

## Question ID 2b15d65f

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: 2b15d65f

3.1

An economist modeled the demand  $Q$  for a certain product as a linear function of the selling price  $P$ . The demand was 20,000 units when the selling price was \$40 per unit, and the demand was 15,000 units when the selling price was \$60 per unit. Based on the model, what is the demand, in units, when the selling price is \$55 per unit?

- A. 16,250
- B. 16,500
- C. 16,750
- D. 17,500

ID: 2b15d65f Answer

Correct Answer: A

Rationale

Choice A is correct. Let the economist's model be the linear function  $Q = mP + b$ , where  $Q$  is the demand,  $P$  is the selling price,  $m$  is the slope of the line, and  $b$  is the y-coordinate of the y-intercept of the line in the xy-plane, where  $y = Q$ . Two pairs of the selling price  $P$  and the demand  $Q$  are given. Using the coordinate pairs  $(P, Q)$ , two points that satisfy the function are  $(40, 20,000)$  and  $(60, 15,000)$ . The slope  $m$  of the function can

be found using the formula  $m = \frac{Q_2 - Q_1}{P_2 - P_1}$ . Substituting the given values into this formula yields  $m = \frac{15,000 - 20,000}{60 - 40}$ , or  $m = -250$ . Therefore,  $Q = -250P + b$ . The value of  $b$  can be found by substituting one of the points into the function. Substituting the values of  $P$  and  $Q$  from the point  $(40, 20,000)$  yields  $20,000 = -250(40) + b$ , or  $20,000 = -10,000 + b$ . Adding 10,000 to both sides of this equation yields  $b = 30,000$ . Therefore, the linear function the economist used as the model is  $Q = -250P + 30,000$ . Substituting 55 for  $P$  yields  $Q = -250(55) + 30,000 = 16,250$ . It follows that when the selling price is \$55 per unit, the demand is 16,250 units.

Choices B, C, and D are incorrect and may result from calculation or conceptual errors.

Question Difficulty: Hard

Question ID be9cb6a2

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	<div><div></div><div></div><div></div></div>

ID: be9cb6a2

3.2

The cost of renting a backhoe for up to 10 days is \$270 for the first day and \$135 for each additional day. Which of the following equations gives the cost  $y$ , in dollars, of renting the backhoe for  $x$  days, where  $x$  is a positive integer and  $x \leq 10$ ?

- A.  $y = 270x - 135$
- B.  $y = 270x + 135$
- C.  $y = 135x + 270$
- D.  $y = 135x + 135$

ID: be9cb6a2 Answer

Correct Answer: D

Rationale

Choice D is correct. It's given that the cost of renting a backhoe for up to 10 days is \$270 for the first day and \$135 for each additional day. Therefore, the cost  $y$ , in dollars, for  $x$  days, where  $x \leq 10$ , is the sum of the cost for the first day, \$270, and the cost for the additional  $x - 1$  days,  $\$135(x - 1)$ . It follows that  $y = 270 + 135(x - 1)$ , which is equivalent to  $y = 270 + 135x - 135$ , or  $y = 135x + 135$ .

Choice A is incorrect. This equation represents a situation where the cost of renting a backhoe is \$135 for the first day and \$270 for each additional day.

Choice B is incorrect and may result from conceptual or calculation errors.

Choice C is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Hard

## Question ID b988eeec

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: b988eeec

3.3

The functions  $f$  and  $g$  are defined as  $f(x) = \frac{1}{4}x - 9$  and  $g(x) = \frac{3}{4}x + 21$ . If the function  $h$  is defined as  $h(x) = f(x) + g(x)$ , what is the  $x$ -coordinate of the  $x$ -intercept of the graph of  $y = h(x)$  in the  $xy$ -plane?

