The SAT® Suite of Assessments
Math that Matters Most:
Heart of Algebra
Problem Solving and Data Analysis
The SAT® Suite of Assessments, one component of the College Board Readiness and Success System, comprises the PSAT™ 8/9, PSAT™ 10, PSAT/NMSQT®, and SAT®, and focuses on the few, durable skills that evidence shows matter most for college and career success. The tests included in the SAT Suite of Assessments are connected by the same underlying content continuum of knowledge and skills, providing schools with the ability to align vertical teams and create cross subject tasks.

The SAT Suite of Assessments is aligned with classroom instruction. At the College Board, we know that the best way to prepare students for college and career is through excellent instruction aligned with college and career ready content and skills, and we have the opportunity to support excellent instruction by designing assessments that measure the skills that matter most for college and career readiness. We are committed to partnering with teachers and school and district leaders to help students build the necessary skills that will ensure their success at their chosen college, university, or career training program.

The purpose of the Professional Development Modules for Educators is to build a deep understanding of the content and skills assessed on the SAT Suite of Assessments, and to support educators as they identify the natural points of alignment across the SAT Suite, classroom instruction, and curriculum. Each professional development module contains descriptions of the assessment content, sample questions, and suggestions for helping students master content and prepare for the assessments in the SAT Suite. The modules are flexible and are designed for download and presentation in various meetings and professional development sessions, for individual or group use. The presentations can be viewed in one sitting or broken into shorter chunks over time. Each module suggests interactive activities for groups and teams, but the content can also be reviewed by individuals. There is no one right way to engage in this professional development; it is our hope that individuals, schools, and districts will utilize the presentations and handouts in ways that maximize effectiveness in a variety of situations.

What’s in the Modules?
You have accessed Module 4 – Math that Matters Most: Heart of Algebra and Problem Solving and Data Analysis, which examines the content assessed in two sub-scores of the SAT Suite of Assessments. In the module, participants review the test specifications for the Math Test, and they review sample questions from the test. Additional modules include:

- Module 1 – Key Features
- Module 2 – Words in Context and Command of Evidence
- Module 3 – Expression of Ideas and Standard English Conventions
- Module 5 – Math that Matters Most: Passport to Advanced Math and Additional Topics in Math
- Module 6 – Using Scores and Reporting to Inform Instruction
- Module 7 – Connecting History/Social Studies Instruction with the SAT Suite of Assessments
- Module 8 – Connecting Science Instruction with the SAT Suite of Assessments
- Module 9 – The SAT Essay

Each module is independent and can be viewed alone, although we strongly recommend becoming familiar with Module 1 before reviewing any of the other modules.

What’s in this Facilitator Guide?
Each module is accompanied by a Facilitator’s Guide like this, which includes suggested discussion points, pacing guide, handouts and activities. Each Facilitator’s Guide lists the approximate length of time needed for each slide and activity. In addition, the guide suggests section breaks (chapters) to allow for a more succinct, targeted review of the content.

WE WANT TO HEAR ABOUT YOUR EXPERIENCE WITH THE MODULES!
Email SATinstructionalsupport@collegeboard.org and take the Exit Survey to share your feedback. © 2016 The College Board.
What Are the Suggestions for Module Presentations?

1. Review the complete Facilitator’s Guide with Handouts and the PowerPoint presentation to get familiar with the suggested talking points, activities, and handouts in the presentation.

2. Provide a paper or electronic copy of the PowerPoint presentation to all participants for personal review and note-taking.

3. Print or email all handouts at the end of this Facilitator’s Guide for each participant.

4. Review the suggested timing for each slide and activity, and choose activities that fit in the time frame allotted for your meeting.

5. Each module assumes a new group of participants is present. If the participants have engaged in other modules, a facilitator may adjust and remove content that is repetitive.

6. Please follow up each presentation with an email to participants that contains a link to the online exit survey. Your feedback is valuable and will be used to improve the modules!

What Are the Follow-Up Activities?

This professional development is meant to be a starting point. Modules 2 through 9 include suggestions for follow-up activities to continue the learning beyond the presentation. Look for suggestions at the end of each Facilitator’s Guide in Modules 2–9.

If you have questions, comments, or suggestions about the presentations, the materials, or the SAT Suite, please email SATInstructionalsupport@collegeboard.org for personalized attention. We look forward to hearing from you!
# Preparing Your Presentation for the Time Alotted*

<table>
<thead>
<tr>
<th>How Much Time Do You Have?</th>
<th>Use These Slides</th>
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| 30 minutes                 | 1–11, 12–25, 30, 36–38 | 💡 Heart of Algebra Sample Question  
💡 Problem Solving and Data Analysis Sample Question  
💡 Questions for Reflection | 1. SAT Math Test Domains  
2. Instructional Strategies for SAT Math  
3. Sample SAT Math Questions  
4. Sample SAT Math Questions - Answer Explanations  
5. Questions for Reflection |
| 60 minutes                 | 1–30, 32–38 | 💡 SAT Math Test Domains Activity  
💡 Heart of Algebra Sample Question  
💡 Problem Solving and Data Analysis Sample Question  
💡 Sample SAT Math Questions  
💡 Questions for Reflection | 1. SAT Math Test Domains  
2. Instructional Strategies for SAT Math  
3. SAT Math Questions  
4. Sample SAT Math Questions - Answer Explanations  
5. Skill-building Strategies Brainstorming Guide  
6. Questions for Reflection |
| 90 minutes                 | All Slides | All Activities and Questions | All Handouts |

*Please note: The time estimations are approximate and will be influenced by the engagement of participants and the pace of the facilitator.
Welcome to Module 4.
This is the fourth in a series of professional development modules. It is intended to be viewed after Module 1, which is an overview of the SAT. Remind participants that more information is available in other modules at collegereadiness.collegeboard.org.
Suggested Discussion Points/Handouts/Activities

SLIDE 3 | ESTIMATED TIME (IN MINUTES): 1

Read the objectives (purpose) for Module 4.

*Ask participants what they hope to learn from this module.*
Suggested Discussion Points/Handouts/Activities

Module 4 will help us look deeply into two subscores related to the Math Test, Heart of Algebra and Problem Solving and Data Analysis.

To build the connection between the SAT Suite, classroom instruction, and college and career readiness, students and educators receive more scores than ever before. These scores provide detailed information about students’ strengths and areas in which they need to strengthen their skills. Each box on this slide represents a score students receive when they take any assessment in the SAT Suite.

This is an important table for understanding the scores that are generated from the SAT Suite. Direct participants’ attention to the three Test Scores in the middle of the table: Reading, Writing and Language, and Math. These are the tests students take.

Move to the second row, and note the two section scores: Evidence-Based Reading and Writing, and Math. The two section scores are added together for one total score.

This table shows that the Evidence-Based Reading and Writing Section Score comprises both the Reading Test and the Writing and Language Test because they’re in the same column. The Math section score is in the same column as the Math Test, demonstrating that the Math Section Score is derived from the Math Test, but note that the scores are on a different scale.

In the middle, you’ll see that the cross-test scores, Analysis in Science and Analysis in History/Social Studies, are derived from all three tests.

At the bottom of the table are the seven subscores. The three subscores listed below Math are derived from the Math Test. Words in Context and Command of Evidence subscores, are derived from the Reading Test and the Writing and Language Test, and the Expression of Ideas and Standard English Conventions subscores are derived from the Writing and Language Test only.

The optional Essay is not factored in to these scores.
All of the tests in the SAT Suite of Assessments will include the same score categories: total score, section scores, test scores, cross-test scores, and subscores. (Notable exceptions: only the SAT has Essay scores, and the PSAT 8/9 does not have a subscore in Passport to Advanced Math.) In this system, by design, the assessments are created to cover a slightly different range of content complexity that increases from the PSAT 8/9 to PSAT 10 and from the PSAT/NMSQT to the SAT. This increase in content complexity also corresponds to an increase in the difficulty level of each test. As one could easily imagine, the PSAT/NMSQT is more difficult/challenging than the PSAT 8/9, and the SAT is more difficult than the PSAT/NMSQT. To support these differences in test difficulty, and to also support a common metric against which students can be measured over time, the total score, section scores, test scores, and cross-test scores are vertically equated across the SAT, PSAT/NMSQT, PSAT 10, and PSAT 8/9. Vertical equating refers to a statistical procedure whereby tests designed to differ in difficulty are placed on a common metric. This allows the tests to function as a system where student performance over time can consistently be measured against a common metric, allowing us to show growth over time for a student (or at an aggregate).

