

Newport-Mesa Unified School District
Office of Secondary Curriculum and Instruction
High School Course of Study

Course Title	<i>Algebra 2</i>	Course Code	<i>M0422-423</i>
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Transcript Title:	Algebra 2AB		Grades Levels:	9-12	Board Adoption Date:	06/23/2020	
Content Area:	Math		GPA Scale:	4.0	Date Course Submitted:	6/2020	
Credential Required:	Math	Graduation Subject Areas:		Math	CALPADS Code:	9252	
UC/CSU “A-G” Area Approvals:				School Site/person that wrote and submitted the course:		Ed Center/ Caroline Karr & Stephanie Marvicsin	
Recommend Skills:	Algebra 1, Geometry						
Next course(s):	Pre-Calculus, Statistics,						
Textbook to be used:	Illustrative Mathematics, Algebra 2						

COURSE DESCRIPTION

Students begin the course with a study of sequences, which is also an opportunity to revisit linear and exponential functions. Next, students extend exponent rules to include rational exponents. Building on rational exponents, students return to their study of exponential functions and establish that the property of growth by equal factors over equal intervals holds even when the interval has non-integer length. They use logarithms to solve for unknown exponents, and are introduced to the number e and its use in modeling continuous growth. Students learn to transform functions graphically and algebraically. The last unit, on statistical inference, focuses on analyzing data from experiments using normal distributions. Within the classroom activities, students have opportunities to engage in aspects of mathematical modeling. Additionally, modeling prompts are provided for use throughout the course.

STANDARDS ADDRESSED

The Algebra 2 course is designed around and informed by the following standards:

- *Common Core State Standards for Mathematics (June 2010)*

SUPPORTS AND EXTENSIONS

Supports for English Language Learners

Embedded within the curriculum are instructional supports and practices to help teachers address the specialized academic language demands in math when planning and delivering lessons, including the demands of reading, writing, speaking, listening, conversing, and representing in math (Aguirre & Bunch, 2012). The framework for supporting English language learners (ELLs) in this curriculum includes four design principles (support sense-making, optimize output, cultivate conversation, and maximize meta-awareness) for promoting mathematical language use and development in curriculum and instruction. The design principles and related routines work to make language development an integral part of planning and delivering instruction while guiding teachers to amplify the most important language that students are expected to bring to bear on the central mathematical ideas of each unit.

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Supports for Students with Disabilities

The additional supports for students with disabilities are activity-specific and provide teachers with strategies to increase access and eliminate barriers without reducing the mathematical demand of the task. Designed for students with disabilities, they are also appropriate for many students who need additional support to access rigorous, grade-level content. The additional supports for students with disabilities were designed using the Universal Design for Learning Guidelines (<http://udlguidelines.cast.org>). Each support aligns to one of the three principles of UDL: engagement, representation, and action and expression.

Extensions

Select classroom activities include an opportunity for differentiation for students ready for more of a challenge. Every extension problem is made available to all students with the heading "Are You Ready for More?" These problems go deeper into grade-level mathematics and often make connections between the topic at hand and other concepts. They are intended to be used on an opt-in basis by students if they finish the main class activity early or want to do more mathematics on their own.

EVALUATION

Student achievement will be measured using multiple assessment tools, included but not limited to check-your-readiness pre-assessments, mid-unit assessments, end-of-unit assessments, lesson activities, practice problems, and cool-downs.

