

SAT Math Toolkit
Problem Solving & Data Analysis – Rates, Ratios, and Unit Rates
PSDA.RRU

Average SAT Frequency: 5.8

SAT Test Specifications

- PSDA.RRU.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.
- PSDA.RRU.2.a Solve problems involving derived units, including those that arise from products (e.g., kilowatt-hours) and quotients (e.g., population per square kilometer)
- PSDA.RRU.2.b Solve problems involving unit conversion, including currency exchange and conversion between different measurement systems.
- PSDA.RRU.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.

CCSS Best Bridge

- 4.MD.2 Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
- 6.EE.2 Apply and extend previous understandings of arithmetic to algebraic expressions. Write, read, and evaluate expressions in which letters stand for numbers.
- 6.RP.3 Understand ratio concepts and use ratio reasoning to solve problems. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
- 7.EE.4 Solve real-life and mathematical problems using numerical and algebraic expressions and equations. Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.
- 7.RP.2 Analyze proportional relationships and use them to solve real-world and mathematical problems. Recognize and represent proportional relationships between quantities.
- 7.RP.3 Analyze proportional relationships and use them to solve real-world and mathematical problems. Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
- 8.G.9 Solve real-world and mathematical problems involving volume of cylinders, cones and spheres. Know the formulas for the volume of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
- 8.SP.1 Investigate patterns of association in bivariate data. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
- A-REI.2 Understand solving equations as a process of reasoning and explain the reasoning. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

- F-IF.7 Analyze functions using different representations. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- F-LE.2 Construct and compare linear, quadratic, and exponential models and solve problems. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- N-Q.1 Reason quantitatively and use units to solve problems. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Student Actions

- Students create multiple ratios from a context in which more than two quantities are given.
- Students use ratio language to describe a relationship between two quantities.
- Students solve problems by analyzing different unit rates given in tables, equations, and graphs.
- Students solve problems by comparing different ratios.
- Given a ratio, students precisely identify the associated rate. They identify the unit rate and the rate unit.
- Students solve unit rate problems including those involving unit pricing and constant speed.
- Students use rates between measurements to convert measurement in one unit to measurement in another unit.
- Students compute unit rates associated with ratios of fractions.
- Students solve multi-step ratio problems including fractional markdowns, markups, commissions, fees, etc.
- Students use equations and graphs to represent proportional relationships arising from ratios and rates involving fractions.
- Students indirectly solve for measurements involving right triangles using scale factors, ratios between similar figures, and ratios within similar figures.
- Students use trigonometric ratios to solve applied problems.

Academic Skills and Suggestions for Improvement (from Skills Insight) with Examples of Student Actions
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	6-14 (120-280)	15-19 (300-380)	20-24 (400-480)	25-29 (500-580)	30-34 (600-680)	35-40 (700-800)
<p>Academic Skills</p>	<p>n/a</p>	<ul style="list-style-type: none"> • Create a rate based on a context and use the rate to solve a simple problem. • Use common English conversions to find an equivalent rate. 	<ul style="list-style-type: none"> • Identify a ratio or a fraction based on a context. • Use proportions to compare quantities and find missing values. • Solve problems that involve converting units within the same measurement system. 	<ul style="list-style-type: none"> • Identify, interpret, and use ratios, proportions, and rates, expressing them in equivalent forms, to solve real-world problems. • Convert units one or more times to solve a contextual problem. • Estimate/find a proportion, rate, percent, or fraction from a graph or a table. • Solve problems involving derived units or unit conversion between different measurement systems. 	<ul style="list-style-type: none"> • Solve mixture problems, using proportional reasoning. • Interpret and compare unit rates, ratios, or rates of change that are based in a context. • Solve multistep problems involving rates, proportions, unit conversion, and percentages, and density. 	<ul style="list-style-type: none"> • Convert units and create and use ratios, proportions, percents, rates, and unit rates to solve problems.
<p>Suggestions for Improvement</p>	<ul style="list-style-type: none"> • When reading a real-world, multistep problem, identify when a rate will help solve the problem. Then, create and use the rate to solve the problem. • When converting units, use a proportion or multiply by a form of one to find the equivalent rate. 	<ul style="list-style-type: none"> • When reading a real-world, multistep problem, identify when a ratio will help solve the problem. Then, create and use the ratio to solve the problem. 	<ul style="list-style-type: none"> • Use the information in a real-world problem to determine whether ratios, proportions, rates and/ or unit rates are needed to solve the problem. Multistep problems often require use of more than one of these concepts to answer the question. • Identify key information and variables from a scenario in order to set up and calculate ratios, proportions, rates, and unit rates. Pay particular attention to units. • When reading a real-world problem, identify key information in the problem to determine a unit rate and then use the unit rate to answer the question. Pay particular attention to the units in rates and variables. Solving multistep problems may require single or multiple unit conversions. • Apply proportional relationships in a real-world problem. 	<ul style="list-style-type: none"> • Use proportional relationships to increase or decrease quantities by a scale factor. • Solve contextualized problems by developing and using ratios, proportions and/or proportional reasoning, rates, and unit rates. Identify the important quantities and the units provided when reading real-world, multistep problems. Make connections between the measurements or units given in order to determine percent increase or decrease. Notice when the base of the percentage changes and think through how this affects the situation. 	<ul style="list-style-type: none"> • Use conversion factors between complex real-world scenarios such as those involving currency rates, temperatures, volume/area/length, weight, speed, and time. 	<p>n/a</p>
<p>Examples of Student Actions</p>	<ul style="list-style-type: none"> • Students create multiple ratios from a context in which more than two quantities are given. • Students use ratio language to describe a relationship between two quantities. • Students solve problems by analyzing different unit rates given in tables, equations, and graphs. 	<ul style="list-style-type: none"> • Students solve problems by comparing different ratios. • Given a ratio, students precisely identify the associated rate. They identify the unit rate and the rate unit. • Students solve unit rate problems including those involving unit pricing and constant speed. 	<ul style="list-style-type: none"> • Students use rates between measurements to convert measurement in one unit to measurement in another unit. • Students compute unit rates associated with ratios of fractions. 	<ul style="list-style-type: none"> • Students will solve multi-step ratio problems including fractional markdows, markups, commissions, fees, etc. 	<ul style="list-style-type: none"> • Students use equations and graphs to represent proportional relationships arising from ratios and rates involving fractions. • Students write and use algebraic expressions and equations to solve word problems related to mixtures. 	<ul style="list-style-type: none"> • Students indirectly solve for measurements involving right triangles using scale factors, ratios between similar figures, and ratios within similar figures.

