

Exponents and Roots

For questions in the Quantitative Comparison format (“Quantity A” and “Quantity B” given), the answer choices are always as follows:

- (A) Quantity A is greater.
- (B) Quantity B is greater.
- (C) The two quantities are equal.
- (D) The relationship cannot be determined from the information given.

For questions followed by a numeric entry box , you are to enter your own answer in the

box. For questions followed by fraction-style numeric entry boxes

All numbers used are real numbers. All figures are assumed to lie in a plane unless otherwise indicated. Geometric figures are not necessarily drawn to scale. You should assume, however, that lines that appear to be straight are actually straight, points on a line are in the order shown, and all geometric objects are in the relative positions shown. Coordinate systems, such as xy -planes and number lines, as well as graphical data presentations such as bar charts, circle graphs, and line graphs, *are* drawn to scale. A symbol that appears more than once in a question has the same meaning throughout the question.

1.

Quantity A

$$25^7$$

Quantity B

$$5^{15}$$

2.

$$216 = 2^x 3^y$$

x and y are integers.

Quantity A

$$x$$

Quantity B

$$y$$

3.

Quantity A

Quantity B

$$\sqrt{18}\sqrt{2}$$

$$\sqrt{6}$$

4.

Quantity A

$$\sqrt{3} + \sqrt{6}$$

Quantity B

$$\sqrt{9}$$

5.

Quantity A

$$\sqrt{7,777,777,777}$$

Quantity B

$$88,000$$

6. If $5,000 = 2^x 5^y$ and x and y are integers, what is $x + y$?

7. If $3^2 9^2 = 3^x$, what is x ?

- (A) 2
- (B) 3
- (C) 4
- (D) 5
- (E) 6

8.

80 is divisible by 2^x .

Quantity A

$$x$$

Quantity B

$$3$$

9.

Quantity A

$$(81)^2(900)^3$$

Quantity B

$$270^6$$

10. If $17\sqrt[3]{m} = 34$, what is $6\sqrt[3]{m}$?

11. 5^{-2} is equivalent to:

- (A) $\frac{1}{25}$
(B) $\frac{1}{5}$
(C) 1
(D) 5
(E) 25

12. If $77,742y^{11} = 4x^2$, what is $\frac{77,742y^{11}}{8x^2}$?

13. $\sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{4}}}}$ =

- (A) $\sqrt{2}$
(B) 2
(C) $2\sqrt{2}$
(D) 4
(E) $4\sqrt{2}$

14.

Quantity A

$$\frac{200}{\sqrt{200}}$$

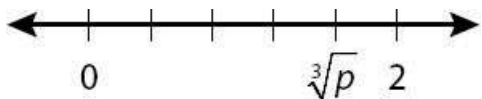
Quantity B

$\sqrt{200}$

15. For what positive integer is the square of the integer divided by the cube root of the integer equal to nine times the integer?

- (A) 4
(B) 8
(C) 16
(D) 27
(E) 125

16.



If the hash marks above are equally spaced, what is the value of p ?

- (A) $3/2$
- (B) $8/5$
- (C) $24/15$
- (D) $512/125$
- (E) $625/256$

17. What is the greatest prime factor of $2^{99} - 2^{96}$?

18. If $2^k - 2^{k+1} + 2^{k-1} = 2^k m$ what is m ?

- (A) -1
- (B) $-1/2$
- (C) $1/2$
- (D) 1
- (E) 2

19.

Quantity A

$$\frac{2}{9}(81)^{50}$$

Quantity B

$$\frac{(3^2)(9)^{99}}{2}$$

20. If $5^{k+1} = 2,000$, what is $5^k + 1$?

- (A) 399
- (B) 401
- (C) 1,996
- (D) 2,000
- (E) 2,001

21. If $3^{11} = 9^x$, what is the value of x ?

22. If $x^7 = 2.5$, what is x^{14} ?

23. If $\sqrt[5]{x^6} = x^{\frac{a}{b}}$, then the value of $a/b =$

24. $\frac{20^{-5}5^{10}8^6}{10^825^{-2}} = ?$

- (A) 1
- (B) 4
- (C) 5
- (D) 6
- (E) 10

25. If $\frac{5^7}{5^{-4}} = 5^a$ and $\frac{2^{-3}}{2^{-2}} = 2^b$ and $3^8(3) = 3^c$, what is the value of $a + b + c$?

