2015 Excellence in Mathematics Contest
Team Project Level I
(Precalculus and above)

CHANDLER-GILBERT COMMUNITY COLLEGE

School Name:

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Group Members:

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Reference Sheet

Formulas and Facts

You may need to use some of the following formulas and facts in working through this project. You may not need to use every formula or each fact.

$A = bh$ Area of a rectangle	$C = 2l + 2w$ Perimeter of a rectangle	$A = \pi r^2$ Area of a circle

$C = 2\pi r$ Circumference of a circle	$A = \frac{1}{2}bh$ Area of a triangle	$s = \int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\, d\theta$ Arc Length

$a^2 + b^2 = c^2$ Pythagorean Theorem	5280 feet = 1 mile	3 feet = 1 yard

$s = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$ Arc Length	2.54 centimeters = 1 inch	$h = -4.9t^2 + v_0 t + h_0$ $h = -16t^2 + v_0 t + h_0$

1 kilogram = 2.2 pounds	1 meter = 39.3701 inches	1 gigabyte = 1000 megabytes

1 mile = 1609 meters	1 gallon = 3.8 liters	1 square mile = 640 acres

1 sq. yd. = 9 sq. ft	1 cu. ft. of water = 7.48 gallons	1 ml = 1 cu. cm.

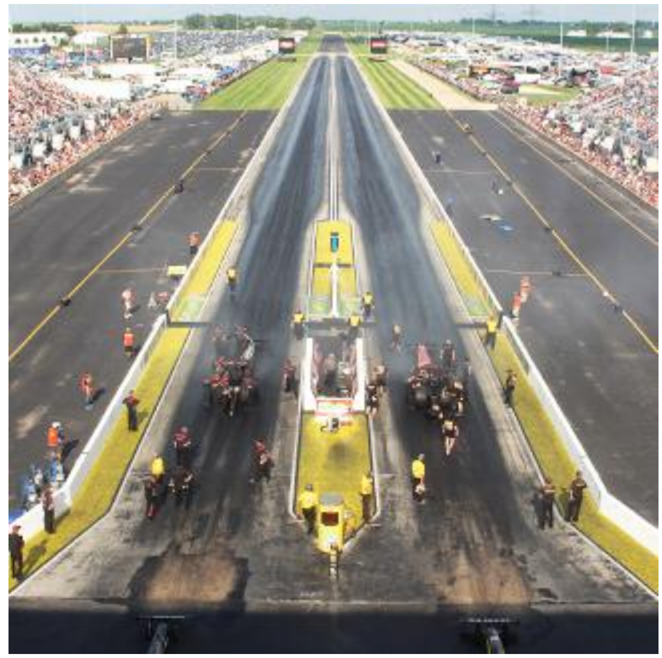
$V = \pi r^2 h$ Volume of cylinder	$V = (Area\ of\ \ Base) \cdot height$ Volume	$V = \frac{4}{3}\pi r^3$ Volume of a sphere

Lateral SA = $2\pi \cdot r \cdot h$ Lateral surface area of cylinder	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Quadratic Formula	$\tan\theta = \frac{\sin\theta}{\cos\theta}$

The Team Project is a group activity in which the students are presented an open ended, problem situation relating to a specific theme. The team members are to solve the problems and write a narrative about the theme which answers all the mathematical questions posed. Teams are graded on accuracy of mathematical content, clarity of explanations, and creativity in their narrative. We encourage the use of a graphing calculator.

Part 1: Background

In June 2013, a 1998 Corvette* raced down the quarter-mile drag strip at the Route 66 Raceway in Joliet, Illinois. The car was at the starting line waiting for the signal light to turn green at which time the driver reacted, stomping on the car's accelerator, and racing down the track. At the end of the race, a printout of data was provided to the driver (see below). Focus on the data for Car #585.



