illuminate education

# FastBridge

# CBMmath Process

Scoring Guide

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## Introduction to *CBMmath Process*

The research behind Curriculum-Based Measurement (CBM) for the purposes of assessing students' math computation skills has existed for well over three decades. Nationally, researchers from a variety of institutions have contributed to what the education field knows today about CBM for mathematics. Through each iteration, researchers and teachers have gained important knowledge about what works well and what improvements can be made to efficiently and accurately assess students' mathematics skills to inform instruction. These tools are designed to better meet the needs of teachers while still offering the measurement properties needed to accurately assess and monitor student performance over time.

Researchers at *FastBridge* partnered with educators to take a fresh look at the various methods of CBM mathematics assessments created by authors nationally. This team determined that a problem with prior iterations available in the market was in the intent and purpose of the tools themselves. CBM for mathematics was previously attempting, via a single measure, to assess both students' automaticity in computing math, along with their skills in the primary process (steps) of completing math computation problems. However, research shows, these are two discrete skills. And, lacking in prior research was an assessment of applied math skills. In response, the *FastBridge* research team designed a suite of CBM assessments for mathematics that a range of mathematics skills. The result is the *FastBridge* suite of CBMmath tools that include *CBMmath Automaticity*, *CBMmath Concepts & Applications* (*CBMmath CAP*) and *CBMmath Process*. These *FastBridge CBMmath* tools cover the full range of elementary and middle school math skills. These tools provide several significant improvements from other CBM math assessments:

1. By assessing automaticity as a distinct assessment, these tools:
    a. Reduces teacher scoring time (the *CBMmath Automaticity* measure is completed online)
    b. Reduces student testing time (*CBMmath Automaticity* is completed online in 2-4 minutes)
    c. Allows teachers to differentiate between students who need skill development in automaticity, process, or both
    d. Allows effective monitoring of student progress as specific skills are developed pertaining to automaticity
2. By assessing the applied use of multiple math skills, *CBMmath CAP* provides information for teachers about how well students apply math skills for different problem types
3. By assessing mathematics computation process as a distinct assessment, *CBMmath Process*:
    a. Allows teachers to focus on what primary processes (steps) students do and do not know when completing math problems
    b. Allows for the sensitivity needed to effectively monitor student progress as they develop specific skills pertaining to the process of completing computation problems

*FastBridge* is leading the way in offering schools the next generation of CBMmath assessments for Automaticity, Concepts and Applications, and Process. All three of these measures have national norms and benchmarks available through the Illuminate Education *FastBridge* website.

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## Overview of *CBMmath*

*FastBridge* CBMmath includes a suite of three distinct measures:

1. ***CBMmath Automaticity*** **(Levels 1-3):**
    a. Evaluates the degree to which basic math facts and operations are accurate and automatic (fluent)
    b. Consists of a General Outcome Measure (GOM) per grade level and benchmark period for universal screening, plus optional multiple and single-skill subtests for further analysis of skills
    c. Computer administered for up to four (4) minutes
2. ***CBMmath Concepts & Applications*** **(CAP) (Levels K-8)**
    a. Evaluates skills for solving complex and multi-step math problems
    b. May be used for screening and progress monitoring
    c. Completely online administration and scoring
3. ***CBMmath Process*** **(Levels 2-6):**
    a. Evaluates the degree to which the primary processes (steps) in a multi-step problem are completed with accuracy
    b. Consists of a General Outcome Measure (GOM) per grade level and benchmark period for universal screening plus optional multiple and single-skill subtests for further diagnostic purposes
    c. Administered via paper-pencil and scored online
    d. Limited to 10 minutes for 2nd and 3rd grade assessments and 15 minutes for 4th through 6th grade assessments

Altogether, these tools are used to screen and monitor students' basic math fact skills, problem solving process, and applied use of math skills. They serve as useful complements to *FastBridge aMath* which is used to assess broad math skills.

