

171. Решить уравнение с модулем

$$\begin{aligned}
 2\cos^2 x = |\cos x| &\Leftrightarrow \begin{cases} \cos x \geq 0 \\ 2\cos^2 x - \cos x = 0 \\ \cos x \leq 0 \\ 2\cos^2 x + \cos x = 0 \end{cases} \Leftrightarrow \begin{cases} \cos x \geq 0 \\ \cos x(2\cos x - 1) = 0 \\ \cos x \leq 0 \\ \cos x(2\cos x + 1) = 0 \end{cases} \Leftrightarrow \\
 &\Leftrightarrow \begin{cases} \cos x \geq 0 \\ \cos x = 0 \\ \cos x = \frac{1}{2} \\ \cos x \leq 0 \\ \cos x = 0 \\ \cos x = -\frac{1}{2} \end{cases} \Leftrightarrow \begin{cases} \cos x = 0 \\ \cos x = \frac{1}{2} \\ \cos x = -\frac{1}{2} \end{cases} \Leftrightarrow \begin{cases} x = \frac{\pi}{2} + \pi k \\ x = \frac{\pi}{3} + 2\pi k \\ x = -\frac{\pi}{3} + 2\pi k \\ x = \frac{2\pi}{3} + 2\pi k \\ x = -\frac{2\pi}{3} + 2\pi k : k \in \mathbb{Z} \end{cases} \Leftrightarrow \begin{cases} x = \frac{\pi}{2} + \pi k \\ x = \frac{\pi}{3} + 2\pi k \\ x = -\frac{\pi}{3} + 2\pi k : k \in \mathbb{Z} \end{cases}.
 \end{aligned}$$

Ответ:  $\left\{ \frac{\pi}{2} + \pi k; -\frac{\pi}{3} + 2\pi k; \frac{\pi}{3} + 2\pi k : k \in \mathbb{Z} \right\}$ .

172. Решить уравнение с модулем

$$\begin{aligned}
 3\tg x = \sqrt{3} |\sin x| &\Leftrightarrow \begin{cases} \sin x \geq 0 \\ 3\tg x - \sqrt{3} \sin x = 0 \\ \sin x < 0 \\ 3\tg x + \sqrt{3} \sin x = 0 \end{cases} \Leftrightarrow \begin{cases} \sin x \geq 0 \\ \sqrt{3} \sin x(\sqrt{3} - \cos x) = 0 \\ \sin x < 0 \\ \sqrt{3} \sin x(\sqrt{3} + \cos x) = 0 \end{cases} \Leftrightarrow \\
 &\Leftrightarrow \begin{cases} \sin x \geq 0 \\ \sin x = 0 \\ \cos x = \sqrt{3} - \text{решений нет} \\ \sin x < 0 \\ \sin x = 0 \\ \cos x = -\sqrt{3} - \text{решений нет} \end{cases} \Leftrightarrow \sin x = 0 \Leftrightarrow x = \pi k : k \in \mathbb{Z}.
 \end{aligned}$$

Ответ:  $\{\pi k : k \in \mathbb{Z}\}$ .

173. Решить уравнение с модулем

$$\begin{aligned}
 \sqrt{3} \ctg x = 3 |\cos x| &\Leftrightarrow \begin{cases} \cos x \geq 0 \\ \sqrt{3} \ctg x - 3 \cos x = 0 \\ \cos x \leq 0 \\ \sqrt{3} \ctg x + 3 \cos x = 0 \end{cases} \Leftrightarrow \begin{cases} \cos x \geq 0 \\ \sqrt{3} \cos x(1 - \sqrt{3} \sin x) = 0 \\ \cos x \leq 0 \\ \sqrt{3} \cos x(1 + \sqrt{3} \sin x) = 0 \end{cases} \Leftrightarrow
 \end{aligned}$$

