2021 – 2022 TMSCA Middle School Invitational Mathematics Test

1. 635 + 87,777 = _____ (nearest hundred)

A. 88,000 B. 88,400 C. 88,500 D. 88,300 E. 90,000

2. 30.06 – 17.88 = _____

A. 12.18 B. 13.18 C. 13.82 D. 12.82 E. 12.94

3. $6\frac{1}{3} \times \frac{18}{19}$ = _____

A. 1 B. $6\frac{6}{19}$ C. $3\frac{2}{3}$ D. 6 E. $5\frac{6}{19}$

4. $20\frac{1}{4} \div 4\frac{1}{2}$ = _____ (decimal)

A. 4.5 B. 4.75 C. 4.25 D. 4.125 E. 4.375

5. 340 milligrams = _____ dekagrams

A. 3,400,000 B. 34 C. 34,000 D. 3.4 E. 0.034

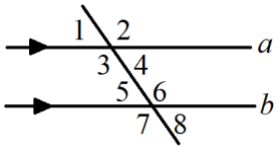
6. Simplify: $\frac{1}{5}(20a - 25) + \frac{2}{3}(9a - 12)$

A. $16a - 9$ B. $16a - 13$ C. $10a - 13$ D. $7a - 13$ E. $10a - 27$

7. Troy starting a movie at 7:20 pm. If the movie lasts 2.2 hours, at what time will the movie end?

A. 9:42 pm B. 9:32 pm C. 9:40 pm D. 9:22 pm E. 9:52 pm

8. Using the picture below, if $m\angle 2 = 112^\circ$, then what is the sum of angles 4, 6, and 7?



A. 248° B. 316° C. 268° D. 292° E. 224°

9. 24 is 16% of what number?

A. 384 B. 184 C. 150 D. 174 E. 166

10. What is the median of the set of numbers 19, 3, 3, 4, 3, 26, 73, 25, 55, 32, 19, 38, 76, 72, 4, 29, 48, and 17?

A. 25 B. 26 C. 26.5 D. 27 E. 25.5

11. What is the sum of the interior angles of a regular heptagon?

A. 900° B. 720° C. $1{,}080^\circ$ D. $1{,}260^\circ$ E. $1{,}540^\circ$

12. 54^2 = _____

A. 2,916 B. 108 C. 2,706 D. 3,136 E. 2,336

13. What is the area of a square with a diagonal of 16 inches?

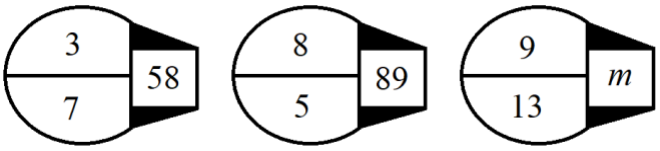
A. 256 in^2 B. 512 in^2 C. 128 in^2 D. 64 in^2 E. 96 in^2

14. What is the unit rate of buying 24 apples for $34.80?

A. $1.25 per apple B. $1.35 per apple C. $0.95 per apple D. $1.45 per apple E. $1.65 per apple

15. If $\pi = 3$, what is the diameter of a circle with an area of 192 units^2?
A. 12 units B. 16 units C. 32 units D. 8 units E. 24 units

16. Use the examples in the picture below to find the value of *m*.



A. 484 B. 117 C. 250 D. 178 E. 234

17. XII + CDIX + LXVII = _____ (Arabic number)
A. 584 B. 483 C. 512 D. 496 E. 488

18. What is the LCM of the numbers 24, 30, and 32?
A. 640 B. 30 C. 240 D. 960 E. 480

19. 19 quarters + 28 dimes + 37 nickels + 46 pennies = _____
A. \$9.44 B. \$9.28 C. \$9.64 D. \$9.86 E. \$9.48

20. If $5b - 17 = 103$, then what is the value of b^2?
A. 576 B. 289 C. 676 D. 524 E. 784

21. Which expression matches "twice a number increased by negative eight"?
A. $2(n + (-8))$ B. $2n - 16$ C. $2(n - 8)$ D. $2(n + 8)$ E. $2n + (-8)$

