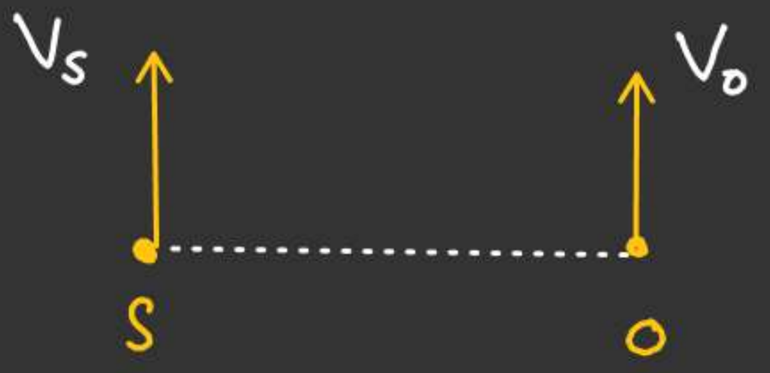
Nishant Jindal

Doppler Effect

⇒ When Source and observer moving parallel to each other



$$\underline{f_{app} = f_{real}} \checkmark$$

Along the line going V_s & V_o is zero.

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(*) **When Source moving in a Circle**

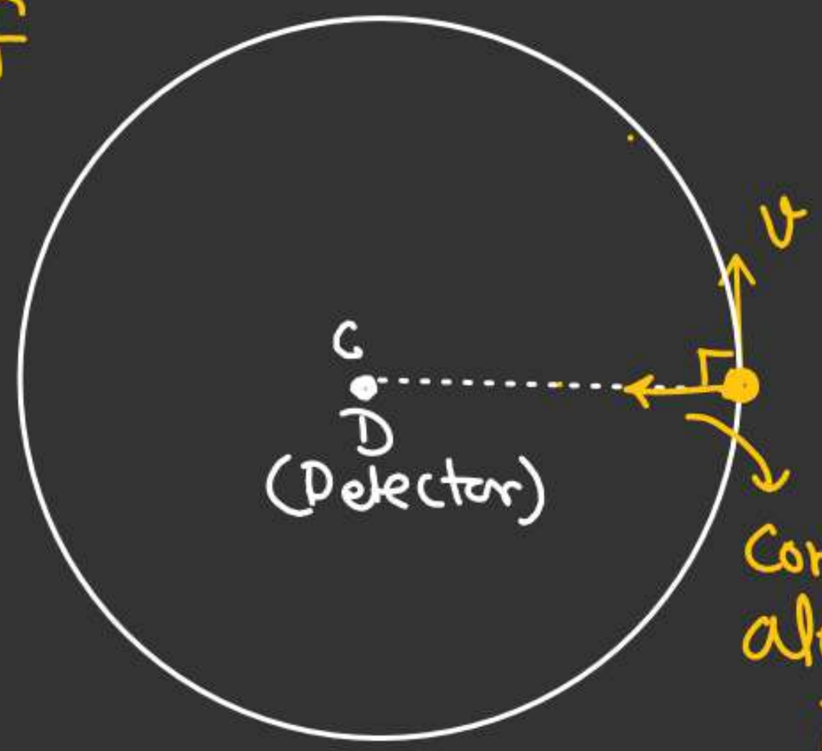
Case-1 Detector at the Center of the Circle on which Source is moving

$$f_{app} = \left(\frac{V \pm V_o}{V \mp V_s}\right) f$$

$V_o = 0$

$(V_s) = 0$

$\underline{f_{app} = f}$



Component of V_s along the line joing is zero.