$$\begin{aligned}
&\Leftrightarrow \left\{ \begin{array}{l} \cos x \geq 0 \\ \cos x = 0 \\ \sin x = \frac{1}{\sqrt{3}} \\ \cos x \leq 0 \\ \cos x = 0 \\ \sin x = -\frac{1}{\sqrt{3}} \end{array} \right. \Leftrightarrow \left\{ \begin{array}{l} \cos x = 0 \\ \cos x \geq 0 \\ \sin x = \frac{1}{\sqrt{3}} \\ \cos x \leq 0 \\ \sin x = -\frac{1}{\sqrt{3}} \end{array} \right. \Leftrightarrow \left\{ \begin{array}{l} x = \frac{\pi}{2} + \pi k \\ \cos x \geq 0 \\ x = \arcsin \frac{1}{\sqrt{3}} + 2\pi k \\ x = \pi - \arcsin \frac{1}{\sqrt{3}} + 2\pi k \\ \cos x \leq 0 \\ x = -\arcsin \frac{1}{\sqrt{3}} + 2\pi k \\ x = \pi + \arcsin \frac{1}{\sqrt{3}} + 2\pi k : k \in \mathbb{Z} \end{array} \right. \Leftrightarrow \\
&\Leftrightarrow \left\{ \begin{array}{l} x = \frac{\pi}{2} + \pi k \\ x = \arcsin \frac{1}{\sqrt{3}} + 2\pi k \\ x = \pi + \arcsin \frac{1}{\sqrt{3}} + 2\pi k : k \in \mathbb{Z} \end{array} \right. .
\end{aligned}$$

Ответ:  $\left\{ \frac{\pi}{2} + \pi k; \arcsin \frac{1}{\sqrt{3}} + 2\pi k; \pi + \arcsin \frac{1}{\sqrt{3}} + 2\pi k : k \in \mathbb{Z} \right\}$ .

174. Решить уравнение с модулем

$$\begin{aligned}
2 \sin^2 x = |\sqrt{3} \operatorname{tg} x| &\Leftrightarrow \left\{ \begin{array}{l} \operatorname{tg} x \geq 0 \\ 2 \sin^2 x = \sqrt{3} \operatorname{tg} x \\ \operatorname{tg} x < 0 \\ 2 \sin^2 x = -\sqrt{3} \operatorname{tg} x \end{array} \right. \Leftrightarrow \left\{ \begin{array}{l} \operatorname{tg} x \geq 0 \\ \sin x (\sin 2x - \sqrt{3}) = 0 \\ \operatorname{tg} x < 0 \\ \sin x (\sin 2x + \sqrt{3}) = 0 \end{array} \right. \Leftrightarrow \\
&\Leftrightarrow \left\{ \begin{array}{l} \operatorname{tg} x \geq 0 \\ \sin x = 0 \\ \sin 2x = \sqrt{3} - \text{решений нет} \\ \operatorname{tg} x < 0 \\ \sin x = 0 \\ \sin 2x = -\sqrt{3} - \text{решений нет} \end{array} \right. \Leftrightarrow \sin x = 0 \Leftrightarrow x = \pi k : k \in \mathbb{Z}.
\end{aligned}$$

Ответ:  $\{\pi k : k \in \mathbb{Z}\}$ .

175. Решить уравнение с модулем

$$\begin{aligned}
2 \cos^2 x = |\operatorname{ctg} x| &\Leftrightarrow \left\{ \begin{array}{l} 2 \cos^2 x \geq 0 - \text{верно} \\ \operatorname{ctg} x = 2 \cos^2 x \\ \operatorname{ctg} x = -2 \cos^2 x \end{array} \right. \Leftrightarrow \left\{ \begin{array}{l} \cos x = 0 \\ \frac{1}{\sin x} = 2 \cos x \\ \frac{1}{\sin x} = -2 \cos x \end{array} \right. \Leftrightarrow \left\{ \begin{array}{l} \cos x = 0 \\ \sin x \neq 0 \\ \sin 2x = 1 \\ \sin 2x = -1 \end{array} \right. \Leftrightarrow
\end{aligned}$$

$$\Leftrightarrow \begin{cases} \cos x = 0 \\ \sin 2x = 1 \\ \sin 2x = -1 \end{cases} \Leftrightarrow \begin{cases} x = \frac{\pi}{2} + \pi k \\ 2x = \frac{\pi}{2} + 2\pi k \\ 2x = -\frac{\pi}{2} + 2\pi k : k \in \mathbb{Z} \end{cases} \Leftrightarrow \begin{cases} x = \frac{\pi}{2} + \pi k \\ x = \frac{\pi}{4} + \pi k \\ x = -\frac{\pi}{4} + \pi k : k \in \mathbb{Z} \end{cases}$$

Ответ:  $\left\{-\frac{\pi}{4} + \pi k; \frac{\pi}{4} + \pi k; \frac{\pi}{2} + \pi k : k \in \mathbb{Z}\right\}$ .

