# Arjuna

## JEE 2024

- Subject Name- Physics
- Lecture 11
- Chapter- Motion in a Plane

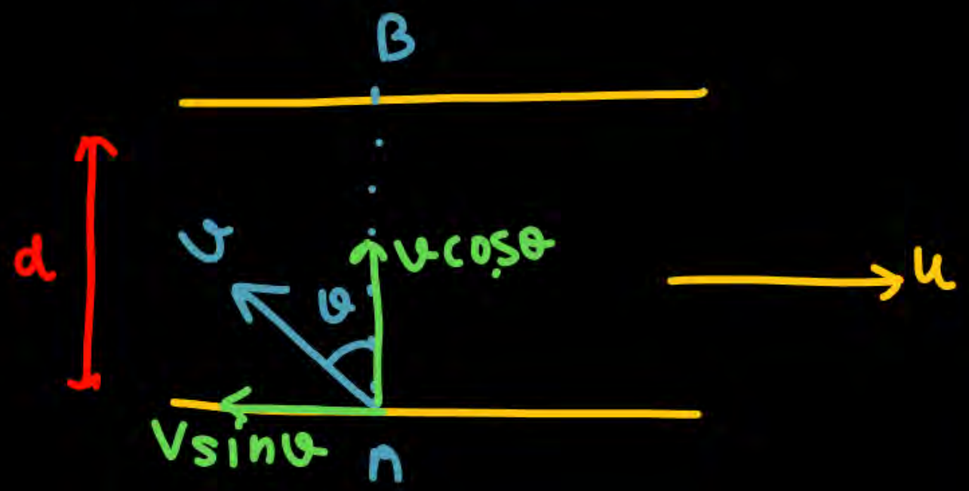


Saleem Ahmed Sir

# Today's Targets

1. River Boat Problem
2. Min Separation between two moving particle.
3.
4.

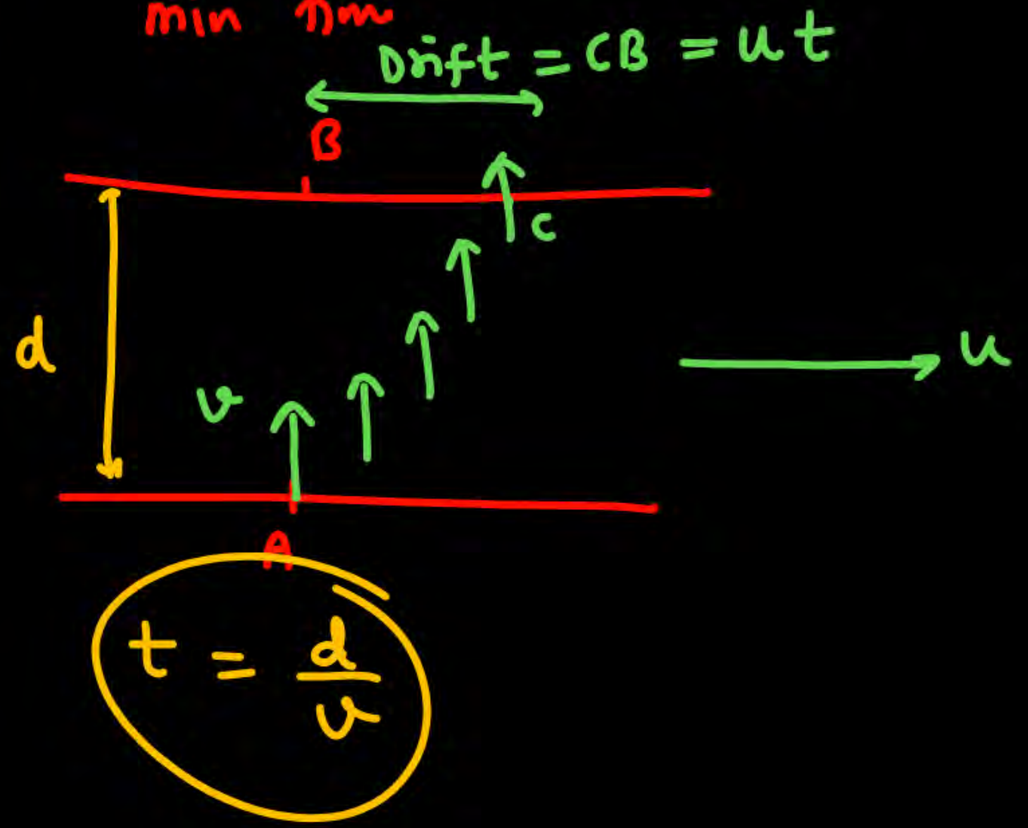
## min distance




$v\sin\theta = u$

$$t = \frac{d}{v\cos\theta}$$

## min time

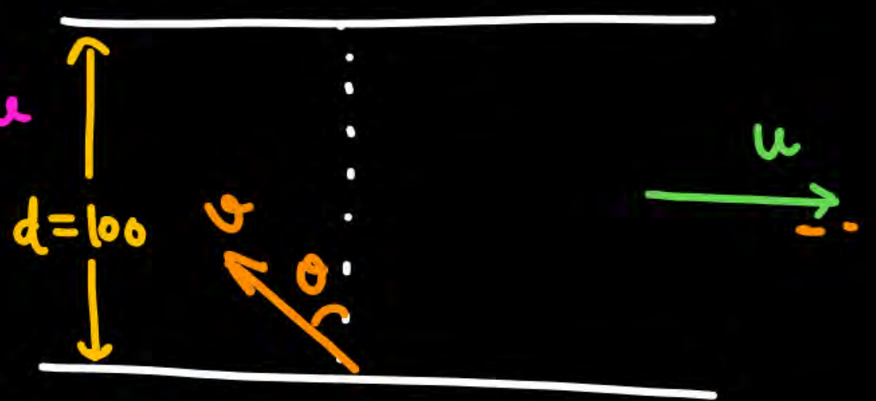



$$t = \frac{d}{v}$$

Q River is flowing with speed 5 m/s

$\vec{v}_{m/r} = 10$ m/s  $d = 100$ m

(1) In which dir$^n$ man should swim so that he crosses the river in min distance travel. also find time taken to cross the river.