ID: b988eeec Answer

Correct Answer: -12

Rationale

The correct answer is  $-12$ . It's given that the functions  $f$  and  $g$  are defined as  $f(x) = \frac{1}{4}x - 9$  and  $g(x) = \frac{3}{4}x + 21$ . If the function  $h$  is defined as  $h(x) = f(x) + g(x)$ , then substituting  $\frac{1}{4}x - 9$  for  $f(x)$  and  $\frac{3}{4}x + 21$  for  $g(x)$  in this function yields  $h(x) = \frac{1}{4}x - 9 + \frac{3}{4}x + 21$ . This can be rewritten as  $h(x) = \frac{4}{4}x + 12$ , or  $h(x) = x + 12$ . The  $x$ -intercept of a graph in the  $xy$ -plane is the point on the graph where  $y = 0$ . The equation representing the graph of  $y = h(x)$  is  $y = x + 12$ . Substituting  $0$  for  $y$  in this equation yields  $0 = x + 12$ . Subtracting  $12$  from both sides of this equation yields  $-12 = x$ , or  $x = -12$ . Therefore, the  $x$ -coordinate of the  $x$ -intercept of the graph of  $y = h(x)$  in the  $xy$ -plane is  $-12$ .

Question Difficulty: Hard

## Question ID af2ba762

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: af2ba762

3.4

According to data provided by the US Department of Energy, the average price per gallon of regular gasoline in the United States from September 1, 2014, to December 1, 2014, is modeled by the function  $F$  defined below, where  $F(x)$  is the average price per gallon  $x$  months after September 1.

$$F(x) = 2.74 - 0.19(x - 3)$$

The constant 2.74 in this function estimates which of the following?

- A. The average monthly decrease in the price per gallon
- B. The difference in the average price per gallon from September 1, 2014, to December 1, 2014
- C. The average price per gallon on September 1, 2014
- D. The average price per gallon on December 1, 2014

ID: af2ba762 Answer

Correct Answer: D

Rationale

Choice D is correct. Since 2.74 is a constant term, it represents an actual price of gas rather than a measure of change in gas price. To determine what gas price it represents, find  $x$  such that  $F(x) = 2.74$ , or  $2.74 = 2.74 - 0.19(x - 3)$ . Subtracting 2.74 from both sides gives  $0 = -0.19(x - 3)$ . Dividing both sides by  $-0.19$  results in  $0 = x - 3$ , or  $x = 3$ . Therefore, the average price of gas is \$2.74 per gallon 3 months after September 1, 2014, which is December 1, 2014.

Choice A is incorrect. Since 2.74 is a constant, not a multiple of  $x$ , it cannot represent a rate of change in price. Choice B is incorrect. The difference in the average price from September 1, 2014, to December 1, 2014, is  $F(3) - F(0) = 2.74 - 0.19(3 - 3) - (2.74 - 0.19(0 - 3)) = 2.74 - (2.74 + 0.57) = -0.57$ , which is not 2.74. Choice C is incorrect. The average price per gallon on September 1, 2014, is  $F(0) = 2.74 - 0.19(0 - 3) = 2.74 + 0.57 = 3.31$ , which is not 2.74.

Question Difficulty: Hard

## Question ID 16889ef3

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: 16889ef3

3.5

Oil and gas production in a certain area dropped from 4 million barrels in 2000 to 1.9 million barrels in 2013. Assuming that the oil and gas production decreased at a constant rate, which of the following linear functions  $f$  best models the production, in millions of barrels,  $t$  years after the year 2000?

- A.  $f(t) = \frac{21}{130}t + 4$
- B.  $f(t) = \frac{19}{130}t + 4$
- C.  $f(t) = -\frac{21}{130}t + 4$
- D.  $f(t) = -\frac{19}{130}t + 4$

ID: 16889ef3 Answer

Correct Answer: C

Rationale

Choice C is correct. It is assumed that the oil and gas production decreased at a constant rate. Therefore, the function  $f$  that best models the production  $t$  years after the year 2000 can be written as a linear function,  $f(t) = mt + b$ , where  $m$  is the rate of change of the oil and gas production and  $b$  is the oil and gas production, in millions of barrels, in the year 2000. Since there were 4 million barrels of oil and gas produced in 2000,  $b = 4$ .

