



MONTANA COUNCIL OF TEACHERS OF MATHEMATICS  
2018 MATH CONTEST  
FINITE TEST

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

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- If  $P(A)=0.2$  and  $P(B)=0.1$ , what is  $P(A \cup B)$  if A and B are independent?  
A) 0.02      B) 0.30      C) 0.28      D) 0.32      E) none of these
- A soft drink dispenser can be adjusted to deliver any fixed number of ounces. If the machine is operating with a standard deviation in delivery equal to 0.3 ounce, what should be the mean setting so that a 12-ounce cup will overflow less than 1% of the time? Assume a normal distribution for ounces delivered.  
A) 11.23 ounces    B) 11.30 ounces    C) 11.70 ounces    D) 12.70 ounces    E) none of these
- Which of the following statements about the correlation coefficient are true? I: The correlation coefficient and the slope of the regression line may have opposite signs. II: A correlation of 1 indicates a perfect cause-and-effect relationship between the variables. III: Correlations of +0.87 and -0.87 indicate the same strength of relationship.  
A) I only      B) II only      C) III only      D) I and III      E) none of these
- Write a formula for the general term (the  $n^{\text{th}}$  term) of the geometric sequence: 5, -15, 45, -135, 405, ...  
A)  $a_n = 5(-3)^n$     B)  $a_n = 5(-3n)$     C)  $a_n = a_1 - 3^n$     D)  $a_n = 5(-3)^{n-1}$     E) none of these
- Solve the system:  $\begin{cases} (x-2)^2 + (y+5)^2 = 20 \\ x + y = -9 \end{cases}$   
A)  $\{(-7,-2), (-9,0)\}$     B)  $\{(-2,-7), (0,-9)\}$     C)  $\{(-7,-2), (-9,4)\}$     D)  $\{(-2,-7), (-9,4)\}$     E) none of these
- Consider the three points (2,11), (3,17), and (4,29). Given any straight line, we can calculate the sum of the squares of the three vertical distances from these points to the line. What is the smallest possible value this sum can be?  
A) 6      B) 9      C) 29      D) 57      E) none of these
- With regard to a particular gene, the percentages of genotypes AA, Aa, and aa in a particular population are, respectively, 60%, 30%, and 10%. Furthermore, the percentages of these genotypes that contract a certain disease are, respectively, 1%, 5%, and 20%. If a person does contract the disease, to the nearest 0.001, what is the probability that the person is of genotype AA?  
A) 0.006      B) 0.600      C) 0.041      D) 0.146      E) none of these
- Which of the following distributions are more likely to be skewed to the right than skewed to the left?  
I: Household incomes      II: Home prices      III: Ages of teenage drivers  
A) II only      B) I and III      C) I and II      D) II and III      E) none of these
- A professor wants to arrange his books on a shelf. He has 30 books and only space on the shelf for 20 of them. How many different 20-book arrangements can he make using the 30 books? This is an example of a problem that can be solved using which method?  
A) Permutations    B) Conditional Probability    C) Randomness    D) Combinations    E) none of these

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**10.** A local eat-in pizza restaurant wants to investigate the possibility of starting to deliver pizzas. The owner of the store has determined that home delivery will be successful if the average time spent on the deliveries does not exceed 29 minutes. The owner randomly selected 23 customers and has delivered pizzas to their homes in order to test if the mean delivery time actually exceeds 29 minutes. Suppose the P-value for the test was found to be 0.0288. State the correct conclusion.

- A) At  $\alpha=0.05$ , we fail to reject  $H_0$       B) At  $\alpha=0.025$ , we fail to reject  $H_0$       C) At  $\alpha=0.025$ , we reject  $H_0$   
 D) At  $\alpha=0.03$ , we fail to reject  $H_0$       E) none of these

**11.** Given the following matrices, which of the following operations CANNOT be done?

$$W = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad X = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{bmatrix} \quad Y = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \\ 7 & 8 \end{bmatrix} \quad Z = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \\ 7 & 8 \end{bmatrix}$$

- A)  $W + XY$       B)  $YW + Z$       C)  $YZ + W$       D)  $WX + X$       E) none of these

**12.** Find the minimum value of  $f(x, y) = -x + 5y$ , subject to the given constraints:

$$1 \leq x + y \leq 2 \quad -4 \leq x - y \leq 0$$

- A) -14      B) 16      C) -4      D) 2      E) none of these

**13.** The 6<sup>th</sup> term of a geometric sequence is 120, the 12<sup>th</sup> term is 12. What is the 20<sup>th</sup> term?

- A) 1.2      B) 0.12      C) 0.56      D) 0.056      E) none of these

**14.** Given  $A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 3 \\ -2 & 2 \end{bmatrix}$ ,  $\det(AB) =$

- A)  $(\det A)(\det B)$       B)  $\det(BA)$       C) both A and B      D) Cannot be done      E) none of these

**15.** Data are obtained for a group of college freshmen examining their SAT scores (math plus verbal) from their senior year of high school and their GPA's during their first year of college. The resulting equation is:  $y = 0.00161x + 1.35$  with  $r = 0.632$ . To the nearest 0.1%, what percentage of variation in GPA's can be explained by looking at SAT scores?

- A) 0.2%      B) 16.1%      C) 39.9%      D) 63.2%      E) none of these

**16.** Rainwater was collected in water collectors at 30 different sites near an industrial complex and the amount of acidity (pH level) was measured. The mean and standard deviation of the values are 4.60 and 1.10, respectively. When the pH meter was recalibrated back at the laboratory, it was found to be in error. The error can be corrected by adding 0.1 pH units to all of the values and then multiplying the result by 1.2. The mean and standard deviation of the corrected pH measurements are

- A) 5.64, 1.44      B) 5.40, 1.44      C) 5.64, 1.20      D) 5.64, 1.32      E) none of these

**17.** Given that 10% of the nails made using a certain manufacturing process have a length less than 2.48 inches, while 5% have a length greater than 2.54 inches, what are the mean and standard deviation of the lengths of the nails? Assume that the lengths have a normal distribution.

- A) 2.506, 0.0205      B) 2.506, 0.0410      C) 2.516, 0.0825      D) 2.516, 0.1653      E) none of these

**FINITE TEST 2018 Answer Key**

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