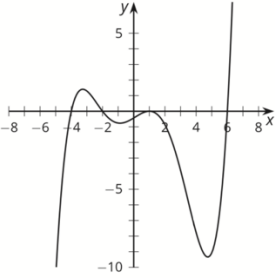
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Unit 1: Sequences and Functions																	
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit															
This unit provides an opportunity to revisit representations of functions (including graphs, tables, and expressions) at the beginning of the Algebra 2 course, using the example of a sequence as a particular type of function. Students begin with an invitation to describe sequences with informal language. They write out the terms of sequences arising from mathematical situations, in addition to interpreting and creating tables and graphs about the given relationship. Expressions for the n^{th} term of a sequence are built up through expressing regularity in repeated reasoning (MP8), building on students' prior experiences studying linear and exponential functions. In the last part of the unit, students use sequences to model several situations represented in different ways (MP4).	Lesson 1: A Towering Sequence Cool Down: Next? A sequence starts 3, 6, . . . 1. Give a rule the sequence could follow, and list the next 3 terms. 2. Give a <i>different</i> rule the sequence could follow, and list the next 3 terms. Lesson 3: Different Types of Sequences Cool Down: Do What's Next Many sequences start with the terms 2 and 8. 1. Find the next two terms of the arithmetic sequence 2, 8, __, __. 2. Find the next two terms of the geometric sequence 2, 8, __, __. 3. Find two possible next terms of a sequence 2, 8, __, __ that is neither geometric nor arithmetic. Lesson 10: Situations and Sequence Types Cool Down: Two Bacteria Populations The table shows two bacteria populations changing over time, measured in hours since the populations were first counted. <table border="1"> <thead> <tr> <th>time (hours)</th><th>population A (millions)</th><th>population B (millions)</th></tr> </thead> <tbody> <tr> <td>0</td><td>12</td><td>64</td></tr> <tr> <td>1</td><td>6</td><td>48</td></tr> <tr> <td>2</td><td>3</td><td>36</td></tr> <tr> <td>3</td><td>1.5</td><td>27</td></tr> </tbody> </table> 1. Describe a pattern for how each population changes from one hour to the next. 2. Write an equation to define each population.	time (hours)	population A (millions)	population B (millions)	0	12	64	1	6	48	2	3	36	3	1.5	27	HSA-SSE.B.4 HSF-BF.A.1 HSF-BF.A.2 HSF-IF.A.3 HSF-IF.B.5 HSF-IF.C HSF-LE.A.1 HSF-LE.A.2 HSN-Q.A.2
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Unit 2: Polynomials and Rational Functions		
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit
In previous courses, students learned about linear and quadratic functions. In this unit, students will expand their earlier work as they investigate polynomials of higher degree and the features that all polynomial functions have in common. Focusing on functions expressed in factored form and their graphs, students make connections between linear factors and horizontal intercepts, identifying that a factor of $(x - a)$ means a is a zero of the function and $(a, 0)$ is a horizontal intercept. Embedded throughout the first half of the unit are opportunities for students to practice multiplying polynomials and some optional review of factoring. From there, the connection between division and multiplication equations is used to establish the Remainder Theorem. Students transition to working with rational functions by considering situations they model, such as average cost. In the final section students study polynomial identities.	Lesson 3: Introducing Polynomials Cool Down: Identifying Features 1. Write an equation for a polynomial with all the following features: a. The degree is 5. b. The polynomial has 4 terms. c. The graph of the polynomial crosses the vertical axis at $y = 12$. 2. Identify the approximate input values of any relative maximums and minimums of this 5th degree polynomial. 	HSA-APR.A HSA-APR.A.1 HSA-APR.B HSA-APR.B.2 HSA-APR.B.3 HSA-APR.C HSA-APR.C.4 HSA-APR.D HSA-APR.D.6 HSA-CED.A HSA-CED.A.1 HSA-CED.A.2 HSA-CED.A.4 HSA-REI.A HSA-REI.A.1 HSA-REI.A.2 HSA-REI.C.7 HSA-REI.D.11 HSA-SSE.A HSA-SSE.A.1 HSA-SSE.A.1.a HSA-SSE.A.2 HSA-SSE.B.3 HSA-SSE.B.4 HSF-BF.A.1 HSF-BF.B.3 HSF-IF.A.2 HSF-IF.B.4 HSF-IF.B.5 HSF-IF.C HSF-IF.C.7 HSF-IF.C.7.c HSS-ID.B.6.a

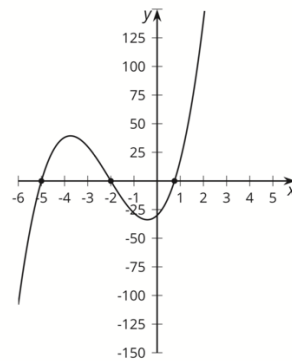
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Lesson 5: Connecting Factors and Zeros

Cool Down: Polynomial Graphing Error

The polynomial $y = (x - 5)(x - 2)(4x + 3)$ has been graphed incorrectly. Identify the error and how to fix the graph.



