T M S C A H I G H S C H O O L

M A T H E M A T I C S

T E S T # 4 ©

N O V E M B E R 9, 2 0 1 9

GENERAL DIRECTIONS

1. About this test:
   A. You will be given 40 minutes to take this test.
   B. There are 60 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.
3. If using a scantron answer form, be sure to correctly denote the number of problems not attempted.
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 used on this test must be conform to the UIL standards. Graphing calculators are allowed. Calculators need not be cleared.
8. All problems answered correctly are worth **SIX** 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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2019-2020 TMSCA High School Math Test # 4

1. **Evaluate:** $10+16\times 2-(7-2)!\div\left(5\times 2^2\right)+3^3$

   (A) 51 **(B) 57** **(C) 63** **(D) 69** **(E) 75**

2. **$27A849B05\div 9$ has a remainder of 3. What is the least value of $A+B$?**

   (A) 4 **(B) 5** **(C) 6** **(D) 7** **(E) 8**

3. **Let $A=\{n,a,p,i,e,r\}$, $B=\{l,o,g,a,r,i,t,h,m,s\}$, and $C=\{b,o,n,e,s\}$. Find the number of elements in $(A\cap B)\cup C$.**

   (A) 6 **(B) 7** **(C) 8** **(D) 9** **(E) 10**

4. **The Azle UIL team hosted a bowling tournament as a fundraiser. Adult tickets cost \$18.50, student tickets cost \$9.85, and senior tickets cost \$14.65. They sold 300 tickets and raised \$4294.40. They sold two more adult tickets than student tickets. How many senior tickets did they sell?**

   (A) 68 **(B) 70** **(C) 72** **(D) 74** **(E) 76**

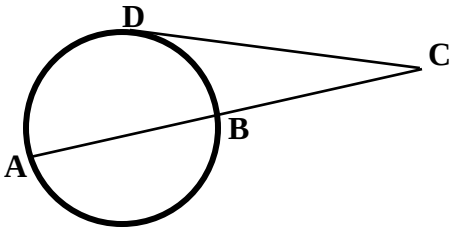
5. **Let $6x^3-41x^2+48x+35=(x-5)(ax^2+bx+c)$. $a+b+c=$ _____.**

   (A) -12 **(B) -9** **(C) -6** **(D) -3** **(E) 0**

6. **$AB=15$ and $BC=16$.**

   $CD=$ _____.

   (nearest tenth)



   (A) 15.5 **(B) 17.2** **(C) 18.9** **(D) 20.6** **(E) 22.3**

7. **Line L_1 contains the points $(-2,-4)$ and $(6,1)$. Line L_2 is parallel L_1 and contains the point $(2,1)$. Which of the following points does not lie on L_2?**

   (A) $(-6,-4)$ **(B) $\left(-3,-\frac{17}{8}\right)$** **(C) $\left(0,-\frac{1}{4}\right)$** **(D) $\left(3,\frac{13}{8}\right)$** **(E) $(6,4)$**

8. **Which of the following is a one-to-one function?**

   (A) $f(x)=2x^2+6$ **(B) $f(x)=-3x^3+2x$** **(C) $f(x)=|x+4|$** **(D) $f(x)=e^x$** **(E) $f(x)=x^4-6x$**

9. **What is the LCM of 33, 55, and 77?**

   (A) 1035 **(B) 1125** **(C) 1155** **(D) 1200** **(E) 1275**

10. Line L_3 contains the points $(-8, 2)$ and $(4, -10)$. What is the shortest distance from L_3 to the point $(3, 5)$? (nearest tenth)

(A) 9.5 (B) 9.7 (C) 9.9 (D) 10.1 (E) 10.3

11. Bowler Bob entered the Azle bowling tournament. His scores before he was eliminated were 213, 222, 212, 236, 222 and 233. Find the average of the mean, median, mode and range of his scores.

(A) 171 (B) 172.75 (C) 174.5 (D) 176.25 (E) 178

12. Find the equation of the directrix for the parabola $y = -4x^2 + 12x + 2$.

(A) $y = 11$ (B) $y = \frac{177}{16}$ (C) $y = \frac{89}{8}$ (D) $y = \frac{45}{4}$ (E) $y = 12$

13. This mathematician developed formulas that relate the coefficients of polynomials to the sums and to the products of the roots, solved the 45th degree equation of van Roomen, and is credited with creating the first infinite representation of π.