22. If five bottles cost \$32.40, how much do nine bottles cost?
A. \$77.76 B. \$71.28 C. \$58.32 D. \$51.84 E. \$45.36

23. If $44{,}100 = 2^a \cdot 3^b \cdot 5^c \cdot 7^d$, then what is the value of $a^b + b^c$?
A. 13 B. 8 C. 4 D. 18 E. 2

24. Ellie drew an angle measuring 48°. What is the measure of the supplement to the complement of Ellie's angle?
A. 42° B. 142° C. 132° D. 138° E. 148°

25. What is the sum of the next three terms of the sequence $-97, -88, -79, -70, \ldots$?
A. -156 B. -264 C. -210 D. -192 E. -165

26. What is the rate of change of the line that produces the values in the table below?

x	2	6	10	12
y	12	50	88	107

A. 9.5 B. 19.5 C. 11.5 D. 13.5 E. 12.5

27. $35{,}000{,}000 - 17{,}000{,}000$ = _____(scientific notation)
A. 1.8×10^{-7} B. 1.8×10^{-6} C. 18×10^7 D. 1.8×10^7 E. 1.8×10^6

28. 134_7 = _____ (base 10)
A. 17 B. 67 C. 64 D. 84 E. 74

29. Let *U* be a universal set and *A* and *B* be subsets of *U* defined as shown. How many elements are in $A' \cup B$?
$U = \{10, 12, 14, 16, 18, 20, 22, 24\}$ $A = \{multiples\ of\ 4\}$ $B = \{multiples\ of\ 3\}$
A. {10, 14, 18, 22} B. {12, 18, 24} C. {10, 12, 14, 18, 22, 24} D. $\{\emptyset\}$ E. {10, 12, 14, 16}

30. Which of the following is equivalent to $8x - 2y = -32$?
A. $y = -4x + 16$ B. $y = 4x + 16$ C. $y = 4x - 16$ D. $y = \frac{1}{4}x + 16$ E. $y = -\frac{1}{4}x + 16$

31. Using a standard deck of cards, what is the probability of drawing a three on the first draw, and with replacement, drawing a red card on the second draw?
A. $\frac{3}{26}$ B. $\frac{25}{663}$ C. $\frac{1}{13}$ D. $\frac{1}{26}$ E. $\frac{2}{13}$

32. What is the *x*-intercept of the graph of the linear equation $6y = 54 - 3x$?
A. 18 B. −½ C. 9 D. -2 E. 2

33. Jordan is buying a new pair of sandals for $19.00 and a new drinking bottle for $14.00. If the tax rate is 7%, what will the total bill be Jordan must pay?
A. $34.91 B. $24.71 C. $35.31 D. $35.61 E. $35.91

34. $\overline{AB}$ has endpoints $A(-14, 18)$ and $B(-12, -2)$. If point *C* is the midpoint of $\overline{AB}$, what is the sum of the coordinates of *C*?
A. 4 B. -5 C. -10 D. -8 E. 2

35. How many permutations can be formed of 12 objects taken 2 at a time?
A. 132 B. 66 C. 144 D. 24 E. 96

36. What is the mean absolute deviation of the set of numbers 42, 56, 81, 91, and 70?
A. 16.4 B. 16.6 C. 14.8 D. 15.2 E. 15.4

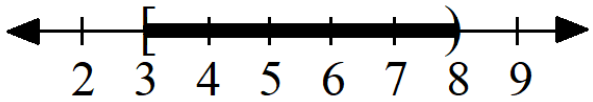
37. Factor completely: $4x^2 + 24x + 36$
A. $(4x + 12)(x + 3)$ B. $4(x + 3)^2$ C. $4(x - 6)(x + 6)$ D. $2(2x + 6)(x + 3)$ E. $(2x + 3)^2$

