Student Name _____ Class _____ Score

For a complete response: **express** your thinking in words; **label** any figures you draw; **identify** any formulas you use; **make clear** the source of any numbers you use.

A. Usually each person in a math study group eats a small round pepperoni pizza with a 6 inch diameter. There are five people in the study group and they want to share one pizza. Precision Pizza will make a round pizza of any diameter. To the nearest half inch, what is the diameter of the pizza that should be ordered from Precision Pizza so that everyone gets the usual amount? Show the work that leads to your answer.

B. Rather than ordering one large pizza, the students decide to order two pizzas, each with half the area of the large pizza. Joshua said that the sum of the circumferences of the two smaller pizzas was equal to the circumference of the large pizza. Barbara claimed he was mistaken. Who was right? Explain your answer.

For a complete response: **express** your thinking in words; **label** any figures you draw; **identify** any formulas you use; **make clear** the source of any numbers you use.

A. Usually each person in a math study group eats a small round pepperoni pizza with a 6 inch diameter. There are five people in the study group and they want to share one pizza. Precision Pizza will make a round pizza of any diameter. To the nearest half inch, what is the diameter of the pizza that should be ordered from Precision Pizza so that everyone gets the usual amount? Show the work that leads to your answer.

B. Rather than ordering one large pizza, the students decide to order two pizzas, each with half the area of the large pizza. Joshua said that the sum of the circumferences of the two smaller pizzas was equal to the circumference of the large pizza. Barbara claimed he was mistaken. Who was right? Explain your answer.

RUBRIC

Notes:

- No more than 2 points should be given if 6 inches is used as the radius instead of the diameter for the five individual pizzas.
- No more than 3 points should be given if the answer to Part A is not rounded to the nearest $\frac{1}{2}$ inch.

Score	Description
1	Correct calculation of the total area needed for Part A.
2	Correct calculation of radius or diameter of large pizza in Part A OR correct calculation of total circumference of two smaller pizzas.
3	Correct calculation of any 3 of the following 4 values: i) diameter of larger pizza ii) circumference of larger pizza iii) diameter (or radius) of smaller pizza in Part B iv) circumference of smaller pizza in Part B.
4	Correct calculations and answers for both parts.

Note: See General Scoring Rubric for Written Response Items for further guidelines.

Name:_____

Problem Solving Rubric

Problem #1

Solution	**0** No answer submitted	**1** Incorrect & unreasonable answer	**2** Incorrect but reasonable answer		**3** Complete, correct answer
Strategy	**0** No response	**1** Work shown, but no strategy shown	**2** Work shown, strategy identified but not explained	**3** Work shown, strategy explained	**4** Work shown, strategy explained step by step
Conclusion	**0** No conclusion or number answer only	**1** Final answer in sentence form	**2** Final answer in sentence form & rationale for answer	**3** Final answer in sentence form, rationale for answer & explanation for real life application or multiple ways to solve	
Total score:					

Problem #2

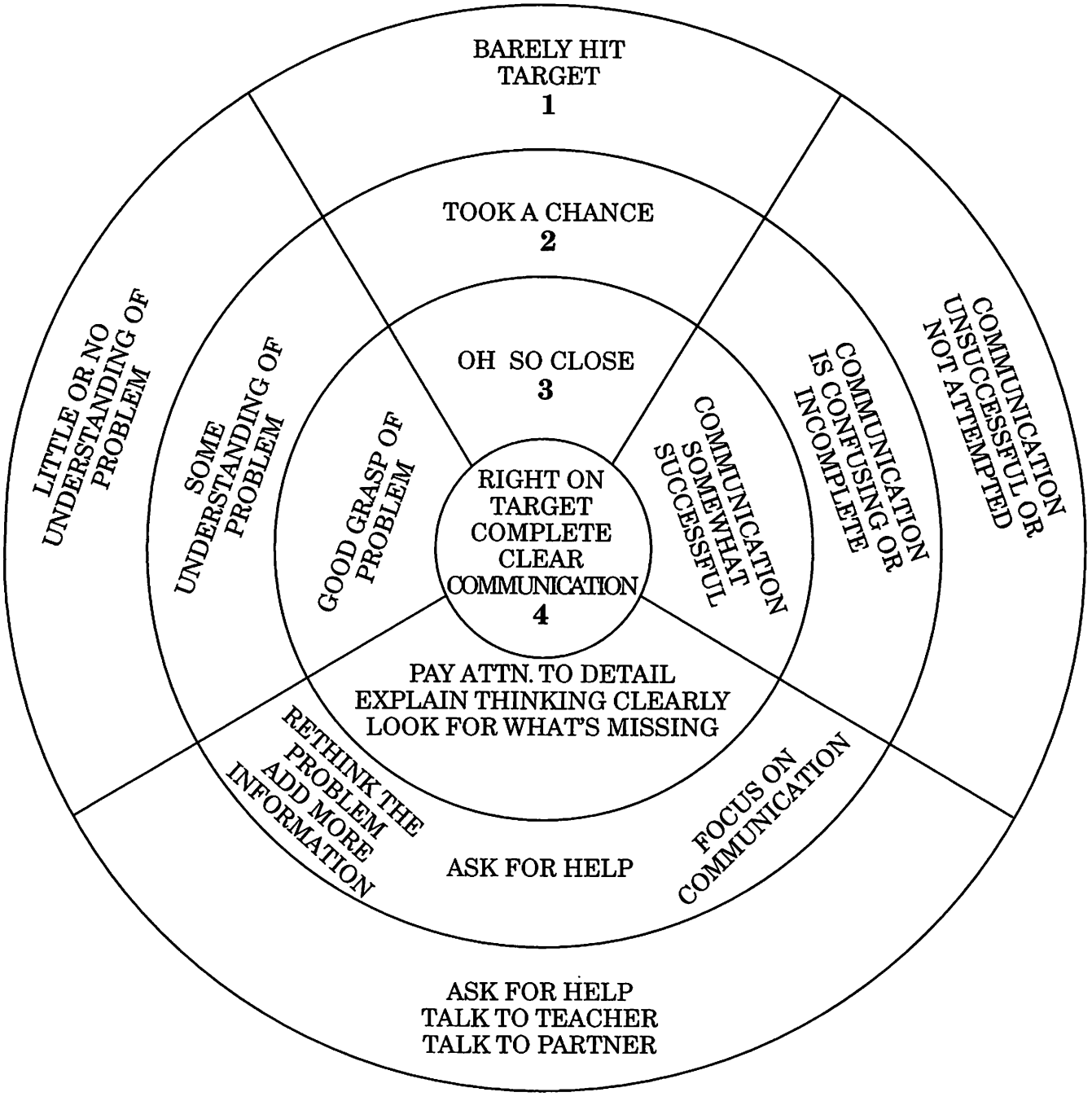
Solution	**0** No answer submitted	**1** Incorrect & unreasonable answer	**2** Incorrect but reasonable answer		**3** Complete, correct answer
Strategy	**0** No response	**1** Work shown, but no strategy shown	**2** Work shown, strategy identified but not explained	**3** Work shown, strategy explained	**4** Work shown, strategy explained step by step
Conclusion	**0** No conclusion or number answer only	**1** Final answer in sentence form	**2** Final answer in sentence form & rationale for answer	**3** Final answer in sentence form, rationale for answer & explanation for real life application or multiple ways to solve	
Total score:					