The min-max scores vary from assessment to assessment to show the difference in complexity of knowledge on the different tests. Theoretically, if a student were to take the PSAT 8/9, PSAT 10, and SAT on the same day, they would score the same on each assessment, but if you scored “perfectly” on all three, you would only get a 720 versus an 800 for Math on the PSAT 8/9 versus the SAT — because the difficulty of questions is that much harder on the SAT.

To see how this plays out across the tests, we have summarized in the graphic on the slide the effect on Section Scores (the 200–800 score for Math and Evidence-Based Reading and Writing that is most commonly referenced in the SAT).
Suggested Discussion Points/Handouts/Activities

SLIDE 6

Move into an overview of the Math Test.
The overall aim of the Math Test is to assess fluency with, understanding of, and ability to apply the mathematical concepts that are most strongly prerequisite for and useful across a wide range of college majors and careers.

The test has a calculator portion and a no-calculator portion. In the calculator portion, students can use their calculators to perform routine computations more efficiently, enabling them to focus on mathematical applications and reasoning. However, the calculator is a tool that students must use strategically, deciding when and how to use it. There are some questions in the calculator portion that can be answered more efficiently without a calculator. In these cases, students who make use of structure or their ability to reason will most likely reach the solution more rapidly than students who use a calculator.

The SAT Math Test has 45 multiple-choice questions and 13 questions that are NOT multiple choice (eight on the calculator portion and five on the no-calculator portion). Students have to grid in their answers rather than select one answer.

On student-produced response questions, students grid in their answers, which often allows for multiple correct responses and solution processes. Such items allow students to freely apply their critical thinking skills when planning and implementing a solution.

The PSAT/NMSQT, PSAT 10, and PSAT 8/9 also have calculator and no-calculator portions, and include multiple-choice and student-produced response questions. They will have fewer questions than the SAT. Slide 10 displays the numbers of questions for the PSAT/NMSQT–PSAT 10 and the PSAT 8/9.
**Suggested Discussion Points/Handouts/Activities**

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The Math Test contains two portions: one in which the student may use a calculator and another in which the student may not. The no-calculator portion allows the assessments in the SAT Suite to assess fluencies valued by postsecondary instructors and includes conceptual questions for which a calculator will not be helpful.

Meanwhile, the calculator portion gives insight into students’ capacity to use appropriate tools strategically. The calculator is a tool that students must use (or not use) judiciously. The calculator portion of the test includes more complex modeling and reasoning questions to allow students to make computations more efficiently. However, this portion also includes questions in which the calculator could be a deterrent to expediency, thus assessing appropriate use of tools. For these types of questions, students who make use of structure or their ability to reason will reach the solution more rapidly than students who get bogged down using a calculator.
Suggested Discussion Points/Handouts/Activities

SLIDE 9  |  ESTIMATED TIME (IN MINUTES):

Student-produced response questions on the SAT Suite measure the complex knowledge and skills that require students to deeply think through the solutions to problems. Set within a range of real-world contexts, these questions require students to make sense of problems and persevere in solving them; make connections between and among the different parts of a stimulus; plan a solution approach, as no scaffolding is provided to suggest a solution strategy; abstract, analyze, and refine an approach as needed; and produce and validate a response. These types of questions require the application of complex cognitive skills.

Responses are gridded in by students, often allowing for multiple correct responses and solution processes. These items allow students to freely apply their critical thinking skills when planning and implementing a solution.
Suggested Discussion Points/Handouts/Activities

There are a total of 58 questions on the SAT Math Test. Other assessments in the SAT Suite have fewer questions.

Subscores: On the SAT, the Heart of Algebra subscore is derived from 19 questions on the Math Test; Problem Solving and Data Analysis subscore is derived from 17 questions; Passport to Advanced Math subscore is derived from 16 questions on the Math Test. The number of questions contributing to each subscore is slightly lower on the PSAT/NMSQT and PSAT 10, as well as on the PSAT 8/9. Numbers are listed on the slide.

On the SAT, eight math questions (14% of total questions) contribute to the Analysis in Science subscore and eight questions (14% of total questions) contribute to the Analysis in History/Social Studies subscore. Seven questions contribute to each cross-test score on the PSAT/NMSQT and PSAT 10; six questions contribute to each cross-test score on the PSAT 8/9.

**NOTE:** Each multiple-choice question will have four answer choices on the SAT Suite. Previously there were five choices.
Suggested Discussion Points/Handouts/Activities

SLIDE 11 | ESTIMATED TIME (IN MINUTES): 1

The **Math Test** requires students to exhibit mathematical practices, such as problem solving and using appropriate tools strategically, on questions focused on the Heart of Algebra, Problem Solving and Data Analysis, and advanced mathematics. Questions in each content area span the full range of difficulty and address relevant practices, fluency, and conceptual understanding. Students are asked to:

› analyze, fluently solve, and create linear equations and inequalities;
› demonstrate reasoning about ratios, rates, and proportional relationships;
› interpret and synthesize data and apply core concepts and methods of statistics in science, social studies, and career-related contexts;
› identify quantitative measures of center, the overall pattern, and any striking deviations from the overall pattern and spread in one or two different data sets, including recognizing the effects of outliers on the measures of center of a data set;
› rewrite expressions, identify equivalent forms of expressions, and understand the purpose of different forms;
› solve quadratic and higher-order equations in one variable and understanding the graphs of quadratic and higher-order functions;
› interpret and build functions.
Suggested Discussion Points/Handouts/Activities

| SLIDE 12 | ESTIMATED TIME (IN MINUTES): 20 MINUTES FOR ACTIVITY |

**Handout:** Math Test Domains

**Activity:** Using the Math Test Domains, organize the large group into smaller groups. Assign each group one Domain. Give the groups 5–7 minutes to review the domain content dimensions and descriptions, then ask one member of each group to share the most important information gleaned from their section. Ask them to predict areas in which students will struggle. Write this information on chart paper if available.

**Outcome:** Participants will have a deeper understanding of the content and skills assessed on the Math Test.
If someone is viewing this module and is not a math teacher, it is important to understand that questions on the Math Test that contribute to the Heart of Algebra subscore and the Problem Solving and Data Analysis subscore also contribute to the Analysis in Science and Analysis in History/Social Studies cross-test scores. Eight questions from the Math Test contribute to each cross-test score on the SAT (seven on the PSAT/NMSQT–PSAT 10, and six on the PSAT 8/9). Those questions have data, tables, charts, and context in the sciences and social studies.

Note that test questions don’t ask students to provide history/social studies or science facts, such as the year the Battle of Hastings was fought or the chemical formula for a particular molecule. Instead, these questions ask students to apply the skills that they have picked up in history, social studies, and science courses to problems in reading, writing, language, and math. On the Math Test, some questions ask them to solve problems grounded in social studies or science contexts. Scores in Analysis in Science and in Analysis in History/Social Studies are drawn from questions on all three of those tests.
Suggested Discussion Points/Handouts/Activities

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Begin discussion of Heart of Algebra.
Algebra is the language of much of high school mathematics, and it is also an important prerequisite for advanced mathematics and postsecondary education in many subjects. Mastering linear equations and functions has clear benefits to students.

The ability to use linear equations to model scenarios and to represent unknown quantities is powerful across the curriculum in the classroom as well as in the workplace.

