ENGINEERING REPORT INSTRUCTIONS

MESA PROJECT COMPETITION PROJECTS

We encourage students participating in the MESA program to becoming effective writers. Writing technical papers is a part of most engineering college curriculums and essential in the world of scientific and engineering research. It is also an opportunity to merge their Language Arts skills with their mathematics and science learning. A student that goes through a MESA section should be comfortable writing an engineering lab report.

Steps in this engineering report are similar to the steps involved in the engineering design process. The steps involved in the Engineering Report are provided below. The Lab Report can be worth 100 points (you may apply your own grading/point scale to the report):

1. Identify the Need and Define the Problem.

**(a) Identify the need.** An engineer must use knowledge of math, science and economics to meet a specific human need. Needs are identified by saying “there must be a better way to do something” and then figuring out the best way to address the need given limited resources and time. **(5 points)**

**(b) Define the problem.** In this case the problem is designing and building a project that addresses your project’s need. The problem is revealed by asking, “how do we address the need?” As a team define the problem in your own words. The way you define the problem will guide how you resolve the problem. Without this step your team risks solving the wrong problem, or a problem that doesn’t need to be solved at this time. **(5 points)**

1. Identify Constraints and Criteria for Success.

**(a) Constraints:** Your team must brainstorm to consider all of the potential constraints for your project. Discuss how the following constraints affect preparation for the competition: (i) Time allocated to project. (ii) Personnel: list students assigned to team, and their skills or expertise; this assumes that all team members may or may not be capable of contributing in a special way. (iii) Organization of team: roles, if any; when, where and how will the team work independently or as a group. (iv) Materials need and their availability. (v) Material properties that must be considered to successfully compete (examples: cardboard is porous, and water-bottles have a pressure threshold). (vi) Other constraints. **(5 points)**

**(b) Criteria for success:** Your team must brainstorm to consider all criteria for success. Discuss how the following criteria affect preparation for the competition:

(i) Performance standard for determining the winning team (how will performance be measured? Refer to the rules.). (ii) Human factors (for example: the art of rowing, stabilizing the boat in the water while entering, measuring the vertical distance traveled by the rocket, etc.). (iii) Craftsmanship (for example, neatness, symmetry, cutting straight lines, thoroughness, etc.). (iv) Durability of material and consequently the project, given the performance environment. (v) Safety and affects on the surrounding (i.e. consider potential hazards and damage to property). (vi) Other criteria for success. **(5 points)**

1. Conceive and/or Research, and Discuss Two Project Design Options.

**(a) Preliminary design options:** Draw preliminary project design options, using pen and paper or a computer program, and document why the designs are being considered **(10 points)**.

**(b) Select a preliminary design.** Based on the design options that were considered, identify the project design that will be selected for the competition and explain why it was selected **(10 points)**.

1. Construct Preliminary Project. Construct a preliminary model or life size project consistent with the selected project’s design.
2. Test and Evaluate Preliminary Project. Test the model or preliminary project under conditions similar to the competition.

**(a) Document the performance outcome:** focus on what team members learn from testing the project. Did the project perform according to plans? Why did it or why didn’t it perform according to plans? **(10 points)**

**(b) Improving performance:** What can the team do to improve the project’s performance? **(10 points)**

**(c) Improving the project’s design:** How will recommendations to improve performance impact the design of the project? Can the project’s design be improved? Document your recommendations **(10 points)**.

1. Repeat Steps 1 – 4 (this step assumes that information valuable to the design and build process was gathered from STEP 5, Test and Evaluate. If your project performed perfectly then address the statements provided below describing and emphasizing why you project performed perfectly. Otherwise, use the information and knowledge gained from STEP 5 to address the following prompts:
   * 1. Identifying new needs, and redefining the problem as needed. **(10 points)**
     2. Identifying any new constraints or criteria for success. **(10 points)**
     3. Based on performance observations, develop a final project design. Draw design. **(10 points)**
     4. Build a final project consistent with final design (no report points).

REPORT RUBRIC Team Member Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ School:\_\_\_\_\_\_\_\_\_\_\_

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|  | **NEEDS TO IMPROVE** | **PROFICIENT** | **ABOVE PROFICEINT** | **ADVANCED** |
| **STEP 1:** Identify the need and define the problem. | Limited response.  0 – 4 points | Team regurgitates examples provided in their own words.  6 points | General original ideas.  8 points | Clear and concise complete ideas representing original work.  10 points |
| **STEP 2:** Identify constraints and criteria for success. | Provide less than 5 constraints and less than 5 criteria for success.  0 – 4 points | Provide 5 constraints and 5 criteria for success.  6 points | Provide more than 5 constraints and more than 5 criteria for success that are relevant to the project.  8 points | Clear and concise complete ideas address more than 5 constraints and more than 5 criteria for success.  10 points |
| **STEP 3:** Conceive of and/or research, and discuss 2 project designs. | Provide one design.  0 – 8 points | Provide 2 preliminary designs and explanations, as well as a statement explaining why one design was selected. The drawings have to be neat and thorough.  12 points | In addition to the things listed under “proficient”, list 2 sources of information researched. Lastly, the drawings have to be labeled with dimensions.  16 points | In addition to the things listed under “above proficient”, the student uses computer software to make the drawings.  20 points |
| **STEP 5:** Test and evaluate preliminary project. | Very limited testing or evaluative information generate.  0 – 12 points | Search for information on 2 concepts vital to the success of the project. Reference the information source and explain why the concepts are related to the project.  18 points | Engage in small scale labs to test subcomponent(s) or idea(s) relevant to the project. Or engage in relevant computer simulations consistent with the project’s design. Document the performance outcome, how performance can be improved, and how the performance recommendations impact the project’s design.  24 points | In addition to things listed under “above proficient”, build a full-size preliminary project consistent with the preliminary design. Test the project and document what was learned clearly and concisely.  30 points |
| **STEP 6:** Repeat appropriate steps using information and knowledge gained to redesign & construct the project. | NA  0 – 12 points | Build a durable preliminary project that can be reused in the MESA Competition. Still the preliminary project must be tested before the MESA Competition. Use the information and knowledge gained to address prompts in STEP 6.  Or, perhaps during your preliminary test the project performed perfectly. Explain why the project worked perfectly addressing prompts in STEP 6 accordingly.  18 points | In addition to those things listed under “proficient”, the team must anticipate potential damage from testing the project and design/build replaceable parts.    24 points | Testing and evaluation generated new information. Incorporate the new information into the process of redesigning and building the project to come up with a final project.  30 points |