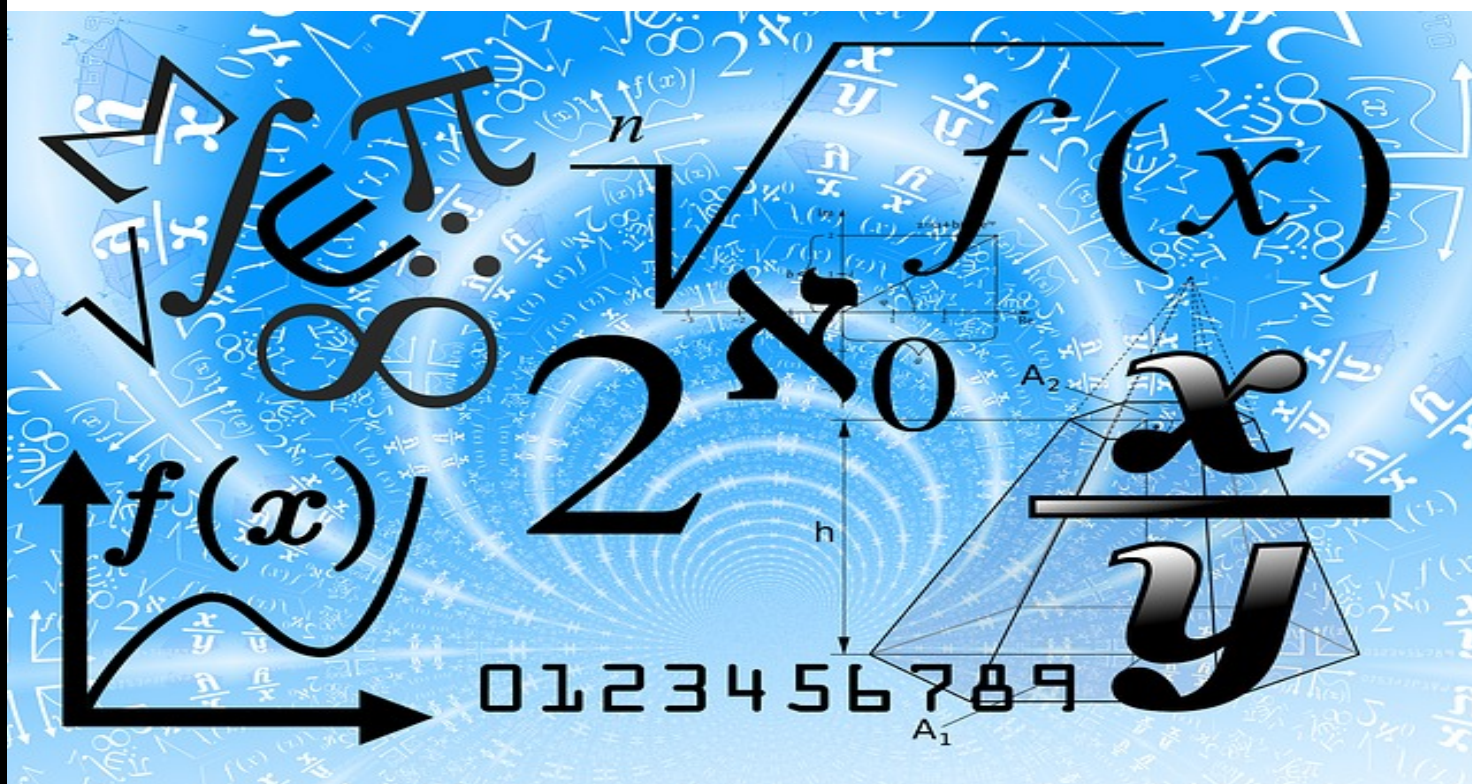# THE ▼IRTUAL MEET EXPERIENCE

2022-2023

HS VIRTUAL CHALLENGE REGIONAL QUALIFIERS' MEET

MATHEMATICS

DO NOT OPEN TEST UNTIL TOLD TO DO SO

The Virtual Challenge Meets™

1. Carl, Cameron and Chris ate at a burger truck. Together they ordered 3 hot dogs for $1.75 each, 2 burgers for $1.50 each, 3 large drinks for $1.78 each and 1 order of cobbler for $3.25. They tipped 20% on the food subtotal and paid tax. Carl paid with two $20 bills and received $18.66 in change. What was the tax rate? (nearest hundredth percent)

    (A) 6.25%   (B) 6.72%   (C) 8.28%   (D) 6.29%   (E) 8.25%

2. Consider the line $\overrightarrow{AB}$ with points A(–5, 9) and B(5, 5). If the point $(1, b)$ lies on $\overrightarrow{AB}$, then $b =$ _____.

    (A) $\dfrac{27}{5}$ (B) 6   (C) $\dfrac{33}{5}$ (D) $\dfrac{29}{5}$ (E) 5

3. Ethan works at a café where a 10-oz cup of coffee costs $0.95, a 14-oz cup costs $1.15 and a 20-oz cup costs $1.50. In one hour, Ethan served 19 cups of coffee, using 274 oz of coffee, for a total cost of $22.55. How many 14-oz cups did Ethan serve?

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

4. The measure of minor arc AB is $(5x)°$, and the measure of minor arc CD is $(4x-13)°$. Find the value of x if $m\angle BEC = 137°$.

    (A) 43   (B) 11   (C) 6   (D) 9   (E) 13
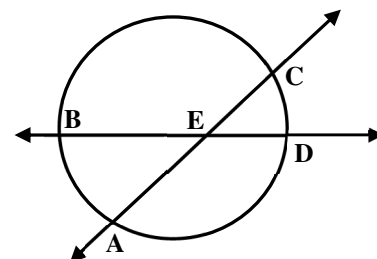
5. Angela, Barb and Carry plan on mowing lawns to earn money this summer. Angela can mow a lawn in 1 hr 20 min, Barb can mow a lawn in 1 hr 15 min, and Carry can mow a lawn in 1 hr 45 min. How long will it take the three of them working together to mow 30 lawns? (nearest minute)

    (A) 15 hr 11 min   (B) 14 hr 14 min   (C) 14 hr 31 min   (D) 14 hr 8 min   (E) 15 hr 7 min

6. Ethan is solving the quadratic equation $x^2 + 7x - 9 = 0$ by completing the square. His second step is $x^2 + 7x + c = 9 + c$. The value of c is _____.

