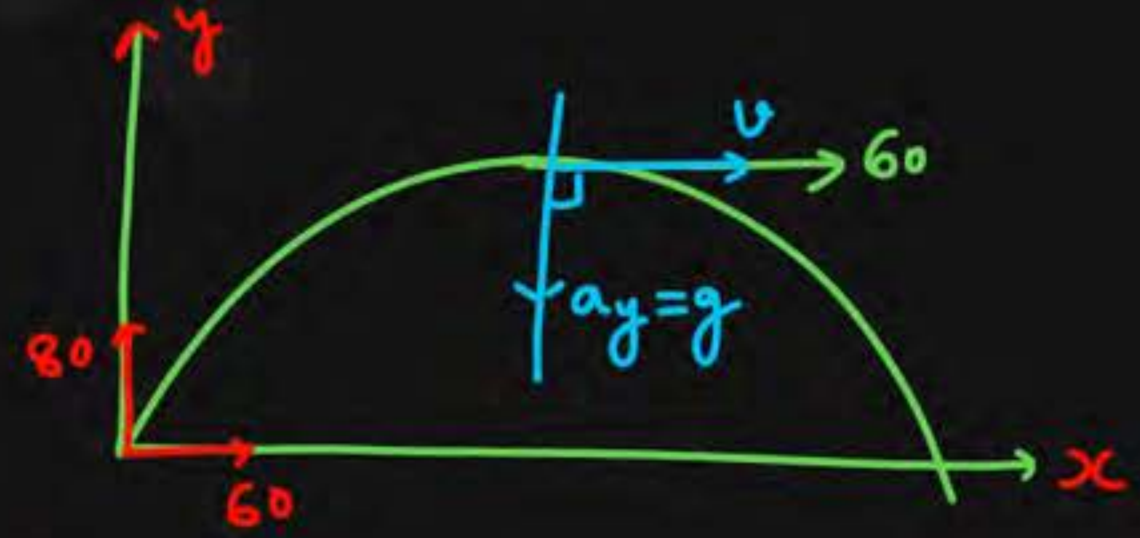
$\boxed{h_{max} = 320}$



h_{max} के लिए
3rd eqn of motion
y में

(h) find $\vec{v}$ at any time 't'

$$\vec{v} = 60\hat{i} + (80 - 10t)\hat{j}$$



(i) find when $\vec{v}$ become perpendicular to $\vec{a}$

$$\vec{v} \cdot \vec{a} = 0$$

$$\vec{v} = 60\hat{i} + (80 - 10t)\hat{j}$$

$$\vec{a} = -10\hat{j}$$

$$\vec{v} \cdot \vec{a} = -10(80 - 10t) = 0$$

$$t = 8 \text{ sec}$$

(y) $v = u + at$

$$\vec{v}_y = 80 - 10t$$

(j) Find the time when velocity of particle become perpendicular to initial velocity.

$$\vec{u} = 60\hat{i} + 80\hat{j}$$

$$\vec{v}_f = 60\hat{i} + (80-10t)\hat{j}$$

$$\vec{v}\cdot\vec{u} = 0$$

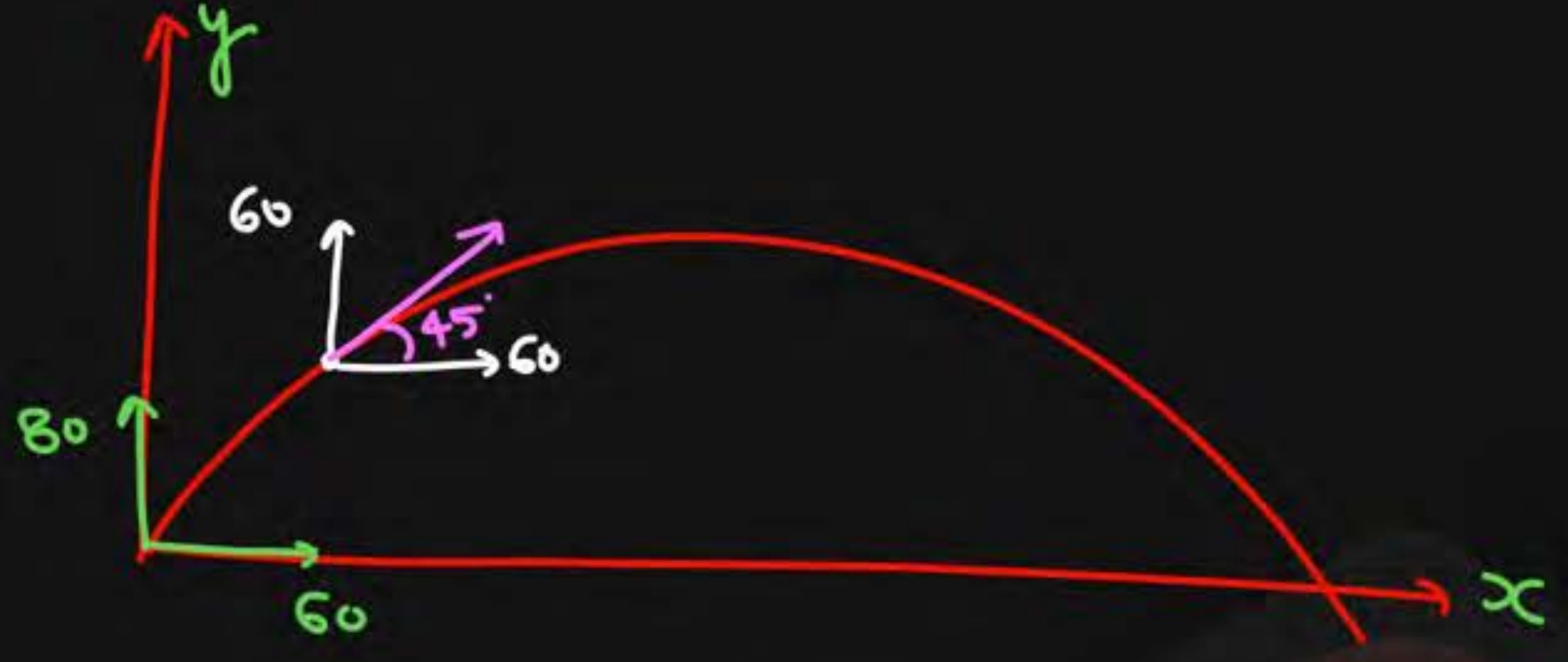
$$60\times 60 + 80(80-10t) = 0$$

$$3600 + 6400 - 800t = 0$$

$$t = \frac{10000}{800} = \frac{100}{8} = 12.5$$

(k) find the angle made by velocity with horizontal at $t = 2$ sec

$t=2, \quad \vec{v} = 60\hat{i} + 60\hat{j}$



$\tan\alpha = \frac{60}{60} = 1$

$\boxed{\alpha = 45^\circ}$

Or direction cosine $\cos\alpha = \frac{A_x}{A} = \frac{60}{60\sqrt{2}} = \frac{1}{\sqrt{2}}$

$\alpha = 45^\circ$

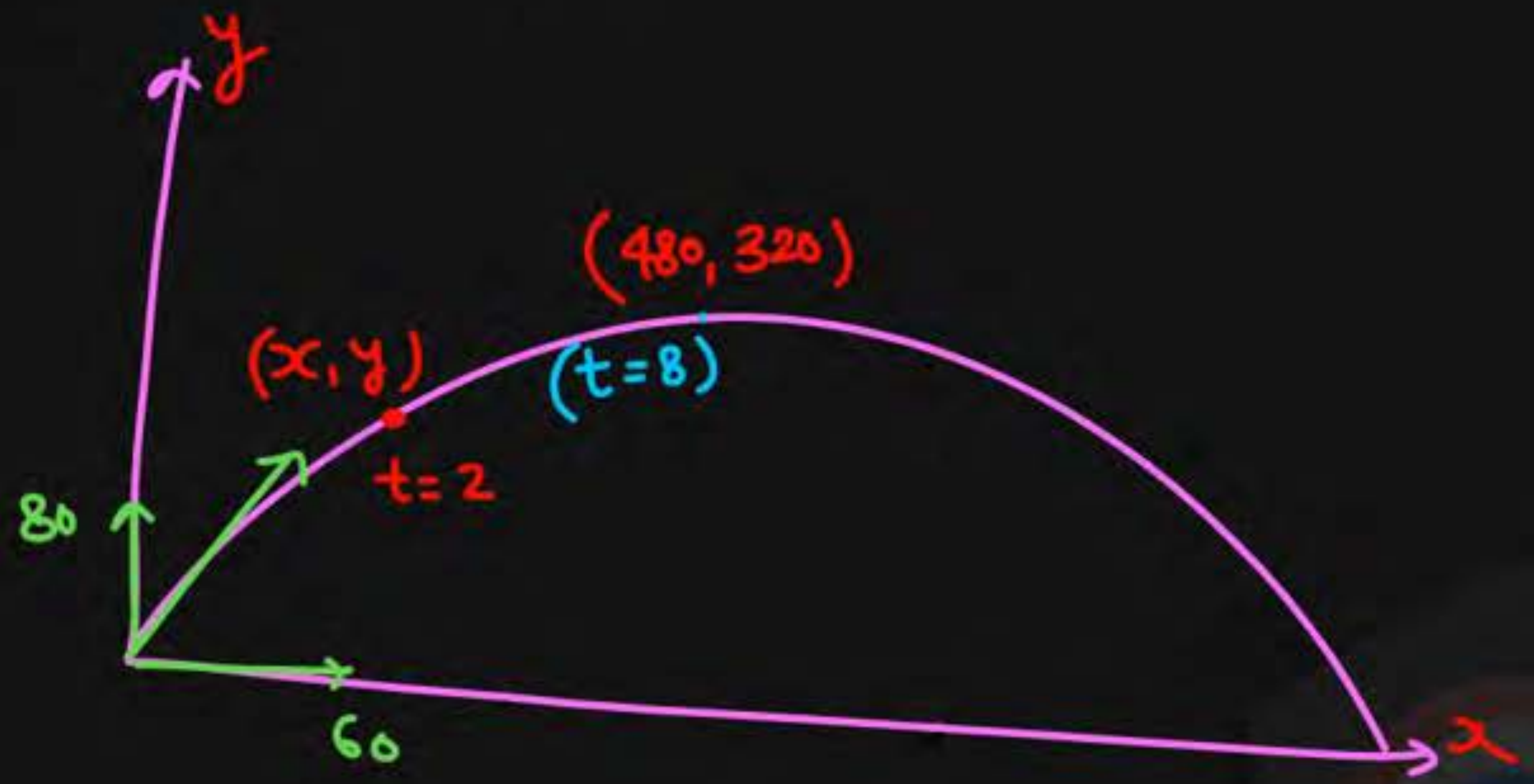
(l) find location of particle at $t=2$, $t=8$ sec

$x = 60\times 2 = 120$

$y = 80\times 2 - \frac{1}{2}\times 10\times 2^2$

$= 160 - 20 = 140$

$(x, y) \Rightarrow (120, 140)$



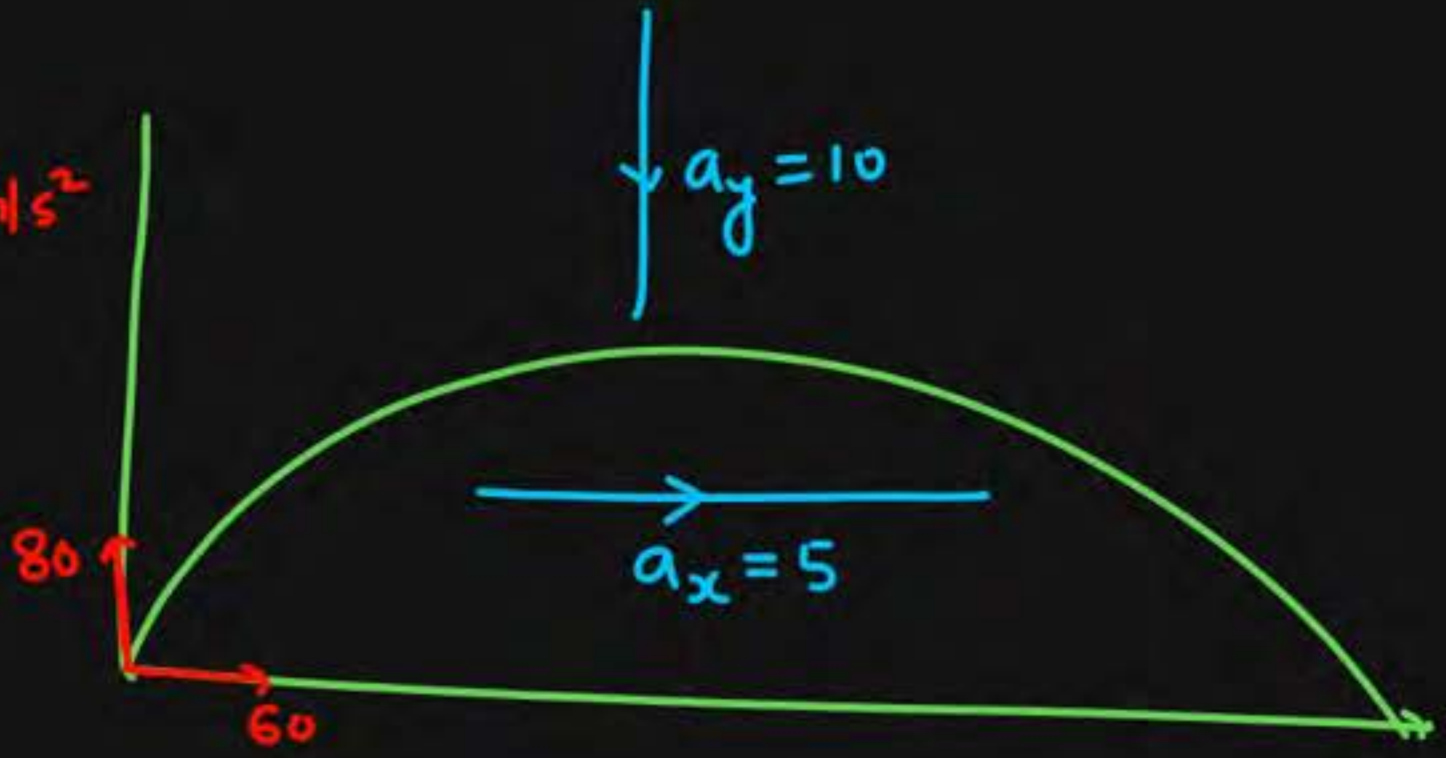
$t=8$, $x = 60\times 8 = 480$

$y = 80\times 8 - \frac{1}{2}\times 10\times 8^2$

$= 640 - 320 = 320$

$(480, 320)$

(m) If air start flowing such that it given horizontal acc of $+5 m/s^2$ to the particle (No air resistance) find



① $T = 8+8 = 16$ (Same)

$T, H_{max} \longrightarrow$ Same.

