

1. Calculator

A student is doing a scale drawing of a woolly mammoth on a piece of poster board for her presentation on the last ice age. She was surprised to find that the woolly mammoth, reaching a height of only about 10 feet, 6 inches, was actually smaller than today's African elephant. Even more surprising is the fact that the woolly mammoth's tusks averaged 11.5 feet in length. If the student draws the mammoth 14 inches tall on her poster, approximately how many inches long should she make the tusks?

- (A) 12.78
 (B) 15.0
 (C) 15.33
 (D) 16.1

Difficulty: Medium

Category: Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

Strategic Advice: Pay careful attention to the units. You need to convert all of the dimensions to inches and then find the scale factor.

Getting to the Answer: There are 12 inches in one foot, so the height of the woolly mammoth was $10 \times 12 = 120 + 6 = 126$ inches. The tusk length was 11.5 feet, or $11.5 \times 12 = 138$ inches. The student plans to draw the mammoth 14 inches tall, so find the scale factor of the two heights by writing them as a fraction $\frac{14}{126} = \frac{1}{9}$. This means the scale factor is $\frac{1}{9}$.

Multiply this by the length of the real mammoth's tusks to find the scaled length: $138 \times \frac{1}{9} = \frac{138}{9} = 15\frac{1}{3}$. This means the student should make the tusks 15.33 inches long.

2. Calculator

In an effort to decrease reliance on fossil fuels, some energy producers have started to utilize renewable resources. One such power plant uses solar panels to create solar energy during the day and then shifts to natural gas at night or when there is cloud cover. One particularly bright morning, the company increases the amount of its power typically generated by solar panels by 60%. During a cloudy spell, it decreases the amount by 30%, and then when the sun comes back out, it increases the amount again by 75% before shutting the panels down for the night. What is the net percent increase of this company's reliance on solar panels during that day?

- (A) 75%
 (B) 96%
 (C) 105%
 (D) 165%

Difficulty: Hard

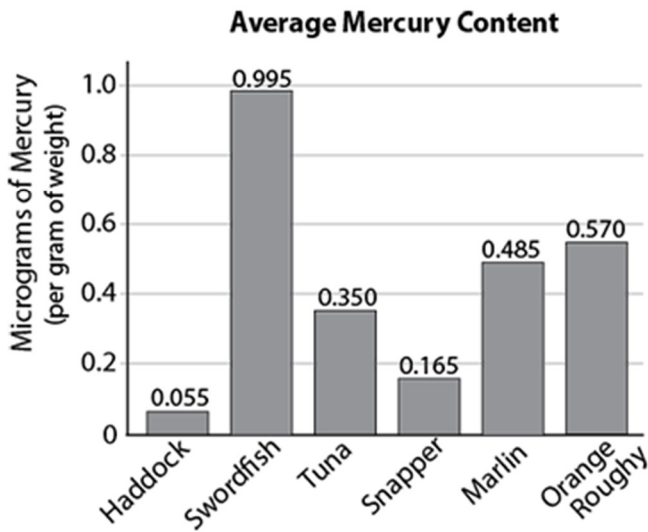
Category: Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

Strategic Advice: Start by determining what the question is asking. You need to find the net percent change in the power reliance on solar panels over the course of a day. To do this, you need to know how much the solar panels were relied on at the beginning of the day and how much at the end (neither of which is given).

Getting to the Answer: Whenever you aren't given a concrete starting point, pick one yourself. The best number to use when dealing with percents is 100. First, find how much power was derived from the solar panels after the first increase: $100 \times 0.6 = 60$. So, the company increased power from the solar panels to $100 + 60 = 160$. Next, find the amount after the decrease: $160 \times 0.3 = 48$, so the solar panels then provided $160 - 48 = 112$ units of power. Finally, find the amount after the last increase: $112 \times 0.75 = 84$, so the plant ended the day at $112 + 84 = 196$, which is $196 - 100 = 96$ more than it started the day with. To find the percent change, use the formula $\text{Percent change} = \frac{\text{amount of change}}{\text{original amount}}$ to get $\frac{96}{100} = 0.96 = 96\%$.

