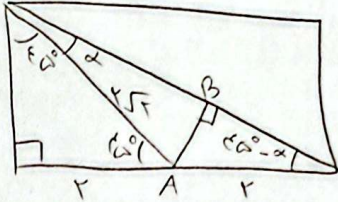


$$S = \frac{1}{r} \times 4 \times \sqrt{r} \times \sin \alpha = 4/r \Rightarrow 2\sqrt{r} \sin \alpha = \frac{4}{r} \Rightarrow \sin \alpha = \frac{\sqrt{r}}{r}$$

$$\alpha < 18^\circ \Rightarrow \alpha = \angle \begin{matrix} 4^\circ \\ 12^\circ \end{matrix} \Rightarrow \frac{12^\circ}{4^\circ} = 3 \checkmark$$



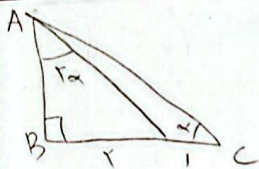
$$\sin \alpha = \frac{AB}{r\sqrt{r}}$$

$$\sin(90-\alpha) = \frac{AB}{r} = \sin 90 \cos \alpha - \sin \alpha \cos 90$$

$$= \sqrt{r} \cos \alpha - \sqrt{r} \sin \alpha = \sqrt{r} (\cos \alpha - \sin \alpha)$$

$$\sin(90-\alpha) = \sqrt{r} \sin \alpha \Rightarrow \sqrt{r} (\cos \alpha - \sin \alpha) = \sqrt{r} \sin \alpha \Rightarrow \cos \alpha - \sin \alpha = \sin \alpha$$

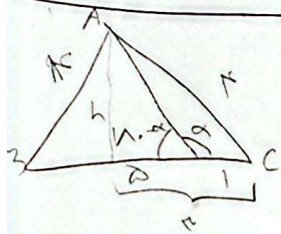
$$\Rightarrow \cos \alpha = 2 \sin \alpha \Rightarrow \cot \alpha = \frac{\cos \alpha}{\sin \alpha} = \frac{2 \sin \alpha}{\sin \alpha} = 2 \checkmark$$



$$\left. \begin{matrix} \tan(\gamma) = \frac{r}{AB} \\ \tan \alpha = \frac{AB}{r} \end{matrix} \right\} \Rightarrow \tan \gamma = \frac{r \tan \alpha}{1 - \tan^2 \alpha} \Rightarrow \frac{r}{AB} = \frac{r \frac{AB}{r}}{1 - \frac{AB^2}{r^2}}$$

$$\Rightarrow \frac{r}{AB} = \frac{r \frac{AB}{r}}{\frac{r^2 - AB^2}{r^2}} \Rightarrow \frac{r AB^2}{r^2} = \frac{r^2 - AB^2}{r} \Rightarrow r AB^2 = r^2 - AB^2 \Rightarrow r AB^2 = r^2$$

$$\Rightarrow AB^2 = \frac{r^2}{r} = \frac{r}{1} \Rightarrow AB = \frac{r}{r} = 1 \Rightarrow \cot \alpha = \frac{1}{\frac{AB}{r}} = \frac{r}{AB} = \frac{r}{\frac{r}{r}} = \frac{r}{1} = r \checkmark$$



$$h = \sqrt{r^2 - r^2} = \sqrt{0} = 0 \Rightarrow \tan(18^\circ - \alpha) = \frac{\sqrt{0}}{r}$$

$$\tan \alpha = -\tan(18^\circ - \alpha) = -\frac{\sqrt{0}}{r} \checkmark$$

$$r \sin^2 n + \cos^2 n = \frac{r}{r} \xrightarrow{\sin^2 n + \cos^2 n = 1} 1 + \sin^2 n = \frac{r}{r} \Rightarrow \sin^2 n = \frac{1}{r}$$

$$r \sin^2 n + \cos^2 n = \frac{r}{r} \xrightarrow{r(\sin^2 n + \cos^2 n) + \sin^2 n + \cos^2 n} r \sin^2 n + r \cos^2 n - \cos^2 n + \cos^2 n = \frac{r}{r}$$

$$\Rightarrow \cos^2 n = \frac{r}{r}$$

$$\Rightarrow \tan^2 n = \frac{\sin^2 n}{\cos^2 n} = \frac{\frac{1}{r}}{\frac{r}{r}} = \frac{1}{r} \checkmark$$

$$= \frac{\sin \alpha + r(1 - \sin \alpha)}{1 + (1 - \sin \alpha)} - \frac{(1 - \sin \alpha) + r \sin \alpha}{1 + \sin \alpha}$$
~~$$= \frac{\sin \alpha + r - r \sin \alpha}{1 + 1 - \sin \alpha} - \frac{1 - \sin \alpha + r \sin \alpha}{1 + \sin \alpha}$$~~

