

# Moving Along the Straight and Narrow ... You Be Tripping or Dat's How'z Uz Roll'z

## Purpose:

1. To design and build a racecar that will run farther, faster and straighter than any other in class.
2. Apply what you have learned in physics to making a working car.
3. To learn more about energy, momentum, position, velocity, and acceleration as an introduction to our unit on mechanics.

## Rules o' the game are.....

1. The car must be all hand assembled and have at least **THREE** working wheels and a **frame**. The wheels must be round and be able to turn separate from the frame; they must touch the ground for the car's entire trip, although they do not have to turn. (No Coffee can cars...)
2. The car must start under its own power and run only on the flat surface of the floor.
3. If a catapult or incline plane is used; the race begins when the car touches the floor.
4. If using an incline plane, the car must first be propelled from the floor up the plane without interruption.
5. Trigger devices (e.g.; releasing a balloon) are acceptable IF they are permanently attached to the car AND require only the movement of a single switch or release to activate.
6. No electrical, *animal*, nuclear, or commercially available motors.
7. No prefabricated wheels; cannot be a "kit" car (like from Boy Scouts) or K'NEX, wheels from other toys. **Can't use something that is designed as a wheel.**
8. No tracks, guidewires, or strings used to maintain a straight path.
9. No CO<sub>2</sub> or NO<sub>2</sub> cartridges or any rockets, combustion or any potentially dangerous vehicle that could jeopardize the safety of any student, teacher, or administrator (well, maybe an administrator) are allowed - if there's a question - ask!
10. The car must move as a whole unit, not part of the car being immobile and part being mobile, i.e. no rubber band launchers.
11. Two to four engineers per group. Each person needs to help with lab write-up/website. Format for lab write-ups is on the back of this handout. If more than 4 engineers are used then for each person over 4 the group has a new differently designed car must be made, and **group will be graded on the lowest performing car with no opportunity to earn bonus points, if no extra car the group grade will be a ZERO.** 5 engineers = 2 cars; 6 = 3 cars; 7 = 4 cars; ect. ***If only 1 person is in group then NO BONUS POINTS can be earned and a 0 / 10 points will be the grade for the group grade part and they must build 2 cars and be graded on the lowest performing car.***
12. **If you have too many engineers in your group or not enough then retesting is not an option.**
13. No Pop and Mentos powered cars. All parts of the cars must stay with the cars and not make a mess on the test track.

## GRADING FOR "Race Car Physics" out of 200 points

- 1) 10 points just for entering ON TIME - Sorry, no excuses.
- 2) 10 points if the racecar moves 1 car length.
- 3) **1 additional points for every ceramic tile (foot) moved beyond one car length.** (*Max of 30 bonus points possible*)
- 4) Fastest car over 10 feet (10 blocks) – (*Max points of 10 if car goes less than 10 blocks*)
 

20.0 pts	19 pts	18 pts	17 pts	16 pts	15 pts
fastest car	next fastest car	third fastest car	fourth fastest	fifth fastest	sixth ..... and so on
- 5) **Zee 'greatest and straightest' distance\*. Specifically, the object is to maximize the value of Z, where  $Z = [D - 3E]$ . D is the distance traveled in feet, E is the lateral movement from the centerline.**

20.0 pts	19 pts	18 pts	17 pts	16 pts	15 pts
greatest Z	next highest Z	third Z	fourth Z	fifth Z	..... and so on
- 6) (Mass)(speed) product as measured from start until car stops. (This is also known as momentum)
 

20.0 pts	19 pts	18 pts	17 pts	16 pts	15 pts
Largest product	second	third	fourth	fifth .....	and so on
- 7) Efficiency – Distance travelled in feet / Mass in grams, higher the number the better. Must move at least 5 feet.
 

20.0 pts	19 pts	18 pts	17 pts	16 pts	15 pts
First	second	third	fourth	fifth .....	and so on
- 8) Creativity as judged by panel of judge(s) appointed by the AP Physics 1 teacher(s).
 

