RISE Placement Test Practice Test

Math Tiers 1, 2, and 3

Overview

There are three RISE math placement tests. Students must earn a 70% on each test to advance to the next. That is, if students earn a 70% or higher on Test 1, then they can take Test 2. If students do not earn a 70% or higher on Test 2, then they cannot take Test 3.

Each test takes approximately 60 minutes to complete.

See the lists below of the content areas for each of the tests.

Tier 1/Test 1

- Whole Numbers
- Fractions and Mixed Numbers
- Decimals
- Ratios, Rates and Proportions
- Percents
- Measurement
- Geometry
- Real Numbers

Tier 2/Test 2

- Solving Equations and Inequalities
- Graphing
- Exponents and Polynomials
- Concepts in Statistics

Tier 3/Test 3

- Factoring
- Rational Expressions and Equations
- Radical Expressions and Equations and Quadratic Equations
- Functions

The following pages contain sample test questions and an answer key organized by tier. Students should use the RISE Placement Test Formula Chart (https://www.waketech.edu/sites/default/files/page-file-uploads/RISE placement test formula chart.pdf) during the practice test and real test experiences.

Tier 1 Practice Test Questions

Whole Numbers

1. A scientist invents a car that can travel for many hours without stopping for fuel. The car travels around a track at 54 miles an hour for 24 hours. At the end of the 24 hours, how far has the car traveled?
    a. 78 miles
    b. 1,286 miles
    c. 1,080 miles
    d. 1,296 miles

2. Constance wants brand new carpet for her square shaped bedroom. Her bedroom is 11 ft. by 11 ft. How much carpeting will Constance need to purchase to cover half of the floor?
    a. 121 sq. ft.
    b. 60.5 sq. ft.
    c. 120 sq. ft.
    d. 65 sq. ft.

Fractions

3. A statue 8 3/5 in. high rests on a stand that is 1 6/10 in. high. What is the total height of statue with the stand? Simplify your answer.
    a. $10\frac{2}{10}$
    b. $7\frac{1}{5}$
    c. $9\frac{12}{10}$
    d. $10\frac{1}{5}$

4. A piece of ribbon is $1\frac{7}{8}$ feet long. If the ribbon is going to be divided into 15 pieces, how long will each piece be?
    a. 1/8
    b. 8
    c. $28\frac{1}{8}$
    d. $13\frac{1}{8}$

(Test continued on next page)

Decimals

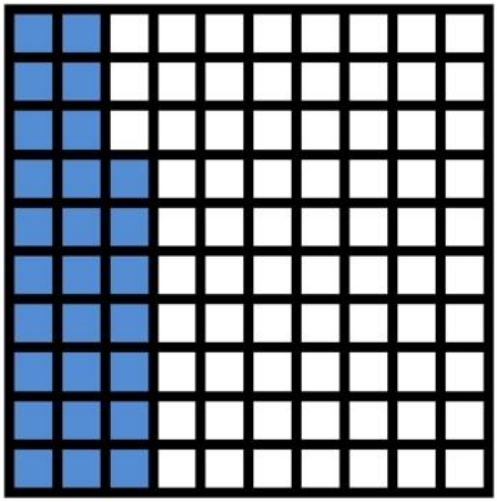


Figure 3

5. In figure 3, above, each square represents 1/100 of an inch. As a decimal, which one of the following is true?
    a. Since each square represents 1/100 of an inch, then the figure is representing 0.2 as an equivalent decimal.
    b. Since each square represents 1/100 of an inch, then the figure is representing 0.27 an equivalent decimal.
    c. Since each square represents 1/100 of an inch, then the figure is representing 0.25 as an equivalent decimal.
    d. Since each square represents 1/100 of an inch, then the figure is representing 0.23 as an equivalent decimal.

(Test continued on next page)

Ratios, Rates and Proportions

6. Tim can decorate 3 T-shirts in 20 minutes. How many T-shirts can he decorate in 180 minutes?
    a. 1/3
    b. 27
    c. 60
    d. 1200

7. The following prices for pecans are all in proportion except,
    a. $2 per oz equals $6 per 3 oz.
    b. $4 per 2 oz equals $20 per 10 oz.
    c. $9 per 4.5 oz equals $36 per 18 oz.
    d. $13 per 6 oz equals $29 per 12 oz.

Percent

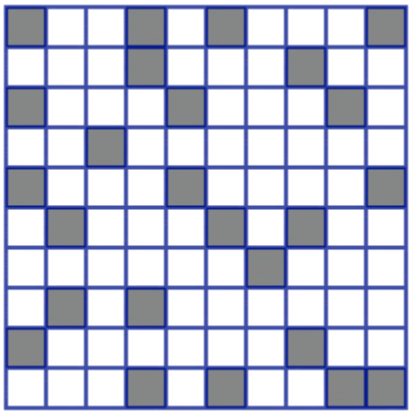


Figure 4

8. In the figure 4 above, what is the percent of unshaded blocks?
    a. 60%
    b. 65%
    c. 70%
    d. 75%

9. What is the discount price for a pair of shoes that cost $ 75.00, if the discount is 25%?
    a. $55.00
    b. $56.25
    c. $57.50
    d. $58.00

(Test continued on next page)

10. To find the original price, use the formula, Percent x Base = Amount.
    What is the original cost of the sofa, if the percent off discount is 40% and the discount amount is $165.00?
    a. $412.50
    b. $413.36
    c. $414.45
    d. $417.18

Measurements

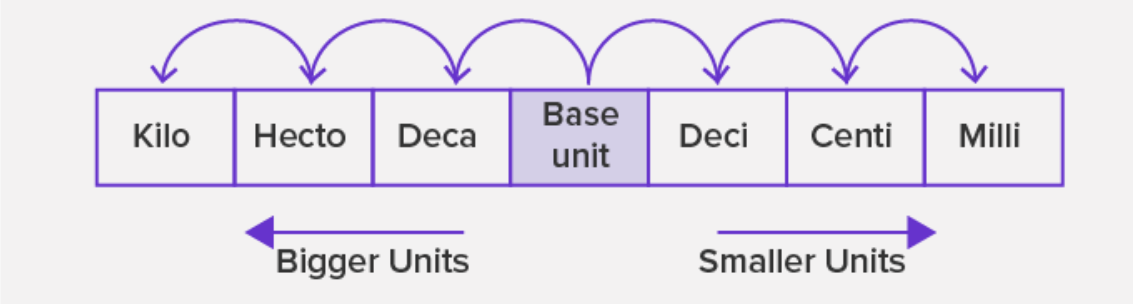


Figure 5

11. In figure 5 above, it is showing the metric system. If the base units are meters, convert 87,000 mm to Km.
    a. 0.87 Km
    b. 0.0087 Km
    c. 0.087 Km
    d. 0.00087 Km

12. In figure 5 above, it is showing the metric system. Laurence purchased a 200ml bottle of juice and purchased a second 3-liter bottle of juice. What is the difference in liters between the two juice bottle amounts?
    a. 2.08 L
    b. 2.008 L
    c. 2.8 L
    d. 28 L

(Test continued on next page)

Figure 6

13. The figure 6 above shows a digital scale and the weight of Ms. Roberson's grandson, Romiin, in kg. How many pounds is Romiin? (Round to the nearest whole number)
    a. 125 lbs.
    b. 126 lbs.
    c. 127 lbs.
    d. 128 lbs.

