2026 SCSU MATH CONTEST
11^{th} and 12^{th} GRADE

DIRECTIONS: Select the <u>BEST</u> completion or response from among those given. Scientific and graphing calculators are allowed. Symbolic calculators are not allowed.

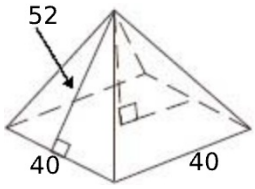
1. A computer store bought 344 memory modules. The store sold the first 320 of the modules for the original total purchase price of all 344 modules. The remaining modules were sold at the same price per module as the first 320.

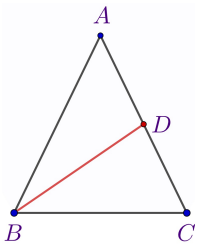
   What percentage profit did the store make by selling all 344 modules?

   (a) 6.98% (b) 7.25% (c) 7.50% (d) 7.75% (e) 8.00%

2. Consider the square pyramid in the diagram below left. Find the lateral area of the pyramid (that is, the total area of all the triangular side faces but not including the square base).

   (a) 2560 (b) 2856 (c) 3200 (d) 3568 (e) 4160





3. In the triangle above right, $\angle A = 36°$, $AB \cong AC$, BD bisects $\angle ABC$, and D is on AC. (The diagram is not to scale.)

   Find the ratio $\dfrac{AB}{BC}$ to *THREE* decimal places.

   (a) 1.140 (b) 1.248 (c) 1.321 (d) 1.576 (e) 1.618

4. A grocer wants to sell a mixture of jellybeans and chocolate eggs for \$4.75 per pound. The jellybeans cost \$6.00 per pound, and the chocolate eggs cost \$4.00 per pound.

   How many pounds of jellybeans will be needed to make 100 pounds of the mixture?

   (a) 7.5 (b) 15 (c) 37.5 (d) 60 (e) 62.5

5. The rectangle $OABC$ has vertex O at the origin of the xy-plane. Vertex A is to the right of the y-axis, in Quadrant I; vertex B is on the positive y-axis; vertex C has coordinates $(-6, 9)$.

   What is the sum of the coordinates of vertex A?

   (a) 8 (b) 9 (c) 10 (d) 11 (e) 12

6. Suppose that $\sqrt{a} = \sqrt{144} + \sqrt[3]{216} = 6\sqrt{b}$. Find the value of $\dfrac{a}{4b}$.

   (a) $\frac{\sqrt{11}}{12}$ (b) $\frac{3}{8}$ (c) $\frac{\sqrt{3}}{4}$ (d) 3 (e) 9

7. Alice's age is 16 more than the sum of Bob's age and Carol's age. The square of Alice's age is 1632 more than the square of the sum of Bob's age and Carol's age.

   What is the sum of all three ages (Alice's, Bob's, and Carol's)?

   (a) 64 (b) 94 (c) 96 (d) 102 (e) 140

8. What is the correct simplification of the fraction $\dfrac{4^{1013}-16^{506}}{8^{675}-2^{2027}}$?

(a) $-\frac{1}{16}$ (b) $-\frac{1}{8}$ (c) $-\frac{1}{4}$ (d) $-\frac{1}{2}$ (e) -1

9. A beaker holds a mixture of acid and water. When the mixture is added to one ounce of water, the new mixture is 20% acid. When one ounce of acid is added to that new mixture, the resulting mixture is $33\frac{1}{3}\%$ acid.

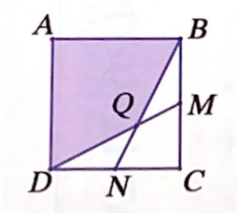
What was the percentage of acid in the original mixture?