3. Calculator

Mercury is a naturally occurring metal that can be harmful to humans. The current recommendation is for humans to take in no more than 0.1 microgram for every kilogram of their weight per day. Fish generally carry high levels of mercury, although certain fish have higher mercury content than others. Fish, however, are healthy sources of many other nutrients, so nutritionists recommend keeping them in the human diet. The figure below shows the average mercury content of several types of fish.



If a person weighs 82 kilograms, how many grams of snapper can he safely consume per day? Round your answer to the nearest gram.

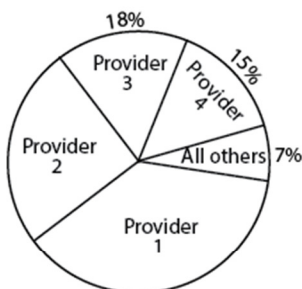
Difficulty: Medium

Category: Problem Solving and Data Analysis / Statistics and Probability

Strategic Advice: The key to answering a question like this is in reading the labels on the graph carefully. You do not need to convert grams to micrograms or vice versa. They are simply the units for mercury content.

Getting to the Answer: Start by determining how many micrograms of mercury a person who weighs 82 kilograms can consume: $82 \times 0.1 = 8.2$ micrograms. Next, find *snapper* on the bar graph and determine how many micrograms it contains (per gram of weight): 0.165. Divide the number of micrograms the person can consume, 8.2, by the number in each gram of snapper to arrive at $8.2 \div 0.165 = 49.697$, or about 50 grams.

4. Calculator



A company's market share is the percent of consumers who utilize the services or buy the products of that company. The pie chart above shows the different market shares of cable providers in a certain region. If the ratio of the market shares of Provider 1 to Provider 2 is 3:2, what is Provider 1's market share?

- (A) 24%
- (B) 30%
- (C) 36%
- (D) 42%

Difficulty: Easy

Category: Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

Strategic Advice: Break the question into steps. Before you can use the ratio, you need to find the percent of the market that utilizes Provider 1 and Provider 2.

Getting to the Answer: The ratio given in the question is 3:2, so write this as 3 parts (Provider 1) and 2 parts (Provider 2). You don't know how big a part is, so call it x . This means that $3x + 2x =$ the percent of consumers that utilize Provider 1 and Provider 2 for cable services, which is $100\% -$ all the other providers: $100 - (18 + 15 + 7) = 100 - 40 = 60$.

$$3x + 2x = 60$$

$$5x = 60$$

$$x = 12$$

Each part has a value of 12 and three parts use Provider 1, so Provider 1's market share is $3 \times 12 = 36\%$.

5. Calculator

Water is vital to human health. An average person should consume approximately 2.5 ounces of water per hour. However, because of the salt in it, seawater actually dehydrates the human body and should not be consumed. This is why boats must carry a supply of fresh water when embarking on long trips. Suppose a sailboat is traveling at an average speed of 4 nautical miles per hour with 3 people on board and the trip is 232 nautical miles. What is the minimum number of ounces of water the boat should stock before leaving?

- (A) 69.6
- (B) 145
- (C) 435
- (D) 1,113.6

Difficulty: Easy

Category: Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

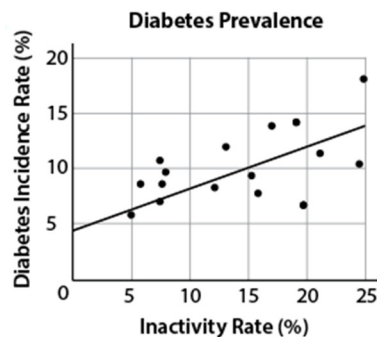
Strategic Advice: This is a question about rates, so pay careful attention to the units. As you read the question, decide if and when you will need to convert units.