Geometry

Figure 6

14. The circumference of a circle is given by the formula, $C = \pi d$. The radius of the tire of a Lexus is 17 inches. Find the circumference of the tire using 3.14 for π. Round your final answer to the nearest whole number.
    a. 104 inches
    b. 105 inches
    c. 106 inches
    d. 107 inches

(Test continued on next page)

15. Given the right triangle below in figure 7, If a = 3 and c = 5, find b, the missing side.

a. 1
b. 2
c. 4
d. 6

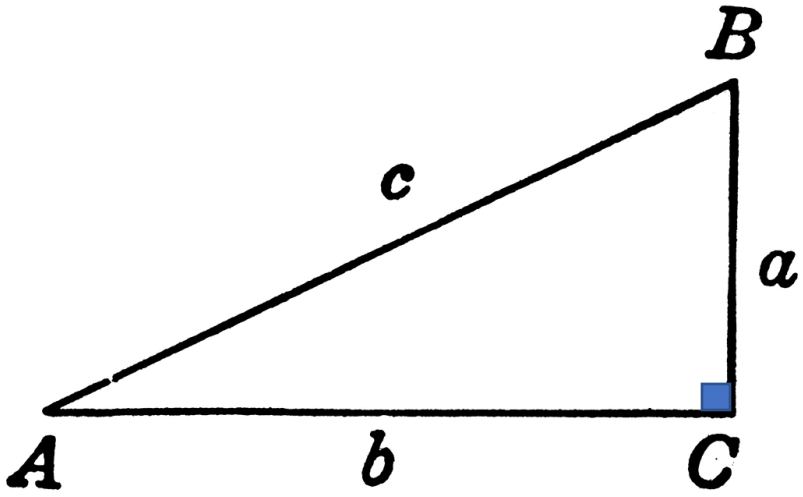


Figure 7

16. What is the positive root for $\sqrt{169?}$

a. -13
b. -12
c. 13
d. 12

(Test continued on next page)

17. For the figure 8 below, find the perimeter of the polygon.

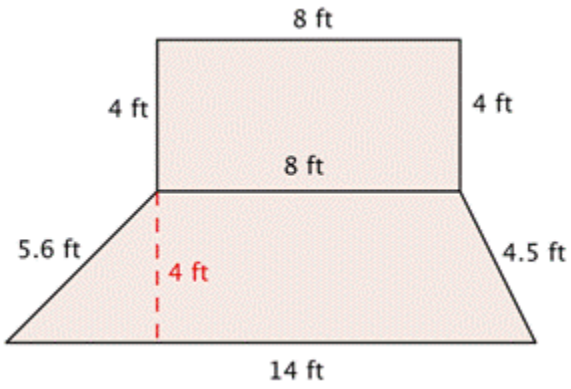


Figure 8

a. 44.0 ft
b. 42.3 ft
c. 40.1 ft
d. 4102 ft

Real Numbers

18. Simplify the expression. $\frac{(2+2^3)^2}{5}$

a. 4
b. 13.2
c. 20
d. 819.2

19. *Simplify*. $\sqrt{36} + |-50| - (-70 + 35)$.

a. 88
b. 89
c. 90
d. 91

20. Translate and evaluate the expression, x divided by 4 plus 9, if x = 4.

a. 11
b. 10
c. 9
d. 8

(Test continued on next page)

21. Simplify the expression. $4^2 - 5^2$.

a. -9
b. 9
c. 10
d. -10

22. Simplify the expression. $(\frac{15}{6} - \frac{9}{6}) - \frac{8}{9}$.

a. 1/9
b. 7/9
c. -8/9
d. -2/6

23. Write -6^3 in expanded notation and evaluate.

a. 216
b. 18
c. -216
d. -18

(End of Tier 1 test)

Tier 1 Answers and Explanations

Whole Numbers and Fractions

1. ANSWER: **d**
   This problem uses the basic principle of multiplication. The car travels 54 miles in one hour. To find the distance traveled in 24 hours multiply 54 x 24. 54 x 24 = 1,296 miles.

2. ANSWER: **b**
   This problem uses the formula for the area of a rectangle, *A = l x w*. In this case, the shape of the room is a square. So, the formula is modified, and the area of a square is *A = s x s.* To cover only half of the floor divide by 2. A = 11 x 11=121/2=60.5 sq. ft.

3. ANSWER: **d**
   This problem uses the Least Common Denominator (LCD). To find the height of the statue with the stand, add the 8 3/5 + 1 6/10 by first finding the LCD. 8 6/10 + 1 6/10 = 9 12/10. 12/10 needs to be written as a mixed number, 1 1/10 and added to 9 to get 10 1/10.

4. ANSWER: **a**
   This problem uses the division of fractions. The piece of ribbon is to be divided into 15 pieces, so, 1 7/8 divided by 15. Turn 1 7/8 into an improper fraction, 15/8. Then 15/8 can be multiplied by the reciprocal of 15, which is 1/15. So, 15/8 x 1/15 = 1/8.

Decimals

5. ANSWER: **b**
   Since each square is 1/100. Counting squares that are blue, there are 27. So, we can write this as a fraction, 27/100. 27/100 can be written as 27 hundredths. Then writing as an equivalent decimal, 0.27.

Ratios, Rates and Proportions

6. ANSWER: **b**
   There are two ratios. First, 3 T-shirts : 20 minutes and second, unknown number of T-shirts (T) : 180 minutes. Using proportions, and setting the two ratios equal to each other, it follows,

   $\frac{3}{20} = \frac{T}{180}$.

By cross multiplying, 20 x T = 3 x 180. Multiplying both sides give, 20T = 540. Solving for T, by dividing both sides by 20, gives, T = 27. So, 27 T-shirts will be decorated in 180 minutes.

7. ANSWER: **d**
To see if two ratios are in proportion, first make sure we are working with the same units, dollars to ounces. Then we set the two ratios equal to each other. Take the cross products of the numerator to denominator which must equal. This show equal proportions. The multiple-choice answers that are in proportion are a, b, and c. d is not in proportion because, 13 x 12 = 6 x 29 does not equal the same number. Therefore, the prices are not in proportion of each other.

Percent

8. ANSWER: **d**
By simply counting the unshaded blocks, there are 75 out of 100 blocks, unshaded. This represents 75% unshaded blocks.

9. ANSWER: **b**
To find the discount price, you first multiply the discount rate x the original price. So, multiply, ($75.00 x .25 = $18.75, remember to change your percent to a decimal by dividing by 100. Therefore, by subtracting $18.75 from the original price of, $75.00, equals the discount price of $56.25.

10. ANSWER: **a**
Following the formula 0.40 x S = $165.00, where S is the unknown original price, solve for S by dividing by 0.40 on both sides. This gives the original price of $412.50.

Measurements

11. ANSWER: **c**
Start counting from the decimal point in the smaller unit, 87,000 mm and move 6 spaces to the left until you get to Km. Now move the decimal, in the number 87,000, 6 places to the left also. Since this is a whole number, the decimal is behind the last zero in 87.000 mm. The conversion is equal to 0.087Km.

12. ANSWER: **c**

The two bottles must be in the same metric units. Convert 200ml to liters. Using Figure 5 above, this gives 0.2 L. Therefore, to find the difference, subtract, 0.2 from 3 and get, 2.8 L.

13. ANSWER: **a**

Converting 56.8Kg to pounds, multiplying by 2.2, (1 kg = 2.2 pounds), therefore, Romiin weighs 124.96 pounds. Rounding to the nearest whole number, the answer is 125 lbs.

Geometry

14. ANSWER: **d**

The diameter of the tire is 2 times the radius, which would be 34 inches. Using the formula above, C = 3.14 x 34 results in 106.76 in. Rounding 106.76 to the nearest whole number gives 107. So, the circumference of the Lexus tire is 107 inches.

15. ANSWER: **c**

To find the missing side, b, use the Pythagorean theorem formula, $a^2 + b^2 = c^2$ Replace a and c in the formula, with their respective values. Therefore,

$a^2 + b^2 = c^2$

$3^2 + b^2 = 5^2$

$9 + b^2 = 25$

subtract 9 from both sides,

$b^2 = 25 - 9$

$b^2 = 16$, take the square root of both sides,

$b = 4\ or\ -4$, but since length cannot be negative, b = 4

16. ANSWER: **c**

Take the square root of 169, so $\sqrt{169}$ = ± 13. So, the positive root is +13.

17. ANSWER: **c**

To find the perimeter of the polygon, add all sides around the shape.
P = 4 + 8 + 4 + 4.5 + 14 + 5.6 = 40.1.

Real Numbers

18. ANSWER: **c**

Following order of operation, PEMDAS, $\frac{(2+2^3)^2}{5}$ =

$2^3 = 8$

$(2 + 8)^2$

$(10)^2$

100

100 ÷ 5

20

19. ANSWER: **d**

Following PEMDAS, $\sqrt{36} + |-50| - (-35)$,

6 + 50 +35

56+35

91

20. ANSWER: **b**

Translated, we have, $\frac{x}{4} + 9$. $Since\ x = 4, then\ \frac{4}{4} + 9 = 1 + 9 = 10.$

21. ANSWER: **a**

By following order of operations, and working from left to right, take the square of 4, by multiplying 4 times 4, and the same for 5 squared. Then subtract the two from each other, as follows: 16 – 25 = -9.