20.0 pts	19 pts	18 pts	17 pts	16 pts	15 pts
First	second	third	fourth	fifth .....	and so on
- 9) Documentation (**WEBSITE**) (**TYPED UP**). Up to 40% total. (purpose; set-up, data, and calculations; analysis of the results and the physics involved; Things that should be included → Pictures / Movies of different stages of lab, Works Cited).
- 10) **Group analysis (Done individually) – 10 points. Type up an explanation that grades how each person contributed to the group (Divide the 10 points among group members, explain why they get the grade they get. If 1 person builds the car they should receive more points than the other group members.) If there is no explanation of why the points are split the way they are then the grade will be a 0/10 points.**

*Lab write-up format is described later in this handout.*

Make sure you include your data, sample calculations, and use units (acceleration might be in feet per second per second).

Thus..... this project is will be graded out of 200 possible points. Note that it is possible to score higher than this.... but there will be a 30 point '**cap**' to the bonus points you can earn.

**Documentation (WEBSITE) format. Please make sure to title each page of the website and write your name and date on each webpage.**

### 1. Purpose/Introduction of team:

- Put in your OWN words!! The intended purpose will not always be the same as what is in the lab(s). This should be to the point.
- Introduce each team member with a video explaining what they did for the team.

## 2. Set Up:

- Use drawings/schematics to aid in making your procedures brief. "Synthesize" elements from the lab and make sure another group could understand well enough to repeat what you do. You need to take pictures of the car at each step in the build and record movies of the trial runs.

### 3. Data:

- Use tables, and include data from practice runs done while building car. Label the measurements and what units you used thoroughly.
- You should have more runs recorded than just what we did in class.

#### 4. Pictures and Movies:

- Take multiple pictures and video of the build progress and testing of your car. **← Important**

### 5. Calculations:

- Use three steps.
  - A) Formula
  - B) Actual data replacing the variables
  - C) The answers with correct units
- Explain what these results / calculations mean.

## 6. Analysis and Results:

- Write a conclusion based on your findings. Be sure to include relationships and references to your data and calculations. Be sure to talk about the physics involved. You may want to include reasons for experimental error, possible improvements to the experiment, etc. here. The **analysis** of what went right, what went wrong, and how your lab could be improved are important. The amount of analysis is the most important part of your lab write-up.

[illegible]

**Data to record for lab write-up:**

At a minimum you should be recording the following data: Car **mass** (in g), **Total distance** (D), **Lateral movement** (E), **Time** (0 to 5 feet- if car goes that far), The **average velocity for 5 ft**, **Time** until car stops, **distance** car traveled, and **average velocity** of for entire trip. (**Mass**)(**Speed**) product in (gram)(feet)/sec.-----> Very funky and non-Physics-like units, but OK for now... and finally find “**Z value**” (straight line distance) = [D - 3E]. **Not a bad idea to record other data! Make sure you film the test trials done outside of school.**

\* NOTE\* If the car does not go 5 feet, determine the average velocity until the car comes to a stop.

# AP Physics 1 Car Project Group Analysis

Take 10 points and divide the 10 points to each member of the group include yourself in the point distribution. When you are done dividing up the points make sure you did not give out more than a total of 10 points.

For example if I have 2 partners I would divide up the points as such:  
(Tony Jefferson 4 pts + Sarah Thomas 4 pts + Myself 2 pts = 10 pts)

For the group grade on the project you need to break down in detail what each person did for the project to justify why each person got the points they did. If you only write a sentence or two about a multi-week project then no points will be awarded for the group part of the project. You should have at least a paragraph on what each person did.

## **BAD example:**

Tony did all of the work that is why he gets 4 points.

## **Better example:**

Tony showed up to 7 of the 8 build sessions. Tony was the one that used the power tools to cut all of parts of he car. Tony helped keep the group on task by sending out reminders about when we would work and he scheduled the times to work around each person's schedule. One example of Tony doing more than others was during the 2<sup>nd</sup> build day when we broke our axle on our car he ran to Lowe's and bought more dowel rods. During the 3<sup>rd</sup> build day Tony brought all of the supplies with him and figured out how to get the wood to properly glue to the metal pieces. One issue with Tony was that he had a habit of getting the off task by complaining about what was going on band that day, he also spent a lot of time on his phone and we had to constantly remind him to get his task finished so we could move on. On the 5<sup>th</sup> build day Tony was the first one to show up and he figured out how to get the wheels to spin better by finding a video on Youtube about a similar type of car project and how they used graphite spray to lubricate the wheels.

## **Engineering failures**

If your car has a break down on testing day you may rebuild it over spring break and re-test after school on the first day school is back in session. The max grade that can be earned on the regrade is 90%, but you must have proof of a working car on the original test day in order to qualify for the retesting.