Chapter 6 Homework Problems
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Section 6.1
Note: A^C is sometimes written as A'.

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1. Use these sets to answer the following.
   $U = \{-1, 0, 1, 11, 12, 13\}$
   $A = \{1, 11, 13\}$
   $B = \{-1, 0, 11, 12\}$
   $C = \{0, 1, 13\}$

   (a) $A \cup C =$

   (b) $(B \cap A) \cup C =$

   (c) $B^C =$

   (d) True or False $\emptyset \in A$

   (e) True or False $C \subseteq A$

2. Using these sets, answer the following questions:
   $U = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$
   $A = \{0, 2, 4, 6, 8\}$
   $B = \{3, 4, 5, 6, 7, 8\}$
   $C = \{0, 2, 9\}$
   $D = \{1, 2, 3, 4, 5, 8\}$
   $E = \{0, 2\}$

   (a) $(A \cup B)^C \cap D =$

   (b) $A \cap D \cap C =$

   (c) $A \cup (B \cap C^C) =$

   (d) $(D \cap A)^C \cap B =$

   (e) $A \cap B \cap E =$

   (f) $(A \cup D)^C =$

   (g) $(B \cap D^C)^C \cap A^C =$

   (h) $B \cap D^C =$

   (i) $B \cup D \cup C =$

   (j) Is $E \subseteq A$?

   (k) Is $\emptyset \in A$?

   (l) Is $4 \subseteq A$?

   (m) How many subsets does A have?

   (n) How many proper subsets does D have?

   (o) Are C and B disjoint sets?

   (p) Are A and D disjoint sets?

3. List all the subsets of $\{m, n, p\}$.

4. List all the proper subsets of $\{m, n, p\}$.

5. Shade the part of the Venn diagram that is represented by

   (a) $A \cap B \cap C$

   (b) $(A^C \cap B) \cup C$

   (c) $(A \cup B) \cap C^C$

   (d) $B \cap C^C$

   (e) $A \cap (B \cup C^C)$

   (f) $A \cap B^C \cap C^C$

   (g) $A^C \cap (B^C \cup C^C)$

   (h) $(A \cap B^C) \cup (B \cap C)$

6. Let U denote the set of all students in the business college. Let

   $A = \{x \in U \mid x \text{ had a course in Accounting}\}$
   $E = \{x \in U \mid x \text{ had a course in Economics}\}$
   $M = \{x \in U \mid x \text{ had a course in Marketing}\}$

   Write the set (using the set notation of $\cap$, $\cup$, and ^{C}) that represents each of the given statements.

   (a) The set of students who have had none of these courses.

   (b) The set of students who have had courses in Economics or Marketing but not Accounting.

   Write a sentence that describes the set.

   (c) $A \cap E^C$

   (d) $(M \cap A^C) \cup E$

7. Let U denote the set of all students at A&M. Let
   D= $\{x \in U \mid \text{x has a dog as a pet}\}$
   C= $\{x \in U \mid \text{x has a cat as a pet}\}$
   F= $\{x \in U \mid \text{x has a fish as a pet}\}$

   Write the set (using the set notation of $\cap$, $\cup$, and ^{C}) that represents each of the given statements.

   (a) The set of all students who have a dog or a cat as a pet but not a fish.

   (b) The set of all students who only have a dog as a pet.

Section 6.2

8. If $n(A) = 14$, $n(A \cup B) = 18$, and $n(B) = 10$, find the following

   (a) How many subsets does the set A have?

   (b) $n(A \cap B) =$

   (c) $n(A \cap B^C) =$

9. Suppose $n(A \cap B) = 7$, $n(B) = 12$, and $n(A) = 15$. What is $n(A \cup B)$?

10. Suppose $n(A \cap B) = 7$, $n(A \cup B) = 25$, and $n(A) = 15$. What is $n(B)$?

11. Fill in a Venn Diagram with this information

    A group of sports fans were asked which of the three sports they like to watch: Football, Basketball, or

Hockey. Fill in the venn diagram so that it will represent this data.