Linear equations and functions are the bedrock upon which much of advanced mathematics is built. Without a strong foundation in the core of algebra, much of this advanced work remains inaccessible.
Suggested Discussion Points/Handouts/Activities

SLIDE 16  ESTIMATED TIME (IN MINUTES): 1

The SAT Suite of Assessments rewards a stronger command of fewer important topics. Students need to exhibit command of mathematical practices, fluency with mathematical procedures, and conceptual understanding of mathematical ideas. The assessments also provide opportunities for richer applied problems.

» Analyzing and fluently solving equations and systems of equations.
» Creating expressions, equations, and inequalities to represent relationships between quantities and to solve problems.
» Rearranging and interpreting formulas.

Heart of Algebra: Assessed Skills

- Analyzing and fluently solving equations and systems of equations
- Creating expressions, equations, and inequalities to represent relationships between quantities and to solve problems
- Rearranging and interpreting formulas
Suggested Discussion Points/Handouts/Activities

SLIDE 17 | ESTIMATED TIME (IN MINUTES): 3

Handout: Sample SAT Math Questions

All questions in the presentation and two additional questions are in the handout for participants to review and use throughout the presentation.

Activity: Ask a participant to read the problem and give people a couple of minutes to solve it. Ask another participant to talk through the answer explanation (next slide).

Working with linear functions to model phenomena has high relevance for postsecondary study and is a core aspect of a rigorous high school curriculum.

Heart of Algebra (Calculator)

When a scientist dives in salt water to a depth of 9 feet below the surface, the pressure due to the atmosphere and surrounding water is 18.7 pounds per square inch. As the scientist descends, the pressure increases linearly. At a depth of 14 feet, the pressure is 20.9 pounds per square inch. If the pressure increases at a constant rate as the scientist’s depth below the surface increases, which of the following linear models best describes the pressure \( p \) in pounds per square inch at a depth of \( d \) feet below the surface?

- A) \( p = 0.44d + 0.77 \)
- B) \( p = 0.44d + 14.74 \)
- C) \( p = 2.2d - 1.1 \)
- D) \( p = 2.2d - 9.9 \)
All answer explanations are in Sample SAT Math Questions – Answer Explanations handout, to be distributed with slide 28.

**Answer Explanation:** Understanding that the pressure increases 2.2 pounds per square inch every 5 feet deeper the scientist dives, and being able to cast this fact into the language of algebra, will steer students to the correct answer, choice B.

Choice B is correct. To determine the linear model, one can first determine the rate at which the pressure due to the atmosphere and surrounding water is increasing as the depth of the diver increases. Calculating this gives \( \frac{20.9 - 18.7}{14 - 9} = \frac{2.2}{5} \), or 0.44. Then one needs to determine the pressure due to the atmosphere or, in other words, the pressure when the diver is at a depth of 0. Solving the equation \( 18.7 = 0.44(9) + b \) gives \( b = 14.74 \). Therefore, the model that can be used to relate the pressure and the depth is \( p = 0.44d + 14.74 \).

Choice A is not the correct answer. The rate is calculated correctly, but the student may have incorrectly used the ordered pair (18.7, 9) rather than (9, 18.7) to calculate the pressure at a depth of 0 feet.

Choice C is not the correct answer. The rate here is incorrectly calculated by subtracting 20.9 and 18.7 and not dividing by 5. The student then uses the coordinate pair \( d = 9 \) and \( p = 18.7 \) in conjunction with the incorrect slope of 2.2 to write the equation of the linear model.

Choice D is not the correct answer. The rate here is incorrectly calculated by subtracting 20.9 and 18.7 and not dividing by 5. The student then uses the coordinate pair \( d = 14 \) and \( p = 20.9 \) in conjunction with the incorrect slope of 2.2 to write the equation of the linear model.
Begin discussion of Problem Solving and Data Analysis.
## Suggested Discussion Points/Handouts/Activities

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Quantitative reasoning is crucial to success in postsecondary education, career-training programs, and everyday life.

Students are asked to demonstrate their ability to solve real-world problems by analyzing data and using ratios, percentages, and proportional reasoning on the SAT Suite of Assessments.

It also illustrates a feature of the SAT Suite: multipart questions. Asking more than one question about a given scenario allows students to do more sustained thinking and explore situations in greater depth. Students will generally see longer problems in their postsecondary work.

### What Is ‘Problem Solving and Data Analysis?’

- **Quantitative Reasoning**
- **Analysis of Data**
  - Ratios
  - Percentages
  - Proportional reasoning
- **In Problem Solving and Data Analysis, students will encounter an important feature of the SAT Suite of Assessments: multipart questions**
  - Asking more than one question about a given scenario allows students to do more sustained thinking and explore situations in greater depth
  - Students will generally see longer problems in their postsecondary work
Suggested Discussion Points/Handouts/Activities

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This is a summary of the assessed skills in the problem solving and data analysis domain.

» Creating and analyzing relationships using ratios, proportions, percentages, and units.

» Describing relationships shown graphically.

» Summarizing qualitative and quantitative data.
### Suggested Discussion Points/Handouts/Activities

**Activity:** Refer participants to the handout, “Sample SAT Math Questions.” Ask a participant to read the question aloud. Participants discuss question with a partner and ask a volunteer to offer a solution.

The correct answer is B – see next slide for explanation.

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**Problem Solving and Data Analysis: Sample Question (Calculator)**

A typical image taken of the surface of Mars by a camera is 11.2 gigabits in size. A tracking station on Earth can receive data from the spacecraft at a data rate of 3 megabits per second for a maximum of 11 hours each day. If 1 gigabit equals 1,024 megabits, what is the maximum number of typical images that the tracking station could receive from the camera each day?

- A) 3
- B) 10
- C) 56
- D) 144

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Suggested Discussion Points/Handouts/Activities

SLIDE 23

ESTIMATED TIME (IN MINUTES): 2

Ask participants to review this rationale for the answer. Read it to them, or ask a participant to read it.

Answer Explanation: In this problem, students must use the unit rate (data-transmission rate) and the conversion between gigabits and megabits as well as conversions in units of time. Unit analysis is critical to solving the problem correctly, and the problem represents a typical calculation that would be done when working with electronic files and data-transmission rates. A calculator is recommended in solving this problem.

Choice A is not the correct answer. The student may not have synthesized all of the information. This answer may result from multiplying 3 (rate in megabits per second) by 11 (hours receiving) and dividing by 11.2 (size of image in gigabits), neglecting to convert 3 megabits per second into megabits per hour and to utilize the information about 1 gigabit equaling 1,024 megabits.

Choice C is not the correct answer. The student may not have synthesized all of the information. This answer may result from converting the number of gigabits in an image to megabits (11,470), multiplying by the rate of 3 megabits per second (34,410) and then converting 11 hours into minutes (660) instead of seconds.

Choice D is not the correct answer. The student may not have synthesized all of the information. This answer may result from converting 11 hours into seconds (39,600), then dividing the result by 3 gigabits converted into megabits (3,072), and multiplying by the size of one typical image.
When students take any assessment in the SAT Suite, they encounter an assessment that is closely connected to their classroom experience, one that rewards focused work and the development of valuable, durable knowledge, skills, and understandings. The questions and approaches they encounter are more familiar to them because they are modeled on the work of the best classroom teachers.

Students are the priority and the most important thing to do is to focus on the work that takes place in the classroom. The SAT Suite, therefore, is more integrated with classroom instruction than ever before. With its deeper focus on fewer topics and current instructional best practices, the Suite aligns to instruction; it does not present more responsibilities. No one will be “teaching to the test” — instead, the test will reflect good teaching.

Ask the participants: What are some of the research-based best practices in math instruction that you use?
Suggested Discussion Points/Handouts/Activities

SLIDE 25

ESTIMATED TIME (IN MINUTES): 1

These strategies are in the Redesigned SAT Teacher Implementation Guide. These strategies do not apply to any specific mathematical process, but are general ideas to consider when designing specific instructional strategies.

» Ensure that students practice solving multistep problems. The SAT often asks them to solve more than one problem to arrive at the correct answer.

