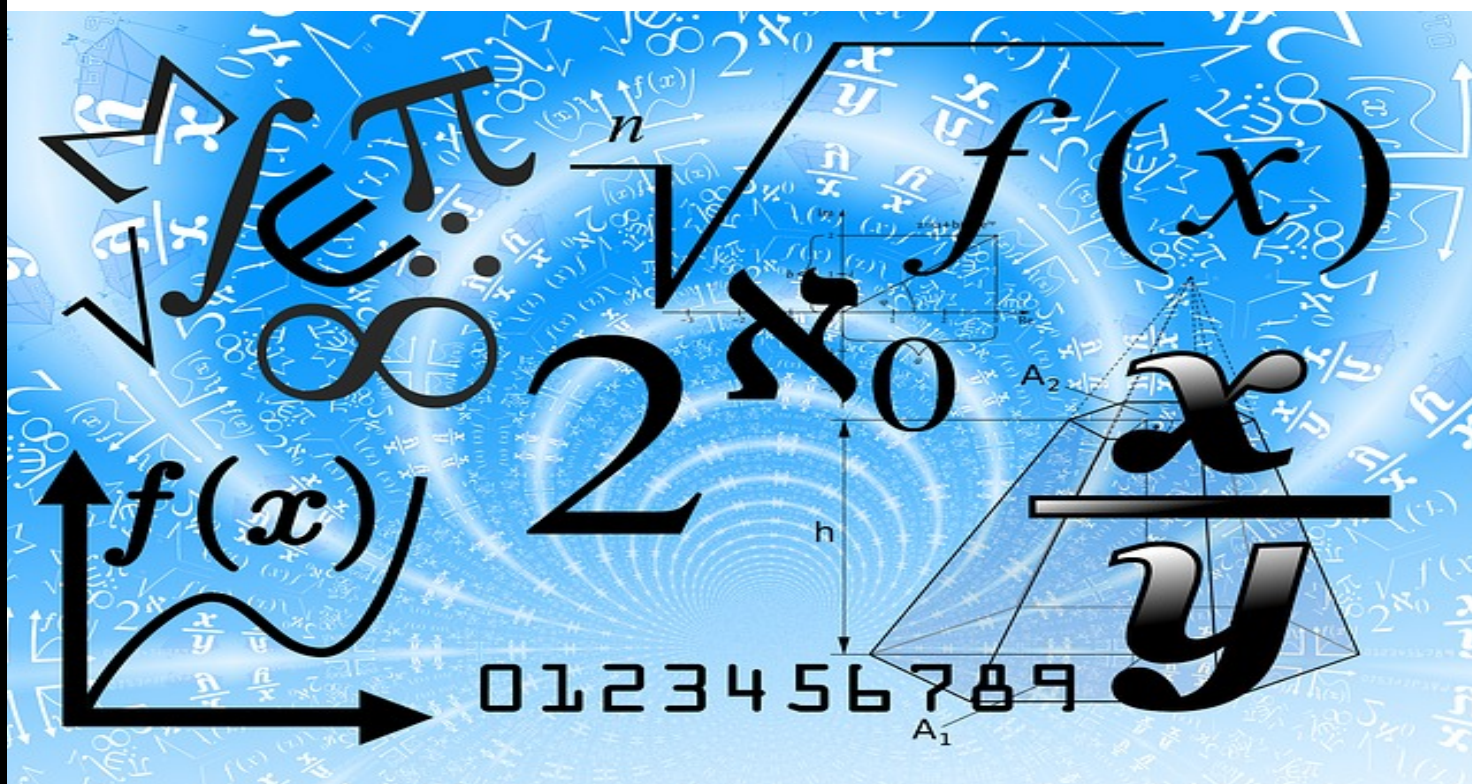# THE VIRTUAL MEET EXPERIENCE

2022-2023
HS VIRTUAL CHALLENGE MEET #3

MATHEMATICS

DO NOT OPEN TEST UNTIL TOLD TO DO SO

The Virtual Challenge Meets™

1. Solve for k if $11(3k+7)=6-(k-3)$.

   (A) -2 (B) $-\dfrac{37}{17}$ (C) $-\dfrac{17}{8}$ (D) $-\dfrac{37}{16}$ (E) $-\dfrac{17}{9}$

2. At Joey's in Wichita Falls, we ordered three fajita plates for $11.75 each, one barbacoa plate for $8.75 and 4 glasses of lemonade for $2.25 each. The tax rate was 8.125%, and we paid with three $20 bills and a $5 bill. I told the waiter to keep the extra as a tip. How much was his tip?

   (A) $12.00 (B) $9.27 (C) $6.67 (D) $7.69 (E) $8.03

3. Caroline drives to work every weekday morning. For the first week in January, her daily average speeds were 35.6 mph, 42.3 mph, 28.7 mph, 37.2 mph and 40.6 mph. What was the average speed for the week on her commute? (nearest tenth)

   (A) 36.9 mph (B) 36.2 mph (C) 36.6 mph (D) 36.7 mph (E) 36.3 mph

4. Given that $\angle ABD$ and $\angle CBD$ form a linear pair, $m\angle ABD=(x^2+1)^\circ$ and $m\angle CBD=(5x+3)^\circ$, find $m\angle CBD$.

   (A) 11° (B) 122° (C) 118° (D) 58° (E) 62°

5. Consider the statements "If a shape is a rectangle, then it is a quadrilateral" and "If a shape is not a quadrilateral, then it is not a rectangle". The second statement is the _____ of the first statement.

   (A) Transpose (B) Converse (C) Contrapositive (D) Antithesis (E) Inverse

6. Consider the line $y=f(x)$ shown on the right. What point on $y=f(x)$ is closest to point P?

   (A) $(1,1)$

   (B) $\left(\dfrac{7}{16},2\right)$

   (C) $\left(\dfrac{5}{9},\dfrac{17}{9}\right)$

   (D) $\left(\dfrac{7}{16},\dfrac{17}{8}\right)$

   (E) $\left(\dfrac{8}{17},\dfrac{32}{17}\right)$
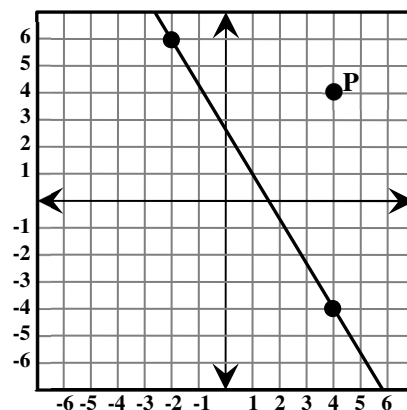
7. If $\dfrac{x+6}{x^2-13x+42}-\dfrac{x-7}{x^2-36}=\dfrac{ax^2+bx+c}{dx^4+ex^3+fx^2+gx+h}$, then $\dfrac{a+b+c}{d+e+f+g+h}=$ _____.

