No calculators allowed on items 1 to 8.

1. Multiply and combine like terms to determine the product of these polynomials.

$(2x - 3)(5x + 6)$

2. Determine whether each expression is equivalent to $(x^3 + 8)$. Select Yes or No for each expression.

	Yes	No
$(x + 8)^3$	☐	☐
$(x - 2)(x^2 + 2x + 4)$	☐	☐
$(x + 2)(x^2 - 2x + 4)$	☐	☐

3. Choose **two** numbers whose product is **irrational**.

Numbers	-5	$\frac{1}{3}$	$\frac{2}{3}$	$3\sqrt{2}$	$\sqrt{8}$

4. Solve the following equation for n.

$18n^2 - 50 = 0$

Enter one solution in the first box. If there are two solutions, enter the second solution in the second box.

5. Suppose $\angle A$ is an angle such that $\cos A < \sin A$.
Select **all** angle measures that are possible values for $\angle A$.

- ☐ 25°
- ☐ 35°
- ☐ 45°
- ☐ 55°
- ☐ 65°
- ☐ 75°

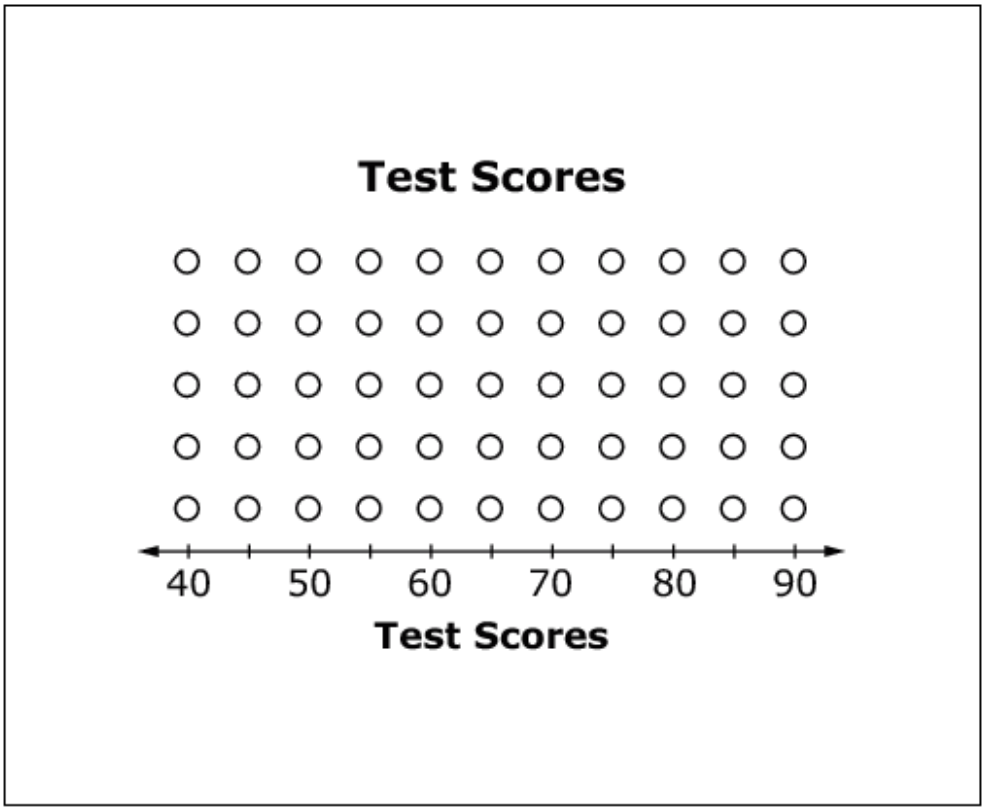
6. Select **all** equations that have at least one integer solution.