22. ANSWER: **a**

Following order of operations and working in parentheses first, subtract the fractions which gives you, 6/6 or 1. Subtract 1 – 8/9 by turning 1 into 9/9. 9/9 – 8/9 = 1/9

23. ANSWER: **c**

To write in expanded form, is, - 6 x 6 x 6 = - 216. The expanded notation is not (-6)(-6)(-6) = -216. Although the answer is the same, the number raised to the 3rd power is a positive 6, and then take the opposite of that.

Tier 2 Practice Test Questions

Solving Equations and Inequalities

1. Solve for *x*: $x+(-9)=27$
   a. x = 18
   b. x = 3
   c. x = 243
   d. x = 36

2. Solve for *y*: $41-y=90$
   a. y = - 49
   b. y = - 48
   c. y = - 47
   d. y = - 46

3. Solve for x: $6x+11=-73$
   a. x = 10.3
   b. x = 14
   c. x = -10.3
   d. x = -14

4. Solve for y: $3y-2=6-4y$
   a. y = 7/8
   b. y = 4/7
   c. y = 8/7
   d. y = -4

5. When solving an equation, which option shows a result that would be translated to a solution of *all real numbers*?
   a. x = 1
   b. x = 0
   c. 0 = 0
   d. 2 = 3

(Test continued on next page)

6. Which equation matches the information: *Henry's appetite (H) is twice as big as Guy's appetite (G)*?
   a. 2(G) = H
   b. G x H = 2
   c. H (2) = G
   d. 2 + G = H

7. Maria can jump twice as high as Ji-ho. If Maria jumps 3 feet, how high does Ji-ho jump?
   a. 1.5 feet
   b. 6 feet
   c. 5 feet
   d. 1 foot

8. Given $h - 28 > 28$, the graph of the solution set will have _____ circle? (Fill in the blank).
   a. a closed
   b. an open

Graphing

9. What is the domain for the following set of points?
   (1,2), (4,6), (8, 10), (12, 14)
   a. {2, 6, 10, 14}
   b. {1, 4, 8, 12}
   c. {1, 6, 8, 14}
   d. {2, 4, 6, 8}

(Test continued on next page)

10. In Figure 10, which quadrant is the rectangle in?
    a. I
    b. II
    c. III
    d. IV

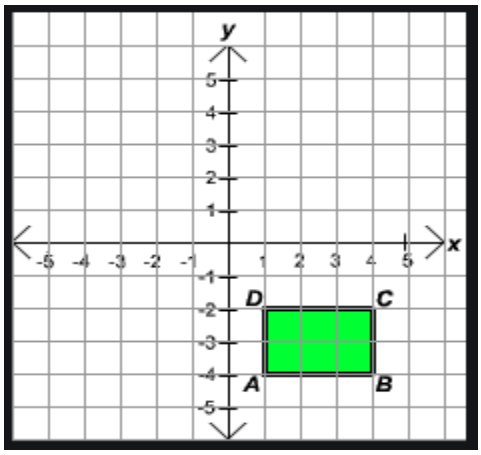


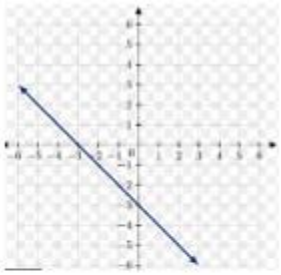
Figure 10

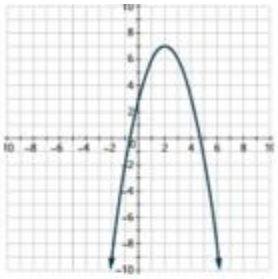
11. In what quadrant will you find the ordered pair (-13, -5)?

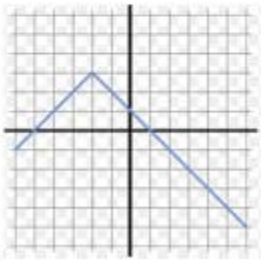
    a. I
    b. II
    c. III
    d. IV

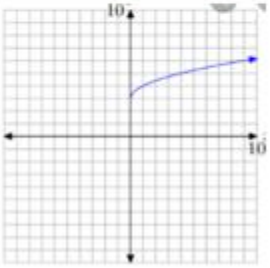
(Test continued on next page)

12. Which of the graphs below represents a linear equation?

a. 

b. 

c. 

d. 

13. What is the simplified slope of the line in Figure 11?
    a. Slope is 8/10
    b. Slope is 10/8
    c. Slope is 4/5
    d. Slope is 5/4

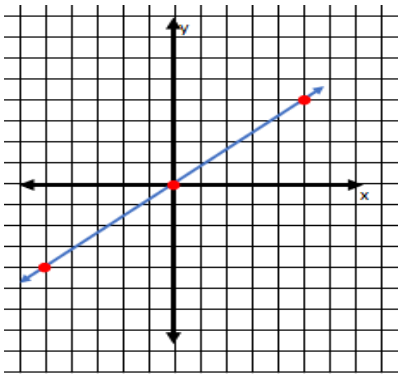


Figure 11

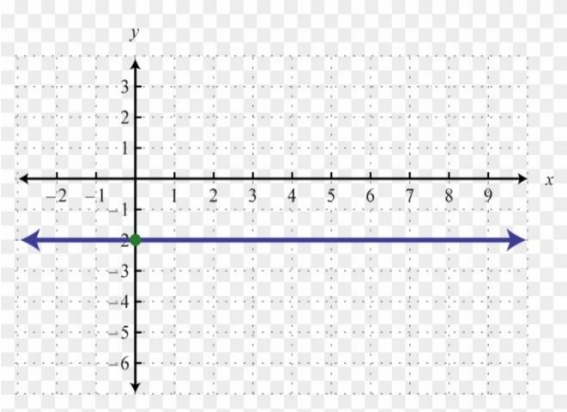
14. The slope-intercept formula, $y = mx + b$, can be used to identify the slope and y-intercept of a line. Which variable in the formula represents the slope?
    a. y
    b. b
    c. x
    d. m

(Test continued on next page)

15. What can be said about the graphs of the lines $y = 7x - 9$ and $y = 7x + 5$?
    a. The lines are skew
    b. The lines are parallel
    c. The lines are perpendicular
    d. None of the above

16. What is the slope of the line in Figure 13?
    a. undefined
    b. -2
    c. 2
    d. 0

Figure 13



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17. In the *Figure 12* graph below, assuming lines n and o are parallel, which two lines are perpendicular?

a. Lines m and o
b. Lines n and o
c. Lines l and m
d. Lines m and A

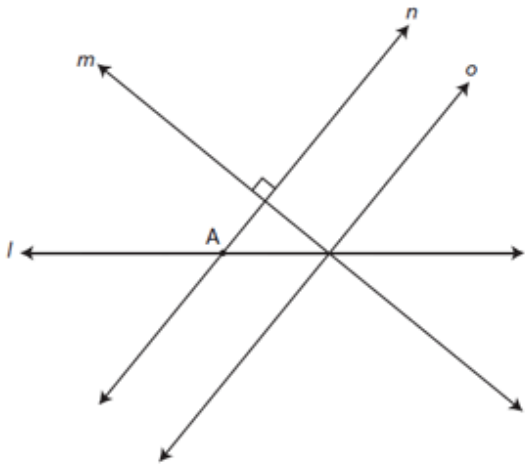


Figure 12

Exponents and Polynomials

18. Given the polynomial expression $6x^4+5x+1$, the constant term is:
    a. 5x
    b. 1
    c. $6x^4$
    d. x

19. Add $\left(-7x^7+5x^4-4x-8\right)+\left(11x^7-10x^5+2x^4+4x-9\right)$.

    a. $4x^7-10x^5+7x^4-17$
    b. $-4x^7+10x^5-7x^4+17$
    c. $4x^{14}-5x^9-2x^5+4x-17$
    d. $x^{29}-17$

(Test continued on next page)