$v\sin\theta = u$

$10\sin\theta = 5$

$\sin\theta = \frac{1}{2}$

$\theta = 30°$

$t = \frac{d}{v\cos\theta} = \frac{100}{10\cos 30} = \frac{20}{\sqrt{3}}$

(b) If he want to cross the river in min possible time

find min time to cross the river & drift

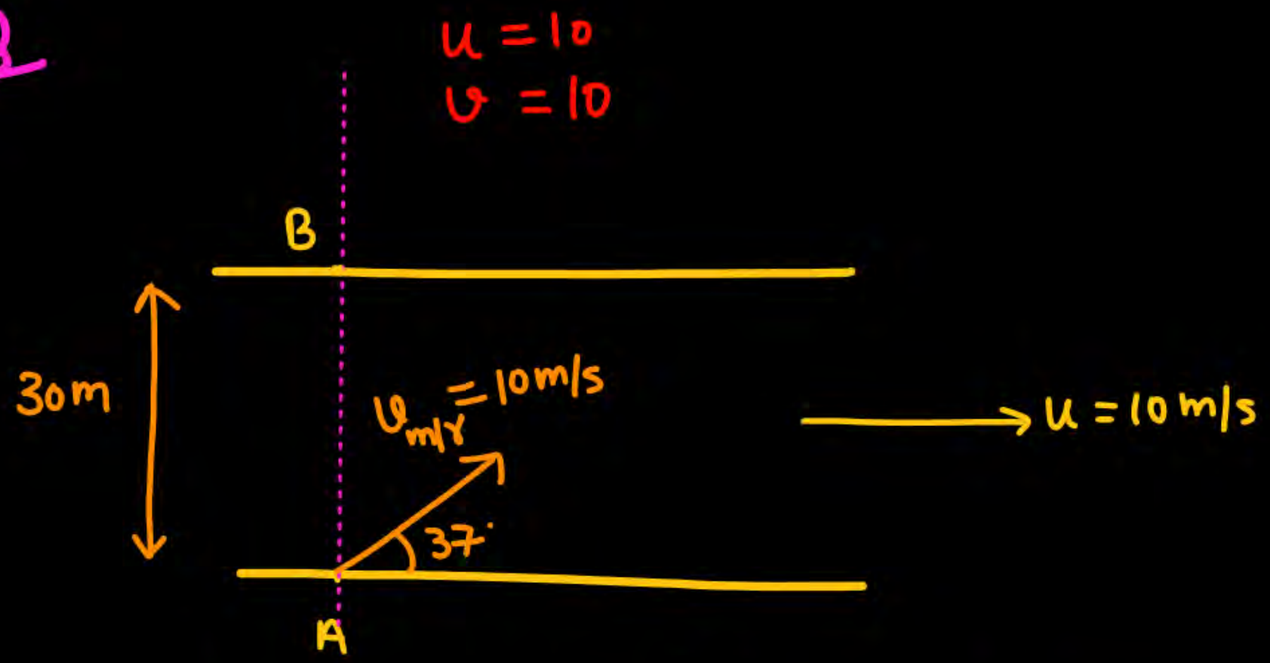



$t = \frac{100}{10} = 10$ sec

$BC = \text{drift} = 5 \times 10$

$= 50$ m

**Q**



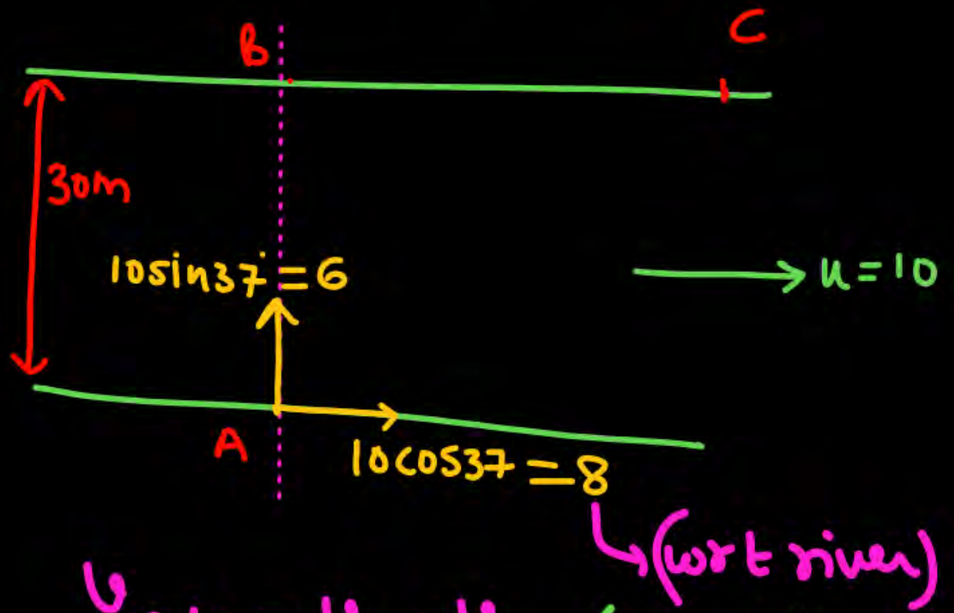

(a) find time taken to cross the river

**Soln**

$$t = \frac{d}{v\sin 37} = \frac{30}{6} = 5 \text{ sec}$$

**Soln (b)** find drift

$BC = 18 \times 5 = 90$

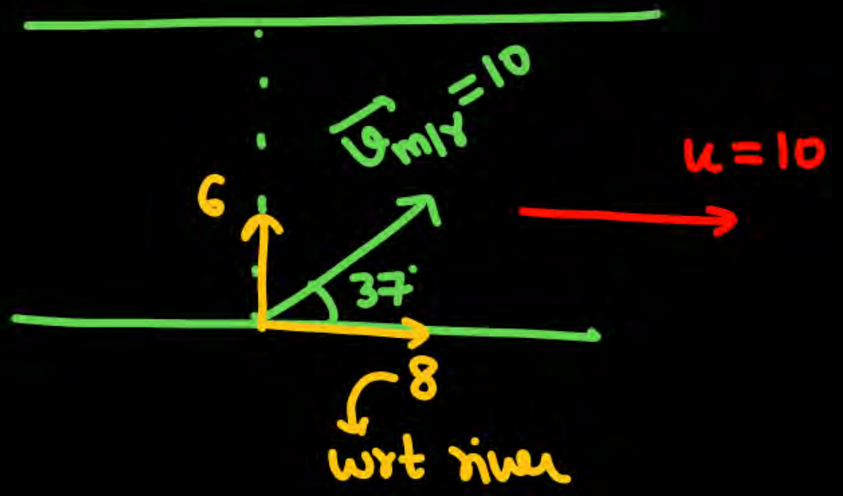



$v_{m/r} = v_m - v_r$ (x Axis)