Getting to the Answer: First determine how long it will take the boat to complete the trip. Set up and solve a proportion:

$$\frac{4 \text{ nautical miles}}{1 \text{ hour}} = \frac{232 \text{ nautical miles}}{x \text{ hours}}$$
$$4x = 232$$
$$x = 58$$

The question asks for the total number of ounces of water needed. The recommended rate of consumption is given in ounces per hour, and you now know the number of hours that it will take the boat to complete the trip. Multiply the number of total hours by the number of ounces needed per hour: $58 \times 2.5 = 145$. Be careful—this isn't the answer. Remember, there are 3 people on board. This is the amount 1 person needs to consume during the trip, so multiply by 3 to get $145 \times 3 = 435$ ounces.

6.



Increased physical activity has been linked to a lower incidence rate of diabetes. The scatterplot above shows the relationship between the percent of people in a certain country whose daily activity qualifies them as "inactive" and the incidence rate of diabetes in that country. The line of best fit for the data is also shown. Which of the following best represents the meaning of the y -intercept of the line of best fit in the context of this question?

- (A) The predicted incidence rate of diabetes when the entire country is considered active
- (B) The predicted incidence rate of diabetes when the entire country is considered inactive
- (C) The predicted percent of people who will be active when the incidence rate of diabetes is 0%
- (D) The predicted percent of people who will be inactive when the incidence rate of diabetes is 0%

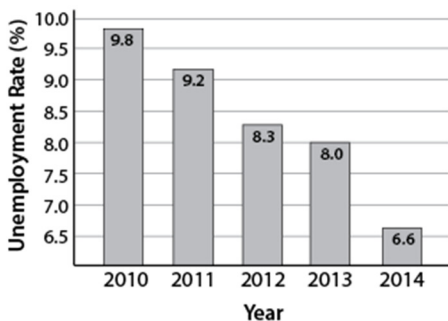
Difficulty: Medium

Category: Problem Solving and Data Analysis / Scatterplots

Strategic Advice: You don't need to know the y -intercept to answer the question, so don't waste valuable time trying to find it. Instead, use the labels on the axes to determine the meaning of the y -intercept.

Getting to the Answer: The y -intercept is the point at which $x = 0$. In this real-world scenario, the percent of people who are considered inactive is graphed on the x -axis, so the y -intercept occurs when 0% of the country is inactive. Now, look carefully at the way the answer choices are worded. Choice (A) is correct because it says the entire country is *active*, which is the same as saying 0% are inactive. Choice B says the entire country is *inactive*, which means 100% is inactive (not 0% inactive).

7. Calculator



The bar graph shows the percent of the United States population that was unemployed as of January 1 on each of the years shown. A governmental agency wants to use the 5-year mean of the data to estimate how many people were unemployed in a certain geographic area between 2010 and 2014. If the total adult population of the area was 250,000, approximately how many adults were unemployed in that area during the indicated time period?

- (A) 16,950
- (B) 20,150
- (C) 20,950
- (D) 104,750

Difficulty: Medium

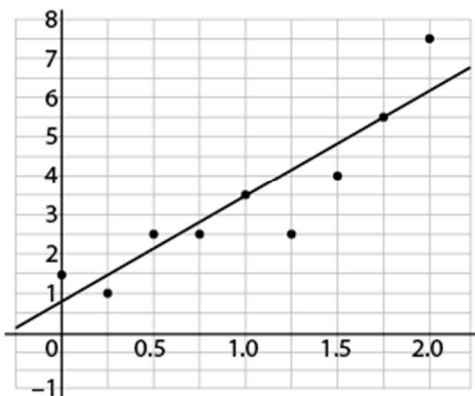
Category: Problem Solving and Data Analysis / Statistics and Probability

Strategic Advice: The mean of a set of numbers is the same as the average, which is the sum of the numbers divided by the amount of numbers.

Getting to the Answer: Use the graph to find the sum of the unemployment rates over all 5 years, and then calculate the mean: $9.8 + 9.2 + 8.3 + 8 + 6.6 = 41.9$. Now, divide by the number of years: $41.9 \div 5 = 8.38$. Read the axis labels carefully. The unemployment rate is given as a percent, so write 8.38 as 0.0838. If there were 250,000 people in the geographic area, then approximately $250,000 \times 0.0838 = 20,950$ people were unemployed during the indicated time period.