20. Consider the rectangle with sides of $(x+3)$ *and* $(4x-7)$. Find the area in terms of x.

a. $5x^2-4$
b. $4x^2-21$
c. $4x^2-5x-21$
d. $4x^2+5x-21$

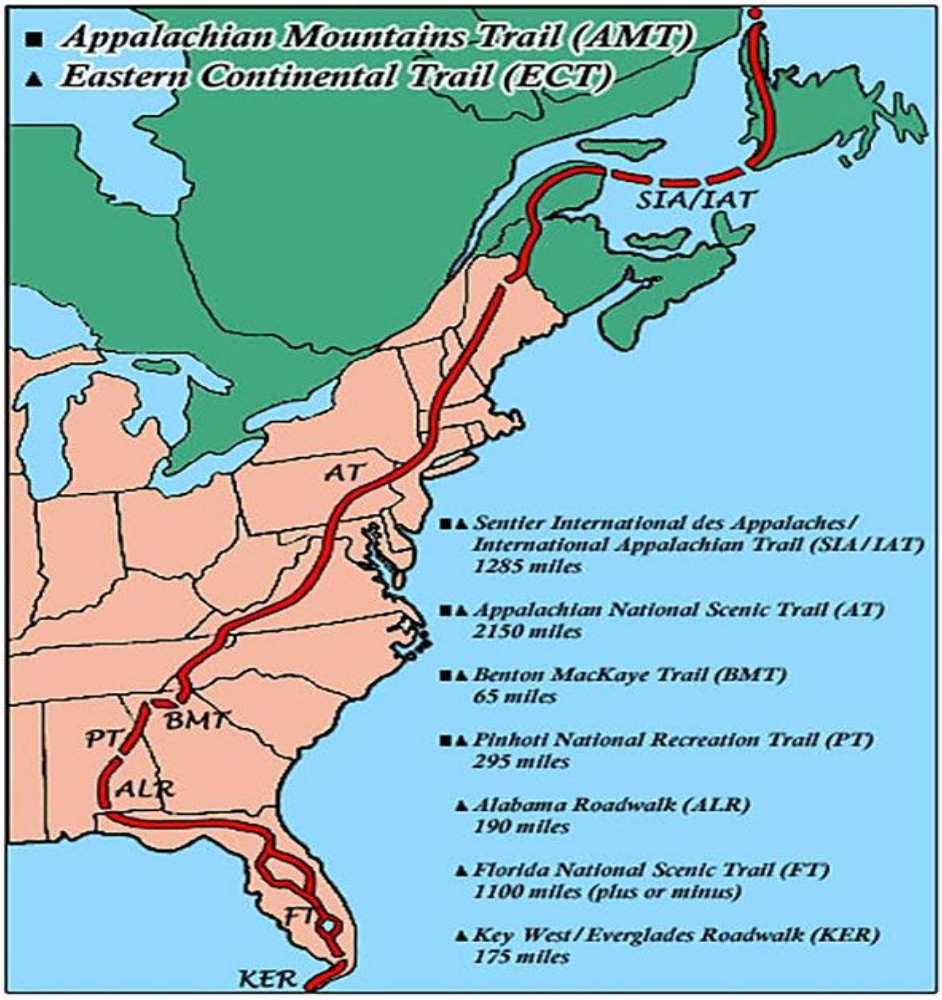
Statistics

21. Find the mean number of miles for the following 5 NASCAR Motor speedways: Talladega 2.660, Pocono 2.500, Atlanta, 1.540, Bristol 0.533 and Lowes (Charlotte) 1.500.
    a. 8.733 mi
    b. 1.540 mi
    c. 1.7466 mi
    d. 107046 mi

(Test continued on next page)

22. Using Figure 15, how many modes are there for the length of the top U.S. top hiking trails?
    a. 0
    b. 1
    c. 2
    d. 3

Figure 15



(End of Tier 2 test)

Tier 2 Answers and Explanations

1. ANSWER: **d** Using the Addition Property of Equality to solve for *x*, add 9 (opposite of -9) to both sides. The solution is x = 36.

2. ANSWER: **a** Solve using the Addition and Multiplication Properties of Equality.

$$\begin{aligned} 41 - y &= 90 \\ \cancel{41} \cancel{-41} - y &= 90 - 41 \\ -y &= 49 \\ \frac{\cancel{-1}y}{\cancel{-1}} &= \frac{49}{-1} \\ y &= -49 \end{aligned}$$

3. ANSWER: **d** Solve using the Addition and Multiplication Properties of Equality.

$$\begin{aligned} 6x + 11 &= -73 \\ 6x \cancel{+11} \cancel{-11} &= -73 - 11 \\ 6x &= -84 \\ \frac{\cancel{6}x}{\cancel{6}} &= \frac{-84}{6} \\ x &= -14 \end{aligned}$$

4. ANSWER: **c** Solve using the Addition and Multiplication Properties of Equality.

$$\begin{aligned} 3y - 2 &= 6 - 4y \\ 3y + 4y - 2 &= 6 \cancel{-4y} \cancel{+4y} \\ 7y \cancel{-2} \cancel{+2} &= 6 + 2 \\ \frac{\cancel{7}y}{\cancel{7}} &= \frac{8}{7} \\ y &= \frac{8}{7} \end{aligned}$$

5. ANSWER: **c** For an equation to have a solution of all real numbers, the equation must be an identity. This means that the two sides are identical, as they are with 0 = 0.

6. ANSWER: **a** Replacing the names with their first letters and the word *is* with =, we get H=2(G), which is equivalent to 2(G)=H.

7. ANSWER: **a** Since Maria can jump twice as high as Ji-ho, then Ji-ho jumps half as high as Maria.

8. ANSWER: **b** Isolate the variable by adding 28 to both sides. $h > 56$. The graph of the inequality will be open since the inequality means "*h is greater than 56*".

9. ANSWER: **b** The numbers are 1, 4, 8, and 12. These are all the x coordinates, which represents the domain of x.

10. ANSWER: **d** The quadrants are counted counterclockwise beginning with the top right quadrant, so the box is in quadrant IV

11. ANSWER: **c** The point is in quadrant III because both coordinates are negative.

12. ANSWER: **a** The graph of a linear equation is a straight line.

13. ANSWER: **c** Using rise/run the slope is 4/5, which is the simplified version of 8/10.

14. ANSWER: **d** The *m* represents the slope of a line in the formula. The variables *x and y* represent the coordinates of points on the line, and the *b* represents the *y*-intercept.

15. ANSWER: **b** The slope in both equations is m = 7. Since the slopes are equal, the lines are parallel.

16. ANSWER: **d** The line is horizontal, so the slope is zero. If the graph were a vertical line, as in the equation x = -2, the slope would be undefined

17. ANSWER: **a** Since line *n* and *o* are parallel, and line *m* is perpendicular to *n,* then *m* is also perpendicular to *o.*

18. ANSWER: **b** The constant term in this polynomial expression is 1 since it is the only term without a variable. The other terms are variable terms, and the numbers in front of the variables are called coefficients.

19. ANSWER: **a** Since it is addition, simply remove the parentheses and combine like terms.

20. ANSWER: **d** Use the FOIL method to multiply the two binomials

21. ANSWER: **c** Adding all the values and dividing by 5 gives the mean of 1.7466.

22. ANSWER: **a** There is no reoccurrence of numbers (miles).

Tier 3 Placement Test Practice Problems

Factoring

1. Completely factor the following polynomial by first factoring out the GCF and then factoring the resulting trinomial.

$$x^5 - 7x^4 + 12x^3$$

a. $6x^4$
b. $x^5(x+3)(x-4)$
c. $x^3(x^2 - 7x + 12)$
d. $x^3(x-4)(x-3)$

2. Factor. $18y^2 - y - 4$

a. $(3y+4)(6y-1)$
b. $(2y-2)(9y-2)$
c. $(2y-1)(9y+4)$
d. $(2y-4)(9y+1)$

3. Factor. $9x^2 - 49$

a. $(3x-7)(3x-7)$
b. $(9x-1)(40x+1)$
c. $(3x+7)(3x+7)$
d. $(3x+7)(3x-7)$

(Test continued on next page)

4. Find the factor that $5y^2 + 33y - 14$ and $10y^2 - 9y + 2$ have in common.

   a. $2y - 1$
   b. $5y - 12$
   c. $5y - 2$
   d. $y + 7$

5. Solve for x. $x^2 + 17x + 50 = -20$

   a. $x = 10$ or $x = 7$
   b. $x = 88$
   c. $x = -10$ or $x = 7$
   d. $x = -10$ or $x = -7$

6. A rectangular sheet of paper has an area of $85\ in^2$. If the length of the paper is $1\frac{1}{2}$ in more than the width, what are the dimensions of the sheet of paper?

   a. $\text{width} = 8\frac{1}{2}$ in
      $\text{length} = 10$ in

   b. $\text{width} = 8$ in
      $\text{length} = 10\frac{1}{2}$ in

   c. $\text{width} = 5$ in
      $\text{length} = 17$ in

   d. $\text{width} = 15\frac{1}{2}$ in
      $\text{length} = 17$ in

(Test continued on next page)

