



The **Alabama**
Mathematical Association of Two Year Colleges

Precalculus Morning Competition Key

Good morning!

Please do NOT open this booklet until given the signal to begin.

There are 40 multiple choice questions and you will be given 90 minutes to complete the test. Record your answers on the electronic grading form by giving the best answer to each question.

The scoring will be done by giving one point for each question answered correctly and zero points for each question answered incorrectly or left blank. Thus, it is to your advantage to answer as many questions as possible, even if you have to guess. If there is a tie, we will start at question number 40 and work backwards until the tie is resolved.

This test was designed to be a CHALLENGE. Do not waste time on questions you are unable to answer; focus and take pride in those questions which you ARE able to answer.

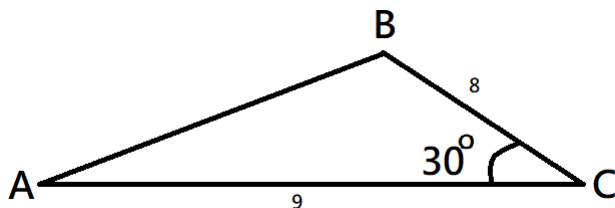
You may write in the test booklet. You may keep your test booklet and any of your scrap papers. Only the electronic grading form will be collected and graded.

Good luck!

Do Not Open Until Signaled.

- What does $\sqrt{20 + \sqrt{20 + \sqrt{20 + \dots}}} - \sqrt{20 - \sqrt{20 - \sqrt{20 - \dots}}}$ equal?
A. 0 B. 20 C. **1** D. $2\sqrt{5}$ E. None of the above
- If $f(x) = \sqrt{23 - 4x}$ and $g(x) = \ln(x)$, find the domain of $(f/g)(x)$.
A. **$(0, 1) \cup (1, \frac{23}{4}]$** B. $(0, \frac{23}{4}]$ C. $(1, \frac{23}{4}]$ D. $[\frac{23}{4}, \infty)$ E. None of the above
- Find the sum of the irrational zeros of the function $f(x) = x^3 - 3x^2 - 3x + 1$.
A. 3 B. $2 + \sqrt{3}$ C. $2 - \sqrt{3}$ D. **4** E. None of the above
- Find the sum of the real solutions to the equation $\frac{2x^2}{16x} = \frac{1}{8}$.
A. **4** B. 1 C. -1 D. 3 E. None of the above

- Find the area of triangle ABC .



- $18\sqrt{2}$ B. 36 C. $18\sqrt{3}$ D. **18** E. None of the above
- Evaluate $2 - \frac{1}{2 - \frac{1}{2 - \frac{1}{2 - \frac{1}{2 - \dots}}}}$.
A. **1** B. $\frac{5}{4}$ C. $\frac{3}{2}$ D. $\frac{7}{4}$ E. None of the above
- If $x^2 - xy + y^2 = a$ and $x^3 + y^3 = b$, what does xy equal?
A. $\frac{a^2 - 2b^3}{3a}$ B. **$\frac{b^2 - a^3}{3a^2}$** C. $-\frac{b}{a}$ D. $\frac{b^2}{a^2} - 1$ E. None of the above
- Given the function $f(x) = \frac{2x+5}{x+k}$ where k is a real number, find the value of k so that $f(x)$ is its own inverse.
A. 2 B. **-2** C. $\frac{5}{2}$ D. $-\frac{5}{2}$ E. None of the above
- Given $P(3x - 2) = 3x^2 - 5x + 7$, find $P(7)$.
A. 119 B. 189 C. **19** D. 27 E. None of the above