Problem #3

Solution	**0** No answer submitted	**1** Incorrect & unreasonable answer	**2** Incorrect but reasonable answer		**3** Complete, correct answer
Strategy	**0** No response	**1** Work shown, but no strategy shown	**2** Work shown, strategy identified but not explained	**3** Work shown, strategy explained	**4** Work shown, strategy explained step by step
Conclusion	**0** No conclusion or number answer only	**1** Final answer in sentence form	**2** Final answer in sentence form & rationale for answer	**3** Final answer in sentence form, rationale for answer & explanation for real life application or multiple ways to solve	
Total score:					

A Model for Interpreting Scores

AIMING FOR SUCCESS IN PROBLEM SOLVING



Stone Creek School
Irvine Unified

General Scoring Rubric for Written Response Items

Category	Score	Description
No Response	0	Either the work is not attempted (i.e., the paper is blank), or the work is incorrect, irrelevant, or off task. The response may minimally interpret or re-state the problem, but does not go beyond that.
Minimal	1	The response demonstrates only a minimal understanding of the problem posed and a reasonable approach is not suggested. Although there may or may not be some correct mathematical work, the response is incomplete, contains major mathematical errors, or reveals serious flaws in reasoning. Requested examples may be absent or irrelevant.
Partial	2	The response contains evidence of a conceptual understanding of the problem in that a reasonable approach is indicated. However, on the whole, the response is not well developed. Although there may be serious mathematical errors or flaws in reasoning, the response does contain some correct mathematics. Requested examples provided may fail to illustrate the desired conclusions.
Satisfactory	3	The response demonstrates a clear understanding of the problem and provides an acceptable approach. The response also is generally well developed and presented, but contains omissions or minor errors in mathematics. Requested examples provided may not completely illustrate the desired conclusions.
Excellent	4	The response demonstrates a complete understanding of the problem, is correct, and the methods of solution are appropriate and fully developed. The response is logically sound, clearly written, and does not contain any significant errors. Requested examples are well chosen and illustrate the desired conclusions.

EXPLANATORY NOTES

(1) Rubrics for specific items should always be used with this general rubric and the following notes about specific rubrics.

(2) The following excerpt from MDTP Guidelines for The Preparation of Written Response Mathematics Questions provides a context for this general rubric. The statement of the question should be explicit and clear. The extent to which students are to discuss their reasoning and results should be explicit. The extent to which students are to provide examples, counterexamples, or generalizations should also be clearly stated.

(3) Although the categories in the General Scoring Rubric are meant to indicate different levels of understanding and accomplishment, teachers should expect that some student responses may be on the boundary between two categories and may be scored differently by different teachers.

(4) Teachers may wish to designate some outstanding responses in the Excellent category as exemplars.

NOTES EXPLAINING HOW TO USE SPECIFIC ITEM RUBRICS

Scoring of written responses is to be based upon both the correctness of the mathematics and the clarity of the presentation. In scoring, do NOT "mind read" the presenter; instead only grade the presentation. Grade each response on the actual mathematics written and on the quality of the presentation of that mathematics. Unexecuted recipes or prescriptions should receive minimal credit. The specific scoring rubric for an item outlines the mathematical development necessary for the given scores. In addition to the formal mathematics, it is essential that students "show their work" and clearly present their methodology. The evaluation of each response should be based in part upon its organization, completeness, and clarity. A score of 1 or 2 may in some cases be based simply upon the mathematics called for in the rubric. Scores of 3 and 4 require effective presentation as well as appropriate mathematics. The mathematics called for in specific rubrics is necessary, but not sufficient, for these scores.

Mathematics Problem Solving Scoring Guide
Based on a Rubric from Northwest Regional Educational Laboratory

	Emerging (1)	Developing (2)	Proficient (3)	Exemplary (4)
Introduction Key Question: *Does the student's interpretation of the problem accurately reflect the important mathematics in the problem?*	• The data you showed was inaccurate. • You used the wrong information in trying to solve the problem. • You did not state what the problem is. • You did not indicate where you were headed in solving the problem.	• The data you show is accurate, but poorly organized. • You used some but not all of the relevant information from the problem. • You stated what the problem is incorrectly. • You partially indicated where you were headed with your solution.	• Your data is organized and accurate, but includes extraneous information not needed to solve the problem. • You used all relevant information from the problem in your solution. • You stated what part of the problem is correctly, but failed to mention other aspects of the problem. • You indicated where you were headed with your solution.	• The data shown is only the data needed to solve the problem and it is well organized and accurate. • You uncovered hidden or implied information not readily apparent. • You stated what all parts of the problem are correctly. • You indicated the starting and ending points for your solution.