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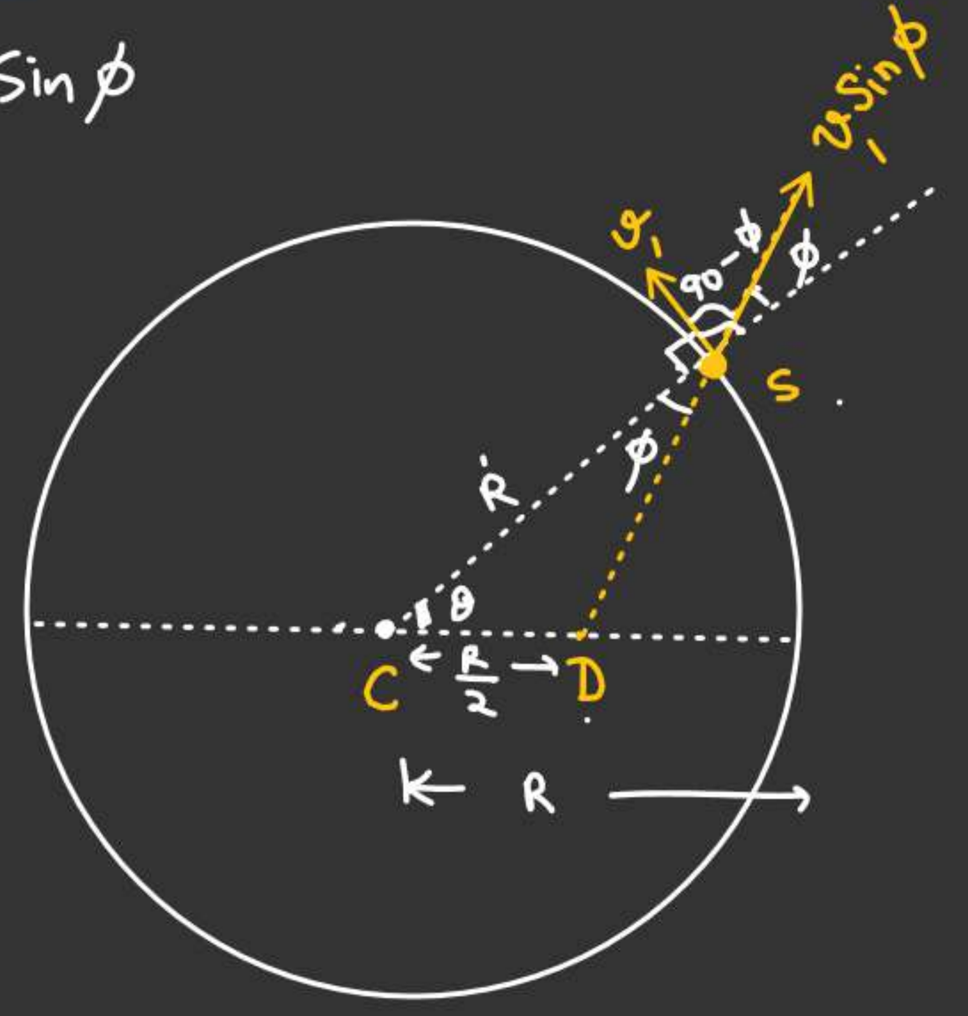
D → Detector