   (A) $-\dfrac{1}{14}$ (B) $\dfrac{13}{210}$ (C) $\dfrac{13}{14}$ (D) $\dfrac{14}{211}$ (E) $-\dfrac{15}{211}$

8. Two consecutive angles in an octagon are supplementary. The other six angles are congruent. What is the measure of one of the six congruent angles?
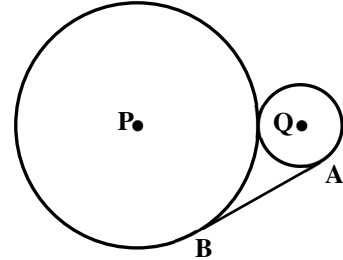
   (A) 60° (B) 90° (C) 150° (D) 120° (E) 135°

9. Find the number that is $\dfrac{3}{5}$ of the way from $-2\dfrac{1}{5}$ to $7\dfrac{3}{10}$.

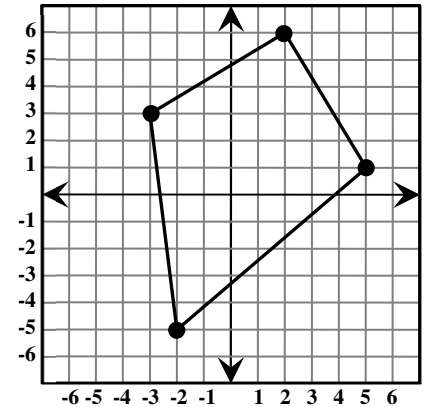(A) $1\dfrac{3}{5}$ (B) $3\dfrac{3}{5}$ (C) $3\dfrac{2}{5}$ (D) $3\dfrac{1}{2}$ (E) $3\dfrac{3}{10}$

10. Circles P and Q have radii 6 and 2 and are tangent to each other. Find the length of the common external tangent $\overline{AB}$. (nearest tenth)

(A) 6.9

(B) 7.1

(C) 7.7

(D) 8.9

(E) 9.6

11. Find the perimeter of the polygon shown on the right. (nearest tenth)

(A) 29.2

(B) 28.9

(C) 28.6

(D) 28.1

(E) 27.7

12. Find the area of the polygon shown on the right.

(A) 46.5

(B) 47

(C) 47.5

(D) 48

(E) 48.5

13. Laurie commutes 56 miles one-way to work. The trip to work takes 10 minutes longer than the return. Her average speed on the return trip is 8 mph faster. How long does it take her to get home?

(A) 60 min (B) 66 min (C) 48 min (D) 50 min (E) 70 min

14. Erica deposited $5,500 into an account earning 3.85% compounded quarterly and $7,800 into an account earning 4.25% compounded monthly. If she makes no further deposits, after how many years will her combined balance reach her goal of $25,000? (nearest quarter year)

(A) 13 years (B) 13.75 years (C) 14.25 years (D) 15.25 years (E) 15.5 years

15. The tires on Jon's new Jeep have a diameter of 101 cm. When he is traveling 55 mph, what is the angular velocity of the wheels in revolutions per minute? (nearest whole number)

(A) 450 rpm (B) 465 rpm (C) 471 rpm (D) 479 rpm (E) 486 rpm

16. The graph of ellipse $\dfrac{x^2}{64}+\dfrac{y^2}{36}=1$ and the line $y=0.8x-1$ intersect at points A and B. Find AB. (nearest tenth)

   (A) 12.2   (B) 13.9   (C) 14.1   (D) 14.7   (E) 15.1

17. Let $g(x)$ be the inverse of $f(x)=6x\sqrt{2x}$. Find the smallest positive integer value of x such that $g(x)>3$.

   (A) 40   (B) 42   (C) 44   (D) 45   (E) 47

18. The population of the Dallas-Ft Worth metro area grew from approximately 866,000 in 1950 to 6,488,000 in 2022. What was the average annual growth rate for the population of the DFW metro area during that 72-year period? (nearest tenth of a percent)

   (A) 3.1%   (B) 9.0%   (C) 8.7%   (D) 2.8%   (E) 3.5%

19. The graph of $f(x)=\dfrac{x^2-2x}{x^2-4}$ has _____ asymptotes.
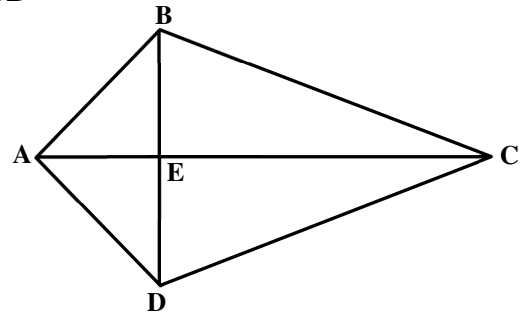
   (A) 0   (B) 1   (C) 2   (D) 3   (E) 4

20. To play in a charity tournament, student council decides to form a basketball team with 10 players. In how many ways can they choose a team from a council of 9 girls and 6 boys if the team must have at least 6 girls?

   (A) 2121   (B) 1980   (C) 5580   (D) 3690   (E) 1260

21. Given that AE = BE = DE = 4 cm and that the area of kite ABCD is 56 cm², find EC.

   (A) 7 cm

   (B) 14 cm

   (C) 10 cm

   (D) 12 cm

   (E) 8 cm

22. In a survey of 42 academic UIL team members, 24 liked to drink water on trips while 32 liked soda. If 6 students didn't like either, how many students liked both?

   (A) 12   (B) 26   (C) 20   (D) 36   (E) 18

23. Train A is traveling north out of Boston at a rate of 85 mph, and Train B is traveling east out of Boston at a rate of 92 mph. How fast is the distance between trains A and B changing when they are 15 mi and 53 mi out of Boston respectively? (nearest mile per hour)

   (A) 105 mph   (B) 112 mph   (C) 128 mph   (D) 137 mph   (E) 177 mph

24. If $\dfrac{16i+14i^8+16i^3}{\sqrt{-196}+14i+21i^4}$ simplifies to $\dfrac{a}{b}+\dfrac{c}{b}i$, and $b>0$, then $a+b+c=$ _____.
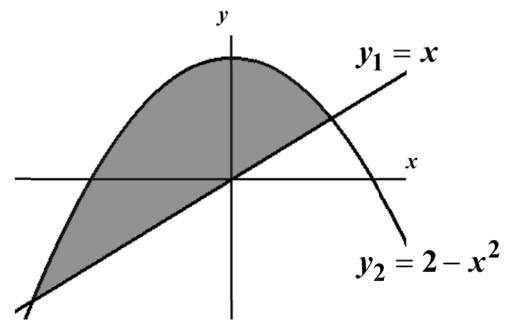
    (A) 23   (B) 39   (C) 27   (D) 161   (E) 117

25. Find x if $2\left(5^{2x+1}\right)-2=12$.

    (A) $\dfrac{\ln 7}{\ln 5}-\dfrac{1}{2}$ (B) $\dfrac{\ln 7}{\ln 25}+\dfrac{1}{2}$ (C) $\dfrac{\ln 7}{\ln 10}-\dfrac{1}{2}$ (D) $\dfrac{\ln 7}{\ln 10}+\dfrac{1}{2}$ (E) $\dfrac{\ln 7}{\ln 25}-\dfrac{1}{2}$

26. Find area of the shaded region shown on the right. (nearest tenth)

    (A) 3.6

    (B) 3.9

    (C) 4.2

    (D) 4.5

    (E) 4.8

27. Find the volume of the solid generated by revolving the shaded region about the line $y=-3$. (nearest tenth)

    (A) 84.2

    (B) 96.1

    (C) 97.8

    (D) 99.2

    (E) 101.3

The figure shows curves $y_1 = x$ and $y_2 = 2 - x^2$ with the region between them shaded.

28. Students taking the SAT receive a critical reading score, a mathematics score and a writing score. The average total score for students in a particular year was 1496. The average math score was 18 points higher than the average reading score, and the average math score was 468 points less than the sum of the average reading and average writing score. Find the average math score.

