

RUBRIC I: Ability to evaluate models, equations, solutions, and claims

Scientific Ability		Missing	Inadequate	Needs some improvement	Adequate
I1	Is able to conduct a unit analysis to test the self-consistency of an equation	No meaningful attempt is made to identify the units of each quantity in an equation.	An attempt is made to identify the units of each quantity, but the student does not compare the units of each term to test for self-consistency of the equation.	An attempt is made to check the units of each term in the equation, but the student either misremembered a quantity's unit, and/or made an algebraic error in the analysis.	The student correctly conducts a unit analysis to test the self-consistency of the equation.
I2	Is able to analyze a relevant special case for a given model, equation, or claim.	No meaningful attempt is made to analyze a relevant special case.	An attempt is made to analyze a special case, but the identified special case is not relevant. OR major steps are missing from the analysis (e.g., no conclusion is made)	An attempt is made to analyze a relevant special case, but the student's analysis is flawed. OR the student's judgment is inconsistent with their analysis.	A relevant special case is correctly analyzed and a proper judgment is made.
I3	Is able to identify the assumptions a model, equation, or claim relies upon. = C8	No assumptions are correctly identified.	Some assumptions are correctly identified by student, but some of the identified assumptions are incorrect.	All of the student's identified assumptions are correct, but some important assumptions are not identified by student.	All significant assumptions are correctly identified, and no identified assumptions are incorrect.
I4	Is able to evaluate another person's problem solution or conceptual claim by direct comparison with their own solution or conceptual understanding	No meaningful attempt is made to evaluate by direct comparison.	The student states his/her own problem solution/conceptual claim, but does not methodically compare it with the other person's solution/claim, and so does not state a judgment about the validity of the other person's solution/claim. OR a judgment is made regarding the other person's solution/claim, but no justification is given.	The student states their own solution/claim and compares it with the other person's solution/claim, but does not make any concluding judgment based on this comparison. OR the student does everything correctly, but their presentation is incomplete (i.e., skipping logical steps)	Student clearly states their own solution/conceptual understanding, and methodically compares it with the other person's work. Based on this comparison, the student makes a sound judgment about the validity of the other person's work.
I5	Is able to use a unit analysis to correct an equation which is not self-consistent	No meaningful attempt is made to correct the equation, even though it failed a unit analysis	Student proposes a corrected equation, but their proposal still does not pass a unit analysis	Student proposes a corrected equation which passes unit analysis, but their proposal is incorrect (i.e., the student failed to remember the proper equation, and therefore proposed an equation which is not physical)	Student proposes a corrected equation which is correct, at least up to unit-less constants.
I6	Is able to use a special-case analysis to correct a model, equation, or claim	No meaningful attempt is made to correct the model, equation, or claim even though it failed a special-case analysis	An attempt is made to modify the model, equation, or claim, but the modifications have nothing to do with the special-case that was analyzed.	An attempt is made to modify the model, equation, or claim based on the special-case analysis, but some mistakes are made in the modification.	The model, equation, or claim is correctly modified in accordance with the special-case that was analyzed.

RUBRIC SC: Ability to evaluate models, equations, solutions, and claims (Special Cases)					
Scientific Ability		Missing	Inadequate	Needs some improvement	Adequate
SC1	Is able to identify an optimally relevant special-case for analysis	No attempt is made to identify a relevant special case	An attempt is made, but the identified special case is either irrelevant or ill-defined	A relevant special case is identified, but it is not an optimal special case (i.e., there are other special cases which give a stronger, more clear-cut analysis of the solution)	A optimally relevant special case is identified and clearly stated
SC2	Is able to state and justify a conceptual expectation for the special case	No attempt is made to state or justify a conceptual expectation	A conceptual expectation is stated, but its justification is either absent or missing major steps	A conceptual expectation is stated, but its justification is either missing minor steps, or is inconsistent with the expectation	A conceptual expectation is stated, fully justified, and the expectation is consistent with its justification
SC3	Is able to use a given solution (or a solution they made up) to predict what would happen for the special case	No attempt is made to state or explain what the given solution predicts for the special case	A prediction is stated, but its derivation from the given solution is either absent or missing major steps	A prediction is stated, but its derivation from the given solution is either missing minor steps, or is inconsistent with the derivation	A prediction is stated and clearly derived from the given solution
SC4	Is able to make, and justify, a reasonable conclusion regarding their conceptual expectation and the solution.	No attempt is made to state or justify a conclusion	A conclusion is stated, but its justification is either absent, missing major steps, or containing major mistakes	A conclusion is stated and justified, but it is inconsistent with the results of the student's analysis, or it is incomplete	A conclusion is stated and justified, and is consistent with the results of the student's analysis