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Class: Math 1301 Date: 1-14-13
Topic/Section: Types of real numbers / Integer and Fractional exponents

| Examples and Vocabulary | Notes/Comments/Questions |
| --- | --- |
| Counting or Natural numbers $= \{1, 2, 3, \ldots\} = \mathbb{N}$ | How are natural numbers used? |
| $\downarrow$ | |
| Integers $= \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\} = \mathbb{Z}$ | How are integers useful? |
| $\downarrow$ $\quad 2x + 8 = 0$, $\quad -8 \quad -8$ | $2x = -8$, $x = -4$ |
| Rational numbers = any number that can be written as $p/q$ where $p$ and $q$ are integers and $q \neq 0$ $= \mathbb{Q}$ | What are other ways of defining the rational numbers? |
| Ex. $\frac{22}{7}$, $\frac{-5}{2}$, $-\frac{11}{4}$, $\frac{1}{3}$ $= 0.\overline{333}$, | |
| $\frac{12}{10} = \frac{6}{5} = 1.2$, $2$ $= 2/1 = 4/2 = -4/-2$, $0 = \frac{0}{9} \neq \frac{9}{0}$ | |

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**Examples and Vocabulary**

Irrational numbers = I

$\sim 1.414213562\ldots$

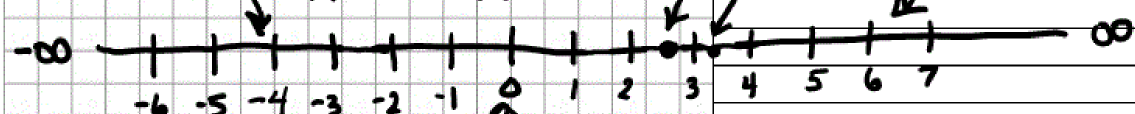
Ex. $\sqrt{2}$, $\sqrt{11}$, $-\sqrt[3]{5}$,

$\pi$, $e$, $\sqrt{9}=3$ circumference

$\frac{\text{circumference}}{\text{diameter}} = \pi$

Real numbers = any number that can be plotted on a real number line

x $\quad x^2 = x \cdot x = (-)(-) = +$



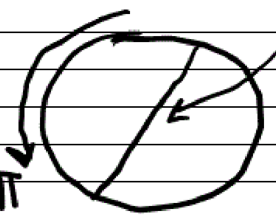

$x = x^2 = x \cdot x = 0 \cdot 0 = 0$

Ex. $\sqrt{-1} = x$ because $x^2 = -1$ $\qquad \sqrt{4} = 2$ because $2^2 = 4$

Is x a real number? No

**Notes/Comments/Questions**

What are some ways of creating irrational numbers?




$\pi \sim 3.14159\ldots$

$e \sim 2.71828\ldots$

$x^2 = x \cdot x = +$

x?

Are all numbers real numbers? No

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| Examples and Vocabulary | Notes/Comments/Questions |
| --- | --- |
| ① Classify each number: | |
| $8, -8^2, \frac{1}{8}, \sqrt{8}, \sqrt[3]{8}$ | |
| $\infty, \sqrt{-8}, 8.8, 8.\overline{8},$ | |
| $8.80800800080000 8\ldots$ | |
| $5^0, 4^{-2}, 8^{1/2},$ | $5^3 = 5 \cdot 5 \cdot 5$ |
| | $= 125$ |
| $9.3 \times 10^7, 5.89 \times 10^{-6}$ | |

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| Examples and Vocabulary | Notes/Comments/Questions |
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| **Rules for Integer and Rational Exponents** | Why is it hard to remember how to simplify integer and fractional exponents? |
| $a^0 = 1 \quad (a \neq 0)$ | What's the best way to do this? |
| $a^{-m} = \frac{1}{a^m} \quad (a \neq 0)$ | What's the relationship between the sign of the exponent and the sign of the base? |
| $a^{1/n} = \sqrt[n]{a}$ | How are fractional exponents related to roots? |
| $a^{m/n} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$ | |

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| Examples and Vocabulary | Notes/Comments/Questions |
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| | |

a. $10^0 = 1$

b. $-10^0 = -1$

$(-10)^0 = 1$

c. $10^{-1} = \frac{1}{10^1}$

$= \frac{1}{10}$

d. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

e. $5^{-3}$

$= \frac{1}{5^3} = \frac{1}{125}$

f. $16^{1/2} \neq 16 \cdot \frac{1}{2}$

$= \sqrt{16} = 4$

g. $27^{1/3}$

$= \sqrt[3]{27} = 3$

h. $32^{1/5} = \sqrt[5]{32} = 2$

i. $16^{3/2}$

$= \sqrt{16^3} = (\sqrt{16})^3$

$= (4)^3 = 64$

j. $27^{2/3} = (\sqrt[3]{27})^2$

$= 3^2 = 9$

k. $16^{-3/2}$

$= \frac{1}{16^{3/2}} = \frac{1}{64}$

l. $27^{-2/3} = \frac{1}{27^{2/3}} = \frac{1}{9}$

m. $9.3 \times 10^7$

$= 9.3 \times 10{,}000{,}000 = 93{,}000{,}000$

n. $5.89 \times 10^{-6}$

$= 5.89 \times \frac{1}{10^6} = 5.89 \times \frac{1}{1000000}$

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| Examples and Vocabulary | Notes/Comments/Questions |
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| 2 | How can we estimate roots of numbers that are not perfect powers? |
| Estimate $\sqrt[5]{250}$ to three decimal places. | $2^5 = 32$ |
| $\sqrt[5]{250} = 250^{1/5} = 250^{0.2}$ | $3^5 = 243$ |
| $\sim 3.017$ | $4^5 = 1024$ |
| | $\sqrt[5]{32} = 2$ |
| | $\sqrt[5]{243} = 3$ |
| | $\sqrt[5]{1024} = 4$ |