

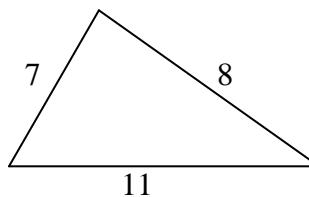
1. If $\cos(\theta) = \frac{15}{17}$, find the smallest possible value of $\sin(\theta)$. Express your answer as a common fraction reduced to lowest terms.
2. Find the **sum** of the first five terms of a geometric sequence whose first term is 2 and whose second term is 6.
3. Find the value of p such that the three-dimensional vectors $\langle 1, -2, 2 \rangle$ and $\langle 2, 3, p \rangle$ are perpendicular.
4. The graph of $y = \frac{-5x + x^2}{2x^2 - 8}$ has a horizontal asymptote when $y = k$. Find the value of k .
5. Find the sum of the first 50 terms of the arithmetic progression: 2, 6, 10, \dots .
6. Find the value of the indicated sum: $\sum_1^4 2^x$
7. A prone surveyor on a mountain peak observes below him on a horizontal water surface two vessels lying at anchor 1 mile apart and in the same vertical plane with his position. He finds the angles of depression of the ships to be 16° and 10° respectively. Find the number of **feet** in the vertical height of the mountain peak above the water. Express your answer as a whole number rounded to the nearest foot.

8. Let $G = \{a, b, c, d, e\}$. If $2a = 5b = 6c = 8d = 15e$, then the median of G is ka . Find the value of k . Express your answer as a common fraction reduced to lowest terms.
9. Jerry has 3 sticks, one of length 6, a second with a length less than 5, and a third with a length less than 4. Find the probability the 3 sticks can form a triangle. Express your answer as a common fraction reduced to lowest terms.
10. (**Always, Sometimes, or Never**) For your answer, write the whole word **Always, Sometimes, or Never**—whichever is correct.

If a function is continuous at $x = c$, then the function has an absolute maximum at $x = c$.

11. Find the sum of the infinite sequence: $\frac{1}{3}, \frac{1}{3}, \frac{5}{27}, \frac{7}{81}, \dots, \frac{2n-1}{3^n}, \dots$.

12. The triangle (not necessarily drawn to scale) has sides of lengths as shown. Find the **exact** value of the tangent of the largest angle of the triangle.



13. Given the following seven points: $(8, 2)$, $(10, -3)$, $(7, 5)$, $(13, -4)$, $(-8, -5)$, $(-3, -2)$, $(-1, 1)$. If three of these seven points are selected at random without replacement, find the probability that fewer than two of the points selected lie below the x -axis. Express your answer as a common fraction reduced to lowest terms.

14. Two parallel chords of a circle with lengths of 8 and 10 serve as bases of a trapezoid inscribed in the circle. If the length of a radius of the circle is 12, find the largest possible area of such a described inscribed trapezoid. Round your answer to the nearest whole number, and express your answer as that whole number.
15. In the vector sum shown, find the value of $(k + w)$: $\langle 2, 3 \rangle + \langle -7, 8 \rangle + \langle w, k \rangle + \langle 4, -31 \rangle = \langle 17, 6 \rangle$.
16. Let k be a positive integer and let n be an integer such that every value for x of the form $(44 + 180n)^\circ$ satisfies the equation $\sin(kx + 2)^\circ = \cos(3x)^\circ$. Find the value of k .
17. Doc and Sandy are together at a point on an infinitely paved plane. At noon, Sandy heads directly east at a constant rate of 50 mph. Doc will also leave at noon and head in a direction of N5°E (5 degrees East of North) at a constant rate of 40 mph. If a random moment is picked between 9:00 and 10:00 in the evening of the same day that Sandy left, find the probability the two will be less than 600 miles apart. Express your answer as a **decimal** rounded to 4 significant digits.
18. Find the value of $\lim_{x \rightarrow 5} \left(\frac{x^2 + 6x - 55}{x - 5} \right)$.
19. If $(2x - y)^6$ is expanded and completely simplified, one of the terms is kx^3y^3 . Find the value of k .
20. How many distinct strings of 5 letters (repetition permitted) of the English alphabet have exactly 3 distinct letters?

2009 SA

Pre-Calculus

Name ANSWERS

School _____

(Use full school name – no abbreviations)

_____ Correct X 2 pts. ea. =

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. $-\frac{8}{17}$ (Must be this negative reduced common fraction.)

11. 1

2. 242

12. $-\sqrt{195}$ (Must be this exact radical.)

3. 2

13. $\frac{13}{35}$ (Must be this reduced common fraction.)

4. $\frac{1}{2}$ or 0.5 or .5

14. 200

5. 5000

15. 44

6. 30

16. 5

7. 2418 (Feet optional.)

17. 0.7962 OR .7962 (Must be this decimal.)
OR 7.962×10^{-1}

8. $\frac{1}{3}$ (Must be this reduced common fraction.)

18. 16

9. $\frac{9}{40}$ (Must be this reduced common fraction.)

19. -160

10. Sometimes (Must be the whole word.)

20. 390,000