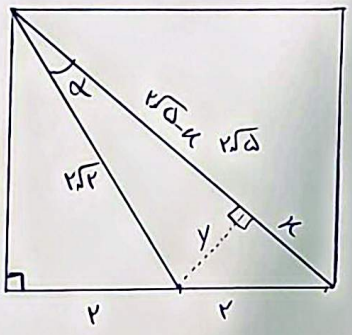
① $S=\frac{ab}{2}\sin\alpha \Rightarrow \sqrt{3}\times 4\times\frac{1}{4}\times\sin\alpha=\frac{9}{4} \Rightarrow \sin\alpha=\frac{\sqrt{3}}{2} \Rightarrow \alpha\begin{cases}\to 60^\circ=\min\alpha\\ \to 120^\circ=\max\alpha\end{cases}$

$\Rightarrow \frac{\max\alpha}{\min\alpha}=\frac{120}{60}=$ ②

② 

$(2\sqrt{5}-x)^2+(y)^2=(2\sqrt{2})^2 \to 20+x^2-4\sqrt{5}x+y^2=8$

$y^2+x^2=4 \longrightarrow y^2=4-x^2$

$\Rightarrow 20+x^2-4\sqrt{5}x+4-x^2=8$

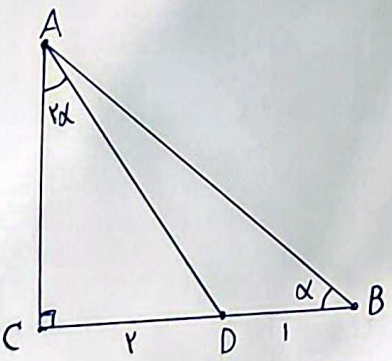
$12=4\sqrt{5}x$

$\frac{3}{\sqrt{5}}=x \longrightarrow y^2=4-\left(\frac{12}{5}\right)$

$y^2=\frac{20}{5}-\frac{16}{5} \Rightarrow y^2=\frac{4}{5} \longrightarrow y=\frac{2}{\sqrt{5}}$

$\cot\alpha=\frac{\text{مجاور}}{\text{مقابل}} \Rightarrow \frac{2\sqrt{5}-\frac{6\sqrt{5}}{5}}{\frac{2\sqrt{5}}{5}}$

$\times 5 \Rightarrow \frac{10\sqrt{5}-6\sqrt{5}}{2\sqrt{5}}=\frac{10-6}{2}=$ ③

③ 

$\tan\alpha=\frac{AC}{3}$

$\tan 2\alpha=\frac{2}{AC} \Rightarrow \tan 2\alpha=\frac{2\tan\alpha}{1-\tan^2\alpha}$

$\Rightarrow \frac{4}{AC}=\frac{\frac{2AC}{3}}{\frac{9-AC^2}{9}} \Rightarrow \frac{9-AC^2}{\frac{AC^2}{9}}=\frac{3}{2}$

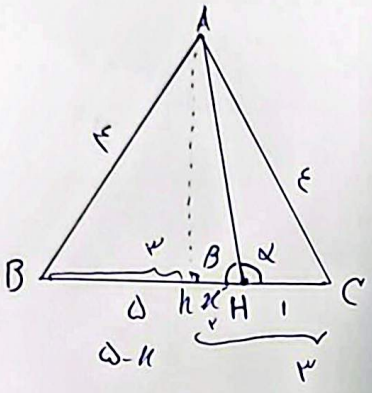
$9-AC^2=\frac{3}{2}AC^2$

$9=\frac{5}{2}AC^2$

$AC=\frac{3\sqrt{2}}{\sqrt{5}}$

$\Rightarrow \tan\alpha=\frac{AC}{3} \longrightarrow \frac{\frac{3}{\sqrt{5}}}{3}=\frac{1}{\sqrt{5}}$

$\Rightarrow \cot 2\alpha=\frac{1}{\tan\alpha}=$ ①



$\alpha+\beta=180^\circ \Rightarrow |\tan\alpha| = |\cot\beta|$ ④

$AC^2 = Ah^2 + (5-x)^2$

$AB^2 = Ah^2 + (x+1)^2$

$(x+1)^2 = (5-x)^2$

$x+1 = 5-x$

$\boxed{x=2}$

$\Rightarrow Ah = \sqrt{AB^2-9} = \sqrt{7}$

$|\tan\beta| = \frac{\sqrt{7}}{2} \Rightarrow \tan\alpha = \frac{\sqrt{7}}{2}$

⑤

$$\begin{cases} 2\sin^2x + \cos^2x = \frac{4}{3} \\ \sin^2x + \cos^2x = 1 \end{cases}$$

