Application of Basic Math Principles to Calculation

Calculation—Most Missed Questions

GED candidates should be able to perform mathematical computations quickly and accurately in each of the content areas. Some of the questions missed were the result of candidates making careless procedural errors. However, other errors were made because candidates lacked knowledge of why or when certain types of calculations should be used.

Skill gaps identified among GED candidates include an inability to:

- Calculate percentages and visualize whether or not their answers are reasonable when they are uncertain of the correct procedure to use.
- Visualize reasonable answers to questions, such as whether an original number should be smaller or larger than a percentage or fraction of that same number.
- Calculate squares and square roots of numbers, both with and without a calculator, and being able to estimate an approximation of a square root if it results in a non-perfect square. When faced with questions that did not provide candidates with a perfect square, they were unable to think through the problem and estimate an answer.
- Recognize and calculate exponents, both positive and negative. Candidates confused exponents and multipliers. When dealing with negative exponents, they did not view the negative exponent as representing a small decimal number, but rather viewed the exponent as a negative number to be multiplied.
- Select a correct equation in a conceptual problem. Candidates had difficulty in "setting up" an equation to solve the problem.

GED-Type Question Samples

The following are examples of GED-type questions for each area that simulate the types of questions most often missed by GED candidates. The following questions were developed by Kenn Pendleton, GEDTS Mathematics Specialist. They address each of the areas in calculation identified by the analysis of the GED Mathematics Test.

Sample Question: Percentages

A rectangular garden had a length of 20 feet and a width of 10 feet. The length was increased by 50%, and the width was decreased by 50% to form a new garden. How does the area of the new garden compare to the area of the original garden?

The area of the new garden is

(1) 50% less

(2) 25% less

(3) the same

(4) 25% greater

(5) 50% greater

COMMON STUDENT ERRORS

When students see that one side of a rectangular figure is increased by 50% and another side decreased by 50%, they assume that the areas continue to be the same. This was a common error made by GED candidates. Teaching students to draw a picture of the problem is a great strategy when comparing two figures. Have students look at the two figures that they have drawn to try and figure out a pattern. Also have students figure out what would occur to the area if the width was increased by 60% and the length decreased by 50%. Have students predict if it would it be the same or different, and why.

Sample Question: Percentages

When Harold began his word-processing job, he could type only 40 words per minute. After he had been on the job for one month, his typing speed had increased to 50 words per minute.

By what percent did Harold's typing speed increase?

(1) 10%

(2) 15%

(3) 20%

(4) 25%

(5) 50%

COMMON STUDENT ERRORS

When taking the GED Test, candidates are often nervous and forget the process to follow when figuring percentages. They forget whether to divide 40 by 50 or subtract 40 from 50 and then divide or use any process they can remember. It is this type of question where the ability to multiply any number by 10% can provide a GED candidate with a technique that can assist him/her in selecting the correct answer.

Sample Question: Conceptual Question Type

A positive number less than or equal to ½ is represented by x. Three expressions involving x are given:

(A) $x + 1$ (B) $1/x$ (C) $1 + x^2$

Which of the following series lists the expressions from least to greatest?

(1) A, B, C

(2) B, A, C

(3) B, C, A

(4) C, A, B

(5) C, B, A

COMMON STUDENT ERRORS

This is the type of question that GED candidates may skip or just answer randomly. Students must first solve for each of the expressions and then place them in order. Because the question uses letters, rather than numbers, candidates did not take the time or have the strategy to substitute numbers for the letters and then solve each of the expressions. It is important to note that a student doesn't need to calculate this problem, but rather to understand the concepts that multiplying any number by a fraction results in a smaller number and dividing a number by a fraction results in a larger number. It is important that students understand concepts to better estimate an answer prior to calculation.

Sample Question: Visualizing Fractions

A survey asked 300 people which of the three primary colors, red, yellow, or blue was their favorite. Blue was selected by ½ of the people, red by ⅓ of the people, and the remainder selected yellow.

How many of the 300 people selected YELLOW?

