TMSCA MIDDLE SCHOOL MATHEMATICS

TEST #13©

FEBRUARY 26, 2022

GENERAL DIRECTIONS

1. About this test:
   A. You will be given 40 minutes to take this test.
   B. There are 50 problems on this test.
2. All answers must be written on the answer sheet/Scantron form/Chatsworth card provided. If you are using an answer sheet be sure to use **BLOCK CAPITAL LETTERS**. Clean erasures are necessary for accurate grading on Scantrons and Chatsworth cards.
3. If you are using a Chatsworth or Scantron card, please follow the specific instructions given at your particular meet.
4. You may write anywhere on the test itself. You must write only answers on the answer sheet.
5. You may use additional scratch paper provided by the contest director.
6. All problems have **ONE** and **ONLY ONE** correct [BEST] answer. There is a penalty for all incorrect answers.
7. Calculators **MAY NOT** be used on this test.
8. All problems answered correctly are worth **FIVE** points. **TWO** points will be deducted for all problems answered incorrectly. No points will be added or subtracted for problems not answered.
9. In case of ties, percent accuracy will be used as a tie breaker.

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1. $-67 + 413 + (-18) =$ _____
A. 328 B. 462 C. 364 D. -275 E. 498

2. $63.0106 - 18.3668 =$ _____ (nearest hundredth)
A. 45.63 B. 45.65 C. 45.64 D. 44.64 E. 44.65

3. $-73 \times (-726) =$ _____
A. 52,198 B. 52,998 C. 54,798 D. 54,248 E. 56,228

4. $34\frac{7}{8} \div 14\frac{2}{5} =$ _____ (improper fraction)
A. $\frac{31}{8}$ B. $\frac{1,385}{576}$ C. $\frac{155}{64}$ D. $\frac{39}{16}$ E. $\frac{257}{128}$

5. Layla has 72 bags of cookies and 24 bags of chips. If Layla wants to create boxes containing the same number of cookie bags and chip bags, what is the greatest number of boxes Layla can create?
A. 12 B. 36 C. 6 D. 144 E. 24

6. $33 + 11 \times 18 =$ _____ (Roman numeral)
A. CCVI B. CCXXXI C. CCXIXVI D. CCXVIII E. CCXXXIV

7. $992 \times 994 + 152 =$ _____
A. 986,200 B. 986,048 C. 986,300 D. 986,896 E. 986,400

8. 520 dekagrams = _____ centigrams
A. 52 B. 5.2 C. 5,200 D. 52,000 E. 520,000

9. How many more square units are in the area of the rectangle than in the area of the triangle?
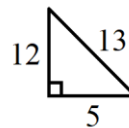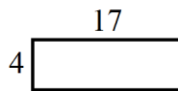
A. 18 units^2 B. 26 units^2 C. 8 units^2 D. 30 units^2 E. 38 units^2

10. Simplify: $-3|23 - 45| - (8 - 14)^2$
A. -102 B. -60 C. 30 D. -30 E. -122

11. The angles in a triangle measure $17.8°$, $101.6°$, and $x°$. What is the complement of the missing angle measure?
A. $29.2°$ B. $119.2°$ C. $60.6°$ D. $29.4°$ E. $119.4°$

12. 19% of 200 = 40% of _____
A. 345 B. 185 C. 135 D. 105 E. 95

13. The number 240 has how many distinct prime factors?
A. 6 B. 5 C. 4 D. 3 E. 16

14. What is the sum of the first nine positive odd integers?
A. 89 B. 85 C. 81 D. 77 E. 87

15. Lexi bought two celery stalks for $1.34. At this rate, how much money will Lexi need to buy 13 stalks?
A. $7.61 B. $7.91 C. $17.42 D. $8.51 E. $8.71

16. 1,000 pennies + 300 nickels = _____ quarters + 40 dimes
A. 76   B. 84   C. 72   D. 88   E. 92

17. For lunch, Jada can choose between spaghetti or pizza for her main course, apple juice, orange juice, milk, or water as her drink and a chocolate cookie, brownie, slice of cake, ice-cream, or piece of fruit for dessert. How many different lunch combinations are possible when Jada chooses one entrée, one beverage, and one dessert?
A. 40   B. 24   C. 60   D. 48   E. 120

18. A number is randomly chosen from 1 to 100, inclusive. What is the probability the number chosen is a multiple of 5?
A. 25%   B. 30%   C. 20%   D. 15%   E. 35%

19. If $\{x, y, z\}$ are the range values of the function $h(x) = 19 - 3x$, when the domain is $\{-2, 0, 11\}$, what is the value of $z - y - x$?
A. 20   B. 25   C. -14 D. -58 E. 9