- ☐ $\sqrt{4x} = 5$
- ☐ $\sqrt{3x} = 75$
- ☐ $\sqrt{x} = \frac{\sqrt{16}}{8}$
- ☐ $\sqrt{x} = x - 12$
- ☐ $\sqrt{10-x} = x - 2$

7. Enter the value of x such that $3^{\frac{4}{5}} \cdot 3^{\frac{3}{x}} = \sqrt[5]{3^7}$ is true.

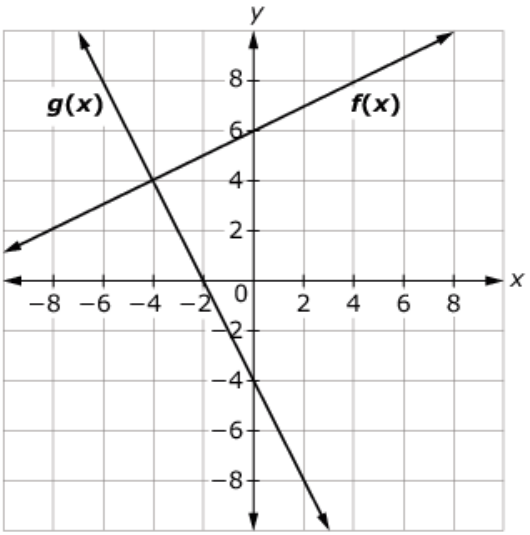
8. Create a dot plot for the given test scores.

90, 45, 85, 70, 85, 50, 75, 85, 65, 75, 60, 85, 80, 65, 80



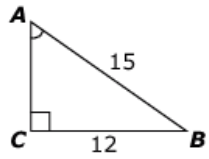
Calculators allowed on following items.

9. This graph shows linear equations $y = f(x)$ and $y = g(x)$.

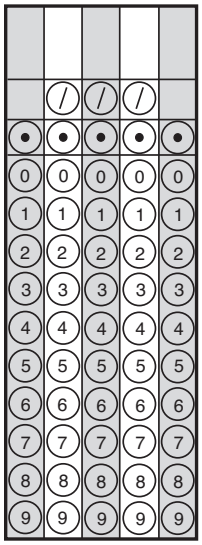


Enter the solution to the equation $f(x) - g(x) = 0$.

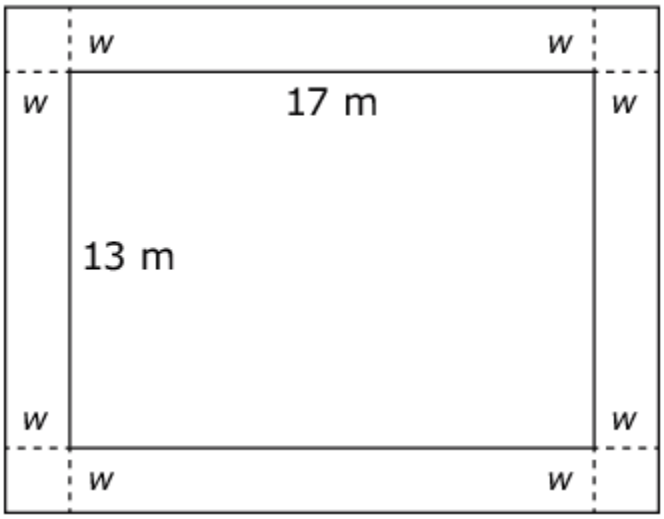
10. Consider this right triangle.



Enter the measure of $\angle CAB$ to the nearest hundredth degree.



11. A rectangular garden measures 13 meters by 17 meters and has a cement walkway around its perimeter, as shown. The width of the walkway remains constant on all four sides. The garden and walkway have a combined area of 396 square meters.



Part A

Enter an equation that could be used to help determine the width, *w*, of the walkway in the first response box.

Part B

Determine the width, in meters, of the walkway. Enter your answer in the second response box.