The rate of change,  $m$ , can be calculated as  $\frac{4 - 1.9}{0 - 13} = -\frac{2.1}{13}$ , which is equivalent to  $-\frac{21}{130}$ , the rate of change in choice C.

Choices A and B are incorrect because each of these functions has a positive rate of change. Since the oil and gas production decreased over time, the rate of change must be negative. Choice D is incorrect. This model may result from misinterpreting 1.9 million barrels as the amount by which the production decreased.

Question Difficulty: Hard

Question ID 6989c80a

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	<div><div></div><div></div><div></div></div>

ID: 6989c80a

3.6

$$F(x) = \frac{9}{5}(x - 273.15) + 32$$

The function  $F$  gives the temperature, in degrees Fahrenheit, that corresponds to a temperature of  $x$  kelvins. If a temperature increased by **2.10** kelvins, by how much did the temperature increase, in degrees Fahrenheit?

- A. **3.78**
- B. **35.78**
- C. **487.89**
- D. **519.89**

ID: 6989c80a Answer

Correct Answer: A

Rationale

Choice A is correct. It's given that the function  $F(x) = \frac{9}{5}(x - 273.15) + 32$  gives the temperature, in degrees Fahrenheit, that corresponds to a temperature of  $x$  kelvins. A temperature that increased by **2.10** kelvins means that the value of  $x$  increased by **2.10** kelvins. It follows that an increase in  $x$  by **2.10** increases  $F(x)$  by  $\frac{9}{5}(2.10)$ , or **3.78**. Therefore, if a temperature increased by **2.10** kelvins, the temperature increased by **3.78** degrees Fahrenheit.

Choice B is incorrect and may result from conceptual or calculation errors.

Choice C is incorrect and may result from conceptual or calculation errors.

Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Hard

Question ID 78391fcc

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: 78391fcc

3.7

$x$	-11	-10	-9	-8
$f(x)$	21	18	15	12

The table above shows some values of  $x$  and their corresponding values  $f(x)$  for the linear function  $f$ . What is the  $x$ -intercept of the graph of  $y = f(x)$  in the  $xy$ -plane?

- A.  $(-3,0)$
- B.  $(-4,0)$
- C.  $(-9,0)$
- D.  $(-12,0)$

ID: 78391fcc Answer

Correct Answer: B

Rationale

Choice B is correct. The equation of a linear function can be written in the form  $y = mx + b$ , where  $y = f(x)$ ,  $m$  is the slope of the graph of  $y = f(x)$ , and  $b$  is the  $y$ -coordinate of the  $y$ -intercept of the graph. The value of  $m$  can be found using the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . According to the table, the points  $(-11, 21)$  and  $(-10, 18)$  lie on the graph of  $y = f(x)$ . Using these two points in the slope formula yields  $m = \frac{18 - 21}{-10 - (-11)}$ , or  $-3$ . Substituting  $-3$  for  $m$  in the slope-intercept form of the equation yields  $y = -3x + b$ . The value of  $b$  can be found by substituting values from the table and solving; for example, substituting the coordinates of the point  $(-11, 21)$  into the equation  $y = -3x + b$  gives  $21 = -3(-11) + b$ , which yields  $b = -12$ . This means the function given by the table can be represented by the equation  $y = -3x - 12$ . The value of the  $x$ -intercept of the graph of  $y = f(x)$  can be determined by finding the value of  $x$  when  $y = 0$ . Substituting  $y = 0$  into  $y = -3x - 12$  yields  $0 = -3x - 12$ , or  $x = -4$ . This corresponds to the point  $(-4, 0)$ .

Choice A is incorrect and may result from substituting the value of the slope for the  $x$ -coordinate of the  $x$ -intercept. Choice C is incorrect and may result from a calculation error. Choice D is incorrect and may result from substituting the  $y$ -coordinate of the  $y$ -intercept for the  $x$ -coordinate of the  $x$ -intercept.