    (A) 514   (B) 496   (C) 486   (D) 532   (E) 504

29. Current standard license plates in Texas consist of 3 letters followed by 4 numbers. How many distinct license plates can be formed in Texas?

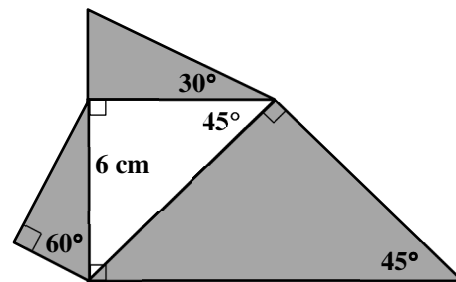   (A) 17,576,000   (B) 6,760,000   (C) 676,000   (D) 175,760,000   (E) 115,316,136

30. Find a if $(3x+5)$ is a factor of $6x^3+ax^2-54x-a$.

    (A) 63   (B) –9   (C) 17   (D) –49   (E) –35

31. The area of the shaded region is _____ cm². (nearest tenth)

(A) 47.3

(B) 52.7

(C) 54.2

(D) 62.1

(E) 64.6

32. Find the angle between the vectors $u = \langle 3, 8, -4 \rangle$ and $v = \langle -2, -1, 3 \rangle$. (nearest tenth)

(A) 137.4°   (B) 137.1°   (C) 136.7°   (D) 136.5°   (E) 136.1°

33. Find the domain of the function $f(x) = \dfrac{\sqrt{3x - 8}}{2x^2 - 19x + 45}$.

(A) $x > \dfrac{8}{3},\ x \neq \dfrac{9}{2}, 5$

(B) $x \geq -\dfrac{8}{3},\ x \neq \dfrac{9}{2}, 5$

(C) $x \leq -\dfrac{8}{3},\ x \neq -5, -\dfrac{9}{2}$

(D) $x < -\dfrac{8}{3},\ x \neq -5, -\dfrac{9}{2}$

(E) $x \geq \dfrac{8}{3},\ x \neq \dfrac{9}{2}, 5$

34. $\displaystyle \lim_{h \to 0} \frac{\sin\left(\dfrac{\pi}{3} + h\right) - \sin\left(\dfrac{\pi}{3}\right)}{h} =$

(A) 1   (B) $\dfrac{1}{2}$ (C) $\dfrac{\sqrt{3}}{2}$ (D) $-\dfrac{1}{2}$ (E) $-\dfrac{\sqrt{3}}{2}$

35. Brian has 10 unique school books. In how many ways can he arrange his books on a single shelf so that he keeps his three math books together?

(A) 40,320   (B) 3,628,800   (C) 120,960   (D) 30,240   (E) 241,920

36. Simplify: $\dfrac{a}{b + \dfrac{1}{c + \dfrac{d}{f}}}$

(A) $\dfrac{acf + ad}{bcf + bd + f}$

(B) $\dfrac{af + ad}{bf + bd + f}$

(C) $\dfrac{ac + ad}{bc + bd + f}$

(D) $\dfrac{acf + ad}{bcf + bd + cf}$

(E) $\dfrac{cf + d}{bcf + bd + f}$

37. Six men can do 8 jobs in three days. How many days would it take 9 men to do 20 jobs?

(A) 10   (B) 8   (C) 6   (D) 5   (E) 4

38. Which of the following is a solution to the system of inequalities $x - y < 2$, $x < 2$ and $y \leq 3$?

(A) $(3, 1)$ (B) $\left(\dfrac{3}{2}, -1\right)$ (C) $\left(1, \dfrac{3}{2}\right)$ (D) $(-2, -4)$ (E) $(1, -3)$

39. Find the distance between the plane $7x - 9y - 2z = 18$ and the point $(-1, -3, 5)$. (nearest tenth)

(A) 0.6   (B) 0.7   (C) 0.9   (D) 2.1   (E) 2.4

40. Which of the following is one of the three cube roots of the 216?

(A) $3 + 3i\sqrt{3}$ (B) -6 (C) $-3 + i\sqrt{3}$ (D) $-3 + 3i\sqrt{3}$ (E) $-3 - i\sqrt{3}$

41. The sum of the first ten terms of an arithmetic sequence is 27.5, and the sum of the first twenty terms is 205. What is the common difference of the sequence?

(A) 2.5   (B) 1.25   (C) 1.5   (D) 2.25   (E) 0.75

42. Mr. Wilson has a weighted tetrahedral die with sides labeled 1, 2, 3 and 4. The table below shows the probability of rolling some of the numbers. What is the expected value for a single roll?

x	1	2	3	4
$p(x)$	$\dfrac{1}{2}$	$\dfrac{1}{6}$	$\dfrac{1}{4}$	

(A) $1\dfrac{7}{12}$ (B) $2\dfrac{1}{2}$ (C) $1\dfrac{5}{6}$ (D) $2\dfrac{1}{3}$ (E) $1\dfrac{11}{12}$

43. When evaluating $\int \left(t^2 e^t \right) dt$ using the method of integration by parts, the best choice for dv is _____.

(A) e^t (B) $t\, dt$ (C) $e^t dt$ (D) t (E) $t^2 dt$

44. Find the rectangular coordinates of the point given in polar coordinates $\left(9, \dfrac{7\pi}{9} \right)$. (all answers are rounded to the nearest hundredth)

(A) $(-6.89, 5.79)$ (B) $(6.89, -5.79)$ (C) $(-7.55, 5.79)$ (D) $(-7.55, -5.79)$ (E) $(8.99, 0.38)$

45. Consider the graph of $f(x) = 4x^4 - 3x^2$. Find the sum of the $y -$ values of the points of inflection. (nearest hundredth)

(A) 0.00   (B) –0.31   (C) –0.63   (D) 0.26   (E) 0.52

46. If $f(x) = 2x + 1$ and $g(x) = x^2$, then $g\left(f\left(x + 2 \right) \right) =$

(A) $4x^2 + 12x + 9$ (B) $x^2 - 25$ (C) $4x^2 + 25$ (D) $4x^2 + 9$ (E) $4x^2 + 20x + 25$

47. If $\sin\theta = -\dfrac{7}{25}$ and $\dfrac{\pi}{2} \le \theta \le \dfrac{3\pi}{2}$, then $\tan\theta =$

(A) $\dfrac{7}{24}$ (B) $\dfrac{24}{25}$ (C) $-\dfrac{24}{7}$ (D) $\dfrac{24}{7}$ (E) $-\dfrac{24}{25}$

48. In a normal distribution with a mean of μ and standard deviation σ, _____% of observations fall within σ of μ. (nearest whole number)
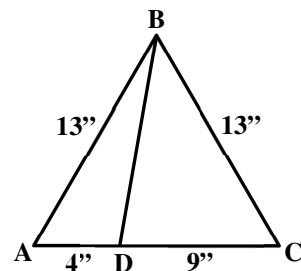
(A) 65   (B) 66   (C) 67   (D) 68   (E) 69

