MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2017 MATH CONTEST
SENIOR

DIRECTIONS: DO NOT WRITE ON THIS TEST. Place the best answer for each question on the separate answer sheet.

1. For the function $y = \frac{x^2-9}{2x^2-5x-3}$, as the variable *x* gets bigger and bigger ("approaches infinity"), the variable *y* gets closer and closer to:

A) 0 **B)** $\frac{1}{2}$ **C)** $\frac{2}{3}$ **D)** $\frac{3}{5}$ **E)** none of these

2. Evaluate the limit when x is measured in radians: $\lim_{x\to 0} \frac{\sin(x)}{x}$

A) 0 **B)** $\frac{\pi}{180}$ **C)** 1 **D)** $\frac{\pi}{2}$ **E)** does not exist

3. For the function $(x) = \frac{x-2}{x-5}$, which of the following limits does NOT exist?

A) $\lim_{x\to 2} g(x)$ **B)** $\lim_{x\to 5} g(x)$ **C)** $\lim_{x\to \infty} g(x)$ **D)** $\lim_{x\to -\infty} g(x)$ **E)** none of these

4. When graphed for $0 \le t \le 2\pi$, the parametric equations x = cos t and y = 2 sin t result in:

A) a line. **B)** a sinusoidal. **C)** a circle. **D)** an ellipse. **E)** none of these.

5. Consider $4x^2 + Cy^2 + 6x + 4y - 12 = 0$. For which value of C will the conic section be an ellipse?

A) -4 **B)** 0 **C)** 4 **D)** 8 **E)** none of these

6. The hyperbola $\frac{(y-1)^2}{9} - \frac{(x+5)^2}{25} = 1$ has two asymptotes. What is the y-intercept of the asymptote that has a positive slope?

A) -2 **B)** $\frac{3}{5}$ **C)** $\frac{25}{9}$ **D)** 4 **E)** none of these

7. Using the greatest integer function $f(x) = [x]$, evaluate f(-3.6).

A) -4 **B)** -3 **C)** 3.6 **D)** 4 **E)** none of these

8. When graphed, the greatest integer function $f(x) = [x]$ results in a graph with "steps" one vertical unit apart from one another. Which modification of the greatest integer function results in a graph with steps that are two vertical units apart?

A) $y = 2[x]$ **B)** $y = [x - 2]$ **C)** $y = [x + 2]$ **D)** $y = [x] + 2$ **E)** none of these

9. Which polynomial function has only imaginary zeros?

A) $y = x^2 - 3$ **B)** $y = x^3 + 2x^2$ **C)** $y = (x - 5)^4$ **D)** $y = x^4 + 2x^2 + 1$ **E)** none of these

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10. Determine the product of the complex numbers $2 + 3i$ and $3 - 5i$.

A) $5 - 2i$ **B)** $-9 + i$ **C)** $-9 - i$ **D)** $21 - i$ **E)** none of these

11. Evaluate $\sqrt{-2}\sqrt{-3}\sqrt{-6}$

A) $6i$ **B)** $-6i$ **C)** -6 **D)** 6 **E)** none of these

12. Simplify $\frac{3+5i}{2-2i}$

A) $-0.5 + 2i$ **B)** $0.5 - 2i$ **C)** $0.5 + 2i$ **D)** $-0.5 - 2i$ **E)** none of these

13. Determine the resulting velocity of an airplane traveling north at 500 km/hr which experiences a 100 km/hr wind blowing 40° north of east. Round all values to the nearest tenth.

A) 442.4 km/hr, 82.3° N of E **B)** 569.5 km/hr, 7.7° E of N **C)** 442.4 km/hr, 7.7° E of N
D) 569.5 km/hr, 82.3° W of N **E)** none of these

14. Two forces act on an object, one at 10 N east and the other at 17 N south. What force applied will keep the object in equilibrium, where equilibrium is the state of a body in which there is no change in its motion? Round all values to the nearest tenth.

A) 19.8 N, 30.5° W of N **B)** 19.7 N, 59.5° S of E **C)** 19.7 N, 30.5° W of N
D) 19.8 N, 59.5° N of W **E)** none of these

15. How many diagonals does a regular octagon have?

A) 16 **B)** 18 **C)** 20 **D)** 22 **E)** none of these

16. What is the next term in the sequence? 1 4 6 14 26

A) 40 **B)** 52 **C)** 54 **D)** 66 **E)** none of these

17. What is the absolute minimum value of the function $f(x) = \frac{1}{3}x^3 + \frac{1}{2}x^2 - 6x + 2$ on the interval [-6, 6]?

A) -16 **B)** $\frac{-35}{2}$ **C)** $\frac{-16}{3}$ **D)** -3 **E)** none of these

18. The sum of two nonnegative numbers is 25. What is the minimum value you can get if you take two times the first number plus the second number squared?

A) 49 **B)** 50 **C)** 51 **D)** 55 **E)** none of these

19. $f(x)$ is an n^{th} degree polynomial and n is odd. The number of relative maximums cannot exceed?

A) $\frac{n}{2} - 1$ **B)** $\frac{n-1}{2}$ **C)** $n - 1$ **D)** n **E)** none of these

20. Determine the equation for the horizontal asymptote for the function $f(x) = \frac{-2x^2-6x+1}{8x^2+9}$.

A) $y = -0.1$ **B)** $y = -0.2$ **C)** $y = -0.3$ **D)** $x = -0.4$ **E)** none of these

SENIOR 2017 Answer Key

1. B
2. C
3. B
4. D
5. D
6. D
7. A
8. A
9. D
10. D
11. B
12. A
13. B
14. C
15. C
16. C
17. A
18. A
19. B
20. E