Department of Mathematics
University of Notre Dame
Math 10120 – Finite Math.
Spring 2013

Name:_____

Instructor: David Galvin

Exam I

February 7, 2013

This exam is in two parts on 12 pages and contains 15 problems worth a total of 100 points. You have 1 hour and 15 minutes to work on it. You **may** use a calculator, but **no** books, notes, or other aid is allowed. Be sure to write your name on this title page and put your initials at the top of every page in case pages become detached.

Record your answers to the multiple choice problems on this page. Place an × through your answer to each problem.

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May the odds be ever in your favor!

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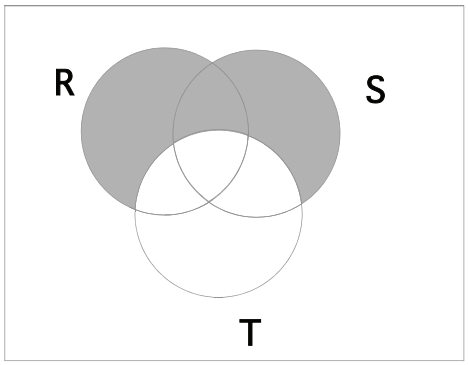
Multiple Choice

1. (5 pts.) Let $U = \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20\}$, $A = \{2, 4, 6, 8, 10\}$, $B = \{4, 8, 12, 16, 20\}$ and $C = \{8, 10, 12, 14, 16\}$. Which of these sets is equal to $(A \cup B')' \cap C$?

(a) $\{12, 16\}$ (b) $\{8, 10, 12, 16\}$ (c) $\{8\}$

(d) $\emptyset$ (e) $\{10\}$

2. (5 pts.) Which region of the Venn diagram below is shaded?



(a) $R \cap S$ (b) $(R \cap S) \cup T'$ (c) $(R \cap S) \cup T'$

(d) $(R \cup S) \cap T'$ (e) $(R' \cup S')' \cap T'$

3. (5 pts.) R and S are subsets of a certain universal set U. If

$$n(R) = 20,\ n(S) = 18,\ n((S \cup R)') = 5 \text{ and } n(U) = 35,$$

how many elements does $S \cap R$ have?

(a) 33 (b) 8 (c) 15 (d) 13 (e) 3

4. (5 pts.) Out of 56 Notre Dame First Years who responded to a survey, 25 were registered in a language class, 15 in a science class, and 20 in a philosophy class. 10 were registered in both a language class and a science class, 5 in both a science and a philosophy class, and 7 in a language and a philosophy class. Three people were registered in all three. How many of the respondents were enrolled in **exactly one** of these types of classes?

(a) 15 (b) 25 (c) 13 (d) 0 (e) 41

5. (5 pts.) A club consisting of ten men and twelve women decide to make a brochure to attract new members. On the cover of the brochure, they want to have a picture of two men and two women from the club. How many pictures are possible (taking into account the order in which the four people line up for the picture)? [Note: there are at least two ways to do this, so if you don't see your answer in terms of C's and P's, compute the numerical value to see which option it matches.]

(a) $P(22,4) \cdot 2! \cdot 2! = 702,240$

(b) $P(10,2) \cdot P(12,2) = 11,880$

(c) $C(10,2) \cdot C(12,2) \cdot 4! = 71,280$

(d) $[C(10,2) + C(12,2)] \cdot 4! = 2,664$

(e) $P(10,2) \cdot P(12,2) \cdot 4! = 285,120$

6. (5 pts.) How many four-letter words (including nonsense words) can be made from the letters of the word

$$EXAMINATION$$

if the letters that you use in the word cannot be repeated?

(a) 11^4 (b) 8^4 (c) $\frac{8 \cdot 7 \cdot 6 \cdot 5}{4 \cdot 3 \cdot 2 \cdot 1}$ (d) $\frac{11 \cdot 10 \cdot 9 \cdot 8}{4 \cdot 3 \cdot 2 \cdot 1}$ (e) $8 \cdot 7 \cdot 6 \cdot 5$

7. (5 pts.) To order a pizza, you have to first choose a style (from among classic, thin crust or deep dish), a sauce (from among red, white and barbecue) and then choose toppings (from among mushroom, pepperoni, sausage, green pepper, artichoke and seaweed). If you are required to choose **at least one** topping, how many different pizzas can you create?

(a) 576 (b) 573 (c) 383 (d) 378 (e) 567

8. (5 pts.) My bicycle lock uses a four-digit combination, each digit being between 0 and 9. At the moment I cannot remember the actual number, but I do remember that it either starts with a 9, or ends with 65 (in that order), or perhaps both. How many such four-digit numbers are there? (Remember that a number may start with a zero).

(a) 990 (b) 1090 (c) 1100 (d) 9997 (e) 9066

9. (5 pts.) A partially eaten bag of M&M's contains 15 candies. 7 of them are red, 6 are white and 2 are blue. A sample of 4 M&M's is to be selected. How many such samples contain more blue M&M's than white?