Range $= R = ut + \frac{1}{2}at^2$ (x dirⁿ $\hat{i}$)

$R = 60 \times 16 + \frac{1}{2} \times 5 \times (16)^2$

$t = 2$, $\vec{v} = (60 + 5 \times 2)\hat{i} + (80 - 10 \times 2)\hat{j}$

$= 70\hat{i} + 60\hat{j}$

Q

$\vec{u}_i = 40\hat{i} + 60\hat{j}$

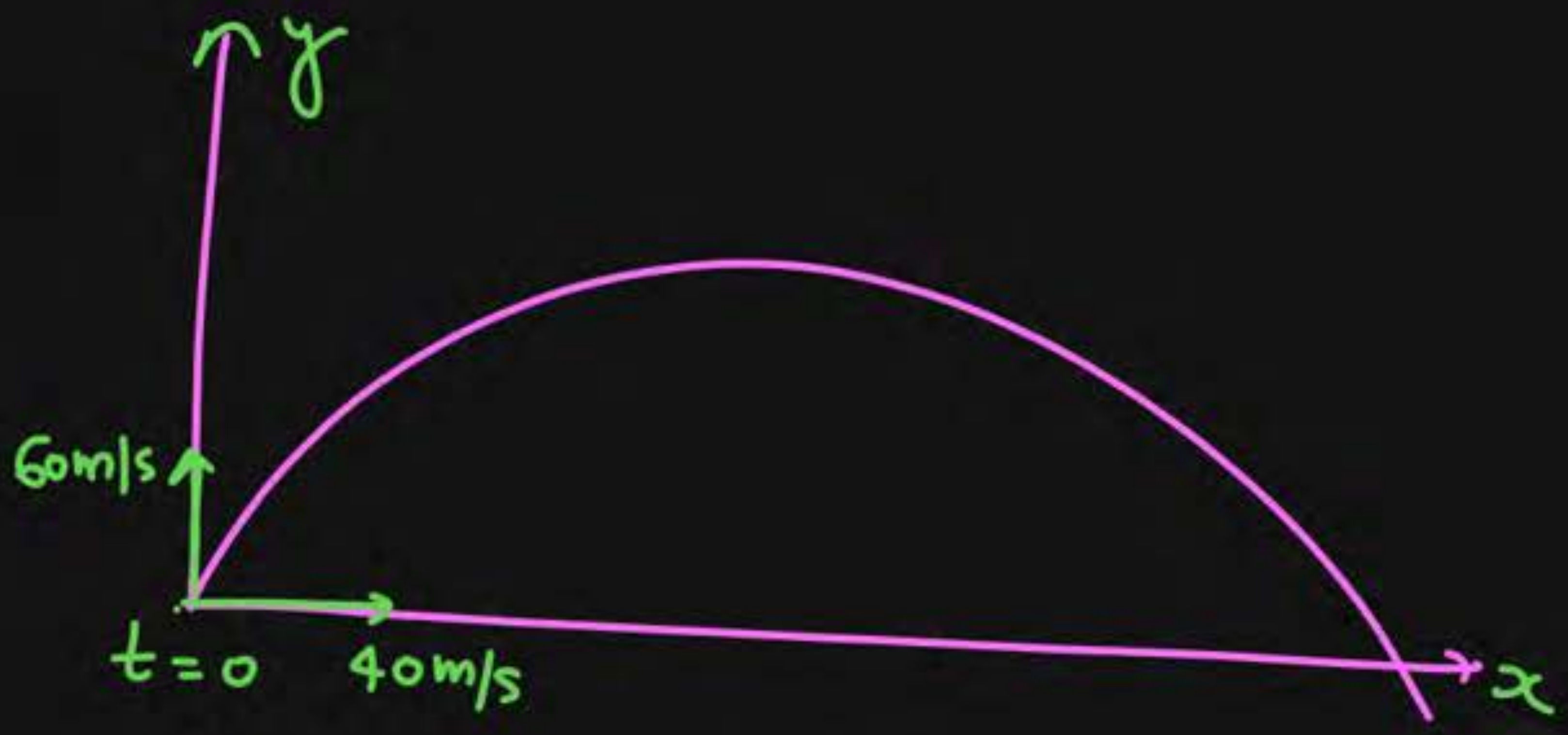
find

① $T = 6+6 = 12$

② $R = 40 \times 12 = 480$

③ $H_{max} = 180$

④ $t=2,\ \vec{v} = 40\hat{i} + 40\hat{j}$



③ $0^2 = 60^2 + 2 \times (-10) h_{max}$

$h_{max} = \frac{3600}{20}$

Q find equation of trajectory

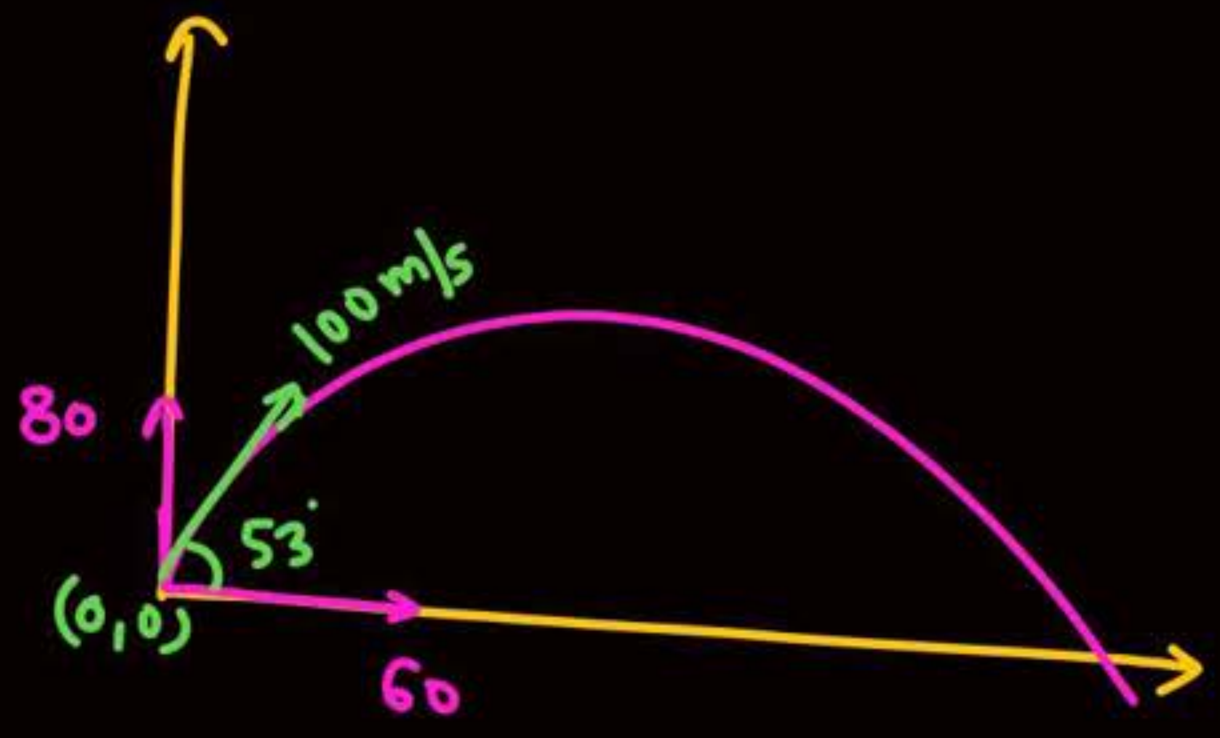
$$x = 60t \Rightarrow t = \frac{x}{60}$$

$$y = 80t - \frac{1}{2} \times 10 \times t^2$$

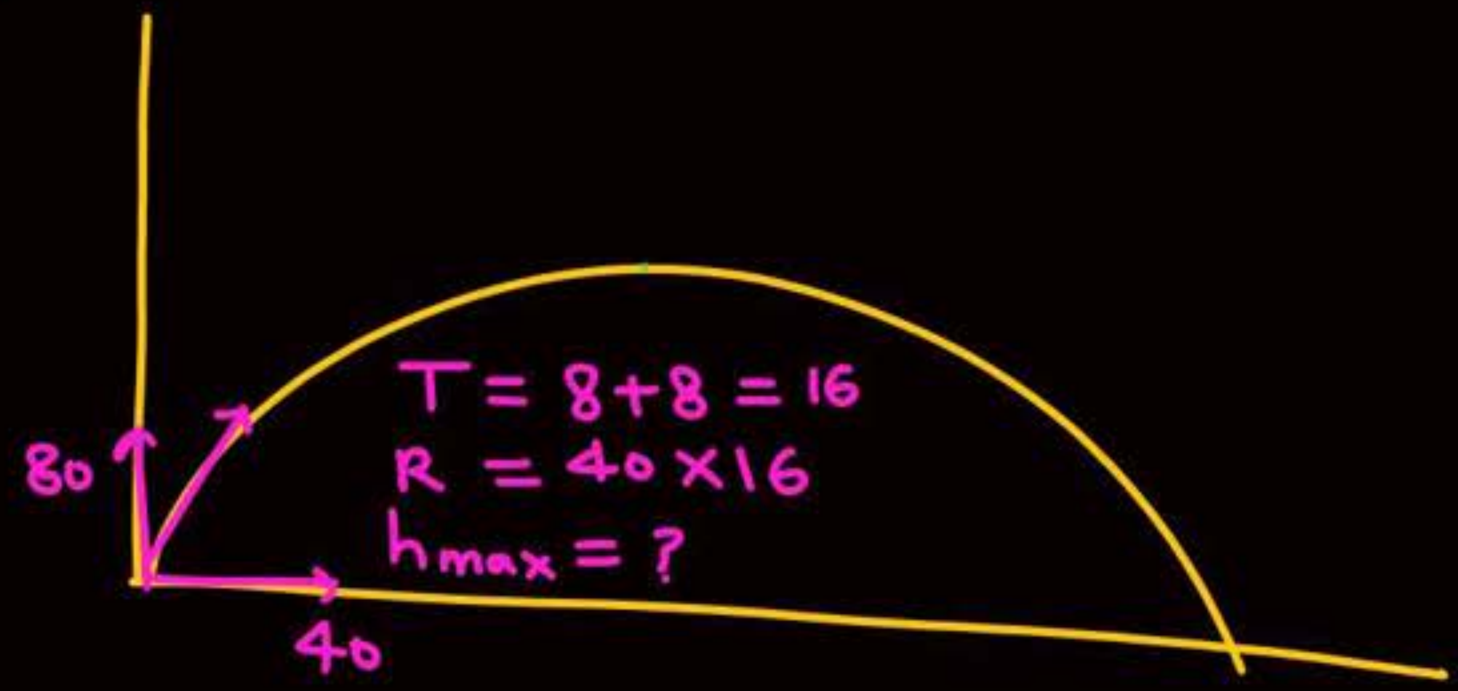
$$y = 80\frac{x}{60} - \frac{1}{2} \times 10 \times \left(\frac{x}{60}\right)^2$$