    (A) 24.5   (B) 3.5   (C) 7   (D) 49   (E) 12.25

7. The chord $\overline{AB}$ is 9 cm from the center of circle O. If AB = 80 cm, the area of circle O is _____ cm². (nearest square centimeter)

    (A) 251   (B) 5281   (C) 5027   (D) 258   (E) 20360

8. Cole's take-home pay is directly related to the number of hours he works. Two weeks ago, he worked 18 hours and received a check for $274.86. Last week, he worked 23 hours and received a check for $351.21. If he worked 31 hours this week on his spring break, how much should he receive in his paycheck?
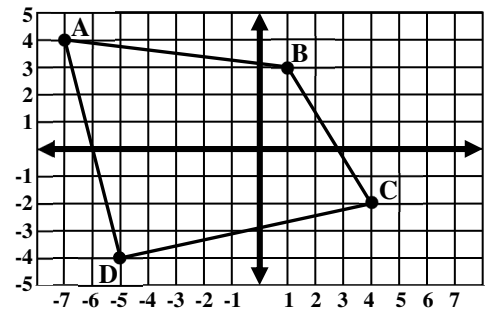
    (A) $427.56   (B) $452.78   (C) $473.37   (D) $397.21   (E) $481.17

9. The perimeter of quadrilateral ABCD show on the right is _____.
(nearest tenth)

(A) 31.4   (B) 31.8   (C) 32.1   (D) 32.3   (E) 32.7

10. The area of quadrilateral ABCD is _____. (nearest tenth)

(A) 54.5   (B) 55   (C) 55.5   (D) 56   (E) 56.5

Problems 9, 10, 11, 12

11. The coordinates of the midpoint of the diagonal $\overline{AC}$ are (a,b). $a+b$ = _____.

(A) –1.5   (B) –0.5   (C) –1   (D) 0   (E) 0.5

12. Find the measure of $\angle DCB$. (nearest tenth)

(A) 69.2°   (B) 69.8°   (C) 71.0°   (D) 71.2°   (E) 71.6°

13. A regular octagon has an apothem length of 8 cm. The area of the octagon is _____ cm². (nearest square centimeter)

(A) 256   (B) 239   (C) 362   (D) 357   (E) 212

14. The odds of drawing a blue marble at random from a bucket of 306 marbles are 6:11. How many blue marbles would have to be removed from the bucket to reduce the odds to 1:3?

(A) 54   (B) 9   (C) 42   (D) 99   (E) 66

15. Four tests together count for 70% of the final grade in a calculus class. The final exam counts for 30%. Angela has an average of 78% after the fourth test. What grade does she need to earn on the final exam to make a "B" in the class, a grade of 80% or higher? Her teacher does not round up individual grades or averages, and only awards whole number scores.

(A) 81%   (B) 82%   (C) 83%   (D) 84%   (E) 85%

Problems 16-17. The base of an inverted conical tank has a diameter of 6 ft, and the vertex angle of the tank is 40°.

16. The total capacity of the tank is _____ gallons. (nearest whole number)

(A) 608   (B) 581   (C) 2324   (D) 2434   (E) 1453

17. The owner of the tank hired a welder to make a new round lid to cover the entire top of the base. If the steel costs $0.38/in², how much did the owner have to pay just for the steel used for the lid?

(A) $6188.69   (B) $1969.92   (C) $5909.76   (D) $1547.17   (E) $1477.44

18. Consider the Fibonacci type series $16 + 7 + 23 + 30 + ... + 574 + 929$. The sum of the series is_____.

  (A) 2425   (B) 2404   (C) 2402   (D) 1890   (E) 1898

19. The 5th term of an arithmetic sequence is 12, while the 9th term is 21. Find the sum of the first 19 terms of the sequence.

  (A) 441.75   (B) 413.25   (C) 313.5   (D) 378.25   (E) 319.5

20. Consider infinite geometric sequences with a fourth term 17280 and sixth term $\dfrac{31104}{5}$. The smallest possible sum for an infinite number of terms of a sequence with these conditions is_____.

  (A) 43,200   (B) –50,000   (C) 82,500   (D) 10,800   (E) –43,200

21. Elisa plans to take 3 days to drive from Denver, CO to Mill City, OR, a distance of 1230 miles. Elisa drove 422 miles at an average speed of 64 mph on Monday and 388 miles at an average speed of 71 mph on Tuesday. What average speed must Elisa travel on Wednesday in order to have an overall average speed of 65 mph for the entire trip? (nearest tenth)

  (A) 60.0 mph   (B) 60.5 mph   (C) 60.8 mph   (D) 61.2 mph   (E) 62.2 mph

22. Ms. Smith sponsors student council. This year, there are 3 freshman, 4 sophomores, 6 juniors and 6 seniors. She has the budget to take 2 students each from the lower 3 grades, and 4 seniors to the state conference. In how many distinct ways can she select the group for the trip?
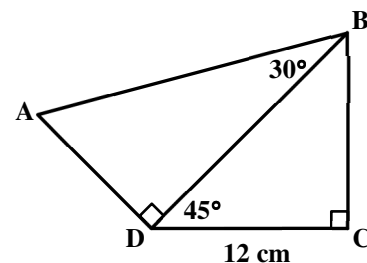
  (A) 4050   (B) 3375   (C) 432   (D) 4320   (E) 6864

23. The area of quadrilateral ABCD is _____ cm^2. (nearest whole centimeter)

  (A) 204   (B) 102   (C) 155   (D) 126   (E) 144

24. The perimeter of quadrilateral ABCD is _____ cm. (nearest centimeter)

  (A) 70   (B) 53   (C) 47   (D) 64   (E) 57

Problems 23, 24

25. Find the remainder when $4x^4 + 2x^3 - 18x^2 - 2x + 8$ is divided by $x^2 - 2$.

  (A) $2x$ (B) –12   (C) 0   (D) $2x - 12$ (E) $x - 12$

26. The tires on Jennifer's car have a diameter of 66 cm. If she has the cruise control set to 68 mph, what is the angular velocity of the wheels in revolutions per minute?

  (A) 853 rpm   (B) 859 rpm   (C) 862 rpm   (D) 866 rpm   (E) 880 rpm

27. Which of the following is one of the fourth roots of $5 - 3i$? (nearest tenth)

  (A) $1.6\operatorname{cis}83.2°$ (B) $1.6\operatorname{cis}229.7°$ (C) $1.6\operatorname{cis}349.7°$ (D) $1.6\operatorname{cis}262.3°$ (E) $1.6\operatorname{cis}355.3°$

28. Total emissions of carbon dioxide have been increasing at about 0.9% per year. If emissions continue to increase at this rate, how long will it take for emissions to double? (nearest year)

  (A) 8 yr   (B) 42 yr   (C) 77 yr   (D) 81 yr   (E) 111 yr

29. If $f(x) = \dfrac{1}{x^2}$, then $\dfrac{f(x+h)-f(x)}{h} = $ _____.

  (A) $\dfrac{-2x+h}{x^2(x+h)^2}$ (B) $-\dfrac{2}{x^3}$ (C) $\dfrac{2}{x^3}$ (D) $-\dfrac{2x+h}{x^4+x^2h^2}$ (E) $\dfrac{-2x-h}{x^2(x+h)^2}$

30. Determine the eccentricity of the ellipse: $x^2 + 4y^2 - 6x - 16y - 11 = 0$. (nearest hundredth)

  (A) 0.82   (B) 0.87   (C) 0.89   (D) 0.91   (E) 0.92

31. How many odd, three-digit counting numbers less than 1000 exist such that the sum of the digits is 6?

  (A) 5   (B) 7   (C) 9   (D) 11   (E) 13

32. Find the distance from the point (–2, –5) and the line $y = -\dfrac{2}{3}x + 5$. (nearest tenth)

  (A) 9.4   (B) 9.7   (C) 9.9   (D) 10.3   (E) 10.5

33. If $f(x) = 5x - 3$ and $g(x) = x^2 - 2$ then $\left(g \circ f^{-1}\right)(7) = $ _____.

  (A) 1022   (B) 237   (C) 288   (D) 2   (E) 14

34. $\dfrac{\cot^2 t}{\csc t} = $

  (A) $\csc t - \sin t$ (B) $\sec t - \sin t$ (C) $\csc t + \sin t$ (D) $\sec t - \cos t$ (E) $\sec t + \cos t$

35. Two players, X and Y, play a game in which X tosses 6 coins and Y throws a fair, 6-sided die. Player X wins if the total number of heads is greater than the number on the die, otherwise, Y wins. If Y throws a 3, what is the probability of Y winning the game?