10. If $\tan(y) = k$, what is $\sin(y)$ in terms of k ?
 A. $\frac{1}{\sqrt{k^2+1}}$ B. $\frac{1}{\sqrt{k^2-1}}$ C. $\frac{k}{\sqrt{k^2-1}}$ D. $\frac{k}{\sqrt{k^2+1}}$ E. None of the above
11. If the graph of $(m+5)x^6 + 4x^{n-3} + 7$ is a line, what is the value of $m+n$.
 A. 9 B. -1 C. 0 D. -5 E. None of the above
12. Find the value of the expression $\cot(\cos^{-1}(\frac{24}{25}))$.
 A. $\frac{24}{7}$ B. $\frac{7}{24}$ C. $\frac{7}{25}$ D. $\frac{25}{7}$ E. None of the above
13. Given $x+y+z=90^\circ$, find $\cos(x)\cos(y) - \sin(x)\sin(y)$.
 A. $\sec(z)$ B. $\cos(z)$ C. $\csc(z)$ D. $\sin(z)$ E. None of the above
14. The parabola $y = ax^2 + x - 2$ has a vertex on the x-axis. Find a .
 A. $\frac{1}{2}$ B. $-\frac{1}{8}$ C. $-\frac{1}{16}$ D. 1 E. None of the above
15. Given $x = \ln(2)$ and $y = \ln(3)$, find $\log_6(12)$ in terms of x and y .
 A. $\frac{x}{2y}$ B. $\frac{2x+y}{x+y}$ C. $\frac{2x}{y}$ D. $\frac{2+y}{y}$ E. None of the above
16. Find the number of points where the circle $x^2 + y^2 = 36$ and the parabola $x^2 + 4y = 24$ intersect.
 A. 3 B. 0 C. 2 D. 4 E. None of the above
17. If $ax^3 + bx^2 + cx + d = (x^2 - 1)(mx + n) + 3x + 4$, what is $b+d$.
 A. 4 B. 2 C. 1 D. 3 E. None of the above
18. Two of the roots of the polynomial $p(x) = 3x^3 + ax^2 + bx + c$ are -3 and $2+2i$. Find the value of $2a+5b+c$.
 A. -4 B. 5 C. 6 D. -3 E. None of the above
19. Solve for x . $\sqrt{7}\sqrt{24-\sqrt{x}} = 49$.
 A. 30 B. 64 C. 12 D. 48 E. None of the above
20. If $5x - 8y = 4$, then find $\frac{32^x}{256^y}$.
 A. $\frac{1}{8}$ B. 8 C. $\frac{1}{16}$ D. 16 E. None of the above

21. Find the biggest of the following numbers: $\sqrt{37} + \sqrt{11}$, $\sqrt{41} + \sqrt{7}$, $\sqrt{43} + \sqrt{5}$, and $\sqrt{35} + \sqrt{13}$

- A. $\sqrt{35} + \sqrt{13}$
- B. $\sqrt{41} + \sqrt{7}$
- C. $\sqrt{43} + \sqrt{5}$
- D. $\sqrt{37} + \sqrt{11}$
- E. None of the above

22. Find the value of x . $x^x = 2^{2048}$.

- A. 40
- B. 256
- C. 8
- D. 69,420
- E. None of the above

23. If $a^2 + b^2 = 3ab$, find $(\frac{a+b}{a-b})^4$.

- A. 25
- B. 64
- C. 16
- D. 36
- E. None of the above

24. Find all solutions in the interval $[0, 2\pi)$. $\ln(\cos^2(x)) + \ln(2) = 0$.

- A. $\frac{\pi}{4}, \frac{7\pi}{4}$
- B. $\frac{\pi}{4}, \frac{3\pi}{4}$
- C. $\frac{3\pi}{4}, \frac{5\pi}{4}$
- D. $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
- E. None of the above

25. Which of the following is equivalent to $\frac{\sin(A-B)}{\cos(A)\cos(B)} + \frac{\sin(B-C)}{\cos(B)\cos(C)}$?

- A. $\frac{\cos(A+C)}{\sin(A)\sin(C)}$
- B. $\frac{\sin(A+C)}{\cos(A)\cos(C)}$
- C. $\frac{\sin(A-C)}{\cos(A)\cos(C)}$
- D. $\frac{\cos(A-C)}{\sin(A)\sin(C)}$
- E. None of the above

26. If $3f(x) - 2f(\frac{1}{x}) = x$, find $f(x)$.

- A. $\frac{5x^2+2}{3}$
- B. $\frac{3x^2-2}{5}$
- C. $\frac{3x^2+2}{5}$
- D. $\frac{5x^2-2}{3}$
- E. None of the above

27. Find the value of $\frac{a^2-(b-c)^2}{(a+c)^2-b^2} + \frac{b^2-(a-c)^2}{(a+b)^2-c^2} + \frac{c^2-(a-b)^2}{(b+c)^2-a^2}$.