$$\boxed{y = \frac{4x}{3} - \frac{x^2}{720}}$$

parabola

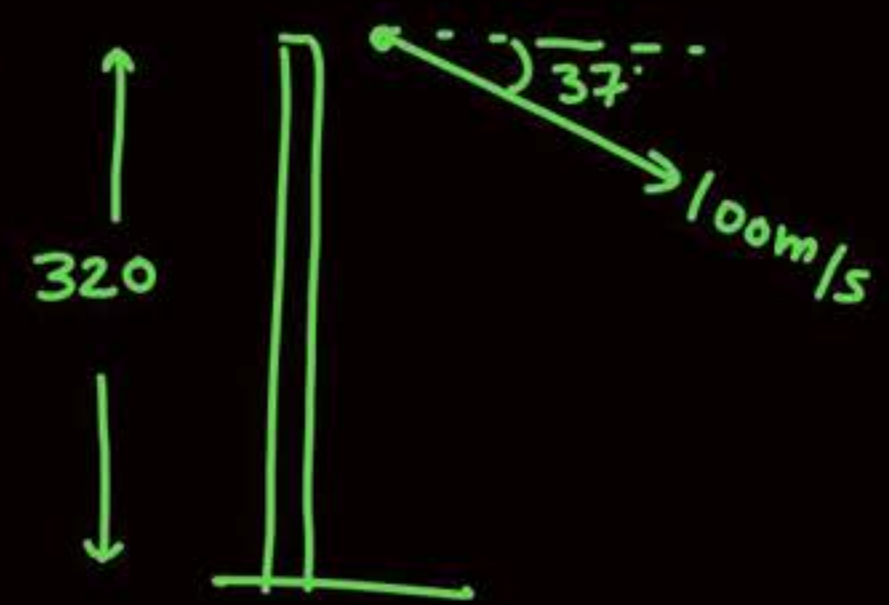


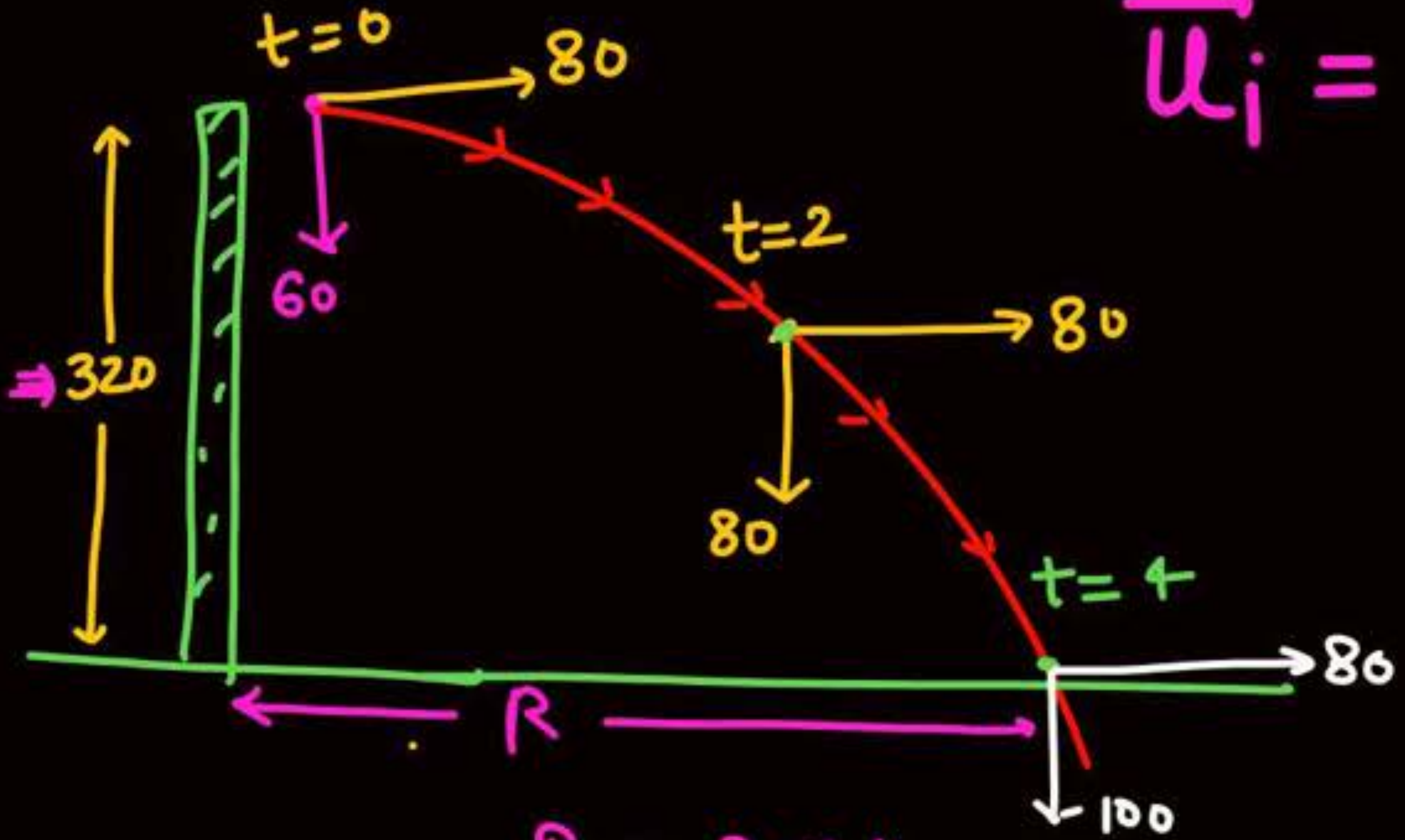
Q



$$0^2 = 80^2 - 2 \times 10 \times h_{max}$$

Q





$\vec{u}_i = 80\hat{i} - 60\hat{j}$

$R = 80 \times 4 = 320$

① when & where particle will strike the ground?

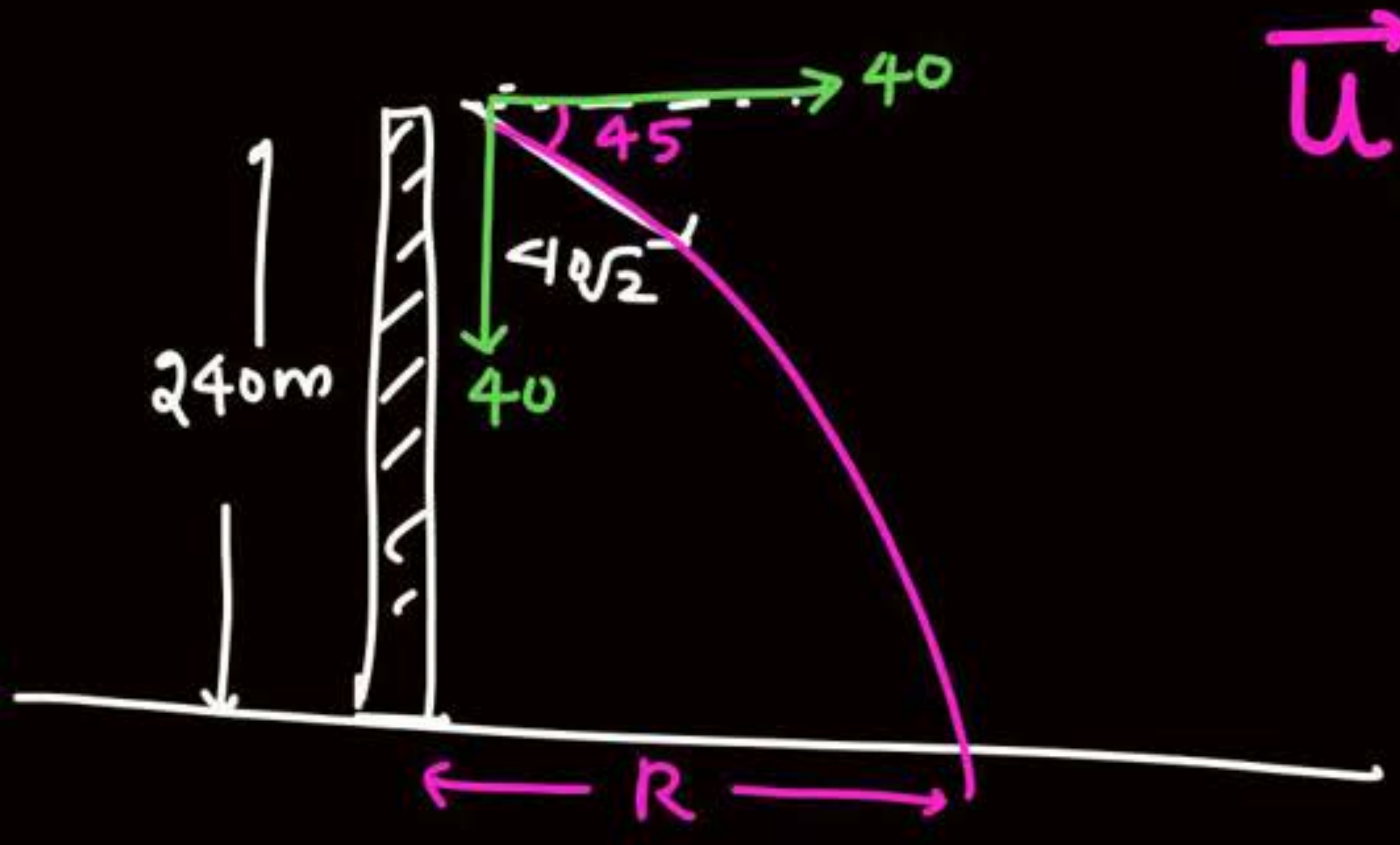
$y = \downarrow +ve \qquad s = ut + \frac{1}{2}at^2$

$+320 = +60 \times t + \frac{1}{2} \times 10 \times t^2$

$\boxed{t = 4\,sec}$

Q

when particle will strike the ground & where



$\vec{u}_i = 40\hat{i} - 40\hat{j}$

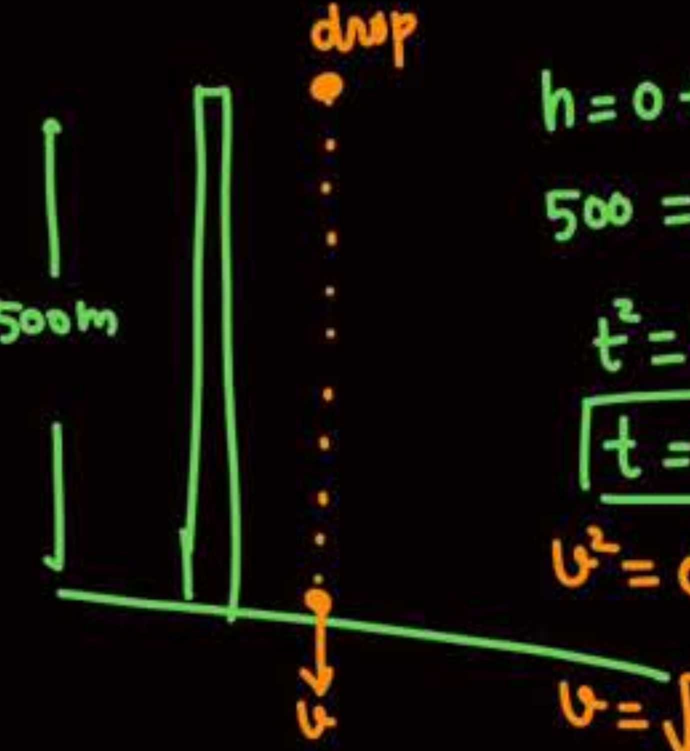
(y) $s = ut + \frac{1}{2}at^2$

$240 = 40t + \frac{1}{2} \times 10 \times t^2$

$\boxed{t = 4}$

$\boxed{R = 40 \times 4 = 160}$

Q



$h = 0 + \frac{1}{2} g t^2$

$500 = \frac{1}{2} \times 10 \times t^2$

$t^2 = 100$

$\boxed{t = 10 \text{ sec}}$

$v^2 = 0^2 + 2gh$

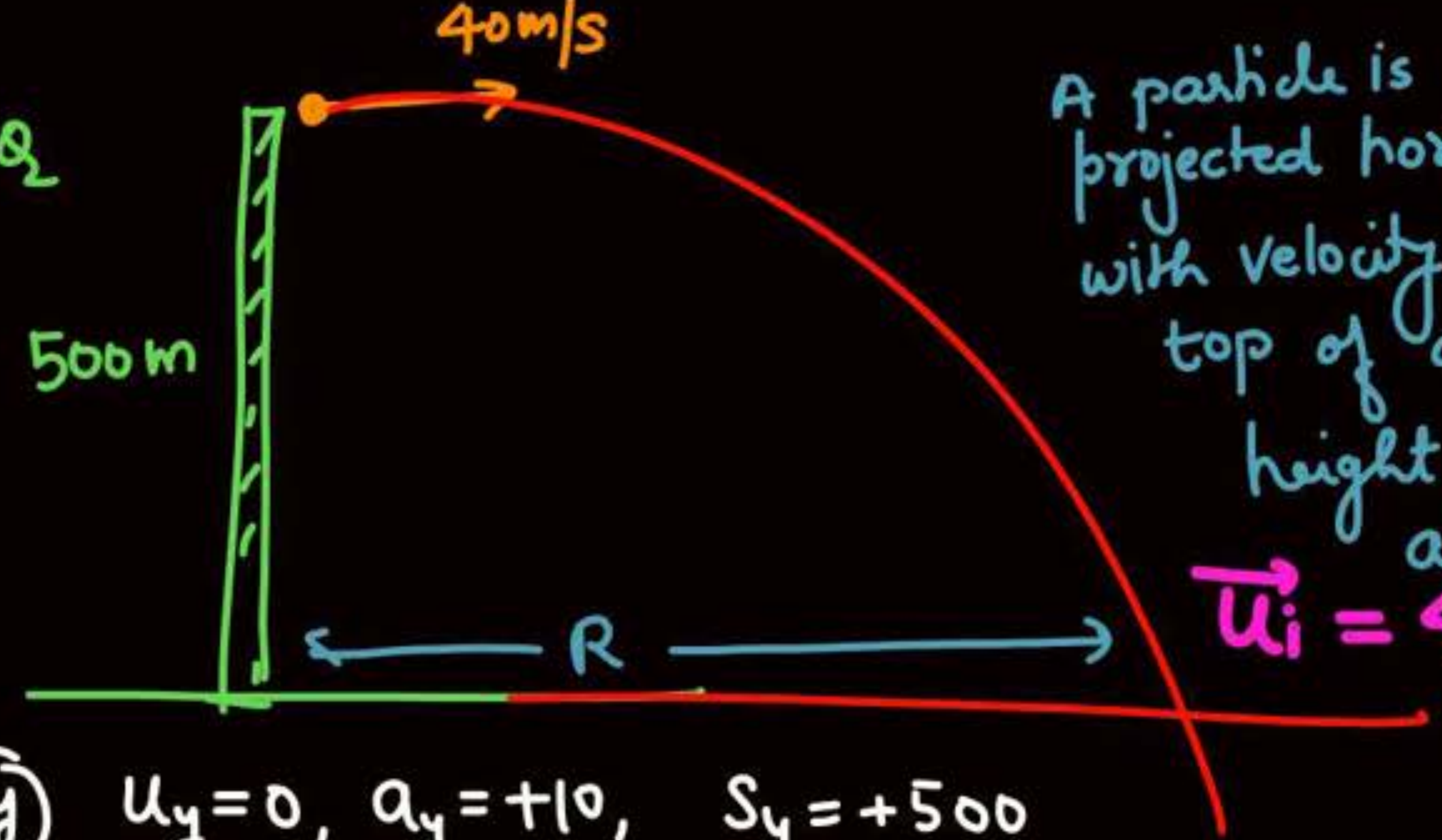
$v = \sqrt{2gh}$

$= \sqrt{2 \times 10 \times 500}$

$= 100$

Q_2

A particle is projected horizontally with velocity 40 m/s from top of a tower of height 500 m above ground