$\sin^2x = \frac{1}{3} \Rightarrow 1+\cot^2x = \frac{1}{\sin^2x} \Rightarrow \cot^2x = 2 \longrightarrow \tan^2x = \frac{1}{2}$

⑥

$$\frac{\sin^4\alpha + 4\cos^2\alpha}{1+\cos^2\alpha} - \frac{\cos^4\alpha + 4\sin^2\alpha}{1+\sin^2\alpha} \longrightarrow \frac{(\sin\alpha^2)^2 + 4\cos\alpha^2}{1+\cos^2\alpha} - \frac{(\cos\alpha^2)^2 + 4\sin\alpha^2}{1+\sin\alpha^2}$$

$$\xrightarrow{\sin^2\alpha+\cos^2\alpha=1} \frac{1+\cos^4\alpha+2\cos^2\alpha}{1+\cos^2\alpha} - \frac{1+\sin^4\alpha+2\sin^2\alpha}{1+\sin^2\alpha} = 1+\cos^2\alpha - 1 - \sin^2\alpha$$

$\Rightarrow \cos^2\alpha - \sin^2\alpha = \boxed{\cos 2\alpha}$

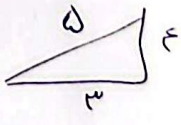
⑦

$\sin\left(\frac{9\pi}{2}+\alpha\right)\cos\left(\frac{7\pi}{2}-\alpha\right) - \tan\left(\alpha-\frac{3\pi}{2}\right)$

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

$\alpha = 3$ درجه

$(+\cos\alpha)(-\sin\alpha) - (-\cot\alpha) = -\cos\alpha\sin\alpha + \cot\alpha$



$+\left(+\frac{3}{5}\right)\left(-\frac{4}{5}\right) + \frac{3}{4} \Rightarrow \frac{-12}{25} + \frac{3}{4} = \frac{-48}{100} + \frac{75}{100} = \frac{27}{100}$

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$x = \frac{\pi}{12}$ ⑧

$3\cos 4x + \sqrt{2}\sin x - \sqrt{2}\cos x \Rightarrow 3\cos 4x + \sqrt{2}(\sin x - \cos x)$

$\sqrt{2}\sin(x - \frac{\pi}{4})$

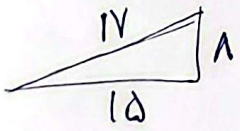
$3\cos 4x + 2\sin(x - \frac{\pi}{4}) \Rightarrow 3\cos\frac{\pi}{3} + 2\sin(-\frac{\pi}{6}) = \frac{3}{2} + (-\frac{2}{2}) = \frac{1}{2}$

$\tan(\frac{\alpha}{2}) = \frac{1}{4}$

$\frac{\tan\alpha - \sin\alpha}{\sin\alpha - \cos\alpha} = \frac{\frac{\sin\alpha}{\cos\alpha} - \sin\alpha}{\sin\alpha - \cos\alpha} = \frac{\frac{\sin\alpha - \sin\alpha\cos\alpha}{\cos\alpha}}{\sin\alpha - \cos\alpha} = \frac{\sin\alpha(1-\cos\alpha)}{\cos\alpha(\sin\alpha - \cos\alpha)}$ ⑨

$= \frac{\sin\alpha(1-\cos\alpha)}{\sin\alpha\cos\alpha - \cos\alpha^2} = \frac{\tan\alpha - \sin\alpha}{\sin\alpha - \cos\alpha} = \frac{\frac{8}{15} - \frac{8}{17}}{\frac{8}{17} - \frac{15}{17}} = \frac{\frac{136 - 120}{255}}{\frac{-7}{17}} = -\frac{16}{105}$

$\tan(\alpha) = \frac{2\tan\frac{\alpha}{2}}{1 - \tan^2\frac{\alpha}{2}} = \frac{\frac{1}{2}}{1 - \frac{1}{16}} = \frac{\frac{1}{2}}{\frac{15}{16}} = \frac{8}{15}$



⑩

$2\sin\alpha < \sin 2\alpha \longrightarrow 2\sin\alpha < 2\sin\alpha\cos\alpha$ ④

اگر $\sin\alpha$ بزرگتر از صفر باشد $\Rightarrow \cos\alpha > 1$ غ‌ق‌ق — آن را خط بزنیم

$0 < \frac{\cos\alpha}{\sin\alpha} \longrightarrow 0 < \frac{\cos\alpha}{\sin^2\alpha} \Rightarrow \cos\alpha > 0$ ① ④ $\longleftarrow$ $\sin\alpha$ مثبت است تا بعد از خط‌زدن آن $>$ ⇓

$\cos\alpha < 1$ که قابل قبول است

$\Rightarrow \sin\alpha < 0$ ③ ④

$\Rightarrow \alpha$ در ناحیه ۳ قرار دارد !