AACA Museum
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Braking Systems

Includes PowerPoint Presentations

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Braking Systems

PROPERTIES, PERCENTAGES, RATES

LEBANON VALLEY COLLEGE – GABRIELLE PRETOT & ASHLEY KUTZ

AACA Museum Safety Unit

KNOWS

- Proportions:
  - Of unknown variables
  - Equivalence
- Equations that represent proportions:
  - $\frac{a}{b} = \frac{p}{100}, a = part, b = base, p = percent$
  - $a = pb, p\ is\ a\ decimal$
  - Know that a (part) goes with "is" and b (base) goes with "of"
- Percent:
  - Increase/decrease in wheel size, wheel torque, and brake force
    - $\frac{big-small}{original}$
- Unit rates
  - Fraction with 1 as the denominator
- Difference between decimals and percent

DOS

Collect Data:

- Wheel diameter
- Possibly the weight of the car and brake force

Research

- Find missing data needed for solving equations
- Research modern car of choice to compare to an old car in the museum

Compare Cars:

- Old vs. New using percent and proportions
- Wheel size
- Braking system
- Weight

Write about the comparison in data

Discuss findings

Find Missing Variables
Solve Proportions
Use given equations to compare cars:

- Break force(lbs)$=\frac{\text{wheel torque(ft}-\text{lb)}}{\text{circumference of wheel(ft)}}$
- Deceleration(g)$=\frac{\text{break force(lbs)}}{\text{weight(lbs)}}$
- Stopping distance(ft)$=\frac{\text{speed(mph)}^2}{(\frac{\text{deceleration (g)}}{29.9})}$

PRIOR KNOWLEDGE

- How to solve one step equations
- Know what a variable is
- How to measure and collect data
- How to find circumference given a diameter
- How to plug in numbers for given variables
- How to convert from one unit to another

ESSENTIAL QUESTIONS

1. How do braking systems in antique cars compare and contrast to modern cars braking systems?
2. How do you find the percent increase/decrease from antique cars to modern cars in deceleration, force, and stopping distance?
3. How did braking systems improve throughout the years?

STANDARDS

M07.A-R.1: Demonstrate an understanding of proportional relationships.

M07.A-R.1.1: Analyze, recognize, and represent proportional relationships and use them to solve real-world and mathematical problems.

M07.A-R.1.1.1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.

M07.A-R.1.1.2: Determine whether two quantities are proportionally related

M07.A-R.1.1.3: Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

M07.A-R.1.1.4: Represent proportional relationships by equations.

M07.A-R.1.1.6: Use proportional relationships to solve multi-step ratio and percent problems.

Performance Task:

Have them pick a specific car and a certain trait about that car (speed, horsepower, acceleration, mpg, etc)
Have them create a proportion between the car and a human
Find the unit rate
Find the percent change between human and car also write in decimal form
Make a poster with an illustration demonstrating all of the data you collected

Benchmark:

- Quiz on proportions and solving for unknown variable
- Pick 5 of your favorite cars then find the better mpg between different models

    - Convert the price of each model to price per 1mpg and compare between models for the best mpg for the cost
- Worksheet on percent change
    - Pick a car find its weight and acceleration
    - What if the company increased the car's weight by 10%?
        - By how much would the weight change?
        - What is the new acceleration?
        - What is the percent change of acceleration?

Lesson Plan Layout

Lesson 1: Ratios
Lesson 2: Evaluating whether two proportions are equal
Lesson 3: Solving for an unknown variable using proportions
Lesson 4: Writing word problems as proportions
Lesson 5: Unit Rates
Lesson 6: Percent Change/ Converting between decimal and percentage

Lesson 1: Ratios

Essential Questions:

1) What does a ratio represent?
2) How do you find a ratio?

Standards:

M07.A-R.1: Demonstrate an understanding of proportional relationships.

Activating Strategy:

When student enters the classroom, give them a colored sticker to split up into groups. Have the students sit in their colored group. Hand each group a Hot Wheel car and a ruler. Provide the ratio between the Hot Wheel and its real life car. Have students figure out how big the real life car would be. Have student share their findings.