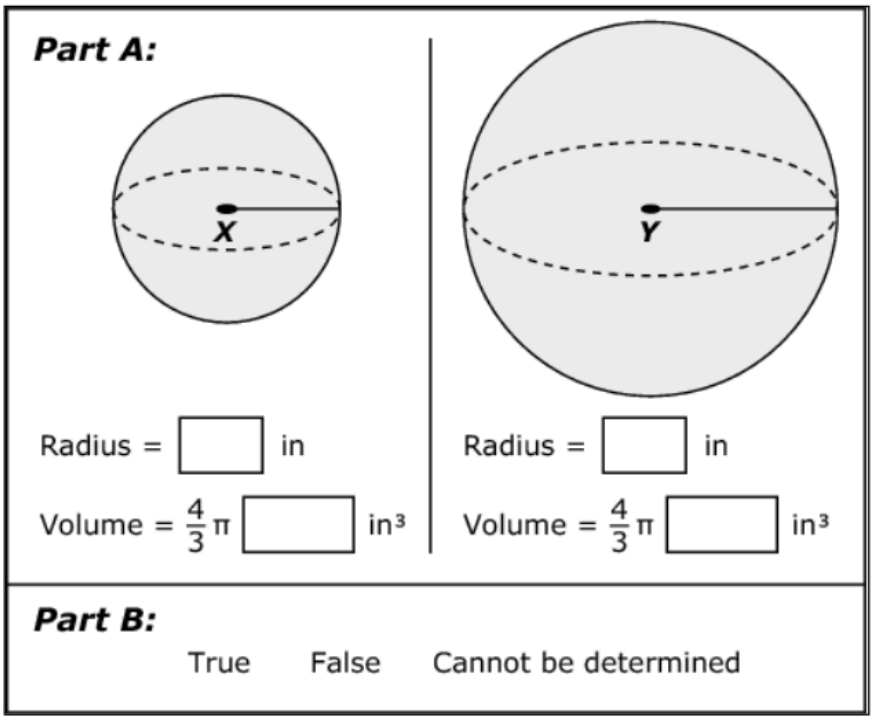
12. The radius of sphere *Y* is twice the radius of sphere *X*. A student claims that the volume of sphere *Y* must be exactly twice the volume of sphere *X*.

Part A

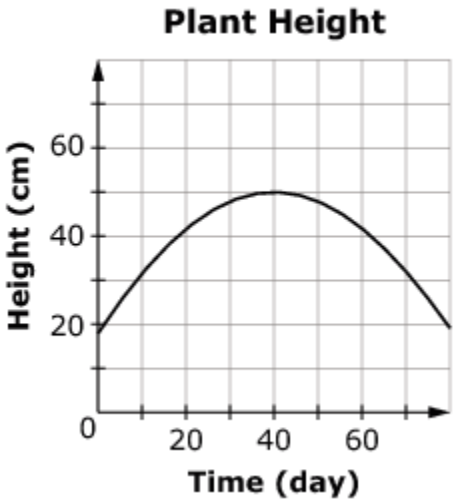
Write numbers in the boxes to create one example to evaluate the student's claim.

Part B

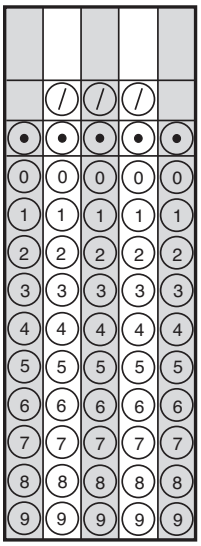
Decide whether the student's claim is true, false, or cannot be determined. Select the correct option.



13. The height of a plant in centimeters is modeled as a function of time in days. Consider this graph of the function.



Enter the average rate of change for the height of the plant, measured in centimeters per day, between day 0 and day 20.



14. Which statement is correct about the values of x and y in the following equation?

$7x + xy = xy + 21$

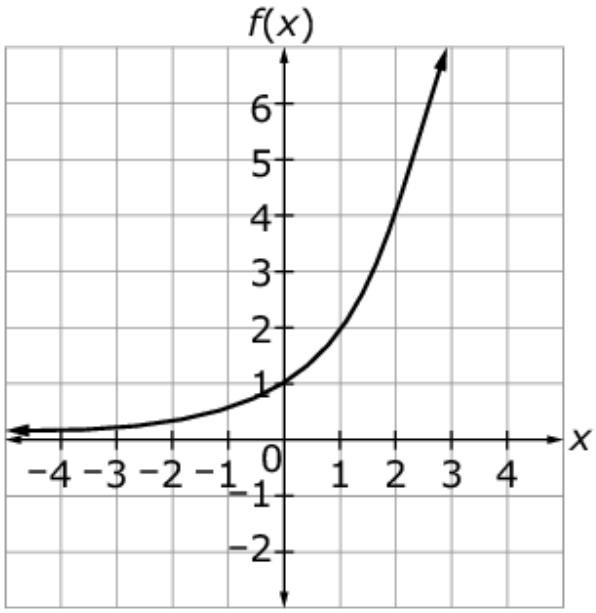
A. The equation is true for all ordered pairs (x, y).

