Warmup:

$\sqrt{\boxed{4} \cdot 3} = 2\sqrt{3}$

perfect squares

1
4
9
16
25
36
49
64
81
100

Simplify the following radicals:

$\sqrt{9} = 3$

$\sqrt{\cancel{12}}$

$\cancel{4} \cdot 3$

$\boxed{2 \cdot 2}$

$2\sqrt{3}$

$\sqrt{\cancel{20}} = \sqrt{4 \cdot 5}$

$2\sqrt{5}$

$\cancel{4} \cdot 5$

$2 \cdot 2$

$2\sqrt{5}$

Simplify the following radicals:

$3\sqrt{18}$ $\quad$ $2\sqrt{40}$ $\quad$ $5\sqrt{200}$

$3\sqrt{2\cdot 9}$

$3\cdot 3$

$3\cdot 3\sqrt{2}$

$9\sqrt{2}$

$2\sqrt{\cancel{20}\cdot 2}$

$\cancel{10}\cdot 2$

$\boxed{5\ 2}$

$2\cdot 2\sqrt{5\cdot 2}$

$4\sqrt{10}$

$5\sqrt{100\cdot 2}$

$5\cdot 10\sqrt{2}$

$50\sqrt{2}$

$5\sqrt{\cancel{100}\ 2}$

$\cancel{50}\ 2$

$\cancel{25}\ \boxed{2}$

$5\ 5$

$=5\cdot 5\cdot 2\sqrt{2}$

$50\sqrt{2}$

Simplify the following radicals:

$\sqrt{-9}$ $\sqrt{-12}$ $\sqrt{-20}$ = No Solution

No real number solution

Imaginary #'s

Can you solve this equation?

$$x^2 - 9 = 0$$

$+9 \quad +9$

$\sqrt{x^2} = \sqrt{9}$

$x = \underline{3}$ or $\underline{-3}$

$x^2 - 9 = 0$

$(x+3)(x-3) = 0$

$x+3=0 \qquad x-3=0$

$-3 \;\; -3 \qquad +3 \;\; +3$

$x=-3 \qquad x=3$

Factor

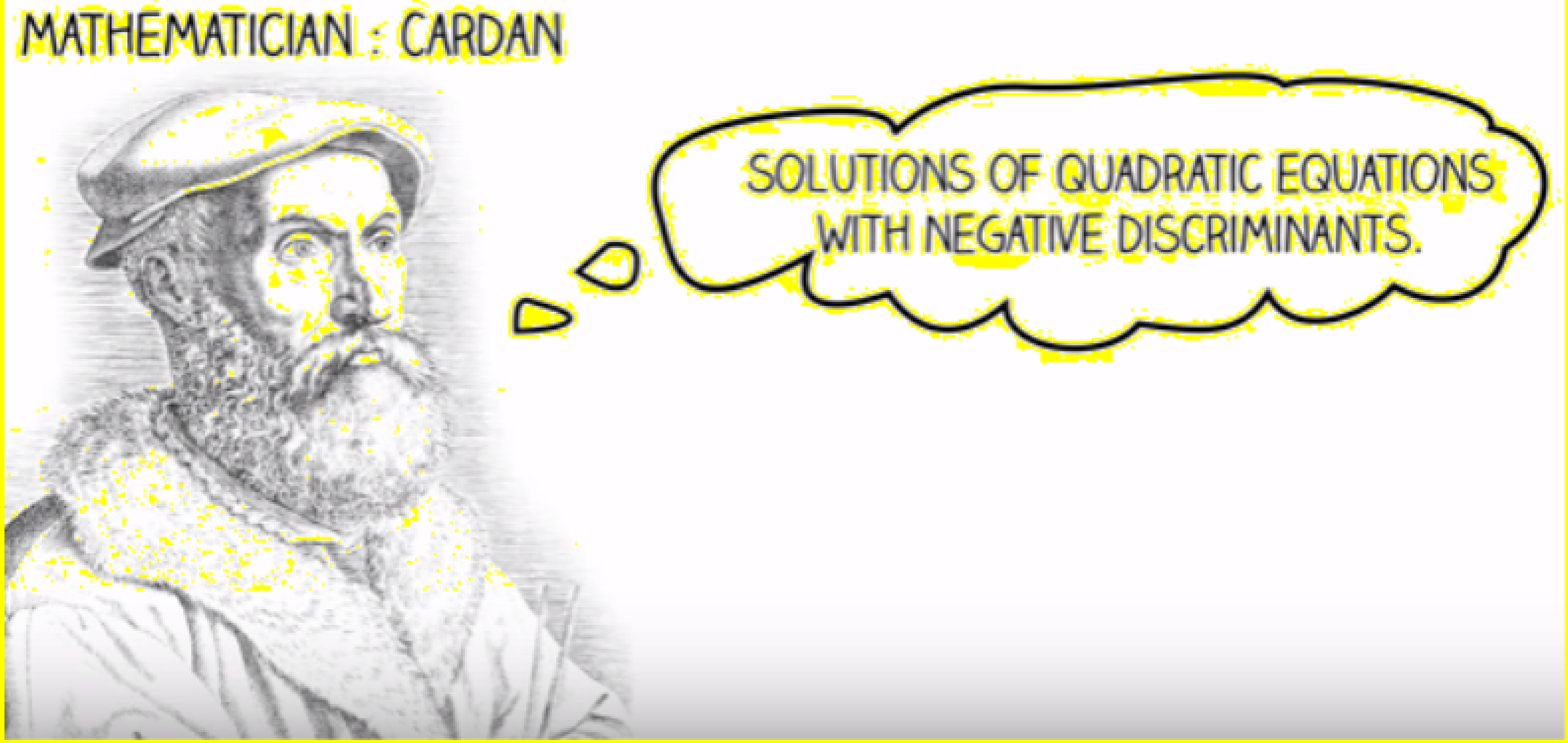
How about this one?