8 said they watch none of these sports.
15 said they watch all of these.
20 said they watch basketball and hockey.
23 said they only watch basketball and football.
25 said they watch football and hockey.
35 said they watch basketball but not hockey.
75 said they watch football.
44 said they watch football or hockey but not basketball.

Additional Venn Diagrams with streaming video solutions can be found on the handout section of the class web page.

12. You hired a student to conduct a marketing survey. You are interested in which of these products: A, B and C, that people buy. The student ticked off in the fact that you are not paying very much for this job and decided to be creative in reporting the results.

    42 people buy at most one of these products.
    25 people buy only product C.
    38 people buy products A and B.
    66 people buy product A.
    15 people buy all three products.
    18 people buy only product A and C.
    30 people buy product B but don't buy product C.
    77 people buy at least 2 of the products.

    (a) How many people were in the survey?
    (b) How many people bought exactly two of the products?
    (c) How many people bought products A and B but not product C?
    (d) $n(C \cap A^C) =$

**For problems 13 − 15, use the given Venn diagrams to answer the questions.**

13. The Venn diagram represents the number of children who were asked which of these cartoons they watched: Animaniacs(A), Tiny Toons(T), and Pinky & the Brain(P).
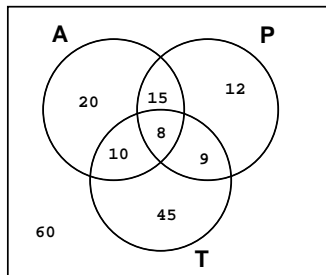
   (a) How many children watch Animaniacs or Pinky & the Brain?

    (b) How many children watch Tiny Toons and Animaniacs but not Pinky & the Brain?
    (c) How many of the children watch at most two of these cartoons?
    (d) $n(T^C \cap P) =$

14. A group of people were surveyed on which of these three sports they watched on Tv: Hockey (H), Baseball (B), and/or Tennis (T).
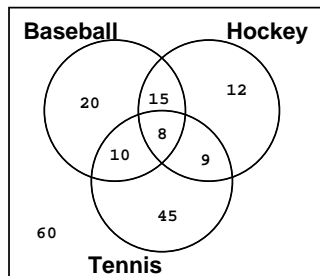
    (a) How many people watched only one of these sports?
    (b) How many people watched Hockey or Tennis?
    (c) $n((B \cap T)^C \cap H) =$
    (d) $n((B \cup H)^C) =$

15. The results of a survey are broken down and represented in the form of a venn diagram. The numbers represent the number of positive responses for that region.
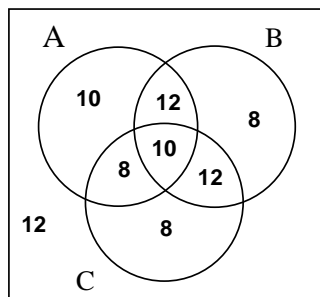
    Use this information to find the following.

    (a) $n((A \cup B) \cap C) =$
    (b) $n(A^C \cup B) =$
    (c) $n((A \cap B)^C \cap C) =$

Section 6.3

16. An automobile dealer offers five models. Each model comes in a choice of four colors, three types of stereo equipment, and with or without air conditioning. In how many different ways can a customer order an auto from this dealer?

17. A license plate consists of three letters followed by two digits. How many different license plates are possible if the letters must be different and all of the digits are even?

18. How many different four digit numbers are there that are odd and greater than 6000?

19. How many five digit numbers are multiples of five and greater than 29,999?

20. An exam consists of 6 true/false questions and 5 multiple choice questions, each with 4 possible answers. How many ways can the exam be worked if each question is answered?

21. An exam consists of 15 multiple choice questions. The first nine questions each have 4 choices and the last 6 questions each have 6 choices. How many ways can the answer sheet be turned in if students are allowed to leave questions blank?

22. How many three-letter identification codes can be constructed from the first 15 letters of the alphabet if the first letter must be a B, a C, or a D and no letters may occur more than once.