B. There are no (x, y) pairs for which this equation is true.

C. For each value of x, there is one and only one value of y that makes the equation true.

D. For each value of y, there is one and only one value of x that makes the equation true.

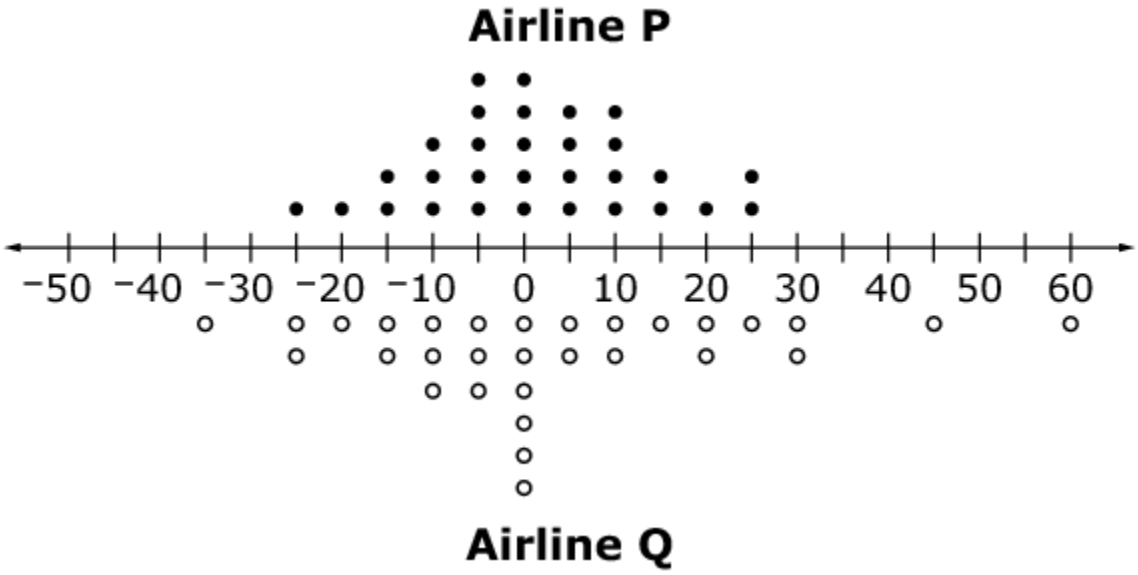
15. The graph of an exponential function *f* passes through (0, 1) and (2, 4), as shown.



What is the value of *f*(6)?

	/	/	/	
•	•	•	•	•
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

16. The dot plots below compare the number of minutes 30 flights made by two airlines arrived before or after their scheduled arrival times.



Negative numbers represent the minutes the flight arrived before its scheduled time.

Positive numbers represent the minutes the flight arrived after its scheduled time.

Zero indicates the flight arrived at its scheduled time.

Assuming you want to arrive as close to the scheduled time as possible, from which airline should you buy your ticket? Use the ideas of center and spread to justify your choice.

17. Ashley claims that when you multiply two different **square roots** together, the product is always **rational**. For example,

$\sqrt{2} \cdot \sqrt{18} = \sqrt{36} = 6$ and $\sqrt{3} \cdot \sqrt{27} = \sqrt{81} = 9$.

She also claims that when you multiply two different **cube roots** together, the product is always **irrational**. For example,

$\sqrt[3]{2} \cdot \sqrt[3]{18} = \sqrt[3]{36} \approx 3.3019$ and $\sqrt[3]{3} \cdot \sqrt[3]{27} = \sqrt[3]{81} \approx 4.3267$.

Which statement correctly classifies Ashley's claim and provides appropriate reasoning?

A. Ashley is correct because her examples support both claims.

B. Ashley is correct about the product of square roots always being rational, but the product of cube roots can sometimes be rational.