» Separate students into small working groups. Ask them to discuss how to arrive at solutions. When their solutions are incorrect, ask them to discuss how to make corrections. Encourage students to express quantitative relationships in meaningful words and sentences to support their arguments and conjectures.

» Vary the types of problems in homework assignments so that students aren’t always using the same strategy to find solutions. Students benefit from the practice of determining the right mathematical strategy to solve the problems, in addition to solving the problems correctly.

» Assign students math problems or create classroom-based assessments that do not allow the use of a calculator. This practice encourages greater number sense, probes students’ understanding of content on a conceptual level, and aligns to the testing format of the SAT Suite of Assessments.

» Instead of choosing a correct answer from a list of options, ask students to solve problems and enter their answers in grids provided on an answer sheet on your classroom and common assessments.
Suggested Discussion Points/Handouts/Activities

SLIDE 26

ESTIMATED TIME (IN MINUTES): 5

**Activity:** Refer participants to the Sample SAT Math Questions, #3. As they work on the sample questions, encourage them to think about the strategies they use in the classroom to teach skills assessed in these questions.

**Answer Explanation:** Students can approach this problem conceptually or concretely. The core skill being assessed here is the ability to make a connection between the graphical form of a relationship and a numerical description of a key feature.

Choice B is correct. The slope of the line is read from the graph as “down 3, over 2.” Translating the line moves all the points on the line by the same amount. Therefore, the slope does not change and the answer is \(-\frac{3}{2}\).

Choice A is not the correct answer. This value may result from a combination of errors. The student may misunderstand how the negative sign affects the fraction and apply the transformation as \((-3 + 5)\) \((-2 + 7)\).

Choice C is not the correct answer. This value may result from finding the slope of the line and then subtracting 5 from the numerator and 7 from the denominator.

Choice D is not the correct answer. This answer may result from adding \(\frac{5}{7}\) to the slope of the line.
Suggested Discussion Points/Handouts/Activities

SLIDE 27  ESTIMATED TIME (IN MINUTES): 3

This is an example of a Problem Solving and Data Analysis question. Have participants read the table themselves.

Move to the next slide for the question prompt and answer choices.
Suggested Discussion Points/Handouts/Activities

SLIDE 28 | ESTIMATED TIME (IN MINUTES): 3

This is the question associated with the information on the previous slide. After discussing this answer explanation, give participants time to answer the rest of the questions in the handout.

**Answer Explanation:** This question asks students to extrapolate from a random sample to estimate the number of 18- to 34-year-olds who voted for Candidate A: this is done by multiplying the fraction of people in the random sample who voted for Candidate A by the total population of voting 18- to 34-year-olds:

\[
\frac{287}{500} \times 30,329,000 = 17,012,668
\]

approximately 17 million, choice D. Students without a clear grasp of the context and its representation in the table might easily arrive at one of the other answers listed.

Choice A is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the entire population, which is an incorrect application of the information.

Choice B is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the total number of people who voted, which is an incorrect application of the information.

Choice C is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the total number of 18- to 34-year-olds, which is an incorrect application of the information.
Suggested Discussion Points/Handouts/Activities


Activity: Ask pairs of participants to discuss and write the strategies they currently use that support the development of skills related to Heart of Algebra and Problem Solving and Data Analysis, using the sample questions as to guide their discussion. Ask them to consider the areas in which students will struggle as they brainstorm instructional strategies.

Ask pairs to share either one idea or one strategy they currently use. On the Skill-Building Strategies Brainstorming Guide, participants can fill in the lower box with new ideas being shared.

Outcome: Participants will connect the questions and assessed skills with strategies they can use for instruction in the classroom.
Suggested Discussion Points/Handouts/Activities

**Handout:** Instructional Strategies for SAT Math

This slide lists additional skill-building strategies found in the Redesigned SAT Teacher Implementation Guide. Share with participants to add to their Skill-Building Strategies Brainstorm Activity.

1. Provide students with explanations and/or equations that incorrectly describe a graph. Ask students to identify the errors and provide corrections, citing the reasoning behind the change.

2. As students work in small groups to solve problems, facilitate discussions in which they communicate their own thinking and critique the reasoning of others as they work toward a solution. Ask open-ended questions. Direct their attention to real-world situations to provide context for the problem.

3. Students can organize information to present data and answer a question or show a problem solution in multiple ways. Ask students to create pictures, tables, graphs, lists, models, and/or verbal expressions to interpret text and/or data to help them arrive at a solution.

4. Use “Guess and Check” to explore different ways to solve a problem when other strategies for solving are not obvious. Students first guess the solution to a problem, then check that the guess fits the information in the problem and is an accurate solution. They can then work backward to identify proper steps to arrive at the solution.
Suggested Discussion Points/Handouts/Activities

SLIDE 31  ESTIMATED TIME (IN MINUTES):

Introduce Scores and Reporting.
Suggested Discussion Points/Handouts/Activities

On the next two slides, three SAT reports are highlighted. There are several additional reports that are available in the K–12 Assessment Reporting Tool.

Reports from the SAT Suite of Assessments provide several data points that help teachers pinpoint what students need, both individually and in groups, for additional support to become college and career ready. The K–12 Assessment Reporting Tool supports effective decision making with a variety of standard reports that can be configured in multiple ways. The tool generates score reports, benchmark reports, and demographic reports. It also provides Instructional Planning and Question Analysis reports that allow teachers to drill down to the student level and analyze the questions students encountered on the actual assessment, as well as content and skill gaps.

Share information listed about the Student Score Report, Question Analysis Report, and Instructional Planning Report to help participants understand how the reports provide information about a student’s learning in Heart of Algebra and Problem Solving and Data Analysis.

Sample Reports

- Score Report (Statistics for state/district/school)
  - Mean scores and score band distribution
  - Participation rates when available
  - High-level benchmark information, with tie to detailed benchmark reports

- Question Analysis Report
  - Aggregate performance on each question (easy vs. medium vs. hard difficulty) in each test
  - Percent of students who selected each answer for each question
  - Applicable subscore and cross-test score mapped to each question
  - Comparison to parent organization(s) performance
  - Access question details for disclosed form (question stem, stimulus, answer choices and explanations)
Suggested Discussion Points/Handouts/Activities

Ask participants to share one way they might use one of the reports.
Suggested Discussion Points/Handouts/Activities

SLIDE 34  ESTIMATED TIME (IN MINUTES): 1

**Handout:** Follow-Up Activity: Tips for Professional Learning Communities and Vertical Teams

**Follow-Up Activity:** Explain that this is one protocol teams can use to review and analyze SAT reports (or any other data). The guide asks participants to make observations about the data, look for areas of focus, identify skills associated with the areas of focus, review other sources of data for additional information, and devise a plan of action.
Suggested Discussion Points/Handouts/Activities

**SLIDE 35**  
**ESTIMATED TIME (IN MINUTES): 5**

**Handout:** Questions for Reflection

**Activity:** Ask participants to reflect on their teaching and what they’ve learned in the presentation.

Give participants 5 minutes to consider the questions in the self-assessment and write their reflections.