## *CBMmath Automaticity* Scoring

All *CBMmath Automaticity* administrations are completed online in *FastBridge* and scored automatically. Teachers do not have to manually score any of *CBMmath Automaticity assessments*.

## *CBMmath CAP* Scoring

All *CBMmath CAP* administrations are completed online in *FastBridge* and scored automatically. Teachers do not have to manually score any of *CBMmath CAP assessments*.

## *CBMmath Process* Scoring

All *CBMmath Process* administrations are completed by students using paper-and-pencil. After the students complete the assessment, the teacher scores it using the scoring key found online in *FastBridge*.

There are two ways to score *CBMmath Process* and these are used according to whether the assessment is for screening or progress monitoring.

- Universal Screening = Rapid scoring
- Progress Monitoring = Error analysis scoring

Note that the Rapid Scoring method is available only for screening and error analysis only for progress monitoring. Details for each method are found in the following sections.

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## *CBMmath Process*: Rapid Scoring

Rapid scoring is designed to help teachers score completed *CBMmath Process* assessments when they are used for benchmark screening. The rapid scoring procedure involves awarding 0%, 50%, or 100% of available problem points for each problem completed. Only those math problems that are attempted are scored. Each attempted problem is scored as follows:

| Description | Number of Errors | Points |
|---|---|---|
| Correct | No errors | 100% of possible points |
| Mostly Correct | 2 or less minor errors | 50% of possible points |
| Incorrect | More than 2 errors | 0% of possible points |

Minor errors are those that involve steps toward solving the problem but not the basic setup or method of solution. Examples of minor errors are:

- Within problem computation mistake
- Not rounding a final division remainder

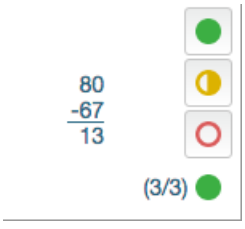
Teachers must exercise judgment with regard to what is a minor error for a given student. Considerations when scoring minor errors include what math skills the student has been taught and those on which s/he has demonstrated mastery in the past.

The rationale for this scoring procedure is that for screening purposes, students who get most of the problems correct or mostly correct are not at risk for math learning problems. In contrast, those who get many, or most, problems as mostly correct or incorrect might need additional math instruction or intervention. This scoring method is a rapid way to identify which students may need help, which is the purpose of screening.

After students complete the paper-and-pencil version of the *CBMmath Process* assessment, the teacher can conduct rapid scoring by using the scoring key in *FastBridge*. To do this, the teacher:

1. Logs in to *FastBridge*
2. Opens the *CBMmath Process* assessment screen for the selected class
3. Compares each student's completed *CBMmath Process* pages with the online scoring key
4. Marks each problem as Correct, Mostly Correct, or Incorrect
5. Submits test score in *FastBridge*

*FastBridge* includes an easy rapid-scoring color system to assist with scoring the problems. This system uses the colors red, yellow and green to indicate the student's score on each problem. For example, here is a second grade problem with the color code shown:




The problem shows the correct answer, as well as three circles of different colors. The colors represent the possible rapid scores:

- Green = 100% of points
- Yellow = 50% of points
- Red = 0 points

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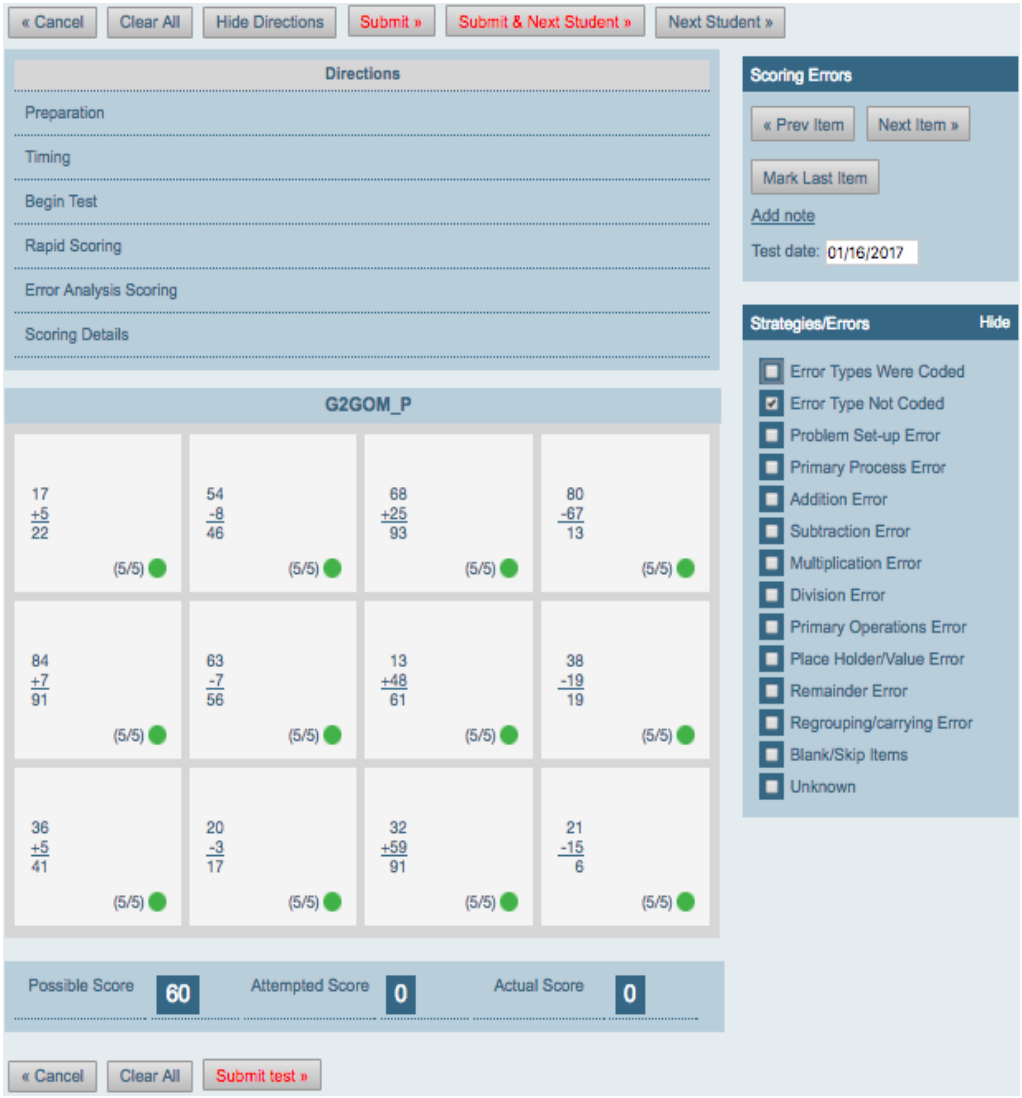
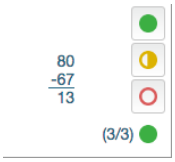
Here is what the examiner's screen will look like when logging in to conduct Rapid Scoring:




To score the following item, the teacher clicks on the color for the points awarded. In the above example, if the student's answer to the following problem of 80 minus 67 was 23, the teacher would know the correct answer is 13:




80
- 67
23

The teacher could award 50% of possible points. This is because the correct answer is 13 and the student made an error when subtracting in the tens column. The student should have reduced the 8 to a 7 after borrowing 10 ones to compute the result of zero minus 7. The student completed a partially correct calculation, but then neglected to recognize the borrow in the tens column.