26. If 12^x is odd and x is an integer, what is the value of x^{12} ?

27. $\frac{200^{\frac{5}{2}}}{\sqrt{200}} = ?$

- (A) 4
- (B) 40
- (C) 400
- (D) 4,000
- (E) 40,000

28.

$$\frac{(10^3)(0.027)}{(900)(10^{-2})} = (3)(10^m)$$

Quantity A

The value of m

Quantity B

3

29. $\frac{1}{3}(10^6 - 10^4) = ?$

- (A) $33.\overline{3}$
- (B) $3,333.\overline{3}$
- (C) 33,000
- (D) 330,000
- (E) 333,333

30. Simplify: $\frac{2^2 + 2^2 + 2^3 + 2^4}{(\sqrt{5} + \sqrt{3})(\sqrt{5} - \sqrt{3})}$

- (A) 2
- (B) 4
- (C) 8
- (D) 16
- (E) 32

31. $\frac{2^{-4}3^{-20}}{4^{-1}9^{-6}} =$

- (A) 2^23^8
- (B) 2^13^{12}
- (C) $\frac{2^23^8}{1}$
- (D) $\frac{2^13^{12}}{1}$
- (E) 2^23^{12}

32. If $\frac{0.000027 \times 10^x}{900 \times 10^{-4}} = 0.03 \times 10^{11}$, what is the value of x ?

- (A) 13
- (B) 14
- (C) 15
- (D) 16
- (E) 17

33. $(\sqrt[2]{x})(\sqrt[3]{x}) =$

- (A) $\sqrt[5]{x}$
- (B) $\sqrt[6]{x}$
- (C) $\sqrt[3]{x^2}$
- (D) $\sqrt[5]{x^6}$
- (E) $\sqrt[6]{x^5}$

34. $\left(\sqrt[3]{x^2}\right)\left(\sqrt[4]{x^5}\right) =$

- (A) $\sqrt[7]{x^{10}}$
- (B) $\sqrt[12]{x^{10}}$
- (C) $\sqrt[12]{x^7}$
- (D) $\sqrt[9]{x^{23}}$
- (E) $\sqrt[12]{x^{23}}$

35.

$$n = 0.00025 \times 10^4 \text{ and } m = 0.005 \times 10^2$$

Quantity A

$$\frac{n}{m}$$

Quantity B

$$0.5$$

36. $\frac{40^{50} - 40^{48}}{2^{96}} \times 10^{-45} =$

- (A) 20
- (B) $10^3(1,599)$
- (C) $10^2(1,601)$
- (D) 200^6
- (E) 200^{53}

37. Which of the following is equal to $x^{\frac{3}{2}}$?

(A) $x^2\sqrt{x}$

(B) $x\sqrt{x}$

(C) $\sqrt[3]{x^2}$

(D) $\sqrt[3]{x}$

(E) $(x^3)^2$

38. $\sqrt{(360)(240)(3)(2)} =$

(A) 180

(B) 360

(C) 720

(D) 1,440

(E) 3,600

39. If $125^{14}48^8$ is written out as an integer, how many consecutive zeroes will that integer have at the end?

(A) 22

(B) 32

(C) 42

(D) 50

(E) 112

Standard Deviation and Normal Distribution

For questions in the Quantitative Comparison format (“Quantity A” and “Quantity B” given), the answer choices are always as follows:

- (A) Quantity A is greater.
- (B) Quantity B is greater.
- (C) The two quantities are equal.
- (D) The relationship cannot be determined from the information given.

For questions followed by a numeric entry box , you are to enter your own answer in the

box. For questions followed by fraction-style numeric entry boxes

All numbers used are real numbers. All figures are assumed to lie in a plane unless otherwise indicated. Geometric figures are not necessarily drawn to scale. You should assume, however, that lines that appear to be straight are actually straight, points on a line are in the order shown, and all geometric objects are in the relative positions shown. Coordinate systems, such as xy -planes and number lines, as well as graphical data presentations such as bar charts, circle graphs, and line graphs, *are* drawn to scale. A symbol that appears more than once in a question has the same meaning throughout the question.