Lesson 18: Graphs of Rational Functions (Part 2)

Cool Down: Publishing a Paperback, Revisited

The average cost for printing x copies of a self-published paperback book with Company A is $c(x) = \frac{120+4x}{x}$. The average cost for printing x copies of a paperback book with Company B is $d(x) = \frac{25+10x}{2x}$.

1. Which company would you recommend to an author who wants to print 100 books? Explain your reasoning.
2. Which company would you recommend to an author who thinks their book will be a best seller and needs to print thousands of books? How could you rewrite the equations to make the choice clearer?

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Unit 3: Complex Numbers and Rational Exponents		
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit
In this unit, students use what they know about exponents and radicals to extend exponent rules to include rational exponents (for example, $5^{\frac{1}{3}} = \sqrt[3]{5}$), solve various equations involving squares and square roots, develop the concept of complex numbers by defining a new number i whose square is -1, and use complex numbers to find solutions to quadratic equations. The first set of lessons in the unit provides an opportunity for students to review what they know about exponent rules and radicals, and extend those rules to make sense of expressions with rational exponents. In the next set of lessons, students connect the $\sqrt{}$ and $\sqrt[3]{}$ symbols with solutions to quadratic and cubic equations. The symbol $\sqrt{-1}$ is quickly renamed i, and students find that negative real numbers also have two square roots, one on the positive imaginary axis, and one on the negative imaginary axis. In the final few lessons, students use what they have learned about square roots and complex numbers to solve quadratic equations that have complex solutions.	Lesson 5: Negative Rational Exponents Cool Down: Switch It 1. Write $7^{-\frac{2}{3}}$ without exponents. 2. Write $\sqrt[4]{11^5}$ without radicals. Lesson 7: Inequivalent Equations Cool Down: Can You Square It? Find the solution(s) to each of these equations, or explain why there is no solution. 1. $\sqrt{x+2} = 5$ 2. $\sqrt{y-8} = -1$ Lesson 10: A New Kind of Number Cool Down: What is Real? What is Imaginary? In your own words, explain what you know about a number that satisfies the equation $x^2 = -1$.	HSA-CED.A HSA-REI.A.1 HSA-REI.A.2 HSA-REI.B.4 HSA-REI.B.4.a HSA-REI.B.4.b HSA-REI.D.11 HSG-GMD.A.3 HSG-MG.A HSN-CN.A.1 HSN-CN.A.2 HSN-CN.C.7 HSN-Q.A HSN-RN.A.1 HSN-RN.A.2