$V_0 = 0, \; v_s = v_1 \sin\phi$

$$f_{app} = \left[\frac{V}{V + v_1 \sin\phi}\right] f$$



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Doppler Effect

$(f_{app})_{max} = ??$

$(f_{app})_{min} = ??$

$$f_{app} = \left(\frac{V \pm V_o}{V \mp V_s}\right) f$$

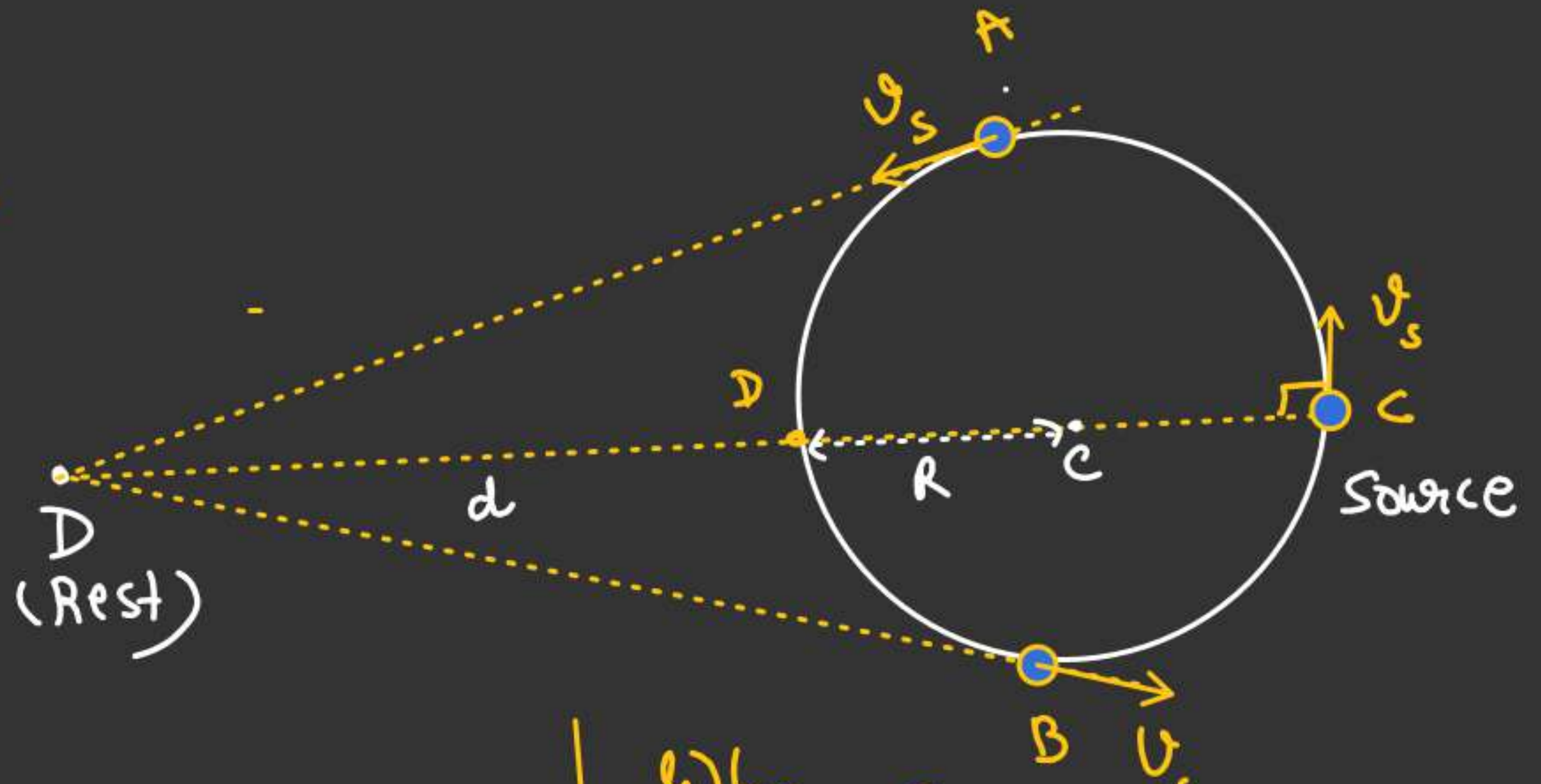
$$V_o = 0$$

$$f_{app} = \left(\frac{V}{V \mp V_s}\right) f$$

for $(f_{app})_{max}$ denominator should be min ie $(V - V_s)$

So, At point A $(f_{app})_{max}$

For $(f_{app})_{min}$, denominator should be maximum ie $(V + V_s)$. So, at point B $(f_{app})_{min}$.