$8\hat{i} = v_m - 10\hat{i}$

$\vec{v}_m = 18\hat{i}$

## शॉर्टकट method



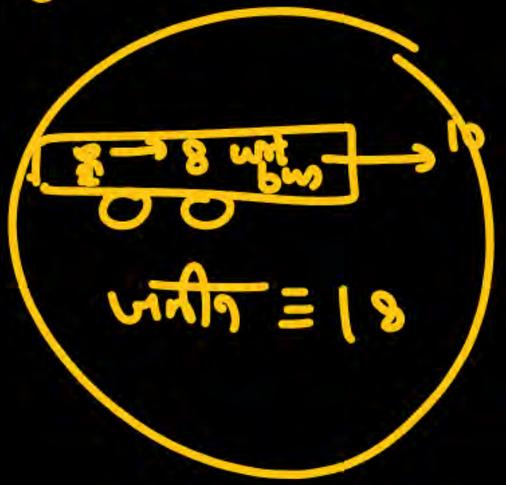

$$\vec{v}_{m/r} = 10\cos 37\,\hat{i} + 10\sin 37\,\hat{j}$$

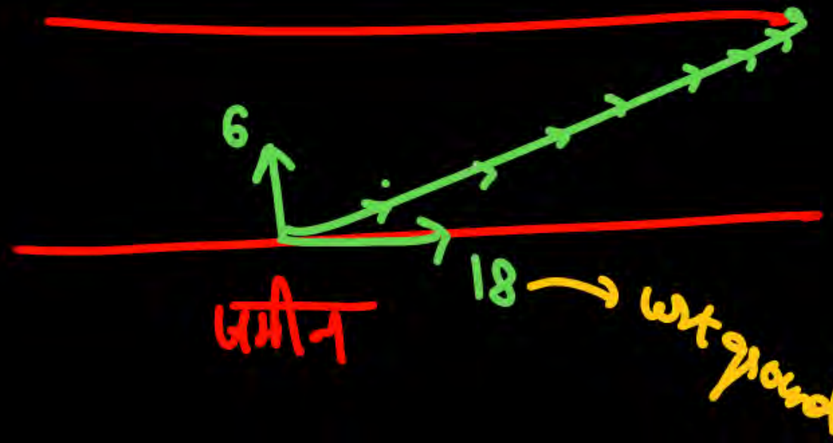
$$\vec{v}_{m/r} = 8\hat{i} + 6\hat{j}$$

$$\vec{v}_m - \vec{v}_r = 8\hat{i} + 6\hat{j}$$

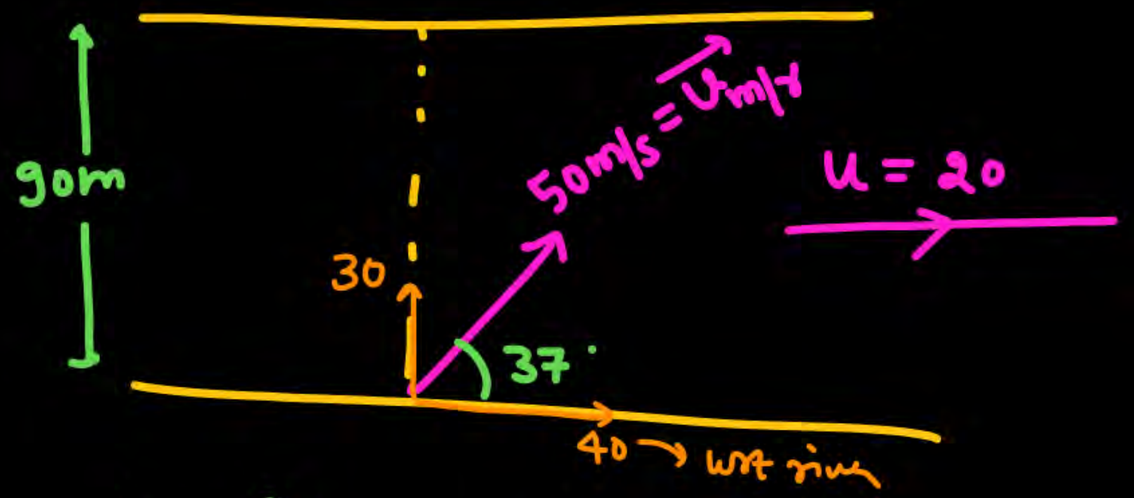
$$\vec{v}_m - 10\hat{i} = 8\hat{i} + 6\hat{j}$$

