



OHIO
Mathematics Benchmarks and Indicators
Grade Nine
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BENCHMARKS AND INDICATORS	PAGE REFERENCES
Number, Number Sense and Operations Standard	
<i>Number and Number Systems</i>	
1. Identify and justify whether properties (closure, identity, inverse, commutative and associative) hold for a given set and operations; e.g., even integers and multiplication.	SE: 21-25, 26-31, 32-35, 410-415, 425-430, 439-443, 481-486 <i>Algebra Activity</i> 28, 437-438 TWE: OEA 25
2. Compare, order, and determine equivalent forms for rational and irrational numbers.	SE: 68-72, 73-78, 103-109, 586-592, 593-597, 648-653 TWE: OEA 72, 109 OH8 #6
<i>Meaning of Operations</i>	
3. Explain the effects of operations such as multiplication or division, and of computing powers and roots on the magnitude of quantities.	SE: 79-82, 84-87, 103-109, 197-203, 410-415, 417-423, 586-592 <i>Graphing Calculator Investigation</i> 265 TWE: F 103 OEA 109
<i>Computation and Estimation</i>	
4. Demonstrate fluency in computations using real numbers.	SE: 11-15, 21-25, 73-78, 79-82, 84-87, 103-109, 586-592, 593-597, 605-610, 611-614
5. Estimate the solutions for problem situations involving square and cube roots.	SE: 103-109, 590 #43, 591 #47, 596 #41-42, 601 #51-52, 602 #57-59, 605-610, 611-614
Measurement Standard	
<i>Measurement Units</i>	
1. Convert rates within the same measurement system; e.g., miles per hour to feet per second; kilometers per hour to meters per second.	SE: 429 #56, 656-658, 661 Ex #5, 662 #27-28, 663 #37-41
<i>Use Measurement Techniques and Tools</i>	
2. Use unit analysis to check computations involving measurement.	SE: 167-168 Ex #4, 656 Ex #3, 658 #28-33, 661 Ex #5, 662 #25-26, 662 #37-41, 685 Ex #2
3. Use the ratio of lengths in similar two-dimensional figures or three-dimensional objects to calculate the ratio of their areas or volumes respectively.	SE: 620 #33-35 <i>Algebra Activity</i> 416
4. Use scale drawings and right triangle trigonometry to solve problems that include unknown distances and angle measures.	SE: 157 Ex #5, 159 #33-34, 261 #57, 616-620, 623-630, 644 Ex #5, 646 #34-37 <i>Algebra Activity</i> 416, 626 TWE: OH14 #4

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5. Solve problems involving unit conversion for situations involving distances, areas, volumes and rates within the same measurement system.	SE: 429 #56-57, 661 Ex #5, 662 #25-26, 663 #37, 663 #41
Geometry and Spatial Sense Standard	
<i>Characteristics and Properties</i>	
1. Define the basic trigonometric ratios in right triangles: sine, cosine and tangent.	SE: 623-630
2. Apply proportions and right triangle trigonometric ratios to solve problems involving missing lengths and angle measures in similar figures.	SE: 616-620, 623-630, 647 #43-47 <i>Algebra Activity</i> 626 TWE: OEA 630 OH26 #7, OH30 #3
<i>Visualization and Geometric Models</i>	
3. Analyze two-dimensional figures in a coordinate plane; e.g., use slope and distance formulas to show that a quadrilateral is a parallelogram.	SE: 296 #25, 296 #45, 613#33-36 TWE: OH13 #17, OH17 #3, OH26 #1, OH27 #1 & #7, OH28 #5, OH29 #1
Patterns, Functions and Algebra Standard	
<i>Use Patterns, Relations and Functions</i>	
1. Define function with ordered pairs in which each domain element is assigned exactly one range element.	SE: 226-231, 245 #41, 262 #67-68 TWE: DI 227 OEA 231
2. Generalize patterns using functions or relationships (linear, quadratic and exponential), and freely translate among tabular, graphical and symbolic representations.	SE: 218-222, 233-238, 240-245, 524-530, 533-538, 554-560 <i>Graphing Calculator Investigation</i> 265, 278-279, 531-532, 545
3. Describe problem situations (linear, quadratic and exponential) by using tabular, graphical and symbolic representations.	SE: 274 Ex #5, 276 #40-43, 280-285, 298-305, 524-530, 533-538 <i>Algebra Activity</i> 271, 299 <i>Graphing Calculator Investigation</i> 306-307 TWE: OH14 #1
4. Demonstrate the relationship among zeros of a function, roots of equations, and solutions of equations graphically and in words.	SE: 533-538, 546-552 TWE: DI 535 OEA 552
5. Describe and compare characteristics of the following families of functions: linear, quadratic and exponential functions; e.g., general shape, number of roots, domain, range, rate of change, maximum or minimum.	SE: 218-222, 272-277, 524-530, 533-538, 554-560 <i>Algebra Activity</i> 569 <i>Graphing Calculator Investigation</i> 265, 278-279, 531-532, 545
<i>Use Algebraic Representations</i>	
6. Write and use equivalent forms of equations and inequalities in problem situations; e.g., changing a linear equation to the slope-intercept form.	SE: 272-277, 286-291, 292-297, 376-381, 382-386, 387-392, 495-500, 546-552 <i>Graphing Calculator Investigation</i> 545 TWE: OH15 #2
7. Use formulas to solve problems involving exponential growth and decay.	SE: 561-565, 572 #69, 592 #68-69, 689 #54 TWE: DI 562