When source at C & D

$$f_{app} = (f_{real})$$

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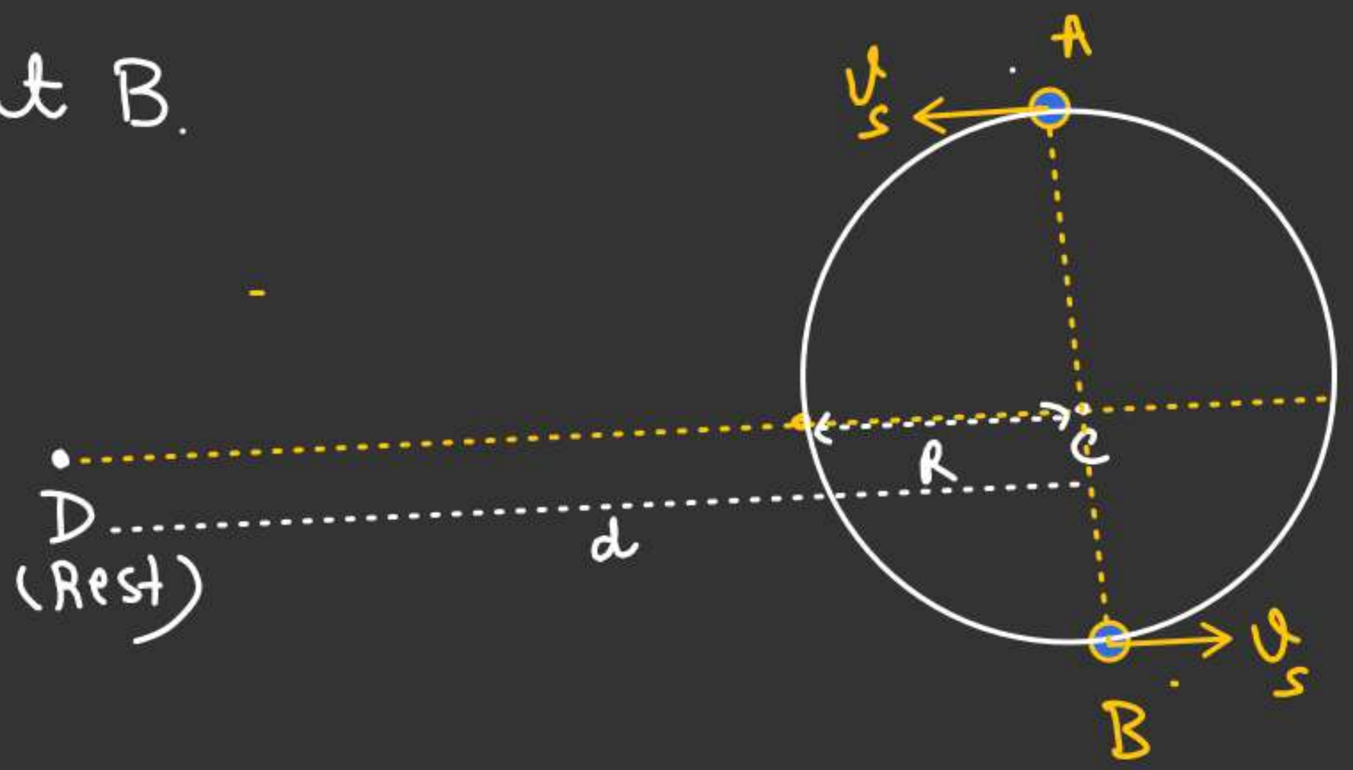
$\left(\underline{R << d} \right)$,

$(f_{app})_{max}$ at A

$(f_{app})_{min}$ at B.