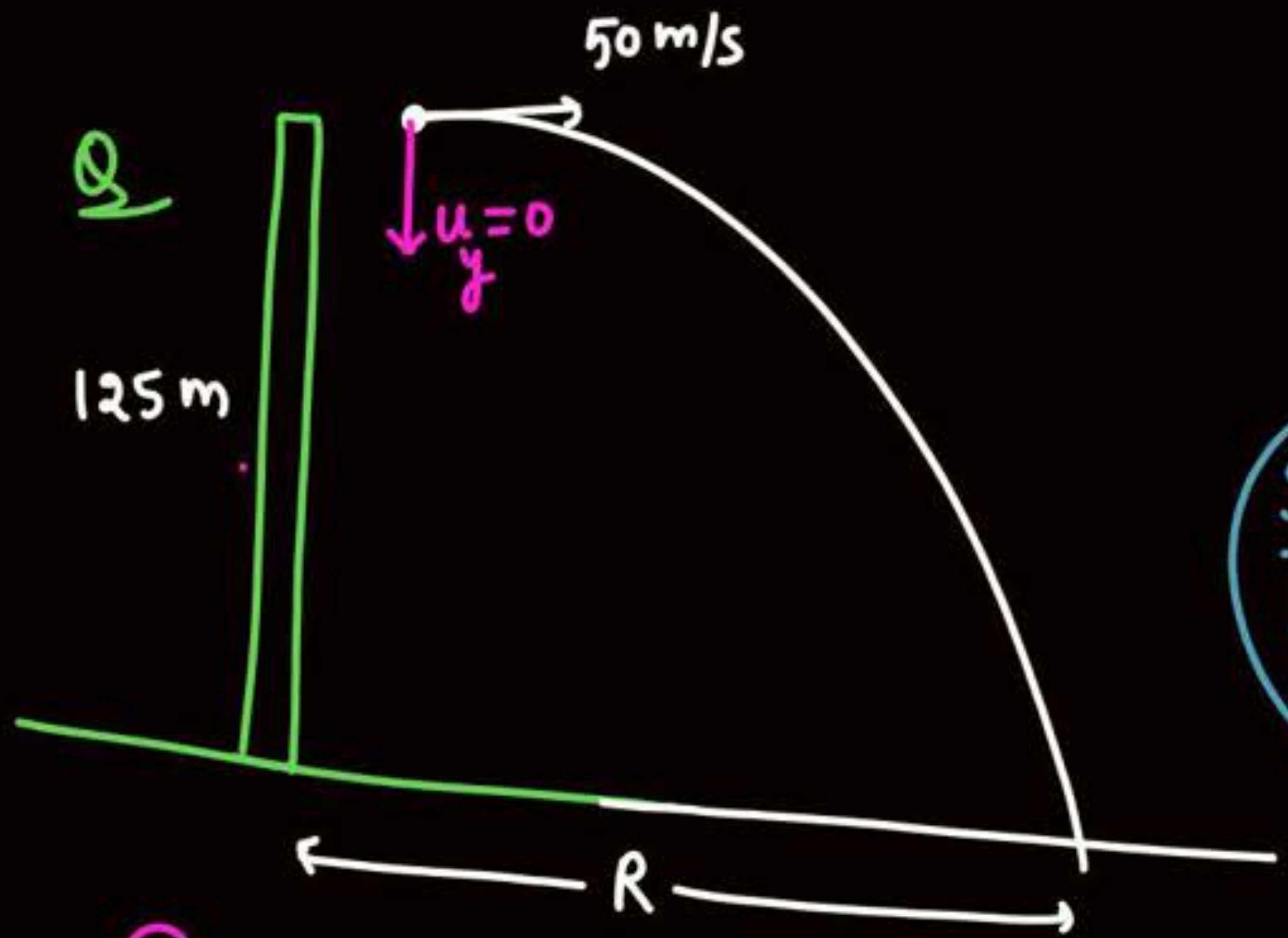
$\vec{u}_i = 40\hat{i}$

(y) $u_y = 0, \quad a_y = +10, \quad S_y = +500$

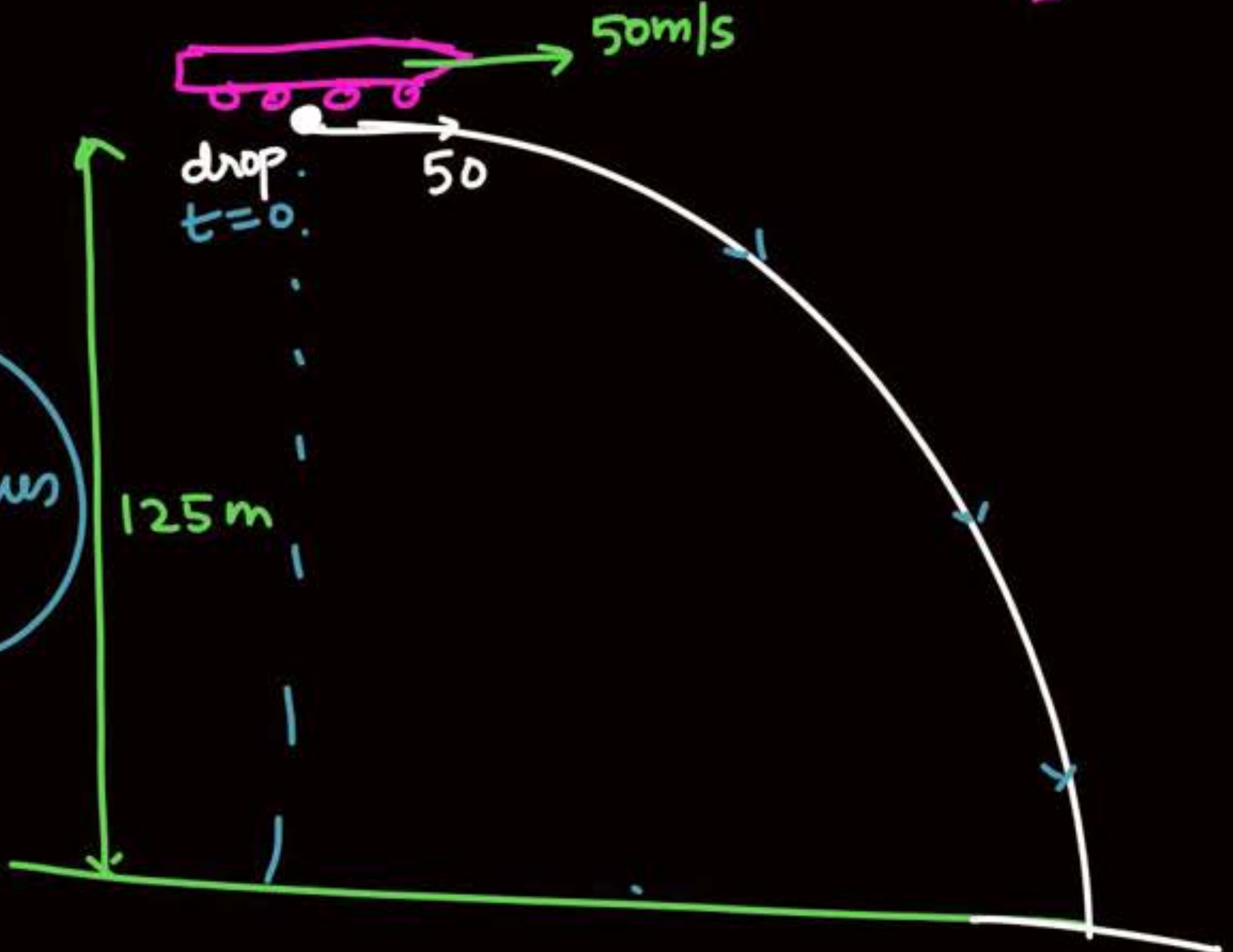
$500 = 0 + \frac{1}{2} \times 10 \times t^2$

$\boxed{t = 10 \text{ sec}}$

$R = 40 \times 10 = 400 \text{ m}$



Same ques



y $\quad 125 = 0 + \frac{1}{2}\times 10 \times t^2$

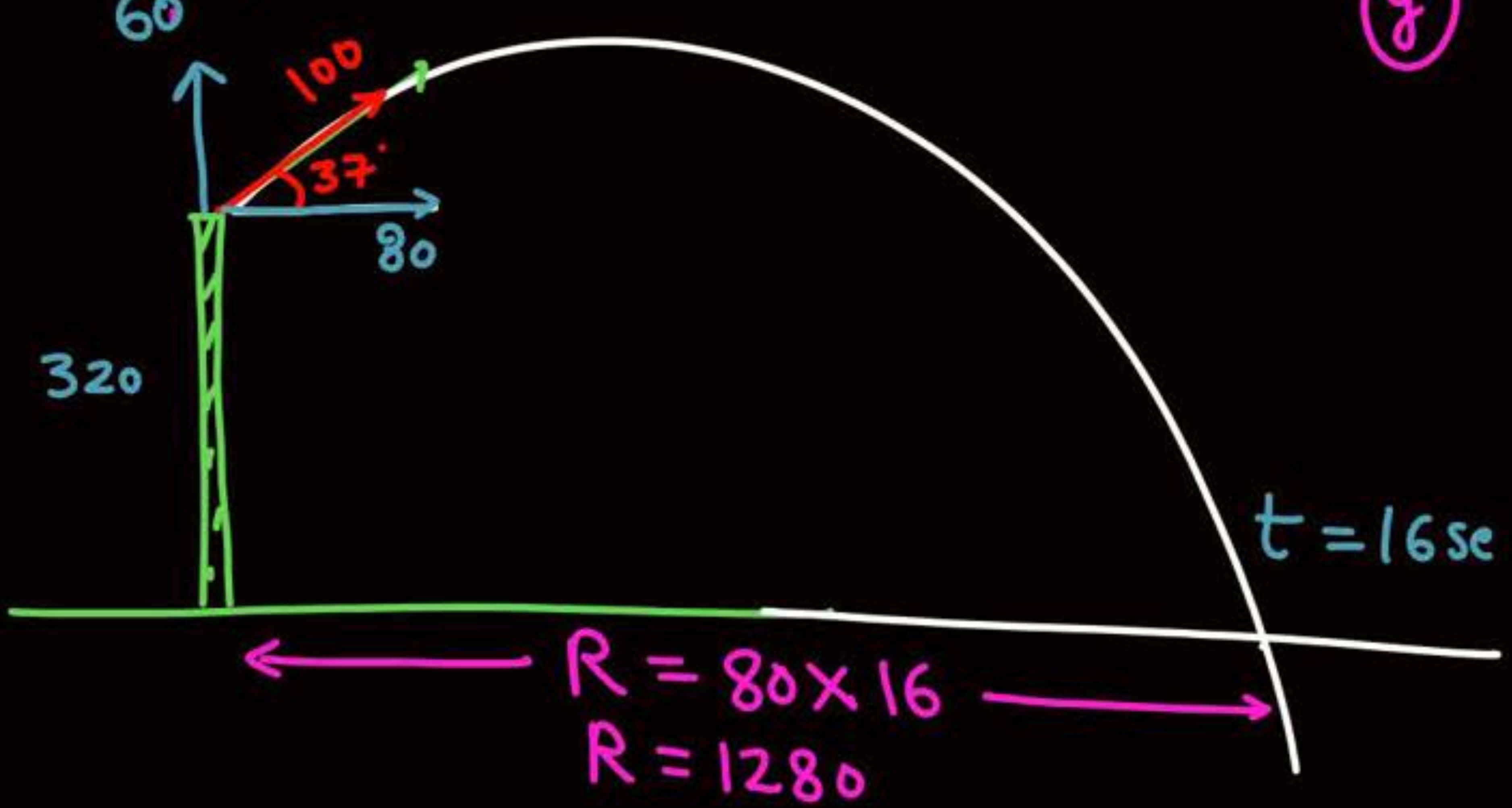
$t = \sqrt{\frac{250}{10}} = 5$

$$\boxed{\begin{aligned} R &= 50\times 5 \\ &= 250\,m \end{aligned}}$$

$t = 5$

$R = 250\,m$

Q



(y) ↑ +ve

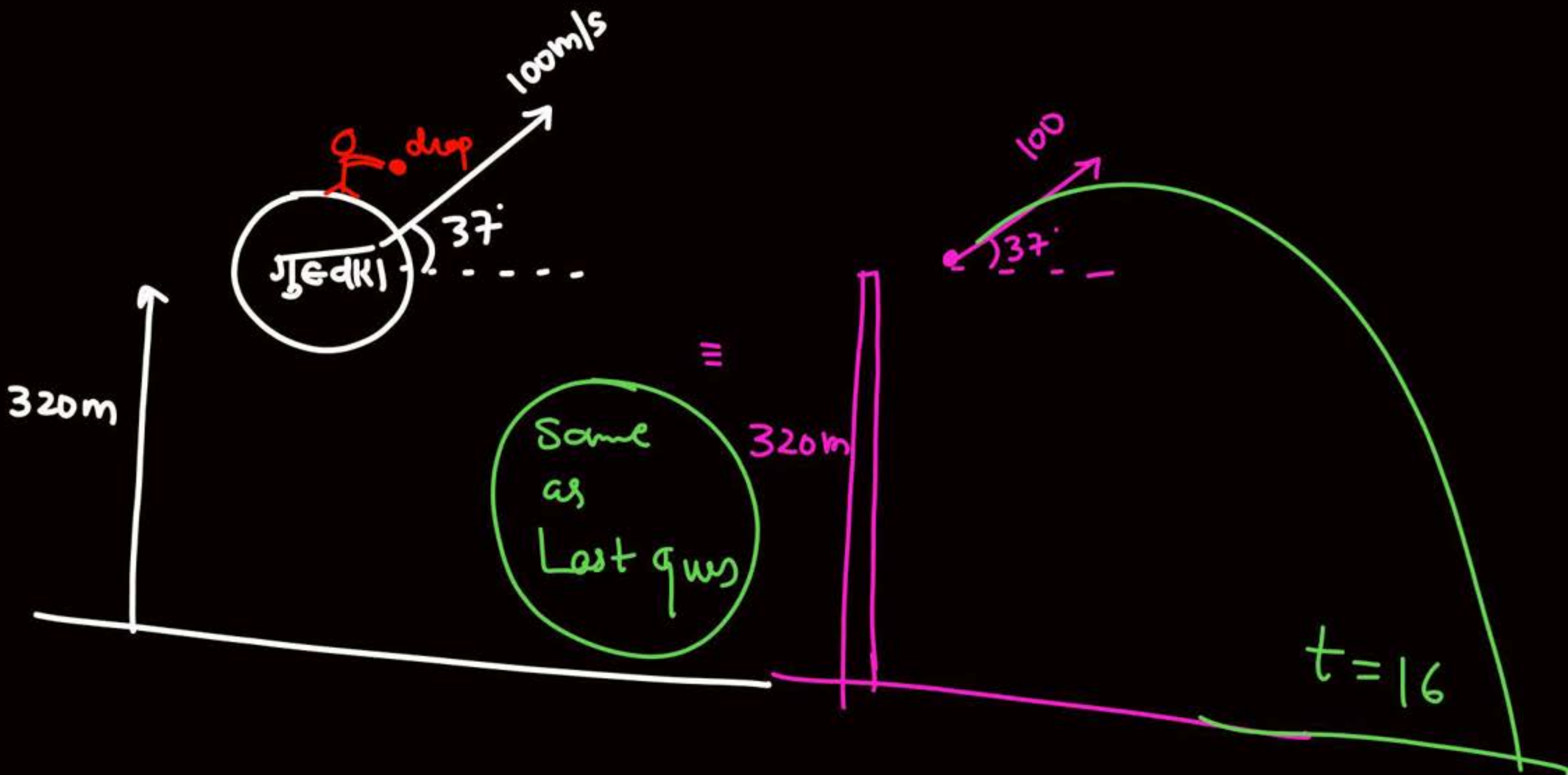
$$\left.\begin{aligned} u_y &= +60 \\ a_y &= -10 \\ S_y &= -320 \end{aligned}\right\} \text{Already } \checkmark$$