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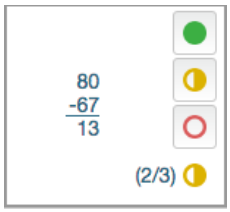
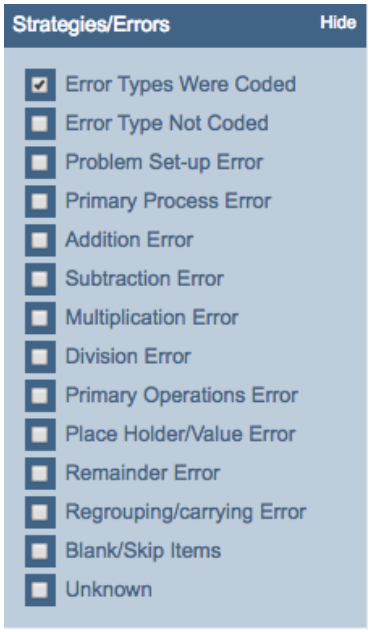
To score the item, the teacher clicks on the color of circle for the points awarded. In this case, the teacher would click on the yellow half-filled circle to show half of the points awarded.




This problem is worth 3 points, and the student received 50% of possible points. For any problems with an odd number of points, the system rounds up. This would be coded as yellow in the system, because the student made less than 2 errors when solving the problem.

## Optional Error Coding

It is also possible to code student errors when using the Rapid Scoring method. There is a box to the right of the scoring matrix with error types listed. The teacher can choose whether to code the errors or not. When including codes, the teacher clicks on each error type made on the assessment. Such codes must be submitted when the original scoring is done and cannot be entered later.




After scoring all the items, the teacher then clicks on **"Mark Last Item"** and then "**Submit test.**" The student's score will be recorded in *FastBridge*, and the teacher can score the next student.

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## *CBMmath Process*: Error Analysis Scoring

Error analysis scoring is designed to help teachers score completed *CBMmath Process* assessments when they are used for progress monitoring. The error analysis scoring method for *CBMmath Process* involves analyzing every student answer and assigning an error code to all errors. *FastBridge* includes 13 different math error types that can be assigned to each problem. Below is a list of all error codes for each type.

Problems for which the student provides the exact correct answer are considered correct and the teacher does not click on any error codes and all possible points are awarded. For problems with errors, the teacher will select one or more types of errors from the list provided. To indicate an error type, the teacher clicks on the box for the specific math problem and then clicks on the error type made in the box on the right side of the screen. With this method, it does not matter if 2 or less errors were made. It is the total number of errors that matter.

The rationale for the error analysis scoring method is that when a student displays significant math difficulties, the teacher needs to know the exact nature of the student's math errors. Such understanding comes from coding all student errors. After coding all student errors, the teacher clicks on **"Mark Last Item"** and "**Submit test.**" The student's score will be recorded in *FastBridge*, and the teacher can score the next student. Once scoring is complete for a student, it cannot be edited.

