



• **ENTRIES.** As many as **THREE** students from each grade level (grades 2 and 3), (grades 4 and 5) and (grades 6, 7, and 8) may be entered in the Number Sense District Contest from each school. The top **TWO** students from each grade level advance to State.

• **ADVANCING TO STATE.** First and second place winners will advance to State from each contest. Third place winners will be alternates at State. (See page 8 for complete rules for advancing to State. See page 108 for an abbreviated chart for contest administration.)

• **NATURE OF THE CONTEST.** The contest presents 80 problems. Elementary (Grades 2 & 3 and Grades 4 & 5) problems requiring the applications of the four basic operations (+, −, ×, ÷) for their solution constitute the core of what is commonly thought of as number sense. The middle school contest may range from whole number arithmetic to topics on the study of sequences in analysis, and topics relating to the efficient and/or high speed solution of mathematics problems, in addition to “special topics” distributed through workshop participation. **Spring 2023 and Spring 2024 topics include: (1) Multiplication by 37, (2) Sum of Reciprocals, (3) Partial Fraction Decomposition, and (4) Remainders in Different Bases.**

• **WHAT HAPPENS IN THE CONTEST.** 1) The contest director will announce the time and place that contestants and one adult should report for verification of the scoring of tests. 2) Contestant ID numbers will be provided to contestants at roll call and seating of substitutes or alternates. Tests will be distributed to contestants face up, and contestants will be instructed to write their grade levels and their contestant ID numbers in the spaces provided on the front cover. Contestants must not open the test until the start signal is given. (Alternates taking the place of absent registered contestants should be sure to let the contest director know as they enter the room to save time in roll call.) No alarm watches or other devices that emit sound are allowed in the contest room, **except the contest director’s stopwatch to precisely time this contest.**

• **TIME ALLOTTED.** Contestants will have 10 minutes beginning at the start signal. No time warning will be given. Contestants shall remain quietly in their seats until the time has expired.

• **MARKING ANSWERS.** Contestants **MUST** bring to contest and use their own standard **non-erasable BLUE** ball point or ink pen(s) to write answers in the blanks provided on the test. Test is disqualified if the required standard **blue** ink is not used. **Pens will NOT be provided by the contest director. Mark-outs and mark-overs on an answer blank constitute a 2-point deduction. Marks of any kind on any portion of the**

**paper, OTHER THAN an answer blank, constitute a disqualification.** Any mark in an answer space will constitute an attempt. Problems are arranged in a sequential format (see p. page 66).

(a) **Fractions.** All fractions must be reduced to lowest terms. Improper fractions are acceptable answers. Decimal answers are permitted for the unstarred problems whose answers are exactly expressible as decimals. For example,  $3/2$ ,  $11/2$ , and 1.5 are all acceptable.

(b) **Symbols.** Symbols such as \$ and % are usually printed on the sheet. Therefore, answers require only the writing of numerals. If a symbol is omitted from the printed sheet, it is not the responsibility of the contestant to make sure the answer is complete. If not printed, the student need not include it in the answer. (This rule excludes dollars and cents markings.)

(c) **Dollars and Cents.** In agreement with the philosophy that answers should be complete, all dollars and cents problems must have complete answers. That is, twenty-three dollars must be written as \$23.00 (with \$ and .00). Sixteen cents must be written as \$.16 or 16¢, depending on the answer blank format. The contestant’s adding of a symbol, such as the \$, to a line that already has the symbol posted does not constitute an error.

(d) **Efficient Forms.** Numerical answers should be written so that the answers are complete as in the two examples above. However, the answer should be written in the most efficient form possible. For example, if the answer is 16, the written answer 16.000 is not acceptable for the purposes of the number sense competition. Extraneous zeroes are not to be used. For example, if .16 is the answer, 0.16 is not an acceptable format.

(e) **Exponentials.** An answer such as  $3 \times 10^3$  should be expressed as 3000 and not left in exponential form.

(f) **Estimation Problems.** Every 10th problem is an estimation problem, denoted by a star. These problems require approximate integral answers, i.e., they permit 5% error; all other problems require exact answers.

(g) **Commas.** Commas are allowed but not recommended. Misuse of the comma will constitute an incorrect answer (for example, if the answer is 16,780 and the contestant responds with 167,80 the answer will be counted wrong since the comma in incorrectly placed).

