

1) Simplificar la siguientes expresiones

a) $2 \cdot \operatorname{tg} \alpha \cdot \cos^2 \frac{\alpha}{2} - \operatorname{sen} \alpha$

b) $(\operatorname{sen} \alpha + \cos \alpha)^2$

c) $\operatorname{sen}^4 \alpha - \cos^4 \alpha$

d) $(1 - \sec) \cdot (1 + \sec)$

e) $\sqrt{1 - \operatorname{sen} \alpha} \cdot \sqrt{1 + \operatorname{sen} \alpha}$

f) $\cot(-\alpha) \cdot \cos(-\alpha) - \operatorname{sen}(-\alpha)$

a) $2 \cdot \operatorname{tg} \alpha \cdot \cos^2 \frac{\alpha}{2} - \operatorname{sen} \alpha$

$$\cos \frac{\alpha}{2} = \sqrt{\frac{1 + \cos \alpha}{2}}$$

$$2 \cdot \operatorname{tg} \alpha \cdot \cos^2 \frac{\alpha}{2} - \operatorname{sen} \alpha = 2 \cdot \frac{\operatorname{sen} \alpha}{\cos \alpha} \cdot \cos^2 \frac{\alpha}{2} - \operatorname{sen} \alpha = 2 \cdot \frac{\operatorname{sen} \alpha}{\cos \alpha} \cdot \left(\sqrt{\frac{1 + \cos \alpha}{2}} \right)^2 - \operatorname{sen} \alpha =$$

$$= 2 \cdot \frac{\operatorname{sen} \alpha}{\cos \alpha} \cdot \frac{1 + \cos \alpha}{2} - \operatorname{sen} \alpha = \frac{\operatorname{sen} \alpha \cdot (1 + \cos \alpha)}{\cos \alpha} - \operatorname{sen} \alpha = \frac{\operatorname{sen} \alpha \cdot (1 + \cos \alpha) - \operatorname{sen} \alpha \cdot \cos \alpha}{\cos \alpha} =$$

$$= \frac{\operatorname{sen} \alpha + \operatorname{sen} \alpha \cdot \cos \alpha - \operatorname{sen} \alpha \cdot \cos \alpha}{\cos \alpha} = \frac{\operatorname{sen} \alpha}{\cos \alpha} = \operatorname{tg} \alpha$$

b) $(\operatorname{sen} \alpha + \cos \alpha)^2$

$$\operatorname{sen}^2 \alpha + \cos^2 \alpha = 1$$

$$(\operatorname{sen} \alpha + \cos \alpha)^2 = \operatorname{sen}^2 \alpha + 2 \cdot \operatorname{sen} \alpha \cdot \cos \alpha + \cos^2 \alpha = \operatorname{sen}^2 \alpha + \cos^2 \alpha + 2 \cdot \operatorname{sen} \alpha \cdot \cos \alpha = 1 + 2 \cdot \operatorname{sen} \alpha \cdot \cos \alpha$$

c) $\operatorname{sen}^4 \alpha - \cos^4 \alpha$

$$\operatorname{sen}^2 \alpha + \cos^2 \alpha = 1 \Leftrightarrow \cos^2 \alpha = 1 - \operatorname{sen}^2 \alpha$$

$$\operatorname{sen}^4 \alpha - \cos^4 \alpha = (\operatorname{sen}^2 \alpha + \cos^2 \alpha) \cdot (\operatorname{sen}^2 \alpha - \cos^2 \alpha) = 1 \cdot (\operatorname{sen}^2 \alpha - \cos^2 \alpha) =$$

$$= \operatorname{sen}^2 \alpha - (1 - \operatorname{sen}^2 \alpha) = -1 + 2\operatorname{sen}^2 \alpha = 2\operatorname{sen}^2 \alpha - 1$$

d) $(1 - \sec) \cdot (1 + \sec)$

$$(1 - \sec) \cdot (1 + \sec) = 1 - \sec^2 \alpha = -\operatorname{tg}^2 \alpha$$

