Number and Quantity: Quantities ★ (N-Q)

Reason qualitatively and use units to solve problems.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. Connections: *SCHS-S1C4-02*; *SSHS-S5C5-01*	A I ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	9.18, 9.21, 1.6, 4.28, 8.1, 5.3, 8.2, 8.3, 8.4, 8.5 8.6, 8.7, 5.3, 5.10, 5.11, 5.14, 5.20, 5.22, 5.23, 5.27, 5.29, 4.15, 4.16, 4.30	To convert from English to metric units of measure	When traveling on vacation, Joe averaged 55 miles per hour. How many miles did Joe travel in 2 weeks if he averaged driving 8 hours per day? **Solution:** $\frac{55\,\text{miles}}{\text{hour}} \bullet \frac{8\,\text{hr}}{1\,\text{day}} \bullet \frac{7\,\text{day}}{1\,\text{week}} \bullet \frac{2\,\text{weeks}}{1} = 6160\,\text{miles}$
			6.2, 6.4, 6.8, 6.12, 6.13, 6.21, 6.22, 6.26, 4.24,	To convert between ohms and mega ohms To convert between amps and milli amps To convert between different battery capacity ratings To convert mega kilos to kilos using dimensional analysis	
			8.6, 1.11, 7.5, 2.3, 4.4	To convert between Celsius and Fahrenheit	

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			4.27	To convert from inches to degrees in toe, camber, and castor	
			4.28	To use conversions and percentage formulas to compute tire diameter from tire sizes being given in a combination of metric and standard measurements and profile percentage	
			5.15, 1.6, 8.7, 8.1, 9.2, 9.21, 2.8	To covert inch pounds to foot pounds and metric to standard for torque	
			8.2, 4.34, 4.35	To use conversions for temperatures, speed,	

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
				pressures and other data from vehicle's computers and between standard and metric	
HS.N-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling. Connection: *SSHS-S5C5-01*	A I A II ★	*HS.MP.4.* Model with mathematics. *HS.MP.6.* Attend to precision.	9.26	To use different quantities when servicing vehicles and to use appropriate quantities for different systems on vehicles	An auto technician worked on a car for a period of 2 weeks. Each week he spent a total of 30 hours on the car. The final bill for labor came to $1800. How much was the labor rate per hour? **Solution:** $30.00 per hour
HS.N-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	A I	*HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.2, 1.6, 1.9, 1.10, 1.12, 2.2, 2.3, 2.5, 2.8, 3.2, 3.4, 3.10, 3.11, 4.4, 4.7, 4.10, 4.11, 4.12, 4.14, 4.15, 4.16, 4.17, 4.18, 4.20, 4.21, 4.22, 4.27, 4.28, 4.30, 4.32, 4.34, 5.11, 5.20, 5.22, 5.23, 6.1, 6.3, 6.4, 6.5, 6.8, 6.9, 6.12, 6.13, 6.15, 6.16, 6.19, 6.20, 6.21, 6.22, 6.23, 6.25, 6.26, 6.29, 6.30, 6.32, 7.1, 7.2, 7.5, 8.1, 8.2, 8.3, 8.4,	To determine if reading is within the measure of margin of error from specifications To choose level of accuracy to make adjustments according to tolerances when performing wheel alignments because specifications are given in fractions of inches and degrees of	A measurement should be 0.1" $\pm$ 0.05. Would a measurement of 0.15" be within tolerance? **Solution:** Yes

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			8.5, 8.6, 8.7, 8.8, 8.9, 8.14, 8.15, 9.7, 9.21, 9.26	tolerances. To choose level of accuracy to make adjustments according to tolerances To determine if a reading is within the measure of margin of error from specifications	