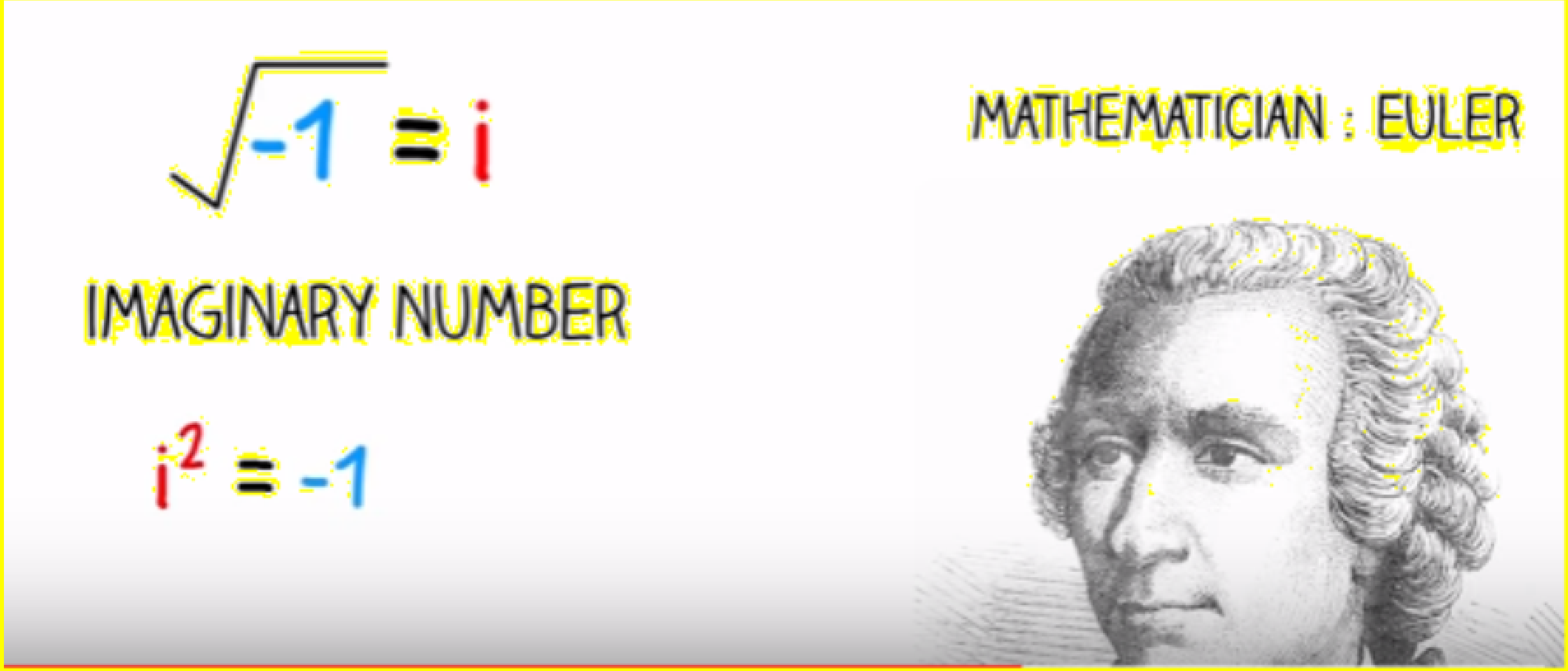
$$x^2 + \cancel{9} = 0$$

$$\quad\; \cancel{-9} \quad -9$$

$$\sqrt{x^2} = \sqrt{-9}$$

$$x = \sqrt{-9}$$


MATHEMATICIAN : CARDAN
SOLUTIONS OF QUADRATIC EQUATIONS WITH NEGATIVE DISCRIMINANTS.



$$i = \sqrt{-1}$$

$$i^2 = -1$$

"Calculating with imaginary numbers is the mathematical equivalent of believing in fairies"

Marcus du Sautoy,
Professor of Mathematics at Oxford

Definition:

The ***imaginary numbers*** consist of all numbers *bi*, where b is a real number and *i* is the imaginary unit, with the property that $i^2 = -1$.

So, if $i^2 = -1$, that means that $i = \sqrt{-1}$.

Now we can express the square roots of negative numbers using the imaginary unit *i*.

$\sqrt{2} \cdot \sqrt{3} = \sqrt{6}$

Example: Simplify $\sqrt{-5}$

$$\sqrt{-5} = \sqrt{-1 \cdot 5}$$

$$\sqrt{-1} \cdot \sqrt{5} = i\sqrt{5}$$

Example:

Simplify $\sqrt{-7}$

$$\sqrt{-1 \cdot 7}$$

$$\sqrt{-1} \cdot \sqrt{7}$$

$$i\sqrt{7}$$