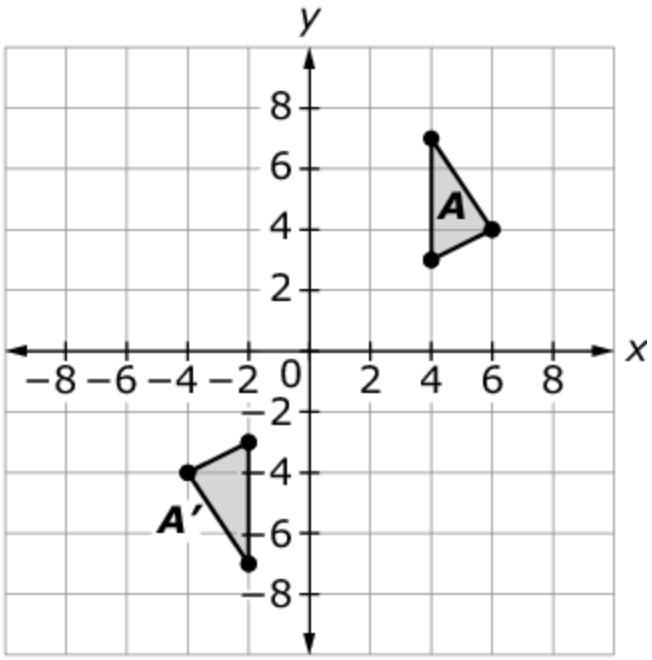
C. Ashley is incorrect about the product of square roots always being rational, but she is correct that the product of cube roots is always irrational.

D. Ashley is incorrect because sometimes the product of square roots can be irrational and sometimes the product of cube roots can be rational.

18. Jim can paint a house in 12 hours. Alex can paint the same house in 8 hours.

Enter an equation that can be used to find the time in hours, t, it would take Jim and Alex to paint the house together.

19. Kristy and Tina are studying geometric transformations.

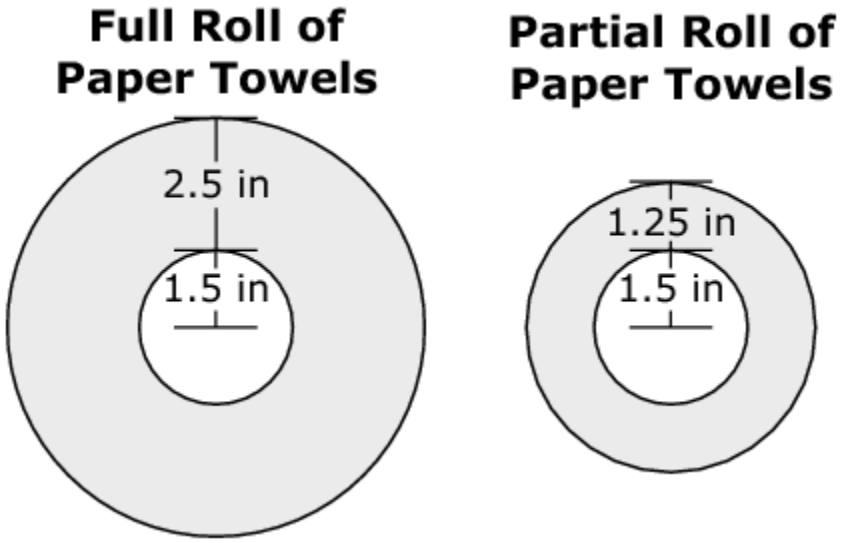


Kristy is able to move triangle *A* to triangle *A′* using the following sequence of basic transformations.

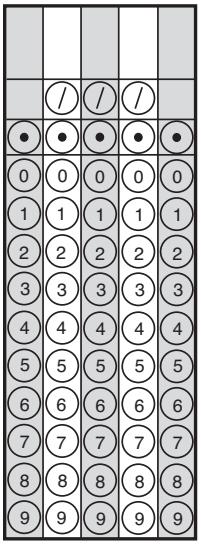
1. Reflection across the *x*-axis
2. Reflection across the *y*-axis
3. Transformation two units to the right

Tina claims that the same three transformations, done in any order, will always produce the same result. Explain why Tina's claim is incorrect.

20. The diagram shows the end view of a roll of paper towels when it is full and the end view of the roll after some of the paper towels have been used.