Academic Approach®

PSDA.RRU SAT Exemplars

SAT TH01

Easy - Calculator

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Joules and British thermal units are both units of energy. They are directly proportional such that 5 British thermal units are equal to 5,275 joules. How much energy, in British thermal units, is equal to 13,082 joules?

Medium - Calculator

3

A bike track is 3.1 miles long. If Julie biked 30 laps around the track last week, which of the following is closest to the number of kilometers she biked last week? (1 kilometer is approximately 0.62 miles.)

- A) 58
- B) 93
- C) 120
- D) 150

Hard - Calculator

Mr. Taylor's Workstation

Component	Average daily energy consumption (kilowatt hours)	Average power usage (watts)
Desktop tower	2.25	150
Monitor 1	0.45	30
Monitor 2	0.375	25

Mr. Taylor uses his computer workstation every workday. The table above shows the average daily energy consumption, in kilowatt hours, and the average power use, in watts, of each component of his workstation under normal operating conditions.

Energy consumption is the product of power usage and time, and 1 kilowatt hour = 1,000 watt hour.

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If Mr. Taylor uses his workstation for 5 days each week and each kilowatt hour of electricity costs \$0.13, what would be the weekly electricity cost of Mr. Taylor's workstation under normal operating conditions, in dollars? (Note: Disregard the \$ sign when gridding your answer.)

E: 12.4

M: D

H: 2

Rates, Ratios, and Proportions

Solve multi-step ratio problems and use equations to represent relationships arising from ratios and rates.

Name: _____

Period: _____

Date: _____

1. Lisa's family is going to visit relatives for the holidays. They are planning to buy a car before they leave. Car dealerships buy a car from the manufacturer at a certain price and then mark up the consumer purchase price. If Lisa paid \$24,000 for the car and it was $\frac{6}{5}$ of the dealership purchase price, what did the dealer pay?
2. Lisa's family begins their drive a few days after purchasing their car. They drive 72 miles on the first day, and they used 3.2 gallons of gas. The next day, Lisa's family has 850 miles remaining on their road trip. The gas tank in their car can hold 15 gallons, and the gas mileage is the same as their first day. They filled the gas tank at the start of the road trip and plan to only stop to fill up when their gas tank nears empty. How many additional refueling stops will Lisa's family need to make to get to their destination?
3. Lisa's dad, Mark, drove for $\frac{1}{2}$ of the entire trip. Lisa's brother, Justin, drove for $\frac{1}{4}$ of the trip. Lisa and her mom, Kerry, divided the rest of the driving evenly between them. How many miles did Lisa drive? Round to the nearest whole mile.
4. Mark drives at an average of 50 mph. Justin averages 60 mph. Lisa and her mom both average 55 mph. How long does the trip take?
5. Because of snowy weather, it takes Lisa's family $\frac{5}{3}$ the amount of time it took to get to the holiday destination to get home. What was their average speed in miles per hour on the way home? Round to the nearest full mile/hour.