



**MONTANA COUNCIL OF TEACHERS OF MATHEMATICS**  
**2014 MATH CONTEST**  
**ADVANCED**

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

1. The equation of a given circle is  $(x + 72)^2 + (y - 33)^2 = 289$ . What are the coordinates of the center and the radius of the circle?

- A) (33, -72),  $r = 19$     B) (33, 72),  $r = 17$     C) (-72, 33),  $r = 17$     D) (72, 33),  $r = 19$     E) None of these

2. Complete the following identity equation:

$$1 + \cot^2 x = \underline{\hspace{2cm}}$$

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

3. Daredevil Nik Wallenda of the famous "Flying Wallendas" family walked on a 2 inch thick cable across a 1500 foot deep gorge near the Grand Canyon in June 2013. The distance between the gorge walls was 1400 feet. If the angle of elevation from one side of the gorge to the other was 4 degrees, how many feet of exposed cable did Wallenda have to walk across?

- A) 1503.7 ft                      B) 1403.4 ft                      C) 1496.3 ft                      D) 1396.6                      E) None of these

4. The number of bleeped out words on an episode of Hell's Kitchen is evenly distributed with a mean of 231 and a standard deviation of about 17 bleeps per episode. If you watch one season of 12 episodes, about how many episodes would you expect to hear less than 197 bleeps?

- A) about 9.97 episodes    B) about 7.02 episodes    C) about 5.14 episodes    D) about 1.35 episodes    E) None of these

5. As a town gets smaller, the population of its high school decreases by 12% each year. The student body has 125 students now. In how many years will it have about 75 students?

- A) 4 years                      B) 7 years                      C) 10 years                      D) 11 years                      E) None of these

6. Solve  $\log_4(x^2 - 17) = 3$ .

- A)  $\pm 8$                       B)  $\pm 9$                       C)  $\pm 10$                       D)  $\pm 11$                       E) None of these

**Use the following information for 7-8:** The circumference of a standard NBA basketball varies from 29.5 to 29.875 in.

7. Which of the following could approximately represent the surface area of a standard NBA basketball?

- A)  $277 \text{ in}^2$                       B)  $434 \text{ in}^2$                       C)  $118 \text{ in}^2$                       D)  $121 \text{ in}^2$                       E) None of these

8. What is the average circumference and the margin of error for an NBA basketball?

- A) 29.6875cm; 0.1578cm                      B) 29.6875cm; 0.1875cm;                      C) 29.5678cm; 0.1875cm  
D) 29.5675cm; 0.1578cm                      E) None of these

9. Uncle Buzzy's raft got caught by a gust of wind and floated north from Rattlesnake Point to the southeast shore of the island across the bay. Uncle Buzzy is at the marina, 2112 feet due west of the Rattlesnake Point camp, and has a  $14^\circ$  line of sight from the Rattlesnake Point to his raft on the island shore. If the marina is 2872 feet from the island shore, how far did the unmanned raft travel?

- A) Not enough information    B) 968 ft                      C) 732 ft                      D) 1413 ft                      E) None of these

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10. The length of a violin string varies inversely as the frequency of its vibrations. A violin string 14 inches long vibrates at a frequency of 450 cycles per second. Find the frequency of a 12 inch violin string.
- A) 386 cycles/second    B) 525 cycles/second    C) 406 cycles/second    D) 585 cycles/second    E) None of these
11. Your long lost Great-Aunt Ethel passed away and bequeathed \$7500 to you. The local bank advertises a fixed APR of 1.25%. If you invest the money in this bank, and interest is compounded monthly, how much will you have at the end of 6 years?
- A) \$973,097.53    B) \$8083.82    C) \$18,344.40    D) \$1528.70    E) None of these
12. The volume  $V$  of a prism is modelled by  $V = x^3 - x^2 - x + 1$ , where  $x - 1$  is the length of the prism and  $x + 1$  is the height. What is the width of the prism?
- A)  $x - 1$     B)  $x - 2$     C)  $x + 1$     D)  $x + 2$     E) None of these
13. Use the properties of logarithms to expand:  $\log_5 \frac{2x}{\sqrt{y}}$ .
- A)  $\log_5 2 + \log_5 x - \frac{1}{2} \log_5 y$     B)  $\log_5 2 - \log_5 x + 2 \log_5 y$     C)  $\log_5 2x + \log_5 \sqrt{y}$   
D)  $\log_5 (2 + x) - \frac{1}{2} \log_5 y$     E) None of these
14. The configuration of a kite contains an equilateral triangle and an isosceles triangle. The sides of the equilateral triangle are 12 cm and the congruent sides of the isosceles triangle are 14 cm. Find the length of the long brace connecting the two noncongruent vertices of the triangles.
- A) 31.32 cm    B) 23.04 cm    C) 20.27 cm    D) 18.33 cm    E) None of these
15. A plane slices a sphere 5 cm from its center. The sphere has a radius of 13 cm. What is the area of the slice to the nearest hundredth?
- A) 425.39 cm<sup>2</sup>    B) 493.52 cm<sup>2</sup>    C) 439.25 cm<sup>2</sup>    D) 452.39 cm<sup>2</sup>    E) None of these
16. In a 45° - 45° - 90° triangle, with sides  $x$  and hypotenuse  $y$ , which of the following is NOT correct?
- A)  $y = \sqrt{2}x$     B)  $x = \frac{\sqrt{2}}{2}y$     C) The triangle is a right isosceles triangle.  
D) If  $x = 5$ , then  $y \approx 7.07$ .    E) None of these
17. Evaluate  $\log_7 54321$  to the nearest hundredth.
- A) 0.18    B) 3.89    C) 4.73    D) 5.60    E) None of these
18. In 2010, a Montana-based cell phone service provider had 57,000 subscribers. If subscriptions increased at 37% per year, how many subscribers did the provider have in 2003?
- A) 2245    B) 6293    C) 56,319    D) 146,567    E) None of these
19. The area of the base of a square pyramid is 225 cm<sup>2</sup>. The volume of the pyramid is 1575 cm<sup>3</sup>. Find the surface area of the pyramid.
- A) 540 cm<sup>2</sup>    B) 855 cm<sup>2</sup>    C) 894 cm<sup>2</sup>    D) 1485 cm<sup>2</sup>    E) None of these

## **ADVANCED 2014 Answer Key**

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