20. Use the examples in the picture below to find the value of M.
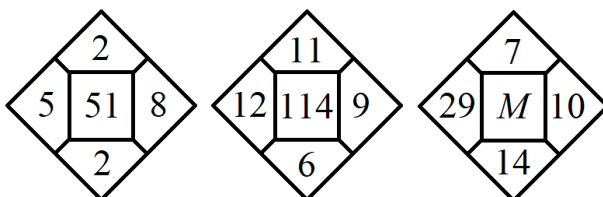
A. 343   B. 192   C. 336   D. 133   E. 180

21. Maya's lunch bill before taxes was $16.00, and after taxes her bill was $17.12. What was the tax rate Maya had to pay?
A. 8.5%   B. 8%   C. 7.5%   D. 7%   E. 6.5%

22. $13^3 = $ _____
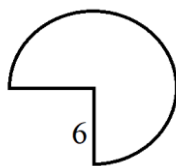A. 2,197   B. 39   C. 2,367   D. 1,877   E. 2,210

23. $(-6) + (-5) + (-4) + \cdots + 11 + 12 + 13 = $ _____
A. 92   B. 91   C. 70   D. 76   E. 82

24. Which of the following is true?
A. $\frac{11}{19} > \frac{2}{3}$ B. $\frac{5}{6} < \frac{7}{9}$ C. $\frac{1}{3} > \frac{3}{8}$ D. $\frac{5}{12} < \frac{3}{8}$ E. $\frac{1}{2} > \frac{4}{9}$

25. If $\pi = 3$, what is the distance around the shape?

A. 36 units   B. 27 units   C. 33 units   D. 39 units   E. 48 units

26. Today, Geehan is buying a new motorcycle for $18,000. If the value of the motorcycle depreciates by ½ each year, what will be the value of the motorcycle after 6 years?
A. $276.25   B. $281.25   C. $293.25   D. $287.25   E. $279.25

27. What is the largest unattainable sum of the numbers 7 and 13?
A. 65   B. 83   C. 143   D. 99   E. 71

28. $53_7 + 43_6 - 12_8 =$ _____ (base 10)
A. 65   B. 45   C. 55   D. 50   E. 40

29. Line m passes through the points $(-9, -19)$ and $(11, -3)$. If the slope of line m is equal to $\frac{a}{b}$, then what is the value of $\frac{8b}{a}$?
A. 8   B. 10   C. 6   D. 12   E. -4

30. Let U be a universal set and A, B, and C be subsets of U defined as shown. Find $(A' \cap C') \cup B$.
    $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $A = \{2, 4, 6, 8, 10\}$ $B = \{1, 3, 5, 7, 9\}$ $C = \{2, 3, 4, 5, 6, 7, 8\}$
A. $\{1, 9\}$ B. $\{1, 3, 5, 7, 9\}$ C. $\{9\}$ D. $\{1, 5, 9\}$ E. $\{2, 4, 6\}$

31. Ali's lock combination is a 3-digit number, where the digits cannot repeat. If the product of the digits of Ali's lock combination is 84, and the digits appear in increasing order from left to right, how many lock combinations could Ali have?
A. 6   B. 720   C. 28   D. 14   E. 2

32. On his birthday, Jesse was 15 years old and his father was 51. Jesse noticed that his age was the reverse of his father's age. How old will Jesse's father be the next time his age is the reverse of Jesse's age?
A. 53   B. 59   C. 56   D. 71   E. 62

33. In the picture below, $a \parallel b \parallel c$. What is the value of y?
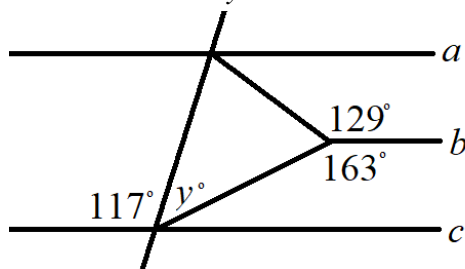
A. 66   B. 68   C. 42   D. 54   E. 46

34. What is the value of the mean absolute deviation of the set of numbers 20, 21, 13, 27, and 29?
A. 3.6   B. 4.2   C. 4.6   D. 3.8   E. 4.8

35. If $a = 1$, $b = 2$, $c = 3$, …, $y = 25$, and $z = 26$, what is the sum of the letters of the word *champion*?
A. 81   B. 79   C. 86   D. 85   E. 78

