Glider Engineering Project

Project Due Date: _____

A glider is an aircraft that lacks an engine and is heavier than air. In this project, you are an aeronautical engineer who must design and build a glider to travel the greatest distance when launched from a catapult. Engineering a glider requires several steps and lots of responsibility. You must (1) create a preliminary design, (2) construct a glider to experiment with, (3) then run tests where one aspect is changed at a time and its effect is recorded. Once your design is optimized, (4) you will submit a technical report that explains your design, experiments, and analysis. Lastly, (5) you will compete against other teams in a class-wide gliding competition. Each step has specifics that you will have to meet in order to move on to the next step and earn full points. *Most materials are available from your teacher and excess should be returned.*

1. Preliminary Glider Design

Design your glider to meet these minimum criteria:

1. Your glider must have a sturdy *fuselage* (main body) that will enable proper launch from the catapult
2. Your glider must be *at least* 12" in *wingspan* and length
3. Your glider must have at least one *variable* design characteristic (See *2. Glider construction* for more information)

2. Glider Construction

You must build a glider that allows one aspect of it to be changed at a time. For example:

- *Variable wing position:* The main wing can slide forward or backward along fuselage
- *Variable weight capability (ballast):* The glider's mass can be increased or decreased with ease
- *Variable center of mass:* The center of mass of the glider can be changed by moving the mass
- *Variable wing characteristics:* The angle of the *ailerons, elevators,* or *flaps* can be changed

3. Testing Phase

With your team, you must devise an experiment that will seek to determine the effect of varying a single aspect of the glider's design. This will allow you to optimize the design of your glider prior to the competition.

- You must plan your experiment before you begin–be sure to write out an experimental procedure
- Keep all aspects of the glider constant except for the single variable which you're changing each trial
- Record accurate data, observations, and any other notes you think will be important to your design report

4. Design Report

As an aeronautical engineer, it is essential that you are able to communicate the important aspects of your design to others. You must write a technical report that answers the following questions:

Design Questions:

1. What experiment did you conduct to improve upon your glider's design?
2. Why was this experiment important or worthwhile?
3. What was the outcome of your experiment, and how did your findings help to justify your design decisions? (Include all data tables, graphs, etc.)

Analysis Questions:

4. If a constant net force of 25 N is applied to your glider, what will be its acceleration?
5. At the acceleration determined in #4, what will be the glider's speed after traveling 1.5 m along the catapult? Assume that the glider starts from rest.
6. At the launch speed determined in #5, how far will the glider travel in 2.0 s of flight? Assume that the glider travels in a straight line, and that air resistance is negligible.

7. The glider's pilot is known to lose consciousness during an acceleration greater than 4.0 g. According to your expected acceleration during launch, will your pilot survive?

Free-Body Diagrams

Provide a FBD for your glider in each of the following scenarios:

8. The glider in the catapult, being held back by a pull (prior to launch)
9. The glider accelerating along the catapult, before taking flight
10. The glider flying through the air (include drag)
11. The glider at rest on the ground

When your design report is submitted, it will either be **approved or denied**. If it is denied (meaning the questions were not accurately addressed) you must **resubmit your design report** *before* being allowed to launch. Your instructor will use the following form to approve or deny the design report:

The design report must address all required questions, and the analysis presented must be accurate.		
Date submitted:	□ Denied	□ Approved
Resubmitted on:	□ Denied	□ Approved

5. Competition & Evaluation

You will receive final launch details prior to the competition. The following rubric will be used to evaluate your project:

Area evaluated:	**Description**		
Glider Design	The glider is designed so that at least one aspect of it can be easily varied for the purpose of the experiments. The glider is sturdy and will survive multiple flights. (10)	The glider's construction is questionable or of low quality. It is not immediately apparent which aspect of the glider can be varied for the experiments. (5)	The glider is poorly constructed, with no consideration for variable design features. (1)
Launch & Flight Performance	The glider successfully launches from the catapult, and flies through the air. (10)	The glider launches from the catapult, but does not fly–rather it falls abruptly. (5)	The glider cannot be launched and it does not fly. (1)
Report– Design Questions	The design questions are addressed with high-quality responses that demonstrate critical thinking and an understanding of cause & effect. (10)	There is insufficient justification for the glider's design. There is little evidence that the experiment influenced design considerations. (5)	The experiment was invalid, or the responses to the questions are of low quality. (1)
Report– Analysis Questions	The physics presented in the analysis is correct, neat, organized, and includes correct units. (10)	The physics analysis is mostly correct, but has a few mistakes. The presentation is messy or disorganized. (5)	The physics analysis is mostly incorrect. The presentation of the work is of very poor quality. (1)
Competition Bonus	1st Place in class (5 bonus)	2nd Place in class (3 bonus)	3rd Place in class (1 bonus)