---

**Self Assessment/Reflection**

- How well do I teach students skills related to Heart of Algebra?
- How well do I teach students skills related to Problem Solving and Data Analysis?
- What can I do in my classroom immediately to help students understand what they’ll see on the SAT?
- How can I adjust my assessments to reflect the structure of questions on the SAT?
- What additional resources do I need to gather in order to support students in becoming college and career ready?
- How can I help students keep track of their own progress toward meeting the college and career ready benchmark?
### Suggested Discussion Points/Handouts/Activities

<table>
<thead>
<tr>
<th>SLIDE 36</th>
<th>ESTIMATED TIME (IN MINUTES): 1</th>
</tr>
</thead>
</table>

The *Redesigned SAT Teacher Implementation Guide* can be accessed at collegereadiness.collegeboard.org

This guide was created for teachers and curriculum specialists to generate ideas about integrating SAT practice and skill development into challenging classroom course work through curriculum and instruction. The College Board reached out to K–12 teachers, curriculum specialists, counselors, and administrators throughout the redesign process. Educator feedback is the basis and inspiration for this guide, which covers the “whys” and “hows” of the SAT and its benefits for you and your students.
Suggested Discussion Points/Handouts/Activities

SLIDE 37  ESTIMATED TIME (IN MINUTES): 2

At the heart of this guide are annotated sample SAT Questions, highlighting connections to the instruction and best practices occurring in classrooms like yours. We indicate **Keys to the SAT** (information about test changes), **General Instructional Strategies** for each Test, and **Skill-Building Strategies** linked to specific sample questions from the Reading Test, Writing and Language Test, Math Test, and the optional SAT Essay. In sum, these recommendations are intended to support teachers to enhance instruction that builds skills necessary for college and career success for each student.
Suggested Discussion Points/Handouts/Activities

SLIDE 38  ESTIMATED TIME (IN MINUTES): 1

Inform participants that they can have their questions answered by emailing SATinstructionalsupport@collegeboard.org
# Suggested Discussion Points/Handouts/Activities

| SLIDE 39 | ESTIMATED TIME (IN MINUTES): 2 |

https://www.surveymonkey.com/s/PD_Module_4
### SAT HEART OF ALGEBRA DOMAIN

<table>
<thead>
<tr>
<th>Content Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear equations in one variable</strong></td>
<td>1. Create and use linear equations in one variable to solve problems in a variety of contexts.&lt;br&gt;2. Create a linear equation in one variable, and when in context interpret solutions in terms of the context.&lt;br&gt;3. Solve a linear equation in one variable making strategic use of algebraic structure.&lt;br&gt;4. For a linear equation in one variable,&lt;br&gt;   a. interpret a constant, variable, factor or term in a context;&lt;br&gt;   b. determine the conditions under which the equation has no solution, a unique solution, or infinitely many solutions.&lt;br&gt;5. Fluently solve a linear equation in one variable.</td>
</tr>
<tr>
<td><strong>Linear functions</strong></td>
<td>Algebraically, a linear function can be defined by a linear expression in one variable or by a linear equation in two variables. In the first case, the variable is the input and the value of the expression is the output. In the second case, one of the variables is designated as the input and determines a unique value of the other variable, which is the output.&lt;br&gt;1. Create and use linear functions to solve problems in a variety of contexts.&lt;br&gt;2. Create a linear function to model a relationship between two quantities.&lt;br&gt;3. For a linear function that represents a context&lt;br&gt;   a. interpret the meaning of an input/output pair, constant, variable, factor, or term based on the context, including situations where seeing structure provides an advantage;&lt;br&gt;   b. given an input value, find and/or interpret the output value using the given representation;&lt;br&gt;   c. given an output value, find and/or interpret the input value using the given representation, if it exists.&lt;br&gt;4. Make connections between verbal, tabular, algebraic, and graphical representations of a linear function, by&lt;br&gt;   a. deriving one representation from the other;&lt;br&gt;   b. identifying features of one representation given another representation;&lt;br&gt;   c. determining how a graph is affected by a change to its equation.&lt;br&gt;5. Write the rule for a linear function given two input/output pairs or one input/output pair and the rate of change.</td>
</tr>
<tr>
<td><strong>Linear equations in two variables</strong></td>
<td>A linear equation in two variables can be used to represent a constraint or condition on two variable quantities in situations where neither of the variables is regarded as an input or an output. A linear equation can also be used to represent a straight line in the coordinate plane.&lt;br&gt;1. Create and use a linear equation in two variables to solve problems in a variety of contexts.&lt;br&gt;2. Create a linear equation in two variables to model a constraint or condition on two quantities.&lt;br&gt;3. For a linear equation in two variables that represents a context&lt;br&gt;   a. interpret a solution, constant, variable, factor, or term based on the context, including situations where seeing structure provides an advantage;&lt;br&gt;   b. given a value of one quantity in the relationship, find a value of the other, if it exists.&lt;br&gt;4. Make connections between tabular, algebraic, and graphical representations of a linear equation in two variables by&lt;br&gt;   a. deriving one representation from the other;&lt;br&gt;   b. identifying features of one representation given the other representation;&lt;br&gt;   c. determining how a graph is affected by a change to its equation.&lt;br&gt;5. Write an equation for a line given two points on the line, one point and the slope of the line, or one point and a parallel or perpendicular line.</td>
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### SAT HEART OF ALGEBRA DOMAIN

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</tr>
<tr>
<td></td>
<td>1. Create and use a linear equation in two variables to solve problems in a variety of contexts.</td>
</tr>
<tr>
<td></td>
<td>2. Create a linear equation in two variables to model a constraint or condition on two quantities.</td>
</tr>
<tr>
<td></td>
<td>3. For a linear equation in two variables that represents a context</td>
</tr>
<tr>
<td></td>
<td>a. interpret a solution, constant, variable, factor, or term based on the context, including situations where seeing structure provides an advantage;</td>
</tr>
<tr>
<td></td>
<td>b. given a value of one quantity in the relationship, find a value of the other, if it exists.</td>
</tr>
<tr>
<td></td>
<td>4. Make connections between tabular, algebraic, and graphical representations of a linear equation in two variables by</td>
</tr>
<tr>
<td></td>
<td>a. deriving one representation from the other;</td>
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<tr>
<td></td>
<td>b. identifying features of one representation given the other representation;</td>
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<td>c. determining how a graph is affected by a change to its equation.</td>
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<td>5. Write an equation for a line given two points on the line, one point and the slope of the line, or one point and a parallel or perpendicular line.</td>
</tr>
<tr>
<td>Systems of two linear equations in two variables</td>
<td>1. Create and use a system of two linear equations in two variables to solve problems in a variety of contexts.</td>
</tr>
<tr>
<td></td>
<td>2. Create a system of linear equations in two variables, and when in context interpret solutions in terms of the context.</td>
</tr>
<tr>
<td></td>
<td>3. Make connections between tabular, algebraic, and graphical representations of the system by deriving one representation from the other.</td>
</tr>
<tr>
<td></td>
<td>4. Solve a system of two linear equations in two variables making strategic use of algebraic structure.</td>
</tr>
<tr>
<td></td>
<td>5. For a system of linear equations in two variables,</td>
</tr>
<tr>
<td></td>
<td>a. interpret a solution, constant, variable, factor, or term based on the context, including situations where seeing structure provides an advantage;</td>
</tr>
<tr>
<td></td>
<td>b. determine the conditions under which the system has no solution, a unique solution, or infinitely many solutions.</td>
</tr>
<tr>
<td></td>
<td>6. Fluently solve a system of linear equations in two variables.</td>
</tr>
<tr>
<td>Linear inequalities in one or two variables</td>
<td>1. Create and use linear inequalities in one or two variables to solve problems in a variety of contexts.</td>
</tr>
<tr>
<td></td>
<td>2. Create linear inequalities in one or two variables, and when in context interpret the solutions in terms of the context.</td>
</tr>
<tr>
<td></td>
<td>3. For linear inequalities in one or two variables, interpret a constant, variable, factor, or term, including situations where seeing structure provides an advantage.</td>
</tr>
<tr>
<td></td>
<td>4. Make connections between tabular, algebraic, and graphical representations of linear inequalities in one or two variables by deriving one from the other.</td>
</tr>
<tr>
<td></td>
<td>5. Given a linear inequality or system of linear inequalities, interpret a point in the solution set.</td>
</tr>
</tbody>
</table>
### SAT Problem Solving and Data Analysis Domain