$$-320 = 60t - \frac{1}{2} \times 10 \times t^2$$

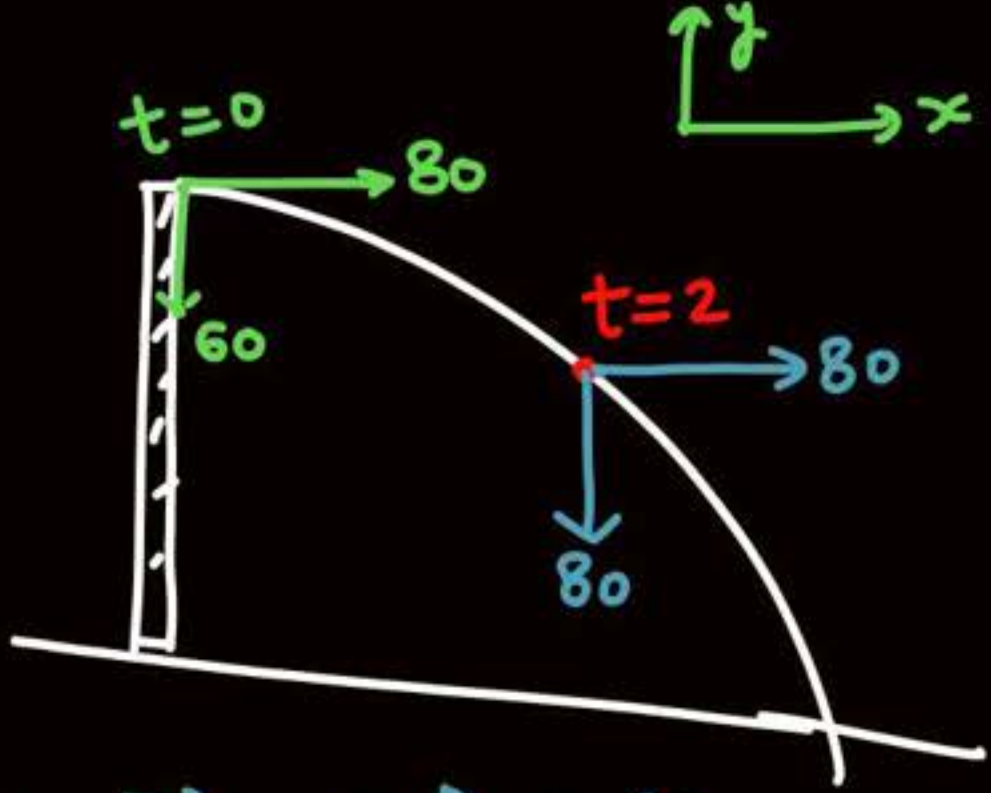
$$\boxed{t = 16 \text{ sec}}$$

find T & R

Q



Q



$t=2,\ \vec{v} = 80\hat{i} - 80\hat{j}$

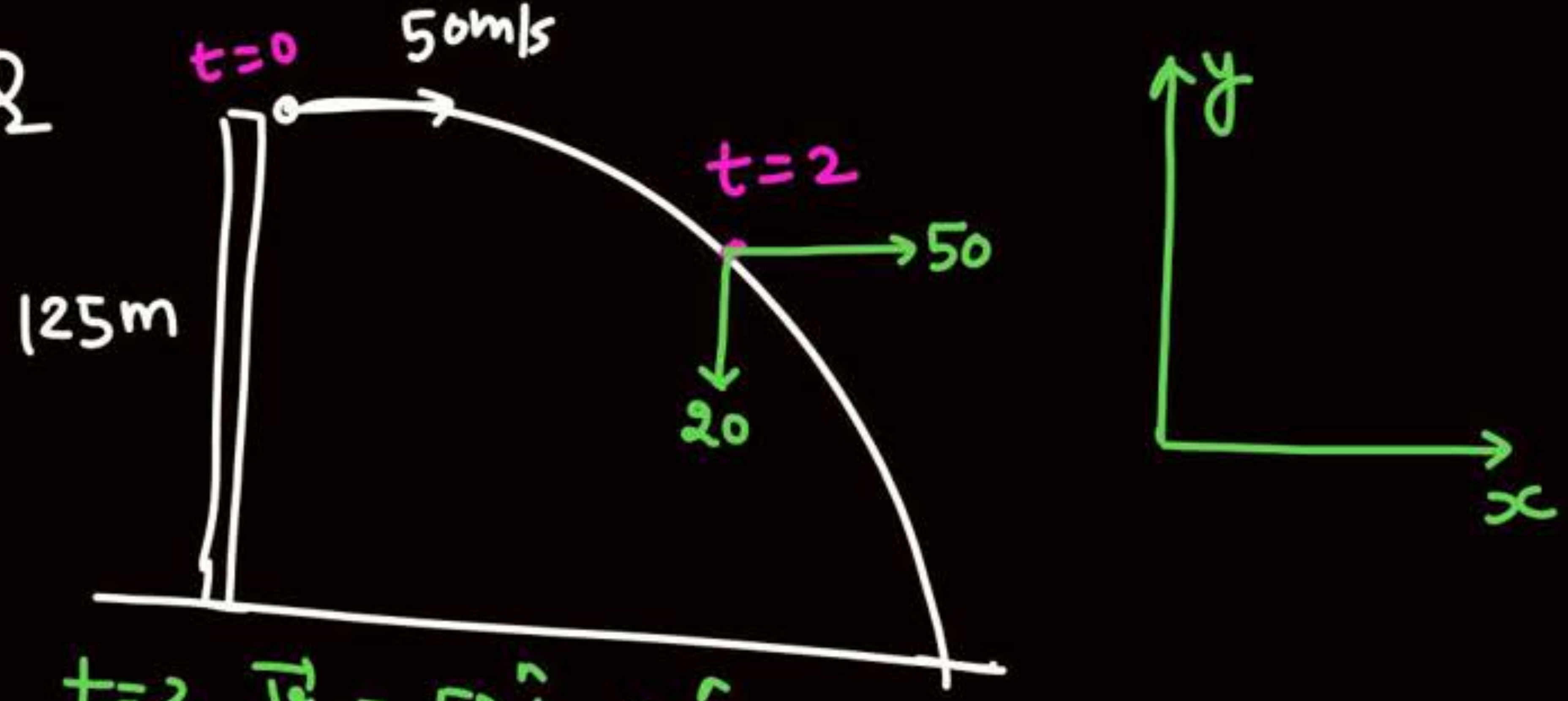
$t=4,\ \vec{v} = 80\hat{i} - 100\hat{j}$

$v_y = u_y + a_y t$

$= +60 + 10 \times 4$

$= 100$ नीचे

Q



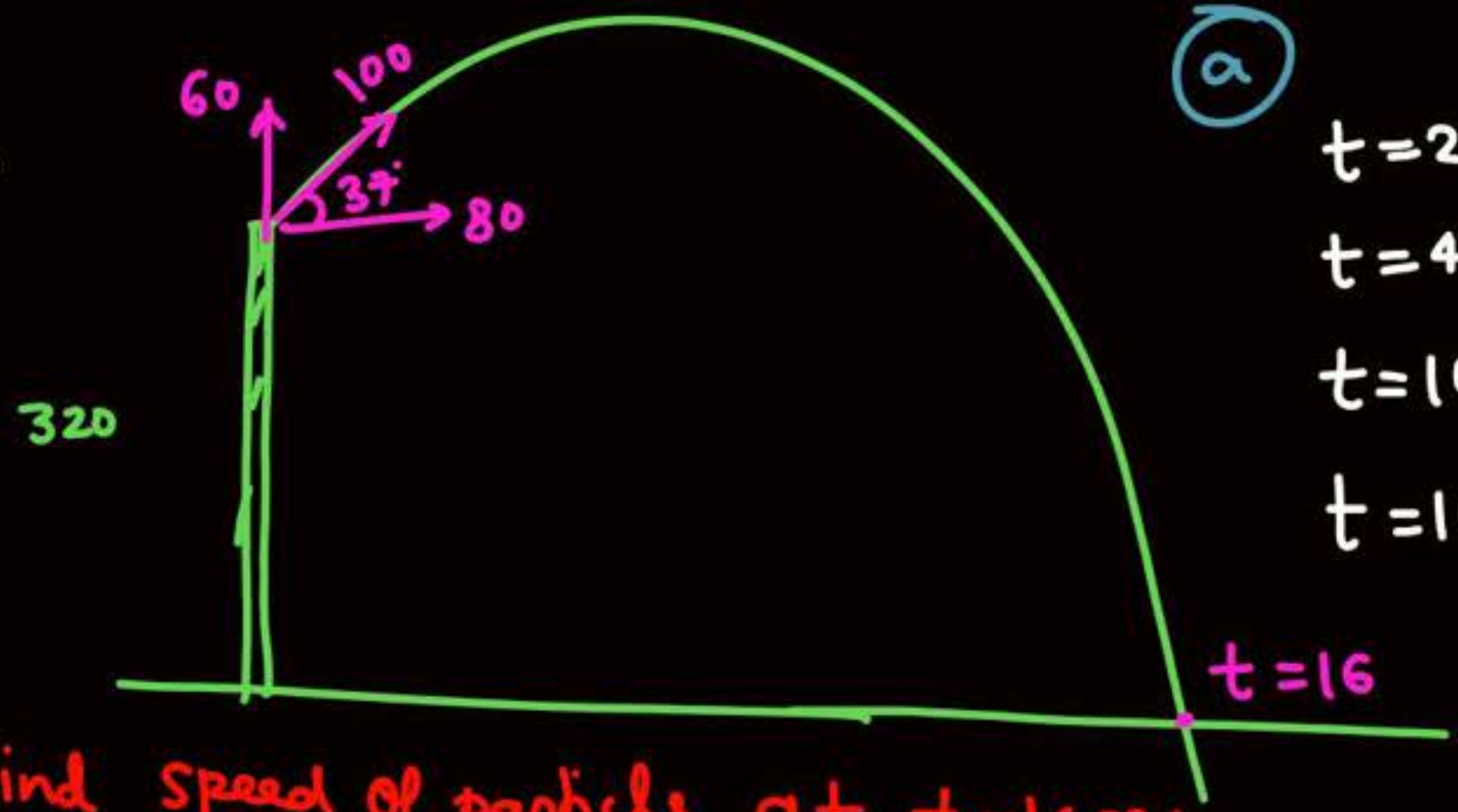
$t=2,\ \vec{v} = 50\hat{i} - 20\hat{j}$

y $\quad v = u + at$

$v = 0 - 10 \times 2$

$v = -20$

Q



(a)

$t=2,\ \vec{v} = 80\hat{i} + 40\hat{j}$

$t=4,\ \vec{v} = 80\hat{i} + 20\hat{j}$

$t=10,\ \vec{v} = 80\hat{i} - 40\hat{j}$

$t=16,\ \vec{v} = 80\hat{i} - 100\hat{j}$

(b)

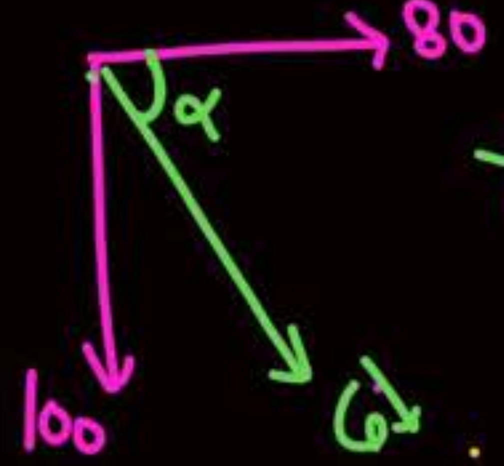
Q2 find speed of particle at $t = 16$ sec

$\vec{v} = 80\hat{i} - 100\hat{j}$ (just before hit the ground)

$|\vec{v}| = \sqrt{(80)^2 + (100)^2}$

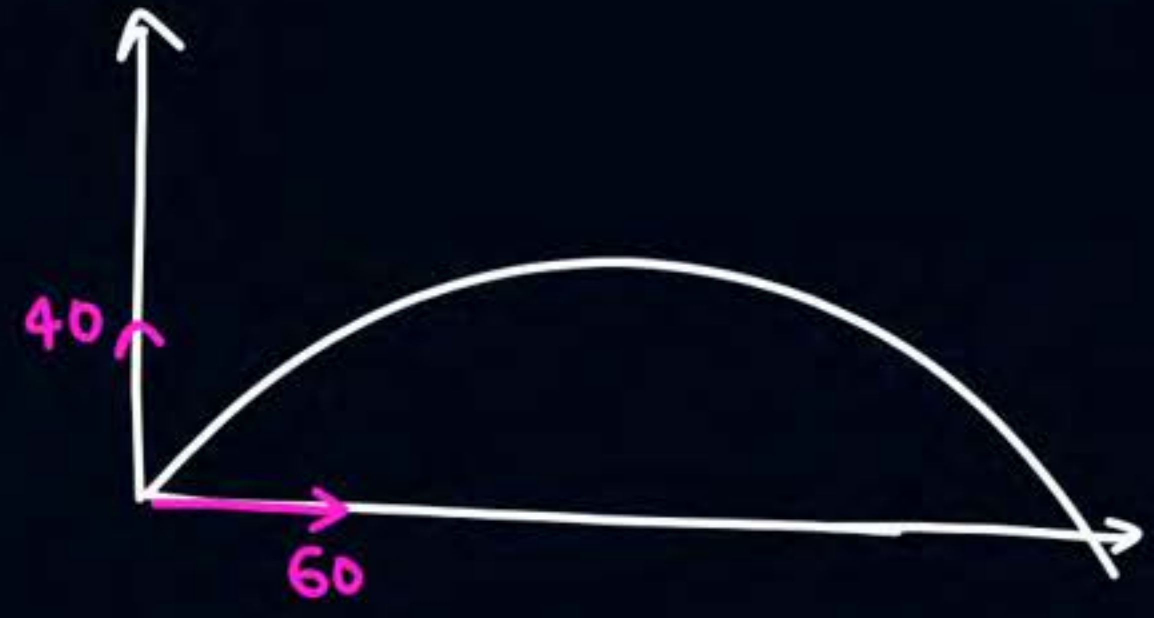
(c) find angle made by $\vec{v}$ with horizonatal at $t = 16$ sec