e) $\sqrt{1-\operatorname{sen} \alpha} \cdot \sqrt{1+\operatorname{sen} \alpha}$

$$\sqrt{1-\operatorname{sen} \alpha} \cdot \sqrt{1+\operatorname{sen} \alpha} = \sqrt{(1-\operatorname{sen} \alpha) \cdot (1+\operatorname{sen} \alpha)} = \sqrt{1-\operatorname{sen}^2 \alpha} = \sqrt{\cos^2 \alpha} = \cos \alpha$$

f) $\cot(-\alpha) \cdot \cos(-\alpha) - \operatorname{sen}(-\alpha)$

Por ángulos opuestos:
$$\begin{cases} \cos(-\alpha) = \cos \alpha \\ \operatorname{sen}(-\alpha) = -\operatorname{sen} \alpha \\ \cot(-\alpha) = -\cot \alpha \end{cases}$$

$$\cot(-\alpha) \cdot \cos(-\alpha) - \operatorname{sen}(-\alpha) = -\cot \alpha \cdot \cos \alpha + \operatorname{sen} \alpha = -\frac{\cos \alpha}{\operatorname{sen} \alpha} \cdot \cos \alpha + \operatorname{sen} \alpha =$$

$$= \frac{\cos \alpha \cdot \cos \alpha + \operatorname{sen}^2 \alpha}{\operatorname{sen} \alpha} = \frac{\cos^2 \alpha + \operatorname{sen}^2 \alpha}{\operatorname{sen} \alpha} = \frac{1}{\operatorname{sen} \alpha} = \operatorname{cosec} \alpha = -\operatorname{cosec}(-\alpha)$$

2) Simplificar la siguientes expresiones

a) $\cos^3 \alpha + \operatorname{sen}^2 \alpha \cdot \cos \alpha$

b) $(1+\operatorname{sen} \alpha) \cdot (1-\operatorname{sen} \alpha)$

c) $\frac{\operatorname{sen} \alpha}{\cos \alpha} + \frac{\cos \alpha}{1+\operatorname{sen} \alpha}$

d) $\frac{\operatorname{sen}^2 \alpha \cdot (1+\cos \alpha)}{1-\cos \alpha}$

e) $\frac{\cos \alpha}{\operatorname{tg} \alpha \cdot (1-\operatorname{sen} \alpha)}$

f) $\frac{\sec^2 \alpha}{\operatorname{cosec}^2 \alpha - \sec^2 \alpha} + \frac{\cot^2 \alpha}{\cot^2 \alpha - 1}$

a) $\cos^3 \alpha + \operatorname{sen}^2 \alpha \cdot \cos \alpha$

$$\cos^3 \alpha + \operatorname{sen}^2 \alpha \cdot \cos \alpha = \cos^2 \alpha \cdot \cos \alpha + \operatorname{sen}^2 \alpha \cdot \cos \alpha = \cos \alpha \cdot (\cos^2 \alpha + \operatorname{sen}^2 \alpha) = \cos \alpha \cdot 1 = \cos \alpha$$

b) $(1+\operatorname{sen} \alpha) \cdot (1-\operatorname{sen} \alpha)$

$$(1+\operatorname{sen} \alpha) \cdot (1-\operatorname{sen} \alpha) = 1 - \operatorname{sen} \alpha + \operatorname{sen} \alpha - \operatorname{sen}^2 \alpha = 1 - \operatorname{sen}^2 \alpha = \cos^2 \alpha = \frac{1}{\sec^2 \alpha}$$

$$c) \frac{\operatorname{sen} \alpha}{\cos \alpha} + \frac{\cos \alpha}{1 + \operatorname{sen} \alpha}$$

$$\frac{\operatorname{sen} \alpha}{\cos \alpha} + \frac{\cos \alpha}{1 + \operatorname{sen} \alpha} = \frac{\operatorname{sen} \alpha \cdot (1 + \operatorname{sen} \alpha) \cdot \cos \alpha \cdot \operatorname{sen} \alpha}{\cos \alpha \cdot (1 + \operatorname{sen} \alpha)} = \frac{\operatorname{sen} \alpha + \operatorname{sen}^2 \alpha + \cos^2 \alpha}{\cos \alpha \cdot (1 + \operatorname{sen} \alpha)} =$$

$$= \frac{\operatorname{sen} \alpha + 1}{\cos \alpha \cdot (1 + \operatorname{sen} \alpha)} = \frac{1}{\cos \alpha} = \sec \alpha$$