Mathematics Problem Solving Scoring Guide
Based on a Rubric from Northwest Regional Educational Laboratory

	Emerging (1)	Developing (2)	Proficient (3)	Exemplary (4)
Methods Key Question: *Is there evidence that the student proceeded from a plan, applied appropriate strategies, and followed a logical and verifiable process toward a solution?*	• Your mathematical representations of the problem were incorrect. • Your strategies were not appropriate for the problem. • You didn't seem to know where to begin. • Your reasoning did not support your work. • There was no apparent relationship between your representations and the task. • Your approach to the problem would not lead to a correct solution.	• You used an oversimplified approach to the problem. • You offered little or no explanation of your strategies. • Your choice of forms to represent the problem was inefficient or inaccurate. • Some of your representations accurately depicted aspects of the problem. • You sometimes made leaps in your logic that were hard to follow. • Your process would lead to a partially complete solution.	• You chose appropriate, efficient strategies for solving the problem. • You justified each step of your work. • Your choices of mathematical representations of the problem were appropriate. • The logic of your solution was apparent. • Your process would lead to a complete, correct solution of the problem.	• You chose innovative and insightful strategies for solving the problem. • Your choice of mathematical representations helped clarify the problem's meaning. • You used a sophisticated approach to solve the problem. • You chose mathematical procedures that would lead to an elegant solution.

Mathematics Problem Solving Scoring Guide
Based on a Rubric from Northwest Regional Educational Laboratory

	Emerging (1)	Developing (2)	Proficient (3)	Exemplary (4)
Results Key Question: *Given the approach taken by the student, is the solution performed in an accurate and complete manner?*	• Errors in computation were serious enough to flaw your solution. • Your mathematical representations were inaccurate. • You labeled incorrectly. • Your solution was incorrect. • You gave no evidence of how you arrived at your answer. • There was no apparent logic to your solution.	• You made minor computational errors. • Your representations were essentially correct but not accurately or completely labeled. • Your inefficient choice of procedures impeded your success. • The evidence for your solution was inconsistent or unclear.	• Your computations were essentially accurate. • All visual representations were complete and accurate. • Your solution was essentially correct. • Your work clearly supported your solution.	• All aspects of your solution were completely accurate. • You used multiple representations for verifying your solution. • You showed multiple ways to compute your answer. • You proved that your solution was correct and that your approach was valid.
Discussion Key Question: *Does the student grasp the deeper structure of the problem and see how the process used to solve this problem connects it to other problems or "real-world" applications?*	• You were unable to recognize patterns and relationships. • You found a solution and then stopped. • You found no connections to other disciplines or mathematical concepts.	• You recognized some patterns and relationships. • You found multiple solutions but not all were correct. • Your solution hinted at a connection to an application or another area of mathematics.	• You recognized important patterns and relationships in the problem. • You found multiple solutions using different interpretations of the problem. • You connected your solution process to other problems, areas of mathematics or applications.	• You created a general rule or formula for solving related problems. • You related the underlying structure of the problem to other similar problems. • You noted possible sources of error or ambiguity in the problem. • Your connection to a real-life application was accurate and realistic.

Mathematics Problem Solving Scoring Guide
Based on a Rubric from Northwest Regional Educational Laboratory

	Emerging (1)	Developing (2)	Proficient (3)	Exemplary (4)
Communication Key Question: *Was I able to easily understand the student's thinking or did I have to make inferences and guesses about what they were trying to do?*	• You had many spelling and/or grammatical errors that detract from your argument. • I couldn't follow your thinking. • Your explanation seemed to ramble. • You gave no explanation for your work. • You did not seem to have a sense of what your audience needed to know. • Your mathematical representations did not help clarify your thinking. • You used mathematical terminology incorrectly.	• You had spelling and/or grammatical errors, but they do not detract from your argument. • Your solution was hard to follow in places. • I had to make inferences about what you meant in places. • You weren't able to sustain your good beginning. • Your explanation was redundant in places. • Your mathematical representations were somewhat helpful in clarifying your thinking. • You used mathematical terminology imprecisely.	• There were no spelling and/or grammatical errors. • I understood what you did and why you did it. • Your solution was well organized and easy to follow. • Your solution flowed logically from one step to the next. • You used an effective format for communicating. • Your mathematical representations helped clarify your solution. • You used mathematical terminology correctly.	• Your explanation was clear and concise. • You communicated concepts with precision. • Your mathematical representations expanded on your solution. • You gave an in-depth explanation of your reasoning. • You used mathematical terminology precisely.

* Type: task-specific analytic

Pros and Cons:

Pros	Cons
• Broken into parts	• very wordy
• very comprehensive	• Unsure that all categories should be equally weighted
• Generic • Can be applied • to multiple assignments	

Uses

- Problem of the month
- tasks
- modified version could be used for problem of the week
- Summative / end of unit

Improve

- weight the category differently.
- Shorten the descriptions
- Discussion category (optional)