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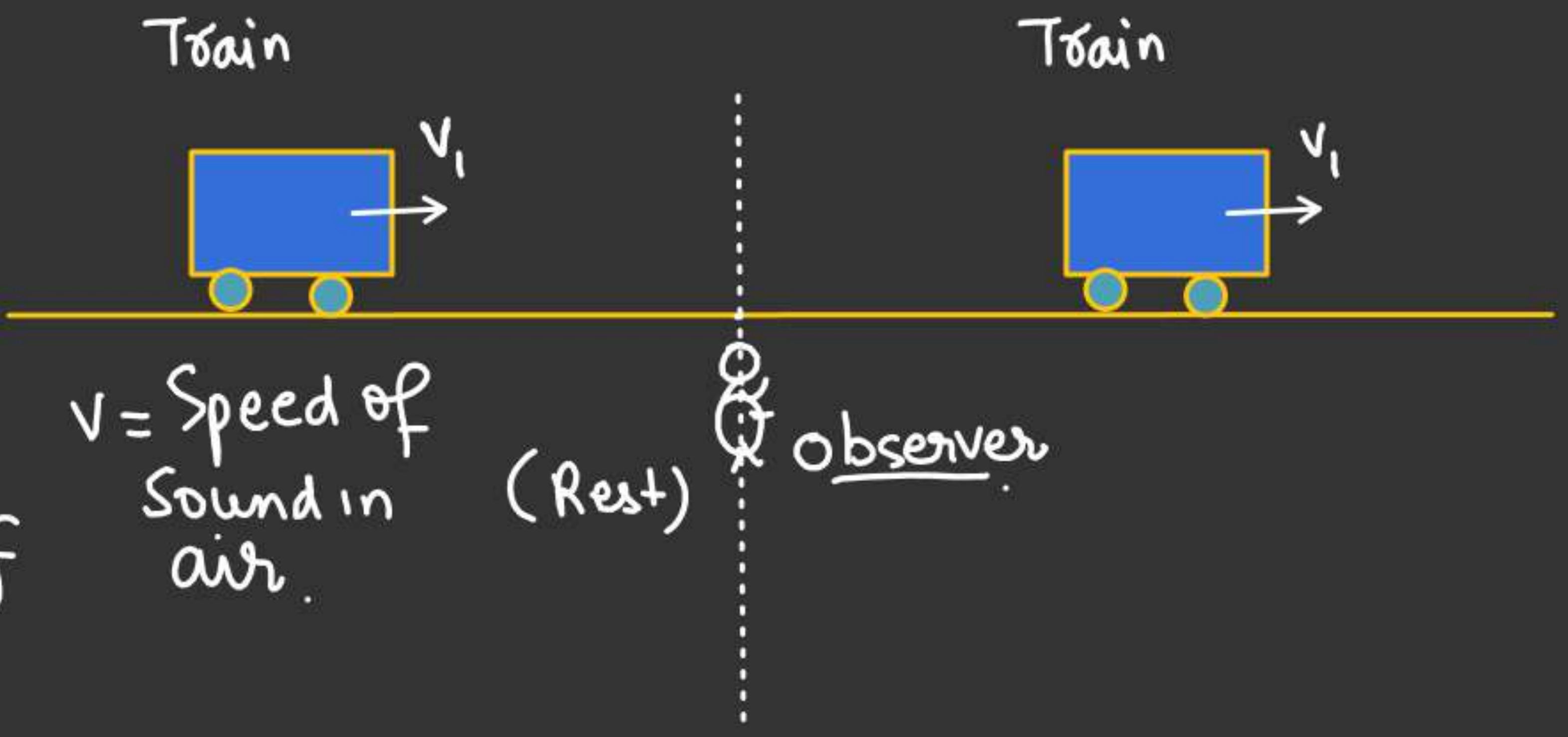
No of beats heard by Observer. ??



When train approaching the Observer.

$$(f_{app})_1 = \left(\frac{V}{V - V_1}\right) f$$

When train moving away from observer

$$(f_{app})_2 = \left(\frac{V}{V + V_1}\right) f$$

$$\text{Beats} = \left|(f_{app})_1 - (f_{app})_2\right|$$

$$= Vf\left[\frac{1}{V - V_1} - \frac{1}{V + V_1}\right]$$

$$= Vf\left[\frac{2V_1}{V^2 - V_1^2}\right] = \left(\frac{2VV_1}{V^2 - V_1^2}\right) f.$$

