SAT

SAT Analysis in Science

Item Sampler

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Sample Analysis in Science Items: SAT Reading and Writing

1.

On the basis of extensive calculations and models, astronomers in the 1990s predicted that the collision of two neutron stars or a neutron star and a black hole could release a massive burst of gamma rays in an event called a kilonova. This _____ was confirmed with observations in 2017.

Which choice completes the text with the most logical and precise word or phrase?

A) theory

B) evidence

C) constant

D) experiment

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Craft and Structure	Words in Context	A

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Identifying hypotheses and other forms of scientific claims	SEP8: Obtaining, Evaluating, and Communicating Information	Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

2.

The majority of plastics today wind up in landfills or are, at best, recycled into materials that have a very limited range of applications. To address this problem, chemist Guoliang Liu and colleagues designed a reactor that melts polyethylene and polypropylene—two widely used plastics—into a wax. The wax can then be transformed into a surfactant (<u>a chemical compound usable as a detergent</u>). With this promising new method, plastic waste could be turned into a range of useful cleaning products.

Which choice best states the function of the underlined portion of the text?

A) It clarifies the meaning of a scientific term.

B) It describes an environmental concern.

C) It explains the significance of a scientific discovery.

D) It identifies a result that confused the team.

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Craft and Structure	Text Structure and Purpose	A

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Understanding findings gathered from experiments and observational studies	SEP8: Obtaining, Evaluating, and Communicating Information	Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

3.

Text 1

Little is known about how plate tectonics—wherein slabs of Earth's crust move over, under, away from, and against one another—began. Some researchers contend that tectonic movements began around 3 billion years ago, often noting that computer models of Earth's mantle temperature at the time indicate that the mantle would have been sufficiently molten to enable the plates to move.

Text 2

Ultimately, any plausible claim about the inception of tectonic movement must rest on empirical evidence from the geological record. Researcher Wriju Chowdhury and his team analyzed the geochemistry of zircon crystals to gain insight into the chemical composition of the magma from which the crystals formed and, based on the data, compellingly argue that plate tectonics may have been occurring as early as 4.2 billion years ago.

Based on the texts, how would the author of Text 2 most likely respond to what "some researchers contend" as described in Text 1?

A) By suggesting that the temperature of Earth's mantle 3 billion years ago was likely insufficient to allow for the level of tectonic movement predicted by computer models

B) By distinguishing between computer models of Earth's mantle temperature that reliably predict the onset of plate tectonics and those that do not

C) By indicating that computer models of Earth's mantle temperature are still being improved such that new models tend to be much more reliable than their predecessors

D) By asserting that a more definitive form of evidence than the computer models suggests a different timeline for the onset of plate tectonics on Earth

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Craft and Structure	Cross-Text Connections	D

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Comparing scientific viewpoints (e.g., determining what one scientist or team would most likely say in response to the findings of a different scientist or team)	SEP7: Engaging in Argument from Evidence	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.

4.

In 2018, scientists discovered an immense aggregation of *Muusoctopus robustus* (pearl octopuses) along a hydrothermal vent 3,200 meters beneath the ocean's surface. Water temperatures at this site—named the Octopus Garden—climb as high as 11°C, much warmer than the ambient 1.6°C typical at this depth. Based on observations made over three years, scientists concluded that temperatures at the site likely confer reproductive benefits and that the site is used exclusively for reproduction—6,000 *M. robustus* adults, hatchlings, and eggs were observed at the garden, but no juveniles were present.

Which statement about *M. robustus* and the Octopus Garden is best supported by the text?

A) *M. robustus* leave the Octopus Garden upon reaching an intermediary stage of development.

B) The *M. robustus* population at the Octopus Garden remains stable despite variations in water temperature.

C) *M. robustus* nests in the Octopus Garden contain on average fewer but larger eggs than nests at similar ocean depths.

D) The Octopus Garden provides an ideal feeding ground for *M. robustus* hatchlings.

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Information and Ideas	Central Ideas and Details	A

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Assessing the scientific and practical implications of research findings	SEP6: Constructing Explanations and Designing Solutions	Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

5.

Narwhals are shy whales that live in the remote Arctic Ocean. Some of them have a long tusk, like a unicorn horn, with sensitive nerves. Narwhals are known for this tusk, but many actually don't have one and its purpose is unknown. One group of scientists came up with a possible purpose in 2014. The scientists suggested that the tusk may help narwhals determine when water around them is likely to start freezing and become dangerous for them. Marine biologist Kristin Laidre disagrees with that idea, though. She reasons that if the narwhal's tusk serves such an important purpose, then it's most likely that _____

Which choice most logically completes the text?

