



MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2017 MATH CONTEST
ADVANCED

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

1. What is the exact value of the $\sin(-\frac{\pi}{4})$?

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

2. Which of the following has the largest volume? Assume that all are measured with the same units.

- A) A cylinder with radius 7 height 20 B) A cube with side lengths of 9 C) A sphere with radius 6
D) A rectangular prism with dimensions 10 x 15 x 6 E) none of these

3. How many different ways can a group of 20 students elect a President, VP, and Treasurer? No student can hold two offices at the same time.

- A) ${}_{20}P_3$ B) ${}_{20}C_3$ C) ${}_3P_{20}$ D) ${}_3C_{20}$ E) none of these

4. Which of the following is NOT equivalent to $3 \log x$

- A) $\log x^2 + \log x$ B) $\log x^3$ C) $\log 1000 x$ D) $3 \log xy - 3 \log y$ E) none of these

5. What is the perimeter of an equilateral trapezoid with bases 40 and 60 and height 10?

- A) 130 B) $100 + 20\sqrt{2}$ C) 500 D) $100 + 20\sqrt{3}$ E) none of these

6. Given the matrix multiplication below, find the values for x and y .

$$\begin{bmatrix} 0 & -1 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} x & 3 \\ -3 & 2y \end{bmatrix} = \begin{bmatrix} 3 & -6 \\ -4 & 6 \end{bmatrix}$$

- A) $x = -2, y = -3$ B) $x = 3, y = -2$ C) $x = 0, y = 0$ D) $x = -3, y = 2$ E) none of these

7. A cell tower is located in the middle of $(x - 15)^2 + (y + 20)^2 = 625$. Where is the cell tower located?

- A) 15 mi West, 20 mi North B) 20 mi West, 15 mi North C) 20 mi East, 15 mi South
D) 15 mi East, 20 mi South E) none of these

8. What is the range of the tower from problem 8?

- A) 15 mi. B) 20 mi. C) 25 mi. D) 625 mi. E) none of these

9. Savannah calls 4 of her friends from work at the locations given. Which friend will be in range of the cell tower above?

- A) Willie is at (25,0) B) Stevin is at (-18,-19) C) Carly is at (-14,20) D) Carin is at (14,10) E) none of these

10. How many times does the function $f(x) = 2\sin\pi x + 3$ have an output value of 3?

- A) never B) once C) twice D) infinitely many E) none of these

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11. Solve $x^2 - 4x = -9$.

- A) $x = 2 \pm 3i$ B) $x = 2 \pm \sqrt{13}$ C) $x = 2 \pm i\sqrt{5}$ D) $x = 2 \pm \sqrt{3}$ E) none of these

12. Write $b^x = n$ in logarithmic form.

- A) $\log_b n = x$ B) $\log_n b = x$ C) $\log_x b = n$ D) $\log_b x = n$ E) none of these

13. Evaluate $\sum_{i=1}^6 (2i + 3)$.

- A) 48 B) 60 C) 63 D) 72 E) none of these

14. Given: $f(x) = x + 2$ and $g(x) = 1/x$. Which of the following is undefined for $x = -2$?

- A) $f(g(x))$ B) $g(f(x))$ C) $f(x) + g(x)$ D) $f(x) * g(x)$ E) none of these

15. Which of the following functions is increasing for $2 \leq x \leq 3$?

- A) $f(x) = -2x + 3$ B) $y = -(x - 2)^2 + 12$ C) $y = (x - 2)^3 + 3$ D) $y = 12/x$ E) none of these

16. Solve the system. $\begin{cases} y = -2x + 12 \\ y = x^2 + 4 \end{cases}$

- A) (2, 8) B) (-4, 20) C) (-4, 20) & (2, 8) D) $(-1 \pm i\sqrt{7})$ E) none of these

17. Find the length of a side of a square with a diagonal length of 12.

- A) $2\sqrt{6}$ B) $6\sqrt{2}$ C) $6\sqrt{3}$ D) $12\sqrt{2}$ E) none of these

18. The equation $r(t) = -16t^2 + 125t + 10$ gives the height of a model rocket at t seconds. What is the maximum height (to the nearest tenth) that the rocket reaches?

- A) 10 ft. B) 3.9 ft. C) 224.3 ft. D) 254.1 ft. E) none of these

19. How long does it take for the rocket in problem 21 to fall to the ground?

- A) 2.6 sec B) 3.9 sec C) 5.4 sec D) 10.3 sec E) none of these

20. The following table shows the number of texts Serena sent each day 2 weeks ago.

Saturday	Monday	Tuesday	Wednesday	Thursday	Friday	Sunday
48	52	103	79	80	216	142

Find the standard deviation of the data.

- A) 48 B) 54.8 C) 59.2 D) 102.9 E) none of these

21. If Serena sends 200 texts the next day, which of the following is true?

- A) The median will stay the same. B) The standard deviation will increase. C) The mean will decrease.
 D) The median will decrease. E) none of these

ADVANCED 2017 Answer Key

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