

MONTANA COUNCIL OF TEACHERS OF MATHEMATICS  
2013 MATH CONTEST  
TEAM 11-12

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

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1) Find all solutions for  $x^3 - 2x^2 - 11x + 52 = 0$

- A) -4, -13      B)  $-2i + 3, 2i + 3, -4$       C)  $2i - 3, 2i + 3, -4$       D)  $-2i, 2i, -4$

2) Find two nonnegative numbers whose sum is 9 and so that the product of one number and the square of the other number is a maximum.

- A)  $x = 1, y = 8$       B)  $x = 3, y = 6$       C)  $x = 4, y = 5$       D)  $x = 6, y = 6$

3) A farmer has 10 acres to plant in wheat and rye. He has to plant at least 7 acres. However, he has only \$1200 to spend and each acre of wheat costs \$200 to plant and each acre of rye costs \$100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is \$500 per acre of wheat and \$300 per acre of rye how many acres of each should be planted to maximize profits?

- A) 4 acres wheat, 4 acres rye      B) 5 acres wheat, 2 acres rye  
C) 2 acres wheat, 5 acres rye      D) 8 acres wheat, 2 acres rye

4) Twenty three kindergarteners have been exposed to the chicken pox. The probability that a particular kindergartener will develop chicken pox is independent of their peers. The probability of developing chicken pox for these students is 36%. The school will declare school closed if more than 8 kindergarteners develop chicken pox. What is the probability that the school will have to close it's doors?

- A) 0.46      B) 0.63      C) 0.17      D) 0.54

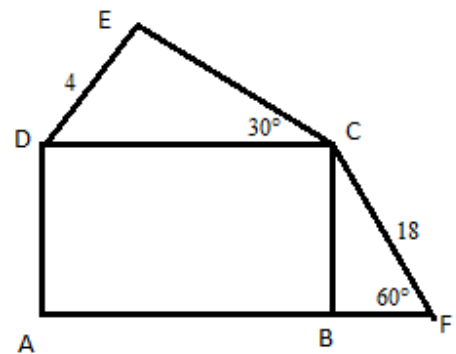
5) There are 9! (362,880) ways in which 9 people can form a line. In how many different ways can 9 people arrange themselves in a circle?

- A) 5,040      B) 362,880      C) 45      D) 40,320

6) Write an explicit rule for the following sequence: 27, 36, 48, 64, ...

- A)  $a_n = 27\left(\frac{4}{3}\right)^{n-1}$       B)  $a_n = 27\left(\frac{4}{3}\right)^n$       C)  $a_n = \frac{4}{3}(27)^{n-1}$       D)  $a_n = \frac{4}{3}(27)^{n-1}$

Use the diagram at right to answer problems 7-8. Angle E is a right angle and quadrilateral ABCD is a rectangle. The figure is NOT drawn to scale.



7) Find the length of  $\overline{BF}$

- A) 18 units      B) 9 units      C)  $9\sqrt{2}$  units      D)  $9\sqrt{3}$  units

8) Find the area of the trapezoid AFCD to the nearest square unit

- A) 306 square units      B) 390 square units  
C) 195 square units      D) 158 square units

9) When defined, which expression is not equal to 1 for all values of  $\theta$ ?

- A)  $\cos \theta \sec \theta$       B)  $\tan \theta \cot \theta$       C)  $\sin^2 \theta + \cos^2 \theta$       D)  $\frac{\tan \theta}{\cot \theta}$

10) A plumbing supply company is making 18 ft long pipes with an inner radius of 2.25 inches and an outer radius of 2.5 inches. Copper weighs 13lb/1000 in<sup>3</sup> and costs \$4.21 per lb. Which value is closest to the company's cost for the copper in 250 pipes?

- A) \$8000      B) \$9000      C) \$10000      D) \$11000

11) Solve the system 
$$\begin{cases} 2x + y - z = -10.6 \\ 4x - y + 3z = 50.6 \\ x + 6y - 0.5z = -8.6 \end{cases}$$

- A) (-5, 1, 1.6)      B) (10, 2, 4.2)      C) (2, -0.6, 14)      D) (3, -7.5, 9.1)

12) Find  $\lim_{x \rightarrow -6} \frac{x^3 + 216}{x + 6}$

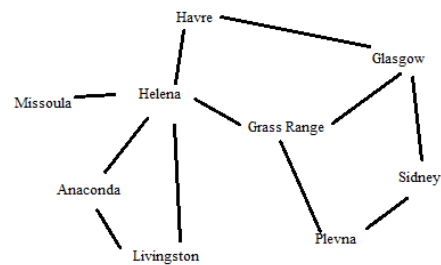
- A) 0      B) 1      C) 36      D) 108

13) Find the equation of the line tangent to  $y = 3x^2 + \frac{1}{4}x$  at (-4, 47)

- A)  $y = 6x + 71$       B)  $y = 6x + 0.25$       C)  $y = -23.75x - 48$       D)  $y = -23.75x + 0.25$

14) What is the fewest number of colors needed to color the cities in the road map below so that no two cities joined by a road are the same color?

- A) 2      B) 3      C) 4      D) 5



15) Identify the foci of the conic sections defined by the equation

$$\frac{x^2}{169} + \frac{y^2}{25} = 1$$

- A) (0, ±12)      B) (±12, 0)      C) (±√194, 0)      D) (0, ±√194)

16) Which answer describes a circle with radius of 7 and center at (2, 3)?

A)  $(x - 2)^2 + (y - 3)^2 = 49$

B)  $x = 2 + 7 \cos t$

C)  $y = 3 + 7 \sin t$

D)  $\frac{(x - 2)^2}{7^2} + \frac{(y - 3)^2}{7^2} = 1$

E) All of the above

17) Find  $\sum_{n=0}^9 \frac{1}{2^n}$  to the nearest thousandth.

- A) 2.000      B) 1.998      C) 1.996      D) 1.994

18) Solve  $\log(8x) - \log(1 + \sqrt{x}) = 2$  for x.

- A) 180.383      B) 0.866      C) 180.383 and 0.866      D) No real answers

19) A river flows from west to east at a speed of 12 knots. Shari rows her boat at a rate of 4 knots at a bearing of 310°. What is Shari's total resultant speed and bearing?

- A) 16 knots, bearing 310°      B) 16 knots, bearing 74°      C) 9.3 knots, bearing 90°      D) 9.3 knots, bearing 74°

20) Let  $f(x) = \frac{4}{x-2}$  and let  $g(x) = \frac{1}{x+3}$ . Find  $(f \circ g)(x)$ .

- A)  $\frac{2x+6}{-x-5}$       B)  $\frac{4x+12}{-2x-5}$       C)  $\frac{4x+12}{x-2}$       D)  $\frac{4}{x^2+x-6}$

**TEAM 11-12 2008 Answer Key**

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