Other Comments

- Multi page rubric seems intimidating

improvements

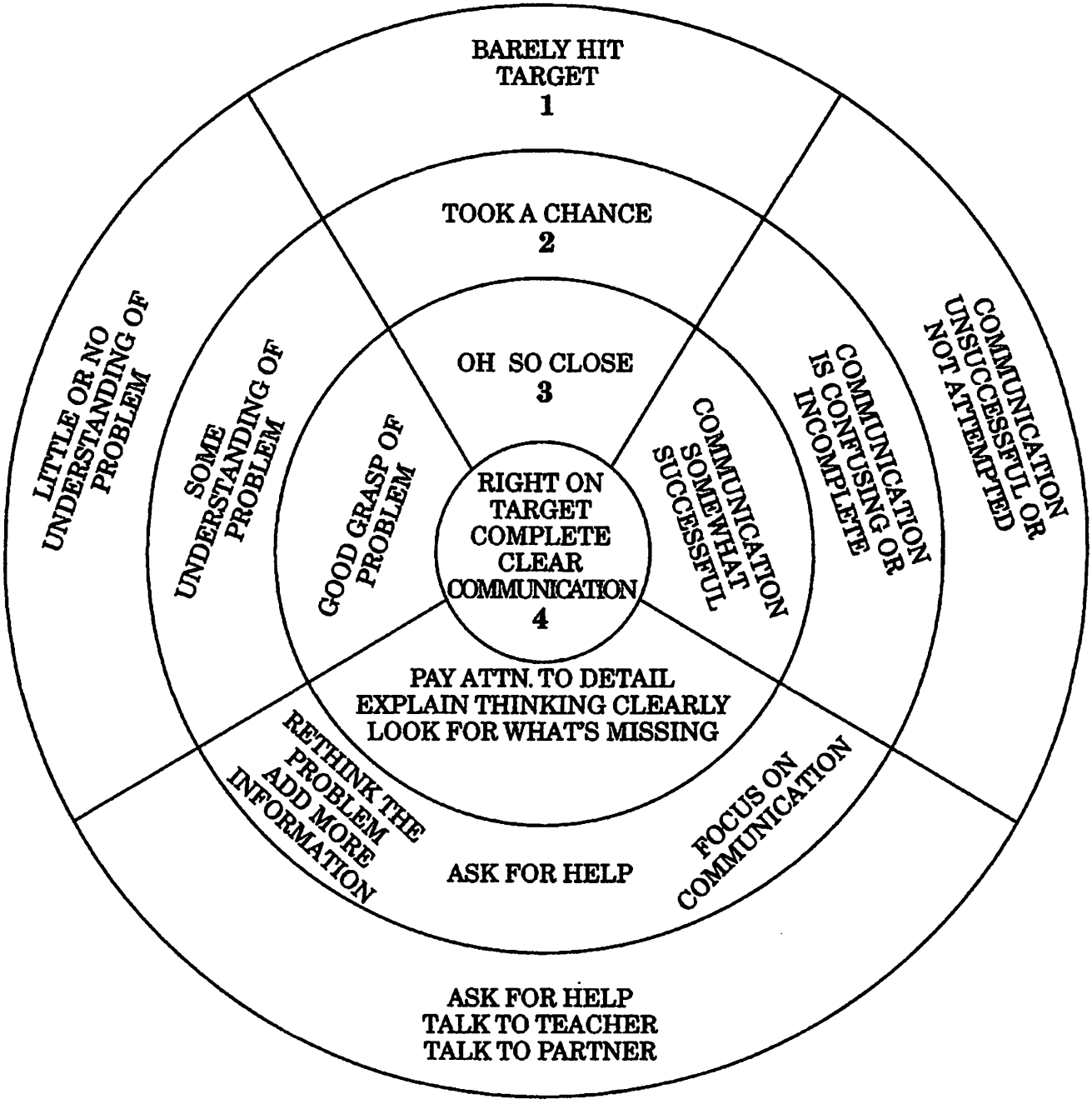
- weight the categories differently
- shorten the descriptions
- condense into a 2-page document
- Discussion category optional

other comments

multi page rubric may seem intimidating to lower level readers

A Model for Interpreting Scores

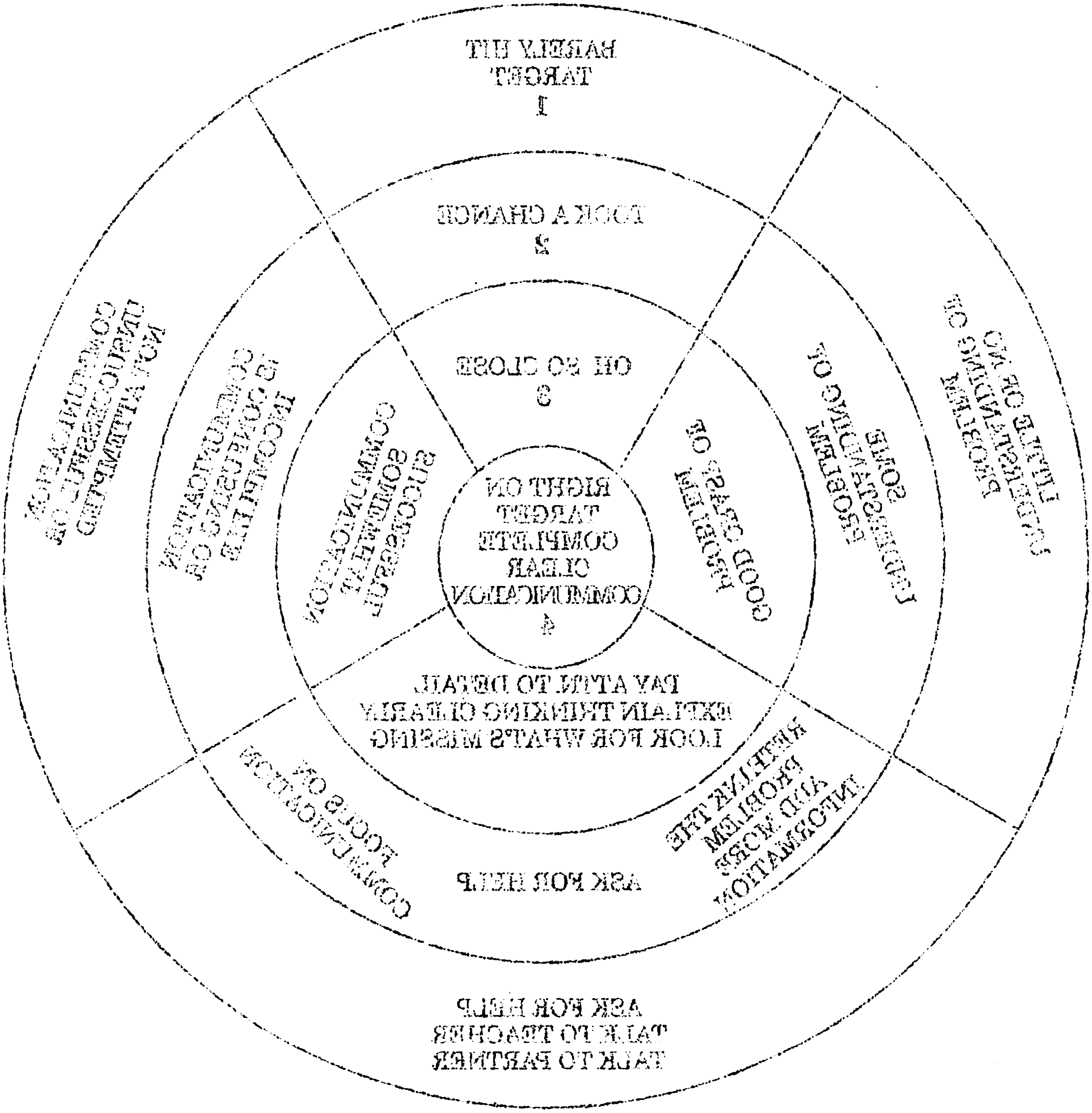
AIMING FOR SUCCESS IN PROBLEM SOLVING



Stone Creek School
Irvine Unified

A Model for Interpreting Scores

AIMING FOR SUCCESS IN PROBLEM SOLVING



Stone Creek School
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Aiming for Success in Problem Solving