36. What is the probability of rolling a pair of dice and not getting a sum of 4?
A. $\frac{11}{12}$ B. $\frac{4}{9}$ C. $\frac{5}{9}$ D. $\frac{7}{9}$ E. $\frac{5}{6}$

37. $\dfrac{(2.4\times10^2)(3.5\times10^2)}{2\times10^{-2}} =$ _____ (scientific notation)
A. 4.2×10^2 B. 4.2×10^{-2} C. 4.2×10^4 D. 4.2×10^6 E. 4.2×10^{-4}

38. If $f(x) = 19 - 3x$, $g(x) = x^3$, and $h(x) = \frac{2}{5}x$, then find the value of $f(g(h(15)))$.
A. -629 B. $-7{,}030.4$ C. $-4{,}031$ D. 1   E. -139

39. Which of the following equations has "*all real numbers*" as its solution?
A. $4n = 4$ B. $2(x - 1) = 2x + 1$ C. $0 = 7y$ D. $3w - 1 = 3w - 1$ E. $\frac{1}{2}a = 2a$

40. If $\dfrac{\frac{2}{3}-1}{\frac{3}{4}-2} = \dfrac{A}{B}$, then what is the value of $A^2 - B$?

A. 4   B. 3   C. -2 D. 5   E. 1

41. Point X is the midpoint of $\overline{WZ}$ and point Y is the midpoint of $\overline{XZ}$. If the coordinates of X are $(-3, 3)$ and the coordinates of Y are $(9, -2)$, then what is the measure of $\overline{WY}$?
A. 39 units   B. 36 units   C. 52 units   D. 26 units   E. 49 units

42. What is the length of the apothem of a regular hexagon with a side length of 18 cm?
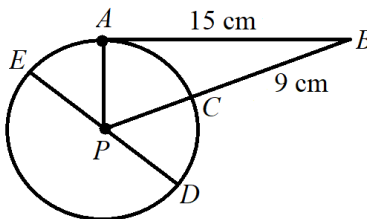A. $18\sqrt{3}$ cm   B. $18\sqrt{2}$ cm   C. $9\sqrt{3}$ cm   D. $9\sqrt{2}$ cm   E. 9 cm

43. If $\sqrt{5 + n} + 1 = n$, then what is the value of n^2?
A. 25   B. 9   C. 36   D. 4   E. 16

44. Which of the following is equivalent to $-i$?
A. i^{45} B. i^{49} C. i^{48} D. i^{47} E. i^{46}

45. In the picture, $\overline{AB}$ is tangent to $\odot P$ at point A, $AB = 15$ cm, and $BC = 9$ cm. What is the measure of the diameter of the circle?

A. 16 cm   B. 24 cm   C. 18 cm   D. 30 cm   E. 12 cm

46. Which of the following is the inverse function of $f(x) = \frac{1}{x} + 5$?
A. $f^{-1}(x) = \frac{1}{x-5}$ B. $f^{-1}(x) = \frac{1}{x} - 5$ C. $f^{-1}(x) = -\frac{1}{x} - 5$ D. $f^{-1}(x) = \frac{1}{x} - \frac{1}{5}$ E. $f^{-1}(x) = \frac{1}{x+5}$

47. What is the solution to the compound inequality $-42 \le 5y + 13 < 58$?
A. $(-11, 9]$ B. $[-11, 9)$ C. $[-11, 9]$ D. $(-11, 9)$ E. $(-9, 11)$

48. The sum of the two linear factors of $x^2 - 16x + 48$ is subtracted from the sum of the two linear factors of $x^2 - 14x + 48$. What is the value of the result?
A. 0   B. 2   C. -2 D. 96   E. -24

49. Find the value of x, if $3\log_2(1 + x) = 6$.
A. 4   B. 3   C. 5   D. 2   E. 63

50. What are the coordinates of the center of the circle with the equation $x^2 + y^2 - 4x - 6y = -8$?
A. $(-2, 3)$ B. $(-4, -6)$ C. $(2, 3)$ D. $(4, 6)$ E. $(8, 6)$

2021 – 2022 TMSCA Middle School Mathematics Test #13 Answer Key

1. A	18. C	35. B
2. D	19. D	36. A
3. B	20. E	37. D
4. C	21. D	38. A
5. E	22. A	39. D
6. B	23. C	40. E
7. A	24. E	41. A
8. E	25. D	42. C
9. E	26. B	43. E
10. A	27. E	44. D
11. D	28. C	45. A
12. E	29. B	46. A
13. D	30. B	47. B
14. C	31. E	48. B
15. E	32. E	49. B
16. B	33. E	50. C
17. A	34. E	

15. To solve this problem, create the proportion, $\frac{2}{1.34} = \frac{13}{x}$. Cross multiply to get $2x = 13(1.34) = 17.42$. Dividing both sides of the equation by 2, we get $x = 8.71$. 13 stalks of celery will cost $8.71.