1. Set S $\{5, 10, 15\}$

If the number 15 were removed from Set S and replaced with the number 1,000, which of the following would change?

Indicate all such statements.

- ☐ The mean
- ☐ The median
- ☐ The standard deviation

- 2.

Set W : -9, -3, 3, 9

Set X : 2, 4, 6, 8

Set Y : 100, 101, 102, 103

Set Z : 7, 7, 7, 7

Which of the following choices lists the four sets above in order from smallest standard deviation to greatest standard deviation?

- (A) W, X, Y, Z
- (B) W, Y, X, Z
- (C) W, X, Z, Y
- (D) Z, Y, X, W
- (E) Z, X, Y, W

3.

Set N is a set of x distinct positive integers where $x > 2$.

Quantity A

The standard deviation of
Set N

Quantity B

The standard deviation of Set N if every number in the set is
multiplied by -3

4. Set S is a set of distinct positive integers. The standard deviation of Set S must increase if which of the following were to occur?

Indicate all such statements.

- ☐ Each number in the set is multiplied by $1/2$.
- ☐ The smallest number is increased to become equal to the median.
- ☐ The smallest number is increased to become larger than the current largest number.
- ☐ The largest number is doubled.

5. The 75th percentile on a test corresponded to a score of 700, while the 25th percentile corresponded to a score of 450.

Quantity A

800

Quantity B

A 95th percentile score

6. Set X consists of 9 total terms, but only two different terms. Six of the terms are each equal to twice the value of each of the remaining 3. Which of the following would provide sufficient additional information to determine the average of the set?

Indicate all such statements.

- ☐ The smaller number is positive and is 3 less than the larger number.
- ☐ The standard deviation of the set is equal to $2\sqrt{3}$.
- ☐ The biggest term in the set is 6.

7. Set $S = \{2, 5, 7, 11, 16, 24, 28, 50, 52, 101, 120, 130\}$

What is the average of the first quartile ("Q1") and the third quartile ("Q3") of set S ?

- (A) 9

- (B) 26
- (C) 42.75
- (D) 76.5
- (E) 85.5

8. The test scores at Millbrook High School are normally distributed, and the 60th percentile is equal to a score of 70.

Quantity A

Quantity B

The 30th percentile score

35

9. The lengths of a certain population of earthworms are normally distributed with a mean length of 30 centimeters and a standard deviation of 3 centimeters. One of the worms is picked at random.

Quantity A

Quantity B

The probability that the worm is between 24 and 30 centimeters, inclusive

The probability that the worm is between 27 and 33 centimeters, inclusive

10. The hourly wage paid to working adults in Maplewood is normally distributed around a mean of \$18 per hour with a standard deviation of \$3.50.

Quantity A

Quantity B

The percent of working adults in Maplewood who are paid between \$18 and \$25 per hour, inclusive

40%

11. Home values among the 8,000 homeowners of Town X are normally distributed, with a standard deviation of \$11,000 and a mean of \$90,000.

Quantity A

Quantity B

The number of homeowners in Town X whose home value is above \$112,000

300

12. Exam grades among the students in Ms. Harshman's class are normally distributed, and the 50th percentile is equal to a score of 77.

Quantity A

Quantity B

The number of students who scored less than 80 on the exam

The number of students who scored greater than 74 on the exam

13. The length of bolts made in factory Z is normally distributed, with a mean length of 0.1630 meters and a standard deviation of 0.0084 meters. The probability that a randomly selected bolt is between 0.1546 meters and 0.1756 meters long is between

- (A) 54% and 61%
- (B) 61% and 68%
- (C) 68% and 75%
- (D) 75% and 82%
- (E) 82% and 89%

14. Birth weight of babies born at City Hospital is normally distributed. A baby 2 standard deviations above the mean birth weight weighs 10.8 pounds, and a baby 1 standard deviation below the mean birth weight weighs 5.85

pounds.