$$d) \frac{\operatorname{sen}^2 \alpha \cdot (1 + \cos \alpha)}{1 - \cos \alpha}$$

$$\frac{\operatorname{sen}^2 \alpha \cdot (1 + \cos \alpha)}{1 - \cos \alpha} = \frac{(1 - \cos^2 \alpha) \cdot (1 + \cos \alpha)}{1 - \cos \alpha} = \frac{(1 - \cos \alpha) \cdot (1 + \cos \alpha) \cdot (1 + \cos \alpha)}{1 - \cos \alpha} = (1 + \cos \alpha)^2$$

$$e) \frac{\cos \alpha}{\operatorname{tg} \alpha \cdot (1 - \operatorname{sen} \alpha)}$$

$$\frac{\cos \alpha}{\operatorname{tg} \alpha \cdot (1 - \operatorname{sen} \alpha)} = \frac{\cos \alpha}{\frac{\operatorname{sen} \alpha}{\cos \alpha} \cdot (1 - \operatorname{sen} \alpha)} = \frac{\cos^2 \alpha}{\operatorname{sen} \alpha \cdot (1 - \operatorname{sen} \alpha)} = \frac{1 - \operatorname{sen}^2 \alpha}{\operatorname{sen} \alpha \cdot (1 - \operatorname{sen} \alpha)} = \frac{(1 + \operatorname{sen} \alpha) \cdot (1 - \operatorname{sen} \alpha)}{\operatorname{sen} \alpha \cdot (1 - \operatorname{sen} \alpha)} = \frac{1 + \operatorname{sen} \alpha}{\operatorname{sen} \alpha}$$

$$f) \frac{\sec^2 \alpha}{\operatorname{cosec}^2 \alpha - \sec^2 \alpha} + \frac{\cot^2 \alpha}{\cot^2 \alpha - 1}$$

$$\frac{\sec^2 \alpha}{\operatorname{cosec}^2 \alpha - \sec^2 \alpha} + \frac{\cot^2 \alpha}{\cot^2 \alpha - 1} = \frac{\frac{1}{\cos^2 \alpha}}{\frac{1}{\operatorname{sen}^2 \alpha} - \frac{1}{\cos^2 \alpha}} + \frac{\frac{\cos^2 \alpha}{\operatorname{sen}^2 \alpha}}{\frac{\cos^2 \alpha}{\operatorname{sen}^2 \alpha} - 1} = \frac{\frac{1}{\cos^2 \alpha}}{\frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha \cdot \cos^2 \alpha}} + \frac{\frac{\cos^2 \alpha}{\operatorname{sen}^2 \alpha}}{\frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha}} =$$

$$\cdot \frac{\frac{1}{\cos^2 \alpha}}{\frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha \cdot \cos^2 \alpha}} = \frac{1}{\cos^2 \alpha} : \frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha \cdot \cos^2 \alpha} = \frac{\operatorname{sen}^2 \alpha \cdot \cos^2 \alpha}{\cos^2 \alpha (\cos^2 \alpha - \operatorname{sen}^2 \alpha)} = \frac{\operatorname{sen}^2 \alpha}{\cos^2 \alpha - \operatorname{sen}^2 \alpha}$$

$$\cdot \frac{\frac{\cos^2 \alpha}{\operatorname{sen}^2 \alpha}}{\frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha}} = \frac{\cos^2 \alpha}{\operatorname{sen}^2 \alpha} : \frac{\cos^2 \alpha - \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha} = \frac{\cos^2 \alpha \cdot \operatorname{sen}^2 \alpha}{\operatorname{sen}^2 \alpha (\cos^2 \alpha - \operatorname{sen}^2 \alpha)} = \frac{\cos^2 \alpha}{\cos^2 \alpha - \operatorname{sen}^2 \alpha}$$

$$= \frac{\operatorname{sen}^2 \alpha}{\cos^2 \alpha - \operatorname{sen}^2 \alpha} + \frac{\cos^2 \alpha}{\cos^2 \alpha - \operatorname{sen}^2 \alpha} = \frac{\cos^2 \alpha + \operatorname{sen}^2 \alpha}{\cos^2 \alpha - \operatorname{sen}^2 \alpha} = \frac{1}{\cos^2 \alpha - \operatorname{sen}^2 \alpha}$$