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-VM.C.6. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. Connections: *9-10.RST.7*; *9-10.WHST.2f*; *11-12.RST.9*; *11-12.WHST.2e*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1* 2.1 3.1 4.1 5.1 6.1 7.1 8.1, 9.22, 9.25 9.26	To utilize service information and represent in a matrix format	A service bulletin is released stating that there is a problem with the oil system of Ford cars. Expectations are that oil changes will rise 50%. Write an inventory matrix for the following situation: An auto shop manager is ordering supplies for the auto shop before the bulletin. For January he orders 4 cases of oil for shop 1 and 6 cases for shop 2. He also orders 18 oil filters for shop 1 and 20 for shop 2. At the end of January he receives the bulletin and adjusts his February order. What affect does this have on his order? **Solution:** January: $\begin{array}{c c} & \begin{array}{cc}\text{Oil} & \text{Filters}\end{array} \\ \begin{array}{c}1\\2\end{array} & \begin{bmatrix}4 & 6\\18 & 20\end{bmatrix}\end{array}$ February: $\begin{array}{c c} & \begin{array}{cc}\text{Oil} & \text{Filters}\end{array} \\ \begin{array}{c}1\\2\end{array} & \begin{bmatrix}6 & 9\\27 & 30\end{bmatrix}\end{array}$
HS.N-VM.C.7. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. Connections: *9-10.RST.3*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1* 2.1 3.1 4.1 5.1 6.1 7.1 8.1, 9.22, 9.25 9.26	To evaluate vehicle and service information	The following is a recall matrix for Car Company A's model line based on service information. The number of cars recalled during the second quarter was increased by 10%. What affect does this have on the number of recalls? $\begin{array}{c c} & \begin{array}{ccc}\text{C1} & \text{C2} & \text{C3}\end{array} \\ \begin{array}{c}\text{A1}\\\text{A2}\\\text{A3}\end{array} & \begin{bmatrix}50 & 20 & 10\\70 & 30 & 40\\90 & 80 & 30\end{bmatrix}\end{array}$ $\boxed{\begin{array}{ll}\text{A1 = model A} & \text{C1 = color 1}\\\text{A2 = model B} & \text{C2 = color 2}\\\text{A3 = model C} & \text{C3 = color 3}\end{array}}$ **Solution:**

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
					$\begin{array}{c c} & \begin{array}{ccc} C1 & C2 & C3 \end{array} \\ \begin{array}{c} A1 \\ A2 \\ A3 \end{array} & \begin{bmatrix} 55 & 22 & 11 \\ 77 & 33 & 44 \\ 99 & 88 & 33 \end{bmatrix} \end{array}$
HS.N-VM.C.8. Add, subtract, and multiply matrices of appropriate dimensions. Connections: *9-10.RST.3*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1, 2.1 3.1 4.1 5.1 6.1 7.1 8.1, 9.22, 9.25 9.26,	To compute the number of services performed at multiple locations	An auto repair has 2 locations. At the first location they did 25 oil changes and 12 tire rotations. At the second location they did 37 oil changes and 10 tire rotations. Find the total number of these services provided. **Solution:** $\begin{bmatrix} 25 \\ 12 \end{bmatrix} + \begin{bmatrix} 37 \\ 10 \end{bmatrix} = \begin{bmatrix} 62 \\ 22 \end{bmatrix}$

Algebra: Seeing Structure in Expressions (A-SSE)

Interpret the structure of expressions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-SSE.A.1. Interpret expressions that represent a quantity in terms of its context.	A I ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.7.* Look for and make use of structure.	4.24, 5.13, 5.32, 5.34, 6.2, 6.3, 6.4, 6.5, 6.7, 6.8, 6.9, 6.21, 6.22, 6.23, 6.25, 6.26, 6.29, 7.3	To use principles of electricity for Ohm's Law with proper math terminology such as term and expression	In Ohm's Law, E = IR, what are I and R called? **Solution:** Factors

Algebra: Creating Equations ★ (A-CED)

Create equations that describe numbers or relationships.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-CED.A.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	5.8 4.28, 4.30, 5.5, 5.10, 5.11, 5.13, 5.14, 9.21 6.2, 6.4, 6.5, 6.21, 6.22, 6.26, 6.29, 6.32	To solve for one of the variables using Pascal's Law (F = P ● A) To use equations to determine tire size versus circumference To use Ohm's Law to solve for missing values	If one is pushing down on a piston with 100 pounds of Force and the area is 2 square inches, how much force is being applied? Use Pascal's Law F = P ● A where F is force, P is Pressure and A is Area. **Solution:** 200 PSI
HS.A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.9, 1.12, 6.2, 6.4	To use a table of values from Ohm's Law to create the formula	Use the following data table to write an equation that represents the relationship between amps and volts. Amps (x): .3, .45, .6, .9 Volts (y): 3, 4.5, 6, 9 **Solution:** y = 10x
HS.A-CED.A.3. Represent constraints by equations or inequalities, and by systems of	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with	1.9, 1.12	To fill cooling systems with recommended anti-freeze and water	The cooling system of a car has a maximum capacity of 16 quarts. It is filled with water and anti-freeze to form the coolant. The number of quarts of water must be greater than or equal to the amount of anti-freeze. Write a system of constraints to represent this scenario. **Solution:**