176. Решить уравнение с модулем

$$4^{|x-2|\sin x} = 2^{x|\sin x|} \Leftrightarrow 2^{2|x-2|\sin x} = 2^{x|\sin x|} \Leftrightarrow 2|x-2|\sin x = x|\sin x| \Leftrightarrow$$

$$\Leftrightarrow \begin{cases} \sin x > 0 \\ 2|x-2|\sin x = x\sin x \\ 0 = 0 - \text{верно} \end{cases} \Leftrightarrow \begin{cases} \sin x > 0 \\ 2|x-2| = x \\ \sin x = 0 \end{cases} \Leftrightarrow \begin{cases} \sin x > 0 \\ 2|x-2| = -x \\ \sin x = 0 \end{cases} \Leftrightarrow$$

$$\begin{cases} \sin x > 0 \\ x \geq 0 \\ 2(x-2) = x \\ 2(x-2) = -x \\ \sin x = 0 \end{cases} \Leftrightarrow \begin{cases} \sin x > 0 \\ -x > 0 \\ 2(x-2) = x \\ 2(x-2) = -x \end{cases} .$$

$$\Leftrightarrow \begin{cases} \sin x > 0 \\ x \geq 0 \\ x = 4 \\ x = \frac{4}{3} \\ \sin x = 0 \end{cases} \Leftrightarrow \begin{cases} x = 4 \\ \sin 4 > 0 - \text{неверно} \\ x = \frac{4}{3} \\ \sin \frac{4}{3} > 0 - \text{верно} \\ x = \pi k : k \in \mathbb{Z} \end{cases} \Leftrightarrow \begin{cases} x = \frac{4}{3} \\ x = \pi k : k \in \mathbb{Z} \end{cases} .$$

Ответ:  $\left\{\frac{4}{3}; \pi k : k \in \mathbb{Z}\right\}$ .

177. Решить уравнение с модулем

$$\sin x = \operatorname{tg} x |\sin x| \Leftrightarrow \begin{cases} \sin x = 0 \\ \sin x > 0 \\ \sin x = \operatorname{tg} x \sin x \\ \sin x < 0 \\ \sin x = \operatorname{tg} x (-\sin x) \end{cases} \Leftrightarrow \begin{cases} \sin x = 0 \\ \sin x > 0 \\ 1 = \operatorname{tg} x \Leftrightarrow \\ \sin x < 0 \\ 1 = -\operatorname{tg} x \end{cases}$$

$$\Leftrightarrow \begin{cases} \sin x = 0 \\ \sin x > 0 \\ x = \frac{\pi}{4} + \pi k \\ \sin x < 0 \\ x = -\frac{\pi}{4} + \pi k : k \in \mathbb{Z} \end{cases} \Leftrightarrow \begin{cases} x = \pi k \\ x = \frac{\pi}{4} + 2\pi k \\ x = -\frac{\pi}{4} + 2\pi k : k \in \mathbb{Z} \end{cases} .$$

Ответ:  $\left\{-\frac{\pi}{4} + 2\pi k, \frac{\pi}{4} + 2\pi k; \pi k : k \in \mathbb{Z}\right\}$ .

178. Решить уравнение с модулем

$$\cos x = \operatorname{tg} x |\cos x| \Leftrightarrow \cos x = \frac{\sin x}{\cos x} |\cos x| \Leftrightarrow \begin{cases} \cos x > 0 \\ \cos x = \sin x \\ \cos x < 0 \\ \cos x = -\sin x \end{cases} \Leftrightarrow$$

$$\Leftrightarrow \begin{cases} \cos x > 0 \\ \operatorname{tg} x = 1 \\ \cos x < 0 \\ \operatorname{tg} x = -1 \end{cases} \Leftrightarrow \begin{cases} \cos x > 0 \\ x = \frac{\pi}{4} + \pi k \\ \cos x < 0 \\ x = -\frac{\pi}{4} + 2\pi k : k \in \mathbb{Z} \end{cases} \Leftrightarrow \begin{cases} x = \frac{\pi}{4} + 2\pi k \\ x = \frac{3\pi}{4} + 2\pi k : k \in \mathbb{Z} \end{cases} .$$

Ответ:  $\left\{\frac{\pi}{4} + 2\pi k; \frac{3\pi}{4} + 2\pi k : k \in \mathbb{Z}\right\}$ .