23. Five boys and 4 girls are to be seated in a row that has 9 seats.

    (a) How many ways can this be done if they alternate seats?

    (b) How many ways can this be done if the girls sit together?

24. How many ways can 7 boys and 4 girls be placed in a row and have them alternate seats?

25. Susan, Sara, Jill, Fred, Jim, Jacob, and Randy sit in a row with Jacob or Fred in the middle seat and Randy sitting next to Susan. How many ways can this be done?

26. A license plate in the metropolis Metropolitan Area consists of two letters and then two digits followed by either a bat logo or an S. The two letters must be different and neither digit is permitted to be a zero. How many different license plates are possible?

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28. Serial numbers assigned to a bicycle by a manufacture have a first symbol of J, H, or T to indicate the plant in which made, followed by 01, 02, 03,..., or 12 to indicate the month in which made, followed by four digits. How many different serial numbers are possible?

29. In how many ways can you get a license plate consisting of three letters and two digits in any order with no digit or letter repeated?

30. You have 11 different books to place on a shelf. Four of the books are blue, 5 are green and 2 are red. In how many ways can all of the books be arranged on a shelf if books of the same color are to be placed together?

31. You have 3 different books written by Tom Clancy, 2 different books written by Zane Gray, 6 different books by R.A. Salvatore, and 5 different books written by Jim Butcher. How many ways can you arrange the books on a shelf if the books are grouped by author?

32. A carnival has a game where you roll three dice: one red, one green, and one blue. A player will win money if one or more fives are rolled. How many ways can somebody win at this game?

33. A yellow and black six-sided die are added to the game in problem 32. Now how many ways can somebody win at the game?

34. Four people are asked to write down an integer between 1 and 13 inclusive. How many ways can exactly 2 of the people pick an even number?

35. How many 4 symbol computer codes can be made using the letters **A, B, E, G, H, I, J,** and **K** if the code has to have at least one vowel? An example of a valid code is **ABBA**.

36. For a group of four people. How many ways can two of the people have the same birthday and everybody else have a different birthday?

37. A club is comprised of 6 guys and 9 girls. How many different photos can be made that consist of 5 club members in a row with the guys and girls alternate positions?

38. How many 3 digit numbers have at least one seven in them?

Additional problems covering the multiplication principle with streaming video solutions can be found in Counting Handout #1 located in the extra handout section on the class web page.

Section 6.4

39. Compute the following.

    (a) $C(4,2)C(48,3)+C(4,3)C(48,2)+C(4,4)C(48,1) =$

    (b) $C(52,5) - [C(4,0)C(48,5) + C(4,1)C(48,4)] =$

    (c) $\dfrac{10!}{3!4!2!} =$

    (d) $C(5,3)P(6,3) =$

    (e) $13C(4,3) * 12C(4,2) =$

    (f) $\dfrac{7^3 - 7}{7^3} =$

    (g) $\dfrac{C(12,8)C(13,2) + C(12,9)C(13,1) + C(12,10)}{C(25,10)} =$

    (h) $C(450,1) =$

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(i) $P(450, 1) =$

(j) $C(450, 0) =$

(k) $P(450, 0) =$

(l) $4!C(5, 2)P(5, 3) =$

40. From a pool of 7 secretaries, three are selected to be assigned to 3 managers, one per manager. In how many ways can they be selected and assigned?

41. How many 6 card hands are possible that have exactly two hearts and exactly three spades?

42. Five freshmen, four sophomores, and two juniors are present at a meeting of students. In how many ways can a six-member committee that contains three freshmen and two sophomores be formed?

43. A child has a set of plastic objects. There are 2 pyramids (all identical), 3 cubes (all identical), and 6 spheres (all identical). How many ways can the child place all of the objects in a row.

44. A company has five vacancies in its executive trainee program. In how many ways can the company select five trainees from a group of ten female and eight male applicants if the vacancies must be filled by two women and three men?

45. Codes to identify entries in a computer file are formed by using sequences of four zeros and six ones. How many such sequences are possible?

46. A prize committee is awarding prizes to 7 different people. In how many ways can 3 different prizes be awarded so that no person can win more than two prizes?