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*		mathematics. *HS.MP.5.* Use appropriate tools strategically.			$x \geq 0$ $y \geq 0$ $x + y \leq 16$ $x \geq y$
HS.A-CED.A.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	5.8 6.2, 6.4	To use Pascal's Law to solve for any variable in F = P ● A To use Ohm's Law to solve for any variable in E = I ● R	**Question 1** Given Pascal's Law, F = PA, solve for A. **Solution:** A = $\frac{F}{P}$ **Question 2** Given Ohm's Law, E = IR, solve for R. **Solution:**

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
					R = $\frac{E}{I}$

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve equations and inequalities in one variable.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.B.4. Solve quadratic equations in one variable.	A I A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.			
a. Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.	A I		5.13	To solve for radius using Pascal's Law if the area is a circle	Knowing that a specific master cylinder will produce 5 psi (P) and an output of 45 pounds of force (F) is needed, how is Pascal's law used ($A = \frac{F}{P}$) to determine the radius of a piston needed to apply that amount of force? Remember the area of a circle is $A = \pi r^2$. **Solution:** $\frac{3}{\sqrt{\pi}}$

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve systems of equations.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.C.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	A I A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use	1.1* 2.1 3.1 4.1 5.1 6.1 7.1 8.1, 9.22,	To compute number of recalled automobiles	Chrysler has three times as many recalls for brake repairs as Ford. The cost for each Chrysler repair was $200 and the cost for each Ford repair was $150. The combined cost for all repairs was $500,000. How many of the brake repairs did each company make? **Solution:**

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)
Solve systems of equations.

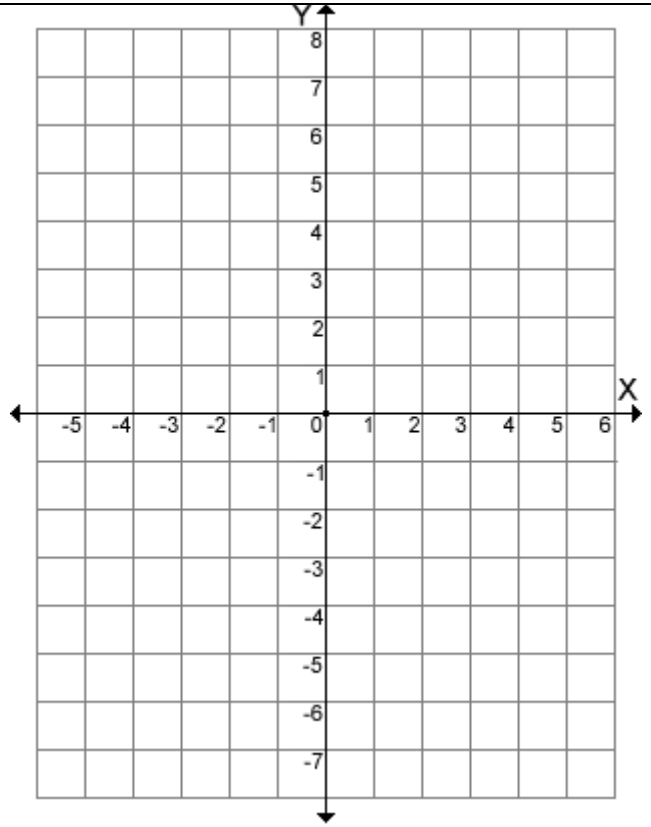
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
Connection: *ETHS-S6C2-03*		appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	9.26		$200x+150y=500,000$ $2x=y$ $200x+150(2x)=500,000$ $500x=500,000$ $x=1000\,cars$ $y=2000\,cars$

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)
Represent and solve equations and inequalities graphically.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.D.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could	A I	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics.	1.9, 1.12, 6.2, 6.4	To describe current with a variable voltage applied to a resistance	Using the following table of data, graph the points and find its equation. Amps: .3, .45, .6, .9 Volts: 3, 4.5, 6, 9

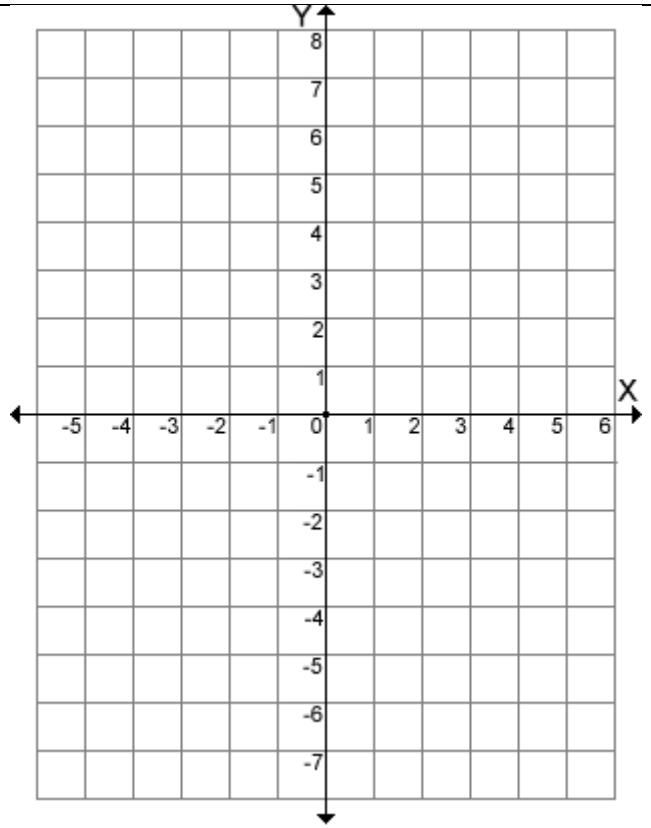
Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve systems of equations.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
be a line).					 **Solution:** y = 10x

