



MONTANA COUNCIL OF TEACHERS OF MATHEMATICS  
2011 MATH CONTEST  
**ADVANCED**

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

- Point R is located in a quadrant in which the sine ratio is negative and the tangent ratio is positive. Which one of the following could represent the coordinates of R?  
(A) (-4, 0)      (B) (-5, 4)      (C) (4, -5)      (D) (-5, -4)
- A circle of radius 4 lies completely inside an equilateral triangle with a side of 20. What is the probability to the nearest hundredth that a randomly selected point inside the triangle also lies inside the circle?  
(A) 0.36      (B) 0.29      (C) 0.22      (D) 0.15
- If  $\log_4 P = \log_8 Q = x$ , which of the following expressions is equivalent to  $Q/P$ ?  
(A)  $2x$       (B)  $2^x$       (C)  $x^2$       (D)  $x/2$
- A ladder is leaning against the vertical side of a building. The angle of elevation is  $33^\circ$  and the bottom of the ladder is 16 feet from the bottom of the building. To the nearest tenth of a foot, what is the length of the ladder?  
(A) 19.1      (B) 24.6      (C) 29.4      (D) 32.9
- A forest ranger spots a fire from the top of a look-out tower. The tower is 160 meters tall, and the angle of depression to the fire is  $12^\circ$ . About how far is the fire from the base of the tower assuming the fire is on the same level as the base?  
(A) 164 m      (B) 753 m      (C) 34 m      (D) 157 m
- A certain strain of bacteria can grow from 200 to 900 in 3 hours. What is the approximate value of  $k$  for the growth formula  $y = ne^{kt}$ ?  
(A) 4.5      (B) 1.369      (C) 1.5      (D) 0.5014
- A cylindrical gasoline tank lies on its side. The height of the tank, which is also its diameter, is 10 feet. The length of the tank is 18 feet. If the tank is filled to a depth of 2 feet, then what is the surface area of the gasoline in the tank? Only consider the surface exposed to the air remaining in the tank.  
(A)  $108 \text{ ft}^2$       (B)  $126 \text{ ft}^2$       (C)  $90 \text{ ft}^2$       (D)  $144 \text{ ft}^2$
- In the 1998 football season, the Smithville Pirates scored the following number of points: 13, 20, 0, 31, 26, 14, 21, 30, and 6. In the 1999 football season, the team scored 28 more points than in the preceding year but played 2 more games. To the nearest tenth, by how much did the mean change from 1998 to 1999?  
(A) +0.2      (B) -0.7      (C) +3.1      (D) -1.8
- In a geometry class, a teacher may need to have a set of Pythagorean triples handy in order to present examples and exercises on the Pythagorean theorem. Knowing that 3, 4, and 5 represent the smallest group of Pythagorean triples, how do you generate other related Pythagorean triples?  
(A) Multiply these numbers by any positive integer greater than 1.  
(B) Square each of these numbers.  
(C) Add a fixed number to each of these numbers.  
(D) Multiply these numbers by squared numbers only.
- On a teeter-totter, a person's weight varies inversely with the distance from the balance point. Joe, weighing 186 pounds, sits on one side of a teeter-totter, and his girlfriend Mary, weighing 122 pounds, sits 6 feet from the balance point. How far must Joe sit from the balance point to balance Mary?  
(A) 9.15 feet      (B) 6 feet      (C) 3.94 feet      (D) 5.29 feet

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11. Given that A, B, and C are square matrices, which one of the following is not true?

- (A)  $A + (B + C) = (A + B) + C$  (B)  $A \times B = B \times A$   
(C)  $A \times (B + C) = A \times B + A \times C$  (D)  $A \times (B \times C) = (A \times B) \times C$

12. To the nearest tenth, what is the area of a triangle with sides 4, 8, and 10?

- (A) 14.1 (B) 15.2 (C) 16.3 (D) 17.4

13. The area of a rhombus is 240 square inches. The length of one diagonal is three times the length of the other diagonal. To the nearest tenth, what is the sum of the lengths of the diagonals?

- (A) 36.8 (B) 43.7 (C) 50.6 (D) 57.5

14. A sheet metal worker wishes to shape a sheet of metal into a trough, 18 feet long, with a rectangular cross-section. If the sheet of metal is 17 inches by 18 feet, how much metal should he turn up on each side, so he will have a maximum capacity in the trough?

- (A) 5.67 inches (B) 8.50 inches (C) 4.25 inches (D) 4.00 inches

15. A section of highway is 4.2 km long and rises at a uniform grade making a  $3.2^\circ$  angle with the horizontal. What is the change in elevation up this section of highway to the nearest thousandths?

- (A) 0.235 km (B) 0.013 km (C) 4.193 km (D) 0.234 km

16. Two cones are similar and the volume of the smaller cone is 54 cubic meters. If the ratio of their areas is  $9/25$ , what is the volume of the larger cone?

- (A)  $100 \text{ m}^3$  (B)  $150 \text{ m}^3$  (C)  $200 \text{ m}^3$  (D)  $250 \text{ m}^3$

17. Find the median of the following distribution: {5, 6, 6, 6, 8, 10, 13, 13, 16, 18, 20}

- (A) 6 (B) 11 (C) 25 (D) 10

18. The circumference of a cylinder is  $16\pi$ . If the height is 12, what is the volume?

- (A)  $768\pi$  (B)  $576\pi$  (C)  $384\pi$  (D)  $192\pi$

19. To find the height of a mountain, surveyors often find the angle of elevation to the top from two points at the same altitude a fixed distance apart. Suppose that the angles of elevation from two points 500 m apart are  $35^\circ 20'$  and  $25^\circ 46'$ . How high is the mountain above the altitude of the two points?

- (A) 756 m (B) 956 m (C) 1010 m (D) 756 m

20. How much larger is each angle of a regular 20-sided figure than each angle of a regular octagon?

- (A)  $12^\circ$  (B)  $17^\circ$  (C)  $22^\circ$  (D)  $27^\circ$

21. The areas of the bottom, the side, and the front of a rectangular box are r, s, and t square inches, respectively. What is the volume of the box, in cubic inches?

- (A)  $(rst)^3$  (B)  $(rst)^2$  (C)  $(rst)^{1/2}$  (D)  $(rst)^{1/3}$

22. If  $\cos \theta = 0.25$  and  $\theta$  is not in the first quadrant, what is the value of  $\sin \theta$ ?

- (A)  $\sqrt{15/4}$  (B)  $\sqrt{17/4}$  (C)  $-(\sqrt{15/4})$  (D)  $-(\sqrt{17/4})$

23. Gerry makes pottery. The diameter of his bowls are normally distributed. The mean of the diameters is 22 cm and the standard deviation is 2 cm. In a typical batch of 40 bowls, how many would you expect to have a diameter between 20 and 24 cm?

- (A) 38 (B) 20 (C) 30 (D) 27

24. A ladder 12 feet long leans against a wall that is perpendicular to the ground. The bottom of the ladder is 3 feet from the wall. If the ladder slips so the angle formed by the ladder and the wall is  $25^\circ$ , how many feet did the top of the ladder drop?

- (A) 0.39 (B) 2.65 (C) 0.74 (D) 3.10

## ADVANCED 2011 Answer Key

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