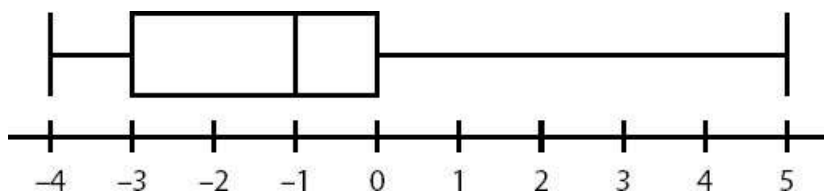
Quantity A

Twice the weight of a baby 2 standard deviations below the mean

Quantity B

The weight of a baby 1 standard deviation above the mean

15. Which of the following sets of data applies to this graph?



- (A) -4, -4, -2, 0, 0, 5
(B) -4, 1, 1, 3, 4, 4
(C) -4, -4, -3, 1, 5
(D) -5, 3, 4, 5
(E) -4, -4, -2, -2, 0, 0, 0, 5
16. If a set of data consists of only the first ten positive multiples of 5, what is the interquartile range of the set?
- (A) 15
(B) 25
(C) 27.5
(D) 40
(E) 45
17. On a given math test out of 100 points, the vast majority of the 149 students in a class scored either a perfect score or a zero, with only one student scoring within 5 points of the mean. Which of the following logically follows about Set T , made up of the scores on the test?

Indicate all such statements.

- ☐ Set T will not be normally distributed.
☐ The range of Set T would be significantly smaller if the scores had been more evenly distributed.
☐ The mean of Set T will not equal the median.

18. If Set X is a normally distributed set of numbers with a mean of 4 and a standard deviation of 4, approximately what is the probability that a number chosen at random from the set will be negative?
- (A) $1/10$
(B) $1/6$
(C) $1/4$
(D) $1/3$
(E) $1/2$
19. Jane scored in the 68th percentile on a test, and John scored in the 32nd percentile.

Quantity A

Quantity B

The proportion of the class that received a score less than John's score

The proportion of the class that scored as high as or higher than Jane

20. If a set of data has a mean of 4.2 and a standard deviation of 7.1, what is the range of values that lie within 2 standard deviations of the mean?

(A) -2.9 to 11.3
(B) -2.9 to 12.6
(C) -10 to 12.6
(D) -10 to 18.4
(E) 4.2 to 18.4

21. If octiles divide up a set of data into 8 ordered groups, each with the same number of terms, what is the median of the sixth octile group of the set of data composed of the integers from 25 to 48, inclusive?



22. In a class with 20 students, a test was administered, scored only in whole numbers from 0 to 10. At least one student got every possible score, and the average was 7.

Quantity A

4

Quantity B

The lowest score that two students could have received

23.

Frequency	6	5	5
Result	4	6	8

Quantity A

The mode of this data set

Quantity B

5

24. A test is scored out of 100 and the scores are divided into five quintile groups. Students are not told their scores, but only their quintile group.

Quantity A

The scores of two students in the bottom quintile group, chosen at random and added together

Quantity B

The score of a student in the top quintile group, chosen at random

25. In a set of 10 million numbers, one percentile would represent what percent of the total number of terms?

(A) 1,000,000
(B) 100,000
(C) 10,000
(D) 100

(E) 1

26. What is the range of the set of numbers comprised entirely of $\{1, 6, x, 17, 20, y\}$ if all terms in the set are positive integers and $xy = 18$?

- (A) 16
- (B) 17
- (C) 18
- (D) 19
- (E) Cannot be determined from the information given.

27. On a particular test whose scores are distributed normally, the 2nd percentile is 1720, while the 84th percentile is 1990. What score, rounded to the nearest 10, most closely corresponds to the 16th percentile?

- (A) 1,750
- (B) 1,770
- (C) 1,790
- (D) 1,810
- (E) 1,830

28. A data set contains at least two different integers.

Quantity A

The range of the data set

Quantity B

The interquartile range of the data set

29. In a normally distributed set of data, one standard deviation above the mean is 77 and the standard deviation is 10. What is the mean of the data?



30. Some rock samples are weighed, and their weights are determined to be normally distributed. One standard deviation below the mean is 250 grams and one standard deviation above the mean is 420 grams.

Quantity A

335 grams

Quantity B

The median weight, in grams

31. In a normally distributed set of data, the mean is 12 and the standard deviation is less than 3.

Quantity A

Number of data points in the set located between 9 and 15

Quantity B

60% of the total number of data points

32.

Quantity A

The standard deviation of the set 10, 20, 30

Quantity B

The standard deviation of the set 10, 20, 20, 20, 20, 30

33.