7. Divide and simplify. $\dfrac{x^2-3x-28}{x-11} \div \dfrac{x^2+x-56}{x-11}$

a. $\dfrac{-2x-86}{x-11}$

b. $\dfrac{-1}{(x-11)^2}$

c. $\dfrac{x+4}{x+8}$

d. $\dfrac{1}{2}$

8. Simplify and express the result in simplest form.

$$\frac{8y}{3x} - \frac{6y^2}{x^2} + \frac{10y^3}{3}$$

a. $\dfrac{2xy(4x-3y+5xy)}{3}$

b. $\dfrac{2y(4x-9y+5x^2y^2)}{3x^2}$

c. $\dfrac{12y^2}{5x}$

d. $2\dfrac{2}{3} \cdot \dfrac{y}{x} - 6 \cdot \dfrac{y^2}{x^2} + 3\dfrac{1}{3} \cdot y^3$

(Test continued on next page)

9. Solve for x: $\frac{2-x}{10} = \frac{x}{5}$

   a. $x = -1$

   b. $x = \frac{2}{3}$

   c. $x = \frac{1}{2}$

   d. $x = 0$

10. The time it takes to travel a particular distance varies inversely as the speed traveled. If it takes a person 15 hours to travel from point A to point B at a speed of 60 miles per hour, how long will it take to travel from point A to point B at 75 miles per hour?

    a. 12 hours
    b. 30 hours
    c. 10 hours
    d. 18.75 hours

Radical Expressions and Equations and Quadratic Formula

11. The formula for the volume of a sphere is $V = \frac{4}{3}\pi r^3$, where V is the volume and r is the radius of the sphere. Solve the formula for r.

    a. $r = \frac{V}{4\pi}$

    b. $r = \frac{4\pi}{V}$

    c. $r = \sqrt[3]{\frac{V - \frac{4}{3}}{\pi}}$

    d. $r = \sqrt[3]{\frac{3V}{4\pi}}$

(Test continued on next page)

12. John and his little brother Kevin have a job that requires them to rake and bag leaves at a large house in their neighborhood. Suppose it takes John 2 hours to do the job alone and Kevin 3 hours to do the job alone. At these rates, how long will it take both boys to complete the job together?

a. 5 hours
b. 1.25 hours
c. 1 hour
d. 1.2 hours

13. Simplify: $\sqrt{x^4y^6z^9}$, $z \geq 0$

a. $x^2 y^3 z^4 \sqrt{z}$

b $\left(2x\right)\left(3y\right)\left(4\frac{1}{2}z\right)$

c. $x^2 \left|y^3\right| z^4 \sqrt{z}$

d. $x^8 y^{12} z^{18}$

14. Simplify: $\sqrt{3b}\left(5\sqrt{3b} - \sqrt{12b^7}\right)$, $b \geq 0$

a. $15b - 6b^4$

b. $3b^3\sqrt{3b}$

c. $6b - 15b^2$

d. $3b^2 - \sqrt{3b}$

(Test continued on next page)

15. Simplify: $\sqrt[3]{54b^8c^9}$

a. $3b^2c^3\sqrt[3]{2b^2}$

b. $3b^4c^4\sqrt{6c}$

c. $162b^{24}c^{27}$

d. $18b^2c^3\sqrt[3]{b^2}$

16. Rationalize the denominator and simplify the result. $\dfrac{6+\sqrt{10}}{\sqrt{5}}$

a. $\dfrac{11\sqrt{5}}{25}$

b. $\dfrac{11\sqrt{10}}{5}$

c. $6+\sqrt{2}$

d. $\dfrac{6\sqrt{5}+5\sqrt{2}}{5}$

17. Solve for x: $-4\sqrt{11+x}+15=3$

a. $x=\sqrt{13}$

b. $x=-2$

c. $x=2$

d. $x=-13$

(Test continued on next page)

18. Solve for x using the Quadratic Formula: $5x^2 - 2 = 12x$

a. $6 + \sqrt{46}$ or $6 - \sqrt{46}$

b. $\frac{6}{5} + \frac{\sqrt{46}}{5}$ or $\frac{6}{5} - \frac{\sqrt{46}}{5}$

c. $\frac{2}{5}$ or $-\frac{2}{5}$

d. $\frac{5}{12}$ or $-\frac{5}{12}$

19. Use the discriminant to determine the number and type of solutions to the following quadratic equation.

$7x^2 - 3x + 1 = 0$

a. one real solution

b. two real solutions

c. no solutions

d. two complex solutions

(Test continued on next page)

Functions

20. What are the domain and range of the following function?

$$\{(5,-8),(9,2),(15,2),(19,-8),(7,0)\}$$

a. $\text{Domain}: \{-8, 0, 2\}$
$\text{Range}: \{5, 7, 9, 15, 19\}$

b. $\text{Domain}: \{5, 7, 9, 15, 19\}$
$\text{Range}: \{-8, 0, 2\}$

c. $\text{Domain}: \{5, 7, 9, 15, 19\}$
$\text{Range}: \{-8, -8, 0, 2, 2\}$

d. $\text{Domain}: \{5, 7, 9, 11, 13\}$
$\text{Range}: \{-8, -4, -2, 0, 2\}$

21. What are the domain and range of the function $f(x) = \sqrt{x}$

a. $\text{Domain}: x > 0$
$\text{Range}: f(x) > 0$

b. $\text{Domain}: x > 0$
$\text{Range}: \text{All real numbers}$

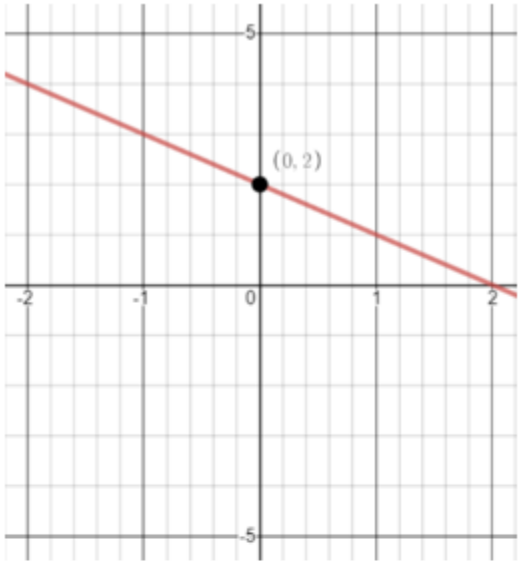
c. $\text{Domain}: x \geq 0$
$\text{Range}: f(x) \geq 0$

d. $\text{Domain}: \text{All real numbers}$
$\text{Range}: \text{All real numbers}$

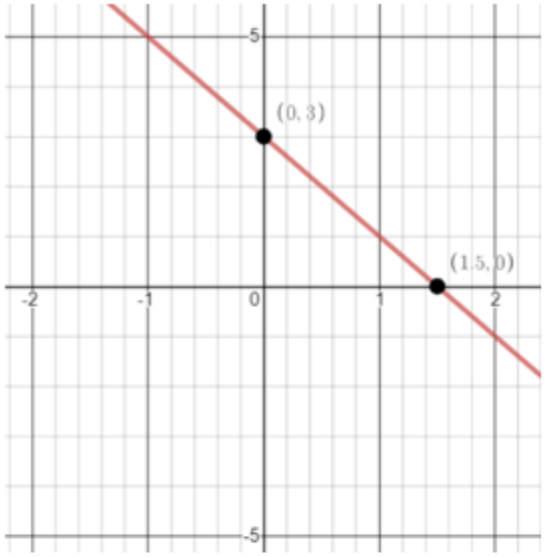
(Test continued on next page)

22. Graph: $f(x) = -2x + 3$

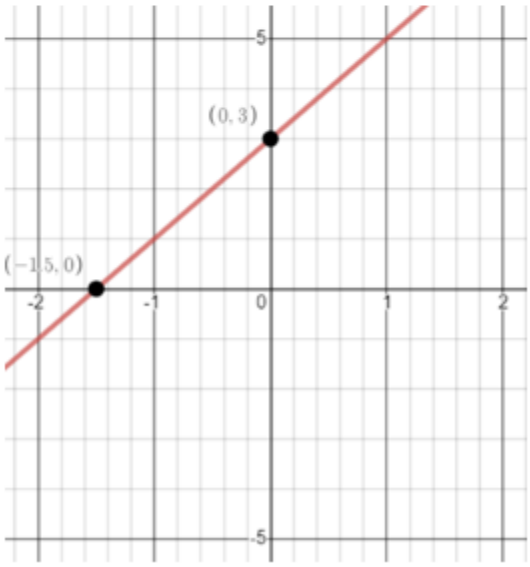
a.