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve systems of equations.

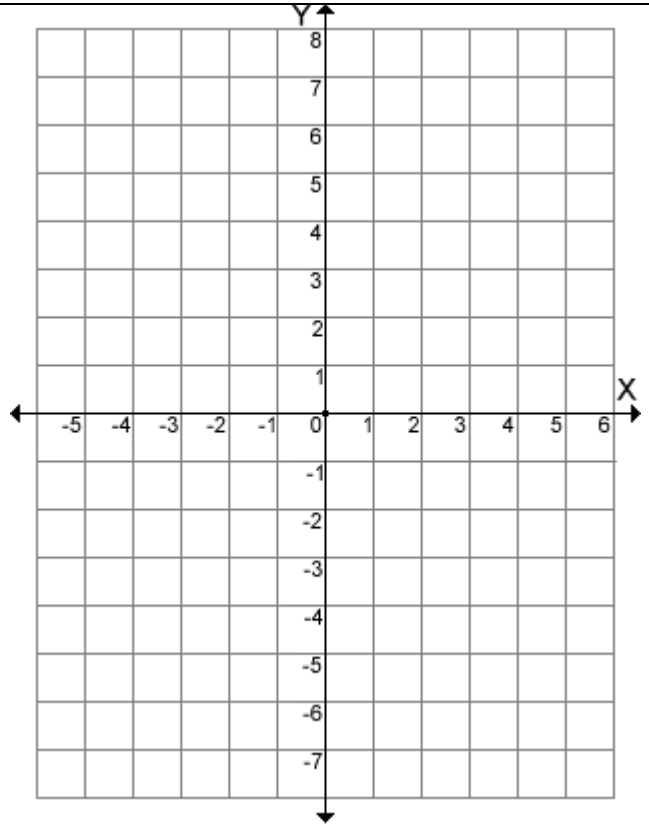
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.D.11. Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. Connection: *ETHS-S6C2-03*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.12	Using antifreeze/coolant mixture table found on back of antifreeze bottles to find freeze/boiling point.	

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* Connections: *ETHS-S6C2.03*; *9-10.RST.7*; *11-12.RST.7*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	6.2* 6.4	To represent the maximum and minimum number of amps for a car	An electrical system on a car with constant resistance has amps as a function of volts or A(V). The maximum number of volts in this circuit is 10 amps. Find the domain of the number of amps allowable in this circuit. **Solution:** [0, 10]
HS.F-IF.B.5. Relate the domain of a function to its graph	A I ★	*HS.MP.2.* Reason abstractly and	5.3*	To test the pedal height of brake pedals for	The brake pedal is a function of the return spring h(s). The brake pedal needs to be tested to make sure it is within specifications. What would be the domain of the height?

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* Connection: *9-10.WHST.2f*		quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.6.* Attend to precision.		specifications to determine necessary action.	**Solution:** $\left[5, 5\frac{1}{2}\right]$

Functions: Interpreting Functions (F-IF)

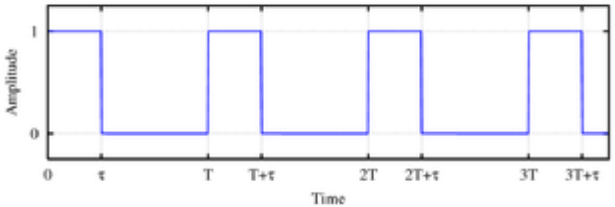
Interpret functions that arise in applications in terms of context.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. Connections: *ETHS-S1C2-01*; *9-10.RST.3*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4*. Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	4.28 6.2, 6.4 1.12	To compare tire size (circumference versus diameter) and final drive ratios rev per min to mph To identify rate of change of Ohm's Law To determine antifreeze versus temperature of water	 Use the above graph and the associated table to calculate the average rate of change (slope) and interpret its meaning over the interval [0.03, 0.12] Amps: 1, 2, 3, 4 Volts: 2, 4, 6, 8 **Solution:**