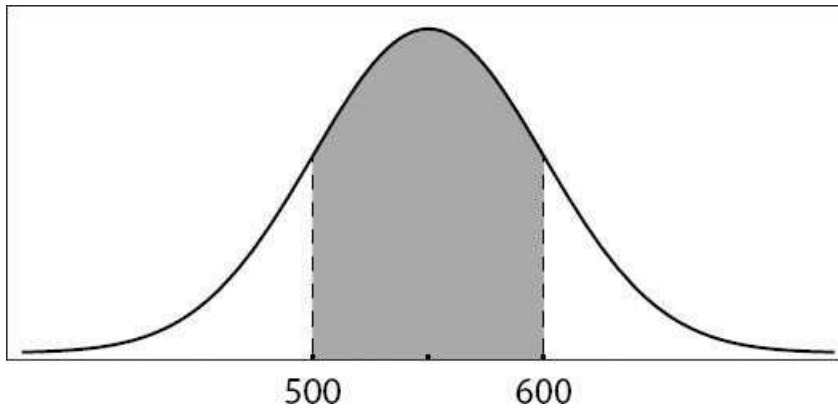
Quantity A

The standard deviation of a set of numbers with a range of 8

Quantity B

The standard deviation of a set of numbers consisting of 3 consecutive multiples of 3

34.



The graph represents the normally distributed scores on a test. The shaded area represents approximately 68% of the scores.

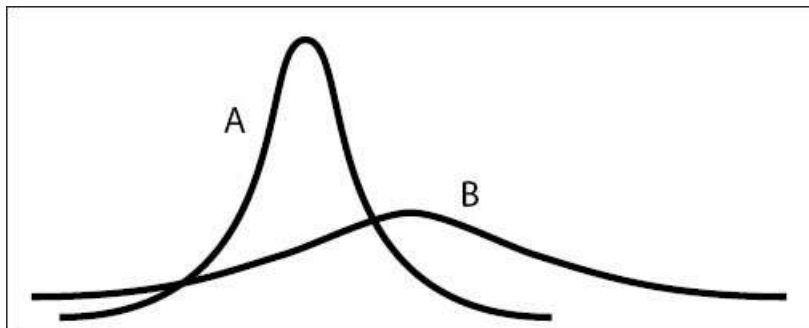
Quantity A

The mean

Quantity B

550

35.



A and B are graphical representations of normally distributed random variables X and Y , respectively, with relative positions, shapes, and sizes as shown. Which of the following must be true?

Indicate all such statements.

- ☐ Y has a larger standard deviation than X .
- ☐ The probability that Y falls within 2 standard deviations of its mean is larger than the probability that X falls within 2 standard deviations of its mean.

☐ Y has a larger mean than X .

36. 300 test results are integers ranging from 15 to 75, inclusive. Dominick's result is clearly in the 80th percentile of those results, not the 79th or the 81st.

Quantity A

Number of other test results in the same percentile as Dominick's

Quantity B

Maximum number of other test-takers with the same result as Dominick

37. The outcome of a standardized test is an integer between 151 and 200, inclusive. The percentiles of 400 test scores are calculated, and the scores are divided into corresponding percentile groups.

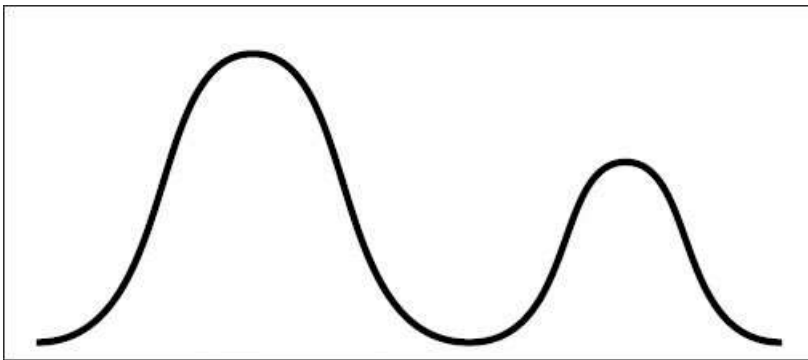
Quantity A

Minimum number of integers between 151 and 200, inclusive, that include more than one percentile group