$$= \frac{\sin \alpha - r \sin \alpha + r}{2 - \sin \alpha} - \frac{\sin \alpha - r \sin \alpha + 1 + r \sin \alpha}{1 + \sin \alpha} = r - \sin \alpha - (1 + \sin \alpha)$$

$$= 1 - r \sin \alpha = \cos \alpha - \sin \alpha = \cos \alpha \quad \checkmark$$

$$= \sin\left(\frac{\pi}{r} + \alpha\right) \cos\left(\frac{\pi}{r} - \alpha\right) - \tan\left(\alpha + \frac{\pi}{r}\right) = (\cos \alpha \times -\sin \alpha) + \cot \alpha$$

$$\tan \alpha = \frac{\sin \alpha}{\cos \alpha} = \frac{r}{a} \Rightarrow \sin \alpha = \frac{r}{a} \cos \alpha \Rightarrow \sin^2 \alpha + \cos^2 \alpha = \frac{r^2}{a^2} \cos^2 \alpha + \cos^2 \alpha = \frac{r^2 + a^2}{a^2} \cos^2 \alpha = 1$$

$$\Rightarrow \cos^2 \alpha = \frac{a^2}{r^2 + a^2} \Rightarrow \cos \alpha = \frac{a}{\sqrt{r^2 + a^2}} \Rightarrow \sin \alpha = \frac{r}{\sqrt{r^2 + a^2}} \Rightarrow \cot \alpha = \left(-\frac{r}{a} \times \frac{r}{a}\right) + \frac{r}{a} = \frac{-r^2 + r^2}{a} = \frac{0}{a} = 0$$

$$= \frac{-r^2 + a^2}{a} = \frac{r^2}{a} \quad \checkmark$$

$$\cot \alpha = \left(r \cos \frac{\pi}{r} + \sqrt{r} \left(\sqrt{r} \sin \alpha - \frac{\pi}{a}\right)\right) = \frac{r}{r} + r \sin\left(\frac{\pi}{r} - \frac{\pi}{r}\right)$$

$$= \frac{r}{r} + r \sin\left(-\frac{\pi}{r}\right) = \frac{r}{r} + r\left(-\frac{1}{r}\right) = \frac{1}{r} \quad \checkmark$$

$$\tan(\alpha) = \tan\left(\frac{\pi}{r}\right) = \frac{r \tan\left(\frac{\pi}{r}\right)}{1 - \tan^2\left(\frac{\pi}{r}\right)} = \frac{r \left(\frac{1}{a}\right)}{1 - \frac{1}{a^2}} = \frac{\frac{r}{a}}{\frac{a^2 - 1}{a^2}} = \frac{r}{a} \cdot \frac{a^2}{a^2 - 1} = \frac{ra}{a^2 - 1} \Rightarrow \sin \alpha = \frac{ra}{a^2 - 1} \cos \alpha$$

$$\Rightarrow \sin^2 \alpha + \cos^2 \alpha = \frac{r^2 a^2}{(a^2 - 1)^2} \cos^2 \alpha + \cos^2 \alpha = \frac{r^2 a^2 + (a^2 - 1)^2}{(a^2 - 1)^2} \cos^2 \alpha = 1 \Rightarrow \cos^2 \alpha = \frac{(a^2 - 1)^2}{r^2 a^2 + (a^2 - 1)^2} \Rightarrow \cos \alpha = \frac{a^2 - 1}{\sqrt{r^2 a^2 + (a^2 - 1)^2}}$$

$$\Rightarrow \sin \alpha = \frac{ra}{\sqrt{r^2 a^2 + (a^2 - 1)^2}}$$

$$\Rightarrow \cot \alpha = \frac{\frac{a^2 - 1}{\sqrt{r^2 a^2 + (a^2 - 1)^2}}}{\frac{ra}{\sqrt{r^2 a^2 + (a^2 - 1)^2}}} = \frac{a^2 - 1}{ra} = \frac{14}{10} = \frac{14}{10} = \frac{7}{5} \quad \checkmark$$

$$r \sin \alpha < \sin \alpha \Rightarrow r \sin \alpha \cos \alpha > r \sin \alpha \Rightarrow r \sin \alpha \cos \alpha - r \sin \alpha > 0$$

$$\frac{\cot \alpha}{\sin \alpha} > 0 \Rightarrow \frac{\cos \alpha}{\sin^2 \alpha} > 0 \Rightarrow \frac{\cos \alpha}{\sin \alpha} > 0 \Rightarrow \cos \alpha > 0$$

$$\rightarrow r \sin \alpha (\cos \alpha - 1) > 0 \xrightarrow{\cos \alpha \in (0, 1]} r \sin \alpha < 0 \Rightarrow \sin \alpha < 0$$

$$\rightarrow r \sin \alpha < 0 \quad \checkmark$$