  (A) $\dfrac{7}{12}$ (B) $\dfrac{1}{2}$ (C) $\dfrac{11}{32}$ (D) $\dfrac{5}{12}$ (E) $\dfrac{21}{32}$

36. Which of the following is a solution to the system of equations $x - y < 2$, $x > -2$ and $y \le 3$?

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

37. Solve $\sqrt{17-2x}+1=x$ for x.

(A) 8   (B) 4   (C) 2   (D) ± 8 (E) ± 4

38. Find the total number of diagonals that can be drawn from the vertices of a regular 18-sided polygon.

(A) 135   (B) 153   (C) 148   (D) 162   (E) 165

39. A school district assigns each student an ID code consisting of 3, non-repeating letters followed by 3 digits that can repeat. The district does not issue codes containing "O", "I", "1" or "0". How many distinct codes are possible?

(A) 2,502,240   (B) 6,217,728   (C) 5,405,512   (D) 4,760,448   (E) 4,080,384

40. Evaluate $\sum\limits_{k=1}^{7}\left(3k^2+2k-1\right)$.

(A) 385   (B) 476   (C) 357   (D) 469   (E) 441

41. Consider the graph of $f(x)=\dfrac{2x^2-5x-3}{x^2-9}$. Which of the following is true?

I. $x=-3$ is a vertical asymptote   II. $(3,1)$ is a hole   III. $y=2$ is a horizontal asymptote

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

42. If $\tan\theta=\dfrac{5}{12}$ and $\cos\theta<0$, then $\sin\theta=$_____.

(A) $-\dfrac{12}{13}$ (B) $-\dfrac{5}{13}$ (C) $\dfrac{12}{5}$ (D) $-\dfrac{5}{12}$ (E) $\dfrac{5}{13}$

43. Find the angle between the two planes given by $6x+2y+5z=4$ and $x-4y+3z=9$. (nearest tenth)

(A) 18.4°   (B) 72.6°   (C) 71.6°   (D) 17.4°   (E) 107.4°

44. If $\int_{2}^{k}\dfrac{1}{x+2}dx=\ln 2$, find the value of k.

(A) 4   (B) 2   (C) 0   (D) 8   (E) 6

45. Find the total area of the two regions enclosed by the curves $y=x^3-4x^2+x-12$ and $y=6x-14$. (nearest whole number)

(A) 67   (B) 53   (C) 111   (D) 78   (E) 29

46. What is the equation of the line through (5, 14) that is normal to $x^2 - y = 11$?

(A) $x - 10y = -19$ (B) $10x - 7 = -9$ (C) $x + 10y = 19$ (D) $x + 10y = 145$ (E) $10x - y = 36$

47. A particle's movement along the number line is defined by the function
$f(t) = t^4 - 4t^3 - 26t^2 + 60t + 25$, At which of the following times is the particle moving to the right?

(A) 2 (B) –4 (C) 0 (D) 3 (E) 4

48. What is the area of the largest isosceles triangle that can be inscribed in the circle with the equation
$x^2 + y^2 + 6x + 10y - 87 = 0$? (nearest whole number)

(A) 52 (B) 157 (C) 13 (D) 91 (E) 39

49. If $y = x^{x^2}$, then $\dfrac{dy}{dx} =$

(A) x^{x^2+1} (B) $x + 2x \ln x$ (C) $\left(2x^{x-1}\right) \ln x$ (D) $x^{2x} \ln x$ (E) $(1 + 2\ln x)x^{x^2+1}$

50. Which of the following tests will show that the series $\displaystyle\sum_{n=1}^{\infty} \left[(-1)^{n+1} \frac{n^2}{n^3 + 1} \right]$ converges?

(A) n^{th} Term test (B) Integral test (C) Alternating Series Test

(D) Telescoping Series test (E) Geometric Series test

51. The side length of an equilateral triangle is increasing at a rate of 2 cm/min. The rate at which the area of the triangle is changing at the instant when the side length is 24 cm is _____ cm² per min. (nearest whole number)

(A) 41 (B) 42 (C) 43 (D) 44 (E) 45

52. Use the first four terms of the McLaurin series for $f(x) = e^{x^2}$ to approximate $f(0.5)$. (6 decimal places)

(A) 1.284025 (B) 1.283215 (C) 1.284584 (D) 1.283854 (E) 1.285283

53. The probability that Clara will get a multiple-choice question right by randomly guessing is 0.25. If she guesses on every question on a 20 question quiz, what is the probability that she will make above a 30% on the quiz? (nearest hundredth)

(A) 0.101 (B) 0.214 (C) 0.190 (D) 0.898 (E) 0.786

54-55. The lifetime of a particular model of clothes dryer is approximately normal with a mean of 8 years and a standard deviation of 15 months. The manufacturer would like to offer a full warranty, but does not want to replace more than 2% of the dryers if they break while under warranty.

54. What z-score should the manufacturer use to set the length of the warranty? (nearest hundredth)

   (A)   −2.05   (B)   −1.99   (C)   −2.01   (D)   −2.08   (E)   −2.10

55. The manufacturer would like to list the warranty in years. They should list a _____-year warranty.

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

Year	2015	2016	2017	2018	2019	2020	2021	2022
Passing Calculus Scores	28	20	33	33	23	46	37	32

The table above shows the number of students in Ms. Angle's class who passed either an AB or BC Calculus AP exam each year. Use the table for problems 56, 57 and 58.