A)   some narwhals would seek a new habitat.

B)   fewer marine animals would also have tusks.

C)   more narwhals would have a tusk.

D)   narwhals would become less shy over time.

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Information and Ideas	Inferences	C

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Tracing aspects of scientific reasoning (e.g., understanding the reason a given study was conducted, determining the logical consequences of particular findings in relation to a hypothesis)	SEP6: Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

6.

To address the susceptibility of materials used in components of high-performance machinery, such as aircraft engines, to creep (deformation that is induced by persistent mechanical stress and that often occurs at elevated temperatures), materials researchers have developed silicon carbide (SiC) fibers for producing aerospace composites. Testing the thermomechanical properties of several commercially available SiC fibers, Ramakrishna T. Bhatt et al. found that in comparison with two polymer-derived SiC fibers, a nitrogen-treated SiC fiber exhibited a lower minimum creep rate, a measure of the rate at which a stress-exposed material deforms at a constant temperature and uniaxial load. The finding suggests that _____

Which choice most logically completes the text?

A) unlike the two polymer-derived SiC fibers, the nitrogen-treated SiC fiber can substantially inhibit creep, provided that temperatures and loads are consistent.

B) the two polymer-derived SiC fibers likely hold similar potential for reducing the creep resistance of materials exposed to stress and elevated temperatures, thus prolonging the life span of aerospace machinery.

C) composites based on the two polymer-derived SiC fibers have chemical properties that may improve the mechanical and thermal stability of aerospace equipment to a greater extent than do composites based on the nitrogen-treated SiC fiber.

D) aerospace composites containing the nitrogen-treated SiC fiber may have the ability to withstand mechanical stress for a longer period of time than can aerospace composites containing either of the two polymer-derived SiC fibers.

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Information and Ideas	Inferences	D

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Understanding findings gathered from experiments and observational studies	SEP6: Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

7.

Early Earth is thought to have been characterized by a stagnant lid tectonic regime, in which the upper lithosphere (the outer rocky layer) was essentially immobile and there was no interaction between the lithosphere and the underlying mantle. Researchers investigated the timing of the transition from a stagnant lid regime to a tectonic plate regime, in which the lithosphere is fractured into dynamic plates that in turn allow lithospheric and mantle material to mix. Examining chemical data from lithospheric and mantle-derived rocks ranging from 285 million to 3.8 billion years old, the researchers dated the transition to 3.2 billion years ago.

Which finding, if true, would most directly support the researchers' conclusion?

A) Among rocks known to be older than 3.2 billion years, significantly more are mantle derived than lithospheric, but the opposite is true for the rocks younger than 3.2 billion years.

B) Mantle-derived rocks older than 3.2 billion years show significantly more compositional diversity than lithospheric rocks older than 3.2 billion years do.

C) There is a positive correlation between the age of lithospheric rocks and their chemical similarity to mantle-derived rocks, and that correlation increases significantly in strength at around 3.2 billion years old.

D) Mantle-derived rocks younger than 3.2 billion years contain some material that is not found in older mantle-derived rocks but is found in older and contemporaneous lithospheric rocks.

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Information and Ideas	Command of Evidence	D

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Using experimental and observational data to evaluate hypotheses (e.g., determining whether data collected support or refute a given hypothesis)	SEP 7: Engaging in Argument from Evidence	Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Sample Analysis in Science Items: SAT Math

1.

The scatterplot shows the temperature, in degrees Fahrenheit (°F), and the distance above sea level, in feet, measured at 6 locations on Mount Jefferson. A line of best fit is also shown.
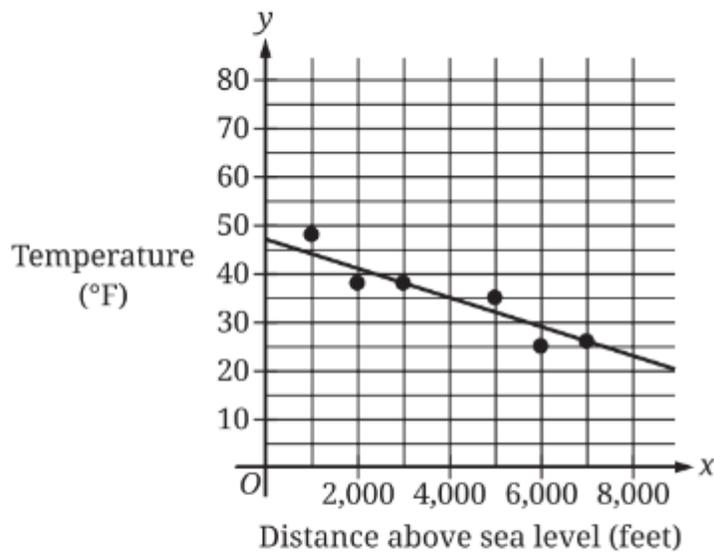
At a distance of 4,000 feet above sea level, what is the temperature, in °F, predicted by the line of best fit?