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
					2 ohms increase for every 1 volt increase

Functions: Interpreting Functions (F-IF)

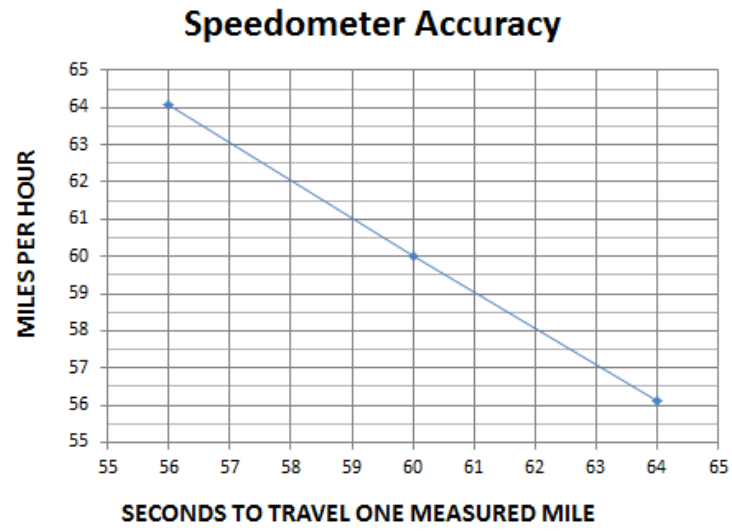
Analyze functions using different representation.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	A I A II + ★	*HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	5.2, 8.8	To use step functions to represent duty cycles or pulse width modulation using an oscilloscope	 In the above graph of a fuel injector, where T =5 ms and t = 1 ms, what is the duty cycle of injector "on time"? **Solution:** 80%
HS.F-IF.C.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger*	A I A II	*HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure.	1.9, 1.12, 6.2, 6.4	To compare two data sets using Ohms' Law	Use Ohm's Law to calculate the resistance for each circuit. Write a statement that best represents the resistance of the two circuits. Circuit 1 Amps: .3, .45, .6, .9 Volts: 3, 4.5, 6, 9 Circuit 2 Amps: .6, .9, 1.2, 1.8 Volts: 3, 4.5, 6, 9 **Solution:** Circuit 2 has the greater resistance.

Functions: Interpreting Functions (F-IF) **Analyze functions using different representation.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
maximum. Connections: *ETHS-S6C1-03*; *ETHS-S6C2-03*; *9-10.RST.7*					

Functions: Linear, Quadratic, and Exponential Models ★ (F-LE)

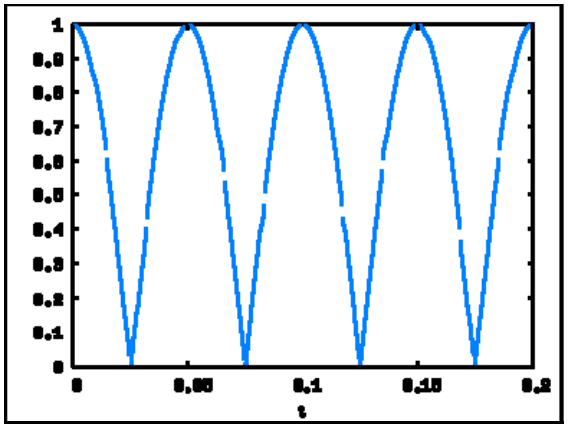
Construct and compare linear, quadratic, and exponential models and solve problems.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-LE.A.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). Connections: *ETHS-S6C1-03*; *ETHS-S6C2-03*; *11-12.RST.4*; *SSHS-S5C5-03*	A I A II ★	*HS.MP.4.* Model with mathematics. *HS.MP.8.* Look for and express regularity in repeated reasoning.	4.28	To identify a speedometer accuracy level in relation to tire size	 Write a function that best represents the speedometer accuracy. **Solution:** f(x) = -x + 65

Functions: Linear, Quadratic, and Exponential Models ★ (F-LE) **Interpret expressions for functions in terms of the situation they model.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context. Connections: *ETHS-S6C1-03*; *ETHS-S6C2-03*;*SSHS-S5C5-03*; *11-12.WHST.2e*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics.	8.1, 9.22, 9.26	To calculate the change of a raise in hourly rate.	The cost for an auto tech to do a diagnosis on a car is a flat rate of $100. He then charges $90 an hour for labor. This function would be expressed as f(h) = $90x + $100. If his hourly rate changed to $110 how would the function change? **Solution:** The slope would be steeper representing that the total bill would be more.