56. The mode of the data is _____ students.

   (A)   32   (B)   32.5   (C)   33   (D)   33.5   (E)   34

57. The interquartile range of the data is _____.

   (A)   3.5   (B)   7.5   (C)   8.5   (D)   9.5   (E)   18

58. Which value(s) are considered outliers?

   (A)   none   (B)   20 only   (C)   46 only   (D)   23 only   (E)   20, 46 only

59. A principal was interested in the link between participation in school activities and academic success. She discovered that in her school population of 430 students, 110 were not involved in any activities and were not passing all their classes, 290 were passing all of their classes, and 210 were involved in school activities. What is the probability that a student involved in school activities is passing all their classes? (nearest percent)

   (A)   42%   (B)   56%   (C)   62%   (D)   78%   (E)   86%

60. A survey asked a random sample of 1000 high school students whether they would work during their summer break. Of the sample, 485 said yes. Construct a 98% confidence interval for the proportion of high school students who would say "yes." if asked this question. (nearest ten-thousandth)

   (A)   (04525,.5175) (B)   (.4482,.5218) (C)   (.4515,.5185) (D)   (.4503,.5197) (E)   (.4478,.5222)

2022-2023
Virtual Challenge Regional Qualifiers' Meet
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. _____

19. _____

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44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

51. _____

52. _____

53. _____

54. _____

55. _____

56. _____

57. _____

58. _____

59. _____

60. _____

2022-2023
VIRTUAL CHALLENGE REGIONAL QUALIFIERS' MEET
MATHEMATICS - KEY

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

Name _____ Grade Level_____

5x(Last Problem Attempted) +_____ +_____ +_____
7x(Number Incorrect)   −_____ −_____ −_____
2x(Number Incorrect SDs)   −_____ −_____ −_____
TOTAL SCORE   _____ _____ _____

Calculator Applications

2022–2023
HS Virtual Challenge Regional Qualifiers' Meet

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}.

Page 23Y-1

23Y-1. (9.82/0.396) + 14.2 --- 1=_____

23Y-2. (9.29 − π)/(5.14) + 0.304 --- 2=_____

23Y-3. (−6.19 − π + 6.31) x (−0.0345) − 0.342 --------------------------- 3=_____
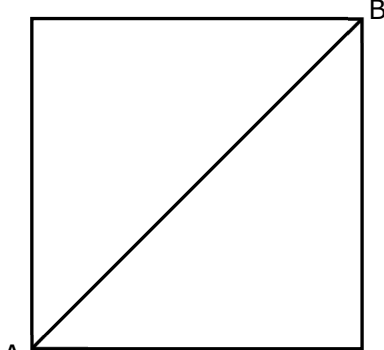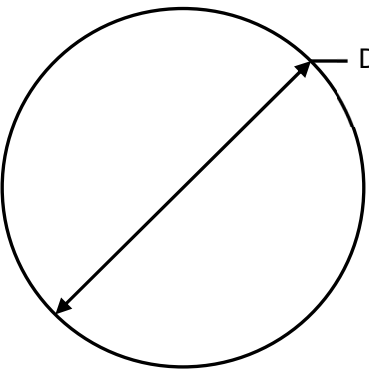
23Y-4. $\dfrac{(6.13)(9.16 - \pi + 10.8)}{(1.62)(2.43)}$ --- 4=_____

23Y-5. −9940 + 1080 − 3140 + $\dfrac{(-47200 + 13300)}{(-6.34)(-4.66)}$ ------------------------ 5=_____

23Y-6. Find the average of 77.2, 13.8 and −44.9. ------------------------------ 6=_____

23Y-7. Mindy purchased a book that cost $27.01 after adding sales tax. If
the tax rate was 8.25%, what was the price of the book? --------------------- 7=$_____

23Y-8. A yard stick is 1.5 in wide. What is the length of the diagonal? ------- 8=_____ in

23Y-9.

SQUARE

AB = 27.3

B

A

Perimeter = ?

23Y-9 =_____

23Y-10.

CIRCLE

Area = 22.8

Diameter = ?

23Y-10 =_____

23Y-11. $\dfrac{(50.9 + 22.6)(-12.8 + 15.3)}{(-8.24)(0.641)(2690 - 8820)}$ --- 11=_____

23Y-12. $\dfrac{\{13.9 + (-4.72)(8.69)(-3.25)\}}{(0.252 + 0.334)(1.56)(1.25 + 0.37)}$ --------------------------------- 12=_____

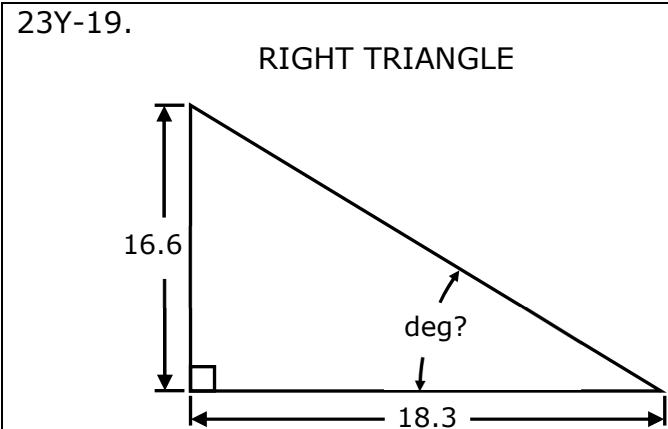23Y-13. $\dfrac{(-0.0607)(372 - 325)\{0.00277 - (-0.0752)(-0.00897)\}}{(-0.00249 + 3.14 \times 10^{-4})(0.069 - 0.159)}$ ----------- 13=_____

23Y-14. $\dfrac{605 + 489 - 1240}{(0.379)(0.14)} - \dfrac{(4.28 \times 10^{6})(1.54 \times 10^{-4} + 1.35 \times 10^{-4})}{0.669 + 0.469 - 1.98}$ --------- 14=_____

23Y-15. $\dfrac{(0.372 + 1.61)}{3.26 - \pi} + \dfrac{-0.23}{85.8 + 832} + \dfrac{(0.989)(107 - 66.1)}{(-171)(0.326)}$ --------------- 15=_____

23Y-16. A convenient rule of thumb is that light travels a distance of 1 foot every nanosecond. What is the percent error in using this approximation given that light actually travels at 299,706,000 m/s in air? ------------------- 16=_____ %(SD)

23Y-17. Find the width of the Central Standard Time zone at 36° north latitude. --- 17=_____ mi

23Y-18. Jace has a new RAM truck. Insurance is $1750 per year, gas costs $3.17 per gallon, and his truck gets 21.4 miles/gallon. If his annual transportation budget is $4000, how far can he drive each day? -------------- 18=_____ mi

23Y-19.

RIGHT TRIANGLE

16.6

deg?

18.3

23Y-19 = _____

23Y-20.

RIGHT TRIANGLE

0.414

?