$$\vec{v}_m = 18\hat{i} + 6\hat{j}$$



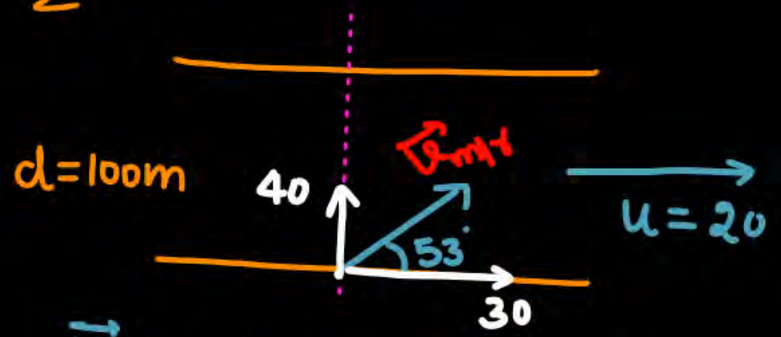
Q




$$t = \frac{90}{50\sin 37} = \frac{90}{30} = 3$$

Drift = $60 \times 3 = 180$

Q




$\vec{v}_{m/r} = 50$ , $u = 20\ m/s$

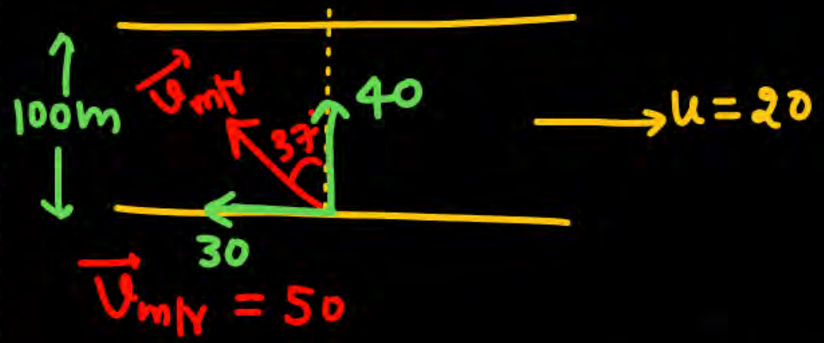
① time to cross river

$$t = \frac{100}{40} = 2.5$$

② Drift $= (30+20) \times 2.5$

$= 125$

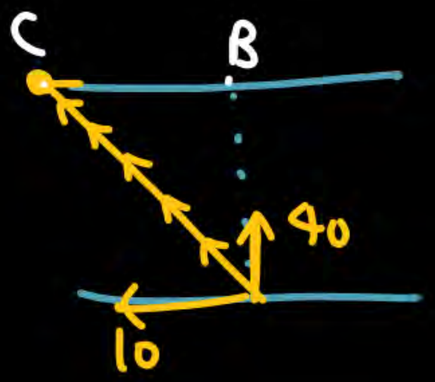
Q




$\vec{v}_{m/r} = 50$

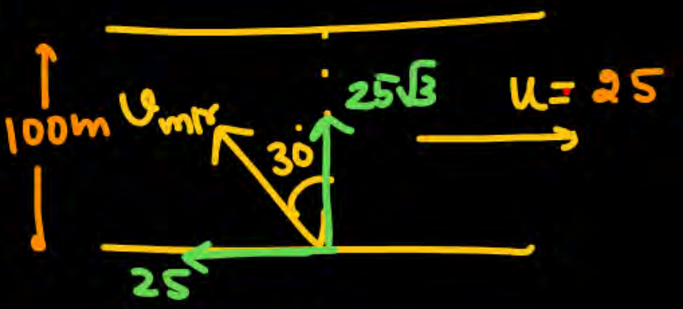
① time to cross $= \frac{100}{40} = 2.5$

② Drift $= 10 \times 2.5 = 25$




$50\cos 37° = 25\sqrt{3}$

Q

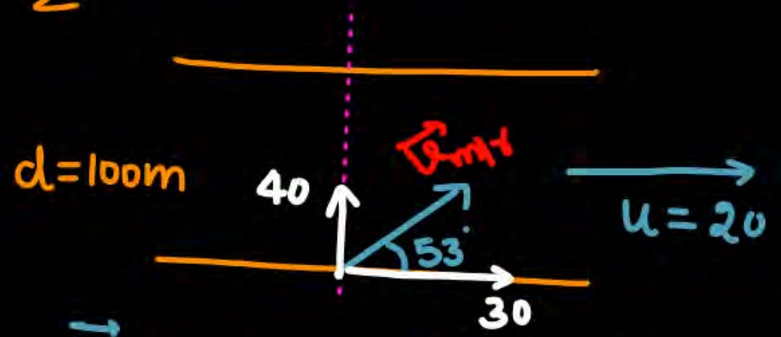



$v_{m/r} = 50$

time to cross $= \frac{100}{25\sqrt{3}}$

Drift $= 0$

Q

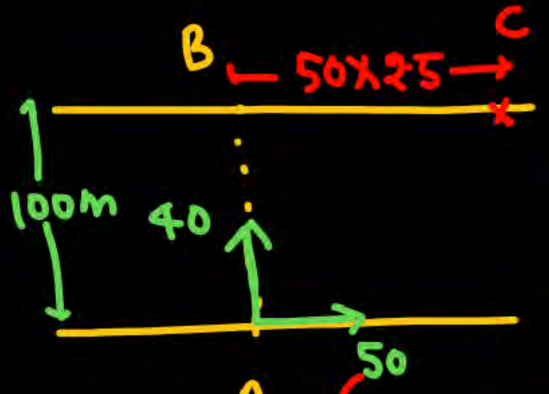



$\vec{v}_{m/r} = 50$ , $u = 20\ m/s$

$\vec{v}_{m/r} = 30\hat{i} + 40\hat{j}$

$\vec{v}_m - 20\hat{i} = 30\hat{i} + 40\hat{j}$

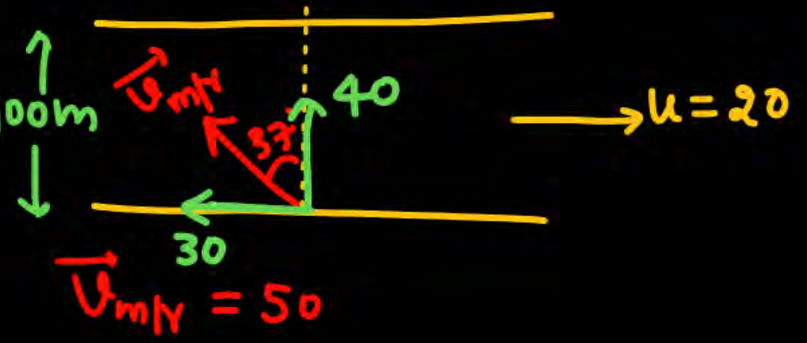
$\vec{v}_m = 50\hat{i} + 40\hat{j}$




(w.r. ground)

$t = \frac{100}{40} = 2.5$

Q




$\vec{v}_{m/r} = 50$

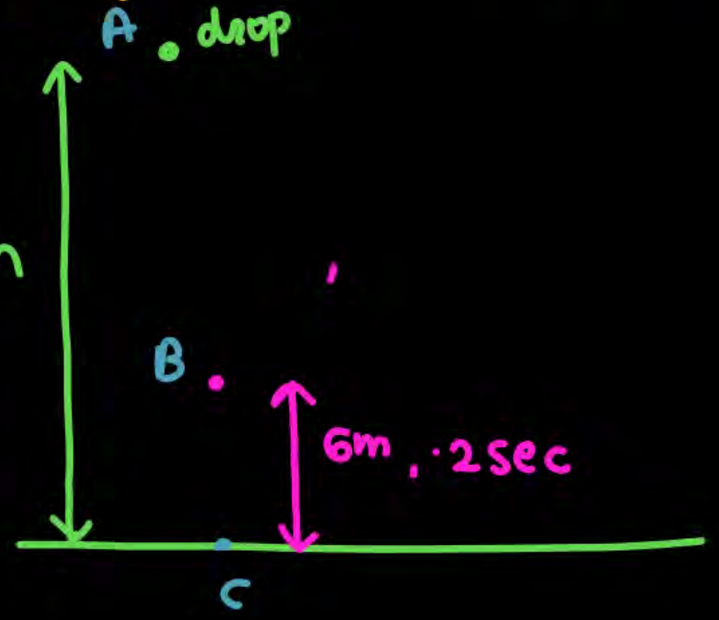
HCV

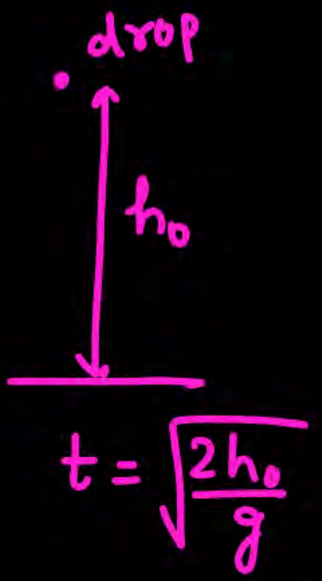
Q

A ball dropped from a height, if it takes ·2 sec to cross the last 6m before hitting the ground. find height from which it was dropped.

