TEST-TAKER RECOMMENDATIONS FOR CALCULATOR-PROHIBITED INDICATORS

The first several questions of the GED® Mathematical Reasoning test assess eight indicators covering various concepts in number sense and computation (Q.1.a through Q.1.d and Q.2.a through Q.2.d) that prohibit the use of the calculator. GED Testing Service has analyzed data on these calculator-prohibited items, resulting in the following comments and recommendations:

Indicator	Background	Recommendations for Test-takers

Q.1.a Order fractions and decimals, including on a number line.	These questions may require
	• comparing or ordering positive numbers, or negative numbers, or both,
	• with or without a number line.
	
	Test takers generally do very well on this indicator, with the exception of questions that require test takers to compare or order a set consisting entirely of ***negative*** numbers.
		• Leverage skills in comparing and ordering ***positive*** fractions and decimals toward similar skills comparing and ordering ***negative*** fractions and decimals.
		• Understand the difference in how negative numbers are compared and ordered:
		  ○ For instance, while 0.7 is greater than 0.2, -0.7 is actually *less than* -0.2.
		  ○ Since positives and negatives are essentially opposites, the rules for ordering each type of number are applied in a similarly opposite manner.

Q.1.b Apply number properties involving multiples and factors, such as using the least common multiple, greatest common factor, or distributive property to rewrite numeric expressions.	Test takers generally perform very well on this indicator, which includes questions that include both context or pure computation (no context) and which test factors of a number, multiples of a number, least common multiple, greatest common factor, etc.	No specific recommendations are provided, as the general population of GED® test takers performs well on this indicator.

Indicator	Background	Recommendations for Test-takers

Q.1.c Apply rules of exponents in numerical expressions with rational exponents to write equivalent expressions with rational exponents	This indicator focuses primarily on the following three rules of exponents:
	• $(2^m)^n = 2^{mn}$
	• $(2^m)(2^n) = 2^{m+n}$
	• $2^m/2^n = 2^{m-n}$
	(NOTE: Numbers other than 2 are used as the base for exponential expressions, and numbers are used in place of letters in test items.)
	
	In general, test takers struggle with this indicator—even the least complex items involving only one operation and positive integer exponents. Introducing more complex elements, such as multiple operations, negative or fractional exponents, or coefficients—e.g., $\mathbf{3}(2^4)$—only exacerbates difficulties for test takers. Data analysis of items at this indicator suggests that a high degree of guessing may be taking place.
		Begin from the ground up in learning the concepts contained in this indicator:
		• Learn how to calculate numbers raised to a power,
		• Move on to the three rules of exponents, and
		• Learn to calculate with
		  ○ coefficients,
		  ○ negative powers,
		  ○ fractional powers, and
		  ○ multiple operations.

Indicator	Background	Recommendations for Test-takers
Q.1.d Identify absolute value of a rational number as its distance from 0 on the number line and determine the distance between two rational numbers on the number line, including using the absolute value of their difference.	This indicator contains two skills: 1) ***calculating the distance*** between two points on a number line; and 2) creating and identifying ***absolute value expressions*** to model this distance. Test takers generally perform better on the first type of item, even in instances where a number line is not present as a visual aid. Test takers perform less well on the second type of item, even though a number line is typically present in items.	• Focus on the calculation of distances between two points on a number line, especially when one or both of the numbers is negative. • Calculate with all types of numbers, since points on the number line may be represented by integers, decimals, or fractions. • Focus on the concept of creating and identifying ***absolute value expressions*** that model ***the distance between two points*** on a number line. (These concepts are very closely related, and may be taught simultaneously or in sequence.)

Q.2.a Perform addition, subtraction, multiplication, and division on rational numbers.	This indicator involves pure computation (items contain no context, just computation only).
	
	Calculations may involve one or more operations, and items may require calculation with integers, decimals, and/or fractions (including mixed numbers), all of which may be positive or negative. This indicator also includes the skill known as order of operations (frequently taught via the acronym PEMDAS - Parentheses, Exponents, Multiplication and Division, Addition and Subtraction - sometimes also abbreviated "Please Excuse My Dear Aunt Sally"). This is a wide range of granular skills (e.g., multiply integers, add fractions) and not every individual skill is assessed on every form of the GED® Mathematical Reasoning test.
		Be able to
		• Multiply and divide with decimals,
		• Compute
		  ○ with fractions
		  ○ using order of operations
		  ○ with mixed numbers
		  ○ with negative numbers

Indicator	Background	Recommendations for Test-takers
Q.2.b Perform computations and write numerical expressions with squares and square roots of positive, rational numbers.	This indicator tests one or more of a number of skills, all involving numerical squares or square roots (without the use of variables). Skills that test takers can expect to encounter include • squaring a number, • taking the root of a perfect square, • simplifying and computing with non-perfect square roots, and • computing with squares, roots, and other rational numbers in combination. While test takers do fairly well with simple squares and square roots, there is a sharp drop-off in performance on items involving additional or more complex computations.	• Memorize the first 12 perfect squares (1, 4, 9, …, 144), • Understand the inverse relationship between pairs of squares and square roots; i.e., $12^2 = 144$ and $\sqrt{144} = 12$. • Understand the difference in squaring a negative number, such as $(-3)^2 = 9$, and the negative of a square number, such as $-3^2 = -9$. • Practice computing with squares and square roots that include fractions and decimals. • Strengthen skills at simplifying, and computing with, non-perfect square roots (e.g., $\sqrt{12} = 2\sqrt{3}$)
Q.2.c Perform computations and write numerical expressions with cubes and cube roots of rational numbers.	This indicator is quite similar to Q.2.b, with the difference being the degree—cubes and cube roots instead of squares and square roots. Beyond that difference, the type of calculations that are found in items at this indicator are essentially the same as those at Q.2.b. As with Q.2.b, test takers do fairly well on items involving simple cubes and cube roots, with a similar drop-off in performance on items involving additional or more complex computations.	• Memorize the first 6 perfect cubes (1, 8, 27, …, 216). • Perform/understand the recommendations for Q.2.b but with cubes rather than squares, noting that there is no difference between the cube of a negative and the negative of a cube, e.g., $(-3)^3 = -3^3 = -27$.

Indicator	Background	Recommendations for Test-takers
Q.2.d Determine when a numerical expression is undefined.	This indicator covers expressions that are undefined over the set of real numbers. There are two types of such expression—fractions with zero in the denominator (or an expression equivalent to zero); and square roots of negative numbers (or expressions which, when simplified, result in negative numbers). In both types of expression, the use of variables and linear expressions, and the substitution of values thereof, may be required.	Reinforce skills on questions involving • Zero in the denominator • Fractions with expressions equivalent to zero in the denominator • Square roots of negative numbers • Expressions which, when simplified, result in square roots of negative numbers • Substitution with linear expressions