Game Plan:

- A/S
- Ratio powerpoint with guided notes
- I do, we do, you do examples
- S/S

Summarizing Strategy:

- Relay Summary:
  - Have students get back into their color groups
  - Have one take out a piece of paper
  - Starting with one student, have the student write a sentence summarizing the lesson
  - Then pass the paper around the circle and have students continue writing a sentence each summarizing the lesson.
  - When the paper returns to the original person, have the student share the paragraph summarizing the lesson with the class.

Differentiation:

- Guided notes
- Group the students with a mixture of ability levels

Assessment/Assignment & Materials Needed:

Informal assessment from the S/S

Homework: At home measure 5 different objects and create a ratio that scales them down to dollhouse size within reason.

- Stickers
- Hot Wheels
- Power point
- Guided Notes

Lesson 2: Evaluating whether two proportions are equal:

Essential Questions:

1) What methods are there to determine if two proportions are equal?
2) How can you represent proportions to solve problems?

Standards:

M07.A-R.1: Demonstrate an understanding of proportional relationships.
M07.A-R.1.1.2: Determine whether two quantities are proportionally related
M07.A-R.1.1.4: Represent proportional relationships by equations.

Activating Strategy:

Treasure Hunt:

- Around the room post simplified fractions/ratios
- Give each student a fraction/ratio that is not simplified
- Have the student simplify their fraction and find the matching posted fraction

Game Plan:

- A/S
- Make a Frayer Model
  - Definition of proportion
  - Example of equal proportions
  - Cross multiplication process
  - Example of proving two proportions are equal
- I do, we do, you do examples on the back of Frayer Model sheet
- S/S

Summarizing Strategy:

Have students explain on a piece of paper how to show two proportions are equal by using cross multiplication. Tell students to assume your reader does not know anything about proportions or ratios.

Differentiation:

Frayer Model for organization help

Assessment/Assignment & Materials Needed:

Informal Assessment: collect the S/S explanations to see if students understand equal proportions.
Materials:

- Treasure hunt questions
- Frayer Model sheets

Lesson 3: Solving for an unknown variable using proportions

Essential Questions:

1) When is it easier to use a proportion to solve for a variable rather than isolating a variable?
2) What is the purpose of representing a proportion in an equation?

Objectives:

SWBAT solve three out of four given proportional equations correctly when working on the white boards during the summarizing strategy.

Standards:

M07.A-R.1.1.4: Represent proportional relationships by equations.

Prior Knowledge:

- How to simplify algebraic expressions
- How to solve equations with one variable
- Know how to manipulate fractions and proportions

Activating Strategy:

Bell ringer: Have a warm up on the board for the students when they enter the class. This warm up will include solving equations that they should be able to do using their prior knowledge. Have different expressions using addition, subtraction, multiplication but more division of rational integers to prepare for working with fractions. Also try some word expressions using real life examples for a challenge question.

Game Plan:

- A/S
- Discovery Lesson:
- Board work guiding students how to manipulate proportions
- They take notes in binders
- Show how you can simplify equivalent fractions
- Manipulate already solved equations into the proportional forms
- Undo steps as guide to solving equations
- I do, we do, you do examples
- S/S

Summarizing Strategy:

- Partner work:
    - Have students get into pairs
    - Each pair gets a white board to do problems
    - Have students solve proportional equations
    - Have a challenge question that requires two steps to solve
    - Check each pair for understanding
    - Switch partners if desired
    - While students are working help students who might have questions

Differentiation:

- Pair students who might struggle with similar students so you can help them together during S/S
- Challenge questions for students who are gifted to work on

Assessment/Assignment & Materials Needed:

Informal assessment from the S/S

Homework: Book page on solving simple proportional equations that goes along with the text book. Complete and check in class next day.

- Warm up problems
- graphic organizer
- white board/markers/erasers

Lesson 4: Writing word problems as proportions

Essential Questions:

1) When would you use a proportion to solve a word problem?
2) What can a proportion tell you about the relationship of real life examples?

Objectives:

SWBAT solve two word problems as proportions.

Standards:

M07.A-R.1.1.4: Represent proportional relationships by equations.

Prior Knowledge:

- How to simplify algebraic expressions
- How to solve equations with one variable
- Know how to manipulate fractions and proportions
- How to solve equations with proportions

Activating Strategy:

Watch youtube video https://www.youtube.com/watch?v=USmit5zUGas on proportions. This video reviews the material taught in the lesson previous as well as an introduction on how proportions relate to real world problems.

