

Learning Outcome: Graduates will understand the scientific inquiry process and be able to critically analyze the physical world using the methodologies and models of science.

| Skill | | Level of Achievement | | | | |
|-------|---|--|----|---|-----|---|
| | | 1 | 2* | 3 | 4** | 5 |
| 1 | Understanding of problem | Student does not exhibit a clear understanding of the problem; Displays little comprehension of the important elements of the problem; Failed to understand enough to start to work the problem. | | Response is free of misconceptions that lead to wrong answers; Student grasps basic parts of the problem as well as the general framework; Understands enough to work most of the problem; Can make a diagram that exhibits some understanding of the model; Can demonstrate some conceptualization of the model. | | Student manifests a thorough understanding of concepts and relationships between concepts; Identifies all the important elements of the problem; Organizes the response in a manner that demonstrates clarity of understanding. |
| 2 | Use of terms, and symbols | Student is unable to communicate scientific concepts though terminology; Fails to employ technical, mathematical, or scientific terms or employs them inappropriately; Fails to use symbols or uses them incorrectly. | | Student uses most terminology and symbols correctly; Provides evidence of reasonable understanding of terms and symbols. | | Student explains thoughts thoroughly using correct terminology and clearly displayed, appropriate symbols; Communicates ideas clearly and concisely; Demonstrates superior knowledge of the language of science and symbolic usage; Knows all the symbols and terms in a mathematical relationship and their association with the scientific model of interest. |
| 3 | Calculations and graphical data presentation. | Student provides no evidence of manipulation of mathematical expressions; Commits numerous arithmetic errors; Fails to present data in graphical or tabular format. | | Response is mainly accurate with some minor arithmetic errors; Student possesses sufficient understanding to work the problem, but presentation is not sophisticated; Provides graphical representation but cannot extract abstract information or interpretation. Presents calculations in an orderly manner, but misses some details; Represents data graphically but commits minor errors. | | Response is fully mathematically accurate; Solution is clearly displayed with various computation steps shown; Student executes algorithms completely and correctly; Presents data in an appropriate graphical or tabular format; Provides a clear interpretation and conceptualization of results. Displays results graphically in a clear and illuminating way. |
| 4 | Solution and graphical data interpretation | Student shows significant misunderstanding of the process; Does not correctly apply or even make attempt to apply appropriate solution; Adopts inappropriate strategy for solving the problem; Attempts to use irrelevant information; Fails to provide a graphical representation of the mathematical thought process or provides an incorrect one. | | Student shows understanding of the process; Adopts a reasonable strategy for solving most of the problem; Displays solution in a rote manner indicating a simple conceptualization of the problem; Shows understanding of some of the problem's concepts. | | Student shows mastery of the process; Presents a detailed solution characterized by logical sequencing and systematic progression; Offers strong supporting arguments; Uses relevant outside information; Solution reflects excellent problem-solving skills. |
| 5 | Answer and conclusions. | Answer lacks units or they are stated incorrectly; Student offers an invalid answer; Fails to offer any empirical findings. | | Answer is stated in correct units; Student expresses empirical findings but is limited in identification of related issues; Is unable to demonstrate complete understanding of the mathematical result and its relationship to the conceptual model. | | Answer is stated in correct units with any unit changes clearly illustrated; Student provides a complete response with a clear, unambiguous, accurate explanation; Fully describes findings in words; Convincingly connects the numeric results and the conceptual model. |
| 6 | Evidence of higher level thinking | Student is unable to plug values directly into equation; Seems incapable of mathematical manipulation. | | Student combines two related concepts; Substitutes correct values and manipulates equation but still has some difficulty with more complicated relationships or model; Has some difficulty in developing a mathematical relationship from the written form. | | Student can solve problems requiring multiple steps with development of concepts evolving into the solution; Can clearly synthesize information and organize it in a path through multiple steps to arrive at the solutions; Has no difficulty connecting mathematical relationships or expressing ideas mathematically; Is capable of interpreting and applying results in a new or modified situation. |