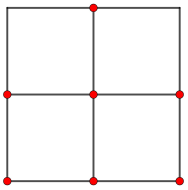
(a) 20% (b) 22% (c) 24% (d) 25% (e) 30%

10. In the diagram below left, square $ABCD$ is 6 inches on a side, M and N are the midpoints of $\overline{BC}$ and $\overline{DC}$ respectively, and the line segments $\overline{BN}$ and $\overline{DM}$ intersect at Q.

What is the area, in square inches, of the quadrilateral $ABQD$?

(a) 21 (b) 22 (c) 23 (d) 24 (e) 25





11. Consider the diagram above right, a grid made up of 4 identical squares with seven points specified at certain corners of the squares (every corner *except* the far upper left and the far upper right).

Suppose that three of the specified points are chosen at random and then connected with line segments. What is the probability that the connected points and line segments form a triangle?

(a) $\frac{24}{35}$ (b) $\frac{5}{7}$ (c) $\frac{27}{35}$ (d) $\frac{25}{28}$ (e) $\frac{32}{35}$

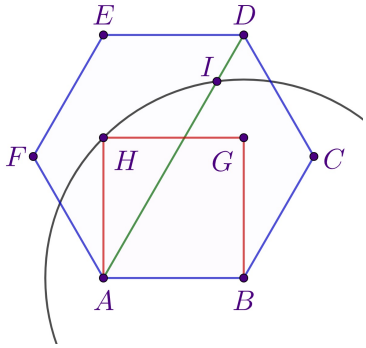
12. Consider the following system of equations:

$$\begin{aligned} x &+ 3y = 7, \\ 2x &+ ny = 14. \end{aligned}$$

For what value of n will this system have not just a single solution in the xy-plane but, rather, an entire LINE of solutions in the xy-plane?

(a) 2 (b) 3 (c) 6 (d) 7 (e) 12

13. In the diagram below, $ABCDEF$ is a regular hexagon, $ABGH$ is a square of sidelength 1, and the arc is part of a circle centered at B.



To the nearest *THOUSANDTH*, what is the length of the segment ID?

(a) 0.318 (b) 0.341 (c) 0.367 (d) 0.382 (e) 0.398

14. Suppose that the quadratic equation $x^2 - 2x + c = 0$ has two solutions r and s. (That is, r can be substituted in for x to make the equation true, and also s can be substituted in for x to make the equation true.) Suppose also that $\dfrac{r}{s} = -2$. What is the value of c?

(a) -18 (b) $-\frac{25}{3}$ (c) -8 (d) 4 (e) 15

15. Consider the equations

$$5x + ay + b = 0 \text{ and } bx - 3y + 9 = 0,$$

where a and b are real numbers. Each equation corresponds to a graph in the xy-plane. How many *ordered pairs* (a, b) exist that result in the same graph for both equations?

(a) zero (b) one (c) two (d) four (e) infinitely many

16. If you already have the graph of a function $y = g(x)$, you can perform two horizontal transformations on it to obtain the graph of $y = g(3x + 2)$. Which of the following (in the order given) would produce the desired graph?

(a) First do a SHIFT of 2 units, and then do a COMPRESSION by a factor of $\frac{1}{3}$.
(b) First do a SHIFT of 3 units, and then do a STRETCH by a factor of 2.
(c) First do a COMPRESSION by a factor of $\frac{1}{2}$, and then do a SHIFT of 3 units.
(d) First do a STRETCH by a factor of 3, and then do a SHIFT of 2 units.
(e) All of the above will produce the same graph.

17. In my favorite triangle, the side lengths, a, b, and c, satisfy the following relationship:

$$a^2 + b^2 = c^2 + ab.$$

What is the measure of the angle opposite the side of length c?

(a) 15° (b) 30° (c) 45° (d) 60° (e) 150°

18. Suppose that g is given by the formula $g(x) = x^2 - 4x$.

Which of the following is equal to $g(x + 3)$?.