Game Plan:

- A/S
- Have students work on problems in stations with an answer sheet to be collected
- Have a few problems written around the room that all are word problems dealing with car proportions
- Each problem will relate to a proportion the students saw in the car museum
- Have two different level questions, harder being A questions and simpler word problems being B questions.
- Assign A question track to students who need a challenge and B questions to students who struggle
- Float around the room to guide and help students
- S/S

Summarizing Strategy:

Have each group stand up in front of the last station they were at and explain how they set up their proportion from the word problem, then have the group give the answer they got to the class.

Differentiation:

Group students in skill level groups then the question tracks will give the students challenge questions and some simpler questions so all students can feel confident answering word problems.

Assessment/Assignment & Materials Needed:

Informal assessment from the S/S: Collect sheets the students did their stations on and grade two problems for correctness.

Homework: Have students think of other proportions they saw in the car museum and write their own proportion word problem. Have them write 3 new proportions and share with the class the following day.

- youtube video
- station questions
- station worksheet

Lesson 5: Unit Rates

Essential Questions:

1) How does finding a unit rate help you solve problems dealing with proportions?
2) What does a unit rate represent?

Objectives:

SWBAT find a unit rate and use that unit rate to solve a word problem about proportions.

Standards:

M07.A-R.1: Demonstrate an understanding of proportional relationships.
M07.A-R.1.1.3: Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

Prior Knowledge:

- How to simplify algebraic expressions
- Know how to manipulate fractions and proportions

Activating Strategy:

- Put 2 or 3 word problems up on the board and have them write a proportion for it. Then as a class solve those proportions together.

Game Plan:

- A/S
- We do two or three example problems together.
- Put 2 different prices and the amount of gas purchased for that amount on the board. Have the students figure out the better deal by finding the unit price.
- Then split them up into their groups from the first lesson when they found the proportions for the hot wheels car. Give them the dimensions of a real life car and a toy car. Have them find the unit rates for the real car to the toy car. Give them specific dimensions for another toy car with the same unit rate to a real car and have them calculate the size of the real life car.
- S/S

Summarizing Strategy:

$2 Summary: With each word worth 10 cents, write a $2 summary of the learning from the lesson

Differentiation:

- Students are grouped with a mixture of ability levels

Assessment/Assignment & Materials Needed:

- Informal Assessment from the A/S because you will be able to see if they learned how to write a word problem as a proportion.
- Informal Assessment from the S/S because you will be able to see if they know how to find a unit rate and then use that to find the dimensions of a new car.
- Materials needed:
    - ❖ Proportions from the first lesson
    - ❖ A document or piece of paper with the problems for the lesson

Lesson 6: Percent Change/Converting Between Decimal and Percentage

Essential Questions:

1) When is it more appropriate to use a decimal and a percent?
2) What types of problems do you need to be able to convert between percent and decimal?

Objectives:

SWBAT convert between percent and decimal and will be able to determine when to use a decimal and when to use a percent.

Standards:

M07.A-R.1.1.6: Use proportional relationships to solve multi-step ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease.

Prior Knowledge:

- How to convert between a fraction and a decimal
- What a percentage is
- What a fraction is

Activating Strategy:

- Give students 10 fractions and have them convert them to a decimal. Go around the room and check their answers to ensure that they know how to do this.

Game Plan:

- A/S
- Powerpoint with guided notes
- I do, We do, You do
- S/S

Summarizing Strategy:

- Give students statistics from a previous year about amount of deaths in car accidents and the percent of which occurred because they were not wearing a seat belt. Have the students convert that percent into both a fraction and a decimal. Let's say that the number of deaths due to people not wearing a seatbelt increased by 5%. Have them use the proportion given to find the estimated number of deaths due to not wearing a seatbelt.