<table>
<thead>
<tr>
<th>Content Dimension</th>
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</tr>
</thead>
</table>
| Ratios, rates, proportional relationships, and units | Items will require students to solve problems by using a proportional relationship between quantities, calculating or using a ratio or rate, and/or using units, derived units, and unit conversion.  
1. Apply proportional relationships, ratios, rates and units in a wide variety of contexts. Examples include but are not limited to scale drawings and problems in the natural and social sciences.  
2. Solve problems involving  
   a. derived units including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer)  
   b. unit conversion including currency exchange and conversion between different measurement systems.  
3. Understand and use the fact that when two quantities are in a proportional relationship, if one changes by a scale factor, then the other also changes by the same scale factor. |
| Percentages |  
1. Use percentages to solve problems in a variety of contexts. Examples include, but are not limited to, discounts, interest, taxes, tips, and percent increases and decreases for many different quantities.  
2. Understand and use the relationship between percent change and growth factor (5% and 1.05, for example); include percentages greater than or equal to 100%. |
| One variable data: Distributions and measures of center and spread |  
1. Choose an appropriate graphical representation for a given data set.  
2. Interpret information from a given representation of data in context.  
3. Analyze and interpret numerical data distributions represented with frequency tables, histograms, dot plots, and boxplots.  
4. For quantitative variables, calculate, compare, and interpret mean, median, and range. Interpret (but don’t calculate) standard deviation.  
5. Compare distributions using measures of center and spread, including distributions with different means and the same standard deviations and ones with the same mean and different standard deviations.  
6. Understand and describe the effect of outliers on mean and median.  
7. Given an appropriate data set, calculate the mean. |
| Two-variable data: Models and scatterplots |  
1. Using a model that fits the data in a scatterplot, compare values predicted by the model to values given in the data set.  
2. Interpret the slope and intercepts of the line of best fit in context.  
3. Given a relationship between two quantities, read and interpret graphs and tables modeling the relationship.  
4. Analyze and interpret data represented in a scatterplot or line graph; fit linear, quadratic, and exponential models.  
5. Select a graph that represents a context, identify a value on a graph, or interpret information on the graph.  
6. For a given function type (linear, quadratic, exponential), choose the function of that type that best fits given data.  
7. Compare linear and exponential growth.  
8. Estimate the line of best fit for a given scatterplot; use the line to make predictions. |
| Probability and conditional probability | Use one- and two-way tables, tree diagrams, area models, and other representations to find relative frequency, probabilities, and conditional probabilities.  
1. Compute and interpret probability and conditional probability in simple contexts.  
2. Understand formulas for probability, and conditional probability in terms of frequency. |
### SAT PROBLEM SOLVING AND DATA ANALYSIS DOMAIN

<table>
<thead>
<tr>
<th>Content Dimension</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Inference from sample statistics and margin of error** | 1. Use sample mean and sample proportion to estimate population mean and population proportion. Utilize, but do not calculate, margin of error.  
2. Interpret margin of error; understand that a larger sample size generally leads to a smaller margin of error. |
| **Evaluating statistical claims: Observational studies and experiments** | 1. With random samples, describe which population the results can be extended to.  
2. Given a description of a study with or without random assignment, determine whether there is evidence for a causal relationship.  
3. Understand why random assignment provides evidence for a causal relationship.  
4. Understand why a result can be extended only to the population from which the sample was selected. |
Heart of Algebra
Calculator

1. When a scientist dives in salt water to a depth of 9 feet below the surface, the pressure due to the atmosphere and surrounding water is 18.7 pounds per square inch. As the scientist descends, the pressure increases linearly. At a depth of 14 feet, the pressure is 20.9 pounds per square inch. If the pressure increases at a constant rate as the scientist’s depth below the surface increases, which of the following linear models best describes the pressure $p$ in pounds per square inch at a depth of $d$ feet below the surface?

A) $p = 0.44d + 0.77$

B) $p = 0.44d + 14.74$

C) $p = 2.2d - 1.1$

D) $p = 2.2d - 9.9$

Problem Solving and Data Analysis
Calculator

2. A typical image taken of the surface of Mars by a camera is 11.2 gigabits in size. A tracking station on Earth can receive data from the spacecraft at a data rate of 3 megabits per second for a maximum of 11 hours each day. If 1 gigabit equals 1,024 megabits, what is the maximum number of typical images that the tracking station could receive from the camera each day?

A) 3

B) 10

C) 56

D) 144

Heart of Algebra
No-Calculator

Line $l$ is graphed in the $xy$-plane below.
3. If line \( l \) is translated up 5 units and right 7 units, then what is the slope of the new line?

A) \( \frac{2}{5} \)
B) \( \frac{3}{2} \)
C) \( \frac{8}{9} \)
D) \( \frac{11}{14} \)

Questions 4 and 5 refer to the following information.

A survey was conducted among a randomly chosen sample of U.S. citizens about U.S. voter participation in the November 2012 presidential election. The table below displays a summary of the survey results.

**Reported Voting by Age (in thousands)**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Voted</th>
<th>Did Not Vote</th>
<th>No Response</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>18- to 34-year-olds</td>
<td>30,329</td>
<td>23,211</td>
<td>9,468</td>
<td>63,008</td>
</tr>
<tr>
<td>35- to 54-year-olds</td>
<td>47,085</td>
<td>17,721</td>
<td>9,476</td>
<td>74,282</td>
</tr>
<tr>
<td>55- to 74-year-olds</td>
<td>43,075</td>
<td>10,092</td>
<td>6,831</td>
<td>59,998</td>
</tr>
<tr>
<td>People 75 years old and over</td>
<td>12,459</td>
<td>3,508</td>
<td>1,827</td>
<td>17,794</td>
</tr>
<tr>
<td>Total</td>
<td>132,948</td>
<td>54,532</td>
<td>27,602</td>
<td>215,082</td>
</tr>
</tbody>
</table>

**Problem Solving and Data Analysis**

Calculator

4. Of the 18- to 34-year-olds who reported voting, 500 people were selected at random to do a follow-up survey where they were asked which candidate they voted for. There were 287 people in this follow-up survey sample who said they voted for Candidate A, and the other 213 people voted for someone else. Using the data from both the follow-up survey and the initial survey, which of the following is most likely to be an accurate statement?

A) About 123 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

B) About 76 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

C) About 36 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

D) About 17 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.
Problem Solving and Data Analysis
Calculator

5. According to the table, for which age group did the greatest percentage of people report that they had voted?
   A) 18- to 34-year-olds
   B) 35- to 54-year-olds
   C) 55- to 74-year-olds
   D) People 75 years old and over

Heart of Algebra
Calculator

6. The toll rates for crossing a bridge are $6.50 for a car and $10 for a truck. During a two-hour period, a total of 187 cars and trucks crossed the bridge, and the total collected in tolls was $1,338. Solving which of the following systems of equations yields the number of cars, $x$, and the number of trucks, $y$, that crossed the bridge during the two hours?
   A) $x + y = 1,338$
      $6.5x + 10y = 187$
   B) $x + y = 187$
      $6.5x + 10y = \frac{1,338}{2}$
   C) $x + y = 187$
      $6.5x + 10y = 1,338$
   D) $x + y = 187$
      $6.5 + 10y = 1,338x$
1. When a scientist dives in salt water to a depth of 9 feet below the surface, the pressure due to the atmosphere and surrounding water is 18.7 pounds per square inch. As the scientist descends, the pressure increases linearly. At a depth of 14 feet, the pressure is 20.9 pounds per square inch. If the pressure increases at a constant rate as the scientist's depth below the surface increases, which of the following linear models best describes the pressure $p$ in pounds per square inch at a depth of $d$ feet below the surface?

A) $p = 0.44d + 0.77$
B) $p = 0.44d + 14.74$
C) $p = 2.2d - 1.1$
D) $p = 2.2d - 9.9$

In approaching this problem, students must determine the relationship between the two variables described within the text: the depth and the pressure.

Choice B is correct. To determine the linear model, one can first determine the rate at which the pressure due to the atmosphere and surrounding water is increasing as the depth of the diver increases.

Calculating this gives $\frac{(20.9 - 18.7)}{(14 - 9)} = \frac{2.2}{5} = 0.44$. Then one needs to determine the pressure due to the atmosphere or, in other words, the pressure when the diver is at a depth of 0. Solving the equation $18.7 = 0.44(9) + d$ gives $d = 14.74$.