38. If $h(x) = 27 - x^2$, then what is the value of $h(-6)$?
A. 21 B. -9 C. 63 D. 15 E. 39

39. Which of the following is a quadratic equation?
I. $y = 4x^2$ II. $y = 2(0.3)^x$ III. $y = (x - 2)(x + 4)$ IV. $y = 3x - 6$ V. $y = (x - 1)^2 + 3$
A. I only B. II, III, and IV only C. I and V only D. II and IV only E. I, III, and V only

40. If $\frac{\frac{4}{6}+\frac{10}{12}+\frac{8}{16}}{4\frac{1}{2}-1\frac{1}{4}-1} = \frac{A}{B}$, then what is the value of $3A - 2B$?
A. 9 B. 6 C. -1 D. -3 E. 4

41. Which of the following inequalities represents the graph below?



A. $3 < x < 8$ B. $3 \leq x \leq 8$ C. $3 \leq x < 8$ D. $3 < x \leq 8$ E. $-\infty < x < \infty$

42. The center of $\odot P$ has coordinates $(-4, -5)$. If point A with coordinates (1, 7) lies on $\odot P$, what is the measure of the diameter of $\odot P$?

A. 26 units B. 24 units C. 20 units D. 32 units E. 16 units

43. ΔABC is a right isosceles triangle. The measure of the hypotenuse of ΔABC is equal to the side length of square $WXYZ$. If one leg of ΔABC measures $16\sqrt{2}$ cm, what is the perimeter of the square?

A. $64\sqrt{2}$ cm B. $256\sqrt{2}$ cm C. 256 cm D. 128 cm E. $128\sqrt{2}$ cm

44. The graph of the quadratic equation $2x^2 + 7 = 16x$ if translated to the right four units and down six units. What are the coordinates of the vertex of the graph after the translation?

A. $(8, -19)$ B. $(0, -19)$ C. $(8, -31)$ D. $(4, -25)$ E. $(4, -19)$

45. If $\pi = 3$, what is the volume of a sphere with a radius of 6 inches?

A. 216 inches^3 B. 864 inches^3 C. 432 inches^3 D. 1,296 inches^3 E. 648 inches^3

46. Karla has 19 coins in her pocket consisting of dimes and nickels. If the total value of Karla's coins is \$1.35, how many nickels does Karla have?

A. 13 B. 12 C. 11 D. 10 E. 9

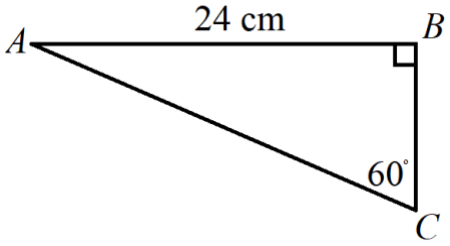
47. What is the rate of decay for the exponential decay function $f(x) = 0.55\left(\frac{3}{5}\right)^x$?

A. 55% B. 45% C. 60% D. 160% E. 40%

48. If $\log_4 M = 3$ and $\log_3 81 = N$, then what is the value of $(M - N)^2$?

A. 6,084 B. 3,042 C. 2,025 D. 3,600 E. 1,600

49. Using the picture below, find *AC*.



A. $16\sqrt{3}$ cm B. $8\sqrt{3}$ cm C. $24\sqrt{3}$ cm D. $32\sqrt{3}$ cm E. 32 cm

50. $\left(\frac{18a^{-5}b^6}{2a^{-3}b}\right) \cdot \left(\frac{a^{-2}b}{a^5b^3}\right)^{-1} \div \left(\frac{3a^3b^2}{a^{-2}b^{-3}}\right)^2 =$ _____

A. $\frac{1}{a^{10}b^{10}}$ B. $\frac{3}{a^7b^2}$ C. $\frac{9}{a^{10}b^{10}}$ D. $\frac{3}{a^5b^3}$ E. $\frac{1}{a^5b^3}$

2021 – 2022 TMSCA Middle School Invitational Mathematics Test Answer Key

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

2021 – 2022 TMSCA Middle School Invitational Mathematics Test Selected Answers

11. The formula to find the total degrees of a polygon is $(n - 2)(180)$, where n is equal to the number of sides of the polygon. Since a heptagon has 7 sides, it has $(7 - 2)(180) = 5(180) = 900^{\circ}$.