(A) Rene Descartes (B) Marin Mersenne (C) Leonard Euler (D) Franciscus Vieta (E) Euclid

14. Find the remainder when $(23456_7 \times 25_7)$ is divided by 6_7.

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

15. Eagle Mountain Lake spans 8694 acres. How many labors is this? (nearest labor)

(A) 49 (B) 53 (C) 57 (D) 61 (E) 65

16. How many prime numbers are there between 40 and 100 that are considered to be Emirp Primes?

(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

17. The roots of $ax^5 + bx^4 + cx^3 + dx^2 + ex + f = 0$ are, $-4, -3, -2, 1,$ and 5. Find d.

(A) -87 (B) -23 (C) -14 (D) 18 (E) 27

18. How many 5 letter codes are possible using 5 letters from MISSISSIPPI?

(A) 490 (B) 520 (C) 550 (D) 580 (E) 610

19. Given: $f''(x) = 24x^2 - 12$, $f'(1) = -4$, and $f(-1) = 0$. $f(2) =$ _____.

(A) 8 (B) 12 (C) 16 (D) 20 (E) 24

20. Shayna is playing a high stakes game of poker in which each person receives 5 cards from a well-shuffled standard deck of 52 cards. What is the probability that Shayna will have one pair? (Example: 7, 7, 8, 9, king) (nearest hundredth)

(A) 0.33 **(B) 0.36** **(C) 0.39** **(D) 0.42** **(E) 0.45**

21. The analog clock on Andy's desk reads 1:28. Find the measure of the obtuse angle formed by the hour hand and the minute hand. (nearest tenth of a degree)

(A) 121.5° **(B) 122.8°** **(C) 124.0°** **(D) 125.3°** **(E) 126.6°**

22. Catherine likes to make her own bread, so she went to Morrison Mills and purchased 4 bushels, 8 pecks, 12 gallons, and 16 quarts of wheat. A bushel of wheat weighs 60 pounds. How many pounds of wheat did Catherine purchase? (nearest pound)

(A) 420 lb **(B) 450 lb** **(C) 480 lb** **(D) 510 lb** **(E) 540 lb**

23. $f(x)=\begin{cases}3x-3 & \text{if } x<0\\ 2x^2+2 & \text{if } 0\le x<2\\ 4x+4 & \text{if } x\ge 2\end{cases}$ $f(-3)+f(2)+f(4)=$ _____.

(A) 12 **(B) 14** **(C) 16** **(D) 18** **(E) 20**

24. A 6-ft long cord is to be cut into two pieces. The first piece will form an equilateral triangle and the second piece will form a square. What is the minimum combined area of the two regions? (nearest square inch)

(A) 123 in^2 **(B) 132 in^2** **(C) 141 in^2** **(D) 150 in^2** **(E) 159 in^2**

25. $\frac{3x+2}{x+4}-\frac{3x-1}{2x+3}=\frac{ax^2+bx+c}{dx^2+ex+f}$. $a+b+c+d+e+f=$ _____.

(A) 32 **(B) 36** **(C) 40** **(D) 44** **(E) 48**

26. $a_1=3,\ a_2=5,\ a_3=4,$ and $a_n=a_{n-2}-a_{n-1}+2\cdot a_{n-3}$. $a_6=$ _____.

(A) 8 **(B) 10** **(C) 12** **(D) 14** **(E) 16**

27. Jenna took off running from the trailhead of the Knob Hills Trail at 8:00 AM. She ran at a pace of 9 minutes per mile. At 9:00 AM, Alyssa left the trailhead and began chasing after Jenna at a pace of 8 minutes per mile. At what time will Alyssa catch up to Jenna?

(A) 4:00 PM **(B) 4:30 PM** **(C) 5:00 PM** **(D) 5:30 PM** **(E) 6:00 PM**

28. Given: $x^3-6x^2y^3+2y^2=-14$. **Find the slope of the tangent line when x = 2.**

(A) $-\frac{1}{8}$ **(B)** $-\frac{3}{17}$ **(C)** $-\frac{5}{12}$ **(D)** $-\frac{9}{13}$ **(E)** $-\frac{11}{14}$

29. $\cos\alpha = -\frac{12}{13}$, α **in quadrant II.** $\sin\beta = -\frac{4}{5}$, β **in quadrant III.** $\cos(\alpha - \beta) =$ _____.

(A) $\frac{12}{65}$ **(B)** $\frac{14}{65}$ **(C)** $\frac{16}{65}$ **(D)** $\frac{18}{65}$ **(E)** $\frac{4}{13}$

30. The water storage tank at Annie's ranch is 70% full. It is shaped like a right circular cylinder with a diameter of 8 feet and a height of 3 feet. How many gallons of water are in the tank? (nearest gallon)

(A) 764 **(B) 777** **(C) 790** **(D) 803** **(E) 816**

31. Find the sum of the coefficients of the x^3y^2 **term and the** x^2y^3 **term of the expansion** $(3x - 2y)^5$.

(A) 210 **(B) 360** **(C) 480** **(D) 840** **(E) 1320**

32. Kunal visited his cousin in Boise last summer and he purchased a video game that was priced at $29.95. With tax, he paid a total of $32.12. He returned to the store 3 days later and purchased a gaming computer that was on sale. It cost him $1340.41 including tax. What was the sale price of the computer?