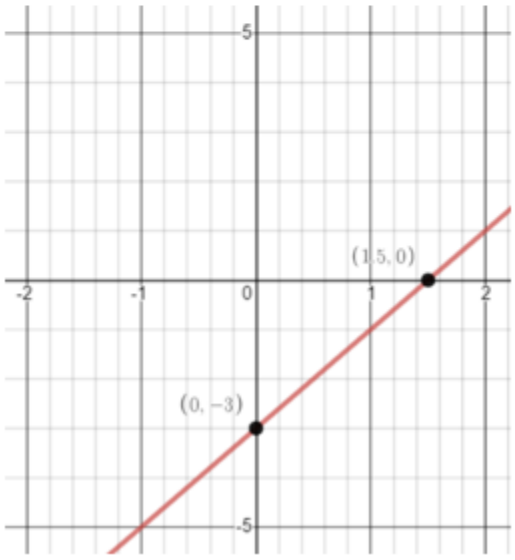
c.



b.



d.



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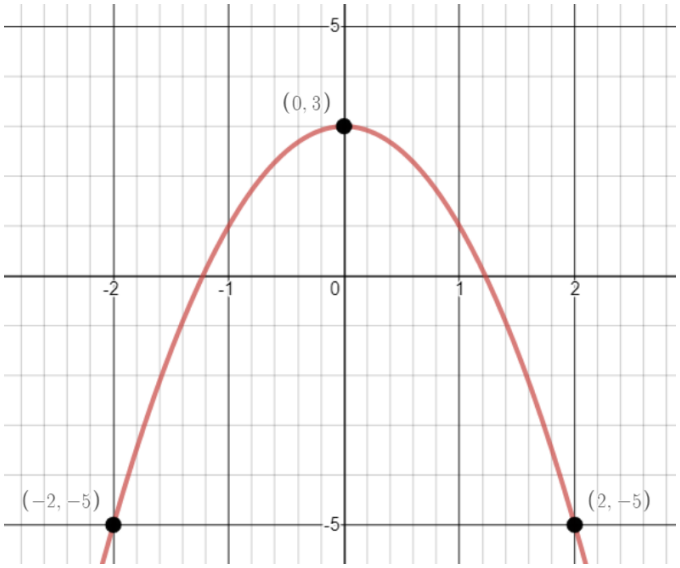
23. Which of the functions below is represented by the following graph?



a. $f(x) = 5x^2 + 3$

b. $f(x) = -2x^2 + 3$

c. $f(x) = -5x^2 + 3$

d. $f(x) = 2x^2 + 3$

24. Which function below has a graph that passes through all 4 of these points:

$(0,1)$, $(-1,0)$, $(-2,-1)$, $(7,2)$

a. $f(x) = (x+1)^2$

b. $f(x) = x + 1$

c. $f(x) = \sqrt[3]{x+1}$

d. $f(x) = -\frac{1}{2}x + 1$

(Test continued on next page)

25. Given that $f(x) = 10x - 3$, find $f(x - 3)$.

a. $f(x - 3) = 10x - 33$

b. $f(x - 3) = -33$

c. $f(x - 3) = 10x - 6$

d. $f(x - 3) = 11x - 6$

(End of Tier 3 test)

Tier 3 Answers and Explanations

1. ANSWER: **d**

The GCF for $x^5 - 7x^4 + 12x^3$ is x^3. When this is factored out of $x^5 - 7x^4 + 12x^3$, this gives $x^3\left(x^2 - 7x + 12\right)$.

However, the resulting trinomial in parentheses, $x^2 - 7x + 12$, is factorable. The trinomial factors into two binomials, $\left(x - 4\right)\left(x - 3\right)$.

So, the completely factored result is $x^3\left(x - 4\right)\left(x - 3\right)$.

Note that you can use FOIL to verify that $\left(x - 4\right)\left(x - 3\right) = x^2 - 7x + 12$.

2. ANSWER: **c**

One way to see that this result is correct is by using FOIL or some other form of the distributive property:

F multiply first terms $\left(2y\right)\left(9y\right) = 18y^2$

O multiply outer terms $\left(2y\right)\left(4\right) = 8y$

I multiply inner terms $\left(-1\right)\left(9y\right) = -9y$

L multiply last terms $\left(-1\right)\left(4\right) = -4$

Now simplifying, you have $18y^2 + 8y - 9y - 4$

$= 18y^2 - y - 4$.

3. ANSWER: **d**

$9x^2 - 49$ is a binomial that is classified as the difference of two perfect squares. This type of polynomial is always factorable. You can check that the answer given is correct by using FOIL:

F multiply first terms $\left(3x\right)\left(3x\right) = 9x^2$

O multiply outer terms $\left(3x\right)\left(-7\right) = -21x$

I multiply inner terms $\left(7\right)\left(3x\right) = 21x$

L multiply last terms $(7)(-7) = -49$

Gathering terms and simplifying, you get $9x^2 - 21x + 21x - 49$

$= 9x^2 - 49$

4. ANSWER: **c**

For this problem, both $5y^2 + 33y - 14$ and $10y^2 - 9y + 2$ need to be completely factored. Here are their factorizations:

$$5y^2 + 33y - 14 = (5y - 2)(y + 7)$$
$$10y^2 - 9y + 2 = (5y - 2)(2y - 1)$$

The factor that both polynomials have in common is $5y - 2$.

5. ANSWER: **d**

The given equation, $x^2 + 17x + 50 = -20$, is a quadratic equation. One means to solve a quadratic equation is by writing it in standard form
($ax^2 + bx + c = 0$) and then attempting to factor the trinomial on the left of the equal sign.

For the given equation, standard form is $x^2 + 17x + 70 = 0$. Note that 20 was added to both sides of the original equation.

The trinomial to the left of the equals sign does indeed factor. So, in factored form, the equation becomes $(x + 7)(x + 10) = 0$.

Setting both factors equal to zero and solving for x, you will get
$x = -10$ or $x = -7$.

You can see that these two solutions are correct by substituting them back into
$x^2 + 17x + 50 = -20$.

6. ANSWER: **a**

The equation that describes the information given in the problem is $w\left(w + 1\frac{1}{2}\right) = 85$, where w represents the width of the sheet of paper. This is a quadratic equation that in standard form ($ax^2 + bx + c = 0$) becomes

$w^2 + 1\frac{1}{2}w - 85 = 0.$

To give an equivalent equation that doesn't contain fractions, you can multiply both sides of the above equation by 2. The resulting equation is

$2w^2 + 3w - 170 = 0.$

The trinomial on the left can be factored and now gives

$(2w - 17)(w + 10) = 0$

Setting both factors equal to zero and then solving for w, you get

$w = 8\frac{1}{2}$ or $w = -10.$

Since the width can't be a negative number, its value is $8\frac{1}{2}$ in. The length is $1\frac{1}{2}$ in more than this, which is 10 in ($8\frac{1}{2} + 1\frac{1}{2} = 10$).

7. ANSWER: **c**

To simplify $\frac{x^2 - 3x - 28}{x - 11} \div \frac{x^2 + x - 56}{x - 11}$, first write the problem in terms of multiplication, then factor the trinomials, and finally cancel common factors:

$$\frac{x^2-3x-28}{x-11} \div \frac{x^2+x-56}{x-11}$$

$$= \frac{x^2-3x-28}{x-11} \cdot \frac{x-1}{x^2+x-56}$$

$$= \frac{(x-7)(x+4)}{x-11} \cdot \frac{x-11}{(x+8)(x-7)}$$

$$= \frac{\cancel{(x-7)}(x+4)}{\cancel{x-11}} \cdot \frac{\cancel{x-11}}{(x+8)\cancel{(x-7)}}$$

$$= \frac{x+4}{x+8}$$

8. ANSWER: **b**

To simplify $\frac{8y}{3x} - \frac{6y^2}{x^2} + \frac{10y^3}{3}$, the fractions need to be written with a common denominator. For this rational expression, the least common denominator (LCD) is $3x^2$.

