Excerpt from Mathematics Core Assessment Report AY 2016 PILOT:

The following student learning outcome was assessed in the Fall semester.

> recognize and apply mathematical procedures to solve applied problems including related rates and optimization

Each of the SM121/131 instructors was asked to assess the work of a few students on the following free response question on the final exam.

> A rectangular storage container with an open top and a square base is to have a volume of 800 m^3. The material for the base costs $10 per square meter. The material for the sides costs $2 per square meter. Find the dimensions for the cheapest such container.

This problem has the highest possible weight, a 3, in Conceptual Understanding Weighting System.

A sample of 55 students was chosen, approximately two students per section of the course. The majority of instructors taught two sections of SM121 or SM131; [to determine if the question can parse high and low performing students] instructors chose four students to assess based on their 12 week grades: one A student, one B student, one C student, and one D or F student. More details are included in Appendix E. Each instructor analyzed their four students' work and rated it in each of five categories as "Unsatisfactory," "Satisfactory," or "Excellent," according to the rubric in Appendix E.

The results were as follows

	E	S	U
Draw and label picture; introduce variables and units	45%	47%	7%
Set up the volume requirement	69%	25%	5%
Set up the cost function using two or three variables	36%	25%	38%
Set up the cost as a single-variable function	45%	13%	42%
Find the critical point; reason it's the right answer; give the answer with units.	20%	40%	40%

These results were reported to the department in two meetings, first at a Service Curriculum Committee meeting on April 5, then in a meeting of the whole department on May 6, 2016. There was general agreement that, as always, we wish that more of our students were doing better on application problems. At the same time, we recognize that this is the most difficult type of problem.

*Question/Data used with permission

Enclosure 1a –

Assumptions: equal weight for each part of the question and attribution to the Solve Tech Problems USNA CLO.

USNA Core Learning Outcome	Course Outcome	Core Course(s)	# of cases		Proficiency Scale (Choose the Scale that Best Aligns with the Departments Assessment Method)					# of cases that meet/exceed expectations
					Expectations Not Met		Expectations Met		Expectations Exceeded	
					Little or no evidence of proficiency	Evidence of approaching proficiency	Minimum level of proficiency evident	Full proficiency evident	Evidence of proficiency exceeds expectations	
4. Solve Technical Problems	Apply mathematical results and procedures	SM121/131	55	Choose one scale per outcome						
					15 (27%)		17 (31%)		24 (44%)	41 (75%)

2) DEPT INDICATES IF XX% is considered acceptable. For example: Given professional expertise (a priori expectation)/departmental discussion/historic benchmarks the department expects between XX and XX% to be at or above expectations or has a cut-off of XX%.

OR w/ more parsing

Enclosure 1a –

Assumptions: three USNA CLO's addressed by different parts of the question identified under course outcome.

USNA Core Learning Outcome	Course Outcome	Core Course(s)	# of cases		Proficiency Scale (Choose the Scale that Best Aligns with the Departments Assessment Method)					# of cases that meet/ exceed expect ations
					Expectations Not Met		Expectations Met		Expectations Exceeded	
					Little or no evidence of proficien cy	Evidence of approaching proficiency	Minimum level of proficiency evident	Full proficiency evident	Evidence of proficiency exceeds expectations	
4. Solve Technical Problems	Apply mathematical results and procedures (Set Up)	SM121/ 131	55	Choose one scale per outcome						
					16 (28%)		**12 (21%)**		**27 (50%)**	**39 (71%)**
5. Communicate Effectively *(visual/ written)*	Apply mathematical results and procedures (Draw/Label)	SM121/ 131	55	Choose one scale per outcome						
					4 (7%)		**26 (47%)**		**25 (45%)**	**51 (93%)**
6. Critically Reason *(appropriately interpret)*	Apply mathematical results and procedures (Find/Reason)	SM121/ 131	55	Choose one scale per outcome						
					22 (40%)		**22 (40%)**		**11 (20%)**	**33 (60%)**

2) DEPT INDICATES IF XX% is considered acceptable. For example: Given professional expertise (a priori expectation) /departmental discussion/historic benchmarks the department expects between XX and XX% to be at or above expectations or has a cut-off of XX%.