$$t_{A \to C} = t = \sqrt{\frac{2h}{g}}$$

$$t_{A \to B} = t - \cdot 2 = \sqrt{\frac{2(h-6)}{g}}$$




hit & trial

H.W

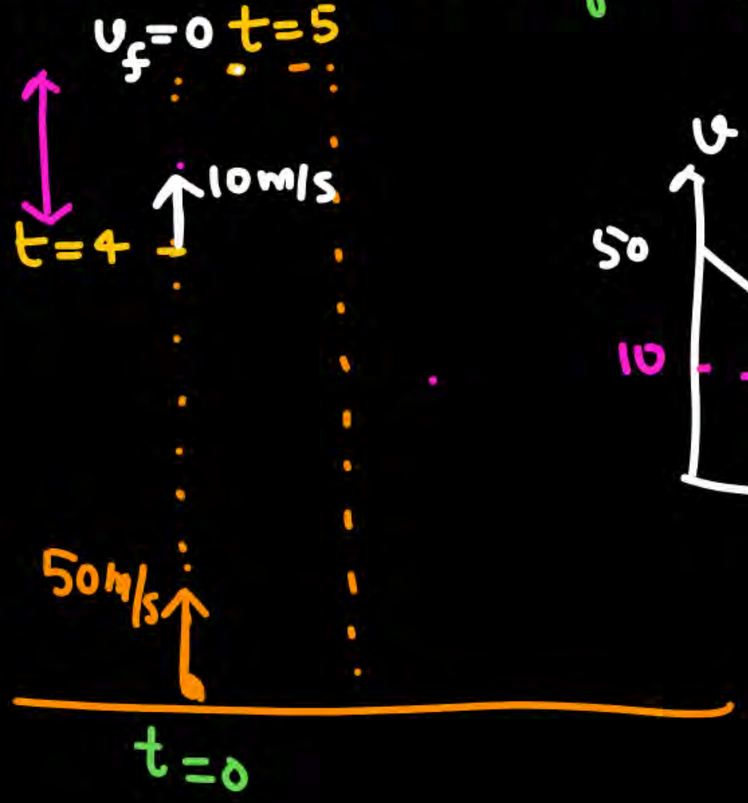
R·m

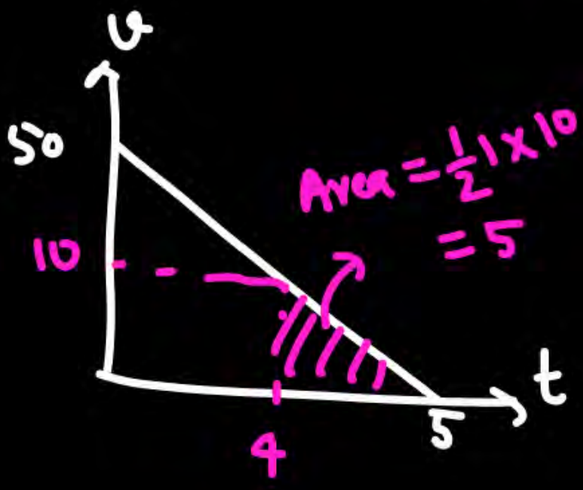
Q A ball is projected vertically upward with velocity 50 m/s find distance travelled by ball in last sec of upward journey.

$v^2 = u^2 + 2as$

$0^2 = 10^2 - 2 \times 10 \times h_0$

$\boxed{h_0 = 5\,m}$



R·m

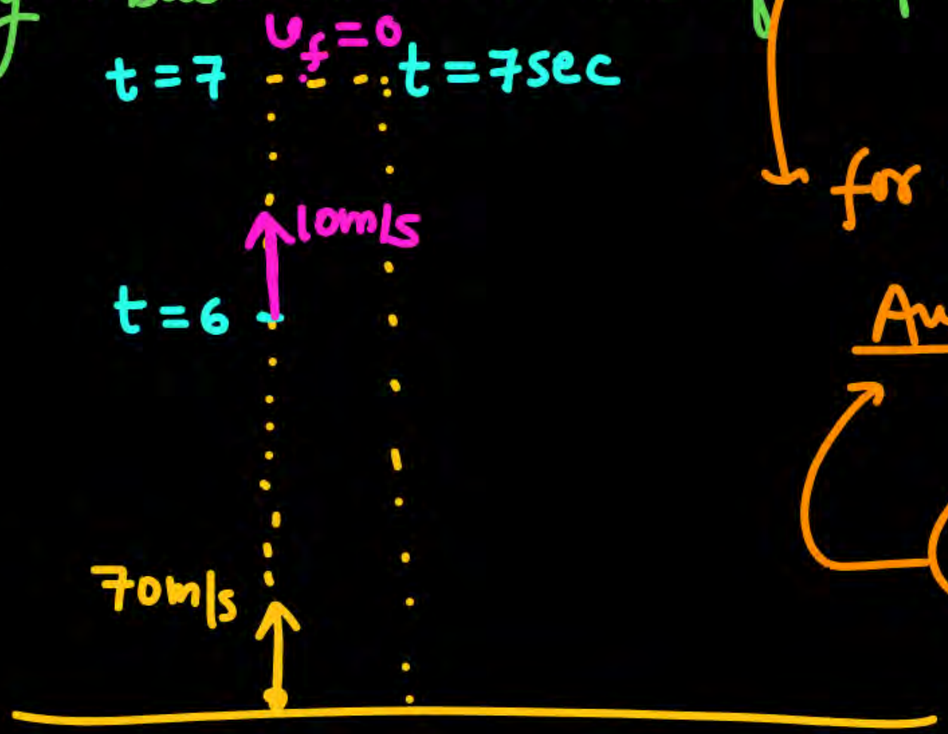
Q

A ball is projected vertically upward with velocity 70 m/s find distance travelled by ball in last sec of upward journey.