47. The Scholarship Committee needs to select a recipient for each of 4 different scholarships from a pool of 15 applicants. How many ways can the scholarships be awarded to the applicants, if no applicant can win more than one scholarship?

48. How many 6-person committees are possible from a group of 12 people if:

(a) Jim, Susan, and Mary must be on the committee?

(b) Only one of the group of Jim, Susan, or Mary must be on the committee?

49. How many different ways can the letters of the work **BOOKKEEPER** be arranged?

50. How many different ways can I rearrange the letters of the word **Millimicron**?

51. A box contains 2 red, 5 green and 7 black balls. A sample of three balls is to be picked from the box. In how many ways can a sample be selected so that

(a) Exactly two of the balls are the same color?

(b) At least 2 of the balls will be green?

52. From a shipment of 60 transistors, 10 of which are defective, a sample of 7 is selected at random.

(a) How many samples contain 4 defective transistors?

(b) How many samples contain at most 6 defective transistors?

53. A box has 5 red balls, 6 green balls, and 4 purple balls. A sample of 6 balls is selected.

(a) In how many ways can you get at least 3 red and at least 1 purple?

(b) In how many ways can you get exactly 2 red or exactly 3 purple?

54. Two freshmen, 5 sophomores and 12 juniors all apply to attend a national conference. If three of these students are selected to attend the conference, how many ways can

(a) All the students have the same classification.

(b) More freshmen than juniors are selected.

55. A student taking an examination is required to answer 10 out of 15 questions. In how many ways can the 10 questions be selected if exactly 2 of the first 3 questions must be answered?

56. A child has three pennies, five nickels, and four dimes. In how many ways can two coins of the same denomination be selected?

57. David is selecting 10 kids from a group of 30 kids to form a summer basketball team. The group of 30 kids is made up of 9 thirteen-year-olds, 13 fourteen-year-olds, and 8 fifteen-year-olds.

(a) In how many ways can any of the 10 kids be selected?

(b) In how many ways can the 10 kids be selected if due to league rules a team has to have exactly 3 kids that are fifteen-years-old?

58. A box contains 7 red, 6 green, 5 black, and 3 purple balls. How many ways can a sample of 7 balls be selected that contains only three red and only 2 black?

59. A box contains 7 red, 4 green, 5 black, and 2 purple balls. How many ways can a sample of 4 be selected such that

(a) All the same color.

(b) Exactly three of the balls the same color.

60. A fruit stand has 30 apples, 14 peaches, 6 plums, and 15 pears. If you buy 7 pieces of fruit,

(a) How many ways can you select exactly 2 apple and exactly 4 peaches?

(b) How many ways can you select exactly 4 plums or exactly 3 pears?

61. Billy has 43 baseball cards and Scottie has 36. How many ways can Billy trade three of his cards for three of Scottie's cards?

62. A box contains 10 green, 7 yellow, and 5 pink balls. How many ways can a sample of 4 balls be selected that contains at least two yellow balls?

63. Your chemistry exam is going to be 20 questions. Your prof, in a fit of kindness, tells you that 7 of the questions have the answer A, 2 of the questions have the answer B, four of the questions have the answer C, six of the questions have the answer D and one question has the answer E. Using this information, how many ways can you answer the exam?

64. How many 6 card hands have exactly 2 hearts or exactly 3 spades?

65. You have 10 blocks that are identical except for their color. Six of them are red and 4 are green. You also have 15 identical sheets of notebook paper. You want to place the sheets of paper in a row and put the blocks on the sheets of paper such no piece of paper has more than one block. How many ways can this be done?

66. An exam is written so that it has 3 parts. The number of questions in each part is in the table.

	Part A	Part B	Part C
number of questions	5	6	4

The prof has stipulated that you must answer exactly 3 questions from part A and at least 4 questions from part B. In how many ways can you select 10 questions to answer.

See counting handout #2 and counting handout #3, found in the extra handout section on the class web page, for additional counting problems. Also has streaming video solutions.