- A. 2
- B. 1
- C. -2
- D. -1
- E. None of the above

28. Given $f(x) = (x+2)^{-1}$ and $g(x) = (3x-1)^{-1}$, find the domain of $(g \circ f)(x)$.

- A. $(-\infty, -2) \cup (-2, 1) \cup (1, \infty)$
- B. $(-\infty, 1) \cup (1, \infty)$
- C. $(-\infty, -\frac{1}{2}) \cup (-\frac{1}{2}, \infty)$
- D. $(-\infty, -\frac{1}{2}) \cup (-\frac{1}{2}, \frac{1}{3}) \cup (\frac{1}{3}, \infty)$
- E. None of the above

29. Identify the horizontal asymptote of the graph of the function $y = -3 * 2^{x+4} - 5$.
 A. $y = 4$ B. $y = -3$ C. $y = 2$ D. $y = -5$ E. None of the above
30. Given the function $f(x) = 9x^2 - x$, evaluate the expression $\frac{f(x)-f(a)}{x-a}$, for $x \neq a$.
 A. $9x - 9a - 1$
 B. $9x + 9a - 1$
 C. $9x + 9a + 1$
 D. $9x - 9a + 1$
 E. None of the above
31. Solve the equation $4^x - 2^{x+3} + 15 = 0$.
 A. 5, 3
 B. $\ln(5), \ln(3)$
 C. $\log(5), \log(3)$
 D. $\log_2(5), \log_2(3)$
 E. None of the above
32. Find the inverse of the function $f(x) = 2e^{x-3} + 1$.
 A. $\ln(3\sqrt{x-1})$
 B. $3 + \ln(x-1) - \ln(2)$
 C. $\ln(2(x-1)) - 3$
 D. $\frac{1}{2e^{x-3}+1}$
 E. None of the above
33. Which of the following are true for the graph of the rational function $f(x) = \frac{x^2-x-30}{x^3+x^2-42x}$.
 i. The graph does not have a vertical asymptote.
 ii. The graph has a vertical asymptote at $x = -7$.
 iii. The graph has a hole at $x = 6$.
 A. i and iii only B. ii only C. ii and iii only D. iii only E. None of the above
34. For an angle, θ in the first quadrant, $\cos(\theta) = \frac{8}{17}$, determine the value of $\sin(2\theta)$.
 A. $\frac{120}{289}$ B. $\frac{180}{289}$ C. $\frac{240}{289}$ D. $\frac{220}{289}$ E. None of the above
35. Simplify the expression $\sin^4(\theta) - \cos^4(\theta)$.
 A. 1 B. $1 - 2\sin^4(\theta)$ C. $\tan^4(\theta)$ D. $-\cos(2\theta)$ E. None of the above

36. What graph best represents the polar equation $r = 3\sin(4\theta)$?
- A. a rose with 8 petals
 - B. a rose with 4 petals
 - C. a rose with 2 petals
 - D. a rose with 3 petals
 - E. None of the above
37. If for all $x, y \in \mathbb{N}$, $f(xy) = f(x) + f(y)$, $f(10) = 14$, and $f(20) = 40$, find $f(500)$.
- A. -12
 - B. 16
 - C. 52
 - D. 26
 - E. None of the above
38. Solve. $\frac{x+2}{x-4} \leq \frac{x+5}{x+3}$.
- A. $(\infty, -\frac{13}{2}] \cup [-3, 4]$
 - B. $[-\frac{13}{2}, -3) \cup (4, \infty)$
 - C. $(\infty, -\frac{13}{2}] \cup (-3, 4)$
 - D. $[-\frac{13}{2}, -3] \cup [4, \infty)$
 - E. None of the above
39. Express the complex number $z = -\sqrt{3} + i$ in polar form.
- A. $2\cos(\frac{\pi}{6}) + 2i\sin(\frac{\pi}{6})$
 - B. $4\cos(\frac{5\pi}{6}) + 4i\sin(\frac{5\pi}{6})$
 - C. $4\cos(\frac{\pi}{6}) + 4i\sin(\frac{\pi}{6})$
 - D. $2\cos(\frac{5\pi}{6}) + 2i\sin(\frac{5\pi}{6})$
 - E. None of the above
40. If $y = ax^2 + bx + c$ is a quadratic function that passes through the points $(-3, -42)$, $(1, 6)$, and $(2, 13)$, find the product abc .
- A. -30
 - B. 60
 - C. 30
 - D. -60
 - E. None of the above