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	Lesson 12: Arithmetic with Complex Numbers Cool Down: Add, Subtract, Multiply 1. $k = 3 - 4i$ and $m = -2 + 9i$. Write each expression in the form $a + bi$, where a and b are real numbers: a. $k + m$ b. $k - m$ 2. Write $-(3i)^3$ in the form $a + bi$, where a and b are real numbers. Lesson 17: Completing the Square and Complex Solutions Cool Down: Make One Write a quadratic equation with solutions that are not real numbers. Solve your equation.	
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Unit 4: Exponential Functions and Equations		
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit
This unit begins by students recalling that an exponential function involves a change by equal factors over equal intervals and can be expressed as $f(x) = a \cdot b^x$, where a is the initial value of the function (the value when x is 0), and b is the growth factor. The next few lessons extend students' ability to write, interpret, and compare exponential functions to include all real number inputs. In the second half of the unit, students learn that logarithms are a way to express the exponent that makes an exponential equation true. Next, students encounter the constant e. They learn that it is irrational, its value is approximately 2.7, and it is used in many exponential functions that model real-life situations with a continuous growth rate. The last few lessons expose students to logarithmic functions in base 2 and base 10. Students analyze the graphs, interpret them in context, and use them to answer questions about real-life situations such as population growth, acidity of substances, and intensity of earthquakes. Logarithmic functions are not studied in depth in this course.	Lesson 4: Representing Functions at Rational Inputs Cool Down: Blog Subscribers At the beginning of the year, a blogger has 150 subscribers. Since then, the number of subscribers to her blog has been doubling every 6 months, thanks to some successful appearances on television. - By what factor is the number of subscribers increasing every month? - Select all equations that represent the number of subscribers, S, in terms of m months since the beginning of the year (when she had 150 subscribers). $S = 150 \cdot 2^m$ $S = 150 \cdot m^2$ $S = 150 \cdot 2^{\frac{m}{6}}$ $S = 150 \cdot \left(\frac{2}{6}\right)^m$ $S = 150 \cdot \left(2^{\frac{1}{6}}\right)^m$ Lesson 8: Unknown Exponents Cool Down: Video Viewers On the day a video was posted online, 5 people watched the video. The next day the number of viewers had doubled. Assume the number of viewers continues to double each day. - On which day will 640 people see the video? Explain or show your reasoning. - What strategy would you use to find the first day when more than 20,000 people will see the video (if the trend continues)?	HSA-SSE.A.1.b HSA-SSE.B.3 HSA-SSE.B.3.c HSF-BF.A.1 HSF-BF.A.1.a HSF-IF.A.2 HSF-IF.B HSF-IF.B.4 HSF-IF.C HSF-IF.C.7 HSF-IF.C.7.e HSF-IF.C.8.b HSF-LE.A HSF-LE.A.1.a HSF-LE.A.1.b HSF-LE.A.1.c HSF-LE.A.2 HSF-LE.A.4 HSF-LE.B.5 HSN-Q.A HSN-RN.A.1

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Lesson 9: What is a Logarithm?

Cool Down: Explaining Logarithm to a Friend

- What values could replace the “?” in these equations to make them true?
 - $\log_{10} 10 = ?$
 - $\log_{10} 10,000 = ?$
 - $\log_{10} ? = 7$
- How would you explain to a friend who doesn’t know about logarithms what the equation $\log_{10} x = y$ says about x and y ?

Lesson 13: Exponential Functions with Base e

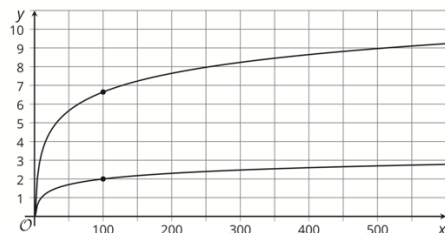
Cool Down: Two Population Predictions

The functions $a(t) = 8.75 \cdot (1 + 0.01)^t$ and $b(t) = 8.75 \cdot e^{(0.01t)}$ each model the population of a city, in thousands, t years after 2010. Describe how each model predicts that the population in the town will grow.

Lesson 17: Logarithmic Functions

Cool Down: Which Graph Represents Which Function?

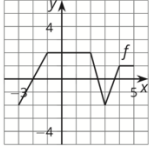
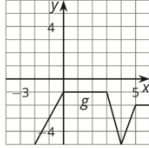
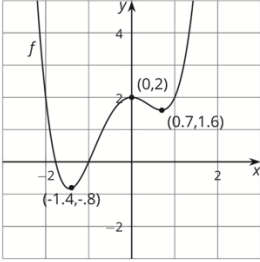
Here are graphs representing two functions defined by $s(x) = \log_{10} x$ and $r(x) = \log_2 x$.



- Explain how you can use the points on the graphs to determine which graph represents which function. Label the graph with the function that it represents.
- Use the graph to estimate $s(250)$ and $r(250)$.

