

# Properties of Irrational Numbers

 Guide Notes

## Math 8

### Properties of Irrational Numbers

#### 1. The decimal expansion of an irrational number is non-terminating non-recurring.

Example:  $\sqrt{5} = 2.23606797 \dots \dots \dots$

#### 2. The sum or difference of a rational number and an irrational number is irrational.

Example:  $5 + \sqrt{3} = 5 + 1.73215 \dots \dots = 6.73215 \dots \dots$

$$5 - \sqrt{3} = 5 - 1.73215 \dots \dots = 3.2679 \dots \dots$$

#### 3. The product or quotient of a non-zero rational number with an irrational number is irrational.

Example:  $2 * \sqrt{2} = 2\sqrt{2}$

$$\sqrt{2} \div (-3) = -\frac{\sqrt{2}}{3}$$

#### 4. If you add, subtract, multiply or divide two irrationals, the result may be rational or irrational.

Example:  $\sqrt{2} + \sqrt{3} = 1.41421 \dots + 1.73215 \dots = 3.14626 \dots \dots$

$$\sqrt{3} - \sqrt{3} = 1.73215 \dots - 1.73215 \dots = 0$$

$$\sqrt{2} - \sqrt{3} = 1.41421 \dots - 1.73215 \dots = -0.3178 \dots \dots$$

$$\sqrt{2} * \sqrt{3} = 1.41421 \dots * 1.73215 \dots = 2.49962 \dots \dots$$

$$\sqrt{2} * \sqrt{2} = 2$$

$$\sqrt{2} \div \sqrt{3} = 1.41421 \dots \div 1.73215 \dots = 0.816447 \dots \dots$$

$$\sqrt{2} \div \sqrt{2} = 1$$

**Sample Problem 1:** Identify if the answer will be rational or irrational.

a.  $3\pi + 2\pi$

$$3\pi + 2\pi = 5\pi$$

$$5\pi = 5 * 3.14159 \dots \dots = 15.707963 \dots \dots$$

**Irrational**

b.  $\sqrt{6} - \sqrt{6}$

$$\sqrt{6} - \sqrt{6} = 0$$

**Rational**

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c.  $\sqrt{5} * \frac{1}{\sqrt{5}}$

$$\sqrt{5} * \frac{1}{\sqrt{5}} = 1$$

**Rational**

d.  $\sqrt{3} \div \sqrt{11}$

$$\sqrt{3} \div \sqrt{11} = 1.73215 \dots \div 3.3166 \dots = 0.52223 \dots$$

**Irrational**

Sample Problem 2: Identify if the answer will be rational or irrational.

a.  $3 + 5\pi$

$$\begin{aligned} 3 + 5\pi &= \\ &= 3 + 5 * 3.14159 \dots \\ &= 3 + 15.707963 \dots \\ &= 18.707963 \dots \end{aligned}$$

**Irrational**

b.  $\sqrt{7} - (-8)$

$$\begin{aligned} \sqrt{7} - (-8) &= \\ &= 2.6475 \dots + 8 = \\ &= 10.6475 \dots \end{aligned}$$

**Irrational**

c.  $\sqrt{5} * (-12)$

$$\begin{aligned} \sqrt{5} * (-12) &= \\ &= 2.2360 \dots * (-12) = \\ &= -26.8328 \dots \end{aligned}$$

**Irrational**

d.  $\sqrt{33} \div 33$

$$\sqrt{33} \div 33 = 1.73215 \dots \div 3.3166 \dots = 0.52223 \dots$$

**Irrational**

<b>Commutative Property</b>	for Addition for Multiplication	$a + b = b + a$ $a * b = b * a$
<b>Associative Property</b>	for Addition: for Multiplication	$(a + b) + c = b + (a + c)$ $(a * b) * c = b * (a * c)$
<b>Distributive Property</b>		$a(b + c) = ab + ac$
<b>Additive Identity</b>		$a + 0 = 0 + a = a$

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**Sample Problem 3:** Insert a rational and an irrational number between each numbers

a. 2 and 3

$$\frac{2 + 3}{2} = \frac{5}{2} = 2.5 \quad \text{Rational}$$

$$\sqrt{2 * 3} = \sqrt{6} \quad \text{Irrational}$$

b. 5 and 6

$$\frac{5 + 6}{2} = \frac{11}{2} = 5.5 \quad \text{Rational}$$

$$\sqrt{5 * 6} = \sqrt{30} \quad \text{Irrational}$$