49. Find the interval of convergence of $\displaystyle\sum_{n=0}^{\infty} \frac{n(x+2)^n}{3^{n+1}}$.

(A) $[-5,1)$ (B) $(-5,1)$ (C) $(-1,1)$ (D) $(-5,5)$ (E) $[-1,5]$

50. Find BD. (nearest quarter inch)

(A) $11\dfrac{1}{2}$ in

(B) $11\dfrac{3}{4}$ in

(C) $10\dfrac{1}{4}$ in

(D) 10

(E) $9\dfrac{1}{2}$

51. Evaluate: $\displaystyle\lim_{x \to \pi^-} \cot x$

(A) –1   (B) 0   (C) $-\infty$ (D) ∞ (E) 1

52. If $f(x) = ax^6 + bx^4 + x$ and $f(2) = 30$, then $f(-2) =$

(A) 28   (B) 26   (C) –30   (D) 30   (E) 32

53. According to Wikipedia, this mathematician "founded the field of game theory as a mathematical discipline."

(A) Charles Babbage   (B) Jon von Neumann   (C) Tommy Flowers

(D) Alan Turing   (E) Christian Goldbach

54. Given: $\displaystyle\int_{-2}^{5} f(x)dx = 9$ and $\displaystyle\int_{-2}^{5} g(x)dx = -6$, evaluate $\displaystyle\int_{-2}^{5} [3f(x) + 4g(x) + 7]dx$

(A) 10   (B) 49   (C) 52   (D) 58   (E) 42

55. The square root of 169_{12} is equal to _____$_{12}$.

(A) 11   (B) A   (C) B   (D) 13   (E) 15

56. Jon's Ice Cream Shop serves 6 different flavors of ice cream with 3 container choices and 2 topping choices. How many possible ways are there to order 2 scoops in a container with 1 topping?

(A) 108   (B) 63   (C) 216   (D) 168   (E) 126

57. How many points of intersection occur when $r = 3\sin\theta - 1$ and $r = 3$ are graphed on the polar coordinate system?

(A) 0   (B) 1   (C) 2   (D) 3   (E) 4

58. The number 31 is considered to be which of the following types of numbers:

I. Happy   II. Polite   III. Odious   IV. Extravagant

(A)   I, II only   (B)   I, III only   (C) I, III, IV only   (D) I, II, III only   (E)   II, III, IV only

59. Find the sum of all the three digit numbers whose digits have a sum of eight and whose digits can all be used to form a perfect cube.

(A)   1420   (B)   1776   (C)   1925   (D)   861   (E)   915

60. Find the constant term in the expansion of $\left(2x^2 - \dfrac{3}{x} \right)^9$.

(A)   −326,592   (B)   489,888   (C)   979,776   (D)   −145,152   (E)   19,683

2022-2023
Virtual Challenge Meet #3
Mathematics – Student Answer Sheet

Contestant Name_____Grade_____

Score 1:_____	Score 2: _____
Score 3:_____	**Final Score:** _____

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

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26. _____

27. _____

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31. _____

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33. _____

34. _____

35. _____

36. _____

37. _____

38. _____

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40. _____

41. _____

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

51. _____

52. _____

53. _____

54. _____

55. _____

56. _____

57. _____

58. _____

59. _____

60. _____

2022-2023
VIRTUAL CHALLENGE MEET #3
MATHEMATICS - KEY

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

Calculator Applications

2022–2023
HS Virtual Challenge Meet #3

DO NOT OPEN THE TEST UNTIL INSTRUCTED TO BEGIN

I.   Calculator Applications rules and scoring—See UIL Constitution
II. How to write the answers
  A.   For all problems except stated problems as noted below—write three significant digits.
  1.   Examples (* means correct but not recommended)
       Correct: 12.3, 123, 123.*, 1.23x10*, 1.23x10^{0*} 1.23x10^1, 1.23x10^{01}, .0190, 0.0190, 1.90x10^{-2}

       Incorrect: 12.30, 123.0, 1.23(10)^2, 1.23·10^2, 1.230x10^2, 1.23*10^2, 0.19, 1.9x10^{-2}, 19.0x10^{-3}, 1.90E-02
  2.   Plus or minus one digit error in the third significant digit is permitted.
  B.   For stated problems
  1.   Except for integer, dollar sign, and significant digit problems, as detailed below, answers to stated problems should be written with three significant digits.
  2.   Integer problems are indicated by (integer) in the answer blank. Integer problems answers must be exact, no plus or minus one digit, no decimal point or scientific notation.
  3.   Dollar sign ($) problems should be answered to the exact cent, but plus or minus one cent error is permitted. The decimal point and cents are required for exact-dollar answers.
  4.   Significant digit problems are indicated by underlined numbers and by (SD) in the answer blank. See the UIL Constitution and Contest Manual for details.
III. Some symbols used on the test
  A.   Angle measure: rad means radians; deg means degrees.
  B.   Inverse trigonometric functions: arcsin for inverse sine, etc.
  C.   Special numbers: π for 3.14159 ...; e for 2.71828 ...
  D.   Logarithms: Log means common (base 10); Ln means natural (base e); exp(u) means e^u.

23W-1. $(-0.513 \times 0.171) + 0.0579$ -- 1=_____

23W-2. $(-7.59 + 1.47) \times (0.159) - 1.51$ ------------------------------------ 2=_____

23W-3. $(36.4 + 73 - 38.2)/(84.7) + 0.498$ ------------------------------- 3=_____
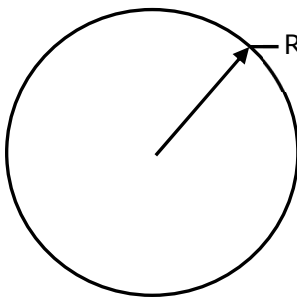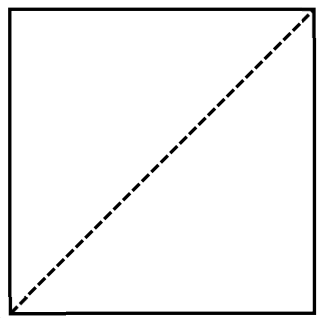
23W-4. $\dfrac{8630 + 31800 - 14400}{(72.7)(-14.4)(53.2)}$ -- 4=_____

23W-5. $\dfrac{(-0.00708 - 0.00206)(9.81)}{\{(0.202)/(8.85)\}} - (-5.73 - 5.66)$ ---------------------- 5=_____

23W-6. Jane bought three tax-free items for $3.75, $7.92 and $5.55. If she
paid for the items with a $20 bill, how much change did she receive? --------- 6=$_____

23W-7. Find the square root of the product of 218 and 379. ----------------- 7=_____

23W-8. What is 33 times the average of 17, 39 and 71?---------------------- 8=_____

23W-9.	23W-10.
CIRCLE	SQUARE
	Area = 222
R = 7.34	B
	A
Circumference = ?	AB = ?
23W-9 =_____	23W-10 =_____

23W-11. $\dfrac{(-985)(-41) - (-17.4)(-264) + 29400}{1.74 \times 10^6 + (-516)(-660)}$ ------------------------------ 11=_____

23W-12. $\dfrac{\{2.55 \times 10^{-5} + (0.0378)(-0.0659)(-0.0427)\}}{(0.858 + 0.926)(-0.0807)(1.95 + 1.9)}$ ---------------------- 12=_____