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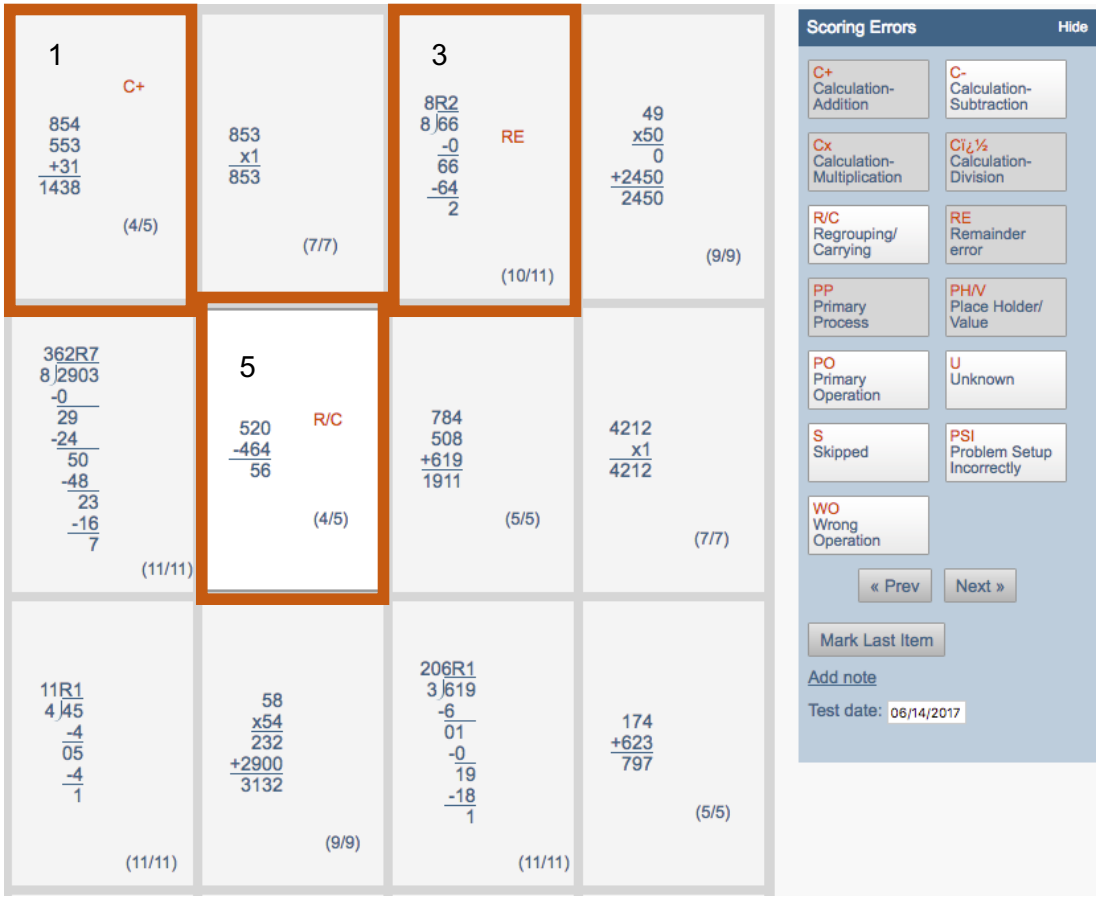
Here is an example of the error analysis method used for a fourth-grade student.

In this example, the student made errors on problems 1, 3, and 5.

1: The student's answer was 1439 so 1 point was deducted.

3: The student's answer included a remainder of 3 so 1 point was deducted

5: The student's answer was 66 and showed that the 2 in 520 was not converted to a 1 when 10 was borrowed for the one's column so 1 point was deducted




## Error Analysis Scoring Method Rules

### Points:

- By default, the student receives all possible points for each item correctly answered. Each problem has different point values depending on the problem type and number of steps.
- Points are deducted for each error that is made in a process (step).
- All final correct answers are correct, regardless of how they are written or calculated.

### Errors:

- **IMPORTANT:** When a student's final answer is not correct, each step that was conducted in error is marked. In multi-step problems, if an error is made in one or more steps, you will notice subsequent calculations are impacted by the original error and thus differ from the answer key. Keep scoring the problem anyway and apply as many error types as necessary for the problem. This assessment emphasizes whether or not students demonstrated each isolated step correctly.

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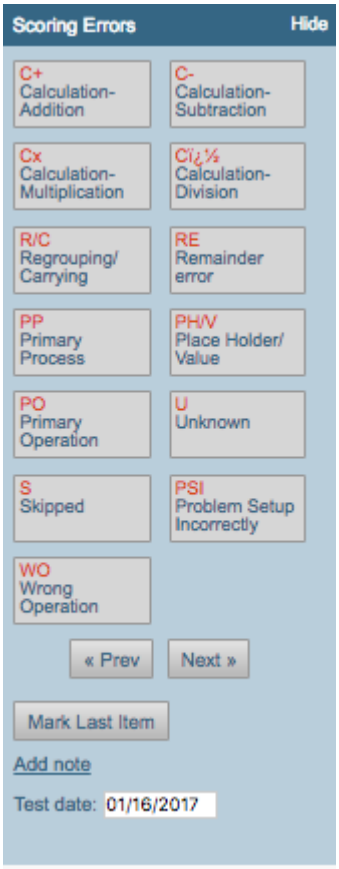
# Example:

| Student's answer | Correct answer |
|---|---|
| 337 + 485 = 712 | 337 + 485 = 822 |