$\vec{v} = 80\hat{i} - 100\hat{j}$



$\tan\alpha = \frac{100}{80}$

Q



$$\boxed{0^2 = 40^2 - 2\times10\times h_{max}}$$

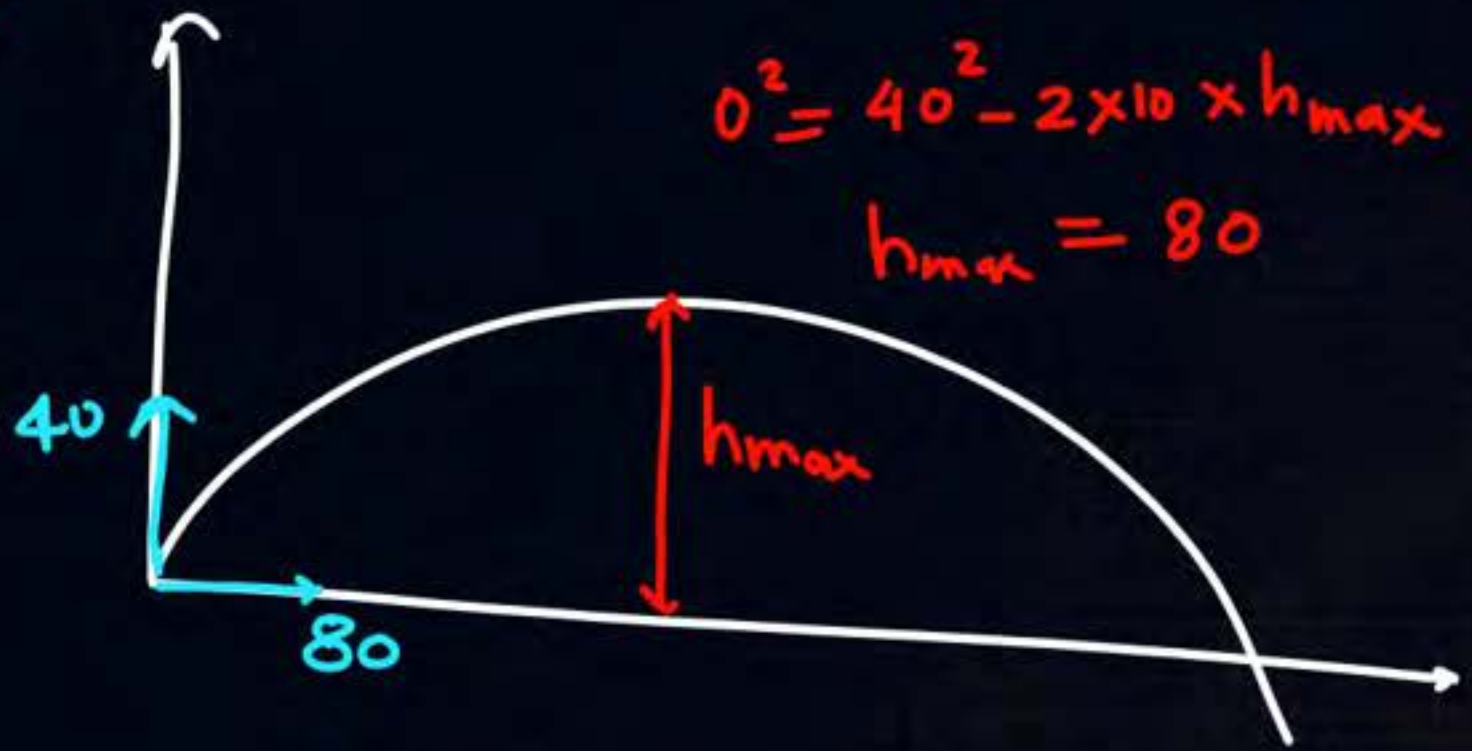
$$T = 4+4 = 8$$

$$h_{max} = 80$$

$$R = 60\times 8 = \underline{480}$$

Va

Q



$$0^2 = 40^2 - 2\times10\times h_{max}$$

$$h_{max} = 80$$

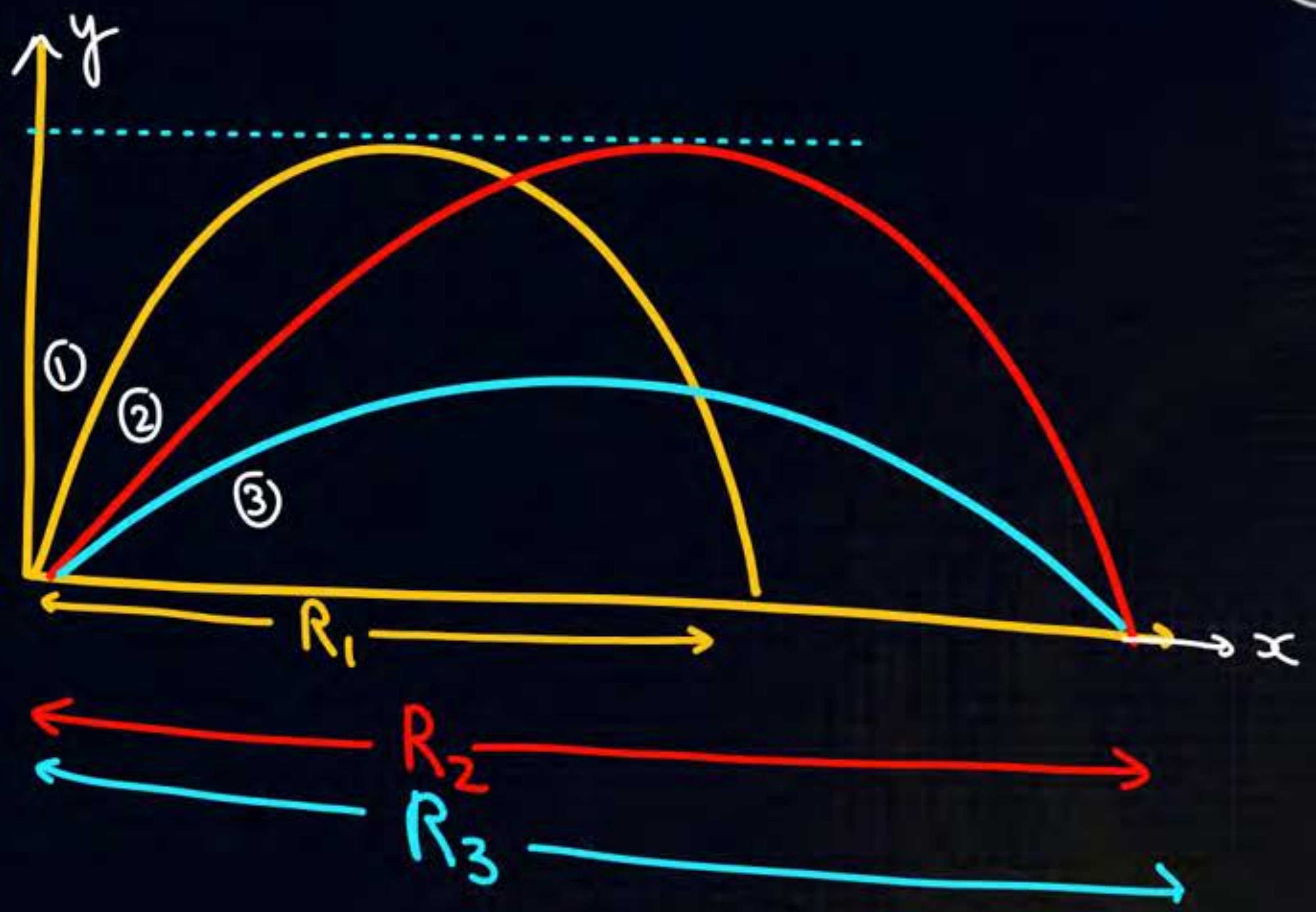
$$T = 4+4 = 8$$

$$h_{max} = 80$$

$$R = 80\times 8 = 640$$

Q

* $(H_{max})_1 = (H_{max})_2 > (H_{max})_3$
* $T_1 = T_2 > T_3$
- $(u_y)_1 = (u_y)_2 > (u_y)_3$
- $R_1 < R_2 = R_3$



Q A particle is projected from ground with speed u at an angle θ with horizontal such that its maximum height is half of range. find θ

$$h_{max} = \frac{1}{2} R$$

$$\frac{u^2 \sin^2\theta}{2g} = \frac{1}{2} \frac{u^2 \sin 2\theta}{g}$$

$$\sin^2\theta = \sin 2\theta$$

$$\sin^2\theta = 2\sin\theta\cos\theta$$

$$\tan\theta = 2$$

$$\boxed{\theta = \tan^{-1} 2}$$

Q Two particle are projected with same speed u at angle 30° & 60° respectively. find ① Ratio of their max height

② " " Range

③ " " time of flight

① $\dfrac{(h_{max})_1}{(h_{max})_2} = \dfrac{\left(\dfrac{u^2 \sin^2 30}{2g}\right)}{\dfrac{u^2 \sin^2 60}{2g}} = \dfrac{\left(\frac{1}{2}\right)^2}{\left(\frac{\sqrt{3}}{2}\right)^2} = \dfrac{1}{3}$

② $\dfrac{R_1}{R_2} = \left(\dfrac{u^2 \sin(2\times 30)}{g}\right) \Big/ \dfrac{u^2 \sin(2\times 60)}{g} = \dfrac{\sin 60}{\sin 120} = \dfrac{\sqrt{3}/2}{\sqrt{3}/2} = 1$

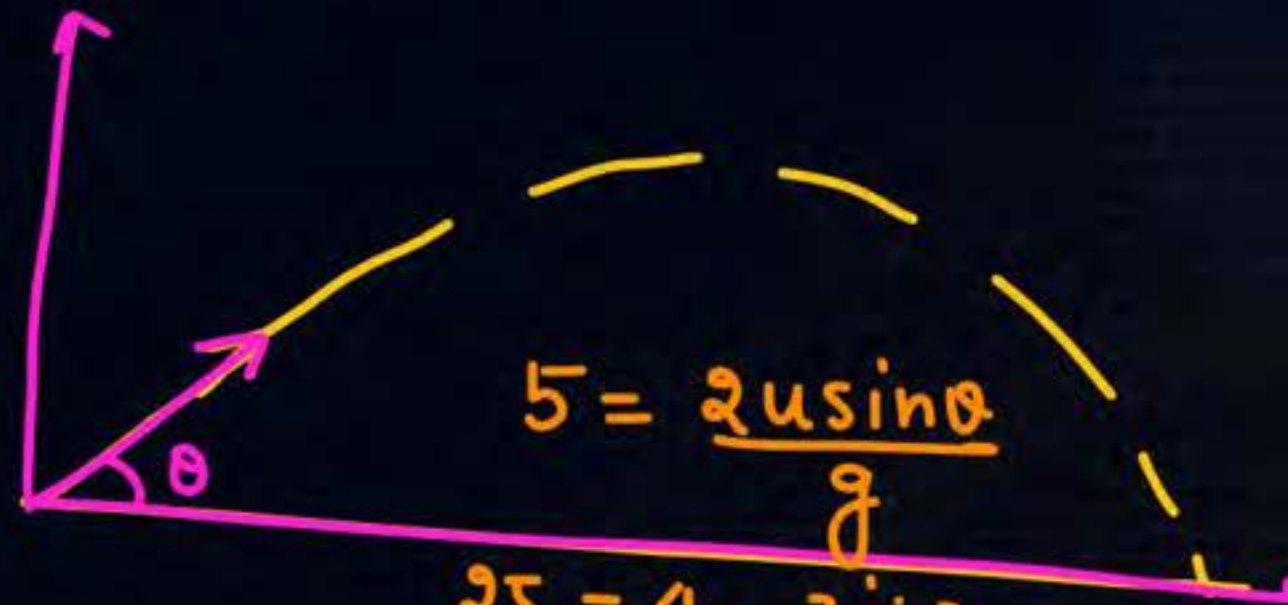
M-2 $\theta = 30$, $90-\theta = 60$ $\longrightarrow R_1 = R_2$

③ $T = \dfrac{2u\sin\theta}{g}$ $\quad \dfrac{T_1}{T_2} = \dfrac{\sin 30}{\sin 60} = \dfrac{1/2}{\sqrt{3}/2} = \dfrac{1}{\sqrt{3}}$

Q An arrow is projected such that its range is 400 m and time of flight is 5 sec. find

(1) h_{max} (2) inclination of arrow at $t=0$

$\theta = ?$



$5 = \frac{2u\sin\theta}{g}$

$25 = \frac{4}{100} u^2 \sin^2\theta$

$u^2\sin^2\theta = 625$

$H_{max} = \frac{u^2\sin^2\theta}{2g} = \frac{625}{20}$

$R = 400 = \frac{u^2 \sin 2\theta}{g}$

$5 = \frac{2u\sin\theta}{g}$

$u = \frac{25}{\sin\theta}$

$400 = \left(\frac{25}{\sin\theta}\right)^2 \cdot \frac{\sin 2\theta}{10}$

$400 = \frac{625}{\sin^2\theta} \cdot \frac{2\sin\theta\cos\theta}{10}$

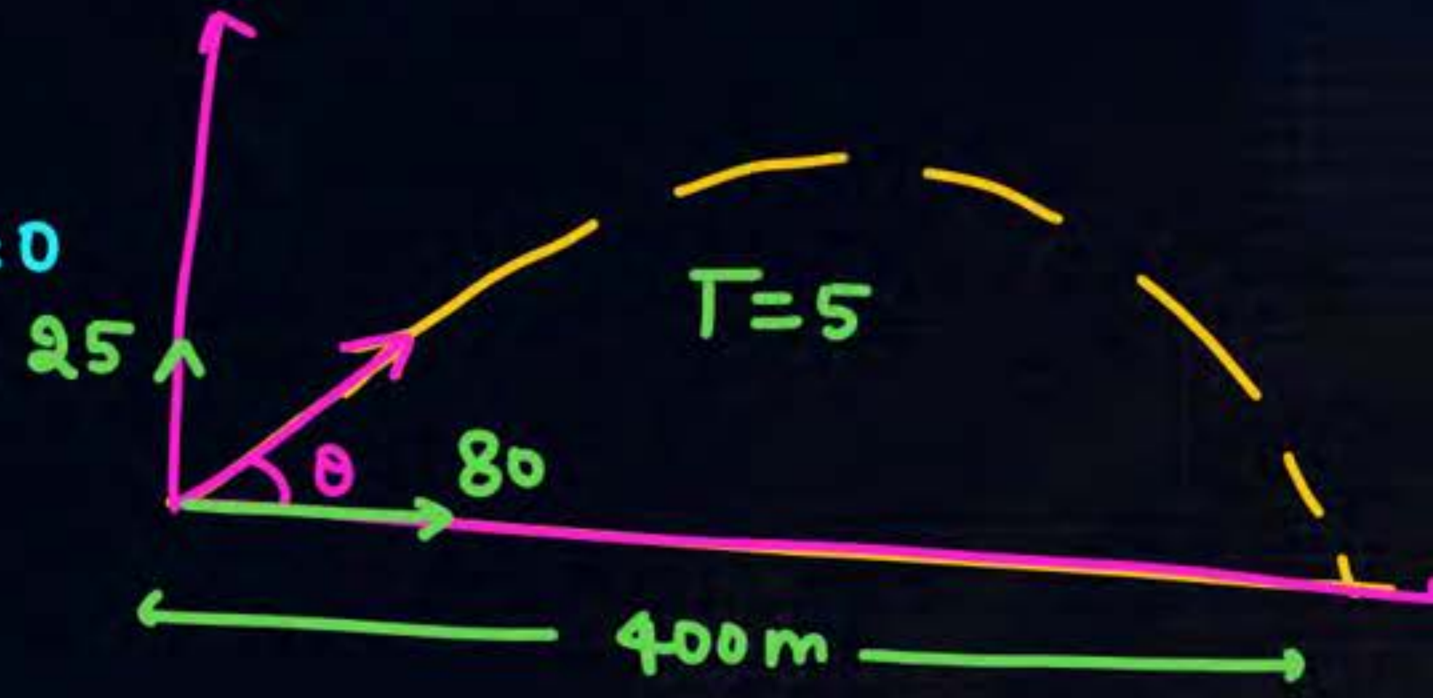
$400 = 125 \frac{\cos\theta}{\sin\theta} = 125 \cot\theta$