23W-13. $\dfrac{(962)(351 - 272)\{-2.60 \times 10^5 - (947)(-205)\}}{(629 + 259)(-19.1 - 20.5)}$ ---------------------- 13=_____
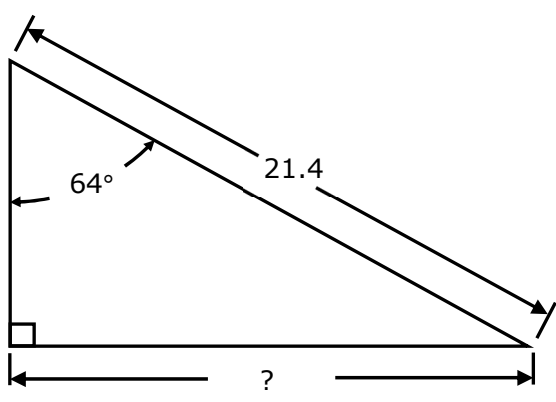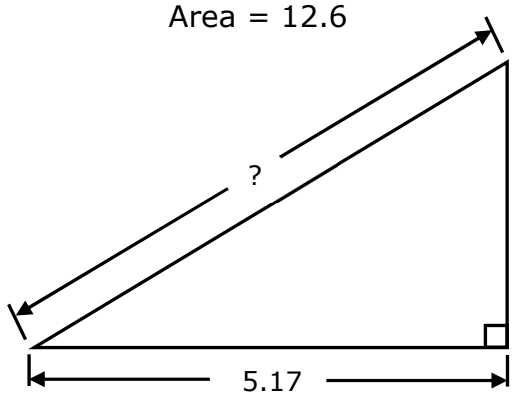
23W-14. $\dfrac{224}{-0.538} + \dfrac{125 + 101 - 111}{0.649 - 0.761} + \dfrac{(5.75 \times 10^{-4} + 0.00106)}{\{(2.84 \times 10^{-8})/(-0.11)\}}$ ------------- 14=_____

23W-15. $\dfrac{(16000 + 11900 - 12700)(0.24 - 0.0724 - 0.174)}{(3.11)(-3.91)(5.52)(3.4 + 1.56 + 2.72)}$ ---------------- 15=_____

23W-16. What is the percent decrease in the speed of light when it goes from crown glass traveling at 197,234 km/s into flint glass traveling at 113,509 mi/s? --- 16=_____ %(SD)

23W-17. If all Florida oranges yield 6 tablespoons of juice, how many Florida oranges must be squeezed to make an 18-oz glass of juice? ------------------ 17=_____ integer

23W-18. Tom saves his spare nickels, dimes and quarters in a jar on his dresser. He currently has a total of 480 coins worth $80.65. He has 67 more quarters than dimes. How many nickels does he have?----------------- 18=_____ integer

23W-19.

RIGHT TRIANGLE

64°

21.4

?

23W-19 =_____

23W-20.

RIGHT TRIANGLE

Area = 12.6

?

5.17

23W-20 =_____

23W-21. $\dfrac{0.571 + 1/(0.888)}{1/(0.194) + 6.59} + \dfrac{1}{(5.6)}$ -- 21=_____

23W-22. $\sqrt{\dfrac{(3.13)(4.19)}{970 + 320}} + 0.0897$ -- 22=_____

23W-23. $\dfrac{\sqrt{6.27 + 1.52 + (0.299)/(0.194)}}{8.92 + 3.92}$ -- 23=_____

23W-24. $\left[-40.5 + \sqrt{1570}\right]^2 \times \left[337 + 548\right]^2 \times \sqrt{76.2/92.9}$ ------------------- 24=_____

23W-25. $(2.44)(0.164)\sqrt{(-0.403)^2/0.897} + 1/\sqrt{25.7 + 31.2}$ ---------------- 25=_____

23W-26. Diane took a trip from Plano to Andrews, a distance of 372 miles.
If she made two 30-minute stops to gas up and rest, how long did her trip
take if her average driving speed was 63 mph? ------------------------------ 26=_____ min

23W-27. If Jim invests $96,000 at 5.25% annual interest compounded
quarterly, how much interest will be made after 6 years? --------------------- 27=$_____

23W-28. Will and William lunch at Southern Barbeque. Will's meal cost
$17.71 and William's meal cost $19.35, both pre-tax. The tax rate is
8.125%. If they left $48.00 on the table, how much was the tip for the
waiter? -- 28=$_____
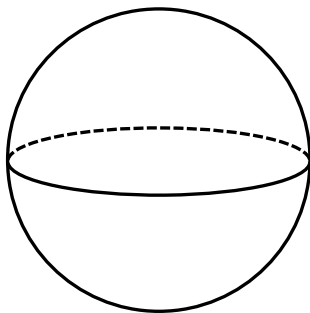
23W-29.	23W-30.
SPHERE	SQUARE PYRAMID
Surface Area = 3020	
Volume = ?	Volume = ?
23W-29 =_____	23W-30 =_____
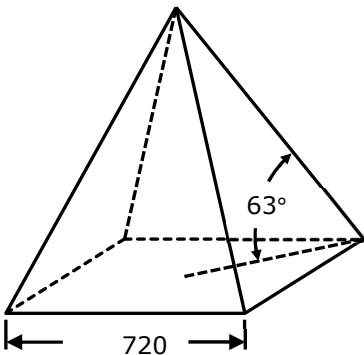
23W-30. 63° 720

23W-31. $\sqrt{\dfrac{5.33}{\sqrt{75 + 14.9}}} \times \left[\dfrac{1}{(4.47 - 2.78)^2} + \dfrac{1}{(2.44 + 1.99)^2}\right]$ ------------ 31=_____

23W-32. $\dfrac{(59 + 117)^2}{\sqrt{56.2 - 16.2}} + \dfrac{89800}{\sqrt{55.9 + 517}}$ ------------------------------------ 32=_____

23W-33. $\dfrac{(8.32 \times 10^5)^2 (9.42 \times 10^{-13} + 4.53 \times 10^{-13})}{0.018 + (-0.528)(-0.0951)} + \dfrac{1}{\dfrac{1}{3.59} + \dfrac{1}{(-11.9)}}$ ------ 33=_____

23W-34. $\dfrac{[0.024/(0.884 + 0.951) + 1/(6.63)]^{1/2}}{(7 + 12.8)^2 \times \sqrt{18.5 - (-6.75)}}$ --------------------------- 34=_____
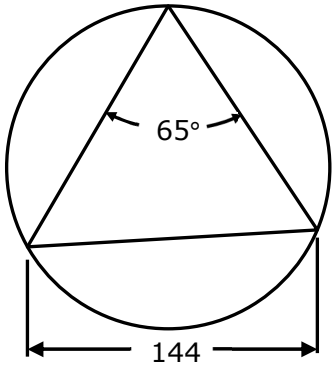
23W-35. $\dfrac{(97.1 + 98.2)^2 - (133 - 43.5)^2}{\sqrt{(105)(0.697)(166 + 110 - 473)^2}}$ ------------------------------ 35=_____

23W-36. How many minutes after 7:15 do the minute and hour hands align? --- 36=_____ min

23W-37. Find the distance between the intersection points of $y_1 = 0.4x^2 - 6$ and $y_2 = 0.3x + 2$. --- 37=_____

23W-38. Nathan and Tommy run a 440-yard race. Tommy runs a mile in 6 min 46 sec. Nathan runs a mile in 8 min 48 sec. How far ahead is Tommy just as he crosses the finish line? -- 38=_____ yd
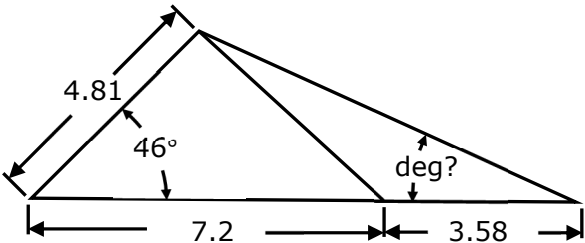
23W-39. SCALENE TRIANGLE AND CIRCLE	23W-40. SCALENE TRIANGLE
65° 144 Area of Circle = ?	4.81 46° deg? 7.2 3.58
23W-39 =_____	23W-40 =_____