$t=6 \longrightarrow t=7$

$0^2 = 10^2 - 2\times10\times h_0$

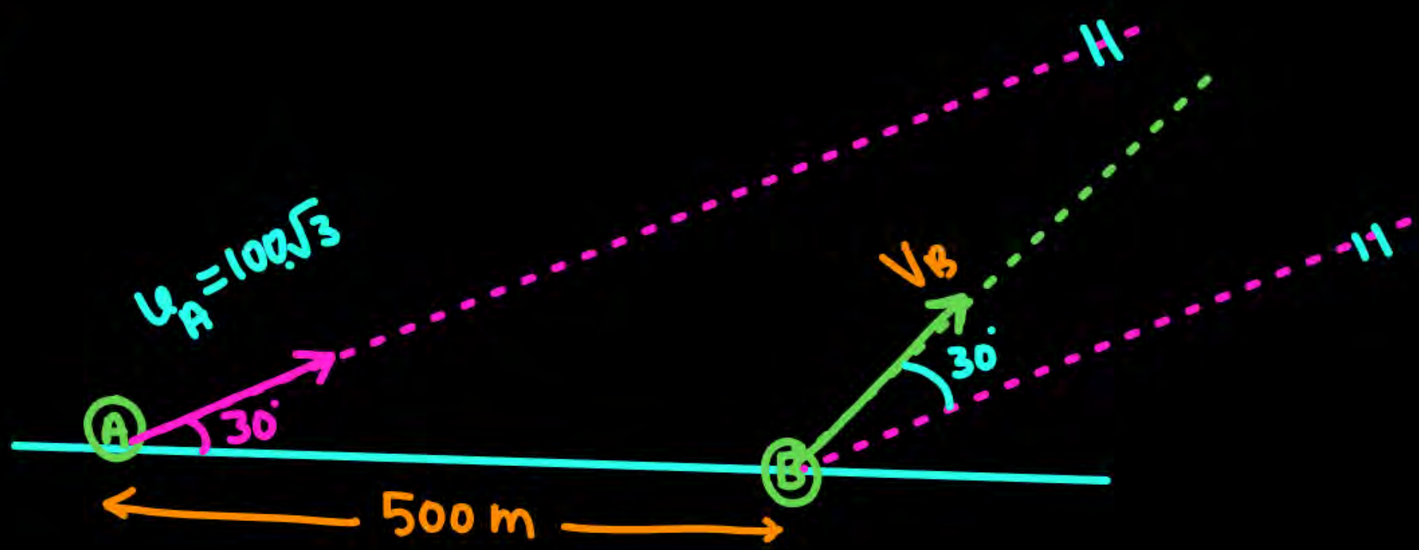
$\boxed{h_0 = 5\,m}$




for any velocity Ans will be same.

K·C

Q

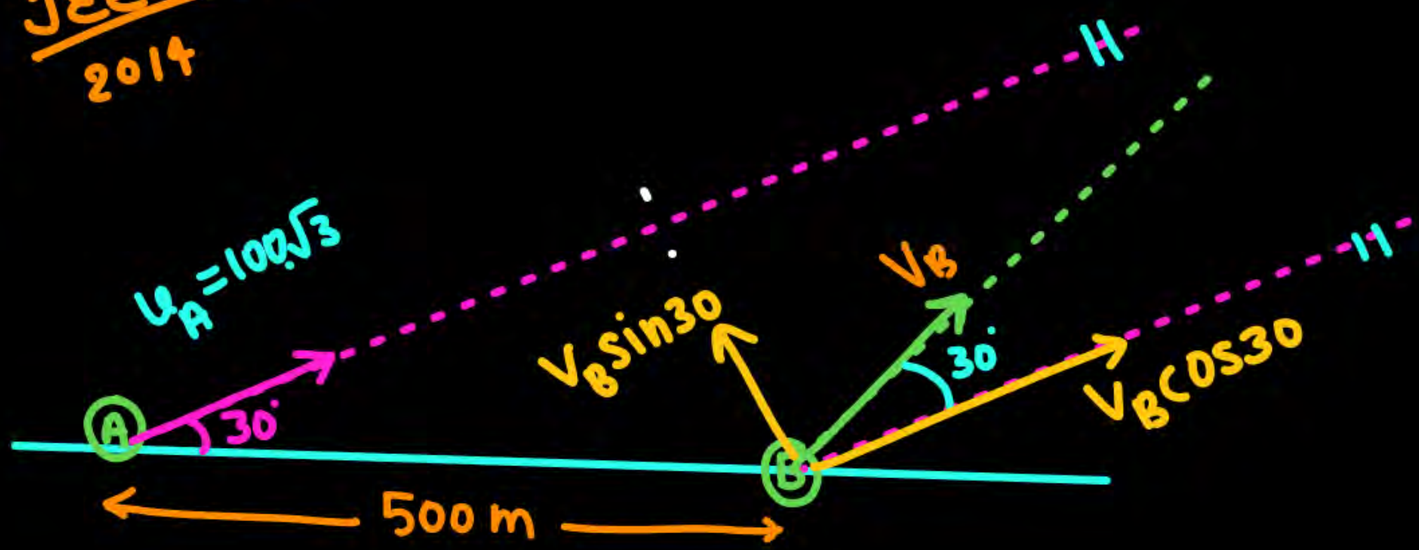



① find $v_B$

if observer in A observe that B is moving with const velocity perpendicular to the line of motion of A

Tough

JEE Adv.
2014



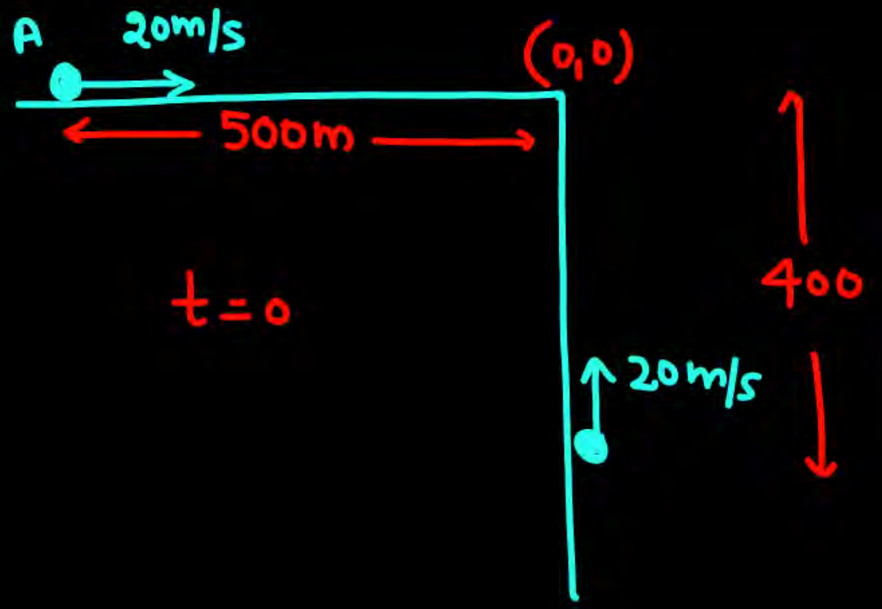

① find $V_B$

if observer in A observe that B is moving with const velocity perpendicular to the line of motion of A