(a) $x^2 - 4x - 12$ (b) $x^2 - 4x + 3$ (c) $x^2 + 2x - 3$ (d) $x^2 + 2x + 9$ (e) $x^2 + 6x + 5$

19. Let k be a positive number, $p = \log_8 k$, and $q = \log_k 5$.

Which of the following expressions is equal to $\log_{10} 5$?

(a) pq (b) $\frac{3p+q}{5}$ (c) $\frac{1+3pq}{p+q}$ (d) $\frac{3pq}{1+3pq}$ (e) $p^2 + q^2$

20. Find the largest prime number less than 100 that is the sum of three consecutive squares.

(a) 23 (b) 29 (c) 43 (d) 61 (e) 83

21. An equilateral triangle is inscribed in a circle. What is the ratio of the area of the circle to the area of the triangle?

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{\sqrt{3}}$ (c) $\frac{2\pi}{3}$ (d) $\frac{4\pi}{3\sqrt{3}}$ (e) $\frac{\pi\sqrt{3}}{2}$

22. How many ordered pairs of *integers* (x, y) satisfy the equation $y^2 = x^2(x - 1)$?

(a) two (b) four (c) five (d) eight (e) infinitely many

23. An analog clock is manufactured incorrectly: The hands move independently of each other, with the minute hand rotating at twice the normal speed (in other words, it takes only half an hour for the minute hand to complete a full revolution). The hour hand completes a revolution in the standard twelve hours. Both hands move clockwise.

    The clock starts running at noon, with the hour and minute hands aligned and both pointing at 12. Intrigued, you watch the clock and write down the *actual* time, to the nearest minute, on the *TENTH* occasion on which the hands line up *after* noon.

    What is the sum of the hour and minute of that (rounded) actual time?

    (a) 18 (b) 29 (c) 38 (d) 49 (e) 64

24. For a 319-yard hole on a golf course, a golfer's first shot travels 200 yards, but it's 20 degrees off-line. The table below gives the ranges of distance for the golfer's favorite clubs (to which the golfer has given pet names).

Club name	Adelaide	Barney	Chaka	Dudley	Elvira
Distance in yards	130 to 145	145 to 165	165 to 180	180 to 195	195 to 220

    Which club should be used for the second shot?

    (a) Adelaide (b) Barney (c) Chaka (d) Dudley (e) Elvira

25. On a remote island, every inhabitant is either a Knight (who always tells the truth) or a Knave (who always lies). You meet Aria, Barrett, and Caspian, who are inhabitants of the island. Aria and Barrett make the following statements.

    - Aria: "*At least one of us is a Knave.*"
    - Barret: "*Caspian and I are of the same type.*"

    Which of the following *IS NOT* a statement that Caspian could make?

    (a) "*I am a Knight.*"
    (b) "*Aria is a Knave.*"
    (c) "*Barret is a Knave.*"
    (d) "*Aria and I are of the same type.*"
    (e) "*Barret and I are of different types.*"

26. A triangle has sides of lengths 11, 17, and 25.

    To the nearest *HUNDREDTH*, what is the *RADIUS* of the circle that circumscribes the triangle?

    (a) 15.28 (b) 15.55 (c) 15.74 (d) 15.99 (e) 16.27

27. Which of the following is the domain for the function f given by

$$f(x) = \frac{\sqrt{5-x}}{\ln(x+3)}?$$

    (a) $(-3,-1)\cup[0,5)$ (b) $(-3,-2)\cup(-2,5]$ (c) $(-3,5]$ (d) $(-\infty,-3)\cup(-3,5]$ (e) $(-\infty,-3]\cup(5,\infty)$

28. In $\triangle ABC$, we have

    - $\tan(\angle A)+\tan(\angle B)\approx -5.204974$ and
    - $\tan(\angle A)\cdot\tan(\angle B)\cdot\tan(\angle C)\approx -3.776826$.

    To five decimal places, what is $\tan(\angle C)$?

    (a) -8.98180 (b) -5.51182 (c) 0.72562 (d) 1.37813 (e) 1.42815