0.298
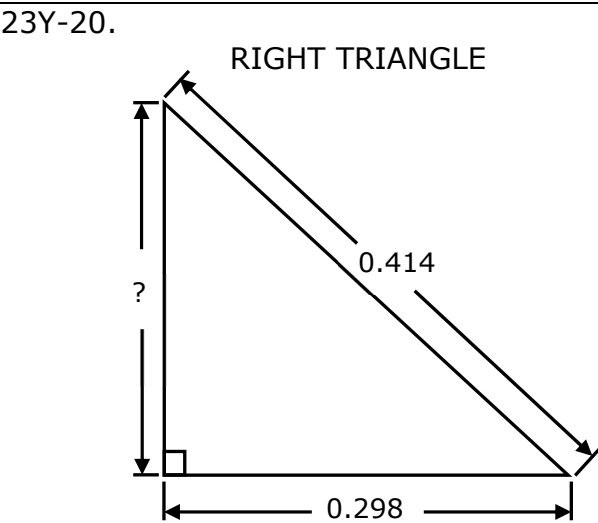
23Y-20 = _____

23Y-21. $\left[\dfrac{\sqrt{2.85 - 0.764}}{8.99} + \dfrac{(0.469)}{5.09}\right]^2$ -- 21=_____

23Y-22. $\dfrac{-0.102 + 1/(-7.93)}{1/(0.216) + 5.76} + \dfrac{1}{(-18.9)}$ -- 22=_____

23Y-23. $\left[\dfrac{0.432 + 0.388 + \sqrt{0.144/0.816}}{0.56 + 0.469}\right]^2$ ------------------------------------ 23=_____
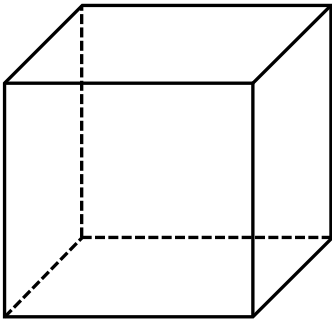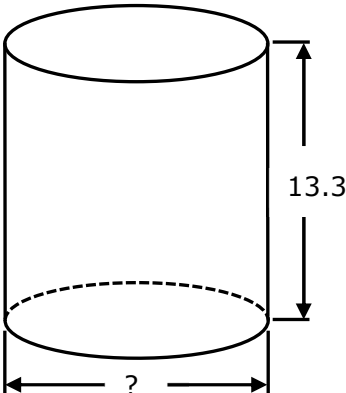
23Y-24. $(797)(8.37 \times 10^{-4})\sqrt{(-0.636)^2/0.503} + 1/\sqrt{1.99 + 15.8}$ ------------- 24=_____

23Y-25. $(-36.6)(-0.0743) + \sqrt{(3.2)/(3.93)} + \left[(0.414)(3.67)\right]^2$ -------------- 25=_____

23Y-26. David ran 10 mi in 54 min 36 sec and then he cycled 30 mi in 56 min 12 sec in the Tech biathlon. What was his average pace for the race? --- 26=_____ mph

23Y-27. Joe paid $3200 for a low mileage used Camero in 1977. In 2022, he paid $43,500 for a low mileage used Camero. Based on these prices, what was the average annual rate of inflation? ------------------------------- 27=_____ %

23Y-28. A sphere had an initial volume of 46.5 cm³. Its volume increased by 22%. Find the positive difference between the final radius and the initial radius. -- 28=_____ cm

23Y-29.	23Y-30.
CUBE	CYLINDER
Volume = 291	Total Surface Area = 576
	13.3
Total Surface Area = ?	?
23Y-29 =_____	23Y-30 =_____

23Y-31. $$\frac{(-4.36\text{x}10^{-4} + 0.00146)^2}{\sqrt{67.1 - 42.8}} + \frac{1.46\text{x}10^{-9}}{\sqrt{6.43\text{x}10^{-4} + 7.62\text{x}10^{-4}}}$$ ---------- 31=_____

23Y-32. $$\left[\frac{-3.94\text{x}10^{-5}}{3.82\text{x}10^{-6} + 1.94\text{x}10^{-6}} + 25.3\right] \times \left\{5620 + (-99.9)^2 - \sqrt{1.59\text{x}10^8}\right\}$$ -- 32=_____

23Y-33. $$\frac{(9.67\text{x}10^5)^2(7.52\text{x}10^{-13} + 1.41\text{x}10^{-13})}{239 + (-0.82)(-1160)} + \frac{1}{\dfrac{1}{6.42\text{x}10^{-4}} + \dfrac{1}{(-5.83\text{x}10^{-4})}}$$ -- 33=_____

23Y-34. $$\frac{\sqrt{(77.6)/\left\{(92.9)/\sqrt{59.9}\right\}}}{2.24 + (0.422)(2.17)} + \left\{0.556 + 0.716\right\}^{1/2}$$ ----------------- 34=_____

23Y-35. $$\frac{\left[\dfrac{0.143}{542}\right]^2 + \sqrt{\dfrac{(0.552)(0.986)}{(1.39\text{x}10^{14})}} + (7.68\text{x}10^{-8})}{0.764 + \sqrt{(-0.375)(-0.503)}}$$ ----------------- 35=_____

23Y-36. Consider the graph of $y = x^3 - 2x + 3$. Find the distance from the
x-intercept to the y-intercept. -- 36=_____
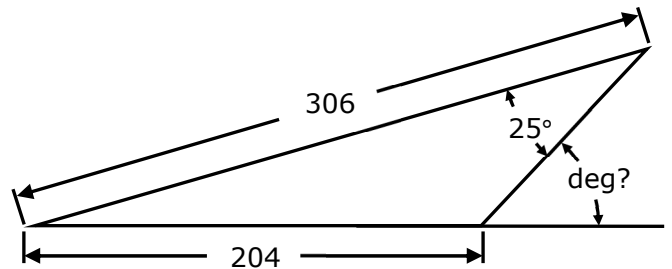
23Y-37. Two boats leave harbor at the same time. One travels west at
15 knots. The second travels southeast at 18 knots. How far apart are the
boats after 6 hours. (1 knot = 1.15 mph)------------------------------------- 37=_____ mi

23Y-38. How long after 8:44 do the minute hand and hour hand align? ------- 38=_____
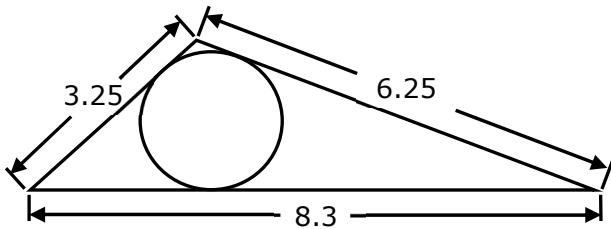
23Y-39. SCALENE TRIANGLE AND CIRCLE	23Y-40. SCALENE TRIANGLE
Area of Circle = ?	
23Y-39 =_____	23Y-40 =_____

23Y-41. $10^{-\{(0.25 - 0.448)/(0.468 + 0.432)\}}$ ------------------------------ 41=_____

23Y-42. $\dfrac{(0.422)}{(-0.88)}\left[1 - e^{-(0.407)(0.556)}\right]$ ------------------------------------ 42=_____