$\cot\theta = \frac{400}{125}$

$\tan\theta = 125/400 = \frac{5}{16}$

Q An arrow is projected such that its range is 400m and time of flight is 5 sec. find

① h_{max} ② inclination of arrow at $t=0$



$\tan\theta = \frac{25}{80} = \frac{5}{16}$

$\vec{u} = 2.5\hat{i} + 80\hat{j}$

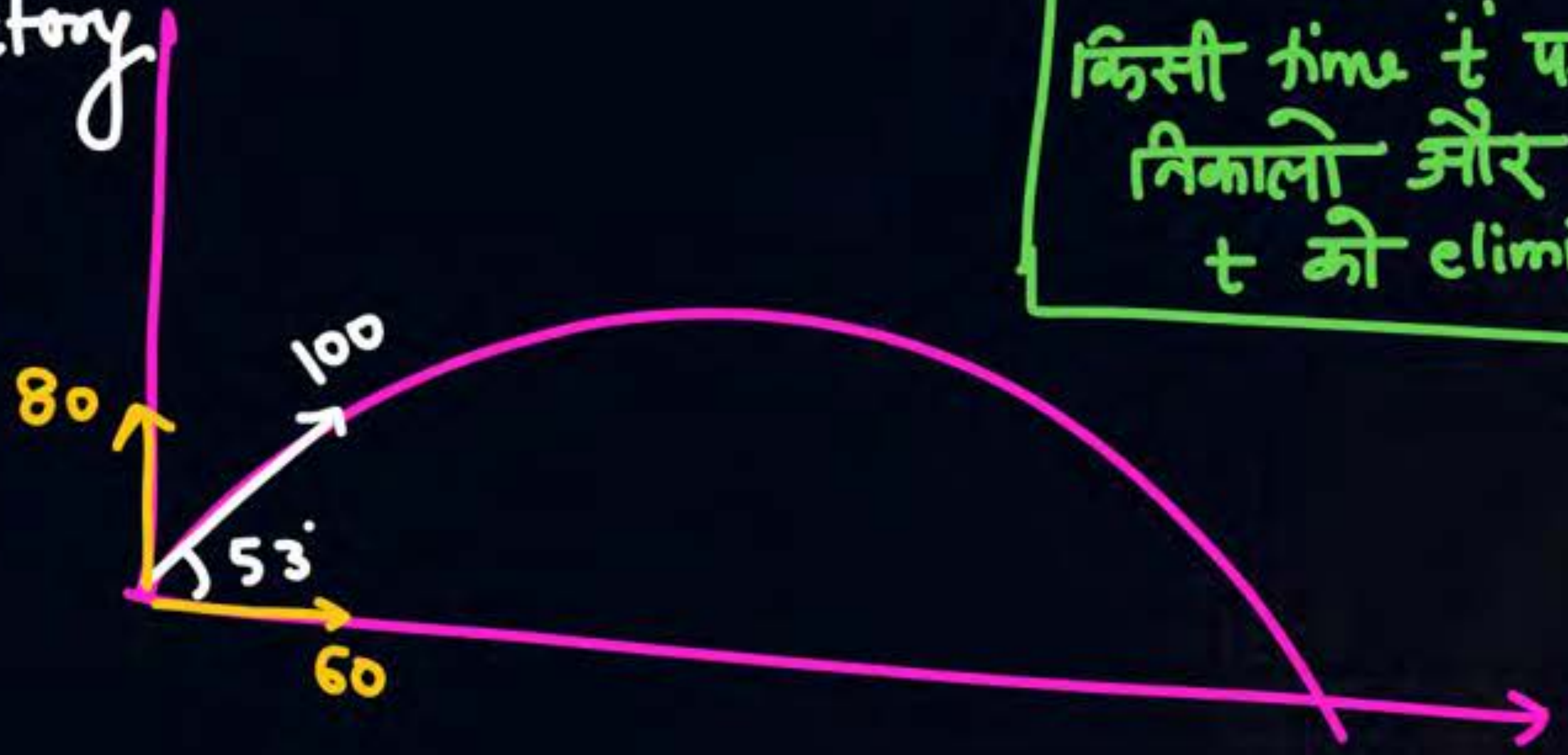
$0^2 = (25)^2 - 2 \times g \times h_{max}$

$h_{max} = \frac{(25)^2}{20} = \frac{625}{20}$

Q A particle is projected at angle θ such that its range is 1200 m and time of flight is 20 sec find (1) angle at which particle is projected.

$$\tan\theta = \frac{100}{60} = \frac{5}{3}$$

Q. Find equation of trajectory.



$x = 60t \qquad t = \frac{x}{60}$

$y = 80t - \frac{1}{2}gt^2$

$y = 80\frac{x}{60} - \frac{1}{2}g\left(\frac{x}{60}\right)^2$

$y = \frac{4}{3}x - \frac{5}{3600}x^2$

* K.C.

किसी time 't' पर x, y निकालो और t को eliminate कर दो

Q

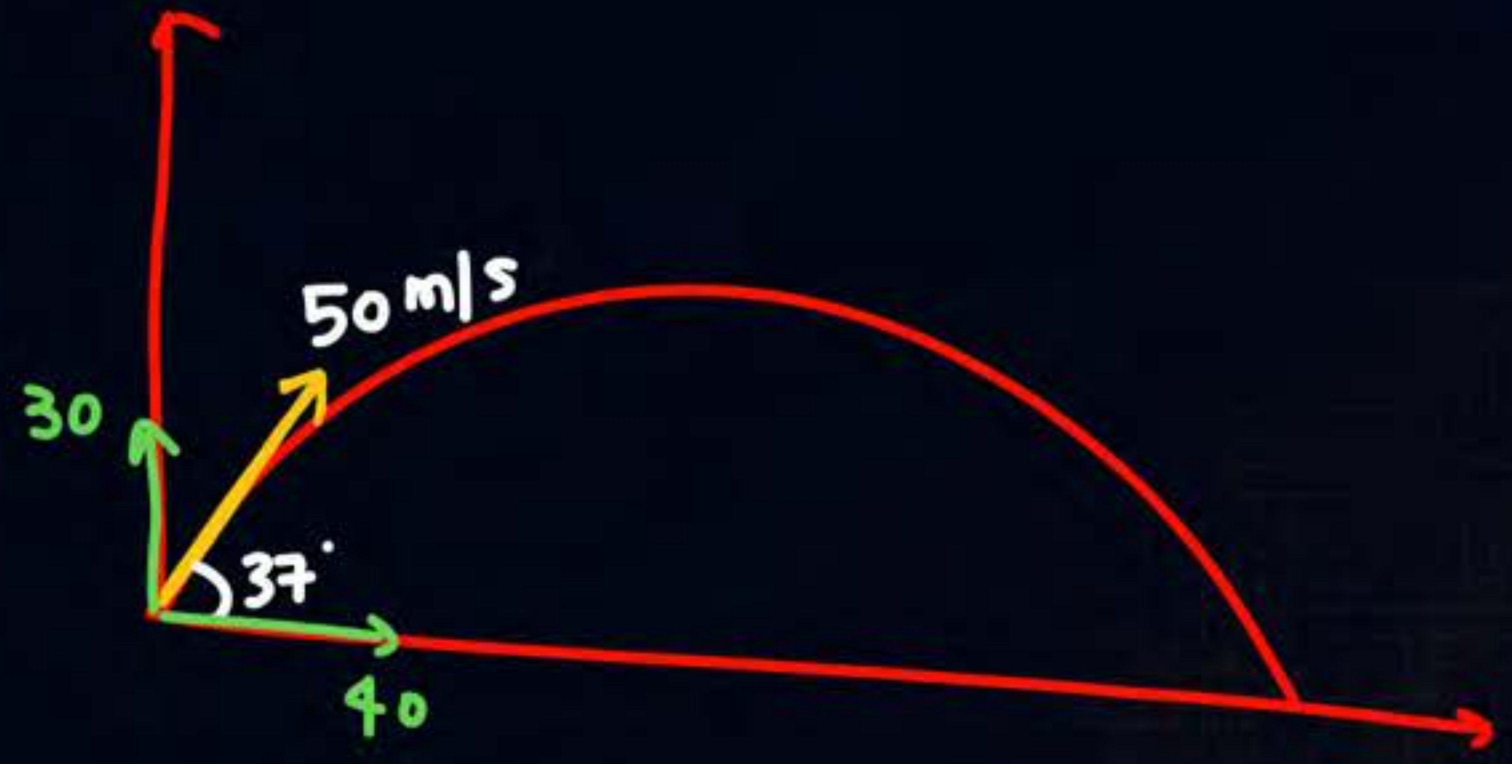
find eqⁿ of trajectory

$x = 40t \qquad t = x/40$

$y = 30t - \frac{1}{2}gt^2$

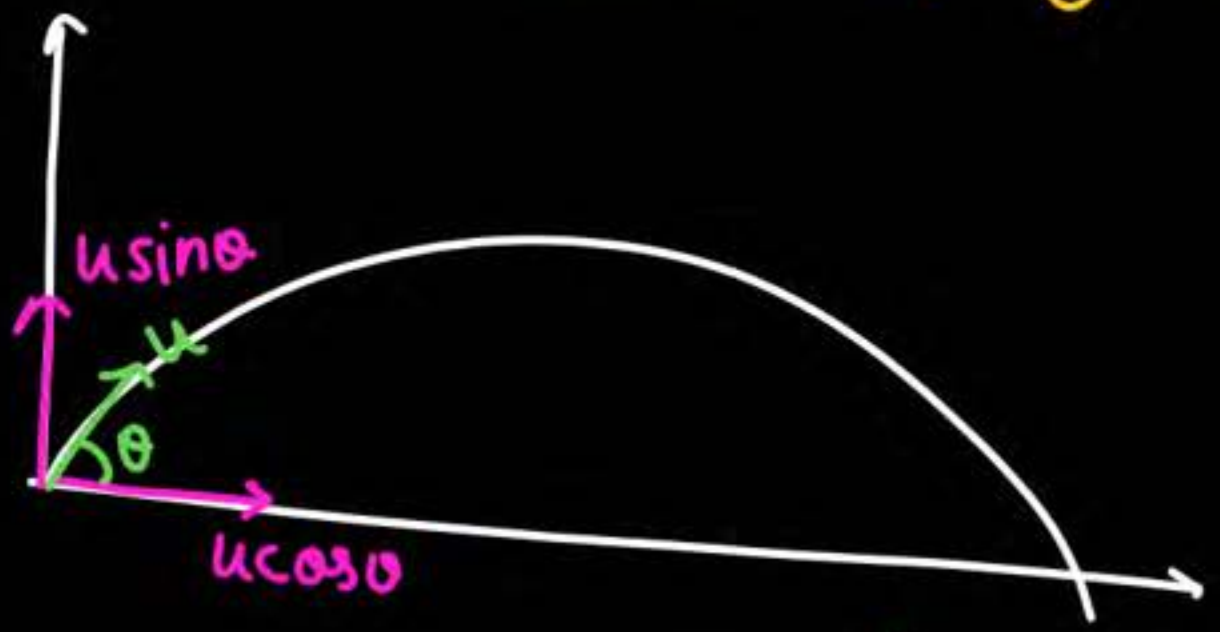
$y = 30 \cdot \frac{x}{40} - \frac{1}{2}g\frac{x^2}{(40)^2}$

$$\boxed{y = \frac{3}{4}x - \frac{5}{1600}x^2}$$



Equation of trajectory

Rough copy में 2 बार calculation करो



$$t = \frac{x}{u\cos\theta}$$

$$x = u\cos\theta \cdot t$$

$$y = u\sin\theta\, t - \frac{1}{2} g t^2$$

$$y = u\sin\theta \cdot \frac{x}{u\cos\theta} - \frac{1}{2} g \frac{x^2}{u^2\cos^2\theta}$$

$$\boxed{y = x\tan\theta - \frac{1}{2} g \frac{x^2}{u^2\cos^2\theta}}$$

$$\boxed{y = x\tan\theta - \frac{1}{2}g\left(\frac{x}{u\cos\theta}\right)^2}$$

Q If eqⁿ of trajectory is given by

$y = x\sqrt{3} - \frac{x^2}{20}$ Find ① u, θ, T, R, θ

$y = x\tan\theta - \frac{1}{2}g\frac{x^2}{u^2\cos^2\theta}$ (Compare)

$\sqrt{3} = \tan\theta$

$\boxed{\theta = 60^\circ}$

$\frac{1}{20} = \frac{g}{2u^2\cos^2\theta}$

$\frac{1}{20} = \frac{10}{2u^2\cos^2 60^\circ}$

$2u^2\frac{1}{4} = 20\times 10$

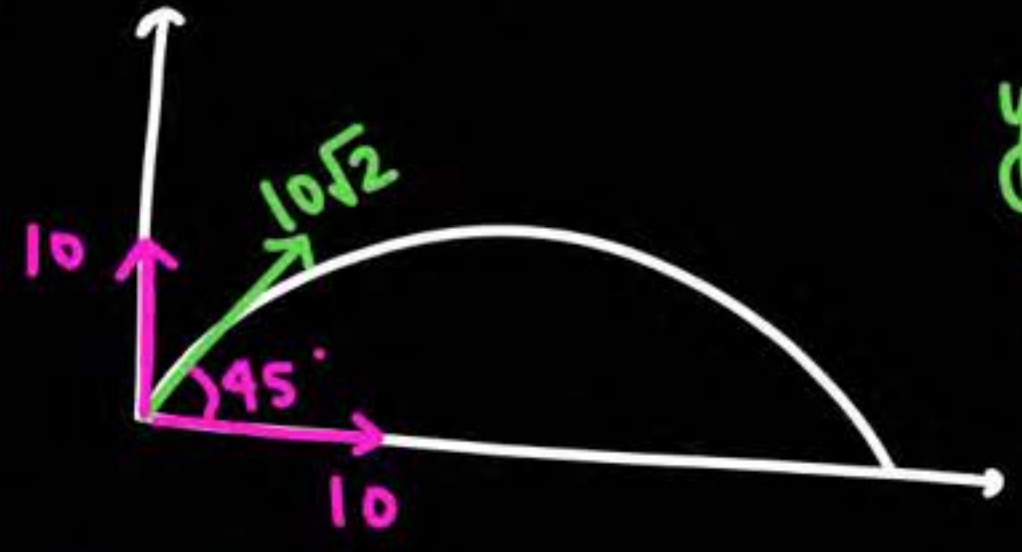
$u^2 = 400$

$\boxed{u = 20}$

Q If eq^n of trajectory is given by

$$y = x - \frac{x^2}{20}$$

① find u, θ, T, R . .