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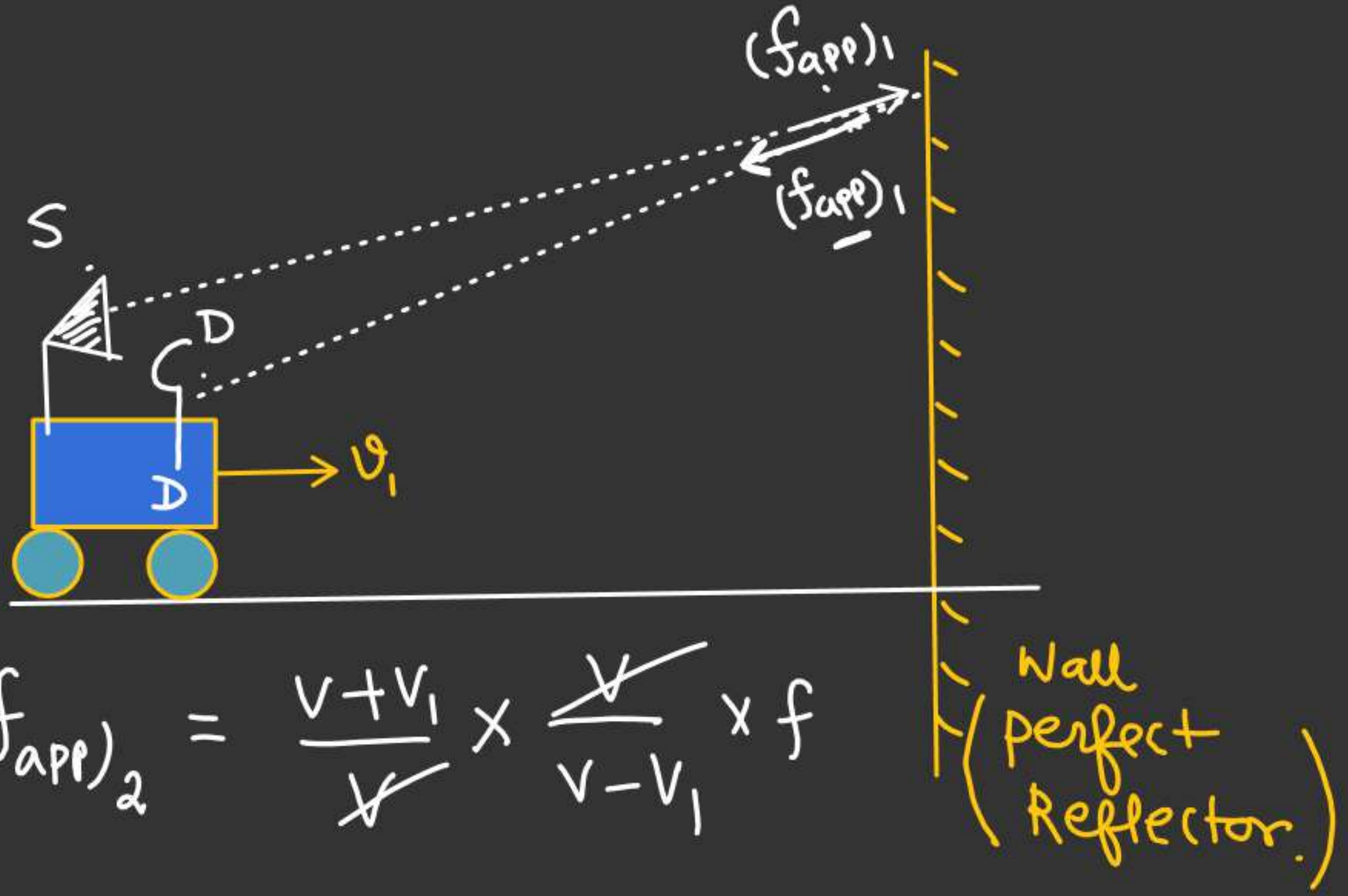
Doppler Effect

Case of perfect reflector

App frequency detect by detector.



Wall as a observer $(V_o = 0)$

Let, $(f_{app})_1$ be the frequency received by wall.

$$(f_{app})_1 = \left(\frac{V}{V - V_1}\right) f \quad -①$$

Wall as a Source $(V_s = 0)$

Let, dectector detects $(f_{app})_2$

$$(f_{app})_2 = \left(\frac{V + V_1}{V}\right) \times (f_{app})_1 \quad -②$$

$$(f_{app})_2 = \frac{V + V_1}{\cancel{V}} \times \frac{\cancel{V}}{V - V_1} \times f$$

$$\boxed{(f_{app})_2 = \left(\frac{V + V_1}{V - V_1}\right) f}$$

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$$\boxed{(f_{app})_2 = \left(\frac{V+V_1}{V-V_1}\right)f}$$