23Y-43. $\dfrac{(-0.078)\text{Log}(0.048 - 0.00755)}{(-0.00875)}$ ----------------------------------- 43=_____
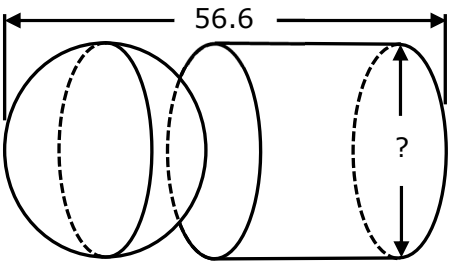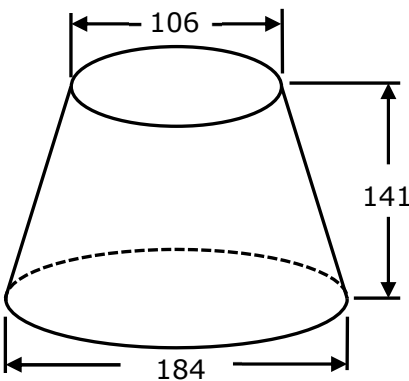
23Y-44. $(585 + 3690)^{1/3} + 1/\{(85.2)^{-0.301}\}$ ------------------------------ 44=_____

23Y-45.(deg) $\{(76700)\sin(-138°)\} \times \{(-19800)\cos(-129°)\}$ ---------------- 45=_____

23Y-46. A 1400-lb marble statue is 8 ft tall. How tall is a plastic model of the statue that weighs 265 grams? The density of marble is 150 lb/ft^3 and the density of plastic is 0.95 g/cm^3. --- 46=_____ in

23Y-47. The population of Mt. Angel has gradually increased. Here are some data, (year, population): (1970, 686), (1980, 744), (1990, 811), (2000, 883) and (2010, 938). Predict the population in 2030. ------------------------------- 47=_____

23Y-48. Solve for w if $7w^{4.7} - 2 = 6w^2 - 3w$. ----------------------------------- 48=_____

23Y-49.

SPHERE AND CYLINDER

Total Surface Area of Sphere =
$\dfrac{2}{3}$(Total Surface Area of Cylinder)

56.6

?

23Y-49 =_____

23Y-50.

FRUSTUM

106

141

184

Total Surface Area = ?

23Y-50 =_____

23Y-51. $10^{+(0.813)} + 10^{-(0.118)} + \left[10^{(0.649/0.898)} - 10^{(0.608)}\right]^{1/2}$ -- 51=_____

23Y-52. $\dfrac{(-0.0269 - 0.0112)\ e^{(0.73)(1.46)}}{e^{-(\pi - 0.177)}}$ ----------------------------------- 52=_____

23Y-53. $\dfrac{(-0.0745)\ \text{Log}(0.0103 + 0.0294)}{\text{Log}(0.866) - (0.573)(0.642)}$ ----------------------------------- 53=_____
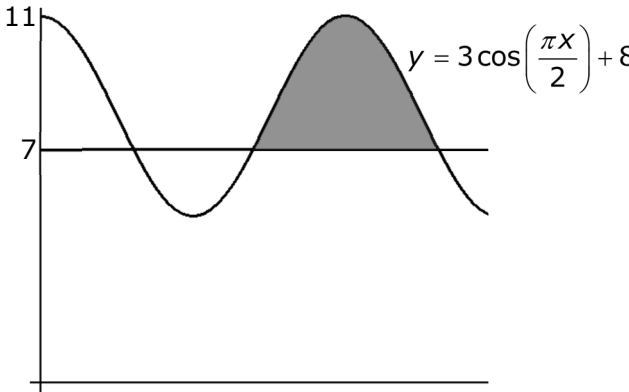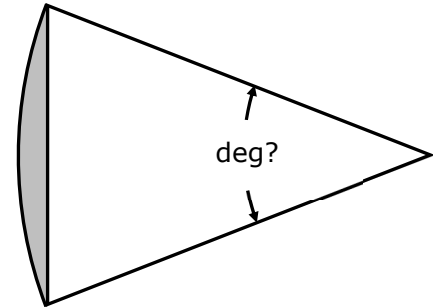
23Y-54. $\dfrac{1}{(0.317)^{(-0.667)}} + (0.599 + 0.596)^{(0.526 - 0.291)}$ ---------------- 54=_____

23Y-55.(rad) $\dfrac{\arctan\{3.99 + (8.61)(0.331)\}}{\arcsin\{(0.682 + 0.619)/1.46\}}$ ----------------------------------- 55=_____

23Y-56.(rad) Find the *y*-intercept of the line tangent to the graph of

$f(x) = 0.5x \cos\left(\dfrac{\pi}{2} - x\right)$ at $x = 4.32$. --- 56=_____

23Y-57. The height of an equilateral triangle is increasing at 3.6 cm/min.
At what rate is the area increasing when the height is 12 cm? ---------------- 57=_____ cm²/min
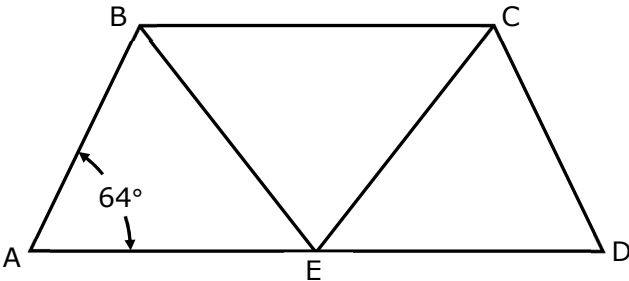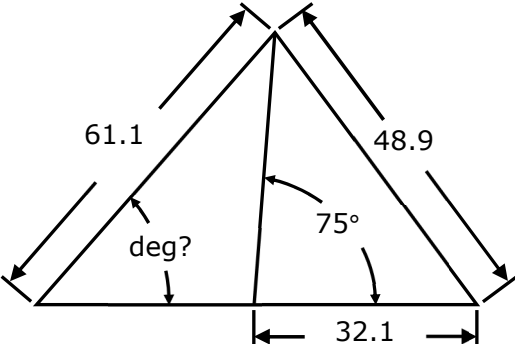
23Y-58. If $\det\begin{bmatrix} 3 & 5 & 1 \\ x & -2 & x \\ 7 & 3 & 8 \end{bmatrix} = -16.95$, then $x = ?$ ------------------------------- 58=_____

23Y-59.

$y = 3\cos\left(\dfrac{\pi x}{2}\right) + 8$

Shaded Area = ?

23Y-59 =_____

23Y-60. ISOSCELES TRIANGLE AND SEGMENT

Triangle Area = 103
Segment Area = 9.64

deg?

23Y-60 =_____

23Y-61. The intensity of light varies as the inverse of the square of the
distance from the source. How far from a 120-W bulb is there adequate light
for reading if the distance from a 90-W bulb is 12 ft?--------------------------- 61=_____ ft

23Y-62. Evaluate 2035^{3520}. -- 62=_____

23Y-63. A brick is dropped from a tower on Earth and hits the ground
2.73 seconds later. If the brick was dropped from a tower of the same
height on the moon, where the acceleration due to gravity is 1/6 that of
earth, how long would it take to hit the ground? ------------------------------- 63=_____ s

23Y-64.	23Y-65.
ISOSCELES TRAPEZOID	SCALENE TRIANGLES

23Y-64.

ISOSCELES TRAPEZOID

AE = BE = DE = 15

Area of Trapezoid?

23Y-64 =_____

23Y-65.

SCALENE TRIANGLES

61.1   48.9

75°

deg?