(h) **Units.** The answer must be written in the correct units given in the problem. If the unit is implied in the question, the contestant is **NOT** responsible for writing the units, but it does not constitute an incorrect answer if the correct units

INSTRUCTIONS FOR THE CONTESTANT *CONTINUED*

word is spelled out. If the incorrect word is given by the contestant, the question shall be marked wrong. A question that end with "\_\_\_\_\_ (numerals)" is asking for the answer to be written with Arabic numerals (0, 1, 2,...) and NOT spelled out (zero, one, two,...). This direction is sometimes necessary if written words are used for clarity in the question or when the question otherwise has no other unit where one might expect it. It further gives guidance to the contestant about how to answer the question.

• **SAMPLE TEST PROBLEMS**

1.  $34 \times 11 =$  \_\_\_\_\_
2. The GCD of 24 and 30 is \_\_\_\_\_.
3.  $79 \div 4$  has a remainder of \_\_\_\_\_.

• **SCORING.** Add 5 points for each correct answer. Subtract 2 points for each incorrect answer, for each answer that was marked through, marked over, or erased, AND for skipped or unanswered test items down through the last item attempted.

• **VERIFICATION PERIOD.** No pens, pencils, papers, cell phones, or any other items should be in contestants' area while tests and answer sheets with keys are reviewed. Contestants and ONE coach OR parent OR adult have 15 minutes to check the computation of scores

and ask questions about items counted incorrect. If the contest is held before last day of District competition the last State Meet, tests must be turned back in to the contest director. Contestants will be disqualified from the contest should the paper be taken from the room prior to this date. After verification has been completed, awards will be issued in reverse order, beginning with 6th place. (At State, medals will be awarded through 6<sup>th</sup> place.)

• **MATERIALS.**

A variety of materials from a large number of sources is available for those who wish to get involved in PSIA number sense competition. Several are listed below. Previous years' PSIA Number Sense tests are included in both the PSIA Elementary and Middle School Academic Study Materials booklets, which may be ordered from the PSIA office (Order forms is in the appendix of this handbook).

2) *The Elements of Number Sense 2021 Edition.* by Doug Ray. A student-friendly resource for learning the basics of Number Sense. Includes a few tricks and tests for honing skills. Available on PSIA Study Materials Order form. Other resources are available at the Dr. Numsen website: [www.academicism.com](http://www.academicism.com). Additional resource providers are linked to the PSIA website: [www.psiacademics.org](http://www.psiacademics.org) under Resources.



## ADDITIONAL INFORMATION FOR COACHES / CONTEST DIRECTOR

• **PREPARATION FOR CONTEST.** Read and follow all instructions provided in the "Information Pertaining to All Contests" section of the *PSIA Academic Handbook*. Observe and practice with students all rules and procedures delineated in the "Instructions to the Contestant" and in the "Checklist for Contest Directors" and the "Checklist for Graders." Preparation for the Number Sense Contest should include multiple mind math practice sessions. Invitational meets with other schools are exciting for students and help them hone their skills in number crunching.

In addition to training students in the format of the tests, the resources named above provide practice that may best prepare students for competition.

• **PERSONNEL NEEDED FOR CONTEST.**

1. **Contest Director.** May be a knowledgeable coach of contestants in the contest.
2. **Assistant Directors.** Two knowledgeable coaches

from different schools other than director's.

3. **Graders.** Director and assistant directors also serve as graders. To expedite the grading process, provide at least two graders for every 8 papers.

• **SCORING REMINDERS.** +5 for each correct answer and -2 for each incorrect answer. REMEMBER: Contestants are NOT allowed to skip items without explanation, resulting in a 2-point deduction. The test will be scored through the last item attempted. Graders should each use a different color pen (excluding blue) or pencil to mark papers and place their initials in the space provided at the bottom of the test answer sheet to indicate that they have graded the paper.