TYPE: General Holistic

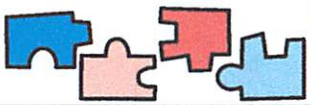
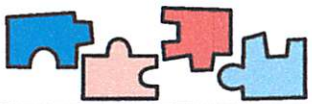
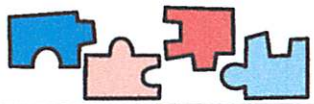
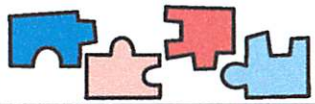
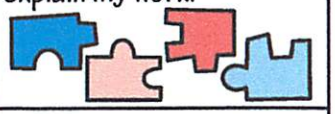
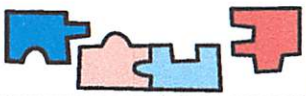
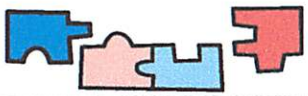
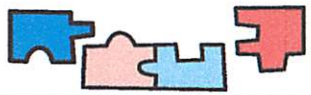
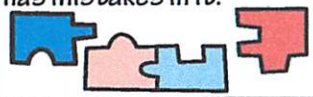
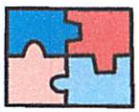
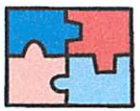
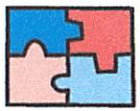
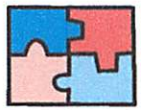
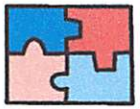
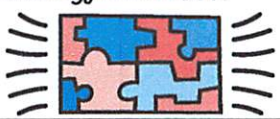
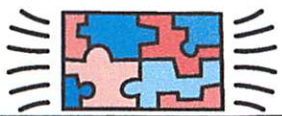
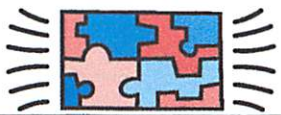
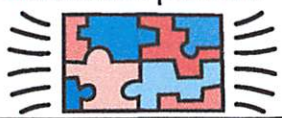
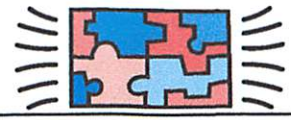
Pros:
- Creative Diagram
- Student Self Evaluation
- Less Wordy
- Great Foundational Rubric

Cons:
- Very General (NOT SPECIFIC)
-

Use of Rubric:
- Group work in Class

Improvements:
- More Detail

Exemplars® Jigsaw Student Rubric

Level	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice Makes an effort No or little understanding	I did not understand the problem. 	My math thinking is not correct. 	I used no math language and/or math notation. 	I did not notice anything about the problem or the numbers in my work. 	I did not use a math representation to help solve the problem and explain my work. 
Apprentice Okay, good try Unclear if student understands	I only understand part of the problem. My strategy works for part of the problem. 	Some of my math thinking is correct. 	I used some math language and/or math notation. 	I tried to notice something, but it is not about the math in the problem. 	I tried to use a math representation to help solve the problem and explain my work, but it has mistakes in it. 
Practitioner Excellent Clear Strong understanding Meets the standard	I understand the problem and my strategy works. My answer is correct. 	All of my math thinking is correct. 	I used math language and/or math notation accurately throughout my work. 	I noticed something about my math work. 	I made a math representation to help solve the problem and explain my work, and it is labeled and correct. 
Expert Wow, awesome! Exceptional understanding!	I understand the problem. My answer is correct. I used a rule, and/or verified that my strategy is correct. 	I showed that I knew more about a math idea that I used in my plan. Or, I explained my rule. 	I used a lot of specific math language and/or notation accurately throughout my work. 	I noticed something in my work, and used that to extend my answer and/or I showed how this problem is like another problem. 	I used another math representation to help solve the problem and explain my work in another way. 

General holistic rubric

Pros

* Levels are not prejudicial
* Drawing help

Cons

* Too many words for students,
* 50¢ vocab.

Use

- Guide for self-reflection

Improve

- Columns for student & teacher reflection
- ~~Box~~ for marking result means

Other

Problem-Solving Rubric

(Adapted from Dept. of Chemical Engineering CRCD Project, August 2002)

Criteria	Exemplary	Good	Needs Improvement
Identifying problem and main objective	**(4 – 5)**	**(2 – 3)**	**(0 – 1)**
Initial questions	Questions are probing and help clarify facts, concepts, and relationships in regard to problem. Follow-up questions are gleaned from appropriate sources.	All questions may not be relevant. May have some difficulty formulating questions to move toward better understanding of the problem.	Few or not questions formulated. Expects others to define the questions. Does not seem to understand the central problem.
Understanding the problem	Clearly defines the problem and outlines necessary objectives in an efficient manner.	Problem statement has some ambiguity or misses some important issues.	Problem is defined incorrectly or too narrowly. Key information is missing or incorrect.
Seeking information	Identifies several sources of information and individuals for support.	Relies on a few sources only. Does not gather extensive information.	Not clear as to what is needed. Waits to be told. Does not seek information sources.
Applying previous knowledge			
Integration of knowledge	Effectively applies previous knowledge to current problem. Integrates with new information to assist problem solving process.	Applies limited amount of prior knowledge to current problem. Does not consistently use information effectively.	Unable to make connection to previous knowledge. Unwilling to review summaries of prior knowledge for useful information.
Sharing previous knowledge	Team members all work together to gain knowledge and apply and synthesize information. All listen respectfully to the opinions of others.	Some exchange of information and discussion occurs, but team members do not work consistently to address each one's needs or understanding.	Each team member must teach him/her self. No sharing of knowledge among team.
Identifying information			
Use of information	Consistently gathers a broad spectrum of resources and information and integrates it with prior knowledge and problem-solving strategies.	Information gathered may not be extensive, or may have occasional difficulty using information effectively in problem solving.	Fails to gather information, or obtains it from limited or inappropriate sources. Can't make connection between information gathered and the problem.