32.1

23Y-65 =_____

23Y-66. $(1/2)\text{Ln}\left[\dfrac{(5.81) \times (1.16) \times (5.37)^3}{(5.37)(8.64)^2}\right]^2$ ----------------------------------- 66=_____

23Y-67. $(74.8)10^{\text{Log}[(7.69)(0.278)]} + \{(34400)(0.926)\}^{1/2}$ ---------------- 67=_____

23Y-68. (rad) $\dfrac{98.2}{6(-4.86)}\{(3.65) + (1.83)\sin(-6.84)\}^5$ ------------------------- 68=_____

23Y-69. $-\dfrac{1}{(3.5)} + \dfrac{1}{3(3.5)^3} - \dfrac{1}{5(3.5)^5} + \dfrac{1}{7(3.5)^7}$ ------------------------- 69=_____

23Y-70. (rad) $\dfrac{\arctan\left\{e^{-(0.37)(0.57)}\sqrt{(-43.3)/(-74.9)}\right\}}{(85.1)\sqrt{(38.7)(24.3)(93.1)}}$ ------------------- 70=_____

23Y-1	$= 39.0$ $= 3.90 \times 10^{1}$	23Y-11	$= 0.00568$ $= 5.68 \times 10^{-3}$	23Y-21	$= 0.0639$ $= 6.39 \times 10^{-2}$
23Y-2	$= 1.50$ $= 1.50 \times 10^{0}$	23Y-12	$= 99.4$ $= 9.94 \times 10^{1}$	23Y-22	$= -0.0749$ $= -7.49 \times 10^{-2}$
23Y-3	$= -0.238$ $= -2.38 \times 10^{-1}$	23Y-13	$= -30.5$ $= -3.05 \times 10^{1}$	23Y-23	$= 1.45$ $= 1.45 \times 10^{0}$
23Y-4	$= 26.2$ $= 2.62 \times 10^{1}$	23Y-14	$= -1280$ $= -1.28 \times 10^{3}$	23Y-24	$= 0.835$ $= 8.35 \times 10^{-1}$
23Y-5	$= -13100$ $= -1.31 \times 10^{4}$	23Y-15	$= 16.0$ $= 1.60 \times 10^{1}$	23Y-25	$= 5.93$ $= 5.93 \times 10^{0}$
23Y-6	$=15.4$ $=1.54 \times 10^{1}$	23Y-16	$=1.700$ (4SD) $=1.700 \times 10^{0}$	23Y-26	$=21.7$ $=2.17 \times 10^{1}$
23Y-7	$=\$24.95$	23Y-17	$=839$ $=8.39 \times 10^{2}$	23Y-27	$=5.97$ $=5.97 \times 10^{0}$
23Y-8	$=36.0$ $=3.60 \times 10^{1}$	23Y-18	$=41.6$ $=4.16 \times 10^{1}$	23Y-28	$=0.153$ $=1.53 \times 10^{-1}$
23Y-9	$=77.2$ $=7.72 \times 10^{1}$	23Y-19	$=42.2$ $=4.22 \times 10^{1}$	23Y-29	$=263$ $=2.63 \times 10^{2}$
23Y-10	$=5.39$ $=5.39 \times 10^{0}$	23Y-20	$=0.287$ $=2.87 \times 10^{-1}$	23Y-30	$=10.0$ $=1.00 \times 10^{1}$