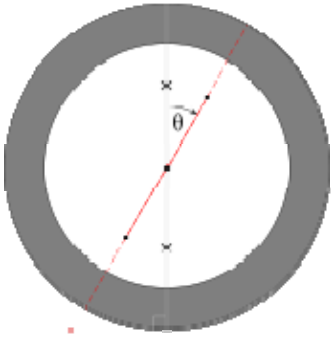
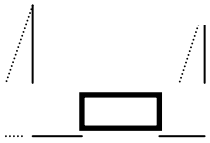
Functions: Trigonometric Functions ★ (F-TF)

Model periodic phenomena with trigonometric functions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-TF.B.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. Connection: *ETHS-S1C2-01*	A II ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	4.30, 5.2, 6.4	To model harmonics to diagnose vibration concerns and what is causing the vibration	An oscilloscope oscillates between 0 and 1 volt. It takes 0.2 second to complete 4 cycles. Find the period, amplitude and frequency.  **Solution:** P = .05 sec, A = .5 volts, F = 20 cycles/sec

Geometry: Congruence (G-CO)

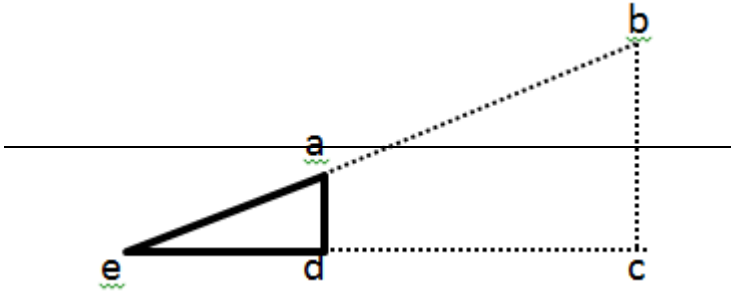
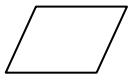
Experiment with transformations in the plane.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-CO.A.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. Connection: *9-10.RST.4*	G	*HS.MP.6.* Attend to precision.	4.27	To describe caster, toe, and camber when performing a wheel alignment.	What best describes caster when one is performing a wheel alignment?  **Solution:** The angle θ between the x axis and the segmented line
HS.G-CO.A.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. Connections: *ETHS-S6C1-03*;	G	*HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure.	4.28	To check cradle (sub-frame) and determine necessary action using translation of camber	A technician measuring front camber observes a situation noted in the sketch below. How would he adjust the engine cradle to correct the camber readings of -1°? **Cradle** 

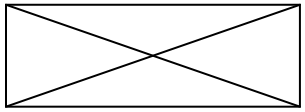
Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
9-10.WHST.4					**Solution:** Move the cradle 1° to the right.

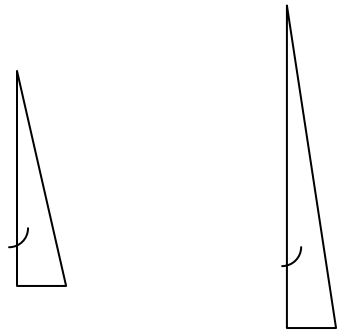
Geometry: Congruence (G-CO)

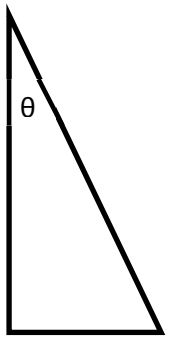
Prove geometric theorems.

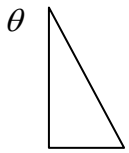
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-CO.C.10. Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.* Connections: *ETHS-S1C2-01; 9-10.WHST.1a-1e*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	4.28	To explain principles of steering geometry utilizing theorems about triangles for caster, camber, and toe	Prove the triangles representing tire slippage (or scrub) are similar by calculating side b. Diagram not to scale.  The distance from $\overline{ad}$ is $\frac{1}{32}$" and the distance from $\overline{ed}$ is 1 foot. If $\overline{ec}$ is 1 mile or 5,280 feet, calculate the distance $\overline{bc}$. **Solution:** 165 feet
HS.G-CO.C.11. Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	4.28	To use instrumentation to verify the accuracy of the wheel alignment machine	A wheel alignment machine goes through a self-check to see that the interior angles from the four cameras form a true parallelogram. If two of the angles are 75° what are each of the opposite angles?  **Solution:** They are both 105°.