The student in this example made a **Regrouping or Carrying Error**. This resulted in an answer of 712, rather than 822. The *only deduction* made was for the regrouping/carrying error because the rest of the calculation ***steps*** were completed properly. Note that each error type can be used only once per problem.

Please see below for additional examples of common student errors. If the student completes a problem with error(s) not provided in these examples, the teacher must use best judgment.

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## Error Explanations

- **Calculation-addition error (C+):** A student made an error in adding two numbers; a student wrote an incorrect answer for an addition problem. This includes addition errors made in all items involving addition, including multi-step multiplication items.

  - *Example:* 5 + 7

    5
    + 7
    11

In this example, the student incorrectly added 5+7. The correct answer is 12.

- **Calculation-subtraction error (C-):** A student made an error in subtracting two numbers; a student wrote an incorrect answer for a subtraction problem. This includes subtraction errors made in all items involving subtraction, including multi-step division items.

  - *Example:* 7 - 5

    7
    - 5
    3

In this example, the student incorrectly subtracted 7-5. The correct answer is 2.

A very common subtraction error is when a student fails to regroup and tries to subtract the smaller number from the larger number, like in the example below:

  - *Example:* 115 - 9

    115
    - 9
    114

In this case, it is both a regrouping error (because the student did not borrow from the ten's column) and a subtraction error (because the calculation is not correct). The correct answer is 106.

- **Calculation-multiplication error (Cx):** A student made an error in multiplying two numbers; a student wrote an incorrect answer for a multiplication problem.

  - *Example:* 5 x 7

    5
    x 7
    30

In this example, the student incorrectly multiplied 5 x 7. The correct answer is 35.

- **Calculation-division error (C÷):** A student made an error in dividing two numbers; a student wrote an incorrect answer for a division problem.

  - *Example:* 12 ÷ 6

    12 ÷ 6 = 3

In this example, the student incorrectly divided 12/6. The correct answer is 2.

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- **Place Holder/Maintain Value error (PH/V):** A student made an error in maintaining place value or using a place holder in calculating a multiplication or division item. This also includes failure to maintain correct decimal places or forgetting to include a decimal.

  - *Example 1:* 610 x 34

```
  610
 x 34
 2440
+1830
 4270
```

In the above example, the student did not maintain place value. The second line of the student work should read "18300," but the final digit was left off. The correct answer is 20,740.

  - *Example 2:* 2.14 x 1.63

```
 2.14
+1.63
  377
```

In the second example, the student did not include the decimal in the answer. The correct answer is 3.77.

- **Primary Operation error (PO):** The student used the wrong operation *at the first step* in the problem, but then solved other parts of the problem correctly. The result is still an incorrect solution.

  - *Example:* 52 x 48

```
  ¹52
 x 48
  500
 2080
 2580
```

In this example, the student added the numbers in the ones place (2, 8) instead of multiplied. The student then applied the correct steps to multiply the rest of the problem, but the final answer was wrong because that first operation was incorrect. The correct final answer is 2496.

- **Primary Process error (PP):** The student *missed one or more primary processes (steps)* used to solve the problem.

  - *Example:* 4.8 x 3.6

```
  ⁴4.8
 x 3.6
  2.88
 ????
```

In this example, the student did not finish the problem. This type of error is worth 2 points, because it makes it difficult to know whether or not the student might have been able to complete some other processes of the problem. The error code *Primary Process is used most often when a student does not complete a problem*.

