

## Standards and Scoring for Student Work in Mathematics

### General Rules

The task is to estimate the extent to which the student's performance illustrates the kind of cognitive work indicated by each of the three standards: Mathematical Analysis, Disciplinary Concepts, and Elaborated Written Mathematical Communication. Each standard will be scored according to different rules, but the following apply to all three standards:

- Scores should be based only on evidence in the student's performance relevant to the criteria. Do not consider things such as following directions, correct spelling, neatness, etc. unless they are relevant to the criteria.
- Scores may be limited by tasks which fail to call for mathematical analysis, disciplinary conceptual understanding, or elaborated mathematical written communication, but the scores must be based only upon the work shown.
- Take into account what students can reasonably be expected to do at the grade level. However, scores should still be assigned according to criteria in the standards, not relative to other papers that have been scored.
- When it is difficult to decide between two scores, give the higher score only when a persuasive case can be made that the paper meets minimal criteria for the higher score.
- If the specific wording of the criteria is not helpful in making judgments, base the score on the general intent or spirit of the standard described in the introductory paragraphs of the standard.
- Completion of the task is not necessary to score high.

|                                       | <b>Mathematical Analysis</b>  | <b>Disciplinary Concepts</b>  | <b>Elaborated Written Communication</b>   |
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| <b>4</b><br><b>Honors Work</b>        | Mathematical analysis was involved throughout the work.                     | The student demonstrates exemplary understanding of the mathematical concepts that are central to the task. Their application is appropriate, flawless, and elegant.  | The student's mathematical explanations or arguments are clear, convincing, and accurate, with no significant mathematical errors. Communication is exemplary.  |
| <b>3</b><br><b>Meets Expectations</b> | Mathematical analysis was involved in a significant proportion of the work. | There is substantial evidence that the student understands the mathematical concepts that are central to the task and applies these concepts to the task appropriately; however, there may be some minor flaws in the application, or details may be missing. | Mathematical explanations or arguments are present. They are reasonably clear and accurate, but less convincing.  |
| <b>2</b><br><b>Approaches</b>         | Mathematical analysis was involved in some portion of the work.             | The student's work demonstrates some understanding of the mathematical concepts that are central to the task. Where he/she uses appropriate mathematical concepts, the application is flawed or incomplete.   | Mathematical explanations, arguments, or representations are present. However, they may not be finished, may omit a significant part of an argument/explanation, or may contain significant mathematical errors. Generally complete, appropriate, and correct work or representations (e.g., a graph, equation, number sentence) should be scored a 2 if no other part of the student's work on the task warrants a higher score. |
| <b>1</b><br><b>Unacceptable</b>       | Mathematical analysis constituted no part of the work.                      | The student's work demonstrates no or very little understanding of the mathematical concepts that are central to the task, i.e., does not go beyond mechanical  | Mathematical explanations, arguments, or representations are absent or, if present, are seriously incomplete, inappropriate, or incorrect. (This may be because the   |

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|  |  | application of an algorithm. | task did not ask for argument or explanation, e.g., fill-in-the-blank or multiple-choice questions, or reproducing a simple definition in words or pictures.) |
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### Criteria for Scoring Analysis

*Student performance demonstrates thinking about mathematical content by using mathematical analysis.*

- ❑ Consider the extent to which the student demonstrates thinking that goes beyond mechanically recording or reproducing facts, rules, and definitions or mechanically applying algorithms.
- ❑ Possible indicators of mathematical analysis are organizing, synthesizing, interpreting, hypothesizing, describing patterns, making models or simulations, constructing mathematical arguments, or inventing procedures.
- ❑ The standard of mathematical analysis calls attention to the fact that the content or focus of the analysis should be mathematics. There are two guiding questions here.
  - ❑ First, has the student demonstrated mathematical analysis? To answer this, consider whether the student has organized, interpreted, synthesized, hypothesized, invented, etc., or whether the student has only recorded, reproduced, or mechanically applied rules, definitions, algorithms. If work is not shown, correct answers can be taken as an indication of analysis if it is clear that the question would require analysis to answer it correctly.
  - ❑ Second, how often has the student demonstrated mathematical analysis? To answer this, consider the proportion of the student's work in which mathematical analysis is involved.
- ❑ To score 3 or 4, there should be no significant mathematical errors in the student's work.
- ❑ If the student showed only the answer(s) to the task and it is incorrect, score it 1. If the student showed only the answer(s) to the task and it is correct, decide how much analysis is involved to produce a correct answer, and score according to the rules above. It is not necessary for the analysis to be at a high conceptual level to score a 3 or 4.
- ❑ In scoring analysis, the proportion of work that illustrates analysis is more important than the number of statements indicating analysis.

### Criteria for Scoring Disciplinary Concepts

*Student performance demonstrates understanding of important mathematical concepts central to the task.*

- ❑ Consider the extent to which the student demonstrates use and understanding of mathematical concepts. Low scores may be due to a task that fails to call for understanding of mathematical concepts.
- ❑ Possible indicators of understanding important mathematical concepts central to the task are expanding upon definitions, representing concepts in alternate ways or contexts, or making connections to other mathematical concepts, to other disciplines, or to real-world situations.
- ❑ A guiding question for using this standard is, "Does the student show understanding of the fundamental ideas relevant to the mathematics used in the task?" Correct use of algorithms does not necessarily indicate conceptual understanding of the material.
- ❑ Even if no work is shown the work may still receive a 3 or 4. Correct answers can be taken as an indication of the level of conceptual understanding if it is clear to the scorer that the task or question requires conceptual understanding in order to be completed successfully. In this case, the scorer must determine the level of understanding and score it appropriately.
- ❑ The score should not be based on the proportion of student work central to the task that shows conceptual understanding but on the quality of the understanding wherever it occurs in the work.

### Criteria for Scoring Elaborated Written Communication

*Student performance demonstrates an elaboration of his or her understanding or explanations through extended writing.*

- ❑ Elaboration consists of two major parts: a conclusion, generalization, or argument AND support for it, in the form of example, summary, illustration, detail, or reason. Elaboration is coherent when the examples, summaries, illustrations, details, or reasons do indeed provide appropriate, consistent support for the conclusions, generalizations, or arguments
- ❑ Consider the extent to which the student presents a clear and convincing explanation or argument.
- ❑ Possible indicators of elaborated written communication are diagrams, drawings, or symbolic representations as well as prose. To score high on this standard the student must communicate in writing an accurate and convincing explanation or argument.

Adapted from material developed by Quest HS, Humble, TX, in collaboration with Fred Newmann, University of Wisconsin

- The score should not be based on the proportion of student work central to the task that contains explanation/argument/representation but on the quality of the mathematical communication, wherever it may be in the work.