8.

Use the data in the scatterplot and the line of best fit shown to answer the following question.



Which of the following values most accurately reflects the average rate of change of the data based on the line of best fit?

- (A) $\frac{3}{8}$
- (B) $\frac{3}{4}$
- (C) $\frac{4}{3}$
- (D) $\frac{8}{3}$

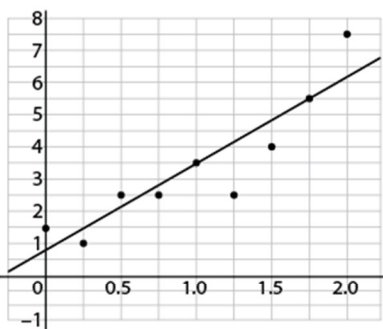
Difficulty: Medium

Category: Problem Solving and Data Analysis / Scatterplots

Strategic Advice: The average rate of change is the same as the slope of the line of best fit. Look for two points that lie on the line (or as close as possible to the line) and then find the slope using the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$. Pay careful attention to how the axes are labeled to make sure you write the points accurately.

Getting to the Answer: Using the points (1, 3.5) and (1.75, 5.5), the average rate of change is $\frac{5.5 - 3.5}{1.75 - 1} = \frac{2}{0.75} = 2.\bar{6}$ or $\frac{8}{3}$.

9.



According to the graph, the data has been modeled using a line of best fit. Another researcher thinks that an exponential model may be a better fit. The table below shows the researcher's results after using a graphing calculator to perform a linear regression and an exponential regression on the data.

LinReg	ExpReg
$y = ax + b$	$y = a \times b^x$
$a = 2.7$	$a = 1.251327$
$b = .68888889$	$b = 2.299749$
$r^2 = .81876039$	$r^2 = .84304281$
$r = .9048538$	$r = .9181736$

Which of the following best explains which regression model is a better fit and why?

- (A) A linear model is a much better fit because its value of a is considerably higher.
 (B) A linear model is a slightly better fit because its value of r is slightly smaller.
 (C) An exponential model is a much better fit because its value of a is much closer to 1.
 (D) An exponential model is a slightly better fit because its value of r is slightly closer to 1.

Difficulty: Medium

Category: Problem Solving and Data Analysis / Scatterplots

Strategic Advice: Performing a regression on a graphing calculator (or using computer software) tells you the approximate equation that could be used to model the data, and how well the model fits the data. The *fit* is indicated by the correlation coefficient, r . The closer this number is to 1 (a 100% fit), the more accurately the model describes the data.

Getting to the Answer: You can eliminate A and C right away because they do not involve the correlation coefficient, r . To choose between B and (D), look at the value of r to find that 0.9181736 is slightly closer to 1 than 0.9048538. This means the exponential model is a slightly better fit than the linear model.

10. Calculator

The Consumer Price Index (CPI) is a weighted average of the cost of certain categories of goods and services in the United States. It is one of the most widely used measures of inflation. According to the U.S. Census Bureau, the CPI was 130.7 in 1990, and was 218.1 in 2010. If the CPI continues to experience the same percent increase over the next 20 years, approximately what will the CPI be in 2030?

- (A) 145.8
 (B) 305.5
 (C) 363.9
 (D) 408.7

Difficulty: Medium

Category: Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

Strategic Advice: Find the percent increase using the formula, $\% \text{ change} = \frac{\text{amount of change}}{\text{original amount}}$. Then apply the same percent increase to the 2010 CPI to find the expected value in 2030.

Getting to the Answer: The amount of increase is $218.1 - 130.7 = 87.4$, so the percent increase is $87.4 \div 130.7 = 0.6687$, or 66.87% over 20 years. If the total percent increase over the next 20 years is the same, the CPI will be about $218.1 \times 1.6687 = 363.9$.