2022–2023
HS Virtual Challenge Regional Qualifiers' Meet – Key

23Y-31 $= 2.52 \times 10^{-7}$

23Y-32 $= 55200$
$= 5.52 \times 10^{4}$

23Y-33 $= -0.00564$
$= -5.64 \times 10^{-3}$

23Y-34 $= 1.93$
$= 1.93 \times 10^{0}$

23Y-35 $= 1.74 \times 10^{-7}$

23Y-36 $= 3.55$
$= 3.55 \times 10^{0}$

23Y-37 $= 211$
$= 2.11 \times 10^{2}$

23Y-38 $= 65.1$
$= 6.51 \times 10^{1}$

23Y-39 $= 3.17$
$= 3.17 \times 10^{0}$

23Y-40 $= 39.3$
$= 3.93 \times 10^{1}$

23Y-41 $= 1.66$
$= 1.66 \times 10^{0}$

23Y-42 $= -0.0971$
$= -9.71 \times 10^{-2}$

23Y-43 $= -12.4$
$= -1.24 \times 10^{1}$

23Y-44 $= 20.0$
$= 2.00 \times 10^{1}$

23Y-45 $= -6.40 \times 10^{8}$

23Y-46 $= 9.77$
$= 9.77 \times 10^{0}$

23Y-47 $= 1070$
$= 1.07 \times 10^{3}$

23Y-48 $= 0.893$
$= 8.93 \times 10^{-1}$

23Y-49 $= 28.3$
$= 2.83 \times 10^{1}$

23Y-50 $= 102,000$
$= 1.02 \times 10^{5}$

23Y-51 $= 8.37$
$= 8.37 \times 10^{0}$

23Y-52 $= -2.14$
$= -2.14 \times 10^{0}$

23Y-53 $= -0.243$
$= -2.43 \times 10^{-1}$

23Y-54 $= 1.51$
$= 1.51 \times 10^{0}$

23Y-55 $= 1.30$
$= 1.30 \times 10^{0}$

23Y-56 $= 3.57$
$= 3.57 \times 10^{0}$

23Y-57 $= 49.9$
$= 4.99 \times 10^{1}$

23Y-58 $= -1.55$
$= -1.55 \times 10^{0}$

23Y-59 $= 6.03$
$= 6.03 \times 10^{0}$

23Y-60 $= 41.6$
$= 4.16 \times 10^{1}$

23Y-61 $= 13.9$
$= 1.39 \times 10^{1}$

23Y-62 $= 1.40 \times 10^{11646}$

23Y-63 $= 6.69$
$= 6.69 \times 10^{0}$

23Y-64 $= 286$
$= 2.86 \times 10^{2}$

23Y-65 $= 46.8$
$= 4.68 \times 10^{1}$

23Y-66 $= 0.957$
$= 9.57 \times 10^{-1}$

23Y-67 $= 338$
$= 3.38 \times 10^{2}$

23Y-68 $= -468$
$= -4.68 \times 10^{2}$

23Y-69 $= -0.278$
$= -2.78 \times 10^{-1}$

23Y-70 $= 2.19 \times 10^{-5}$

The Virtual Challenge Meets
HS Number Sense Test • VCM RQ • 2022–2023

Contestant's Name _____

School _____

Contestant's Grade   9   10   11   12

Final _____ _____

2nd _____ _____

1st _____ _____

Score   Initials

**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) $2107 - 2023 + 145 =$ _____

(2) $\frac{5}{6} \times \frac{8}{10} \times \frac{16}{12} =$ _____

(3) $713 \div 5 =$ _____ **(mixed number)**

(4) $11 \times 94 =$ _____

(5) $27^2 =$ _____

(6) $\frac{18}{25} =$ _____**(decimal)**

(7) $15 \times 7 + 18 \div 3 =$ _____

(8) $214\frac{2}{7}\% =$ _____ **(improper fraction)**

(9) $25(11) + 25(16) + 25(21) =$ _____

*(10) $347 \times 354 =$ _____

(11) $2\frac{3}{4} + 3\frac{3}{8} =$ _____**(mixed number)**

(12) The largest prime divisor of 111 is_____

(13) $(47 \times 38) \div 4$ has a remainder of _____

(14) Which is smaller, $\frac{3}{7}$ or $\frac{11}{29}$?_____

(15) $1 + 3 + 5 + \ldots + 69 =$ _____

(16) $12^3 =$ _____

(17) If 1 gram = 0.04 oz, then 150 grams =_____lbs

(18) 37.5% of 320 is_____

(19) $53^2 - 37^2 = 45 \times$_____

*(20) $342185 \div 431 =$_____

(21) 23% of 234 is 69% of_____

(22) $0.533333\ldots =$ _____ **(fraction)**

(23) $54^2 =$_____

(24) Let $\frac{2x}{9} = \frac{32}{x}$, x > 0. Find x. _____

(25) 11 pecks =_____ **quarts**

(26) $24 \times 95 =$_____

(27) If f(x) = 3x² – 7x – 5, then f(– 3) =_____

(28) $0.222\ldots + 0.565656\ldots =$ _____**(fraction)**

(29) $512_8 =$ _____**₁₀**

*(30) $\sqrt{4131857} =$ _____

(31) $1594 \times 6 + 36 =$_____

(32) $5\frac{1}{4} \times 8\frac{2}{5} =$_____ **(mixed number)**

(33) $9\frac{2}{3} \times 9\frac{2}{3} =$_____ **(mixed number)**

(34) $\left(11^3 - 1\right) \div (11 - 1) =$_____

(35) $24^2 \div 8^2 \times \left(\frac{8}{3}\right)^2 =$ _____

(36) The positive integral divisors of 42 total _____

(37) If 3x – 1 = 8x – 13, then 10x =_____

(38) 17, 15, 20, 11, 23, 7, p, q, 29, – 1, … . p + q =_____

(39) 91 × 429 =_____

*(40) 180 square feet =_____square inches

(41) If $\sqrt{4x+5} = 9$, then x = _____

(42) P and Q are roots of $4x^2 – 3x – 5 = 0$,
     then P + Q + PQ =_____

(43) $(5x – 9)^3 = ax^3 + bx^2 + cx + d$. a + b + c + d = _____

(44) The diagonal of a square is $4\sqrt{3}$. The area is _____

(45) $9^3 – 9^2$ =_____ base 9

(46) 105 has how many positive integral divisors?_____

(47) $5\frac{1}{m} \times n\frac{1}{4} = 12$, where m and n are
     natural numbers. Find mn. _____

(48) $15^{34} \div 17$ has a remainder of _____

(49) If $\frac{a}{13}$ has a remainder of 4 and $\frac{b}{13}$ has a
     remainder of 7, then $\frac{3ab}{13}$ has a remainder of_____

*(50) 14285.7×105 =_____

(51) $53^2 + 25^2$ =_____

(52) $14_6 \times 4_6 + 312_6$ = _____${}_6$

(53) (3 – 7i)(2 + 3i) = a + bi.   Find a + b._____

(54) 12 + 9 + 6.75 + 5.0625 + … =_____

(55) ${}_{11}C_3$ =_____

(56) $log_3 9 + log_3 27 + log_3 81$ =_____

(57) The probability of rolling a sum
     of 10 or 11 when rolling two 6-sided die._____

(58) (15 + 17 + 32 + 49 + 81 + 130) +
     (211 + 341 + 552 + 893) = _____

(59) $\sum_{k=1}^{22}(-1)^k(k)^2$ =_____

*(60) $\sqrt{3500} \times 375$ =_____

(61) Find the coefficient of the x^2y^4 term
     in the expansion of $(5x + y)^6$ is _____

(62) $537_9 \div 8_9$ has a remainder of_____

(63) The harmonic mean of the roots
     of $6x^4 – 17x^3 – 11x^2 + 12x – 9 = 0$ is_____

(64) $|7 + 4i\sqrt{2}|$ =_____

(65) $(\sin 45° \sin 60°)^2$ =_____(fraction)

(66) $\frac{7!}{5!} \times (7^2 – 1)$ = _____

(67) $\sqrt{72} \div \sqrt{32}$ = _____

(68) Change 0.32 base 8 to a base 10 fraction. _____

(69) If xy = 7, x + y = 9, then $x^3 + y^3$ =_____

*(70) $\sqrt{171} \times \sqrt[3]{3300} \times \sqrt[3]{5000}$ =_____

(71) $(18, \frac{2\pi}{3})$ are polar coordinates for (x, y). x = _____

(72) $\lim\limits_{x \to -3} \frac{22x+66}{x^2-9}$ = _____

(73) Find the slope of the tangent line
     to $f(x) = x^2 – 8x – 13$ at the point (10, 7)._____

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

(75) 783×111 = _____

(76) $\int_3^9 (5x – 11)\, dx$ =_____

(77) $0.1515..._7$ = _____(base 7 fraction)

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

(79) The 15th pentagonal number is_____

*(80) 72.7272…% of (27×800) = _____

(1) 229

(2) $\frac{8}{9}$

(3) $142\frac{3}{5}$

(4) 1034

(5) 729

(6) .72

(7) 111

(8) $\frac{15}{7}$

(9) 1200

*(10) 116697 – 128979

(11) $6\frac{1}{8}$

(12) 37

(13) 2

(14) $\frac{11}{29}$

(15) 1225

(16) 1728

(17) $\frac{3}{8}$ or .375

(18) 120

(19) 32

*(20) 755 – 833

(21) 78

(22) $\frac{8}{15}$

(23) 2916

(24) 12

(25) 88

(26) 2280

(27) 43

(28) $\frac{26}{33}$

(29) 330

*(30) 1932 – 2134

(31) 9600

(32) $44\frac{1}{10}$

(33) $93\frac{4}{9}$

(34) 133

(35) 64

(36) 96

(37) 24

(38) 29

(39) 39039

*(40) 24624 – 27216

(41) 19

(42) $-\frac{1}{2}$

(43) 24

(44) -64

(45) 800

(46) 8

(47) 6

(48) 4

(49) 6

*(50) 1424999 – 1574998

(51) 3434

(52) 420

(53) 22

(54) 48

(55) 165

(56) 9

(57) $\frac{5}{36}$

(58) 2321

(59) 253

*(60) 21077 - 23294

(61) 375

(62) 7

(63) 3

(64) 9

(65) $\frac{3}{8}$

(66) 2016

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

(68) $\frac{13}{32}$

(69) 540

*(70) 3163 – 3495

(71) -9

(72) $-\frac{11}{3}$ or $-3\frac{2}{3}$

(73) 12

(74) 3

(75) 86913

(76) 114

(77) $\frac{1}{4}$

(78) 360

(79) 330

*(80) 14924 – 16494