Quantity B

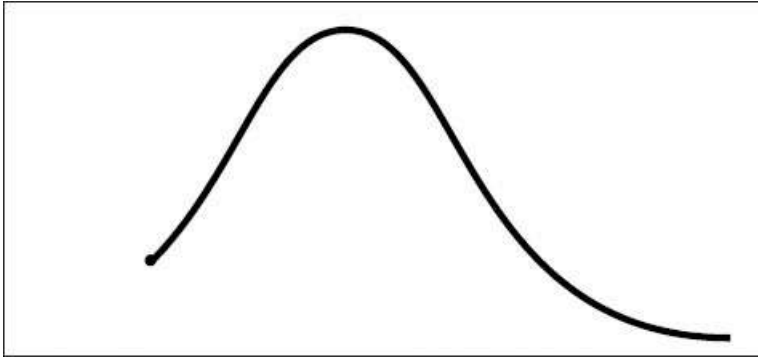
Minimum number of percentile groups that correspond to a score of 200

38.



Which of the following would the data pattern shown best describe?

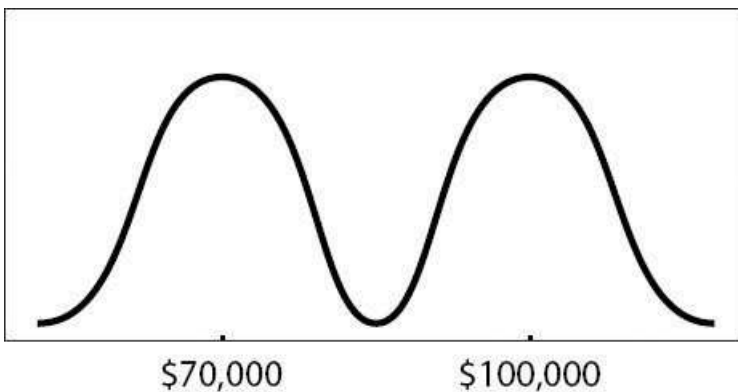
- (A) The number of grams of sugar in a selection of drinks is normally distributed.
 - (B) A number of male high school principals and a larger number of female high school principals have normally distributed salaries, distributed around the same mean.
 - (C) A number of students have normally distributed heights, and a smaller number of taller, adult teachers also have normally distributed heights.
 - (D) The salary distribution for biologists skews to the left of the median.
 - (E) The maximum-weight bench presses for a number of male athletes are normally distributed, and the maximum-weight bench presses for a smaller number of female athletes are also normally distributed, although around a smaller mean.
- 39.



Which of the following would the data pattern shown best describe?

- (A) The weights of raccoons in a population are normally distributed.
- (B) Salaries in a certain field appear normally distributed, except that salaries cannot dip below the limits of a minimum-wage law.
- (C) The fraction of people at a certain age in a certain population is inversely proportional to age.
- (D) a set of consecutive integers
- (E) a set with a standard deviation of zero

40.

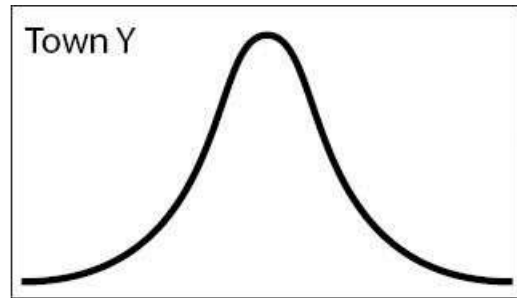
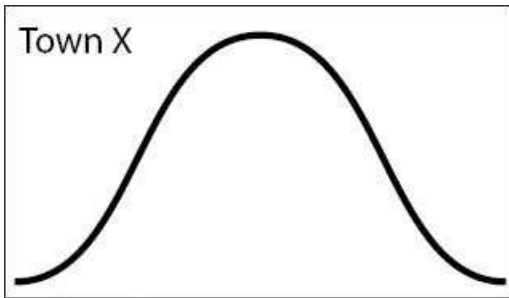


A number of scientists' salaries were reported; physicists' salaries clustered around a mean of \$100,000, and biologists' clustered around a mean of \$70,000. Which of the following could be true, according to the graph above?

Indicate all such statements.

- ☐ Some biologists earn more than some physicists.
- ☐ Both biologists' and physicists' salaries are normally distributed.
- ☐ The range of salaries is greater than \$150,000

41.