(A) $1233.05 **(B) $1238.65** **(C) $1244.25** **(D) $1249.85** **(E) $1255.45**

33. Consider $\overline{AB}$ **with point A at** $(-3, 4)$ **and the midpoint of** $\overline{AB}$ **at** $(1, 1)$. **The sum of the x and y coordinates of point B.**

(A) 1 **(B) 2** **(C) 3** **(D) 4** **(E) 5**

34. Find the 18^{th} **term of the following sequence. 1, 4, 5, 9, 14, 23, 37, ...**

(A) 4558 **(B) 5782** **(C) 7375** **(D) 9026** **(E) 11933**

35. $212121_3 + 121212_3 =$ _____$_9$

(A) 1423 **(B) 1443** **(C) 1463** **(D) 1483** **(E) 1523**

36. If $4x + 3y = 5$ **and** $12x - 6y = 5$, **then** $6x + 4y =$ _____

(A) $\frac{37}{6}$ **(B)** $\frac{13}{2}$ **(C)** $\frac{41}{6}$ **(D)** $\frac{43}{6}$ **(E)** $\frac{15}{2}$

37. How many integers, n, satisfy the inequality $\frac{1}{8} < \frac{n}{16} < \frac{3}{4}$ **?**

(A) 5 **(B) 6** **(C) 7** **(D) 8** **(E) 9**

38. The points A, B, C, D and E are collinear and arranged alphabetically from left to right. Find CD if $AE = 36,\ CE = 14,$ and $DE = \frac{3}{11}(AC)$.

(A) 6 (B) 7 (C) 8 (D) 9 (E) 10

39. Eighty students at Texas Tech were asked which athletic contests they had watched in person in the previous school year. Thirty said baseball, 31 said track and 34 said basketball. Sixteen said baseball only, 5 said basketball and track only, 7 said baseball and basketball only, and 4 said baseball, basketball and track. How many did not attend a track meet, a baseball game or a basketball game last year?

(A) 6 (B) 7 (C) 8 (D) 9 (E) 10

40. Consider the numbers 24, 30 and 36. What is the positive difference between the geometric mean and the harmonic mean of these numbers? (nearest thousandth)

(A) 0.393 (B) 0.405 (C) 0.417 (D) 0.432 (E) 0.444

41. Which Platonic solid has 30 edges and 20 vertices?

(A) tetrahedron (B) hexahedron (C) octahedron (D) dodecahedron (E) icosahedron

42. What is the sum of the composite numbers between 100 and 110?

(A) 525 (B) 527 (C) 628 (D) 630 (E) 737

43. $x + 4 = y$ and $y = x + 4$ is an example of the _____ property of equality

(A) reflexive (B) symmetric (C) commutative (D) associative (E) identity

44. The vectors $\langle 2, 5\rangle$ and $\langle 10, b\rangle$ are orthogonal. b = _____.

(A) –4 (B) –2 (C) 4 (D) 15 (E) 25

45. Consider regular hexagon ABCDEF. If $DF = 12\sqrt{3},$ then the area of ABCDEF is _____. (nearest whole number)

(A) 356 (B) 362 (C) 368 (D) 374 (E) 380

46. The vertices of triangle ABC are $(-6, -12)$, $(4, 8)$ and $(10, -7)$. Find the area of triangle ABC.

(A) 123 (B) 126 (C) 129 (D) 132 (E) 135

47. Vidit spent all day running last Saturday. He left his house and ran 9.6 miles on a bearing of 61°. He briefly stopped for lunch and then he ran 8.2 miles on a bearing of 105°. After stopping for supper, he ran 12.3 miles on a bearing of 166°. It was now dark outside, so he called Shash to come pick him up. How far from home was Vidit when he finished running? (nearest tenth of a mile)

(A) 21.1 mi (B) 21.5 mi (C) 21.9 mi (D) 22.3 mi (E) 22.7 mi

48. The vertices of triangle DEF are $(-5, 8)$, $(2, 6)$ and $(-1, -4)$. The perimeter of the triangle is _____. (nearest tenth)

(A) 29.8 (B) 30.4 (C) 31.0 (D) 31.6 (E) 32.2

49. Let $h(x) = 4x^3 + 6x^2 + 8x + 10$. The point of inflection of the graph of h(x) is (a, b). Find the y-intercept of the line tangent to h(x) at (a, b).