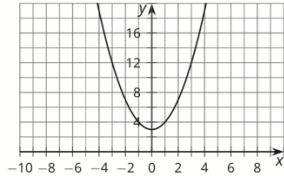
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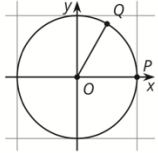
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Unit 5: Transformations of Functions			
Unit Overview	Model Assignments		California State Content Standards Covered in this Unit
The purpose of this unit is for students to consider functions as a whole and understand how they can be transformed to fit the needs of a situation, which is an aspect of modeling with mathematics (MP4). The unit begins with students informally describing transformations of graphs, eliciting their prior knowledge and establishing language that will be refined throughout the unit. The first types of transformations students consider are vertical and horizontal translations. Next, students investigate how transformations such as reflections across the horizontal and vertical axes are defined using function notation and make connections to the same topic from geometry. From translations and reflections, students move on to explore the effect of multiplying the output or input of a function by a scale factor.	Lesson 3: More Movement Cool Down: Translate This - Describe the transformation that gives you the graph of g starting with the graph of f. - Express g in terms of f.   Lesson 4: Reflecting Functions Cool Down: Two Reflections - Graph the function g given by $g(x) = -f(x)$. - Graph the function h given by $h(x) = f(-x)$. Draw each graph in a different color and label each graph with the name of the function. 		HSF-BF.A.1 HSF-BF.A.1.b HSF-BF.B.3 HSF-IF.B.4 HSF-IF.C HSF-IF.C.8 HSF-LE.B HSN-Q.A.2 HSN-Q.A.3 HSS-ID.B.6 HSS-ID.B.6.a

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	Lesson 9: Scaling the Inputs Cool Down: The Right Scale Let f be a function where $f(x) = x^2 + 3$.  Priya wants to transform the graph of f by stretching it horizontally by a factor of 5. She says that an equation for her new function p in terms of f is $p(x) = f(5x)$ which means $p(x) = (5x)^2 + 3$. Is Priya's equation correct? Explain or show your reasoning.	
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Unit 6: Trigonometric Functions		
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit
In this unit, students are introduced to trigonometric functions. The unit opens with a study of the motion of clock hands. Using the structure of the coordinate plane with the clock centered at the origin allows students to quantify the motion of the end of a clock hand as time passes. The ability to find the coordinates of a point 1 unit away from the origin using cosine, sine, and an angle leads to the development of the unit circle. Once students have a working understanding of the unit circle and its relationship to trigonometry, they are ready to transition to thinking about cosine and sine as functions. Using the unit circle, students graph cosine and sine and identify common features between the two functions. Next, students apply their previous work with transformations of graphs to trigonometric functions. Finally, students apply trigonometric functions to model different situations.	Lesson 3: The Unit Circle (Part 1) Cool Down: Radian measure  Here is a circle with radius 1 unit. - The arc PQ has a length of $\frac{\pi}{3}$. What is the measure of $\angle POQ$ in radians? - If Q has approximate coordinates $(0.5, 0.87)$, name one other (x, y) coordinate pair that must also be on this circle that has either the same x- or y-coordinate. - Label the point R on the circle so that $\angle POR$ has measure $\frac{\pi}{2}$ radians. Explain how you determined R.	HSF-BF.B.3 HSF-IF.B.4 HSF-IF.C HSF-IF.C.7 HSF-IF.C.7.e HSF-TF.A HSF-TF.A.1 HSF-TF.A.2 HSF-TF.B HSF-TF.B.5 HSF-TF.C HSF-TF.C.8 HSN-Q.A.1

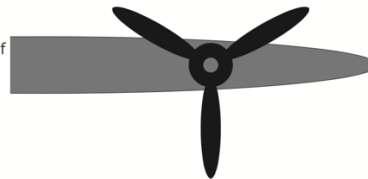
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Lesson 7: Finding Unknown Coordinates on a Circle

Cool Down: An Airplane Propeller

The center of an airplane propeller is 13 feet off the ground and the radius of the propeller is 3 feet. The blades of the propeller are set at $\frac{\pi}{6}$, $\frac{5\pi}{6}$, and $\frac{3\pi}{2}$ radians from 0 radians directly to the right of the center of the propeller.

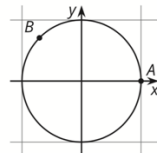


What is the height of the tip of each propeller in this position?

Lesson 11: Extending the Domain of Trigonometric Functions

Cool Down: Turn it Around Again

Point A is at 0 radians with coordinates $(1, 0)$ on the unit circle. Point B is the result of point A rotating $-\frac{5\pi}{4}$ radians. Name two other angles of rotation that take A to B . At least one must be negative. Explain your reasoning.