$$u_A = u_B \cos 30$$

$$100\sqrt{3} = u_B \frac{\sqrt{3}}{2}$$

# Min distance between two moving particle.




find min gap between them

Soln

$\vec{v}_A = 20\hat{i}$

$\vec{v}_B = 20\hat{j}$

$\vec{v}_{B/A} = 20\hat{j} - 20\hat{i}$

$\vec{v}_{B/A} = -20\hat{i} + 20\hat{j}$

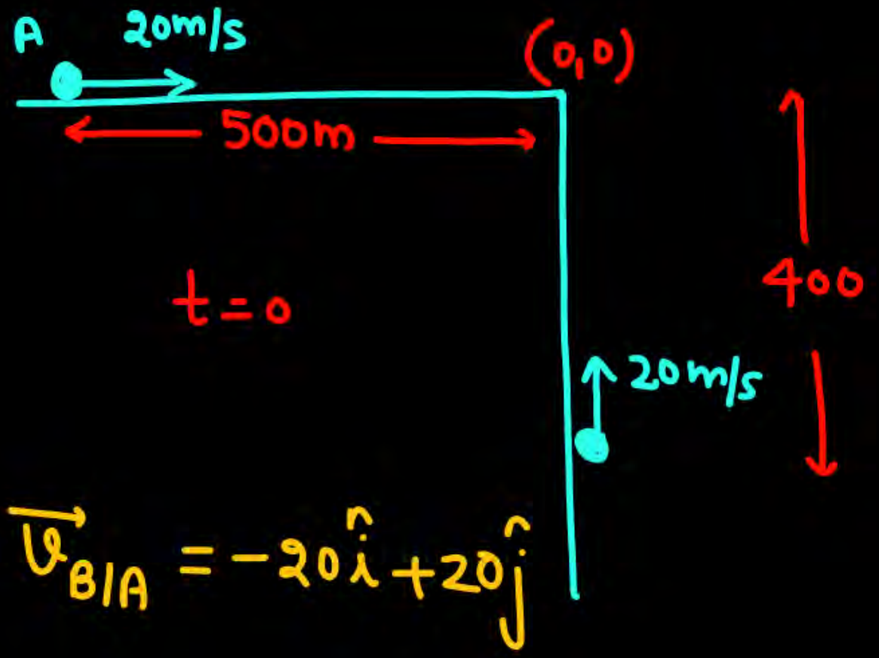
① $v_A$ $v_B$ = ✓

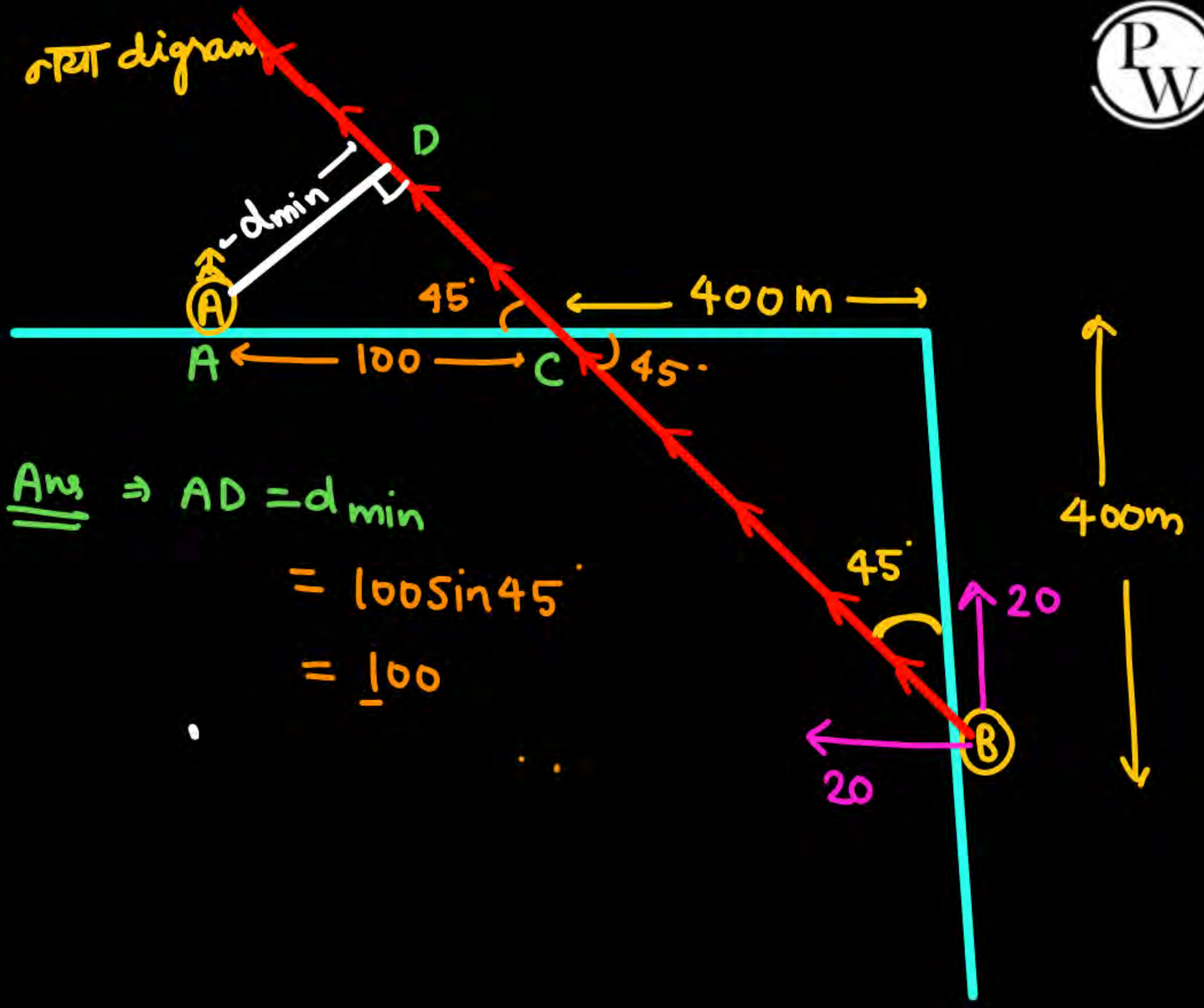
② $v_{B/A}$ = ?