23W-41. $(-0.403)(0.348)10^{\{-0.67/-0.0912\}}$ ----------------------------- 41=_____

23W-42. $\dfrac{(3.88 \times 10^5)}{(4.68 \times 10^5)}\left[1 - e^{-(0.849)(0.472)}\right]$ ----------------------------- 42=_____

23W-43. $(-8.83 \times 10^{-7} - 2.56 \times 10^{-6})\, \text{Ln}\{(-8.66 \times 10^{-7})(-9.50 \times 10^{-7})\}$ ------- 43=_____

23W-44. $(555 + 642)^{1/3} + 1/\{(381)^{-0.437}\}$ --------------------------------- 44=_____

23W-45.(deg) $\dfrac{\cos\{(9.13°)/(7.24)\}}{\sin\{160° - 663°\}}$ --------------------------------------- 45=_____
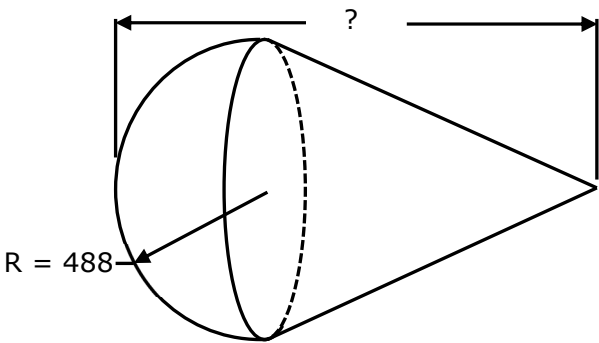
23W-46. A recipe calls for 6 cups of sugar and makes 15 dozen 4-inch cookies. How many cups of sugar are needed to make 24 dozen 6-inch cookies?-- 46=_____ cups

23W-47. Helen started a workout program at her gym. It includes running on the treadmill. She has gradually been increasing her time spent running each week. The total times spent running each of the first 5 weeks were 22 min, 26 min, 31 min, 33 min and 42 minutes. Predict how many minutes she will run in week 12. --- 47=_____ min

23W-48. For what negative value of x does $x^8 - x^5 = -x + 3$? ----------------- 48=_____
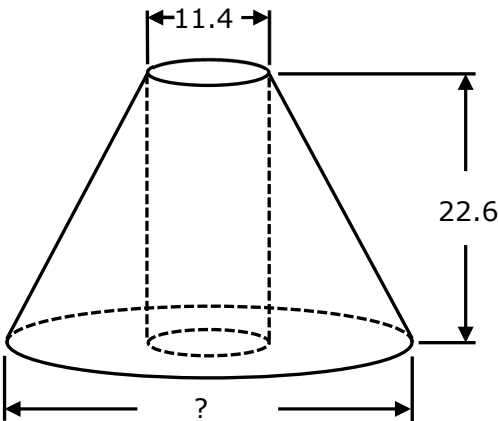
23W-49. CONE AND HEMISPERE	23W-50. HOLLOW FRUSTUM
Hemisphere Surface Area = Cone Surface Area	Volume = 5310
R = 488 ?	11.4 22.6 ?
23W-49 =_____	23W-50 =_____

23W-51. $\dfrac{10^{(0.37)} \times 10^{-(0.258)} + 0.884}{10^{(1.92 + 0.827)}}$ --- 51=_____

23W-52. $\dfrac{1 + e^{+\{0.627 + (0.684)(1.18)\}}}{(-39900)(5.26 - e^{(-0.641)})}$ ------------------------------------- 52=_____

23W-53. $\dfrac{\text{Log}\{1.84 \times 10^{-7} + (9.07 \times 10^{-4})(3.68 \times 10^{-4})\}}{5.26 - \text{Log}\{(57.6)/(0.0348)\}}$ --------------------- 53=_____

23W-54. $\dfrac{(\pi)^{0.265} - (5.05)^{-0.191}}{-5.16 \times 10^{-6} + 8.60 \times 10^{-7}}$ -- 54=_____

23W-55.(rad) $\dfrac{\arcsin\{(8.72 \times 10^5)(4.90 \times 10^5)/(7.73 \times 10^{11})\}}{-5.64 \times 10^9 + (3.28 \times 10^5)(-21000)}$ ---------------- 55=_____

23W-56.(rad) For what value of x, $0 < x < 20$, does the slope of the curve

$y = 2\cos\left(\dfrac{x}{4}\right) = 0.447$?--- 56=_____

23W-57. A 13-ft ladder is leaning against a wall. The base of the ladder is
being pulled away from the wall at 1.25 ft/sec. At what rate is the top of the
ladder sliding down the wall at the moment the base of the ladder is 5 feet
from the wall? --- 57=_____ ft/s

23W-58. Given $A = \begin{bmatrix} 3 & x \\ x & 11 \end{bmatrix}$ and $B = \begin{bmatrix} -18 & 24 \\ 32 & 42 \end{bmatrix}$. Find the positive value of x

such that $\det(A \cdot B) = 69{,}882$. --- 58=_____

23W-59.

$y = \dfrac{12}{x} + 6x$

$x + y = ?$
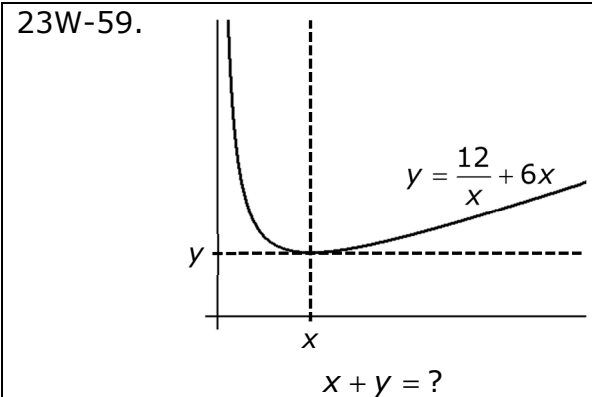
23W-59 = _____

23W-60.
RIGHT TRIANGLES AND QUARTER CIRCLE

22

30

deg?
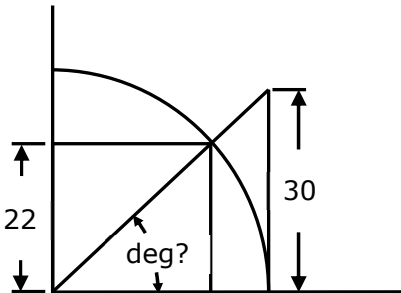
23W-60 = _____

23W-61. What is the closest approach of the line $y = 2x + 7$ to the origin? --- 61=_____

23W-62. Evaluate 14782^{-14782}. --- 62=_____

23W-63. A projectile is fired from Aberdeen to American Falls 16 miles away, at a release angle of 42°. What is the maximum elevation of the projectile during the flight? --- 63=_____ ft

23W-64.	23W-65.
CIRCLE AND SEGMENT	CYLINDER
Shaded Area = 1160	AB = 190 and BC = 113 C is the center
R = 21.1 ?	B ? A C
23W-64 =_____	23W-65 =_____

