DIRECTIONS

Write neatly and PRINT YOUR NAME!
Use only the scratch paper provided. If you need more scratch paper, just ask me.
There are 3 pages with writing on both sides of every page.
There is a 5 point deduction for any errors in following directions. This includes errors on your exam (missing name, ID number, and signature) or scantron (missing name or version letter) or failure to return all scratch paper (used or not)
NO LATE EXAMS!! Penalty is (at least) 10 points off your score.
Put your VERSION letter on your scantron along with your name and section number.
There is a bonus problem on the back of this cover page.

A standard deck of 52 cards has 13 cards in 4 different suits. The red suits are hearts and diamonds. The black suits are spades and clubs. The cards in each suit are A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K. The J, Q, and K are face cards.
The English alphabet has 26 letters. There are 5 vowels (a, e, i, o and u)

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There are 8 multiple choice questions to answer on the front of your scantron. These questions are worth 4 points each.

1. A shipment of 14 video games contains exactly 3 defective games. A sample of 4 is chosen at random for testing. How many ways can this sample be chosen so that no defective games are found?
   (A) 1001  (B) 660  (C) 330  (D) 165  (E) none of the above

2. A multiple choice test has 3 questions, each with 5 possible answers and 4 more questions each with 2 possible answers. How many ways can these 7 questions be answered?
   (A) 1,728,016  (B) 2000  (C) 141  (D) 23  (E) none of the above

3. A shelf at the beauty store has 13 bottles of shampoo for sale. There are 5 identical bottles of Brand A, 3 identical bottles of Brand B, 4 identical bottles of Brand C and a bottle of Brand D. How many distinguishable ways can these bottles be arranged on the shelf?
   (A) 6,227,020,800  (B) 360,360  (C) 17,280  (D) 414,720  (E) none of the above

4. You are dealt a hand of 5 cards from a standard deck of 52 cards. How many ways can this hand contain at least 3 aces?
   (A) 5  (B) 216,576  (C) 4560  (D) 1181  (E) none of the above

5. How many different three scoop ice cream cones are possible if you have 8 flavors to choose from and three of the same flavor is not allowed?
   (A) 56  (B) 336  (C) 448  (D) 504  (E) none of the above

6. You have 7 red and 4 green marbles. How many ways can these marbles be arranged if the green balls are not next to each other?
   (A) 70  (B) 35  (C) 330  (D) 120,960  (E) none of the above

7. A crew will be picked to help at a carnival. One teacher will picked from 4 available teachers. Two parents from group of 8 parents will be picked. One parent is for set-up and one for clean-up. Four students will be picked from a group of 12 students. How many different crews are possible?
   (A) 514  (B) 55,440  (C) 2,661,120  (D) 110,880  (E) none of the above

8. A group of 5 couples is going to the movies. How many ways can these couples be seated if the couples are seated together?
   (A) 113,400  (B) 30,240  (C) 3840  (D) 160  (E) none of the above
Questions 51 - 58 are worth 2 points each. Use A for TRUE and B for FALSE. Put your answer on the BACK of the scantron.

51. If \( S \cup T = \emptyset \) then \( S = \emptyset \) and \( T = \emptyset \)

Given a universal set \( U = \{0, 1, 2, 3, 4, 5, 6\} \) and the sets \( A = \{1, 2, 3\} \), \( B = \{4, 5, 6\} \), and \( C = \{0, 2, 4, 6\} \) then

52. \( 2 \in C \)

53. \( C \subseteq C \)

54. \( C \)

55. \( A \) and \( B \) are mutually exclusive

56. \( A \cap C = \{2\} \)

57. \( n(B \cup C) = 7 \)

58. \( C \) has 16 subsets

---------------------------- WORK OUT QUESTIONS -------------------------------

**Question 1** (8 points) A candy bowl has candies that may be chocolate, or have nuts or have caramel. Fill in the Venn diagram using the information below.

- 2 candies were chocolate and had nuts and caramel
- 3 candies had chocolate and nuts and no caramel
- 6 candies had nuts and caramel
- 17 candies had nuts
- 5 candies had only chocolate
- 23 candies had no caramel
- 10 candies had at least two of these properties
- 7 candies did not have chocolate or nuts.

![Venn Diagram](image)

**Question 2** (8 points) Find the optimal (minimum and maximum) solutions, if any, to the following linear programming problem using the Method of Corners.

\[
f(x, y) = 2x + 3y
\]

subject to

\[
\begin{align*}
6x + 5y &\leq 30 \\
4x + y &\leq 8 \\
2x + 9y &\leq 18
\end{align*}
\]
Question 3 (4 points) Find $n \left[ A^c \cap (B \cup C^c) \right]$

Question 4 (6 points) A teacher is ordering binders and folders. The binders hold 3” of paper and the folders hold 4” of paper. Money and space constrain her to a feasible region bounded by the points (0, 7), (4, 6), (12, 0) and (0, 0) where $x$ represents the number of binders and $y$ is the number of folders ordered. How many of each item should be ordered to maximize the number of inches of paper to be held?

Question 5 (6 points) SET UP, but do not solve the following linear programming problem:

A company makes tables and chairs. If the company makes only tables one day, they can make 10 tables. If they make only chairs, they can make 12 chairs in a day. Each day they want to have at least four times as many chairs as they do tables. If the revenue is $90 for each table and $40 for each chair, how many of each item should the company make each day to maximize revenue?
Question 6 (4 points) Find the Venn diagram for the following information: In a desk drawer there are 22 pens. Twelve of the pens are black and 10 pens are felt-tipped. Fourteen of the pens are black or felt tip.

Question 7 (10 points) Set up and solve the following linear programming problem using the simplex method. Be sure show each of the simplex tableaus and circle the pivot element chosen. Don’t forget to fully explain your answer at the end.

An investor has up to $5000 to invest in stocks and bonds. The stocks pay 9% per year and the bonds pay 4% per year. If the investor wants no more than 30% of his total investment to be in stocks, how much should be invested in each option to maximize the interest earned?

Question 8 (6 points) For each of the tableaus below, pick one of the following options.
(A) Simplex is done. Write the values of all the variables under the tableau. Variables are (x, y, u, v, f)
(B) More pivot operations are needed. Circle the best pivot element (do not pivot)
(C) The problem has no solution or a parametric solution (list the solution if it is parametric)

1 1 0 7 0 | 10
0 4 1 1 0 | 6
0 9 0 5 1 | 40

0 2 1 3 0 | 4
1 3 0 4 0 | 8
0 0 0 2 1 | 16
Bonus problem (5 points) Given that

\( n(A) = 11, n(B) = 14, n(C) = 19, n(U) = 36, n(A \cap B) = 4, n(A \cap C) = 8, n(B \cap C) = 7 \) and \( n(A \cup B \cup C) = 28 \),

Find \( n(A \cap B \cap C) = \) ________