$$T = 1 + 1 = 2$$

$$R = 10 \times 2 = 20$$

$$y = x - \frac{x^2}{20}$$

$$y = x\tan\theta - \frac{1}{2} g \frac{x^2}{u^2\cos^2\theta}$$

$$\tan\theta = 1$$

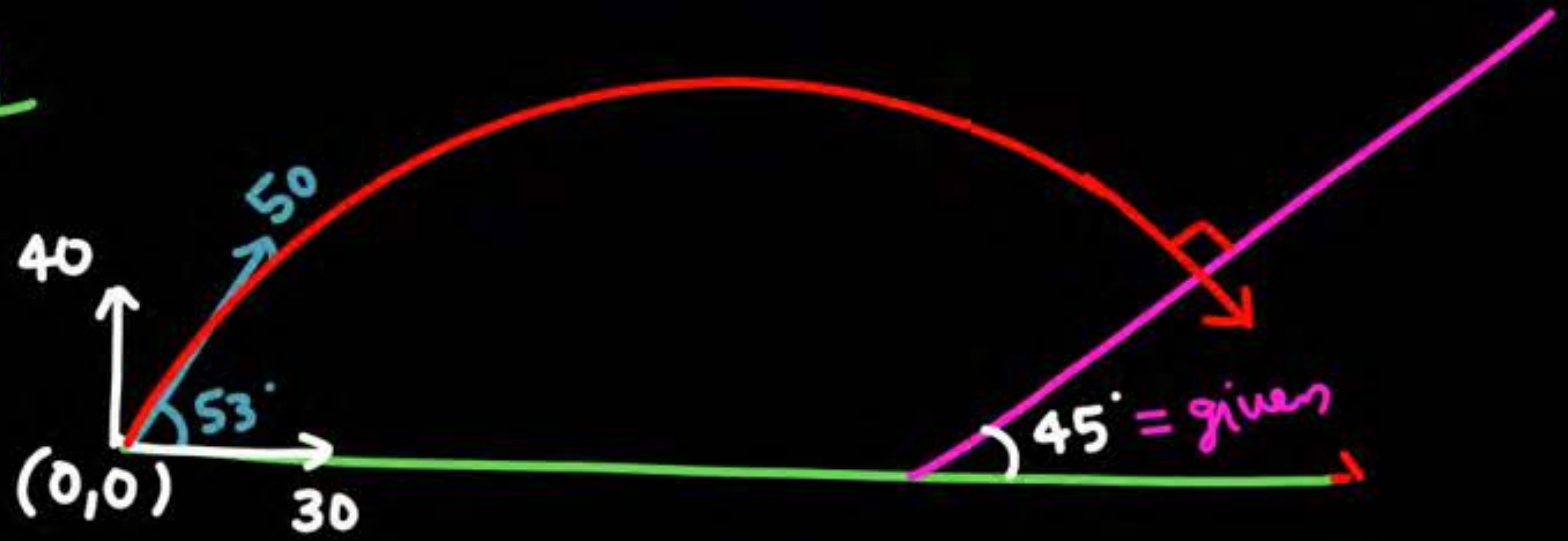
$$\theta = 45^\circ$$

$$\frac{1}{20} = \frac{g}{2u^2\cos^2 45^\circ}$$

$$2u^2 \frac{1}{2} = 200$$

$$\boxed{u = 10\sqrt{2}}$$

Q



particle strike the plane perpendicularly.

find T.

Co-ordinate of point where particle strike at plane

$v\cos 45 = 30$

$v = 30\sqrt{2}$

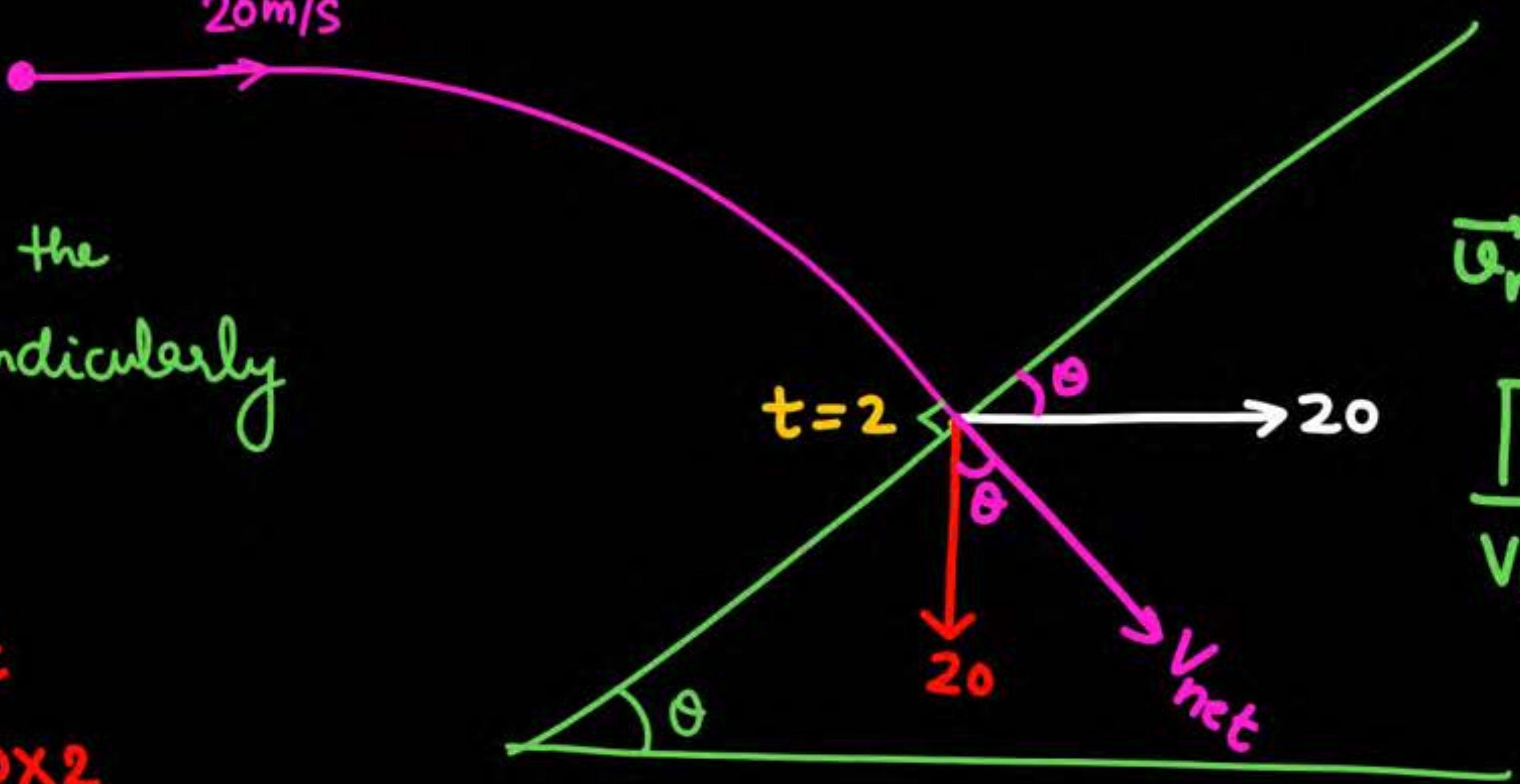
$t = 7 \Rightarrow x = 30\times 7 = 210$

$y = 40\times 7 - \frac{1}{2}\times 10\times 7^2$

(JA) find distance of striking point from projection point

Distance formula $= \sqrt{(x-0)^2 + (y-0)^2} =$

Q



particle strike the plane perpendicularly find θ

(y) $v = u + at$

$v = -10 \times 2$

$v = -20 = u_y$

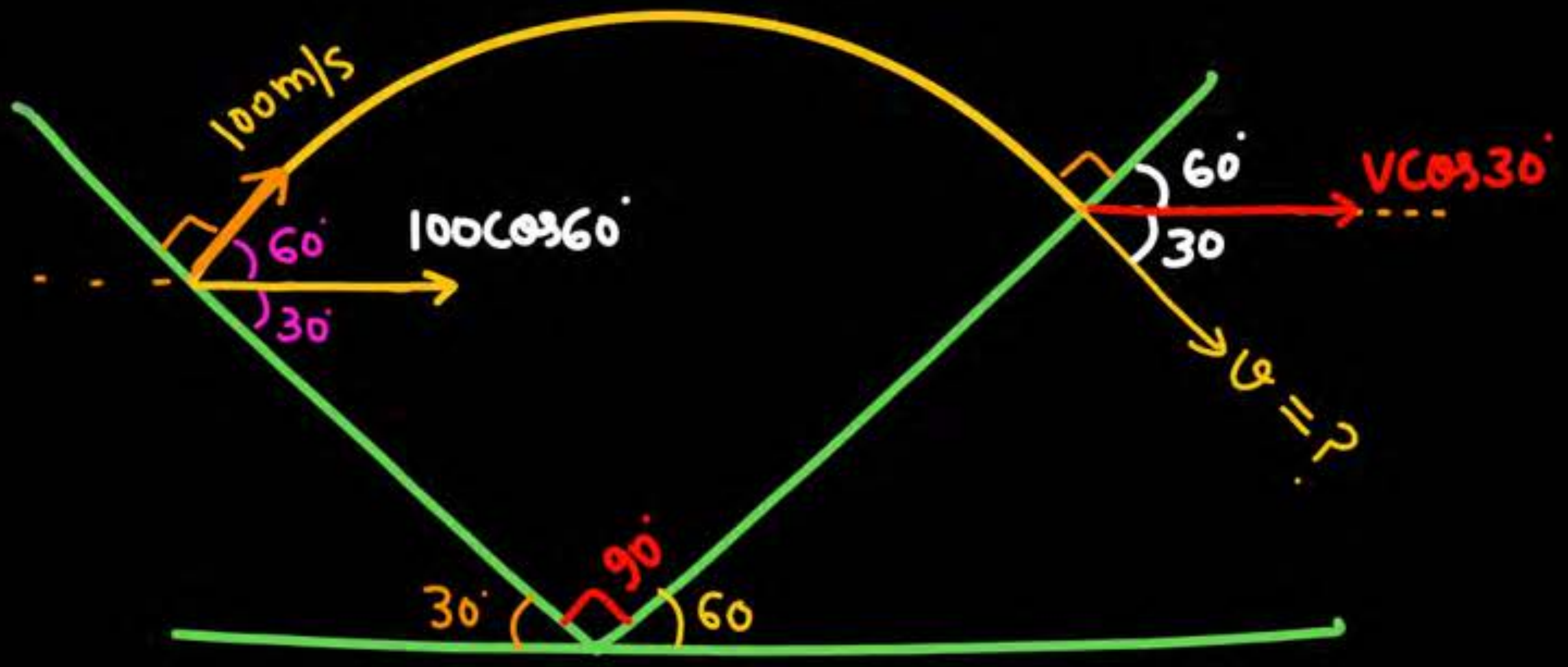
नीचे

$\vec{v}_{net} = 20\hat{i} - 20\hat{j}$

$\boxed{\theta = 45^\circ}$

$V_{net} = 20\sqrt{2}$

Q



$$100\cos 60 = V\cos 30$$

$$100 \times \frac{1}{2} = V\frac{\sqrt{3}}{2}$$

$$\boxed{V = \frac{100}{\sqrt{3}}}$$

$$\vec{r} = 4t^2\hat{i} + 2t^3\hat{j} + 4t^4\hat{k}$$

Q A particle is moving such that

$$x = 4t^2$$
$$y = 2t^3$$
$$z = 4t^4$$

$$v_x = \frac{dx}{dt} = 8t \longrightarrow a_x = 8$$
$$v_y = \frac{dy}{dx} = 6t^2 \longrightarrow a_y = 12t$$
$$v_z = \frac{dz}{dt} = 16t^3 \longrightarrow a_z = 48t^2$$

① find velocity at $t = 1\,sec$

$$\vec{v} = 8\hat{i} + 6\hat{j} + 16\hat{k}$$

$$\vec{v} = 8t\,\hat{i} + 6t^2\,\hat{j} + 16t^3\,\hat{k}$$
$$\vec{a} = 8\hat{i} + 12t\,\hat{j} + 48t^2\,\hat{k}$$

② find acc at $t = 2\,sec$

$$\vec{a} = 8\hat{i} + 24\hat{j} + 192\hat{k}$$

Q A particle is moving such that

$$\vec{r} = 2t^2\hat{i} + 4t^3\hat{j} + 6t^2\hat{k}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = 4t\hat{i} + 12t^2\hat{j} + 12t\hat{k}$$

$$\boxed{\vec{a} = 4\hat{i} + 24t\hat{j} + 12\hat{k}}$$

Q

Q A particle is moving such that

$$\vec{r} = 3t^2\hat{i} + 2t^3\hat{j} + 10t\,\hat{k}$$

find ① find $\vec{v}$ & $\vec{a}$ at $t = 1\,sec$

$$\vec{v} = 6t\,\hat{i} + 6t^2\hat{j} + 10\hat{k}$$

$$\vec{a} = 6\hat{i} + 12t\hat{j} + 0\hat{k}$$

$t = 1$ $\quad \vec{v} = 6\hat{i} + 6\hat{j} + 10\hat{k}$

$$\vec{a} = 6\hat{i} + 12\hat{j}$$

vector

② find angle b/w $\vec{v}$ & $\vec{a}$ at $t = 1\,sec$

$$\vec{a}\cdot\vec{v} = av\cos\theta$$

$$\cos\theta = \frac{\vec{a}\cdot\vec{v}}{av} = \frac{36+72+0}{\sqrt{6^2+12^2}\sqrt{6^2+6^2+10^2}}$$

$= \checkmark$