(1) 50

(2) 100

(3) 150

(4) 200

(5) 250

COMMON STUDENT ERRORS

Visualizing fraction parts appears to be a common error pattern for GED candidates. Candidates added ½ and ⅓ to get ⅚ and then multiplied. The answer selected was

for those people who selected blue or red. Another step was required to get the correct answer for the number of people who selected yellow.

Sample Question: Visualizing Fractions

Of all the items produced at a manufacturing plant on Tuesday, $\frac{5}{6}$ passed inspection.

If 360 items passed inspection on Tuesday, how many were PRODUCED that day?

(1) 300

(2) 432

(3) 492

(4) 504

(5) 3000

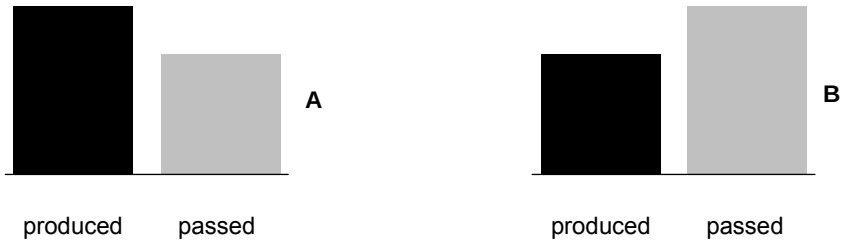
COMMON STUDENT ERRORS

This question is an excellent example of how students fail to visualize a reasonable answer. To solve the problem, they multiplied 360 by $\frac{5}{6}$ and obtained 300. If candidates had drawn a picture of what they had calculated, they would have noticed that the number of items that passed inspection was greater than the number that had been produced that day.

EXAMPLE

The following is an example of two depictions of the problem that clearly show that if 300 is selected as an answer, the number of items that pass inspection was greater than the number that had been produced that day.

Which of the following diagrams correctly represents the relationship between items produced and those that passed inspection?



Sample Question: Visualize Reasonable Answer

A cross-section of a uniformly thick piece of tubing is shown below. The width of the tubing is represented by *x*.

What is the measure, in inches, of *x*?

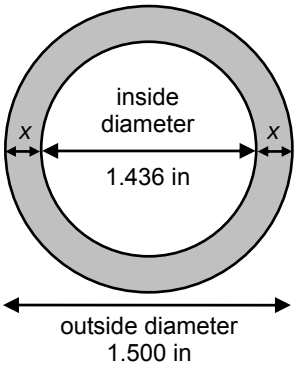
(1) 0.032

(2) 0.064

(3) 0.718

(4) 0.750

(5) 2.936



COMMON STUDENT ERRORS

GED candidates made a simple calculation error on this problem by selecting 0.064. Instead of visualizing that this answer was for both unknowns and dividing by two, they selected the first calculation they completed. This problem can be solved through subtraction and division or through addition. It is important that students understand there may be more than one way to solve a problem. Create situations in which learners can talk about what they see in problems like this. Helping learners describe their visualizations is a good way for them to clarify whether their mental picture and their description of it actually connect.

Sample Question: Negative Exponents

If $a = 2$ and $b = -3$, what is the value of $4^a \times a^b$?

(1) -96

(2) -64

(3) -48

(4) 2

(5) 1

COMMON STUDENT ERRORS

GED candidates viewed exponents as multipliers. Instead of finding the square of 4, they multiplied 4 × 2. Also, instead of multiplying ½ × ½ × ½ (the negative exponent), they multiplied -2 × -2 × -2. Distinguishing between exponents and multipliers is an important concept for GED candidates to comprehend. This question is from Part I of the GED Mathematics Test, which allows students to use a calculator. The concepts needed to solve this problem are: positive exponents create larger numbers and negative exponents create smaller decimal numbers. If they understand this concept, they can eliminate three of the five answers given.

Sample Question: Calculating Square Root

The "golden rectangle" discovered by the ancient Greeks is thought to have an especially pleasing shape. The length (*L*) of this rectangle in terms of its width (*W*) is given by the following formula.

$$L = \frac{W \times \left(1 + \sqrt{5}\right)}{2}$$

If the width of a golden rectangle is 10 meters, what is its approximate length in meters?