Differentiation:

- Guided notes

Assessment/Assignment & Materials Needed:

- Informal Assessment from the S/S because you will be able to see which students could convert between percents, fractions, and decimals. Then they have to take it one step further and find the unit rate to use for the final part of the questions.
- Materials:
  - ❖ Powerpoint

Performance Task Rubric

	Superior	Outstanding	Adequate	Inadequate
Collect Data 8 Points	Student collected all data needed related to car model. Data is clearly displayed. Source is provided.	Student collected most of the data needed related to the car model. Data is somewhat clearly displayed. Source is provided.	Student collected some of the data needed related to the car model. Data is unclearly displayed. Source is incorrectly provided.	Student collected little to none of the data needed related to the car model. Data is not displayed. Source is not provided.
Created Proportion 8 Points	Student set up the proportion correctly between the car and a human. Correctly solved for the unknown variable and showed all work.	Student set up the proportion correctly between the car and a human. Correctly solved for the unknown variable but did not show all work.	Either the student set up the proportion incorrectly or solved it incorrectly for the unknown variable and did not show most of the work.	Student set up the proportion incorrectly. The student solved it incorrectly for the unknown variable. Student did not show any work.
Percent Change/ Unit Rate 8 Points	Student correctly found the unit rate. Student correctly found the percent change from car to human and expressed it in both a percent and a decimal. Student showed all work.	Student correctly found the unit rate. Student correctly found the percent change from car to human and expressed it in both a percent and a decimal. Student did not show all work.	Either the student incorrectly found the unit rate or incorrectly found the percent change and did not express it as a percent and a decimal. Student did not show most of the work.	Student incorrectly found the unit rate. Student incorrectly found the percent change and did not express it as a percent and a decimal. Student did not show any work.
Poster 8 Points	Student created a poster that contained all the data that they collected along with an illustration that related to what they researched. Student went above and beyond and it was organized.	Student created a poster that contained most of the data that they collected along with an illustration that related to what they researched. Poster was somewhat organized.	Student created a poster that contained some of the data that they collected with little illustration that related to what they researched. Poster was cluttered.	Student created a poster that contained little of the data that they collected and no illustration. Poster was disorganized. Or student did not create a poster.

Presentation 8 Points	Student got up in front of the class and discussed all the data that was represented on their poster. They used math terms correctly. Student kept eye contact with the class and made the presentation interesting.	Student got up in front of the class and discussed all the data that was represented on their poster. They used most math terms correctly. Student kept eye contact with the class for the majority of the presentation and lost some class interest at some point in the presentation.	Student got up in front of the class and did not discuss all of the data that was represented on their poster. They used math terms correctly. Student did not keep eye contact with the class for the whole presentation. Student lost interest of the class for most of the presentation.	Student got up in front of the class and did not discuss any of the data on their poster. Student failed to make eye contact with the class and did not keep interest of the class. Or the student did not present their poster.

Ratios

Ratio: _____

_____

Rate: _____

_____

Ways to write a ratio:

1) _____ 2) _____ 3) _____

Example 1: Tom's car can hold 12 gallons of gas and Sherry's car can hold 15 gallons of gas. Write the ratio of gallons of gas Tom's car holds to Sherry's car.

Example 2: There are 25 drivers in the driver education class. 21 of these drivers drive an automatic vehicle. Write the ratio of people who drive manual to automatic.

Lesson 6 Activating Strategy

Write the following fractions as a decimal (you can use a calculator)