Question Difficulty: Hard



Question ID a04050d8

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: a04050d8

3.8

Energy per Gram of Typical Macronutrients

Macronutrient	Food calories	Kilojoules
Protein	4.0	16.7
Fat	9.0	37.7
Carbohydrate	4.0	16.7

The table above gives the typical amounts of energy per gram, expressed in both food calories and kilojoules, of the three macronutrients in food. If the 180 food calories in a granola bar come entirely from  $p$  grams of protein,  $f$  grams of fat, and  $c$  grams of carbohydrate, which of the following expresses  $f$  in terms of  $p$  and  $c$  ?

- A.  $f = 20 + \frac{4}{9}(p + c)$
- B.  $f = 20 - \frac{4}{9}(p + c)$
- C.  $f = 20 - \frac{4}{9}(p - c)$
- D.  $f = 20 + \frac{9}{4}(p + c)$

ID: a04050d8 Answer

Correct Answer: B

Rationale

Choice B is correct. It is given that there are 4.0 food calories per gram of protein, 9.0 food calories per gram of fat, and 4.0 food calories per gram of carbohydrate. If 180 food calories in a granola bar came from  $p$  grams of protein,  $f$  grams of fat, and  $c$  grams of carbohydrate, then the situation can be represented by the equation  $180 = 4p + 9f + 4c$ . The equation can then be rewritten in terms of  $f$  by subtracting  $4p$  and  $4c$  from both sides of the equation and then dividing both sides of the equation by 9. The result is the equation  $f = 20 - \frac{4}{9}(p + c)$ .

Choices A, C, and D are incorrect and may be the result of not representing the situation with the correct equation or incorrectly rewriting the equation in terms of  $f$ .

Question Difficulty: Hard

## Question ID daad7c32

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: daad7c32

3.9

An object hangs from a spring. The formula  $\ell = 30 + 2w$  relates the length  $\ell$ , in centimeters, of the spring to the weight  $w$ , in newtons, of the object.

Which of the following describes the meaning of the 2 in this context?

- A. The length, in centimeters, of the spring with no weight attached
- B. The weight, in newtons, of an object that will stretch the spring 30 centimeters
- C. The increase in the weight, in newtons, of the object for each one-centimeter increase in the length of the spring
- D. The increase in the length, in centimeters, of the spring for each one-newton increase in the weight of the object

ID: daad7c32 Answer

Correct Answer: D

Rationale

Choice D is correct. The value 2 is multiplied by  $w$ , the weight of the object. When the weight is 0, the length is  $30 + 2(0) = 30$  centimeters. If the weight increases by  $w$  newtons, the length increases by  $2w$  centimeters, or 2 centimeters for each one-newton increase in weight.

Choice A is incorrect because this describes the value 30. Choice B is incorrect because 30 represents the length of the spring before it has been stretched. Choice C is incorrect because this describes the value  $w$ .

Question Difficulty: Hard

## Question ID 023c0a8d

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Algebra	Linear functions	■ ■ ■

ID: 023c0a8d

3.10

For the function  $f$ , if  $f(3x) = x - 6$  for all values of  $x$ ,  
what is the value of  $f(6)$ ?

- A.  $-6$
- B.  $-4$
- C.  $0$
- D.  $2$

ID: 023c0a8d Answer

Correct Answer: B

Rationale

Choice B is correct. It's given that  $f(3x) = x - 6$  for all values of  $x$ . If  $3x = 6$ , then  $f(3x)$  will equal  $f(6)$ .

Dividing both sides of  $3x = 6$  by 3 gives  $x = 2$ . Therefore, substituting 2 for  $x$  in the given equation yields  $f(3 \times 2) = 2 - 6$ , which can be rewritten as  $f(6) = -4$ .

Choice A is incorrect. This is the value of the constant in the given equation for  $f$ . Choice C is incorrect and may result from substituting  $x = 6$ , rather than  $x = 2$ , into the given equation. Choice D is incorrect. This is the value of  $x$  that yields  $f(6)$  for the left-hand side of the given equation; it's not the value of  $f(6)$ .

Question Difficulty: Hard