3) Simplificar la siguientes expresiones

$$a) \frac{1 - \cos 2\alpha}{\cos^2 \alpha}$$

$$b) \frac{\operatorname{sen} \alpha (\operatorname{sen}^2 \alpha - 1)}{\cos \alpha (1 - \cos^2 \alpha)} \cdot \operatorname{tg} \alpha$$

$$c) \frac{\operatorname{tg} \alpha + \operatorname{tg} \alpha \cdot \cot^2 \alpha}{1 + \operatorname{tg}^2 \alpha}$$

$$d) \frac{\sec(-\alpha)}{\operatorname{tg}(-\alpha)}$$

$$e) \frac{\operatorname{cosec} \alpha}{1 + \cot^2 \alpha}$$

$$f) \frac{\operatorname{sen}^4 \alpha + \operatorname{sen}^2 \alpha \cdot \cos^2 \alpha}{\cos^4 \alpha - \cos^2 \alpha \cdot \operatorname{sen}^2 \alpha} \cdot \cot \alpha$$

$$a) \frac{1 - \cos 2\alpha}{\cos^2 \alpha}$$

$$\cos 2\alpha = \cos^2 \alpha - \operatorname{sen}^2 \alpha$$

$$\begin{aligned} \frac{1 - \cos 2\alpha}{\cos^2 \alpha} &= \frac{1 - (\cos^2 \alpha - \operatorname{sen}^2 \alpha)}{\cos^2 \alpha} = \frac{1 - \cos^2 \alpha + \operatorname{sen}^2 \alpha}{\cos^2 \alpha} = \frac{(1 - \cos^2 \alpha) + \operatorname{sen}^2 \alpha}{\cos^2 \alpha} = \\ &= \frac{\operatorname{sen}^2 \alpha + \operatorname{sen}^2 \alpha}{\cos^2 \alpha} = \frac{2\operatorname{sen}^2 \alpha}{\cos^2 \alpha} = 2 \operatorname{tg}^2 \alpha \end{aligned}$$

$$b) \frac{\operatorname{sen} \alpha (\operatorname{sen}^2 \alpha - 1)}{\cos \alpha (1 - \cos^2 \alpha)} \cdot \operatorname{tg} \alpha$$

$$\operatorname{sen}^2 \alpha + \cos^2 \alpha = 1 \begin{cases} \cos^2 \alpha = \operatorname{sen}^2 \alpha - 1 \\ \operatorname{sen}^2 \alpha - 1 = -\cos^2 \alpha \\ \operatorname{sen}^2 \alpha = 1 - \cos^2 \alpha \end{cases}$$

$$\frac{\operatorname{sen} \alpha (\operatorname{sen}^2 \alpha - 1)}{\cos \alpha (1 - \cos^2 \alpha)} \cdot \operatorname{tg} \alpha = \frac{-\operatorname{sen} \alpha \cdot \cos^2 \alpha}{\cos \alpha \cdot \operatorname{sen}^2 \alpha} \cdot \operatorname{tg} \alpha = \frac{-\operatorname{sen} \alpha \cdot \cos^2 \alpha}{\cos \alpha \cdot \operatorname{sen}^2 \alpha} \cdot \frac{\operatorname{sen} \alpha}{\cos \alpha} = \frac{-\operatorname{sen}^2 \alpha \cdot \cos^2 \alpha}{\cos^2 \alpha \cdot \operatorname{sen}^2 \alpha} = -1$$

$$c) \frac{\operatorname{tg} \alpha + \operatorname{tg} \alpha \cdot \cot^2 \alpha}{1 + \operatorname{tg}^2 \alpha}$$