BENCHMARKS AND INDICATORS	PAGE REFERENCES
8. Find linear equations that represent lines that pass through a given set of ordered pairs, and find linear equations that represent lines parallel or perpendicular to a given line through a specific point.	SE: 272-277, 280-285, 286-291, 292-297, 298-305 <i>Algebra Activity</i> 293, 299 <i>Graphing Calculator Investigation</i> 306-307 TWE: OH15 #2, OH25 #5
9. Solve and interpret the meaning of 2 by 2 systems of linear equations graphically, by substitution and by elimination, with and without technology.	SE: 369-374, 376-381, 382-386, 387-392 <i>Algebra Activity</i> 376 <i>Graphing Calculator Investigation</i> 375 <i>Spreadsheet Investigation</i> 368 TWE: OH18 #1-4, OH19 #1, 6, & 7
10. Solve quadratic equations with real roots by factoring, graphing, using the quadratic formula and with technology.	SE: 481-486, 489-494, 495-500, 501-506, 508-513, 533-538, 546-552 TWE: OH22 #2 & 6, OH23 #3
11. Add, subtract, multiply and divide monomials and polynomials (division of polynomials by monomials only).	SE: 410-415, 417-423, 432-436, 439-443, 444-448, 452-457 <i>Algebra Activity</i> 437-438, 450-451 <i>Graphing Calculator Investigation</i> 418 TWE: DI 445
Analyze Change	
12. Simplify rational expressions by eliminating common factors and applying properties of integer exponents.	SE: 417-423, 648-653, 655-658, 660-664 <i>Graphing Calculator Investigation</i> 418, 654 <i>Reading Mathematics</i> 665
13. Model and solve problems involving direct and inverse variation using proportional reasoning.	SE: 264-270, 277 #56-57, 285 #51, 298-305, 642-647 <i>Graphing Calculator Investigation</i> 265, 306-307 TWE: DI 266, 644 OH14 #2
14. Describe the relationship between slope and the graph of a direct variation and inverse variation.	SE: 264-270, 298-305, 642-647 <i>Algebra Activity</i> 299
15. Describe how a change in the value of a constant in a linear or quadratic equation affects the related graphs.	SE: 264-269, 276 #44, 292-297 <i>Graphing Calculator Investigation</i> 265, 278-279, 531-532, 545 TWE: OEA 277
Data Analysis and Probability Standard	
Data Collection	
1. Classify data as univariate (single variable) or bivariate (two variables) and as quantitative (measurement) or qualitative (categorical) data.	SE: 50-55, 88-94, 298-305, 722-728, 731-736, 737-742 TWE: OH10 #1, OH20 #1, OH30 #4
2. Create a scatterplot for a set of bivariate data, sketch the line of best fit, and interpret the slope of the line of best fit.	SE: 298-305 <i>Algebra Activity</i> 299 <i>Graphing Calculator Investigation</i> 306-307, 729-730 TWE: OH14 #1
Statistical Methods	
3. Analyze and interpret frequency distributions based on spread, symmetry, skewness, clusters and outliers.	SE: 722-728, 731-736, 737-742 <i>Algebra Activity</i> 743-744 TWE: OEA 728, 736, 742

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4. Describe and compare various types of studies (survey, observation, experiment), and identify possible misuses of statistical data.	SE: 708-712 <i>Reading Mathematics 714</i> TWE: OEA 713 OH23 #6, OH24 #5
5. Describe characteristics and limitations of sampling methods, and analyze the effects of random versus biased sampling; e.g., determine and justify whether the sample is likely to be representative of the population.	SE: 708-712 <i>Reading Mathematics 714</i> TWE: OEA 713 OH23 #6, OH24 #5
6. Make inferences about relationships in bivariate data, and recognize the difference between evidence of relationship (correlation) and causation.	SE: 298-305 TWE: OH14 #1
<i>Probability</i>	
7. Use counting techniques and the Fundamental Counting principle to determine the total number of possible outcomes for mathematical situations.	SE: 754-758 TWE: DI 755 OEA 758 OH32 #1
8. Describe, create and analyze a sample space and use it to calculate probability.	SE: 774 #28-31 TWE: OH32 #7
9. Identify situations involving independent and dependent events, and explain differences between, and common misconceptions about, probabilities associated with those events.	SE: 769-776 TWE: DI 770 F 769 OEA 776
10. Use theoretical and experimental probability, including simulations or random numbers, to estimate probabilities and to solve problems dealing with uncertainty; e.g., compound events, independent events, simple dependent events.	SE: 769-776, 777-780, 782-787 TWE: OEA 788

Codes Used for TWE Pages

DI	Differentiated Instruction
F	Focus
OEA	Open-Ended Assessment
OH	Countdown to OGT