Writing each fraction in terms of the $3x^2$, gives

$$\frac{8y}{3x} \cdot \frac{x}{x} - \frac{6y^2}{x^2} \cdot \frac{3}{3} + \frac{10y^3}{3} \cdot \frac{x^2}{x^2}$$

$$\frac{8xy}{3x^2} - \frac{18y^2}{3x^2} + \frac{10x^2y^3}{3x^2}$$

$$\frac{8xy - 18y^2 + 10x^2y^3}{3x^2}$$

Finally, factoring the numerator above gives

$$\frac{2y\left(4x - 9y + 5x^2y^2\right)}{3x^2}.$$

9. ANSWER: **b**

One way to solve the rational equation, $\frac{2-x}{10} = \frac{x}{5}$, is by eliminating the fractions. This can be accomplished by multiplying both sides of the equation by the least common denominator (LCD) of the fractions. In this case, the LCD is 10.

Here is the result of multiplying both sides of the equation by 10 and then continuing to solve for x:

$$10 \cdot \frac{2-x}{10} = \frac{x}{5} \cdot 10$$

$$2 - x = 2x$$

$$-2x - x = -2$$

$$-3x = -2$$

$$x = \frac{2}{3}$$

10. ANSWER: **a**

Since the problem deals with inverse variation, it can be modeled with the equation $t = \frac{k}{v}$, where t is the time, v is the speed, and k is proportionality constant.

Substituting $t = 15$ and $v = 60$ into the equation and then solving for k, this gives

$$15 = \frac{k}{60}$$

$$60 \cdot 15 = \frac{k}{60} \cdot 60$$

$$900 = k$$

So, now the general form of the inverse variation equation is

$$t = \frac{900}{v}$$

To find how long it will take to travel from point A to point B at 75 miles per hour, just substitute 75 for v in the general equation:

$$t = \frac{900}{75}$$

$$t = 12$$

It will take 12 hours to travel from point A to B at a speed of 75 miles per hour.

11. ANSWER: **d**

The solution for this problem requires using algebraic steps to solve the volume formula, $V = \frac{4}{3}\pi r^3$, for V:

$$V = \frac{4}{3}\pi r^3$$

$$V = \frac{4\pi}{3} r^3$$

$$\frac{3}{4\pi} \cdot V = \frac{3}{4\pi} \cdot \frac{4\pi}{3} r^3$$

$$\frac{3V}{4\pi} = r^3$$

The last step in isolating r is to take the cube root of both sides of the equation:

$$\frac{3V}{4\pi} = r^3$$

$$\sqrt[3]{\frac{3V}{4\pi}} = \sqrt[3]{r^3}$$

$$r = \sqrt[3]{\frac{3V}{4\pi}}$$

12. ANSWER: **d**

There's more than one way to think about finding a solution to this problem, but here's one approach:

Summarizing the information given in the problem, it takes John 2 hours to do the job alone, and it takes Kevin 3 hours to do the job alone.

This means that John could do 3 jobs in 6 hours and Kevin could do 2 jobs in 6 hours. In other words, together they could do 5 jobs in 6 hours. Using this rate to calculate the number of hours per job, you get

$$\frac{6 \text{ hours}}{5 \text{ jobs}} = 1.2 \text{ hours per job}.$$

13. ANSWER: **c**

Simplifying the radical expression, $\sqrt{x^4y^6z^9}$, $z \geq 0$, requires writing the radicand (part under the radical) in terms of perfect squares since the radical is a square root. Here is the radical simplified with perfect squares:

$$\sqrt{x^4y^6z^9}$$

$$= \sqrt{\left(x^2\right)^2\left(y^3\right)^2\left(z^4\right)^2 z}$$

The factors highlighted in red are perfect squares, which means that when the square root is taken, the result will be the portion inside parentheses. So further simplifying, you will get

$$\sqrt{\left(x^2\right)^2\left(y^3\right)^2\left(z^4\right)^2 z}$$

$$= x^2 y^3 z^4 \sqrt{z}$$

This appears to be the solution, but it isn't. You were told at the beginning of the problem that $z \geq 0$, but you were not told anything about the variables x or y. In fact, they could be negative numbers. If y, in particular, is negative then the above solution is incorrect.

So, since we don't know whether y is negative or positive, the correct solution is

$x^2 \left|y^3\right| z^4 \sqrt{z}$.

Check the YouTube video below for a detailed explanation of why absolute value bars are necessary for the result.

https://www.youtube.com/watch?v=dqek7EkXcYo

14. ANSWER: **a**

For this problem, since $b \geq 0$, the final result won't require any absolute value bars, as was the case in problem #13. To simplify $\sqrt{3b}\left(5\sqrt{3b} - \sqrt{12b^7}\right)$, distribute and continue simplifying:

$$\sqrt{3b}\left(5\sqrt{3b} - \sqrt{12b^7}\right)$$

$$= 5\sqrt{9b^2} - \sqrt{36b^8}$$

$$= 5(3b) - 6b^4$$

$$= 15b - 6b^4$$

15. ANSWER: **a**

To simplify the given radical expression, $\sqrt[3]{54b^8c^9}$, the radicand (expression under the radical symbol) needs to be expressed in terms of perfect cubes, since the radical is a cube root:

$$\sqrt[3]{54b^8c^9}$$

$$= \sqrt[3]{(3)^3 \cdot 2\left(b^2\right)^3 \cdot b^2 \cdot \left(c^3\right)^3}$$

The factors in red are perfect cubes, and once the cube root of these is extracted, the result will be the expression inside the parentheses. So, simplifying further, you have

$$\sqrt[3]{(3)^3 \cdot 2\left(b^2\right)^3 \cdot b^2 \cdot \left(c^3\right)^3}$$

$$3b^2c^3\sqrt[3]{2b^2}$$

Note that since the original radical is a cube root (index is odd), there won't be a need for absolute value bars in the final answer. In short, when the index of a radical is odd (cube roots, 5^{th} roots, etc.), or the variables in the radicand are all positive, absolute value bars won't be necessary in final result.

16. ANSWER: **d**

To rationalize the denominator in $\frac{6+\sqrt{10}}{\sqrt{5}}$, means to get rid of the radical in the denominator. This is achieved by multiplying the numerator and denominator of the radical expression by $\sqrt{5}$ and then simplifying:

$$\frac{6+\sqrt{10}}{\sqrt{5}}$$

$$= \frac{6+\sqrt{10}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}}$$

$$\frac{\sqrt{5}\left(6+\sqrt{10}\right)}{\sqrt{25}}$$

$$= \frac{6\sqrt{5}+\sqrt{50}}{5}$$

$$= \frac{6\sqrt{5}+\sqrt{5^2 \cdot 2}}{5}$$

$$= \frac{6\sqrt{5}+5\sqrt{2}}{5}$$

17. ANSWER: **b**

To solve for x, isolate the radical expression so that it is alone on one side of the equation:

$$-4\sqrt{11+x}+15=3$$

$$-4\sqrt{11+x}=-12$$

$$\sqrt{11+x}=3$$

Now, just square both sides of the above equation. This will cancel the square root.

$$\left(\sqrt{11+x}\right)^2 = (3)^2$$

$$11 + x = 9$$

$$x = -2$$

18. ANSWER: **b**

The Quadratic Formula will be used to solve $5x^2 - 2 = 12x$. This can be obtained from the provided formula chart: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

The first step in obtaining the solution is to write the given quadratic in standard form ($ax^2 + bx + c = 0$). This gives

$$5x^2 - 2 = 12x$$

$$5x^2 - 12x - 2 = 0$$

From here, identify the constants, a, b, and c, to substitute into the Quadratic Formula.

$$a = 5$$
$$b = -12$$
$$c = -2$$

Substituting these values in the Quadratic Formula gives:

$$x = \frac{-(-12) \pm \sqrt{(-12)^2 - 4(5)(-2)}}{2(5)}$$

$$= \frac{12 \pm \sqrt{144 + 40}}{10}$$

$$= \frac{12 \pm \sqrt{184}}{10}$$

$$= \frac{12 \pm 2\sqrt{46}}{10}$$

$$= \frac{6 \pm \sqrt{46}}{5}$$

Thus, the solutions are $\frac{6}{5} + \frac{\sqrt{46}}{5}$ or $\frac{6}{5} - \frac{\sqrt{46}}{5}$.

19. ANSWER: **d**

To determine the number and type of solutions for $7x^2 - 3x + 1 = 0$,
the discriminant will be used. The discriminant is the expression under the radical in the Quadratic Formula: $b^2 - 4ac$.

When $b^2 - 4ac = 0$, the given quadratic equation will have one real solution.

When $b^2 - 4ac > 0$, the given quadratic equation will have two real solutions.

When $b^2 - 4ac < 0$, the given quadratic equation will have two complex solutions.