Geometry: Congruence (G-CO) **Prove geometric theorems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
conversely, rectangles are parallelograms with congruent diagonals. Connection: *9-10.WHST.1a-1e*					

Geometry: Congruence (G-CO) **Make geometric constructions.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-CO.D.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.* Connection: *ETHS-S6C1-03*	G	*HS.MP.5.* Use appropriate tools strategically. *HS.MP.6*. Attend to precision.	1.6*	To construct the center of a rectangle to apply a fastening device.	With a straight edge, construct the center of a rectangle. **Solution:** 

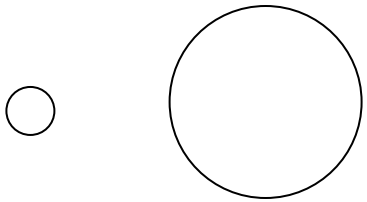
Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Understand similarity in terms of similarity transformations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-SRT.A.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. Connections: *ETHS-S1C2-01*; *9-10.RST.4*; *9-10.WHST.1c*	G	*HS.MP.3*. Construct viable arguments and critique the reasoning of others. *HS.MP.5*. Use appropriate tools strategically. *HS.MP.7*. Look for and make use of structure.	4.28	To use measurements for toe utilizing similar triangles	If Sean changed the size of his tires, would his degree of toe angle remain the same? Prove the following right triangles are similar. The opposite side for the first triangle is 10, and the hypotenuse is 26. The opposite side for the second triangle is 15, and its hypotenuse is 39. Prove they are similar.  **Solution:** Similarity for triangles is the equality of all corresponding pairs of angles and the proportionality of all corresponding sides. The opposite sides have a proportion of 10/15, which reduces to 2/3. The hypotenuses have a proportion of 26/39, which also reduces to 2/3. The proportionality of the corresponding sides is equal. If one uses trigonometry, the angles are both equal at 22.6 degrees.
HS.G-SRT.A.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be	G	*HS.MP.3*. Construct viable arguments and critique the reasoning of others.	4.28	To use measurements for toe utilizing similar triangles	**Question 1** Draw 2 right triangles to find the missing side and mark the top angles congruent. The opposite side for the first triangle is 10 and the hypotenuse is 26. The opposite side for the second triangle is 15. What is its hypotenuse?

Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Understand similarity in terms of similarity transformations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
similar. Connections: *ETHS-S1C2-01*; *9-10.RST.7*				To use trig ratios to check and adjust caster To use trig ratios to compute change in caster angle to maintain same caster trail	**Solution:** 30 **Question 2** The caster angle θ is 5°, and the radius of the tire is 14 inches. What is the caster trail?  **Solution:** –Tan 5° = 14/x

Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Define trigonometric ratios and solve problems involving right triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Connections: *ETHS-S6C2-03*; *9-10.RST.7*	G ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.4*. Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	4.28	To use trig ratios to check and adjust caster To use trig ratios to compute change in caster angle to maintain same caster trail	The caster angle θ is 5^0, and the caster trail is 14 inches. What is the radius of the tire?  **Solution:** – Cos 5° = x/14

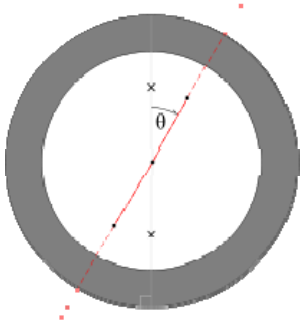
Geometry: Circles (G-C)

Understand and apply theorems about circles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-C.A.1. Prove that all circles are similar. Connections: *ETHS-S1C2-01*; *9-10.WHST.1a-1e*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	4.27, 4.28, 5.11, 5.13	To use similar circles to check toe out on turns and determine necessary action	Prove the circles are similar if the radius of circle one is 1 inch and the second is 4 inches.  **Solution:** To prove that 2 circles are similar, the ratios of the radii and the diameters must be the same. Circle 1 – r = 1 Circle 2 = r = 4 The ratio of the radii is ¼. Circle 1 - d = 2 Circle 2 – d = 8 The ratio of the diameters is 2/8 which reduces to ¼. Therefore, the circles are similar.