13. The formula for area of a square when given the diagonal is $A = \frac{d^2}{2}$. Therefore, the area of a square with a diagonal of 16 inches is equal to $\frac{16^2}{2} = \frac{256}{2} = 128$ in^2.

31. The probability of drawing a three on the first draw is $\frac{4}{52} = \frac{1}{13}$, and with replacement, the probability of drawing a red card on the second draw is $\frac{26}{52} = \frac{1}{2}$. Therefore, the probability of drawing a three on the first draw, and with replacement, drawing a red card on the second draw is $\frac{1}{13} \cdot \frac{1}{2} = \frac{1}{26}$.

37. $4x^2 + 24x + 36 = 4(x^2 + 6x + 9) = 4(x + 3)(x + 3) = 4(x + 3)^2$.

38. If $h(x) = 27 - x^2$, then $h(-6) = 27 - (-6)^2 = 27 - 36 = -9$.

42. The distance formula between two point (x_1, y_1) and (x_2, y_2) is $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$. If point A with coordinates (1, 7) lies on $\odot P$, with center $(-4, -5)$, then the radius is $r = \sqrt{(1 + 4)^2 + (7 + 5)^2} = \sqrt{5^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} = 13$. If the radius of $\odot P$ is 13 units, then the diameter is 13(2) = 26 units.

45. The formula for volume of a sphere is $V = \frac{4}{3}\pi r^3$. Therefore, if $\pi = 3$, the volume of a sphere with a radius of 6 inches is equal to $\frac{4}{3}(3)(6^3) = \frac{4}{3}(3)(216) = 4(216) = 864$ in^3.

47. An exponential decay function is in the form $y = a \cdot b^x$, where $0 < b < 1$, and $b = 1 - r$. a is the initial amount, b is the decay factor and r is the rate. In the function $f(x) = 0.55\left(\frac{3}{5}\right)^x$, the rate of decay is equal to $\frac{3}{5} = 1 - r$. Subtracting both sides of the equation by 1 gives us $-\frac{2}{5} = -r$. Dividing both sides of the equation by -1, and $r = \frac{2}{5}$. The rate of decay of the function is therefore, $\frac{2}{5} = 0.4 = 40\%$.

48. $\log_x y = z$ can be rewritten as $x^z = y$. This means, $\log_4 M = 3$ can be rewritten as $4^3 = M$. Because $4^3 = 64$, then $M = 64$. Also, $\log_3 81 = N$ can be rewritten as $3^N = 81$, and because $81 = 3^4$, $3^N = 3^4$ and $N = 4$. Therefore, $(M - N)^2 = (64 - 4)^2 = 60^2 = 3{,}600$.

50. $\left(\frac{18a^{-5}b^6}{2a^{-3}b}\right) \cdot \left(\frac{a^{-2}b}{a^5b^3}\right)^{-1} \div \left(\frac{3a^3b^2}{a^{-2}b^{-3}}\right)^2 = \left(\frac{9b^5}{a^2}\right) \cdot \left(\frac{1}{a^7b^2}\right)^{-1} \div \left(\frac{3a^5b^5}{1}\right)^2 = \left(\frac{9b^5}{a^2}\right) \cdot \left(\frac{a^7b^2}{1}\right) \div \left(\frac{9a^{10}b^{10}}{1}\right) =$
$\left(\frac{9b^5}{a^2}\right) \cdot \left(\frac{a^7b^2}{1}\right) \div \left(\frac{9a^{10}b^{10}}{1}\right) = \left(\frac{9b^5}{a^2}\right) \cdot \left(\frac{a^7b^2}{1}\right) \cdot \left(\frac{1}{9a^{10}b^{10}}\right) = \frac{9a^7b^7}{9a^{12}b^{10}} = \frac{1}{a^5b^3}$.