16. 1,000 pennies $= 1,000(0.01) = \$10.00$. 300 nickels $= 300(0.05) = \$15.00$. $\$10.00 + \$15.00 = \$25.00$. 40 dimes $= 40(0.1) = \$4.00$. $\$25.00 - \$4.00 = \$21.00$. $\$21.00 \div 0.25 = 84$ quarters.

19. To find the range values $\{x, y, z\}$ of the function $h(x) = 19 - 3x$, when the domain is $\{-2, 0, 11\}$, you must substitute each domain value into the function separately and solve for the range value. Find each value as, $h(-2) = 19 - 3(-2) = 25, h(0) = 19 - 3(0) = 19$, and $h(11) = 19 - 3(11) = -14$. Therefore, $x = 25$, $y = 19$, and $z = -14$ and $z - y - x$ is equal to $-14 - 19 - 25 = -58$.

26. A new motorcycle starts at $18,000. After 1 year, it will be worth ½(18,000) = $9,000. After 2 years, it will be worth ½(9,000) = $4,500. After 3 years, ½(4,500) = $2,250. After 4 years, ½(2,250) = $1,125. After 5 years, ½(1,125) = $562.50. Finally, after 6 years, ½(562.50) = $281.25.

30. If $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $A = \{2, 4, 6, 8, 10\}$, $B = \{1, 3, 5, 7, 9\}$, and $C = \{2, 3, 4, 5, 6, 7, 8\}$, then $A' = \{1, 3, 5, 7, 9\}$ and $C' = \{1, 9, 10\}$. $A' \cap C' = \{1, 3, 5, 7, 9\} \cap \{1, 9, 10\} = \{1, 9\}$. Therefore, $(A' \cap C') \cup B$ $= \{1, 9\} \cup \{1, 3, 5, 7, 9\} = \{1, 3, 5, 7, 9\}$.

31. The product of the three digits is 84, and $84 = 2 \cdot 2 \cdot 3 \cdot 7$. Therefore, the only arrangements in increasing order from left to right are 3-4-7 and 2-6-7, which is 2 possible combinations.

40. $\frac{\frac{2}{3}-1}{\frac{3}{4}-2} = \frac{\frac{2}{3}-\frac{3}{3}}{\frac{3}{4}-\frac{8}{4}} = \frac{-\frac{1}{3}}{-\frac{5}{4}} = -\frac{1}{3} \div \left(-\frac{5}{4}\right) = -\frac{1}{3} \cdot \left(-\frac{4}{5}\right) = \frac{4}{15} = \frac{A}{B}$. Therefore, $A^2 - B = 4^2 - 15 = 16 - 15 = 1$.

48. $x^2 - 16x + 48$ can be factored to $(x - 12)(x - 4)$, so $x - 12 + x - 4 = 2x - 16$. $x^2 - 14x + 48$ can be factored to $(x - 8)(x - 6)$, so $x - 8 + x - 6 = 2x - 14$. Therefore, $2x - 14 - (2x - 16) = 2x - 14 - 2x + 16 = -14 + 16 = 2$.

49. $3 \log_2(1 + x) = 6$ can be rewritten as $2^6 = (1 + x)^3$. $2^6 = 64$, so the equation is now $64 = (1 + x)^3$. Cube root both sides of the equation to get $4 = 1 + x$. Subtracting 1 from both sides of the equation and we get $x = 3$.

50. We will need to change the given circle equation $x^2 + y^2 - 4x - 6y = -8$ into center-radius form. First, rewrite the equation as $x^2 - 4x + y^2 - 6y = -8$. Now write as $x^2 - 4x + A + y^2 - 6y + B = -8 + A + B$. The value of A needed to create a perfect square trinomial is $\left(\frac{-4}{2}\right)^2 = 4$. The value of B needed to create a perfect square trinomial is $\left(\frac{-6}{2}\right)^2 = 9$. Now rewrite the equation as $x^2 - 4x + 4 + y^2 - 6y + 9 = -8 + 6 + 9$. Factoring $x^2 - 4x + 4$ becomes $(x - 2)^2$ and factoring $y^2 - 6y + 9$ becomes $(y - 3)^2$. Therefore, the circle equation $x^2 + y^2 - 4x - 6y = -8$ becomes $(x - 2)^2 + (y - 3)^2 = 5$, and the center has coordinates (2, 3).