

MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2016 MATH CONTEST
ADVANCED

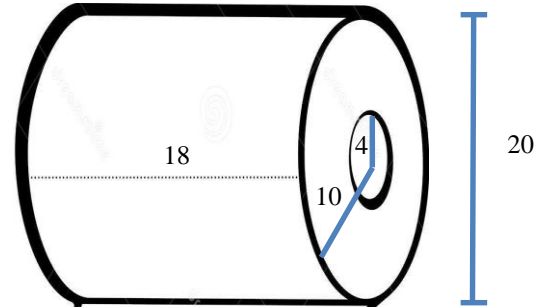
DIRECTIONS: DO NOT WRITE ON THIS TEST. Place the best answer for each question on the separate answer sheet.

1. Use properties of logarithms to fully expand the following: $\log_5 100x^2$.

- A) $\log_5(25) * \log_5(4) * \log_5(x^2)$ B) $\log_5(25) + \log_5(4) + \log_5(2x)$ C) $2 + \log_5(4) + 2\log_5(x)$
 D) $25 \log_5(4) + \log_5(x^2)$ E) none of these

2. Find the volume of the figure with a hollow center (shown at right) to the nearest tenth. All measurements are in centimeters.

- A) 5654.9 cm^3 B) 4750.1 cm^3 C) 2035.8 cm^3
 D) 904.8 cm^3 E) None of these



3. Find the surface area of the same figure as #2 to the nearest tenth. All measurements are in centimeters.

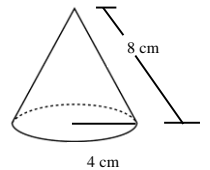
- A) 2111.2 cm^2 B) 908.2 cm^2 C) 1658.8 cm^2 D) 1759.3 cm^2 E) none of these

4. Multiply: $\begin{bmatrix} 2 & 1 \\ 3 & 7 \\ -2 & 5 \end{bmatrix} * \begin{bmatrix} -4 & 0 \\ 6 & 7 \\ 3 & -4 \end{bmatrix} =$

- A) $\begin{bmatrix} -8 & 0 \\ 18 & 49 \\ -6 & -20 \end{bmatrix}$ B) $\begin{bmatrix} -2 & 1 \\ 9 & 14 \\ 1 & 1 \end{bmatrix}$ C) $\begin{bmatrix} -8 & 19 & 2 \\ -12 & 67 & -19 \\ 8 & 23 & -26 \end{bmatrix}$ D) $\begin{bmatrix} 4 & 53 \\ 29 & 29 \end{bmatrix}$ E) none of these

5. The object at right (cone) is made of silver, which has a density of 10.49 g/cm^3 . What is the mass of the object to the nearest tenth?

- A) 3653.1 g B) 1406.1 g C) 1217.7 g D) 11.1 g E) none of these



6. An I-90 bridge project can be completed by 6 workers in 27 days. In order to complete the project sooner, the company plans to hire additional workers. How many more workers are needed to complete the project in 18 days?

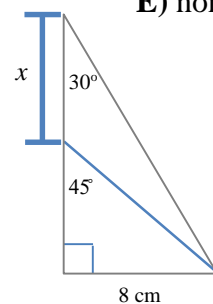
- A) 9 B) 6 C) 3 D) 1 E) none of these

7. The number of hours that it takes m men to slay z zombies varies directly as the number of zombies and inversely as the number of men. If four men can slay 12 zombies in four hours, how many men are needed to slay 36 zombies in eight hours?

- A) 6 B) 1 C) 8 D) 24 E) none of these

8. Find the value of x in the diagram at right.

- A) $8\sqrt{3} - 8$ B) 8 C) $16\sqrt{3} - 8$
 D) $8\sqrt{2} - 8$ E) None of these



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9. Jane graphed the number of water sports injuries per month and ice cream sales (in billions of dollars) per month for 2014. She found a correlation coefficient of 0.9216 for the linear equation fitting the scatterplot of the data. What can Jane assume?

- A) More ice cream causes more water sports injuries.
- B) More ice cream causes fewer water sports injuries.
- C) Less ice cream causes more water sports injuries.
- D) Less ice cream causes fewer water sports injuries
- E) None of the above.

10. Timmy's dodgeball cannon is located at (-6, 13) on a coordinate plane. It can reach 30 meters in all directions. What is the equation of the perimeter of the dodgeball cannon's reach?

- A) $x^2 + y^2 = 900$
- B) $(x + 6)^2 + (y - 13)^2 = 900$
- C) $(x - 6)^2 + (y - 13)^2 = 900$
- D) $(x + 6)^2 + (y - 13)^2 = 30$
- E) None of these

11. In 2014, 328 students took the MCTM "Advanced" test. The results showed a normal distribution, with a mean score of 13 out of 20 questions and a standard deviation of 2. How many students scored within 2 standard deviations of the mean?

- A) 312
- B) 223
- C) 213
- D) 17
- E) None of these

12. Solve for x: $3^{2x} - 3 = 78$

- A) 1
- B) 27
- C) 2
- D) 4
- E) None of these

13. Facebook use among teens dropped from 72% to 45% in the past 6 months. If this trend is exponential, what percent of teens will be using Facebook 18 months from now? Round to the nearest percent.

- A) 2%
- B) 0%
- C) -9%
- D) 18%
- E) None of these

14. Batman is atop a 50m tower in Gotham. He throws a Batarang which travels in a straight line at a ground level baddie. It travels 200m before striking him. At what angle of declination did Batman throw the Batarang?

- A) 14.5°
- B) 75.5°
- C) 25°
- D) 4°
- E) None of these

15. A regular polygon has side lengths of 12 m, apothem of 34m and an area of 3672m^2 . How many sides does it have?

- A) 108
- B) 306
- C) 9
- D) 18
- E) None of these

16. Philip had \$0.93 in a bank account with an APR of 1.75% compounded quarterly. If he is cryogenically frozen for 1000 years, how much money will he have when he is unfrozen? Assume that his bank is in good standing throughout this time.

- A) \$35,649,987.20
- B) \$31,834,706.18
- C) \$73.18
- D) \$66.03
- E) None of these

17. Complete the following identity equation:

$$\tan^2 x = \underline{\hspace{2cm}} - 1$$

- A) $\sin^2 x$
- B) $\cos^2 x$
- C) $\cot^2 x$
- D) $\sec^2 x$
- E) None of these

ADVANCED 2016 Answer Key

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