When the full roll of paper towels is unrolled, it has a length of 528 inches of paper towels of uniform width and thickness. Enter the length in inches of the paper towels remaining on the partial roll.



21. At a local fair, the price of admission includes the opportunity for a person to spin a wheel for free ride tickets.

Each spin of the wheel is a random event.

The result from each spin of the wheel is independent of the results of previous spins.

Each spin of the wheel awards tickets according to the probabilities shown below.

Spin the Wheel

1 ticket	35%
2 tickets	25%
3 tickets	20%
5 tickets	15%
10 tickets	5%

Let X be the number of tickets a person wins based on 2 spins. There are 13 possible values for X.

Some values of X are more common than others. For example, winning only 2 tickets in 2 spins is a somewhat common occurrence with a probability of 0.1225. It means the person wins 1 ticket on the first spin and 1 ticket on the second spin (0.35 • 0.35). A list of the possible values of X and the corresponding probabilities for most of the values of X is shown below.

Fill in the three missing probability values in the table.

X	Probability
2	0.1225
3	0.1750
4	
5	0.1000
6	0.1450
7	0.0750
8	0.0600
10	
11	0.0350
12	0.0250
13	
15	0.0150
20	0.0025

22. Consider this function given its recursive form.

$f(1) = -3$

$f(n) = 3f(n - 1);\ n \geq 1.$

A. $f(n) = -3(n)$

B. $f(n) = -1(3)^n$

C. $f(n) = -3(n - 1)$

D. $f(n) = -1(3)^{(n - 1)}$

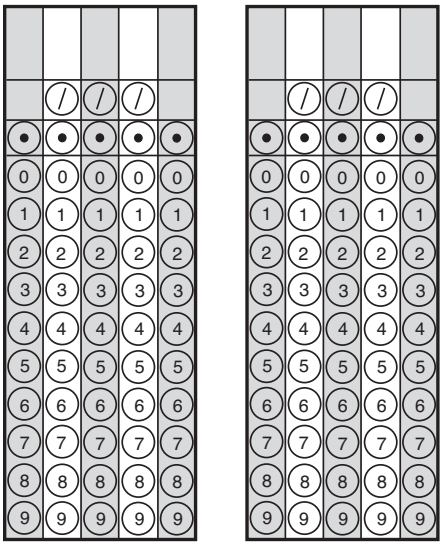
23. Determine values for c and d for which the equation

$$\sqrt{3x + 1} - \sqrt{cx + d} = 0$$

has no solution.

Enter a value for c in the first response box.

Enter a value for d in the second response box.



24. There is a traffic jam on the highway. From an aerial view, a reporter is trying to estimate the number of vehicles stuck in the traffic jam.

Select **all** information that will help the reporter make a reasonable estimate of the number of vehicles in the traffic jam.

- ☐ the cause of the traffic jam
- ☐ the average length of a vehicle
- ☐ the number of lanes on the highway
- ☐ the average distance between vehicles
- ☐ the average number of people in each vehicle
- ☐ the distance from the beginning to the end of the traffic jam

ANSWER KEY

1. $10x^2 - 3x - 18$ or its equivalent

2.

	Yes	No
$(x + 8)^3$	☐	☑
$(x - 2)(x^2 + 2x + 4)$	☐	☑
$(x + 2)(x^2 - 2x + 4)$	☑	☐

3.

Numbers	-5	$\frac{1}{3}$	$\frac{2}{3}$	$3\sqrt{2}$	$\sqrt{8}$

4. $\frac{5}{3}, -\frac{5}{3}$

5.

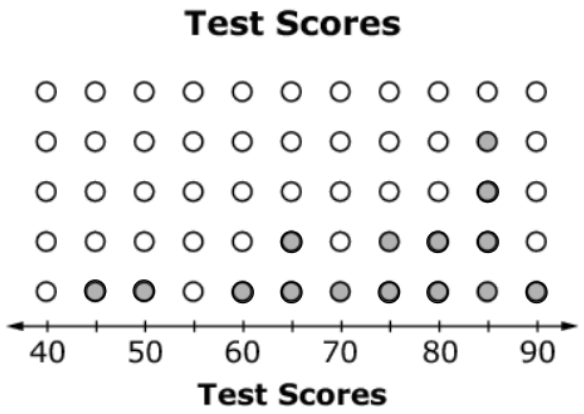
- ☐ 25°
- ☐ 35°
- ☐ 45°
- ☑ 55°
- ☑ 65°
- ☑ 75°

6.

