

# ■ Expanded Practice Worksheet: Number Systems in Number Theory

*Covers classification, true/false, proofs, edge cases, primes, and intervals.*

## A. Classify Each Number

- 1 1) 7
- 2 2) 0
- 3 3)  $-8$
- 4 4)  $5/6$
- 5 5)  $-2/5$
- 6 6)  $\sqrt{9}$
- 7 7)  $\sqrt{2}$
- 8 8)  $\pi$
- 9 9) 0.125
- 10 10) 0.333...
- 11 11)  $-\sqrt{16}$
- 12 12)  $3 + 4i$
- 13 13)  $-2i$
- 14 14)  $e$
- 15 15)  $-11.75$

## B. True/False — Justify Your Answer

- 1 1) Every integer is a rational number.
- 2 2) Every rational number is an integer.
- 3 3) Every irrational number is a real number.
- 4 4) Some complex numbers are real numbers.
- 5 5) If a decimal expansion terminates, the number is rational.
- 6 6) If a decimal repeats, the number is irrational.
- 7 7) The number 0 is rational.
- 8 8) If  $x \in \mathbb{R}$  and  $x \neq 0$ , then  $1/x \in \mathbb{R}$ .

## C. Short Proof or Reasoning

- 1 1) Prove  $\sqrt{2}$  is irrational.
- 2 2) Show that the sum of a rational and an irrational number is irrational.
- 3 3) Show that the product of a nonzero rational and an irrational is irrational.

## D. Applications and Edge Cases

- 1 1) Classify  $0/7$  and  $7/0$  (if defined).
- 2 2) Is  $\sqrt{(16/9)}$  rational? Classify it.
- 3 3) Decide whether  $0.101001000100001\dots$  is rational or irrational.
- 4 4) Let  $a = 1/3$  and  $b = 2/3$ . Classify  $a + b$ ,  $a \times b$ , and  $b - a$ .
- 5 5) Determine whether  $-\sqrt{(25)}$  and  $\sqrt{(-25)}$  are real.

## E. Integer Subfamilies: Primes and Composites

- 1 1) Determine if 19 is prime or composite.
- 2 2) Factorize 84 completely into primes.
- 3 3) List all primes less than 20.
- 4 4) Why is 1 not prime or composite?
- 5 5) Is  $-7$  prime, composite, or neither? Explain.

## F. Intervals

- 1 1) Express all real numbers greater than  $-2$  and  $\leq 6$  in interval notation.
- 2 2) Write  $(-\infty, 3)$  in words.
- 3 3) Which integers belong to  $[4, 9)$ ?
- 4 4) Express the set  $\{x \in \mathbb{R} \mid x \geq 0\}$  in interval notation.
- 5 5) Write the interval of numbers strictly between  $\pi$  and 5.

## ■ Answer Key

### E. Integer Subfamilies — Answers

- 1 1) 19 is prime (only divisors 1,19).
- 2 2)  $84 = 2 \times 2 \times 3 \times 7 = 2^2 \times 3 \times 7$ .
- 3 3) Primes  $<20$ : 2,3,5,7,11,13,17,19.
- 4 4) 1 has only one divisor (itself), so not prime/composite.
- 5 5)  $-7$  is neither (definitions of prime/composite usually apply to positive integers only).

### F. Intervals — Answers

- 1 1)  $(-2,6]$ .
- 2 2) All real numbers less than 3.
- 3 3) Integers:  $\{4,5,6,7,8\}$ .
- 4 4)  $[0,\infty)$ .
- 5 5)  $(\pi,5)$ .