Therefore, the model that can be used to relate the pressure and the depth is $p = 0.44d + 14.74$.

Choice A is not the correct answer. The rate is calculated correctly, but the student may have incorrectly used the ordered pair $(18.7, 9)$ rather than $(9, 18.7)$ to calculate the pressure at a depth of 0 feet.

Choice C is not the correct answer. The rate here is incorrectly calculated by subtracting 20.9 and 18.7 and not dividing by 5. The student then uses the coordinate pair $d = 9$ and $p = 18.7$ in conjunction with the incorrect slope of 2.2 to write the equation of the linear model.

Choice D is not the correct answer. The rate here is incorrectly calculated by subtracting 20.9 and 18.7 and not dividing by 5. The student then uses the coordinate pair $d = 14$ and $p = 20.9$ in conjunction with the incorrect slope of 2.2 to write the equation of the linear model.
**CONTENT:** Problem Solving and Data Analysis  
**CALCULATOR USAGE:** Calculator  
**KEY:** B

2. A typical image taken of the surface of Mars by a camera is 11.2 gigabits in size. A tracking station on Earth can receive data from the spacecraft at a data rate of 3 megabits per second for a maximum of 11 hours each day. If 1 gigabit equals 1,024 megabits, what is the maximum number of typical images that the tracking station could receive from the camera each day?

   A) 3  
   B) 10  
   C) 56  
   D) 144

In this problem, students must use the unit rate (data-transmission rate) and the conversion between gigabits and megabits as well as conversions in units of time. Unit analysis is critical to solving the problem correctly, and the problem represents a typical calculation that would be done when working with electronic files and data-transmission rates. A calculator is recommended in solving this problem.

Choice B is correct. The tracking station can receive \(118,800\) megabits each day, which is about \(116\) gigabits each day. If each image is 11.2 gigabits, then the number of images that can be received each day is \(\frac{116}{1.024} = 10.4\).

Since the question asks for the maximum number of typical images, rounding the answer down to 10 is appropriate because the tracking station will not receive a complete 11th image in one day.

Choice A is not the correct answer. The student may not have synthesized all of the information. This answer may result from multiplying 3 (rate in megabits per second) by 11 (hours receiving) and dividing by 11.2 (size of image in gigabits), neglecting to convert 3 megabits per second into megabits per hour and to utilize the information about 1 gigabit equaling 1,024 megabits.

Choice C is not the correct answer. The student may not have synthesized all of the information. This answer may result from converting the number of gigabits in an image to megabits (11,470), multiplying by the rate of 3 megabits per second (34,410) and then converting 11 hours into minutes (660) instead of seconds.

Choice D is not the correct answer. The student may not have synthesized all of the information. This answer may result from converting 11 hours into seconds (39,600), then dividing the result by 3 gigabits converted into megabits (3,072), and multiplying by the size of one typical image.
3. If line $l$ is translated up 5 units and right 7 units, then what is the slope of the new line?

A) $\frac{-2}{5}$  
B) $\frac{-3}{2}$  
C) $\frac{-8}{9}$  
D) $\frac{-11}{14}$

Students can approach this problem conceptually or concretely. The core skill being assessed here is the ability to make a connection between the graphical form of a relationship and a numerical description of a key feature.

Choice B is correct. The slope of the line is read from the graph as “down 3, over 2.” Translating the line moves all the points on the line by the same amount. Therefore, the slope does not change and the answer is $\left(\frac{3}{2}\right)$.

Choice A is not the correct answer. This value may result from a combination of errors. The student may misunderstand how the negative sign affects the fraction and apply the transformation as $\left(\frac{-3+5}{-2+7}\right)$.

Choice C is not the correct answer. This value may result from finding the slope of the line and then subtracting 5 from the numerator and 7 from the denominator.

Choice D is not the correct answer. This answer may result from adding $\frac{5}{7}$ to the slope of the line.
Questions 4 and 5 refer to the following information.

A survey was conducted among a randomly chosen sample of U.S. citizens about U.S. voter participation in the November 2012 presidential election. The table below displays a summary of the survey results.

**Reported Voting by Age (in thousands)**

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**CONTENT:** Problem Solving and Data Analysis  
**CALCULATOR USAGE:** Calculator  
**KEY:** D

4. Of the 18- to 34-year-olds who reported voting, 500 people were selected at random to do a follow-up survey where they were asked which candidate they voted for. There were 287 people in this follow-up survey sample who said they voted for Candidate A, and the other 213 people voted for someone else. Using the data from both the follow-up survey and the initial survey, which of the following is most likely to be an accurate statement?

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B) About 76 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

C) About 36 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

D) About 17 million people 18 to 34 years old would report voting for Candidate A in the November 2012 presidential election.

The second question asks students to extrapolate from a random sample to estimate the number of 18- to 34-year-olds who voted for Candidate A: this is done by multiplying the fraction of people in the random sample who voted for Candidate A by the total population of voting 18- to 34-year-olds: \( \frac{287}{500} \times 30,329,000 = \) approximately 17 million, choice D. Students without a clear grasp of the context and its representation in the table might easily arrive at one of the other answers listed.

Choice A is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the entire population, which is an incorrect application of the information.
Choice B is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the total number of people who voted, which is an incorrect application of the information.

Choice C is not the correct answer. The student may not have multiplied the fraction of the sample by the correct subgroup of people (18- to 34-year-olds who voted). This answer may result from multiplying the fraction by the total number of 18- to 34-year-olds, which is an incorrect application of the information.

<table>
<thead>
<tr>
<th>CONTENT: Problem Solving and Data Analysis</th>
<th>CALCULATOR USAGE: Calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEY: C</td>
<td></td>
</tr>
</tbody>
</table>

5. According to the table, for which age group did the greatest percentage of people report that they had voted?

A) 18- to 34-year-olds
B) 35- to 54-year-olds
C) 55- to 74-year-olds
D) People 75 years old and over

To succeed on these questions, students must conceptualize the context and retrieve relevant information from the table, next manipulating it to form or compare relevant quantities. The first question asks students to select the relevant information from the table to compute the percentage of self-reported voters for each age group and then compare the percentages to identify the largest one, choice C. Of the 55- to 74-year-old group's total population (59,998,000), 43,075,000 reported that they had voted, which represents 71.8% and is the highest percentage of reported voters from among the four age groups.

Choice A is not the correct answer. The question is asking for the age group with the largest percentage of self-reported voters. This answer reflects the age group with the smallest percentage of self-reported voters. This group’s percentage of self-reported voters is 48.1%, or 30,329, which is less than that of the 55- to 74-year-old group.

Choice B is not the correct answer. The question is asking for the age group with the largest percentage of self-reported voters. This answer reflects the age group with the largest number of self-reported voters, not the largest percentage. This group’s percentage of self-reported voters is 63.4%, or 47,085, which is less than that of the 55- to 74-year-old group.

Choice D is not the correct answer. The question is asking for the age group with the largest percentage of self-reported voters. This answer reflects the age group with the smallest number of self-reported voters, not the largest percentage. This group’s percentage of self-reported voters is 70.0%, or 12,459, which is less than that of the 55- to 74-year-old group.
6. The toll rates for crossing a bridge are $6.50 for a car and $10 for a truck. During a two-hour period, a total of 187 cars and trucks crossed the bridge, and the total collected in tolls was $1,338. Solving which of the following systems of equations yields the number of cars, \( x \), and the number of trucks, \( y \), that crossed the bridge during the two hours?

A) \[ x + y = 1,338 \]
   \[ 6.5x + 10y = 187 \]

B) \[ x + y = 187 \]
   \[ 6.5x + 10y = \frac{1,338}{2} \]

C) \[ x + y = 187 \]
   \[ 6.5x + 10y = 1,338 \]

D) \[ x + y = 187 \]
   \[ 6.5x + 10y = 1,338 \times 2 \]

This question assesses student's ability to create a system of linear equations that represents a real-world situation. Students will have to make sense of the situation presented, choose and define two variables to use, and set up the equations based on the relationships from the information given.

