

|   | 4   | 3   | 2  | 1  | 0  | NA (Prob)  | NA (Solver)   |
|---|---|---|--|--|--|--|---|
| <p><b>Physics Approach</b></p> <p>[skill: selecting relevant basic physics concepts and principles]</p>         | The solver has clearly stated an appropriate and complete physics approach.   | The approach is clear but contains minor omissions or errors.                           | The approach is unclear, or an important physics concept or principle of the approach is missing or inappropriate. | An attempt is made to identify relevant physics concepts or principles, but most of the approach is vague, incomplete, or inappropriate. | The solution does not indicate a basic physics approach, or all of the chosen concepts and principles are inappropriate. | A physics approach is not necessary for this <u>problem</u> . (i.e., has already been stated in the problem or textbook heading) | An explicit physics approach is not necessary for this <u>solver</u> , as indicated by the overall solution process.    |
| <p><b>Useful Description*</b></p> <p>[skill: representing information symbolically and visually]</p>            | The solution includes an appropriate and useful problem description.  | The description is useful but contains minor omissions or errors.                       | The description is not useful, or a key feature of the description is missing or incorrect.                        | An attempt is made, but most of the description is not useful, incomplete, or incorrect.   | The solution does not include a description, or all of the description is incorrect.                                     | A description is not necessary for this <u>problem</u> . (i.e., it has already been given to the solver)                         | A description is not necessary for this <u>solver</u> , as indicated by the overall solution process.                   |
| <p><b>Specific Application of Physics**</b></p> <p>[skill: applying physics to specific problem conditions]</p> | The solution indicates an appropriate and complete application of physics to the specific conditions in this problem. | The specific application of physics to this problem contains minor omissions or errors. | An important specific relationship or condition is missing or applied incorrectly.                                 | An attempt is made, but most of the specific application of physics to this problem is missing or incorrect.                             | The solution does not indicate a specific application of physics, or all of the application is incorrect.                | Specific application of physics is not necessary for this <u>problem</u> . (i.e., basic principles are sufficient)               | Specific application of physics is not necessary for this <u>solver</u> , as indicated by the overall solution process. |

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|--|--|---|--|--|---|--|--|
| <b>Mathematical Procedures</b><br>[skill: applying math rules and procedures in the context of physics]                              | Suitable mathematical procedures are used during the solution execution. | Suitable mathematical procedures are used with minor omissions or errors. | An important mathematical procedure is missing or is used with errors. | Attempted mathematical procedures are inappropriate, left unfinished or contain serious errors | There is no evidence of mathematical procedures in the problem solution or all mathematical procedures are inappropriate. | Mathematical procedures are not necessary for this <u>problem</u> , or constitute a very small part of the solution.                     | Mathematical procedures are not necessary for this <u>solver</u> , as indicated by the overall solution process. |
| <b>Logical Organization</b><br>[skills: communicating reasoning clearly, goal directedness, and evaluating solution for consistency] | The entire problem solution is clear, focused, and logically connected.  | The solution is clear and focused with minor inconsistencies.             | Parts of the solution are unclear, unfocused, and/or inconsistent.     | Most of the solution parts are unclear, unfocused, and inconsistent.                           | The entire solution is unorganized (haphazard) and contains obvious logical breaks.                                       | Logical Organization is not necessary for this <u>problem</u> or constitutes a very small part of the solution (i.e., one-step problem). | Logical Organization is not necessary for this <u>solver</u> , as indicated by the overall solution process.     |

\*A “problem description” could include: restating known and unknown parameters, defining variables, selecting convenient/unique symbols, stating the goal or target variable, drawing a picture, stating qualitative expectations, drawing graphs, defining a coordinate system, or an abstracted physics diagram (force diagram, motion diagram, ray diagram, energy bar chart, etc.)

\*\*A “specific application of physics” includes a statement of definitions, relationships between the defined variables, initial conditions, and assumptions or constraints in the problem (i.e., friction negligible, massless spring, massless pulley, inextensible string, etc.)