(1) 6.1

(2) 6.6

(3) 11.2

(4) 12.2

(5) 16.2

COMMON STUDENT ERRORS

This question was intended for Part I of the GED Mathematics Test because it uses a non-perfect square. Even using a calculator, this type of question may be difficult. GED candidates did not answer the question correctly. Suppose a GED candidate is reluctant to use/trust the calculator, but knows that $\sqrt{5}$ is slightly more than $\sqrt{4}$, and also knows that $\sqrt{4}$ is 2. Then the student can mentally calculate that the estimated answer is 15, leaving only one possible correct answer—16.2. Mental math and estimation skills can assist students in solving problems that they may otherwise just skip.

Incorporating Calculation Skills into the Classroom

To maximize long-term learning and understanding, it is important to support a discourse-rich classroom culture where students work towards mathematical understanding by sharing ideas with each other and the instructor. Some ideas to facilitate more effective learning and transference of calculation skills are the following:

- Create learning situations in which students discuss the strategies they've used to solve problems. This makes strategy development and selection intentional and increases student problem-solving skills.
- Develop questioning and observation skills in students. Help them to develop efficient algorithms for computation through experiencing different types of problems and experimenting with solutions, rather than having the instructor "tell them what to do." Students may need assistance in crafting the types of questions that they need to explore.
- Use real-world numbers and situations when developing lessons. Students are better able to apply mathematical skills when concepts are taught in the context of real-life skills. Providing instruction in context is more complex than the more traditional type of instruction that relies heavily on books and worksheets. To provide

more context-based instruction, encourage students to bring in their own authentic materials. Suggestions of authentic materials include:

- Newspapers and magazines, including sales papers, promotional materials, and advertisements
- Copies of utility or phone bills
- Credit card statements
- Leases for automobiles or apartments
- Recipes, cookbooks
- Timesheets, pay stubs
- Tax forms

- Teach estimation and mental math skills. Many tasks do not require precise, computed answers, but rather estimates, such as the approximate distance to the store or approximately how long something will take to complete. Have students list real-life situations in which estimates may be used. Identify different estimation techniques used by students, such as multiplying a restaurant bill by 10% and then adding half more to create a 15% tip or adding prices at a grocery store by using whole numbers, such as $1.00 for an item that is 97 cents.
- Teach students to multiply any number by 10% and how to find 25% of a number by first halving it and then halving it again.
- Provide students with problems that require them to use different problem-solving strategies so that they have numerous ways to solve any problem. After students have solved a problem, ask them whether there are other ways to solve that problem.
- Allow students to use the calculator to solve problems. Have students develop games and activities that will help the class to discover different functions that they can use to solve problems. Students should be able to use the calculator for the basic skills, as well as for calculating square roots and exponents.
- Show students sample questions that incorporate the three different question types. Have students explore why each question type is used and explain their reasoning. Provide students with practice in generating their own questions. These questions are often more meaningful to students as they express real-life problems.
- Provide students with practice in substituting numbers for variables. In algebraic equations, students can substitute a number for the unknown quantity, such as x. Students can then use basic calculation to find the answer. Students may wish to explore whether or not substitution works for all types of equations.
- Use manipulatives and real-world materials when developing lessons. Manipulatives, such as fraction squares, pattern blocks, tangrams, geoboards, and algebra tiles, provide students with the material they often need to express their mathematical thinking.
- Provide students with irregular shapes where they need to calculate area. Have students brainstorm how to calculate area more easily by partitioning the figure.

Example: Provide them with an outline map of the state in which they live and have them calculate how many square miles comprise the state. You may wish to provide students with graph paper and basic measuring tools.

- Have students explore possible versus impossible triangles and discover what conditions are required to create the different types of triangles.
- Encourage students to keep a math journal to reflect on what they have learned or to identify areas of concern or questions they wish to explore. A sample journal is included in Appendix B7 of this manual.