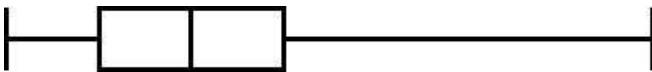


The graph on the left represents the number of family members per family in Town X, while the graph on the right represents the number of family members per family in Town Y. The median family size for Town X is equal to the median family size for Town Y. The horizontal and vertical dimensions of the boxes above are identical and correspond to the same measurements. Which of the following must be true?

Indicate all such statements.

- ☐ The range of family sizes measured as the number of family members is larger in Town X than in Town Y.
- ☐ Families in Town Y are more likely to have sizes within 1 family member of the mean than are families in Town X.
- ☐ The data for Town X has a larger standard deviation than the data for Town Y.

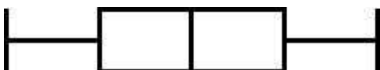
42.



The box-and-whisker plot shown could be a representation of which of the following?

- (A) a data set with a range of 100, symmetrically distributed around its median
- (B) a data set with a range of 10 and an interquartile range of 6
- (C) a data set in which the median of the upper half of the data is closer to the lowest value in the set than to the highest value
- (D) a set of consecutive integers
- (E) a normal distribution

43.



The box-and-whisker plot shown could be a representation of which of the following sets?

- (A) -2, 0, 2, 4
- (B) 3, 3, 3, 3, 3, 3
- (C) 1, 25, 100
- (D) 2, 4, 8, 16, 32
- (E) 1, 13, 14, 17

44.

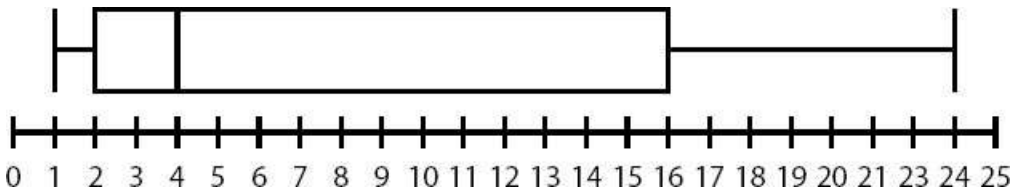


Which of the following must be true about the data described by the box-and-whisker plot above?

Indicate all such statements.

- ☐ The median of the whole set is closer to the median of the lower half of the data than it is to the median of the upper half of the data.
- ☐ The data is normally distributed.
- ☐ The set has a standard deviation greater than zero.

45.



The box-and-whisker plot above represents a data set with:

- (A) a mean of 4 and a range of 14
 - (B) a mean of 4 and a range of 23
 - (C) a median of 4 and a range of 14
 - (D) a median of 4 and a range of 23
 - (E) a median of 4 and a range of 24
46. The earthworms in Sample A have an average length of 2.4 inches, and the earthworms in Sample B have an average length of 3.8 inches. The average length of the earthworms in both samples is 3.0 inches. Which of the following must be true?

Indicate all such statements.

- ☐ There are more earthworms in Sample A than in Sample B.
- ☐ The median length of the earthworms is 3.2 inches.
- ☐ The range of lengths of the earthworms is 1.4.

Answer Key Exponents and Roots					Answer key standard deviation					
1	B	21	5.5		1	I and III only	22	B	42	C
2	C	22	6.25		2	D	23	B	43	A
3	A	23	6/5		3	B	24	D	44	III only
4	A	24	C		4	IV only	25	E	45	D
5	A	25	19		5	D	26	D	46	I only
6	7	26	0		6	I and III only	27	D		
7	E	27	E		7	C	28	D		
8	D	28	B		8	D	29	67		
9	B	29	D		9	B	30	C		
10	12	30	D		10	A	31	A		
11	E	31	C		11	B	32	A		
12	1/2	32	A		12	C	33	D		
13	B	33	E		13	D	34	D		
14	C	34	E		14	B	35	I and III only		
15	D	35	A		15	E	36	C		
16	D	36	B		16	B	37	A		
17	7	37	B		17	I only	38	C		
18	B	38	C		18	B	39	B		
19	B	39	B		19	C	40	I, II and III		
20	B				20	D	41	I and II only		