# Number Sense Problem Sequences

## Grades 2-3 Problem Sequence

### Problems 1 - 20:

Addition / subtraction (1 and 2 digits)  
Money conversion  
Reading a clock  
Unit conversion  
Basic geometry  
Place value  
Rounding  
Recognizing relative size of numbers  
Basic multiplication (single digits)

### Problems 21 - 40:

Addition / subtraction (3 and 4 digits)  
Multiplication / division Facts  
Sequences  
Repeated addition—multiplication property  
Unit conversions  
Applications of multiplication / division  
Representations of fractions

### Problems 41 - 60:

Multiplication tricks ( $\times 11$ ,  $\times 25$ ,  $\times 50$ )  
Simplifying fractions  
Perimeter and area of squares, rectangles, and triangles  
Word problems  
Addition / subtraction of decimals  
Other multiplication tricks

### Problems 61 - 80:

Multiplication / division of decimals  
Addition / subtraction of fraction with common denominator series  
Roman Numeral to/from Arabic Numeral conversions  
Place value and rounding with decimals (tenths, hundredths, etc.)  
Other multiplication tricks  
Order of operations  
Squaring numbers  
Difference of two squares  
Percentages  
Prime numbers and prime divisors  
Redistribution of factors

## Grades 4-5 Problem Sequence

### Problems 1 - 20:

Operations (+, -,  $\times$ ,  $\div$ ) with whole numbers  
Recognizing place value  
Rounding numbers  
Multiplication short-cuts  
Remainder type problems  
Even and odd number type problems  
Expanded notation  
Sums of whole numbers (series)  
Roman numerals/Arabic numerals

### Problems 21 - 40:

Addition/subtraction of fractions with common denominators  
Operations (+, -,  $\times$ ,  $\div$ ) with decimal fractions  
Comparing decimal fractions and common fractions  
Conversion problems (fractions / percents / decimals)  
Order of operations  
Multiplication short-cuts  
Ratio/Proportion  
Consumer type problems  
Prime number problems  
Greatest common divisor (GCD)  
Least common multiple (LCM)  
Conversion problem (length / weight / volume)

### Problems 41 - 60:

Operations (+, -,  $\times$ ,  $\div$ ) with fractions and mixed numbers  
Substitution problems  
Perimeter and area of squares, rectangles, triangle, circles  
Powers and roots of numbers  
Solving simple equations  
Sequences and series  
Sets  
Word problems  
Volume of cubes and rectangular boxes  
Right triangle problems  
Multiplication short-cuts  
Base systems  
Percent problems

### Problems 61 - 80:

Operations (+, -,  $\times$ ,  $\div$ ) with integers  
Inverses  
Basic geometry facts  
More area problems  
Squaring two-digit numbers  
Multiplication short-cuts  
Powers of numbers  
Consumer type problems  
Inequalities  
Probability  
Area problems with parallelograms, rhombi, and trapezoids  
Coordinate geometry on the number line

## Grades 6-8 Problem Sequence

### Problems 1 - 20:

Operations (+, -,  $\times$ ,  $\div$ ) with whole numbers, fractions, and decimals  
Order of operations  
Distributive property  
Comparison of fractions and decimals  
Multiplication short-cuts  
Squaring numbers  
Roman numerals/Arabic numerals  
Mean, median and mode  
Sums of whole numbers

### Problems 21 - 40:

Operations (+, -,  $\times$ ,  $\div$ ) with mixed numbers and integers  
Multiplication short-cuts  
Percent problems  
Conversion problems (English/metric, length, area, volume, time)  
Consumer type problems  
Substitution problems  
Solving simple equations  
Square roots and cube roots  
Greatest common divisor (GCD)  
Least common multiple (LCM)  
Number theory  
Prime numbers  
Divisors  
Perimeter and area of squares, rectangles, and circles  
Ratio and proportion  
Inverses and reciprocals

### Problems 41 - 60:

Sets  
Word problems  
Pythagorean theorem  
Sequences  
Volume and Surface area of rectangular solids and cubes  
Base systems  
Area of parallelograms, rhombi, and trapezoids  
Solving inequalities  
Basic geometry facts  
Remainder problems  
Multiplication short-cuts

### Problems 61 - 80:

Repeating decimals  
Number theory  
Powers of numbers  
Volume of circular cylinders, pyramids, cones, and spheres  
Sequences and series  
Multiplication short-cuts  
Factorial  
Coordinate geometry  
Probability  
More percent problems  
More remainder problems

### Remember!

Problem types can appear later in the test than listed, and when they do, you should expect them to be harder.

For example, on the Grade 4-5 test, a GCD problem can first appear between #21 and #40, but it could also appear at problems #41 and beyond (and the farther down the test, the harder the problem).