A) 47

B) 35

C) 25

D) 0

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	B

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits, slope, intercept, and correlation coefficient for data) to scientific and engineering questions and problems, using digital tools when feasible.

2.

The bar graph summarizes the charge, in kilowatt-hours (kWh), a battery received each day for 15 days.
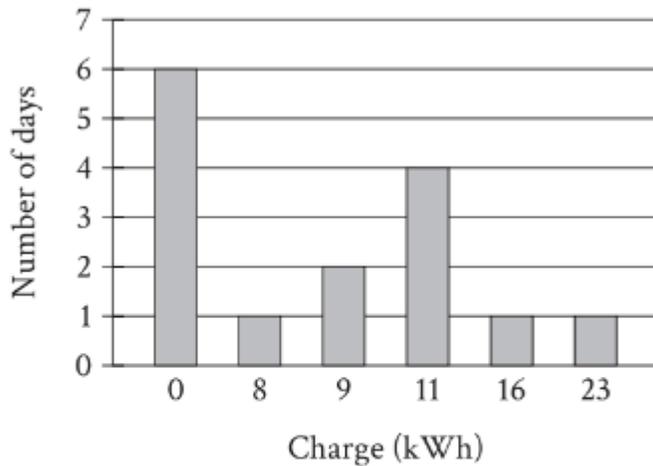
For how many of these 15 days did the battery receive a charge of 0 kWh?

A) 0

B) 1

C) 4

D) 6

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	One-variable data: Distributions and measures of center and spread	D

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

3.

The function $f(t) = 40,000(2)^{\frac{t}{790}}$ gives the number

of bacteria in a population t minutes after an initial

observation. How much time, in minutes, does it

take for the number of bacteria in the population to

double?

A) 2
B) 790
C) 1,580
D) 40,000

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Advanced Math	Nonlinear Functions	B

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

4.

During a study, the temperature, in degrees Celsius (°C), of the air in a chamber was recorded to the nearest integer at certain times. The scatterplot shows the recorded temperature y, in °C, of the air in the chamber x minutes after the start of the study.
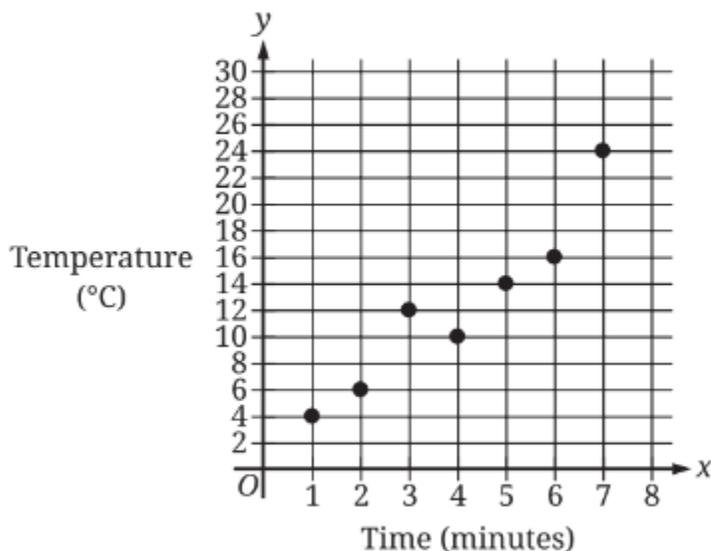

What was the average rate of change, in °C per minute, of the recorded temperature of the air in the chamber from $x = 5$ to $x = 7$?

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	5

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

5.

The number of raccoons in a 131-square-mile area is estimated to be 2,358. What is the estimated population density, in raccoons per square mile, of this area?

A) 18

B) 131

C) 149

D) 2,376

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	Ratios, rates, proportional relationships, and units	A

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

6.