For $7x^2 - 3x + 1 = 0$, $a = 7$, $b = -3$, $c = 1$. Substituting these values
into the discriminant gives:

$b^2 - 4ac$

$(-3)^2 - 4(7)(1)$

$= 9 - 28$

$= -19$

This negative result for the value of the discriminant means that $7x^2 - 3x + 1 = 0$ will have two complex (not real) solutions.

20. ANSWER: **b**

In the function, $\{(5,-8), (9,2), (15,2), (19,-8), (7,0)\}$, the domain is the set of all x-values, and the range is the set of all y-values. For example, in the ordered pair, $(5, -8)$, 5 would be in the domain, and -8 would be in the range.

Considering all the ordered pairs in the function, the domain and range are

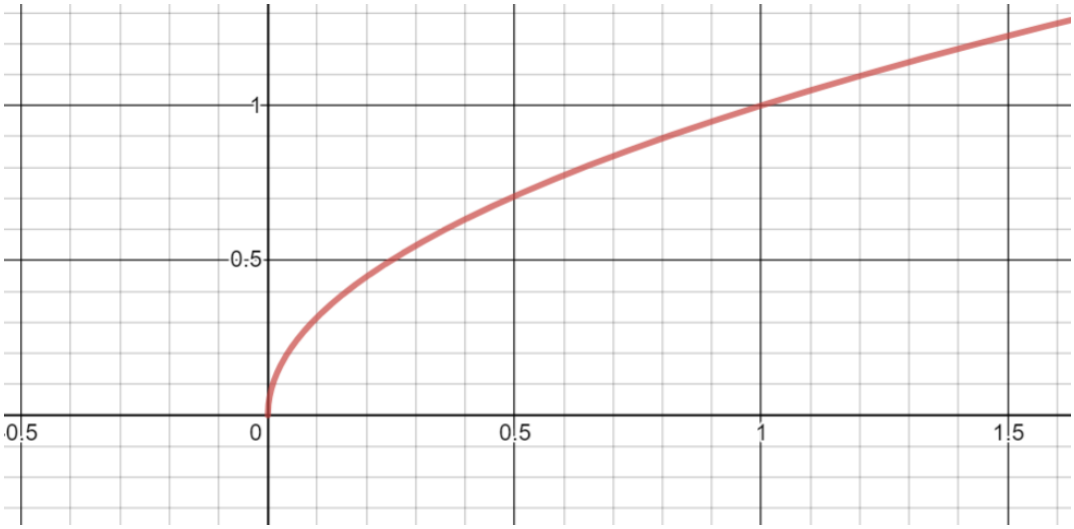
$\text{Domain}: \{5, 7, 9, 15, 19\}$

$\text{Range}: \{-8, 0, 2\}$

Note that although -8 and 2 are found in more than one of the ordered pairs, these values should only be included once in the range.

21. ANSWER: **c**

The domain and range for $f(x) = \sqrt{x}$ can most easily be determined by observing its graph, which looks like the graph below.



The domain of the function is the set of all x values, which from looking at the graph are numbers bigger than or equal to zero. The y values are also numbers bigger than or equal to zero. Symbolically, this is written

$$\text{Domain}: x \geq 0$$

$$\text{Range}: f(x) \geq 0$$

Note that f(x) represents the y values.

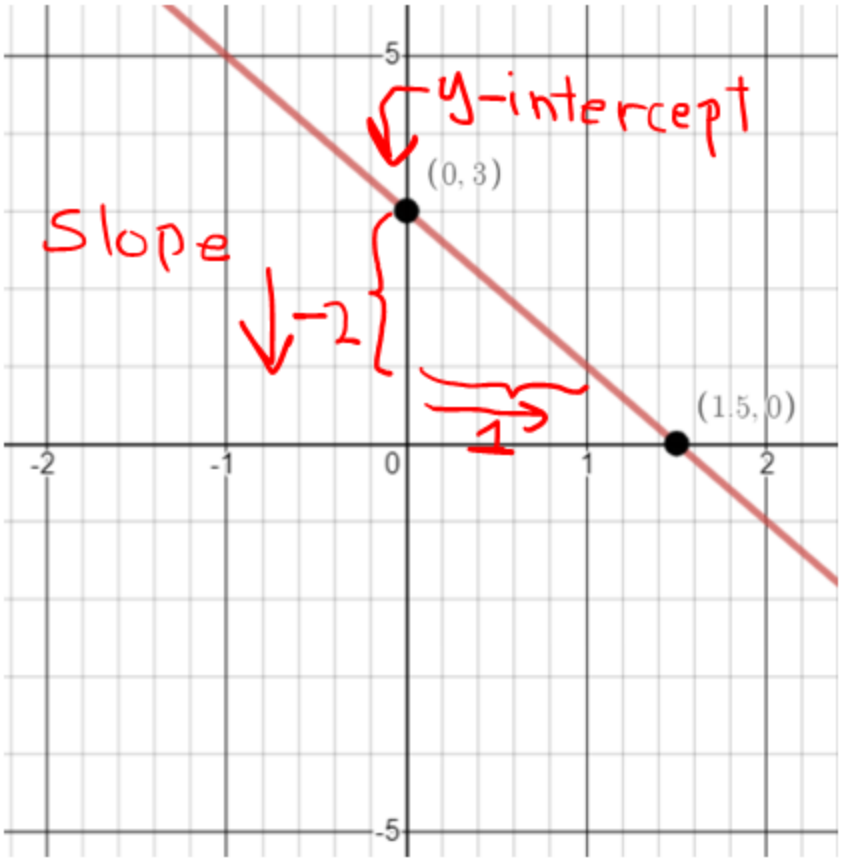
22. ANSWER: **c**

To graph $f(x) = -2x + 3$, note that the equation is given in slope-intercept form, $y = mx + b$ (see the provided formula sheet).

In this form, m is the slope, and b is the y-intercept. So, for the given equation, the slope is -2 and the y-intercept is 3. So, you should expect the graph to cross the y-axis at 3 and have a negative slope (the line falls when proceeding from left to right). Also, the slope can be thought of in terms of the rise over the run.

$$m = -2 = \frac{-2}{1} \quad \begin{matrix}\text{rise change in y} \\ \text{run change in x}\end{matrix}$$

See how these quantities play out on the correct graph below.



23. ANSWER: **b**

The graph given is in the shape of a parabola (think of a bowl shape) and has a vertex at the point (0,3). Note that this point is also the y-intercept. Due to the graph being a parabola, this means that it was formed from a quadratic equation, which has general form of $f(x) = ax^2 + bx + c$. In this form, the vertex is given by

$\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$. (This vertex formula can be found on the provided formula sheet.)

Also, when the leading coefficient, **a**, is negative, the parabola turns downwards, which is the case for the graph in the problem. So, for the choices given in the problem, only b. and c. are possible solutions since the first terms in each are negative.

Finally, note that the graph passes through the points $(-2, -5)$ and $(2, -5)$. So, these two points would need to satisfy the equation describing the graph. The only equation where this is true is $f(x) = -2x^2 + 3$:

$$f(-2) = -2(-2)^2 + 3 = -2(4) + 3 = -8 + 3 = -5$$

$$f(2) = -2(2)^2 + 3 = -2(4) + 3 = -8 + 3 = -5$$

24. ANSWER: **c**

To find which function passes through all 4 points, you could take each function and substitute each x-value into the function and show that the corresponding y-value is obtained. In short, you would be using a process of elimination. Here's what this process looks like for $f(x) = \sqrt[3]{x+1}$:

Recall that the points are $(0,1)$, $(-1,0)$, $(-2,-1)$, $(7,2)$.

$$f(0) = \sqrt[3]{0+1} = \sqrt[3]{1} = 1$$

$$f(-1) = \sqrt[3]{-1+1} = \sqrt[3]{0} = 0$$

$$f(-2) = \sqrt[3]{-2+1} = \sqrt[3]{-1} = -1$$

$$f(7) = \sqrt[3]{7+1} = \sqrt[3]{8} = 2$$

This shows that all the points satisfy $f(x) = \sqrt[3]{x+1}$. This is not the case for the other functions given.

25. ANSWER: **a**

Given that $f(x) = 10x - 3$, find $f(x - 3)$.

The solution is obtained by substituting $x - 3$ for x in $f(x) = 10x - 3$:

$$f(x - 3) = 10(x - 3) - 3$$

$$= 10x - 30 - 3$$

$$= 10x - 33$$