

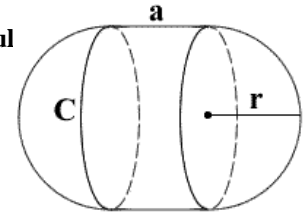
MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2013 MATH CONTEST
ADVANCED

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

- How long would it take to double your principal at an annual interest rate of 7% compounded continuously?
A) 9.9 years B) 14.3 years C) 2 years D) 28.6 years
- Solve $\log(6x) - 3 = -4$.
A) $-\frac{1}{6}$ B) $\frac{1}{6}$ C) $\frac{1}{10}$ D) $\frac{1}{60}$
- The ratio of the surface areas of two cubes is 25:1. What is the ratio of their volumes?
A) 5:1 B) 25:1 C) 50:1 D) 125:1
- Solve $7^{3x} = 515$ (to the nearest ten-thousandth)
A) 1.0696 B) 24.5238 C) 169.3333 D) 7.0548
- Solve $\log(4x + 2) - \log x = 3$ (to the nearest thousandth)
A) 0.012 B) 0.002 C) 0.333 D) 3.333
- Simplify $\cos x + \sin x \tan x$
A) $\sec x$ B) $\cos x$ C) $\tan^2 x$ D) $\cot x$
- Matt is on a bank of the Boulder River and Erin is on the same bank 30 feet due east from Matt. They both see the same fish upstream swimming in the current. The fish is located 49° north of east from Matt's position and 66° north of west from Erin's position. Approximately how many yards is Erin from the fish?
A) 10.1 yd B) 25 yd C) 27.4 yd D) 30.2 yd
- Solve $2X + 3 \begin{bmatrix} 6 & -2 \\ 3 & -4 \end{bmatrix} = \begin{bmatrix} 12 & -3 \\ 4 & 1 \end{bmatrix}$
A) $\begin{bmatrix} 3 & 0.5 \\ -0.5 & 2.5 \end{bmatrix}$ B) $\begin{bmatrix} -3 & 1.5 \\ -2.5 & 6.5 \end{bmatrix}$ C) $\begin{bmatrix} -12 & 4.5 \\ -7 & 12.5 \end{bmatrix}$ D) $\begin{bmatrix} 1.2 & -0.2 \\ 0.2 & 1 \end{bmatrix}$
- The hypotenuse of a 45-45-90 triangle is $4\sqrt{2}$ cm long. How long are the legs?
A) 4 cm B) 2 cm C) $2\sqrt{2}$ cm D) $8\sqrt{2}$ cm
- Find the area of an equilateral triangle with side length of 8 cm.
A) 16 cm^2 B) 32 cm^2 C) $16\sqrt{3} \text{ cm}^2$ D) $32\sqrt{3} \text{ cm}^2$
- For a set of values, suppose the median is 20 and the range is 5. To get a new set of values, each value in the original set is multiplied by 4 and 3 is subtracted. What is the median and the range for the new set of values?
A) Median 80; Range 20
B) Median 77; Range 20
C) Median 80; Range 17
D) Median 77; Range 17

12. In a game of chance, two die are rolled simultaneously. If the sum of the two die is less than 5 the player wins \$15. If the sum of the two die is greater than 9 the player wins \$12. All other sums earn the player no money.
- A) The player can expect to win on average \$8.33 per game.
 B) The player can expect to win on average \$5.50 per game.
 C) The player can expect to win on average \$6.75 per game.
 D) The player can expect to win on average \$4.50 per game.

Use for problems 13-14. A capsule is formed by a cylinder with a hemisphere on each circular end, as seen at right. The radius (r) is 8 mm and the height of the cylinder (a) is 12 mm.



13. What is the surface area of the capsule?
 A) $192\pi \text{ mm}^2$ B) $256\pi \text{ mm}^2$ C) $448\pi \text{ mm}^2$ D) $704\pi \text{ mm}^2$
14. What is the volume of the capsule?
 A) $1450.7 \pi \text{ mm}^3$ B) $1109.3\pi \text{ mm}^3$ C) $682.7\pi \text{ mm}^3$ D) $1365.3\pi \text{ mm}^3$

15. Find the inverse of the following matrix: $\begin{bmatrix} 4 & 2 \\ 1 & 7 \end{bmatrix}$
- A) $\begin{bmatrix} 7 & -2 \\ -1 & 4 \end{bmatrix}$ B) $-\begin{bmatrix} 4 & 2 \\ 1 & 7 \end{bmatrix}$ C) $\begin{bmatrix} 7/26 & -1/13 \\ -1/26 & 2/13 \end{bmatrix}$ D) Does not exist

16. Suppose z varies directly as x and inversely as the square of y . If $z = -1$, when $x = 8$ and $y = -4$, find x when $y = 12$ and $z = -2$.
 A) $x = 144$ B) $x = 1.5$ C) $x = 1.25$ D) -0.75

17. Linda is receiving the Golden Pencil as a retirement present from her friend Kelli. Kelli's only mailing box measures 20 cm by 4 cm by 5 cm. Which is the longest pencil which will fit in the box?
 A) 22 cm B) 21 cm C) 20.6 cm D) 20.4 cm

18. Nate needs to know the surface area of his triangular field so he can order the correct amount of fertilizer for his alfalfa crop. The fence lengths measure 400 m, 500 m, and 650 m. What is the surface area of his field in acres? (1 acre is approximately 4047 square meters.)

- A) 99951.1 acres B) 24.7 acres C) 162500 acres D) 40.2 acres

19. Solve for x : $\frac{1}{81} = 9^{3x-3}$

- A) $x = 2$ B) $x = -2$ C) $x = \frac{1}{3}$ D) $x = \frac{2}{3}$

20. The number of minutes needed to build a train set varies directly as the number of train cars and inversely as the number of elves working on the train set. It takes 4 elves 36 minutes to build a 18 car train set. How many minutes will it take 6 elves to build a 42 car train set?

- A) 8 minutes B) 56 minutes C) 72 minutes D) 112 minutes

Use this set of data for questions 21-23.

{5, 8, 5, 8, 5, 9, 1, 5, 5}

- 21) Abe is hunting vampires. From his cabin, he tracks one 3.2 miles at 15° east of north. He then changes direction and hikes 2.8 miles at 40° south of east, where he catches the vampire and stakes him. If Abe goes directly back to his cabin, how far is it?

- A) 6 miles B) 3.24 miles C) 2.12 miles D) 0.4 miles

- 22) Find the 5-number summary (minimum, Q1, median, Q3, maximum)

- A) (5, 6.5, 5, 3, 5) B) (1, 5, 5, 5, 9) C) (1, 5, 5, 8, 9) D) (1, 3, 5, 8, 9)

- 23) What are the outliers?

- A) 1 B) 9 C) 1 and 9 D) none

- 24) Find the mean and standard deviation.

- A) 5.67, 2.26 B) 5, 2.26 C) 51, 2.26 D) 5.67, 2.39

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- 1) A
- 2) D
- 3) D
- 4) A
- 5) B
- 6) A
- 7) B
- 8) B
- 9) A
- 10) C
- 11) B
- 12) D
- 13) C
- 14) A
- 15) C
- 16) A
- 17) B
- 18) B
- 19) C
- 20) B
- 21) B
- 22) C
- 23) D
- 24) A