대수적으로 이차부등식 풀기 ($ax^2 + bx + c \leq 0$ $(a > 0,\ b, c \in \mathbb{R})$)

(Solving Quadratic Inequalities ($ax^2 + bx + c \leq 0$ $(a > 0,\ b, c \in \mathbb{R})$) in Algebra)

Start End

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$$ax^2 + bx + c \leq 0 \;(a > 0,\ \ b, c \in \mathbb{R})$$

Start End

$$ax^2 + bx + c \leq 0 \ (a > 0,\ \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

Start End

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- $D > 0$

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Start End

$$ax^2 + bx + c \leq 0 \ (a > 0,\ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots

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Start End

$$ax^2 + bx + c \leq 0 \ (a > 0,\ \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$

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$$ax^2 + bx + c \leq 0 \ (a > 0,\ \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where

Start End

$$ax^2 + bx + c \leq 0 \ (a > 0,\ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.

Start End

$$ax^2 + bx + c \leq 0 \ (a > 0,\ \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore$

▸ Start ▸ End

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  $\therefore \alpha \leq$

Start End

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Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x$

Start End

$$ax^2 + bx + c \leq 0 \ \left(a > 0,\ \ b, c \in \mathbb{R}\right)$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x \leq$

Start End

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Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x \leq \beta$ proof

Start End

$ax^2 + bx + c \leq 0 \ (a > 0, \ b, c \in \mathbb{R})$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x \leq \beta$ proof
- $D = 0$

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  $\therefore \alpha \leq x \leq \beta$ proof
- $D = 0$
  $\therefore\ x = -\dfrac{b}{2a}$ proof

Start End

$$ax^2 + bx + c \leq 0\ (a > 0,\ \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x \leq \beta$ proof
- $D = 0$
  $$\therefore\ x = -\frac{b}{2a}$$ proof
- $D < 0$

Start End

$$ax^2 + bx + c \leq 0 \ (a > 0, \ b, c \in \mathbb{R})$$

Let $D = b^2 - 4ac$

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  $\therefore \alpha \leq x \leq \beta$ proof
- $D = 0$
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- $D < 0$
  $\therefore$

Start End

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Let $D = b^2 - 4ac$

- $D > 0$: Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
  $\therefore \alpha \leq x \leq \beta$ proof
- $D = 0$
  $\therefore\ x = -\dfrac{b}{2a}$ proof
- $D < 0$
  $\therefore$ No solutions. proof

Home Start End

Home Start End

$$ax^2 + bx + c \leq 0$$

Home Start End

$$ax^2 + bx + c \quad \leq \quad 0 \quad (a > 0,\ b, c \in \mathbb{R})$$

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$$\begin{aligned} ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\ x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \end{aligned}$$

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Let α and β

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Let α and β be roots

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\end{aligned}
$$

Let α and β be roots of $ax^2 + bx + c = 0$

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Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.

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Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
$(\because b^2 - 4ac > 0)$

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Let α and β be roots of $ax^2 + bx + c = 0$ where $\alpha < \beta$.
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$$(x - \alpha)(x - \beta) \leq 0$$

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i) $x - \alpha \geq 0,\ x - \beta \leq 0$

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$$(x - \alpha)(x - \beta) \leq 0$$

i) $x - \alpha \geq 0, x - \beta \leq 0 \Rightarrow$

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ii) $x - \alpha \leq 0, x - \beta \geq 0$

Home Start End

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Home Start End

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by i), ii)

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by i), ii) $\therefore$

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by i), ii) $\therefore \alpha$

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by i), ii) $\therefore \alpha \leq x$

Home Start End

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i) $x - \alpha \ge 0, x - \beta \le 0 \Rightarrow \alpha \le x \le \beta$

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by i), ii) $\therefore \alpha \le x \le \beta$

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$$ax^2 + bx + c \leq 0$$

Home Start End

$$ax^2 + bx + c \quad \le \quad 0 \quad (a > 0,\ b, c \in \mathbb{R})$$

Home Start End

$$\begin{aligned} ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\ x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \end{aligned}$$

Home Start End

$$\begin{aligned} ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\ x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \\ \left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} &\leq 0 \end{aligned}$$

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$$
\begin{aligned}
ax^2 + bx + c &\le 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\
x^2 + \frac{b}{a}x + \frac{c}{a} &\le 0 \quad (\because a > 0) \\
\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} &\le 0 \\
\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2} &\le 0
\end{aligned}
$$

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$$\begin{aligned}
ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\
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\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} &\leq 0 \\
\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2} &\leq 0 \\
\left(x + \frac{b}{2a}\right)^2 &\leq 0 \quad (\because b^2 - 4ac = 0)
\end{aligned}$$

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ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\
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\left(x + \frac{b}{2a}\right)^2 &\leq 0 \quad (\because b^2 - 4ac = 0)
\end{aligned}
$$

$$\therefore\ x = -\frac{b}{2a}$$

Home Start End

$$ax^2 + bx + c \leq 0$$

Home Start End

$$ax^2 + bx + c \quad \leq \quad 0 \quad (a > 0,\ b, c \in \mathbb{R})$$

Home Start End

$$\begin{aligned} ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\ x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \end{aligned}$$

Home Start End

$$\begin{aligned} ax^2+bx+c &\le 0 \quad (a>0,\ b,c\in\mathbb{R}) \\ x^2+\frac{b}{a}x+\frac{c}{a} &\le 0 \quad (\because a>0) \\ \left(x+\frac{b}{2a}\right)^2-\frac{b^2}{4a^2}+\frac{c}{a} &\le 0 \end{aligned}$$

Home Start End

$$\begin{aligned}
ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\
x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \\
\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} &\leq 0 \\
\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2} &\leq 0
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\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2} &\le 0
\end{aligned}
$$

$\therefore$ No solutions

Home Start End

$$\begin{aligned} ax^2 + bx + c &\leq 0 \quad (a > 0,\ b, c \in \mathbb{R}) \\ x^2 + \frac{b}{a}x + \frac{c}{a} &\leq 0 \quad (\because a > 0) \\ \left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} &\leq 0 \\ \left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2} &\leq 0 \end{aligned}$$

$$\therefore \text{ No solutions } (\because b^2 - 4ac < 0)$$

Github:
https://min7014.github.io/math20210521002.html

Click or paste URL into the URL search bar, and you can see a picture moving.