Criteria	Exemplary	Good	Needs Improvement
Framework	Creates and applies a framework (e.g. diagram, written description) throughout the process. Revises it as necessary.	Can create a framework but may not use it consistently in an effective manner, or revise it as needed.	Creates a vague framework that doesn't move the problem-solving process along. Doesn't seek help from others.
Tasks	Team takes the initiative to define tasks, match assignments to expertise, rotate responsibilities, maintain open communication, and develop strategies to enhance group success.	All team members generally cooperate and prioritize tasks, but may not consistently rotate responsibilities or work out most effective strategies for success.	Team spends time on tasks that interfere with the problem-solving process. Team members don't know who is responsible for which task.
Designing and conducting experiments			
Design	Each team member can describe planned experiments and how they relate to the problem; relate hypotheses to previous knowledge; identify necessary steps and timeline for project.	Description of planned experiments, relation of hypotheses, identification of steps and timeline, can be accomplished by joint effort of the whole team but not by each team member.	Fails to formulate hypotheses to test. Does not express possible outcomes.
Use of evidence	Continuously uses results to refine plan. Draws correct conclusions from results. Generates appropriate visual aids that facilitate understanding of the problem. Explores new ways to approach problem.	Usually adjusts experimental plan on basis of new knowledge. Usually plots/tabulates results to aid in reaching conclusions.	Data obtained are inadequate or incorrectly calculated. Tables and graphs are not prepared or are difficult to read and interpret. Conclusions are incorrect or not based on evidence.
Documentation	Comprehensive collection of raw and summarized data. Includes detailed information to allow repetition of experiments based only on written notes.	Data are summarized and organized, but may lack some details or some explanation necessary for repetition of experiments.	Laboratory notes aren't organized. Experimental results cannot be easily found. Experiments cannot be repeated because of lack of information.
Analyzing and interpreting results			
Use of analytic tools	Consistently uses new procedures and tools	Uses new methods and tools, but may not	Errors made in analytical methods,

	successfully, and can describe rationale for them. Runs appropriate control and replicate experiments.	always be successful. May not accurately explain rationale. Control and replicate experiments run.	but sources of error aren't found. Appropriate control or replicate experiments not run.
Interpretation of data	Able to describe results and conclusions clearly and concisely. Relates results to hypothesis and to currently accepted theory.	Draws correct conclusions from results, but may not relate them well to original hypothesis or current theory.	States conclusions without justification. Does not consider internal consistency of results. Cannot compare control or replicate results.
Analyzing alternative interpretations and solutions	Can account for unexplained results. Recognizes limitations of current hypothesis and proposes alternative interpretations.	Recognizes results that don't fit hypothesis but may not readily come up with alternative interpretations.	Does not recognize that results do not conform to original hypothesis. Cannot suggest alternative interpretation.
Assessing self and others			
Problem solving process	Critically reflects on problem-solving techniques, strategies, and results. Identifies those most helpful to self. Offers clear insights regarding self-knowledge.	Can identify problem-solving techniques that are most helpful, but may not be able to clearly summarize self-knowledge.	Unable to reveal insights about own learning. Cannot discuss relevance of problem-solving techniques.
Collaborative learning	Group develops strategies for success, and demonstrates understanding of how problem solving process relates to other activities. Creates a positive environment for reflection on the learning process.	Group can assess the contributions of members' skills, knowledge, and attitudes to the success of the team, but may not develop an overall strategy for success or overview of problem solving.	Assessments of group performance are not insightful. No commitment to group skill development for the future is shown. Little or no attention paid to group morale.
Overall assessment	Clearly and concisely articulates the problem-solving process and describes how well it was applied to the current problem.	Can describe the problem-solving process, but may not critically assess how well it was applied to the current problem.	Shows little or no understanding of the problem solving process, and cannot assess how well it was applied to the current problem.

- General Analytic
- Con-length
  Pro/Con-Range
- Team/Real World Project
  break into pieces (sections)
- Short bullets - Weighted categories
  Knowledge application

Thank you for your interest in this study.

Please read the following information carefully before deciding whether to participate. If you have any questions, please do not hesitate to ask.

Participation in this study is entirely voluntary.

You are free to withdraw at any time, without giving a reason.

- Emphasize it is too long.
  - College Level
  - A lot of one-on-one Check in w/teacher

Classic Exemplars Rubric

Level	Understanding	Strategies, Reasoning, Procedures	Communication
Novice	• There is no solution, or the solution has no relationship to the task. • Inappropriate concepts are applied and/or procedures are used. • The solution addresses none of the mathematical components presented in the task.	•No evidence of a strategy or procedure, or uses a strategy that does not help solve the problem. • No evidence of mathematical reasoning. • There were so many errors in mathematical procedures that the problem could not be solved.	• There is no explanation of the solution, the explanation cannot be understood or it is unrelated to the problem. • There is no use or inappropriate use of mathematical representations (e.g. figures diagrams, graphs, tables, etc.). • There is no use, or mostly inappropriate use, of mathematical terminology and notation.
Apprentice	• The solution is not complete indicating that parts of the problem are not understood. • The solution addresses some, but not all of the mathematical components presented in the task.	• Uses a strategy that is partially useful, leading some way toward a solution, but not to a full solution of the problem. • Some evidence of mathematical reasoning. • Could not completely carry out mathematical procedures. • Some parts may be correct, but a correct answer is not achieved.	• There is an incomplete explanation; it may not be clearly presented. • There is some use of appropriate mathematical representation. • There is some use of mathematical terminology and notation appropriate of the problem.
Practitioner	• The solution shows that the Student has a broad understanding of the problem and the major concepts necessary for its solution. • The solution addresses all of the mathematical components presented in the task.	• Uses a strategy that leads to a solution of the problem. • Uses effective mathematical reasoning. • Mathematical procedures used. • All parts are correct and a correct answer is achieved.	• There is a clear explanation. • There is appropriate use of accurate mathematical representation. • There is effective use of mathematical terminology and notation.
Expert	• The solution shows a deep understanding of the problem including the ability to identify the appropriate mathematical concepts and the information necessary for its solution. • The solution completely addresses all mathematical components presented in the task. • The solution puts to use the underlying mathematical concepts upon which the task is designed.	• Uses a very efficient and sophisticated strategy leading directly to a solution. • Employs refined and complex reasoning. • Applies procedures accurately to correctly solve the problem and verify the results. • Verifies solution and/or evaluates the reasonableness of the solution. • Makes mathematically relevant observations and/or connections.	• There is a clear, effective explanation detailing how the problem is solved. All of the steps are included so that the reader does not need to infer how and why decisions were made. • Mathematical representation is actively used as a means of communicating ideas related to the solution of the problem. • There is precise and appropriate use of mathematical terminology and notation

Exemplars K-12 We Set the Standards!