No of beats as detect by detector

$$= \left|(f_{app})_2 - f\right|$$

$$= \left|\frac{V+V_1}{V-V_1} - 1\right| f$$

$$= \left(\frac{2V_1}{V-V_1}\right)f$$

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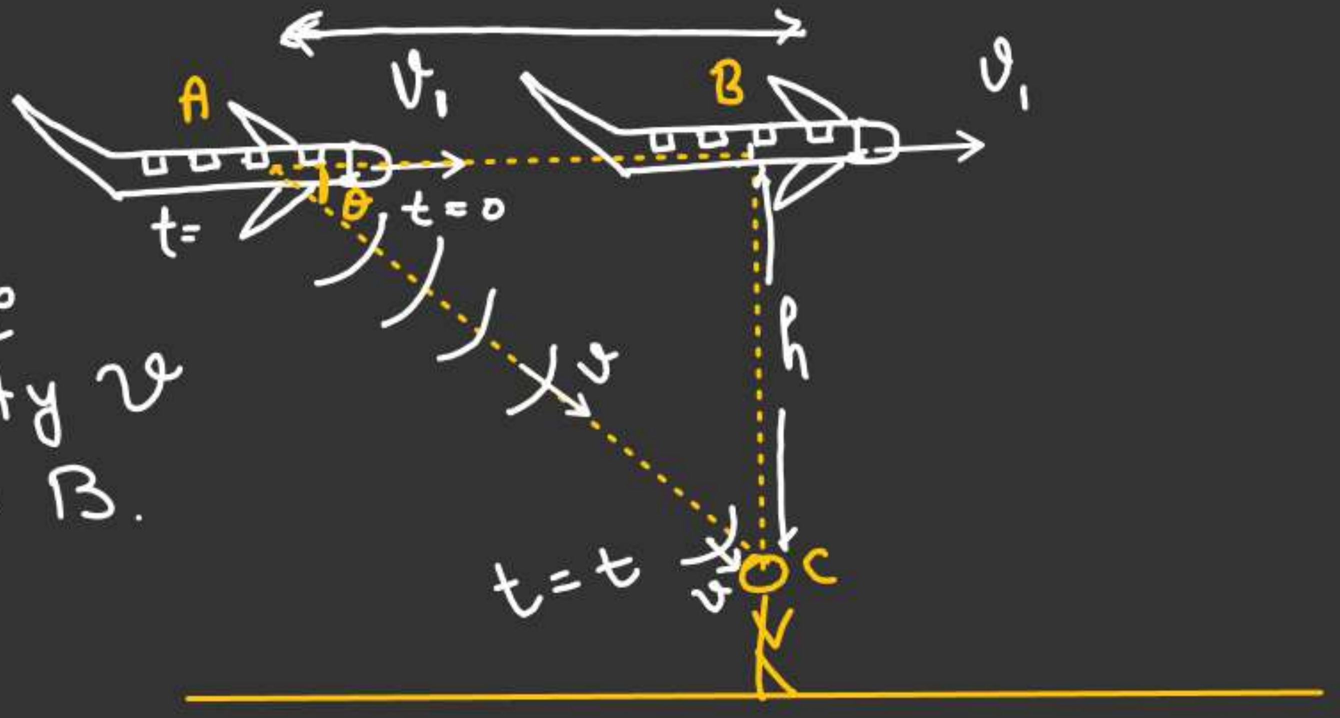
Doppler Effect

When plane just above the observer

$(f_{app}) = ??$

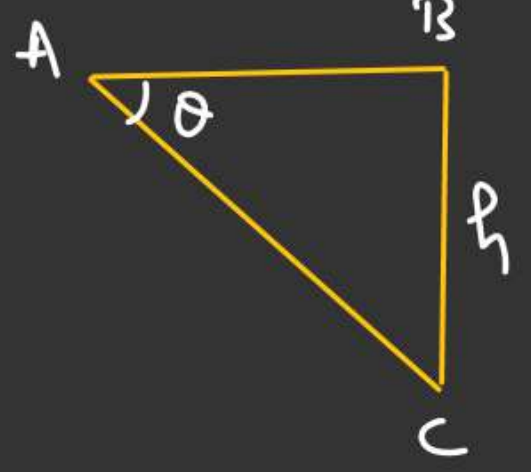


When sound emitted by aeroplane at A reaches to C with velocity v then aeroplane is at position B.

$$\frac{AB}{v_1} = \frac{AC}{v}$$

time taken by aeroplane to reach from A to B

time taken by sound wave to reach from A to C.