23W-66. $10^{0.747} \times \sqrt{\dfrac{(10^{0.943})(10^{0.561})}{(10^{-6.11})(10^{0.151})}}$ ----------------------------------- 66=_____

23W-67. (rad) sin(1.54)cos(5.89) − cos(1.54)sin(5.89) ----------------------- 67=_____

23W-68. (deg) $\left\{\cos^2(43.3°) - \sin^2(43.3°)\right\} \times \dfrac{\tan(43.3°)}{1 - \tan^2(43.3°)}$ ------------- 68=_____

23W-69. $1 + \dfrac{(0.46)^4}{2} - \dfrac{(0.46)^6}{6} + \dfrac{(0.46)^8}{24} - \dfrac{(0.46)^{10}}{120}$ ----------------------- 69=_____

23W-70. (rad) $e^{(6.07)}\left[\dfrac{(1.4)\sin(3.92) - (0.646)\cos(-2.02)}{(3.4)\sqrt{(1.4)^2 + (0.646)^2}}\right]$ ---------------- 70=_____

2022–2023
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23W-1	$= -0.0298$ $= -2.98 \times 10^{-2}$	23W-11	$= 0.0313$ $= 3.13 \times 10^{-2}$	23W-21	$= 0.323$ $= 3.23 \times 10^{-1}$
23W-2	$= -2.48$ $= -2.48 \times 10^{0}$	23W-12	$= -0.000238$ $= -2.38 \times 10^{-4}$	23W-22	$= 0.191$ $= 1.91 \times 10^{-1}$
23W-3	$= 1.34$ $= 1.34 \times 10^{0}$	23W-13	$= 142000$ $= 1.42 \times 10^{5}$	23W-23	$= 0.238$ $= 2.38 \times 10^{-1}$
23W-4	$= -0.467$ $= -4.67 \times 10^{-1}$	23W-14	$= -7780$ $= -7.78 \times 10^{3}$	23W-24	$= 545000$ $= 5.45 \times 10^{5}$
23W-5	$= 7.46$ $= 7.46 \times 10^{0}$	23W-15	$= 0.189$ $= 1.89 \times 10^{-1}$	23W-25	$= 0.303$ $= 3.03 \times 10^{-1}$
23W-6	$=\$2.78$	23W-16	$=7.3816$ (5SD) $= 7.3816 \times 10^{0}$	23W-26	$=414$ $= 4.14 \times 10^{2}$
23W-7	$=287$ $= 2.87 \times 10^{2}$	23W-17	$=6$ integer	23W-27	$=\$35,275.60$
23W-8	$=1400$ $= 1.40 \times 10^{3}$	23W-18	$=67$ integer	23W-28	$=\$7.93$
23W-9	$=46.1$ $= 4.61 \times 10^{1}$	23W-19	$=19.2$ $= 1.92 \times 10^{1}$	23W-29	$=15600$ $= 1.56 \times 10^{4}$
23W-10	$=21.1$ $= 2.11 \times 10^{1}$	23W-20	$=7.11$ $= 7.11 \times 10^{0}$	23W-30	$= 1.73 \times 10^{8}$

2022-2023
HS Virtual Challenge Meet #3 – Key

23W-31 $= 0.301$
$= 3.01 \times 10^{-1}$

23W-41 $= -3.11 \times 10^{6}$

23W-51 $= 0.00390$
$= 3.90 \times 10^{-3}$

23W-61 $= 3.13$
$= 3.13 \times 10^{0}$

23W-32 $= 8650$
$= 8.65 \times 10^{3}$

23W-42 $= 0.274$
$= 2.74 \times 10^{-1}$

23W-52 $= -2.75 \times 10^{-5}$

23W-62 $= 1.01 \times 10^{-61637}$

23W-33 $= 19.3$
$= 1.93 \times 10^{1}$

23W-43 $= 9.58 \times 10^{-5}$

23W-53 $= -3.08$
$= -3.08 \times 10^{0}$

23W-63 $= 19000$
$= 1.90 \times 10^{4}$

23W-34 $= 0.000206$
$= 2.06 \times 10^{-4}$

23W-44 $= 24.0$
$= 2.40 \times 10^{1}$

23W-54 $= -144000$
$= -1.44 \times 10^{5}$

23W-64 $= 9.58$
$= 9.58 \times 10^{0}$

23W-35 $= 17.9$
$= 1.79 \times 10^{1}$

23W-45 $= -1.66$
$= -1.66 \times 10^{0}$

23W-55 $= -4.67 \times 10^{-11}$

23W-65 $= 70.7$
$= 7.07 \times 10^{1}$

23W-36 $= 23.2$
$= 2.32 \times 10^{1}$

23W-46 $= 32.4$
$= 3.24 \times 10^{1}$

23W-56 $= 17.0$
$= 1.70 \times 10^{1}$

23W-66 $= 30100$
$= 3.01 \times 10^{4}$

23W-37 $= 9.37$
$= 9.37 \times 10^{0}$

23W-47 $= 73.1$
$= 7.31 \times 10^{1}$

23W-57 $= 0.521$
$= 5.21 \times 10^{-1}$

23W-67 $= 0.935$
$= 9.35 \times 10^{-1}$

23W-38 $= 102$
$= 1.02 \times 10^{2}$

23W-48 $= -1.12$
$= -1.12 \times 10^{0}$

23W-58 $= 8.88$
$= 8.88 \times 10^{0}$

23W-68 $= 0.499$
$= 4.99 \times 10^{-1}$

23W-39 $= 19800$
$= 1.98 \times 10^{4}$

23W-49 $= 1330$
$= 1.33 \times 10^{3}$

23W-59 $= 18.4$
$= 1.84 \times 10^{1}$

23W-69 $= 1.02$
$= 1.02 \times 10^{0}$

23W-40 $= 24.9$
$= 2.49 \times 10^{1}$

23W-50 $= 28.8$
$= 2.88 \times 10^{1}$

23W-60 $= 42.8$
$= 4.28 \times 10^{1}$

23W-70 $= -58.0$
$= -5.80 \times 10^{1}$

The Virtual Challenge Meets
HS Number Sense Test • VCM #3 • 2022-2023

Contestant's Name _____

School _____

Contestant's Grade   9   10   11   12

**Read directions carefully
before beginning test**

**DO NOT UNFOLD THIS SHEET
UNTIL TOLD TO BEGIN**

Directions: Do not turn this page until the proctor gives the signal to begin. This is a ten-minute test test. There are 80 problems. Solve accurately and quickly as many as you can in the order in which they appear. ALL PROBLEMS ARE TO BE SOLVED MENTALLY. Make no calculations with paper and pencil. Write only the answer in the space provided at the end of each problem. Problems marked with an (*) require approximate integral answers; any answer to a problem with an asterisk that is within five percent of the exact answer will be scored correct; all other problems require exact answers.

The person conducting this contest should explain these directions to the contestants.

STOP – WAIT FOR SIGNAL!