In the given scatterplot, a line of best fit for the data is shown.
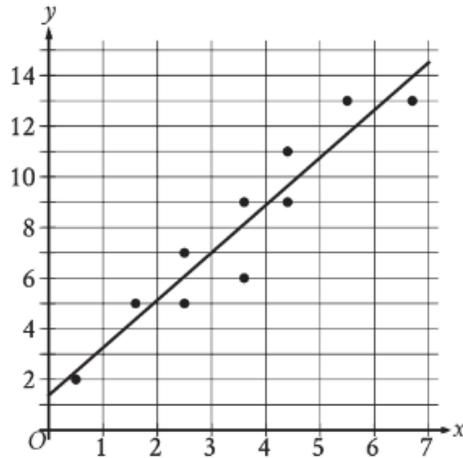
Which of the following is closest to the slope of the line of best fit shown?

A) 0

B) $\dfrac{1}{2}$

C) 1

D) 2

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	D

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits, slope, intercept, and correlation coefficient for data) to scientific and engineering questions and problems, using digital tools when feasible.

7.

$$h(t) = -16t^2 + b$$

The function h estimates an object's height, in feet, above the ground t seconds after the object is dropped, where b is a constant. The function estimates that the object is 3,364 feet above the ground when it is dropped at $t = 0$. Approximately how many seconds after being dropped does the function estimate the object will hit the ground?

A) 7.25

B) 14.50

C) 105.13

D) 210.25

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Advanced Math	Nonlinear functions	B

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

8.

The speed of a vehicle is increasing at a rate of 7.3 meters per second squared. What is this rate, in **miles per minute squared**, rounded to the nearest tenth? (Use 1 mile = 1,609 meters.)

A) 0.3

B) 16.3

C) 195.8

D) 220.4

SAT Content Domain	SAT Skill/Knowledge Element	Best Answer
Problem-Solving and Data Analysis	Ratios, rates, proportional relationships, and units	B

SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Analysis in Science Item Sampler Summary Tables

Table 1. SAT Reading and Writing Items

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
1	Craft and Structure	Words in Context	Identifying hypotheses and other forms of scientific claim	SEP8: Obtaining, Evaluating, and Communicating Information	Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).
2	Craft and Structure	Text Structure and Purpose	Understanding findings gathered from experiments and observational studies	SEP8: Obtaining, Evaluating, and Communicating Information	Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
3	Craft and Structure	Cross-Text Connections	Comparing scientific viewpoints (e.g., determining what one scientist or team would most likely say in response to the findings of a different scientist or team)	SEP7: Engaging in Argument from Evidence	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.
4	Information and Ideas	Central Ideas and Details	Assessing the scientific and practical implications of research findings	SEP6: Constructing Explanations and Designing Solutions	Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.
5	Information and Ideas	Inferences	Tracing aspects of scientific reasoning (e.g., understanding the reason a given study was conducted, determining the logical consequences of particular findings in relation to a hypothesis)	SEP6: Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
6	Information and Ideas	Inferences	Understanding findings gathered from experiments and observational studies	SEP6: Constructing Explanations and Designing Solutions	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
7	Information and Ideas	Command of Evidence	Using experimental and observational data to evaluate hypotheses (e.g., determining whether data collected support or refute a given hypothesis)	SEP 7: Engaging in Argument from Evidence	Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Table 2. SAT Math Items

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
1	Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits, slope, intercept, and correlation coefficient for data) to scientific and engineering questions and problems, using digital tools when feasible.
2	Problem-Solving and Data Analysis	One-variable data: Distributions and measures of center and spread	Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
3	Advanced Math	Nonlinear Functions	Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
4	Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
5	Problem-Solving and Data Analysis	Ratios, rates, proportional relationships, and units	Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).
6	Problem-Solving and Data Analysis	Two-variable data: Models and scatterplots	Locating and analyzing relevant experimental and observational data represented in words as well as in informational graphics	SEP4: Analyzing and Interpreting Data	Apply concepts of statistics and probability (including determining function fits, slope, intercept, and correlation coefficient for data) to scientific and engineering questions and problems, using digital tools when feasible.

Item Number	SAT Content Domain	SAT Skill/ Knowledge Element	SAT Analysis in Science Skill	Related NGSS Practice	Related NGSS Skill Statement
7	Advanced Math	Nonlinear functions	Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply techniques of algebra and functions to represent and solve scientific and engineering problems.
8	Problem-Solving and Data Analysis	Ratios, rates, proportional relationships, and units	Creating and using algebraic equations, functions, and inequalities to model relationships and solve problems in scientific contexts	SEP5: Using Mathematics and Computational Thinking	Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).