Legend:
R/T – Reaction Time
E.T. – Elapsed Time

Car # ...	587	585
Class ...		
DIAL ...		
R/T ...	.264	.734
60' ...	1.626	2.063
330 ...	4.673	5.387
1/8 ...	7.250	8.025
MPH ...	94.99	94.23
1000 ...	9.498	10.312
E.T. ...	11.416	12.259
MPH ...	117.15	116.14

*Murawska, J. and Nabb, K. (2015). Mathematics Teacher Vol. 109, No. 2, September 2015. National Council of Teachers of Mathematics

Part 2: 60 MPH

For sports cars, a common measure of performance is the number of seconds it takes the car to accelerate from 0 to 60 mph. The driver of this Corvette would like to know, according to these data, how many seconds it took him to reach a speed of 60 mph. Your task is to determine this time and support your claim mathematically. Include an explanation in words and a graph, if necessary. Note that you should focus on the data for Car #585 and that you should disucss what it means, in terms of your data, for the driver to have a reaction time of 0.734 seconds. Furthermore, note that it is conventional for drag strip data to provide the time at 60 feet, 330 feet, 1/8 of a mile, 1000 feet, and at the finish line (1/4 mile). The speed recorded at the finish line was 116.14 mph.

Car # ...	587	585
Class ...		
DIAL ...		
R/T ...	.264	.734
60' ...	1.626	2.063
330 ...	4.673	5.387
1/8 ...	7.250	8.025
MPH ...	94.99	94.23
1000 ...	9.490	10.312
E.T. ...	11.416	12.259
MPH ...	117.15	116.14

Part 2: Continued…

Part 3: Maximum Speed

The image shows the speedometer for a Corvette. The maximum speed shown by the speedometer is 200 mph. Your task is to determine the amount of additional time needed for the drag racing Corvette from Part 2 to reach a speed of 200 mph. How long (distance) would the race need to be for this to occur? Clearly state any assumptions you make in responding to this issue.

Part 4: Constant Acceleration?

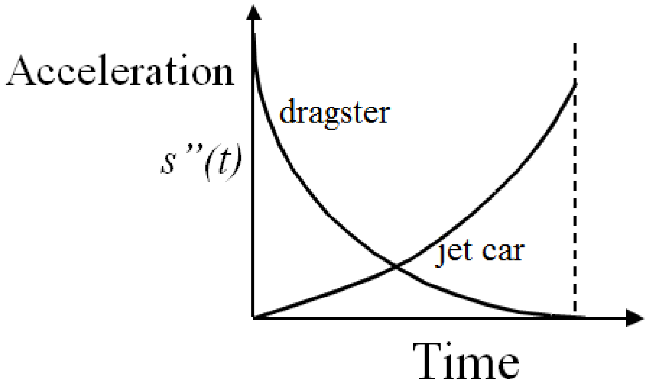
We will now make a new assumption and create some new data. Rather than the situation presented earlier, let's assume that the Corvette completed the quarter-mile drag race in such a way that its acceleration was constant.

1. At what constant acceleration would allow the Corvette to complete the quarter-mile race in 11.514 seconds after a 0.682 second reaction time? That is, the total elapsed time is the sum of these two times. Futhermore, assume you know that the time to reach the 1/8 mile mark was 7.522 seconds after the reaction time.

2. Give the constant acceleration determined in #1, how long would it take the Corvette to reach a speed of 60 mph?

Part 5: Dragster vs. Jet Car

Suppose a traditional dragster and a jet dragster raced such that they produced the acceleration graphs shown. The vertical dashed line represents the final time at the end of the race.



1. Compare the velocities of the two cars at the end of the race. Clearly explain your thinking.

2. Assuming that the finish line is a quarter mile from the starting line, which car won the race? Clearly explain your thinking.

Part 5: continues…

3. In #2 above, you made a claim and an argument about either the jet car or the dragster winning the race. Now, imagine a situation where the other car wins the race. Sketch acceleration graphs that would support the case that the other car wins the race. That is, how might you change the acceleration graphs given in #1 (of this Part 5) so that the other car wins the race? In the space below, neatly show the graphs and write an explanation detailing why your new graphs support the claim that the other car now wins the race.