③ नया figure बनाओ

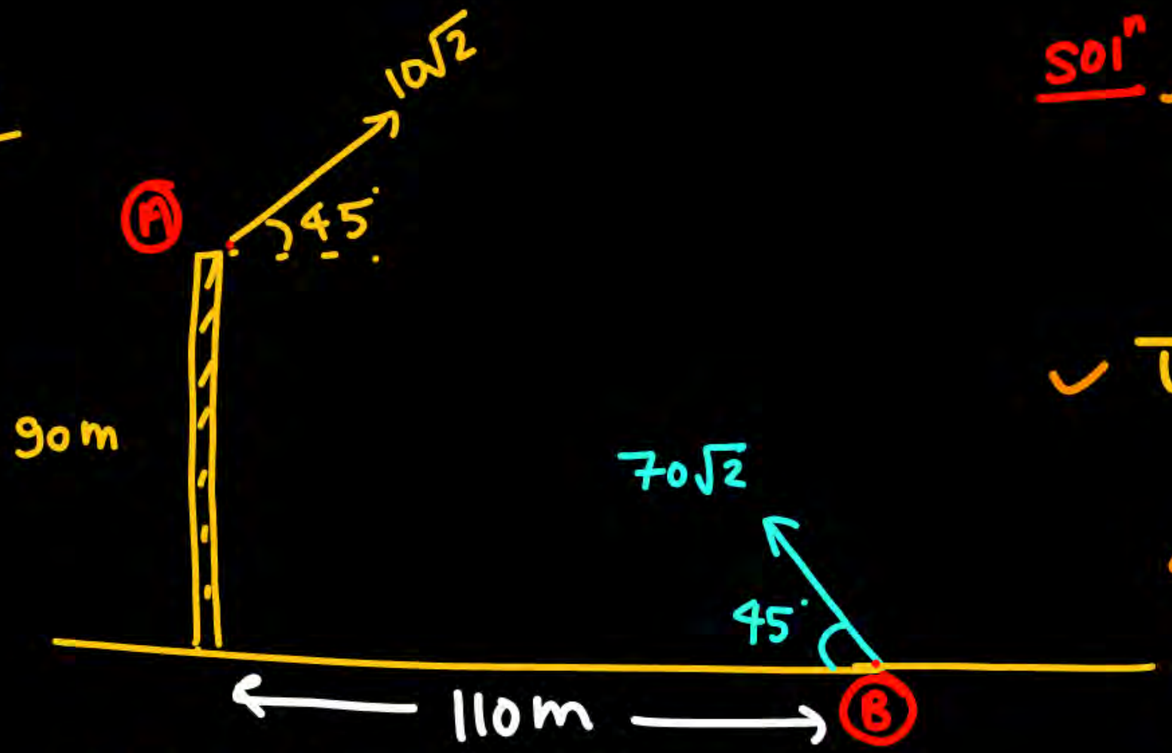
④ रास्ता समझो ⊥ draw करो।

("Maths")


A
20m/s
(0,0)
500m
400
t=0
20m/s
$\vec{v}_{B/A} = -20\hat{i} + 20\hat{j}$


नया digram
D
$d_{min}$
A
45°
400m
A
100
C
45°
Ans ⇒ AD = $d_{min}$
= 100 sin 45°
= 100
45°
20
400m
20
B

Q




Min Distance between them

Sol$^{n}$ ✓ $\vec{v}_A = 10\hat{i} + 10\hat{j}$

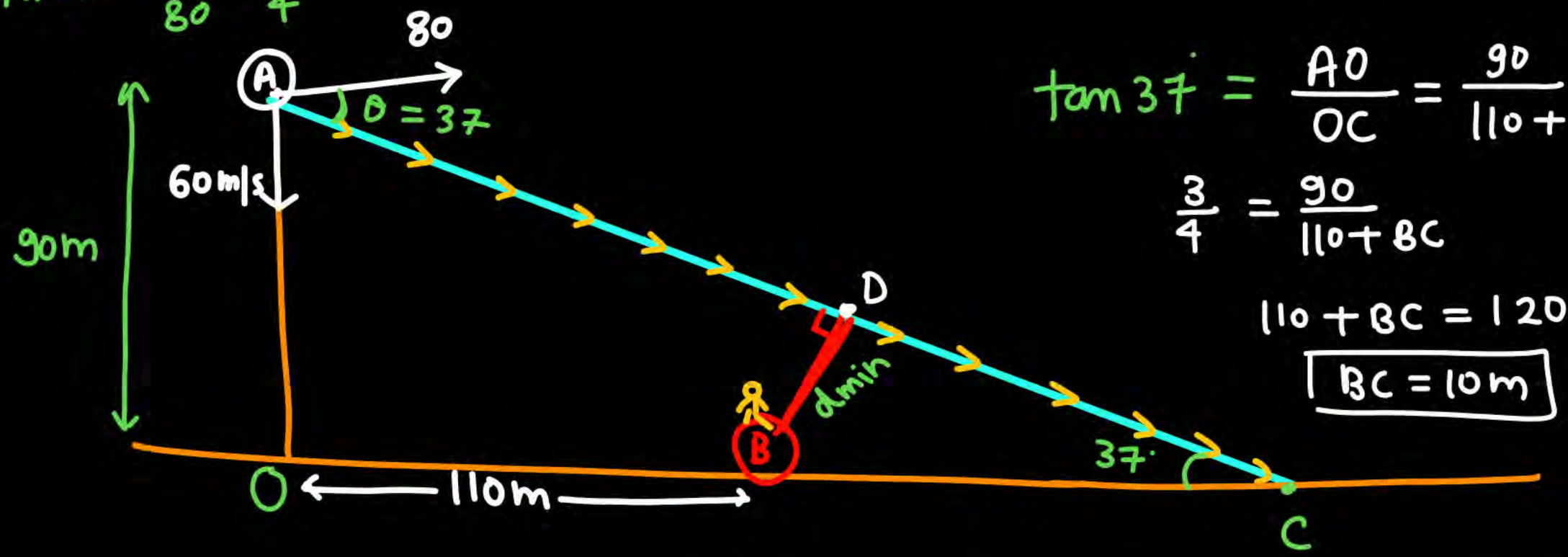
$\vec{v}_B = -70\hat{i} + 70\hat{j}$

✓ $\vec{v}_{A|B} = 80\hat{i} - 60\hat{j}$

$\vec{a}_{A|B} = 0$

नया daigram ✓

$\tan\theta = \frac{60}{80} = \frac{3}{4}$




$\tan 37^\circ = \frac{AO}{OC} = \frac{90}{110+BC}$

$\frac{3}{4} = \frac{90}{110+BC}$

$110 + BC = 120$

$\boxed{BC = 10\text{m}}$

Ans $BD = d_{min} = 10\sin 37 = 6$

$\sin 37^\circ = \frac{BD}{BC} = \frac{BD}{10}$

# Home work

- DPP-05 ⇒ (1.5 hour), Solve very carefully with fresh mind

  expectation ≡ ⩾ 40%.

- KPP is Back

  ⇓

  motion in a plane (PYQ)

{1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 31
 19, 20, 22, 24, 25, 29, 33, 34, 37, 39, 42, 43}

Solve Rest ques on Saturday

(Solve Thursday - Friday when you got time)


thank you