(A) 8.75 (B) 9 (C) 9.25 (D) 9.5 (E) 9.75

50. $f(x) = 1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \ldots$ What digit is in the hundred-thousandth place of $f(.6)$?

(A) 2 (B) 3 (C) 5 (D) 6 (E) 8

51. If $2^{x+y} = 128$ and $3^{3x-y} = 243$, then $6^y =$ _____.

(A) 6 (B) 36 (C) 216 (D) 1296 (E) 7776

52. Two roots of $ax^3 + bx^2 + cx + d = 0$ are 4 and 2i. $a + b + c + d =$ _____.

(A) −15 (B) −7 (C) 0 (D) 9 (E) 17

53. Find the harmonic mean of the zeros of $f(x) = x^3 - 9x^2 + 26x - 24$.

(A) $-\frac{3}{8}$ (B) $-\frac{9}{26}$ (C) $\frac{12}{13}$ (D) $\frac{13}{12}$ (E) $\frac{36}{13}$

54. If $\frac{6x + 8}{x^2 + 7x + 12} = \frac{A}{x + 3} + \frac{B}{x + 4}$, then $A + B =$ _____.

(A) −6 (B) −2 (C) 0 (D) 2 (E) 6

55. If $f(x) = ax^5 + bx^3 + cx - 12$ and $f(2) = 20$, then $f(-2) =$ _____.

(A) −44 (B) −32 (C) −18 (D) −6 (E) 8

56. If p and q are zeros of $f(x) = 10x^2 + 2x - 84$, then $pq^2 + p^2q =$

(A) 0.88 **(B) 1.68** **(C) 3.36** **(D) 5.16** **(E) 8.44**

57. Given: x varies inversely as the square of y. If x = 12 when y = 8, then x = 16 when y = _____.

(A) 4 **(B) $2\sqrt{3}$** **(C) 6** **(D) $4\sqrt{3}$** **(E) 8**

58. Given: $PQR_7 + QRP_7 + RPQ_7 = 684$ base 10. If Q equals 2P and R equals Q plus 2, then R = _____.

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

59. Curtis has a favorite function, f(x), because $f(x) = f'''(x)$. $f(x) =$ _____.

(A) $\frac{1}{x}$ **(B) ln(x)** **(C) e^x** **(D) sin(x) – cos(x)** **(E) cos(x) – sin(x)**

60. Lauren opened up a fast food restaurant in Roanoke that offers beef, chicken, fish, veggie, sausage, and cheese sliders. Vedant came in and purchased 8 sliders for the math team, which was having a practice session at Ryan's house Tuesday night. How many different ways could Vedant place an order for 8 sliders?

(A) 1039 **(B) 1101** **(C) 1163** **(D) 1225** **(E) 1287**

2019 – 2020 TMSCA High School Mathematics Test # 4
Answer Key

1. C	**21. C**	**41. D**
2. A	**22. C**	**42. A**
3. C	**23. E**	**43. B**
4. B	**24. C**	**44. A**
5. A	**25. C**	**45. D**
6. E	**26. A**	**46. E**
7. E	**27. C**	**47. B**
8. D	**28. B**	**48. B**
9. C	**29. C**	**49. D**
10. C	**30. C**	**50. B**
11. B	**31. B**	**51. D**
12. B	**32. D**	**52. A**
13. D	**33. C**	**53. E**
14. B	**34. C**	**54. E**
15. A	**35. B**	**55. A**
16. A	**36. D**	**56. B**
17. A	**37. E**	**57. D**
18. C	**38. C**	**58. E**
19. B	**39. C**	**59. C**
20. D	**40. B**	**60. E**