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- **Problem Setup Incorrectly (PSI):** The student rewrote the problem incorrectly.
    - *Example:* 3.54 – 1.6
      was rewritten to be 354-16 = 338

In this example, the student rewrote the problem without taking into account the decimal points and values. The correct answer is 1.94

- **Regrouping or Carrying error (R/C):** A student made an error in adding numbers with a sum greater than 10 or subtracting numbers with a difference less than 0; the student made an error in "borrowing" from the next placeholder to solve the subtraction problem or “carrying” a number to the next placeholder to solve the addition problem.
    - *Addition Example:* 25 + 37

      25
      + 37
      52

In this example, the student did not carry the 1 from 5 + 7 = 12 to the tens place. The correct answer is 62.

    - *Subtraction Example:* 35 - 27

      35
      - 27
      18

In this example, the student "borrowed" from the tens place to complete 15 -7, but did not correctly regroup the tens place afterwards. The correct answer is 8.

- **Remainder error (RE):** A student made an error in a division problem in regard to the remainder; the remainder in the solution is incorrect.
    - *Example:* 10 ÷ 3
      10 ÷ 3 = 3 R3

In this example, the student did not correctly calculate the remainder. The correct answer is 3 R1. The most common remainder errors are (a) when the remainder is larger than the divisor, (b) when the remainder is left off the answer, or (c) when the student continues to calculate past the end of the dividend.

Please note, if the student subtracted incorrectly resulting in an incorrect remainder, that is usually a Calculation Subtraction error. It would only be a remainder error if one of the three scenarios above also occurred, in which case it would be both a subtraction and a remainder error.

- **Skipped (S):** The student left the item blank and did not attempt to solve the item.

- **Unknown error (U)**: The nature of the student’s error cannot be specifically identified or coded.

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- **Wrong Operation error (WO):** A student made an error due to misreading a *primary operation* sign and *performing a different operation* than specified in the item. This type of error does not include secondary operation signs (e.g., addition within a multi-step multiplication problem or subtraction within a multi-step division problem).

  o *Example:* 7 + 3

  $$\begin{array}{r} 7 \\ +\ 3 \\ \hline 4 \end{array}$$

In this example, the student misread the addition sign and subtracted 7-3 instead of adding 7+3. The correct answer is 10.

Please note that if a student is completing a problem like a 3-digit by 3-digit subtraction problem and reverses the sign for one of the subtraction calculations, this would be a Subtraction error, not a Wrong Operation error. It would only be a Wrong Operation error if the entire problem was added rather than subtracted.

## Online Scoring

To score items online, first click on the problem you want to score. Then from the list of errors in the Scoring Errors column on the right, click the type of errors the student made. The score for each item will be reduced by each type of error that is selected. The error type will be listed in red in the box. To unmark an error type, click the error box on the right a second time and it will be removed from the box, and the score will be increased by the appropriate amount. Not all errors are available for all problems. The potential errors will be shown in white once you have clicked on the problem. Below are the point values the student loses for each type of error:

- Calculation Addition = 1 point
- Calculation Subtraction = 1 point
- Calculation Multiplication = 1 point
- Calculation Division = 1 point
- Place Holder/Value = 1 point
- Primary Operation = All points
- Primary Process = 2 points
- Problem Setup Incorrectly = 1 point
- Regrouping/Carrying = 1 point
- Remainder Error = 1 point
- Skipped = All Points
- Unknown = All points
- Wrong Operation = 1 point

If the student did not complete all items in the time allotted, grade the last item the student worked on and then click "**Mark Last Item.**" Doing so will make all of the remaining items worth zero points.
When you have completed grading the form, please click "**Submit Test**" to submit the assessment.

If you have additional questions about scoring guidelines for *CBMmath Process*, please contact the FastBridge Support Team at help@fastbridge.org.

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