1. Find the amplitude of the graph of the equation $y = -16\sin\left(80(4x° - 64°)\right)$.

2. Find the **ordered pair** (k, w) in the following vector sum: $(k, w) + (-7, 11) = (-15, -29)$.

3. The three-dimensional vectors $(k, -2, 2)$ and $(2, 3, w)$ are perpendicular. Find the value of $(k + w)$.

4. The graph of $y = \dfrac{-5x + x^2}{2x^2 - 8}$ has a horizontal asymptote when $y = k$ and a vertical asymptote at $x = w$ with $w > 0$. Find the value of $(k + w)$. Write your answer as a simplified proper or improper fraction, whichever is appropriate.

5. Find the sum of the first 20 terms of the geometric progression: 2, 6, 18, $\cdots$.

6. Find the value of the indicated sum: $\sum_{2}^{4} 2^{(x+1)}$.

7. For all real values of x for which the fractions in this problem are defined, $\dfrac{2x-1}{x^2+4x+3} = \dfrac{A}{x+3} + \dfrac{B}{x+1}$. Find the value of $(2A + 16B)$.

8. Let $F = \{a, b, c\}$. If $2a = 3b = 8c$, then the arithmetic mean of F is ka. Find the value of k. Express your answer as a common fraction reduced to lowest terms.

9. In this problem, assume a normal, flat football field, 100 yards from goal line to goal line. The fifty-yard line is midway between the goal lines, with the numbering of the yardlines decreasing from the fifty-yard line in both directions until the goal line, which is yard-line zero. Ted kicks off from his 30-yard line across the fifty-yard line and in the direction of his opponents' goal line at an angle of 42.46° with the horizontal and with an initial velocity of 74.89 feet per second. Ted continues running directly down the middle of the field at a constant speed of 29.49 feet per second. Assume the effect-on-gravity vector is $(0,-16t^2)$ where *t* is measured in seconds. Devon catches the ball 4.816 feet above the ground in the middle of the field. At what yard line of his opponent will Ted be when the ball is caught? Express your answer rounded to the nearest whole number.

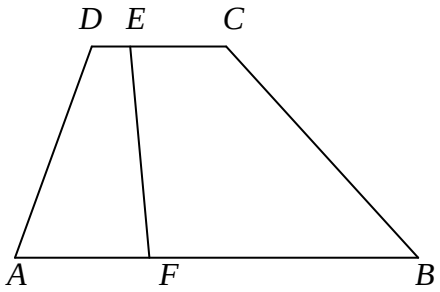
10. **(Always, Sometimes, or Never)** For your answer, write the *whole word* **Always, Sometimes, or Never**—whichever is correct.

    If a function is continuous at $x = c$, then the value of the function at c equals the limit of the function as $x \to c$.

11. Let $0° \le x \le 360°$. Then the solution set for x, in degrees, of the equation $\sin(kx-7)° - \cos(3x+9)° = 0$ is $\{11, 53, 56, 101, 146, 191, 233, 236, 281, 326\}$. Find the value of k.

12. Assume that Jack has a 40% probability of making any free throw he attempts. Assume that Karen has a 50% probability of making any free throw she attempts. Jack and Karen agree to the following procedure. Jack will get the first free throw. Thereafter, they will alternate, but Karen will get two successive shots while Jack will only get one. For example, Jack shoots first, Karen second and third, Jack fourth, Karen fifth and sixth, Jack seventh, etc. Find the probability that Jack will be the first to make a free throw that either Jack or Karen attempts. Express your answer as a common fraction reduced to lowest terms.

13. In the diagram,
    $ABCD$ is a trapezoid with $\overleftrightarrow{AB} \parallel \overleftrightarrow{DC}$.
    $AB = 32.00$, $DC = 10.00$, $\angle DAB = 62°$,
    $\angle DCB = 152°$. $DE = 2.500$, $AF = 8.000$
    E lies on $\overline{DC}$, F lies on $\overline{AB}$. Find EF.
    Express your answer as a decimal rounded to 4 significant digits.



14. In Triangle ABC, $AB = 16$, $BC = 21$, and $AC = 19$. $\overrightarrow{AD}$ bisects $\angle CAB$, and $\overrightarrow{CD}$ bisects $\angle ACB$. Expressed in simplest radical form, $AD = k\sqrt{w}$ where k and w are positive integers. Find the value of $(k+w)$.

15. The **sum** of the terms of a geometric sequence whose first term is $\frac{1}{3}$ and whose second term is 1 is $\frac{40}{3}$. Find the number of terms in this geometric sequence.

16. The two lines represented by $3x-5y=k$ and $wx-37y=-4694$ meet at a point whose *y*-coordinate is 2. If the tangent of the positive acute angle formed by the lines is $\frac{21}{20}$ and if $w>0$, find the value of $(k+w)$.

17. The equations of L_1 and L_2 are $y=kx$ and $y=wx$, respectively. L_1 makes an angle θ with the horizontal and L_2 makes an angle ∂ with the horizontal (measured counterclockwise from the positive *x*-axis). The slope of L_1 is 7 times the slope of L_2. If $0°<\theta<90°$ and $\theta=2(\partial)$, find the value of θ (in degrees). Express your answer as a decimal rounded to the nearest hundredth of a degree.

18. Find the value of $\lim_{x\to 3}\left(\frac{x^3-27}{x-3}\right)$.

19. If $(3x-y)^6$ is expanded and completely simplified, one of the terms is kx^3y^3 with k a real number. Find the value of k.

20. 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. There is a 50% chance that Doc will also leave at noon and head in a direction of N5°E at a constant rate of 40 mph. Otherwise, Doc will stay at the point at which he was at noon. 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.

2009 SAA
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. 16

2. $(-8,-40)$ **(Must be this ordered pair.)**

3. 3

4. $\frac{5}{2}$ **(Must be this reduced improper fraction.)**

5. 3,486,784,400

6. 56

7. -17

8. $\frac{23}{36}$ **(Must be this reduced common fraction.)**

9. 40 **(Opponents, yard and/or yard-line optional.)**

10. Always **(Must be the whole word.)**

11. 5

12. $\frac{8}{17}$ **(Must be this reduced common fraction.)**

13. 9.143 or 9.143×10^{0} **(Must be this Decimal.)**

14. 21

15. 4

16. 71

17. 80.41 **(Must be this decimal, degrees optional.)**

18. 27

19. -540

20. 0.8981 or $.8981$ or 8.981×10^{-1} **(Must be this decimal.)**