(1) $3214 + 2023 =$ _____

(2) $194 - 797 =$ _____

(3) $2023 \div 7 =$ _____

(4) $14 \div 3\frac{1}{3} =$ _____ (improper fraction)

(5) $15\frac{1}{2} \times 22 =$ _____

(6) $12^0 + 9^1 - 7^2 =$ _____

(7) $23^2 =$ _____

(8) $17 \times 15 - 23 \times 15 =$ _____

(9) $25 \times 432 =$ _____

*(10) $245 \times (111 \times 3) =$ _____

(11) $17 \times 23 =$ _____

(12) The GCD of 28 and 80 is_____

(13) $26 \times 86 =$ _____

(14) $45 \times 82 =$ _____

(15) $3 \text{ m}^2 =$ _____ cm²

(16) If 9 dozen eggs cost $42.00,
then 12 dozen eggs cost $ _____

(17) $1 + 3 + 5 + \dots + 47 =$ _____

(18) $28^2 - 16^2 = 4 \times$_____

(19) $48 \times 32 + 32^2 =$ _____

*(20) $(28 \times 32)^2 =$ _____

(21) $3257 \div 9$ has a remainder of_____

(22) The sum of the distinct prime divisors of 140 is ____

(23) $4^{-1} + 4^{-2} + 4^{-3} =$ _____ (fraction)

(24) $836 \div 11 =$ _____

(25) 1 gram = 0.04 oz, and 52 oz = _____ grams

(26) The arithmetic mean of 11, 15, 23, and 27 is_____

(27) $234_9 =$ _____₁₀

(28) $9\frac{3}{10} \times 9\frac{7}{10} =$ _____ (mixed number)

(29) The smallest root of $6x^2 - 7x - 3 = 0$ is_____

*(30) $\sqrt{784231} =$ _____

(31) $1998 \times 14 + 5 \times 14 =$ _____

(32) $57 \times 57 =$ _____

(33) The number of positive integral
divisors of 45 that are composite is _____

(34) $(12^3 - 1) \div (12 - 1) =$ _____

(35) If x + y = 8 and y = 3x, then $y^2 =$ _____

(36) $4\frac{2}{9} \times 5\frac{2}{9} =$ _____(mixed number)

(37) If $(4x + 3)^3 = ax^3 + bx^2 + cx + d$,
then $a + b + c + d =$ _____

(38) $\left[35 + 21 \times 22 - 12^2\right] \div 11$ has a remainder of____

(39) Given 1, 3, 6, 10, p, q, …, 36, 45, r . p + q + r = _____

*(40) $31975 \div 13 =$_____

(41) $18^2 \div 6^2 \times 2^2 =$_____

(42) If $\frac{a}{11}$ has a remainder of 6 and $\frac{b}{11}$ has a
remainder of 2, then $\frac{2ab}{11}$ has a remainder of_____

(43) Let $x^2 - 8x + k = 0$ and the roots of x are
both positive prime numbers, then k =_____

(44) The coefficients of the x^3y^4 term of $(2x + y)^7$ is _____

(45) $97 \times 106 =$_____

(46) If y varies directly with x and y = 24 when x = 12,
then y = _____ when x = 8

(47) $9^4 - 1 =$ _____ 9

(48) $\left(\frac{4}{9}\right)^{-\frac{1}{2}} =$_____

(49) If $\sqrt{3x + 1} = 5$, then $7x + 4 =$_____

*(50) $285.71 \times 84 =$ _____

(51) $0.48484\ldots - 0.2222\ldots =$ _____ (fraction)

(52) $3\frac{9}{m} \times n\frac{2}{3} = 14$, where m and n are
natural numbers. Find m + n. _____

(53) $(5 - 4i)(1 + 5i) = a + bi$. Find a._____

(54) $3 + 2 + \frac{4}{3} + \frac{8}{9} + \ldots =$ _____

(55) $837 \times 111 =$ _____

(56) $12^{2.5} = a\sqrt{b}$. Find a. _____

(57) The vertex of $(x - 5)^2 = 8(y - 4)$ is at (h, k). h + k =__

(58) $\sum_{k=1}^{15}(-1)^k(k)^2 =$_____

(59) How many numbers between 1 and 100, inclusive,
are not divisible by either 2 or 3? _____

*(60) $\sqrt{1900} \times \sqrt[3]{1700} =$ _____

(61) $7! = k \times 5! + 10 \times 6!$. $k =$ _____

(62) $\left(5x^3 + 10x^2 - 11x + 14\right) \div (x - 2)$
has a remainder of _____

(63) The harmonic mean of $\frac{1}{5}, \frac{1}{3}$, 3, and 5 is_____

(64) $|2 + 3i\sqrt{5}| =$_____

(65) $18^{24} \div 23$ has a remainder of _____

(66) $22 \times \frac{25}{27} =$ _____ (mixed number)

(67) Let $f(x) = x^2 + 22x + 121$ and $g(x) = \sqrt{2x + 7}$.
$f(g(9)) =$_____

(68) A triangle has sides of x, 11, and 23. The maximum
integral value of the perimeter is _____

(69) $\sec\left(Arccos \frac{5}{7}\right) =$ _____

*(70) The radius of a sphere is 15.
The surface area is_____

(71) $746_8 =$ _____ $_2$

(72) $\lim_{x \to 2}\frac{2sin(x-2)}{x^2-4} =$ _____

(73) Find x, $0 \le x \le 10$, if $4x - 1 \cong 9(mod\ 11)$. _____

(74) The graph of $y = \frac{x-5}{9x^2-4}$ has _____asymptotes

(75) If xy = 5 and x − y = 3, then $x^3 - y^3 =$ _____

(76) $\int_2^4\left(6x^2\right) dx =$ _____

(77) $18^8 \div 3^{10}$ has a remainder of_____

(78) How many distinguishable permutations can be
made using the letters, P, O, P, P, E, R, S?_____

(79) 0.32_4 written in base 8 is 0. _____

*(80) $0.2727\ldots \times 3.33 \times 10^4 =$_____

2022-2023 Virtual Challenge Meet #3 • HS Number Sense - Key

(1) 5237

(2) − 603

(3) 289

(4) $\frac{21}{5}$

(5) 341

(6) − 39

(7) 529

(8) − 90

(9) 10800

*(10) 77506 – 85664

(11) 391

(12) 4

(13) 2236

(14) 3690

(15) 30000

(16) 56.00

(17) 576

(18) 132

(19) 2560

*(20) 762676 – 842956

(21) 8

(22) 14

(23) $\frac{21}{64}$

(24) 76

(25) 1300

(26) 19

(27) 193

(28) $90\frac{21}{100}$

(29) $-\frac{1}{3}$

*(30) 842 – 929

(31) 28042

(32) 3249

(33) 3

(34) 157

(35) 36

(36) $22\frac{4}{81}$

(37) 343

(38) 1

(39) 91

*(40) 2337 – 2582

(41) 36

(42) 2

(43) 15

(44) 280

(45) 10282

(46) 16

(47) 8888

(48) $\frac{3}{2}$, $1\frac{1}{2}$ or 1.5

(49) 60

*(50) 22800 – 25199

(51) $\frac{26}{99}$

(52) 14

(53) 25

(54) 9

(55) 92907

(56) 288

(57) 9

(58) − 120

(59) 33

*(60) 495 – 546

(61) − 18

(62) 72

(63) $\frac{15}{32}$

(64) 7

(65) 2

(66) $20\frac{10}{27}$

(67) 256

(68) 67

(69) $\frac{7}{5}$, $1\frac{2}{5}$ or 1.4

*(70) 2687 – 2968

(71) 111100110

(72) $\frac{1}{2}$ or .5

(73) 8

(74) 3

(75) 72

(76) 112

(77) 0

(78) 840

(79) 7

*(80) 8628 – 9535