$$\operatorname{cosec}^2 \alpha = 1 + \cot^2 \alpha$$

$$1 + \operatorname{tg}^2 \alpha = \sec^2 \alpha$$

$$\begin{aligned} \frac{\operatorname{tg} \alpha + \operatorname{tg} \alpha \cdot \cot^2 \alpha}{1 + \operatorname{tg}^2 \alpha} &= \frac{\operatorname{tg} \alpha \cdot (1 + \cot^2 \alpha)}{1 + \operatorname{tg}^2 \alpha} = \frac{\operatorname{tg} \alpha \cdot \operatorname{cosec}^2 \alpha}{\sec^2 \alpha} = \frac{\operatorname{sen} \alpha}{\cos \alpha} \cdot \frac{1}{\operatorname{sen}^2 \alpha} = \frac{\operatorname{sen} \alpha}{\cos \alpha \cdot \operatorname{sen}^2 \alpha} = \frac{1}{\cos \alpha \cdot \operatorname{sen} \alpha} = \\ &= \frac{1}{\cos \alpha \cdot \operatorname{sen} \alpha} : \frac{1}{\cos^2 \alpha} = \frac{\cos^2 \alpha}{\cos \alpha \cdot \operatorname{sen} \alpha} = \frac{\cos \alpha}{\operatorname{sen} \alpha} = \cot \alpha \end{aligned}$$

$$d) \frac{\sec(-\alpha)}{\operatorname{tg}(-\alpha)}$$

Por ángulos opuestos: $\sec(-\alpha) = \sec \alpha$

$$\frac{\sec(-\alpha)}{\operatorname{tg}(-\alpha)} = \frac{\sec \alpha}{-\operatorname{tg} \alpha} = \frac{\frac{1}{\cos \alpha}}{-\frac{\sin \alpha}{\cos \alpha}} = -\left(\frac{1}{\cos \alpha} : \frac{\sin \alpha}{\cos \alpha}\right) = \frac{-\cos \alpha}{\sin \alpha \cos \alpha} = -\frac{1}{\sin \alpha} = -\operatorname{cosec} \alpha$$

$$e) \frac{\operatorname{cosec} \alpha}{1 + \cot^2 \alpha}$$

$$\sin^2 \alpha + \cos^2 \alpha = 1$$

$$\frac{\operatorname{cosec} \alpha}{1 + \cot^2 \alpha} = \frac{\frac{1}{\sin \alpha}}{1 + \frac{\cos^2 \alpha}{\sin^2 \alpha}} = \frac{\frac{1}{\sin \alpha}}{\frac{\sin^2 \alpha + \cos^2 \alpha}{\sin^2 \alpha}} = \frac{\frac{1}{\sin \alpha}}{\frac{1}{\sin^2 \alpha}} = \frac{1}{\sin \alpha} : \frac{1}{\sin^2 \alpha} = \frac{\sin^2 \alpha}{\sin \alpha} = \sin \alpha$$

$$f) \frac{\sin^4 \alpha + \sin^2 \alpha \cdot \cos^2 \alpha}{\cos^4 \alpha - \cos^2 \alpha \cdot \sin^2 \alpha} \cdot \cot \alpha$$

$$\cot \alpha = \frac{\cos \alpha}{\sin \alpha}$$

$$\frac{\sin^4 \alpha - \sin^2 \alpha \cdot \cos^2 \alpha}{\cos^4 \alpha - \cos^2 \alpha \cdot \sin^2 \alpha} \cdot \cot \alpha = \frac{\sin^2 \alpha (\sin^2 \alpha - \cos^2 \alpha)}{\cos^2 \alpha (\cos^2 \alpha - \sin^2 \alpha)} \cdot \frac{\cos \alpha}{\sin \alpha} = \frac{-\sin^2 \alpha (-\sin^2 \alpha + \cos^2 \alpha) \cdot \cos \alpha}{\cos^2 \alpha (\cos^2 \alpha - \sin^2 \alpha) \cdot \sin \alpha} =$$

$$= \frac{-\sin^2 \alpha (\cos^2 \alpha - \sin^2 \alpha) \cdot \cos \alpha}{\cos^2 \alpha (\cos^2 \alpha - \sin^2 \alpha) \cdot \sin \alpha} = \frac{-\sin^2 \alpha \cdot \cos \alpha}{\cos^2 \alpha \cdot \sin \alpha} = -\frac{\sin \alpha}{\cos \alpha} = -\operatorname{tg} \alpha$$

4) Comprueba las siguientes identidades.