Example:

Simplify $\sqrt{-99}$

$= i\sqrt{\cancel{99}}$

$11 \quad \cancel{9}$

$3 \quad 3$

$3i\sqrt{11}$

Example: Simplify

$$\sqrt{-\frac{9}{16}}$$

$= i\sqrt{9/16}$

$i \cdot \frac{3}{4}$

or

$\frac{3}{4} \cdot i$

or

$\frac{3i}{4}$

$$\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$$

You try: Simplify each of the following radicals using *i*.

$\sqrt{-36}$

$i\sqrt{36}$

$6i$

$\sqrt{-160}$

$i\sqrt{160}$

$4i\sqrt{10}$

$4\sqrt{10}\,i$

$\sqrt{-\frac{25}{4}}$

$i\sqrt{\frac{25}{4}}$

$\frac{5}{2}i$

Express these numbers in terms of *i*.

1. $\sqrt{-2}$ $\sqrt{2}\ i$ or $i\sqrt{2}$

2. $\sqrt{-3}$ $i\sqrt{3}$

3. $\sqrt{-49}$ $7i$

4. $\sqrt{-25}$ $5i$

5. $-\sqrt{-9}$

6. $-\sqrt{-16}$ $-4i$

7. $\sqrt{-128}$ $8i\sqrt{2}$

8. $\sqrt{-12}$ $2i\sqrt{3}$

9. $-\sqrt{-80}$ $-4i\sqrt{5}$

10. $-\sqrt{-75}$ $-5i\sqrt{3}$

5) $-1\cdot\sqrt{-9}$ $\quad 3\ 3$

$-1\cdot i\sqrt{9}$

$-1\cdot i\cdot 3$

$-3i$

Homework #1:
Imaginary Numbers