- General ~~Holistic~~ Analytic Scoring Rubric

-

PROS	CONS
- Looks godd	- too vaguve - wordy - font

- General Class Discussion

- 3 Categories/Levels

Apprentice
Journeyman/woman
Master

- too forced to do it
- too complicated
- would have to be modified a lot for task

Quadratic Equation Math Rubric

Suitable for 9th to 12th Grade

4	3	2	1
Demonstrates a thorough understanding when interpreting graphs of quadratic functions.	Demonstrates an understanding interpreting graphs of quadratic functions.	Demonstrates a partial understanding interpreting graphs of quadratic functions.	Demonstrates little understanding interpreting graphs of quadratic functions.
Very capably and independently manipulates algebraic expressions as they relate to quadratic functions.	Independently manipulates algebraic expressions as they relate to quadratic functions.	With some assistance, manipulates algebraic expressions as they relate to quadratic functions.	With limited accuracy manipulates algebraic expressions as they relate to quadratic functions.
Independently determines the relationships between the graphs and the equations of quadratic functions.	Determines the relationships between the graphs and the equations of quadratic functions.	Some effectiveness evident when determining the relationships between the graphs and the equations of quadratic functions.	Requires assistance to determine the relationships between the graphs and the equations of quadratic functions.
With complete accuracy, factors polynomials using the common factors, factors the difference of squares and factors trinomials of the form $x^2 + bx + c$.	With considerable accuracy, factors polynomials using the common factors, factors the difference of squares and factors trinomials of the form $x^2 + bx + c$.	With some accuracy factors polynomials using the common factors, factors the difference of squares and factors trinomials of the form $x^2 + bx + c$.	With minimal accuracy, yet some understanding, factors polynomials using the common factors, factors the difference of squares and factors trinomials of the form $x^2 + bx + c$.

TYPE OF RUBRIC: TASK-SPECIFIC ANALYTIC

PROS

- FLEXIBLE USAGE (test, HW, project)
- separately evaluates understanding of quadratics (graph only, vs. graph how it relates to expressions)

CONS

- only usuable with quadratic
- no "above & beyond" column
- doesn't include anything about justification and explanation
- descriptors (not specific "independently determines" vs. "determines")

USES:

anything (one problem, project, test question, etc) or performance task

IMPROVEMENTS:

- add a "5" column for "above & beyond" work
- be more clear on the difference between "demonstrates through understanding" vs "demonstrates understanding" (for example)

VA

OTHER COMMENTS:

useful for teachers but not students

Math Project Rubric

	1	2	3	4
Mathematical Knowledge and Understanding (30%)	The student attempts to apply methods, rules and/ or formulas to instruct their topic.	The student sometimes uses appropriate methods, rules and/ or formulas to instruct their topic.	The student generally uses appropriate methods, rules and/ or formulas to instruct their topic.	The student consistently uses appropriate methods, rules and/ or formulas to instruct their topic.t.
Level of Difficulty (10%)	Topic has been covered in class and not extended.	Topic has been covered in class and their has been an attempt to extend the topic.	Topic has been covered in class and has been successfully extended.	Topic explores beyond material covered in class.
Use of Math Technology (20%)	The student uses the computer (grapher, equation editor) or TI-84 calculator for only routine calculations in their topic.	The student attempts to use a TI-84 calculator or computer (grapher, equation editor) in a manner that could enhance the development of their topic.	The student makes a limited amount of use of a TI-84 calculator or computer (grapher, equation editor) in a manner that enhances the development of their topic.	The student makes full use of a TI-84 calculator or computer (grapher, equation editor) in a manner that enhances the development of their topic.
Communication (20%)	Topic and/or question has not been stated or introduced. The student shows no use of mathematical language and/or forms of mathematical representation (formulas, diagrams, tables, charts, graphs, and models). Reasoning, explanations and conclusion are non-existent. There are no references.	Topic and/or question has been poorly stated or introduced. The student shows basic use of mathematical language and/or forms of mathematical representation (formulas, diagrams, tables, charts, graphs, and models). Reasoning, explanations and conclusions are difficult to follow. References are poorly done.	Topic and/or question has been stated or introduced. The student shows some use of mathematical language and forms of mathematical representation (formulas, diagrams, tables, charts, graphs, and models). Reasoning, explanations and conclusions are logical but not always complete. References are included.	Topic and/or question has been stated or introduced. The student shows good use of mathematical language and forms of mathematical representation (formulas, diagrams, tables, charts, graphs, and models). Reasoning, explanations and conclusions are logical and complete. References are included.
Presentation (20%)	Little effort appears to have been put into the presentation.	Problems with the presentation make it difficult to follow.	The presentation is generally easy to follow and it is obvious that some effort has been made.	The presentation is easy to follow and it is obvious that considerable effort has been made.