179. Решить уравнение с модулем

$$|\cos x|(2x-4) = |x-2| \Leftrightarrow \begin{cases} x-2 > 0 \\ 2|\cos x|(x-2) = x-2 \\ x-2 = 0 \\ 0 = 0 - \text{верно} \\ x-2 < 0 \\ 2|\cos x|(x-2) = -(x-2) \end{cases} \Leftrightarrow$$

$$\Leftrightarrow \begin{cases} x > 2 \\ 2|\cos x| = 1 \\ x-2 = 0 \\ x < 2 \\ 2|\cos x| = -1 - \text{решений нет} \end{cases} \Leftrightarrow \begin{cases} x > 2 \\ \cos x = \frac{1}{2} \\ \cos x = -\frac{1}{2} \\ x = 2 \end{cases} \Leftrightarrow \begin{cases} x > 2 \\ x = \frac{\pi}{3} + 2\pi k : k \in \mathbb{Z} \\ x = -\frac{\pi}{3} + 2\pi m : m \in \mathbb{Z} \\ x = \frac{2\pi}{3} + 2\pi n : n \in \mathbb{Z} \\ x = -\frac{2\pi}{3} + 2\pi l : l \in \mathbb{Z} \\ x = 2 \end{cases} .$$

$$\Leftrightarrow \begin{cases} x = \frac{\pi}{3} + 2\pi k, k = 1, 2, \dots \\ x = -\frac{\pi}{3} + 2\pi m, m = 1, 2, \dots \\ x = \frac{2\pi}{3} + 2\pi n, n = 0, 1, \dots \\ x = -\frac{2\pi}{3} + 2\pi l, l = 1, 2, \dots \\ x = 2 \end{cases}$$

Ответ:  $\left\{ \frac{\pi}{3} + 2\pi k, k = 1, 2, \dots; -\frac{\pi}{3} + 2\pi m, m = 1, 2, \dots; \frac{2\pi}{3} + 2\pi n, n = 0, 1, \dots; -\frac{2\pi}{3} + 2\pi l, l = 1, 2, \dots; 2 \right\}$ .

180. Решить уравнение с модулем

$$\begin{aligned} |\sin x|(4x+2) = |2x+1| &\Leftrightarrow \begin{cases} 2x+1 > 0 \\ 2|\sin x|(2x+1) = 2x+1 \end{cases} \Leftrightarrow \begin{cases} 2x+1 = 0 \\ 0 = 0 - \text{верно} \end{cases} \\ &\Leftrightarrow \begin{cases} 2x+1 = 0 \\ 2|\sin x|(2x+1) = -(2x+1) \end{cases} \\ &\Leftrightarrow \begin{cases} x > -\frac{1}{2} \\ 2|\sin x| = 1 \end{cases} \Leftrightarrow \begin{cases} x > -\frac{1}{2} \\ \sin x = \frac{1}{2} \\ \sin x = -\frac{1}{2} \end{cases} \Leftrightarrow \begin{cases} x > -\frac{1}{2} \\ x = \frac{\pi}{6} + 2\pi k : k \in \mathbb{Z} \\ x = \frac{5\pi}{3} + 2\pi m : m \in \mathbb{Z} \\ x = -\frac{\pi}{6} + 2\pi n : n \in \mathbb{Z} \\ x = \frac{7\pi}{3} + 2\pi l : l \in \mathbb{Z} \\ x = 2 \end{cases} \\ &\Leftrightarrow \begin{cases} x = \frac{\pi}{6} + 2\pi k, k = 0, 1, \dots \\ x = \frac{5\pi}{6} + 2\pi m, m = 0, 1, \dots \\ x = -\frac{\pi}{6} + 2\pi n, n = 1, 2, \dots \\ x = \frac{7\pi}{6} + 2\pi l, l = 0, 1, \dots \\ x = -\frac{1}{2} \end{cases} \end{aligned}$$

Ответ:  $\left\{ \frac{\pi}{6} + 2\pi k, k = 0, 1, \dots; \frac{5\pi}{6} + 2\pi m, m = 0, 1, \dots; -\frac{\pi}{6} + 2\pi n, n = 1, 2, \dots; \frac{7\pi}{6} + 2\pi l, l = 0, 1, \dots; -\frac{1}{2} \right\}$ .