19-20 TMSCA HSMA Test # 4 Selected Solutions

4. $A+B+C=300$

$(18.5)A+(9.85)B+(14.65)C=4294.4$

$A=B+2$

$C=70$

5. $(x-5)\left(6x^2-11x-7\right)$

$6-11-7=-12$

6. $(16)(31)=x^2$

$x=22.3$

7. $m=\dfrac{1--4}{6--2}=\dfrac{5}{8}$

$y-1=\dfrac{5}{8}(x-2)$

$y=\dfrac{5}{8}x-\dfrac{1}{4}$

10. $m=\dfrac{-10-2}{4--8}=-1$

$y-2=-(x+8)$

$x+y+6=0$

$d=\dfrac{|3(1)+5(1)+6|}{\sqrt{1^1+1^1}}$

$d=9.9$

11. $\bar{x}=223,\ \text{Med}=222,\ \text{M}=222,\ \text{R}=24$

$\dfrac{223+222+222+24}{4}=172.75$

12. $y=-4\left(x^2-3x+\dfrac{9}{4}\right)+2+9$

$y=-4\left(x-\dfrac{3}{2}\right)^2+11$

$\dfrac{1}{4p}=-4,\ p=-\dfrac{1}{16}$

$11+\dfrac{1}{16}=\dfrac{177}{16}$

15. $8694\div 177.136$

49

16. $71, 73, 79, 97$

17. $(x+4)(x+3)(x+2)(x-1)(x-5)$

$x^5+3x^4-23x^3-87x^2-14x+120$

19. $f'=8x^3-12x+C$

$-4=8-12+C$

$f=2x^4-6x^2+D$

$0=2-6+D$

$f(x)=2x^4-6x^2+4$

$f(2)=12$

20. $(13)\left({}_4C_2\right)\left({}_{12}C_3\right)\left({}_4C_1\right)^3\div\left({}_{52}C_5\right)=.42$

21. $\left(23-\left(\dfrac{28}{60}\right)(5)\right)(6)=124$

22. $4+\dfrac{8}{4}+\dfrac{12}{8}+\dfrac{16}{32}=8$

$8(60)=480$

23. $-12+12+20=20$

$A = \frac{x^2\sqrt{3}}{4} + w^2$

$3x + 4w = 72$

24. $A = \frac{x^2\sqrt{3}}{4} + \left(\frac{72-3x}{4}\right)^2$

$A' = 0,\ x = 13.65$

$A(13.65) = 141$

25. $\frac{3x^2 + 2x + 10}{2x^2 + 11x + 12}$

$3 + 2 + 10 + 2 + 11 + 12$

40

27. $\left(\frac{60}{9}\right)(t+1) = \left(\frac{60}{8}\right)t$

$t = 8$

$9 + 8 \rightarrow 5:00\ \text{PM}$

30. $(.7)\frac{\pi(48)^2(36)}{231}$

790

31. $1080 - 720 = 360$

32. $(29.95)w = 32.12$

$(x)(w) = 1340.41$

$x = 1249.85$

33. $\frac{-3+x}{2} = 1 \quad \frac{4+y}{2} = 1$

$x + y = 3$

35. $\frac{1111110}{1443}$

$8x + 6y = 10$

$12x - 6y = 5$

36. $x = \frac{3}{4}$ and $y = \frac{2}{3}$

$6x + 4y = \frac{43}{6}$

37. $2 < n < 12$

$3 \rightarrow 11$

9

39. $16 + w + 4 + 7 = 30$

$w = 3$

$3 + y + 9 = 31$

$y = 19$

$34 + 19 + 19 + z = 80$

$z = 8$

40. $\sqrt[3]{(24)(30)(36)} = 29.5945$

$\frac{3}{\frac{1}{24} + \frac{1}{30} + \frac{1}{36}} = 29.189189$

$29.5945 - 29.1891 = 0.405$

41. $20 + f - 30 = 2$

$f = 12$

42. $102 + 104 + 105 + 106 + 108$

525

44. $2(10) + 5b = 0$

$b = -4$

45. $6 \cdot \frac{12^2\sqrt{3}}{4} = 374$

46. $A = \pm(.5)\begin{vmatrix} -6 & -12 & 1 \\ 4 & 8 & 1 \\ 10 & -7 & 1 \end{vmatrix}$

$A = 135$

48. $d_1 = \sqrt{7^2 + 2^2}$

$d_2 = \sqrt{3^2 + 10^2}$

$d_3 = \sqrt{4^2 + 12^2}$

$P = 30.4$

49. $y''(x) = 0$

$x = -.5$

$y = 5x + 9.5$

50. $\cos(.6) = .825335615$

51. $x + y = 7$

$3x - y = 5$

$x = 3,\ y = 4$

$6^4 = 1296$

52. $(x-4)(x-2i)(x+2i)$

$x^3 - 4x^2 + 4x - 16$

$1 - 4 + 4 - 16 = -15$

54. $\frac{-10}{x+3} + \frac{16}{x+4}$

$-10 + 16 = 6$

55. $20 + 12 = 32$

$-32 - 12 = -44$

57. $12 \cdot 8^2 = 16 \cdot y^2$

$y = 4\sqrt{3}$

$57P + 57Q + 57R = 684$

$P + Q + R = 12$

58. $Q = 2P$

$R = Q + 2$

$R = 6$

60. ${}_{13}C_8 = 1287$