

MONTANA COUNCIL OF TEACHERS OF MATHEMATICS
2015 MATH CONTEST
ADVANCED

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

1. Complete the following identity equation:

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

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

2. Solve $\log_5(x + 2) = 2$

- A) 3 B) 5 C) 0 D) 23 E) None of these

3. Use properties of logarithms to condense $\log_7 3 + \frac{1}{2} \log_7 5 - \log_7 2$

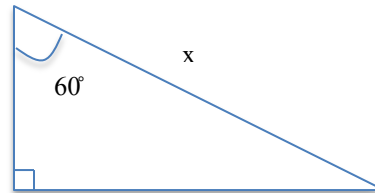
- A) $\log_7 \frac{3\sqrt{5}}{2}$ B) $\log_7 \frac{15}{4}$ C) $\frac{1}{2} \log_7 6$ D) $\log_7 \frac{\sqrt{15}}{2}$ E) None of these

4. From 2013 to 2014 the number of Instagram users increased by 23% to 80 million. If this trend continues, approximately how many users will Instagram have in 2018 (to the nearest million)?

- A) 149 million B) 154 million C) 183 million D) 225 million E) None of these

5. For the right triangle below, which of the following is NOT true?

- A) The hypotenuse is double the shorter leg
B) The shorter leg is $\frac{x}{2}$
C) The longer leg is $x\sqrt{3}$
D) The ratio of the short leg to the hypotenuse is 0.5
E) None of the above



6. Determine the number of triangles: $A = 62^\circ$, $a = 15$, $b = 18$

- A) 0 B) 1 C) 2 D) infinite E) None of these

7) You won a \$500 cash award at the local I LOVE MATH contest. You invest the \$500 into a savings account with a fixed annual percentage rate of 1.75%, compounded monthly. How many years (to the nearest tenth) will it take for this money to double?

- A) 6.8 B) 39.6 C) 68.1 D) 4.2 E) None of these

8) Liam Neeson jumps off an 80 foot cliff, then simply walks away 450 feet. At what angle of elevation, to the nearest degree, is his original location from his current location (assume a right triangle)?

- A) 45° B) 6° C) 10° D) 7° E) None of these

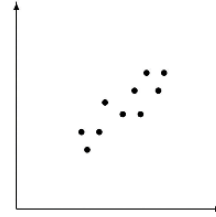
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9) If the surface area of a cube is doubled, what happens to the cube's volume, V ?

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

10) Which is best estimate for the correlation coefficient for the linear equation fitting the graph at right?

- A) 1.836 B) 0.836 C) 0.136
D) -0.841 E) None of these



11) A few years ago, 468 students took MCTM's "Advanced" test. The results showed a normal distribution, with a mean score of 12 out of 20 questions, and a standard deviation of 3. How many students scored within 1 standard deviation of the mean?

- A) 445 B) 318 C) 234 D) 156 E) None of these

12) A cell phone tower is at coordinates (12, -41) on a coordinate plane. It can reach 50 miles in all directions. What is the equation of the perimeter of the cell phone's reach?

- A) $x^2 + y^2 = 2500$ B) $(x + 12)^2 + (y - 41)^2 = 50$ C) $(x - 12)^2 + (y + 41)^2 = 50$
D) $(x + 12)^2 + (y - 41)^2 = 2500$ E) None of these

13) According to Hooke's Law, the force needed to stretch a spring is directly proportional to the amount the spring is stretched. If 35 pounds of force stretches a spring five inches, how far will the spring be stretched by a force of 154 pounds?

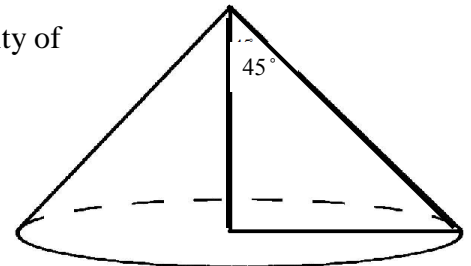
- A) 22 inches B) 4.4 inches C) 124 inches D) 7 inches E) None of these

14) In approximately 200 BC, Eratosthenes of Cyrene calculated the circumference of the Earth to be about 46620 km. The currently accepted equatorial circumference of the earth is about 40,075.16 km. Given this accepted measurement, which of the following is the best approximation of the Earth's surface area?

- A) 511,211,550 km^2 B) 49,796,652,380 km^2 C) 2,044,846,199 km^2
D) 170,403,850 km^2 E) cannot be determined

15) Find the mass of the cone at right if it is made of steel, which has a density of 8.05 g/cm^3 . The height of the cone is 12 cm.

- A) 1810 g B) 14567 g C) 43701 g
D) 5429 g E) cannot be determined



16) Michael is standing atop the Madison Plateau in Yellowstone National Park. He is roughly 28 miles from the fire tower lookout atop Mt. Holmes. He is roughly 32 miles from the fire lookout tower atop Mt. Sheridan. His horizontal angle of sight between the two peaks is 73° . As the crow flies, which of the following is the best approximation of the distance between Mt. Holmes and Mt. Sheridan?

- A) 36 mi B) 10 mi C) 56 mi D) 55 mi E) None of these

ADVANCED 2015 Answer Key

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