Lesson 15: Features of Trigonometric Graphs (Part 1)

Cool Down: To the left, to the right

- Write another function that has the same graph as $y = 2 \cos(x) - 1$.
- Describe how the graphs of $y = 2 \cos(x) - 1$ and $y = 2 \cos(2x) - 1$ are alike and how they are different.

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Unit 7: Statistical Inferences		
Unit Overview	Model Assignments	California State Content Standards Covered in this Unit
In this unit, students explore the normal distribution and apply their understanding of the distribution to provide estimates with a margin of error. The unit also examines experimental studies, observational studies, and surveys. The unit begins with an exploration of statistical questions and the type of study that is used to answer different kinds of questions. The unit then transitions to an analysis of the data collected by examining the shapes of distributions and focusing on the normal distribution as a common and standardized shape. The unit concludes with ways to analyze the results from experimental studies. Students ultimately collect data from an experiment involving their heart rates and analyze the data using randomization distributions.	Lesson 1: Being Skeptical Cool Down: A New Show A company that produces television shows is interested in what type of show people would like to watch for a prime time slot (crime drama, animated comedy, or reality contest). 1. Explain why it is better to select people for the survey using a random process rather than selecting people for the survey who say they watch television with their children. 2. The company asks, "Which show would you be most likely to watch during prime time?" ◦ <i>Mr. Winslow</i> ◦ <i>Kibble</i> ◦ <i>Extreme Mountain Hunter</i>: a show in which 20 contestants attempt to climb some of the tallest mountains in the world using only equipment they create from nature Will this question likely produce data that would allow the company to answer the question they are interested in? Explain your reasoning. Lesson 5: Normal Distributions Cool Down: What's Normal? 1. What shape of distribution is best modeled by a normal curve? 2. Two normal distributions have the same mean, but different standard deviations. Describe the differences between how the two distributions will look, or sketch what they might look like. 3. Two normal distributions have the same standard deviation, but different means. Describe the differences between how the two distributions will look, or sketch what they might look like.	HSG-GPE.B.7 HSS-IC.A.1 HSS-IC.A.2 HSS-IC.B.3 HSS-IC.B.4 HSS-IC.B.5 HSS-IC.B.6 HSS-ID.A.1 HSS-ID.A.2 HSS-ID.A.4

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	Lesson 9: Variability in Samples Cool Down: What's Wrong With That? 1. Mai gathers a random sample of 30 students at her school and asks them whether they would be willing to start and end the school day 1 hour later than usual. 27 of the students agree that this would be a good idea. Mai goes to the principal and says, "Exactly 90% of students think it's a good idea to start and end the school day an hour later than usual!" What is wrong with this statement? 2. After collecting more data, Mai reports that the proportion of students who think it's a good idea to change school hours is 90% with a margin of error of 3%. What does this mean? Lesson 14: Using Normal Distributions for Experiment Analysis Cool Down: The Science Experiment Jada and Han are working together on a science experiment. They want to determine whether rechargeable batteries are heavier when they are fully charged than when they are depleted. They collect 12 rechargeable batteries of the same type and connect 6 of them to phones until the charge in each battery runs down. The other 6 batteries are left fully charged. They record the weight of the batteries in each group and find that the difference in mean weights for the groups is 0.19 grams. 1. Jada writes a computer program to recombine all the data into all 924 possible different groupings and finds that 208 of the different groupings have a difference in means of at least 0.19. Is there enough evidence for Jada to conclude that the difference in means is due to the batteries having lost charge? Explain or show your reasoning. 2. Han writes a different computer program to simulate redistributing the data into different groups 500 times and examines the list of the difference of means for each simulation. He finds that the mean of the differences found from the simulation is 0.006 grams and the standard deviation is 0.182 grams. Han then models the simulation differences with a normal distribution and finds that the area under the normal curve greater than 0.19 grams is 0.156 and the area less than -0.19 grams under the normal curve is 0.156. Based on this analysis, is there enough evidence for Han to conclude that the difference in means is due to the batteries having lost charge? Explain or show your reasoning.	
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