1. $\frac{1}{2}$

2. $\frac{2}{8}$

3. $\frac{7}{10}$

4. $\frac{11}{16}$

5. $\frac{15}{25}$

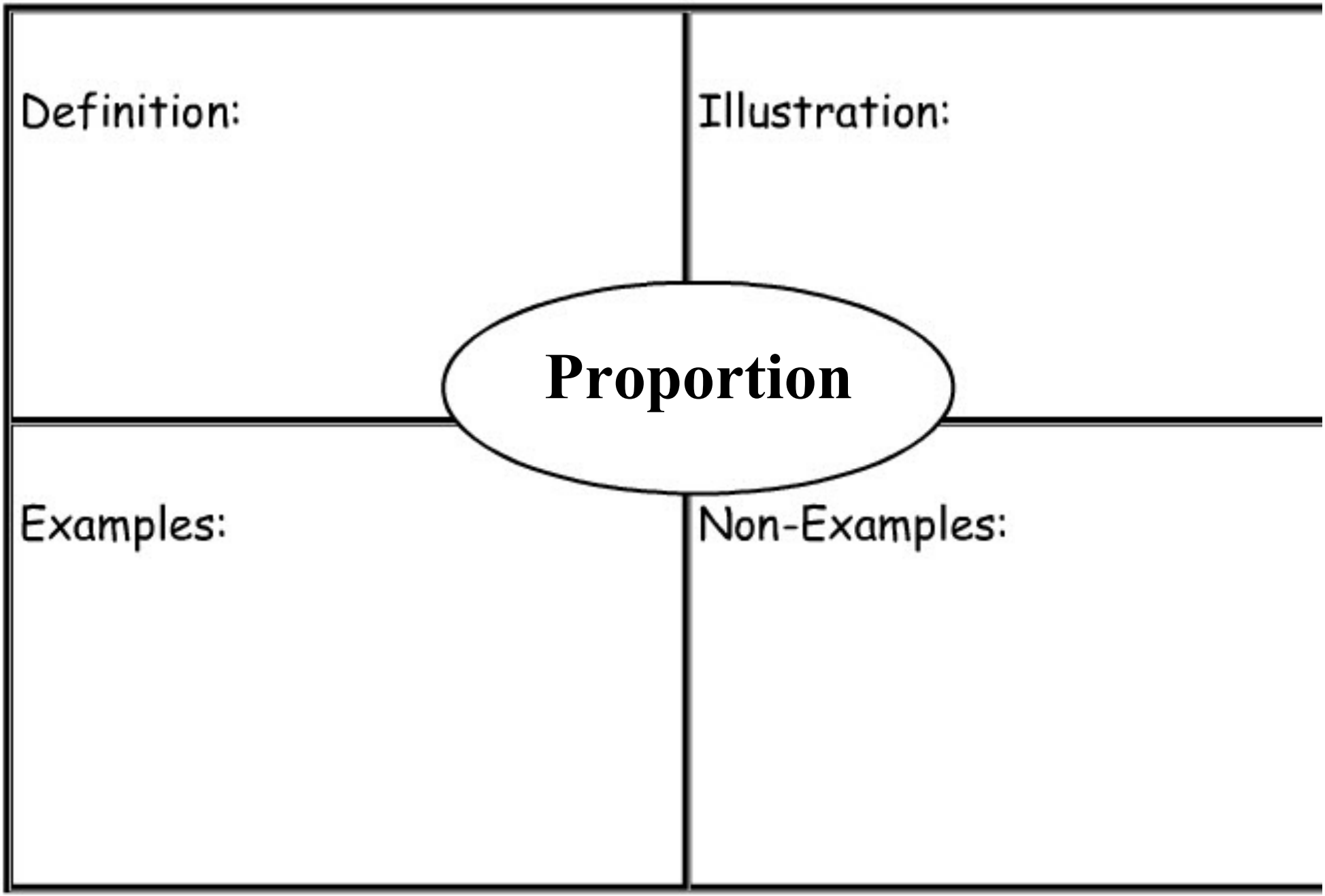
6. $\frac{4}{20}$

7. $\frac{3}{6}$

8. $\frac{12}{15}$

9. $\frac{24}{30}$

10. $\frac{27}{18}$


Definition:
Illustration:
Proportion
Examples:
Non-Examples:

Word problem stations:

1. A car traveled 35 miles in 40 minutes so how many miles can the car travel in 100 minutes?

2. In the first 4 races of the season, a race car driver won a total of 10 races. If this trend continues, how many races will the driver win in the 18 remaining races of the season?

3. A car traveling 50 miles per hour goes 15 miles farther in the same amount of time as a car traveling 30 miles per hours. Find the distance that each car travels.

4. If a car is decelerating at a rate of 10 feet per second, how much force would the car need to stop if the car weighed 3,000lbs.

   Deceleration(fps)=$\frac{\text{break force(lbs)}}{\text{weight(lbs)}}$

5. How fast can a car be traveling if they had 55 feet to stop and were decelerating at a rate of 6 fps?

   Stopping distance(ft)=$\frac{\text{speed}^2\text{(mph)}}{(\frac{\text{deceleration (fps)}}{29.9})}$

6. If a driver was applying 2,000lbs of break force to a car which has a tire circumference of 32π inches, how much wheel torque is needed to keep the tire on the car?

   Break force(lbs)=$\frac{\text{wheel torque(ft-lb)}}{\text{circumference of wheel(ft)}}$