a) $\cot^2 \alpha + 1 = \frac{1}{\sin^2 \alpha}$

b) $\operatorname{tg} \alpha \cdot \cot \alpha = \sin^2 \alpha + \cos^2 \alpha$

c) $\sin \alpha \cdot \sec \alpha = \operatorname{tg} \alpha$

d) $(\sin \alpha + \cos \alpha)^2 = 1 + \frac{2 \sin \alpha}{\cos \alpha}$

e) $\operatorname{tg} \alpha + \cot \alpha = \sec \alpha \cdot \operatorname{cosec} \alpha$

f) $\frac{\sin \alpha \cdot \cos \alpha}{\cos^2 \alpha - \sin^2 \alpha} = \frac{\operatorname{tg} \alpha}{1 - \operatorname{tg}^2 \alpha}$

a) $\cot^2 \alpha + 1 = \frac{1}{\sin^2 \alpha}$

$$\cot^2 \alpha + 1 = \left(\frac{\cos \alpha}{\sin \alpha} \right)^2 + 1 = \frac{\cos^2 \alpha}{\sin^2 \alpha} + 1 = \frac{\cos^2 \alpha + \sin^2 \alpha}{\sin^2 \alpha} = \frac{1}{\sin^2 \alpha}$$

b) $\operatorname{tg} \alpha \cdot \cot \alpha = \sin^2 \alpha + \cos^2 \alpha$

$$\operatorname{tg} \alpha \cdot \cot \alpha = \frac{\sin \alpha}{\cos \alpha} \cdot \frac{\cos \alpha}{\sin \alpha} = 1 = \sin^2 \alpha + \cos^2 \alpha$$

c) $\sin \alpha \cdot \sec \alpha = \operatorname{tg} \alpha$

$$\sin \alpha \cdot \sec \alpha = \sin \alpha \cdot \frac{1}{\cos \alpha} = \frac{\sin \alpha}{\cos \alpha} = \operatorname{tg} \alpha$$

d) $(\sin \alpha + \cos \alpha)^2 = 1 + \frac{2 \sin \alpha}{\cos \alpha}$

$$\begin{aligned} (\sin \alpha + \cos \alpha)^2 &= \sin^2 \alpha + 2 \cdot \sin \alpha \cdot \cos \alpha + \cos^2 \alpha = \sin^2 \alpha + \cos^2 \alpha + 2 \cdot \sin \alpha \cdot \cos \alpha = 1 + 2 \cdot \sin \alpha \cdot \cos \alpha = \\ &= 1 + \frac{2 \cdot \sin \alpha}{\sec \alpha} \end{aligned}$$

e) $\operatorname{tg} \alpha + \cot \alpha = \sec \alpha \cdot \operatorname{cosec} \alpha$

$$\begin{aligned} \operatorname{tg} \alpha + \cot \alpha &= \frac{\sin \alpha}{\cos \alpha} + \frac{\cos \alpha}{\sin \alpha} = \frac{\sin \alpha \cdot \sin \alpha + \cos \alpha \cdot \cos \alpha}{\cos \alpha \cdot \sin \alpha} = \frac{\sin^2 \alpha + \cos^2 \alpha}{\cos \alpha \cdot \sin \alpha} = \\ &= \frac{1}{\cos \alpha \cdot \sin \alpha} = \frac{1}{\cos \alpha} \cdot \frac{1}{\sin \alpha} = \sec \alpha \cdot \operatorname{cosec} \alpha \end{aligned}$$

f) $\frac{\sin \alpha \cdot \cos \alpha}{\cos^2 \alpha - \sin^2 \alpha} = \frac{\operatorname{tg} \alpha}{1 - \operatorname{tg}^2 \alpha}$

$$\frac{\sin \alpha \cdot \cos \alpha}{\cos^2 \alpha - \sin^2 \alpha} = \frac{\frac{\sin \alpha \cdot \cos \alpha}{\cos^2 \alpha}}{\frac{\cos^2 \alpha - \sin^2 \alpha}{\cos^2 \alpha}} = \frac{\frac{\sin \alpha}{\cos \alpha}}{\frac{\cos^2 \alpha}{\cos^2 \alpha} - \frac{\sin^2 \alpha}{\cos^2 \alpha}} = \frac{\operatorname{tg} \alpha}{1 - \operatorname{tg}^2 \alpha}$$