Geometry: Circles (G-C)

Understand and apply theorems about circles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-C.A.2. Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.* Connections: *9-10.WHST.1c; 11-12.WHST.1c*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	4.27, 4.28	To use relationships in circles to determine caster trails and recalculation due to tire change To use relationships in circles to determine caster trails	 The radius of the tire x is 14"and the caster angle is 5° (θ). What is the caster trail for the side opposite the angle? **Solution:** 1.22"

Geometry: Geometric Measurement and Dimension (G-GMD) **Explain volume formulas and use them to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-GMD.A.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. Connection: *9-10.RST.4*	G ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively.	8.1, 8.2, 8.4, 8.5	To use bore (diameter) and stroke (height) to calculate volumes of cylinders for computing displacements, compressions ratios, etc. To use volumes to calculate manifold pressures and compression pressure To use volume and pressure to calculate volumetric efficiency	The volume (displacement) of a cylinder is 0.71 liters. What is the height (stroke) if the diameter (bore) is 4 inches? **Solution:** .06 inches

Geometry: Geometric Measurement and Dimension ★ (G-MG)

Apply geometric concepts in modeling situations.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-MG.A.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). Connections: *ETHS-S1C2-01*; *9-10.WHST.2c*	G ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	4.28, 8.4, 8.5	To make connections between the shape of an auto part and a geometric shape.	What geometric shape most closely resembles a combustion chamber? **Solution:** Hemisphere
HS.G-MG.A.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). Connection: *ETHS-S1C2-01*	G ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	8.1, 8.2	To use density of atmosphere at different altitudes and temperatures to calculate proper air fuel measurements	Stoichiometric air fuel ratio is 14.7:1. If Pam had an air density of approximately 0.075 pounds per cubic foot at sea level and drove to an altitude of 10,000 feet where the air density was approximately 0.050 pounds per cubic foot, what percentage would she have to lean out her fuel? **Solution:** 33%

Statistics and Probability: Interpreting Categorical and Quantitative Data★ (S-ID) **Summarize, represent, and interpret data on a single count or measurement variable.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-ID.A.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). Connections: *SSHS-S1C1-01*; *ETHS-S6C2-03*; *9-10.WHST.1a*	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4*. Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	1.1, 2.1, 3.1, 4.1, 5.1, 6.1, 6.4, 7.1, 8.1	Checking how far out of spec. is an item.	In checking 4 rotors on a car looking for a variation in rotor run out. Using vehicle recommended specs. We reject or fail to reject each rotor based on factory specs.

Statistics and Probability: Interpreting Categorical and Quantitative Data ★ (S-ID)

Interpret linear models.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-ID.C.7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. Connections: *SCHS-S5C2-01*; *ETHS-S1C2-01*; *ETHS-S6C2-03*; *9-10.RST.4*; *9-10.RST.7*; *9-10.WHST.2f*	A I ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	6.2, 6.4 3.1, 4.28 1.12	To analyze ate of change using Pascal's Law (F = P ● A) To determine tire size (circumference vs. diameter) and calculate final drive ratios rev per min to mph To identify rate of change of Ohm's Law To determine resistance versus temperature of water	Sam conducted an experiment to determine the resistance of an unknown resistor. By using a variable voltage power supply, he was able to measure the different amperages. He was then able to compute the rate of change. Amps: 0.06, 0.12, 0.24 Volts: 3, 6, 12 Find an equation for Sam's experiment and describe what the slope (rate of change) and the intercept (constant term) mean. **Solution:** y = 0.50 x; the slope is the number of ohms, and the intercept means at 0 amps there are 0 volts.
HS.S-ID.C.9. Distinguish between correlation and causation. Connection: *9-10.RST.9*	A I ★	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with	6.2, 6.4	To show causation using Ohm's Law	An auto student states, "In a circuit with 5 volts, as you raise the resistance the amperage goes down." Is this conclusion justified? If yes, how could one prove it? **Solution:** Using Ohm's law, if one had a 5 volt circuit with 2 Ohms resistance one would have a 2.5 amp current flow. If one raised the resistance to 5 Ohms, he would have a current flow of 1 amp, which is lower.

Statistics and Probability: Interpreting Categorical and Quantitative Data ★ (S-ID) **Interpret linear models.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
		mathematics. *HS.MP.6.* Attend to precision.			

Statistics and Probability: Using Probability to Make Decisions ★ (S-MD) **Use probability to evaluate outcomes of decisions.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-MD.B.5. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. Connections: *SSHS-S5C2-03*; *SSHS-S5C5-03*; *SSHS-S5C5-05*; *ETHS-S1C2-01; ETHS-S6C2-03*	+ ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1* 2.1 3.1 4.1 5.1 6.1 7.1 8.1 9.26	To understand probabilities associated with failures.	The owner of a repair shop received a service bulletin saying that the probability of part A failing is $\frac{1}{100}$. The probability of part B failing is $\frac{1}{50}$, and the probability of part C failing is $\frac{1}{25}$. What is the probability of any of these parts failing? **Solution:** Probability of any of those happening is the sum of the probabilities. $\frac{1}{100}+\frac{1}{50}+\frac{1}{25}=\frac{7}{100}$