$$\tan\theta = \frac{BC}{AB}$$

$$AB = h\cot\theta$$

$$\sin\theta = \frac{h}{AC}$$

$$AC = h\operatorname{cosec}\theta$$

$$\frac{\cancel{h}\cot\theta}{v_1} = \frac{\cancel{h}\operatorname{cosec}\theta}{v}$$

$$\cos\theta = \left(\frac{v_1}{v}\right)$$

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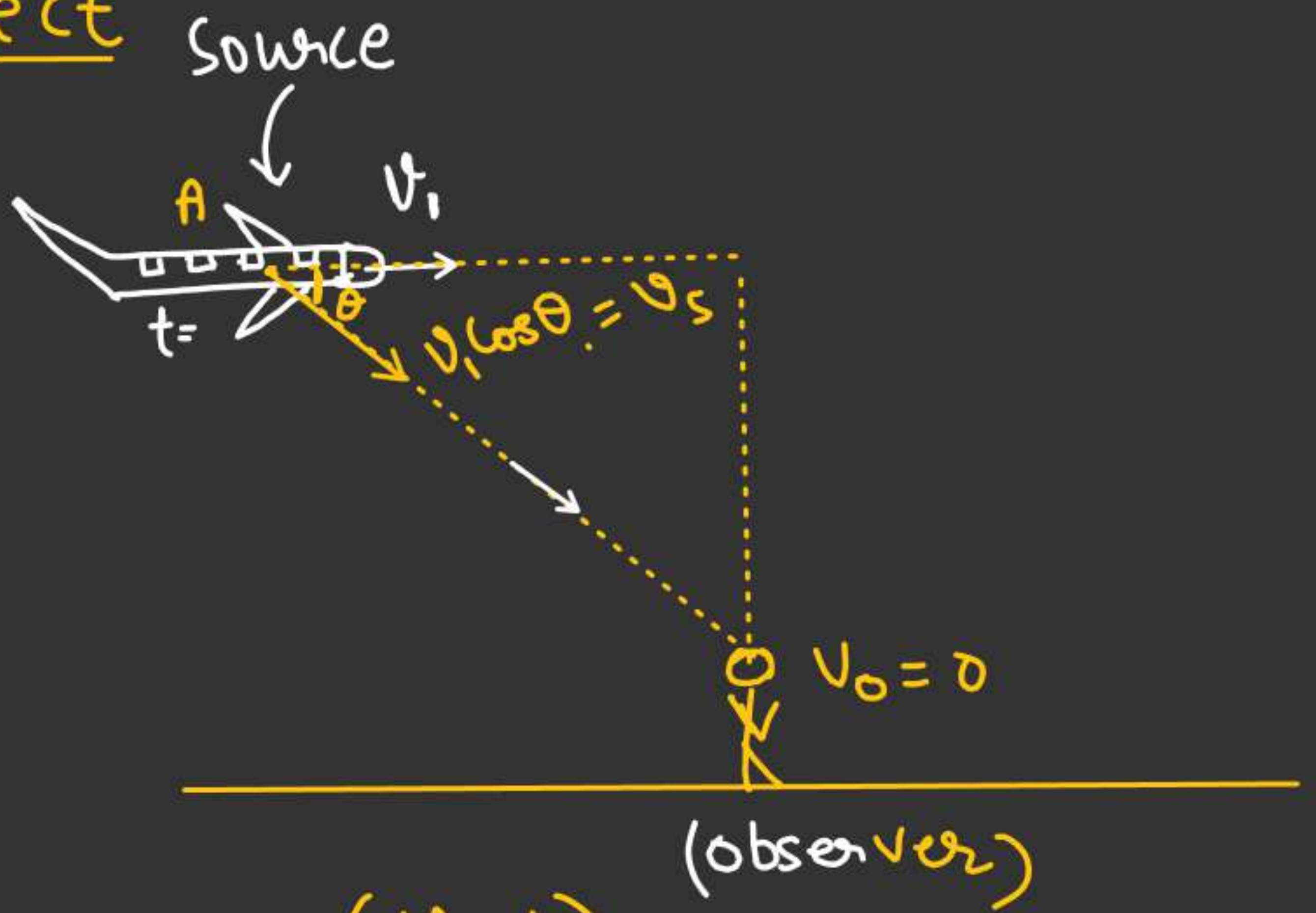
$$\cos\theta = \left(\frac{v_1}{v}\right)$$

$$f_{app} = \left(\frac{V}{V - v_1\cos\theta}\right) \times f$$

$$f_{app} = \left(\frac{V}{V - v_1 \times \frac{v_1}{v}}\right) \times f$$

$$\boxed{f_{app} = \left(\frac{V^2}{V^2 - V_1^2}\right) \times f}$$



Doppler (H.W)

→ H.C. Verma

Sound wave