- ☐ $\sqrt{4x} = 5$
- ☑ $\sqrt{3x} = 75$
- ☐ $\sqrt{x} = \frac{\sqrt{16}}{8}$
- ☑ $\sqrt{x} = x - 12$
- ☐ $\sqrt{10 - x} = x - 2$

7. 5

8.



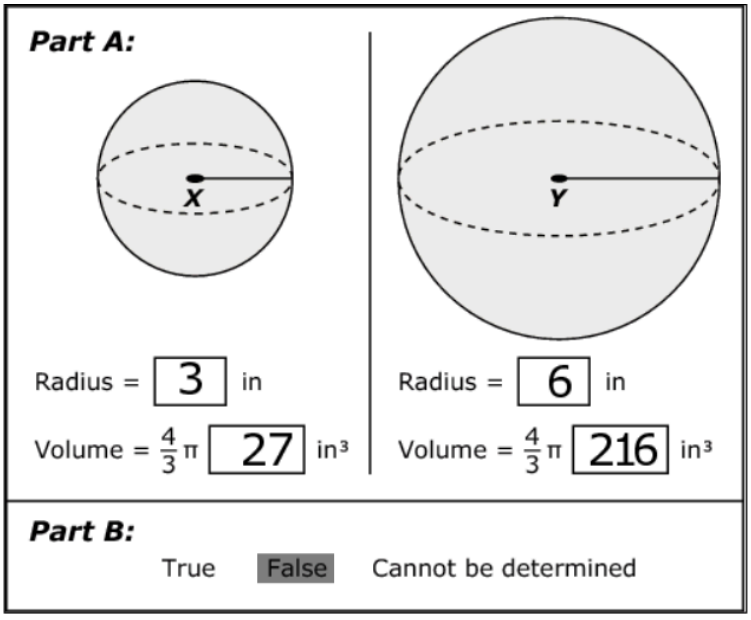
9. -4.2 to -4

10. 53.13

11. First response box: $(17 + 2w)(13 + 2w) = 396$ or an equivalent equation

Second response box: $\frac{5}{2}$ or $w = \frac{5}{2}$ or equivalent values

12.



13. 1 to 1.4, inclusive

14. D

15. 64

16. I would buy the ticket from Airline P. Both airlines are likely to have an on-time arrival since they both have median values at 0. However, Airline Q has a much greater range in arrival times. Airline Q could arrive anywhere from 35 minutes early to 60 minutes late. For Airline P, the flights arrived within 10 minutes on either side of the scheduled arrival time about 2/3 of the time, and for Airline Q, that number was only about 1/2. For these reasons, I think Airline P is the better choice.

17. D

18. $2t + 3t = 24$ or $\frac{1}{12} + \frac{1}{8} = \frac{1}{t}$ or $\frac{t}{12} + \frac{t}{8} = 1$ or equivalent equation

19. Tina is incorrect because some orders of basic transformation do not produce the same results. Suppose we move triangle *A* 2 units to the right first. The point (4, 3) is then (6, 3). Then, we take the reflection across the *x*-axis, which makes that point (6, -3) across the *y*-axis gives us (-6, -3), which is not one of the vertices of triangle *A'*. Therefore, the basic transformations done in any order do not produce the same result.

20. 202 - 206, inclusive

21.

X	Probability
2	0.1225
3	0.1750
4	0.2025
5	0.1000
6	0.1450
7	0.0750
8	0.0600
10	0.0225
11	0.0350
12	0.0250
13	0.02
15	0.0150
20	0.0025

22. B

23. 3 in the first response box, -2 in the second response box. Other correct solutions are possible

24.

- [ ] the cause of the traffic jam
- [x] the average length of a vehicle
- [x] the number of lanes on the highway
- [x] the average distance between vehicles
- [ ] the average number of people in each vehicle
- [x] the distance from the beginning to the end of the traffic jam