A MATH PROJECT RUBRIC

- Analytic & General
  - Analytic → in components
  - General → no specific math topic

PROS	CONS
• Can be applied to any math topic	• Lacks specificity ↳ Students won't know particulars
• Students get used to consistent format	• Lengthy & verbose for students to read
• A good base to build on	

- USE IT!!!: • Actually have students fill in their own specifics for their project
  - A self evaluation / justification
  - Make students build SPECIFIC rubrics
- IMPROVEMENT: (see above)

General Scoring Rubric for Written Response Items

Category	Score	Description
No Response	0	Either the work is not attempted (i.e., the paper is blank), or the work is incorrect, irrelevant, or off task. The response may minimally interpret or re-state the problem, but does not go beyond that.
Minimal	1	The response demonstrates only a minimal understanding of the problem posed and a reasonable approach is not suggested. Although there may or may not be some correct mathematical work, the response is incomplete, contains major mathematical errors, or reveals serious flaws in reasoning. Requested examples may be absent or irrelevant.
Partial	2	The response contains evidence of a conceptual understanding of the problem in that a reasonable approach is indicated. However, on the whole, the response is not well developed. Although there may be serious mathematical errors or flaws in reasoning, the response does contain some correct mathematics. Requested examples provided may fail to illustrate the desired conclusions.
Satisfactory	3	The response demonstrates a clear understanding of the problem and provides an acceptable approach. The response also is generally well developed and presented, but contains omissions or minor errors in mathematics. Requested examples provided may not completely illustrate the desired conclusions.
Excellent	4	The response demonstrates a complete understanding of the problem, is correct, and the methods of solution are appropriate and fully developed. The response is logically sound, clearly written, and does not contain any significant errors. Requested examples are well chosen and illustrate the desired conclusions.

EXPLANATORY NOTES

(1) Rubrics for specific items should always be used with this general rubric and the following notes about specific rubrics.

(2) The following excerpt from MDTP Guidelines for The Preparation of Written Response Mathematics Questions provides a context for this general rubric. The statement of the question should be explicit and clear. The extent to which students are to discuss their reasoning and results should be explicit. The extent to which students are to provide examples, counterexamples, or generalizations should also be clearly stated.

(3) Although the categories in the General Scoring Rubric are meant to indicate different levels of understanding and accomplishment, teachers should expect that some student responses may be on the boundary between two categories and may be scored differently by different teachers.

(4) Teachers may wish to designate some outstanding responses in the Excellent category as exemplars.

NOTES EXPLAINING HOW TO USE SPECIFIC ITEM RUBRICS

Scoring of written responses is to be based upon both the correctness of the mathematics and the clarity of the presentation. In scoring, do NOT "mind read" the presenter; instead only grade the presentation. Grade each response on the actual mathematics written and on the quality of the presentation of that mathematics. Unexecuted recipes or prescriptions should receive minimal credit. The specific scoring rubric for an item outlines the mathematical development necessary for the given scores. In addition to the formal mathematics, it is essential that students "show their work" and clearly present their methodology. The evaluation of each response should be based in part upon its organization, completeness, and clarity. A score of 1 or 2 may in some cases be based simply upon the mathematics called for in the rubric. Scores of 3 and 4 require effective presentation as well as appropriate mathematics. The mathematics called for in specific rubrics is necessary, but not sufficient, for these scores.

General and Holistic Rubric

Pros - Generic, multi-use
- Quick

Cons - Generic, doesn't give much useful feedback to Students.
- "Wordy"
- Gives all problems equal weight
  - Doesn't allow for differentiation of problems.

How would you use/improve?
- Use on performance task, justifications
- Add column for examples in work.
- Add specificity

Exemplars® Standards-Based Math Rubric (cont.)*

	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Practitioner	A correct strategy is chosen based on mathematical situation in the task. Planning or monitoring of strategy is evident. Evidence of solidifying prior knowledge and applying it to the problem solving situation is present. Note: The practitioner must achieve a correct answer.	Arguments are constructed with adequate mathematical basis. A systematic approach and/or justification of correct reasoning is present. This may lead to... • clarification of the task. • exploration of mathematical phenomenon. • noting patterns, structures and regularities.	A sense of audience or purpose is communicated. and/or Communication of an approach is evident through a methodical, organized, coherent sequenced and labeled response. Formal math language is used throughout the solution to share and clarify ideas.	Mathematical connections or observations are recognized.	Appropriate and accurate mathematical representations are constructed and refined to solve problems or portray solutions.
Expert	An efficient strategy is chosen and progress towards a solution is evaluated. Adjustments in strategy, if necessary, are made along the way, and/or alternative strategies are considered. Evidence of analyzing the situation in mathematical terms, and extending prior knowledge is present. Note: The expert must achieve a correct answer.	Deductive arguments are used to justify decisions and may result in formal proofs. Evidence is used to justify and support decisions made and conclusions reached. This may lead to... • testing and accepting or rejecting of a hypothesis or conjecture. • explanation of phenomenon. • generalizing and extending the solution to other cases.	A sense of audience and purpose is communicated. and/or Communication at the Practitioner level is achieved, and communication of argument is supported by mathematical properties. Precise math language and symbolic notation are used to consolidate math thinking and to communicate ideas.	Mathematical connections or observations are used to extend the solution.	Abstract or symbolic mathematical representations are constructed to analyze relationships, extend thinking, and clarify or interpret phenomenon.

*Based on revised NCTM standards.

Exemplars® Standards-Based Math Rubric*

	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice	No strategy is chosen, or a strategy is chosen that will not lead to a solution. Little or no evidence of engagement in the task present.	Arguments are made with no mathematical basis. No correct reasoning nor justification for reasoning is present.	No awareness of audience or purpose is communicated. or Little or no communication of an approach is evident or Everyday, familiar language is used to communicate ideas.	No connections are made.	No attempt is made to construct mathematical representations.
Apprentice	A partially correct strategy is chosen, or a correct strategy for only solving part of the task is chosen. Evidence of drawing on some previous knowledge is present, showing some relevant engagement in the task.	Arguments are made with some mathematical basis. Some correct reasoning or justification for reasoning is present with trial and error, or unsystematic trying of several cases.	Some awareness of audience or purpose is communicated, and may take place in the form of paraphrasing of the task. or Some communication of an approach is evident through verbal/written accounts and explanations, use of diagrams or objects, writing, and using mathematical symbols. or Some formal math language is used, and examples are provided to communicate ideas.	Some attempt to relate the task to other subjects or to own interests and experiences is made.	An attempt is made to construct mathematical representations to record and communicate problem solving.

*Based on revised NCTM standards.

What type of rubric is it?

* general holistic

Pros & Cons

pro

* covers 5 different dimensions
* doesn't align itself with A, B, C, D, F

con

* not kid-friendly
* what does "some" mean?

How might you use the rubric?

* for a bigger problem or project with multiple components

Improvements?

* simplify language - make it clearer and more kid-friendly
* tell how many points each level is worth

Other comments

* complete for teachers - very precise