Choice C is correct. If \( x \) is the number of cars that crossed the bridge during the two hours and \( y \) is the number of trucks that crossed the bridge during the two hours, then \( x + y \) represents the total number of cars and trucks that crossed the bridge during the two hours and \( 6.5x + 10y \) represents the total amount collected in tolls in the two hours. Therefore, the correct system of equations is \( x + y = 187 \) and \( 6.5x + 10y = 1,338 \).

Choice A is not the correct answer. The student may have mismatched the symbolic expressions for total cars and trucks and total tolls collected with the two numerical values given. The expression \( x + y \) represents the total number of cars and trucks that crossed the bridge, which is 187.

Choice B is not the correct answer. The student may have attempted to use the information that the counts of cars, trucks, and tolls were taken over a period of two hours, but this information is not needed in setting up the correct system of equations. The expression \( 6.5x + 10y \) represents the total amount of tolls collected, which is $1,338, not $\frac{1,338}{2}$.

Choice D is not the correct answer. The student may have attempted to use the information that the counts of cars, trucks, and tolls were taken over a period of two hours, but this information is not needed in setting up the correct system of equations. The expression \( 6.5x + 10y \) represents the total amount of tolls collected, which is $1,338, not $1,338 \times 2$. 
» Provide students with explanations and/or equations that incorrectly describe a graph. Ask students to identify the errors and provide corrections, citing the reasoning behind the change.

» Students can organize information to present data and answer a question or show a problem solution in multiple ways. Ask students to create pictures, tables, graphs, lists, models, and/or verbal expressions to interpret text and/or data to help them arrive at a solution.

» Ask students to solve problems that require multiple steps to arrive at the solution.

» As students work in small groups to solve problems, facilitate discussions in which they communicate their own thinking and critique the reasoning of others as they work toward a solution. Ask open-ended questions. Direct their attention to real-world situations to provide context for the problem.

» Help students strengthen their skills in problem solving and data analysis by reading and understanding graphs in many contexts. Ask them to find a chart/graph/table from a periodical and write a series of questions about the graphic to be discussed in class. Challenge them to dig deep into the data and the purpose of the graphic, then ask meaningful questions about it. Ask them to present purposefully incorrect interpretations and ask the class to correct their analyses.

» The Math Test emphasizes students’ ability to apply math to solve problems in rich and varied contexts, and features items that require problem solving and data analysis to solve problems in science, social studies, and career-related contexts. Students must see how the math problems they solve are generated from questions in science, social studies, economics, psychology, health, and other career content areas. Give them many opportunities to practice in all of their classes.

» Use “Guess and Check” to explore different ways to solve a problem when other strategies for solving are not obvious. Students first guess the solution to a problem, then check that the guess fits the information in the problem and is an accurate solution. They can then work backward to identify proper steps to arrive at the solution.

» Assign math problems for students to solve without the use of a calculator. Assign problems for which the calculator is actually a deterrent to expedience and give students the choice whether to utilize the calculator. Discuss how to solve both ways, and which method is more advantageous.
<table>
<thead>
<tr>
<th>HEART OF ALGEBRA AND PROBLEM SOLVING AND DATA ANALYSIS</th>
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</thead>
<tbody>
<tr>
<td>What strategies am I currently using in the classroom to teach Heart of Algebra and Problem Solving and Data Analysis? What are students doing in my classroom to develop these skills?</td>
</tr>
<tr>
<td>What strategies are being shared that I might use in lesson planning for my students?</td>
</tr>
</tbody>
</table>

**SKILL-BUILDING STRATEGIES BRAINSTORM ACTIVITY**
FOLLOW-UP ACTIVITY – TIPS FOR PROFESSIONAL LEARNING COMMUNITIES/VERTICAL TEAMS

Protocols for analyzing data can provide guidance and focus for Professional Learning Communities as they review and discuss data and reports.

1. Review your data. These data may include SAT results on the Score Report, Question Analysis Report, Instructional Planning Report, or other reports from the K–12 Assessment Reporting Tool. These reports can be reviewed independently, together, or in combination with local assessment data. Ask each person in the group to make an observation about the data. Consider the following questions for guidance:
   a. What scores are higher/lower than average?
   b. What scores are higher/lower than in previous years?
   c. What scores are higher/lower than expected?
   d. Which questions were answered correctly more often than average? Less often?

2. Examine all of the observations of the group. Select one or two findings from the observations to analyze and discuss further. Determine whether the group discussion should be focused on gaps, strengths, or both. To help select an area of focus, the group can consider:
   a. Are the scores on one subscore exceptionally high or low?
   b. Are there high/low scores on several questions related to the same content or skill?
   c. Do several questions with high/low scores ask students to engage in the same tasks (e.g., are the questions all no-calculator questions or are they all student-produced response questions)?

3. Identify content and skills associated with the area of focus; how are the content and skills included in your curriculum/lesson plans?
   a. Is the skill listed as an objective in lesson plans? Is it practiced frequently?
   b. Is the skill explicitly assessed? Is it assessed differently on different tests?
   c. Does the curriculum provide sufficient attention to the skill?

4. Review other sources of data, such as class and state assessments, to look for evidence of students' performance on this skill/topic.

5. Develop an action plan for addressing the area of focus:
   a. Set a goal for improvement, including a time frame for measuring progress.
   b. Determine how you’ll measure success.
   c. Design specific steps for addressing the issue:
      i. Add a unit to the curriculum?
ii. Include specific lessons in current units?

iii. Observe lessons in other classrooms to expand repertoire of instructional strategies and incorporate a variety of strategies more frequently?

iv. Add formative assessment, collaborative learning, or other student engagement activities?

d. Assess students and measure progress at regular intervals.

e. Discuss results and celebrate successes.
<table>
<thead>
<tr>
<th>PROFESSIONAL LEARNING COMMUNITY DATA ANALYSIS</th>
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</thead>
<tbody>
<tr>
<td>Review the data and make observations.</td>
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</tr>
<tr>
<td>Identify content/skills associated with the area(s) of focus.</td>
</tr>
<tr>
<td>Review other sources of data for additional information.</td>
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<tr>
<td>Develop the action plan.</td>
</tr>
<tr>
<td>Goal:</td>
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<td>Measure of Success:</td>
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<tr>
<td>Steps:</td>
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<tr>
<td>When you’ll measure:</td>
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</table>
### QUESTIONS FOR REFLECTION

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>How well do you teach skills related to Heart of Algebra?</td>
</tr>
<tr>
<td>How well do you teach skills related to Problem Solving and Data Analysis?</td>
</tr>
<tr>
<td>What can you do in your classroom immediately to help students understand what they’ll see on the SAT?</td>
</tr>
<tr>
<td>What long-term adjustments can you make to support students in developing their mastery of Heart of Algebra and Problem Solving and Data Analysis?</td>
</tr>
<tr>
<td>What additional resources do you need to gather in order to support students in becoming college and career ready?</td>
</tr>
<tr>
<td>How can you help students keep track of their own progress toward meeting the college and career readiness benchmarks?</td>
</tr>
</tbody>
</table>
FOLLOW-UP ACTIVITIES: SAT MATH TEST SPECIFICATIONS

Curriculum Mapping
1. Gather curriculum maps for math courses.
2. Referencing the SAT Math Test Domains handout (pp. 44–47), identify where each content and skill is taught.
3. Consider and discuss other places in the curriculum where each content and skill can be reinforced.
4. Review common assessments and ensure each content and skill is assessed and student progress is measured.

Assessment Study Groups
1. Form Assessment Study Groups to review SAT Test Questions with the SAT Test Specifications.
2. Go to collegereadiness.collegeboard.org or Khanacademy.org/sat to find four (4) full-length SAT practice forms.
3. Use the SAT Math Test Domains handout (pp. 44–47) to compare the assessed content and skills with the questions on the test forms. Identify the types of questions used to assess the content and skills in the test specifications.
4. Gather question stems from various content areas and practice writing test questions similar to those used on the SAT practice forms.