(a) 435 (b) 84 (c) 42

(d) 133 (e) 1365

10. (5 pts.) There are 100 Senators in the U.S. Senate, two from each of the 50 states. A committee of six Senators is to be formed, such that no two are from the same state. In how many ways can this be done?

(a) $\frac{C(100,6)}{50}$ (b) $C(50,6) \cdot 6^2$ (c) $C(50,6) \cdot 2^6$

(d) $C(100,6) - 2^6$ (e) $C(50,6) \cdot 2^{50}$

Partial Credit

You must show **all of your work** on the partial credit problems to receive credit! Make sure that your answer is clearly indicated. You're more likely to get partial credit for a wrong answer if you explain your reasoning.

11. (10 pts.) A family has nine chihuahuas and four dalmatians (yikes!). Answer the following questions; if your answer involves a $C(n, r)$ or $P(n, r)$ or $r!$, you must calculate the actual value numerically for full credit.

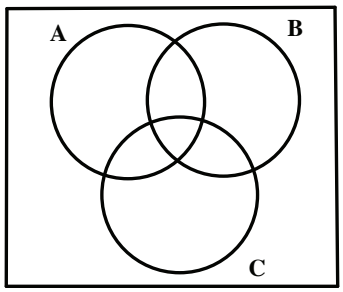
(a) In how many ways can the 13 dogs be fed in the evening, one after the other, if all the dalmatians have to be fed before all the chihuahuas?

(b) In how many ways can the family pick either three chihuahuas or three dalmatians to take on a walk?

(c) Three dogs are allowed on the bed each night; at least two of them must be chihuahuas. How many different ways can these three lucky dogs be selected?

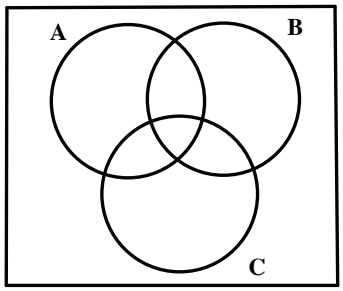
12. (10 pts.) Shade **ONLY** the appropriate regions in the diagrams below:

(a)



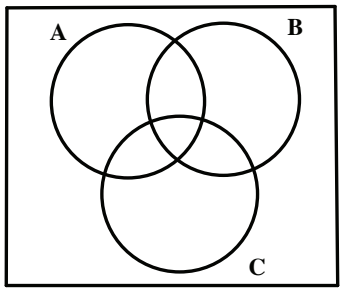
$(A \cap B) \cup C'$

(b)



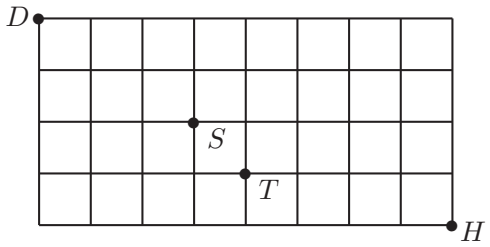
$(A' \cup B) \cap C$

(c)



$C \cap A'$

13. (10 pts.) Both parts of this problem refer to the following city map, where I have marked the houses of David (D), Harry (H), Sam (S) and Terri (T). For this problem, you may leave your answer in terms of mixtures of combinations and permutations (i.e. $C(n, r)$ and $P(n, r)$ for appropriate n and r) if you choose.



(a) In how many ways can David walk from his house (D) to Harry's house (H), in as few blocks as possible (12)? (Ignore "S" and "T" at this point.)

(b) Harry wants to walk from his house (H) to David's (D), but on the way he has to visit either Terri's house (T) or Sam's house (S) to pick something up (he doesn't mind if his route takes him past both S and T). In how many ways can he make this trip in as few blocks as possible (12)?

14. (10 pts.) Remember that a poker hand consists of a sample of 5 cards drawn from a deck of 52 cards. The deck consists of four suits (hearts, clubs, spades, diamonds), and within each suit there are 13 denominations: ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, jack, queen, king (so in total there are four cards of each denomination, one from each suit). The order of the cards within the hand doesn't matter. For this problem, you may leave your answer in terms of mixtures of combinations and permutations (i.e. $C(n, r)$ and $P(n, r)$ for appropriate n and r) if you choose.

(a) How many poker hands are there that only include jacks, queens and kings?

(b) How many poker hands are there that consist of three queens and two sevens?

(c) 3-of-a-kind is a poker hand that includes three cards of one particular denomination and two other cards of different denominations (so three queens, one seven and one ace is an example of 3-of-a-kind, but three queens and two sevens is not). How many different 3-of-a-kind poker hands are there?

15. (10 pts.) Six married couples are going to be in a group picture, all lined up in a row. For each of these parts, you can give your answer using either $C(n, r)$, $P(n, r)$ or factorial notation, or you can give a numerical answer.

(a) In how many ways can the 12 people line up?

(b) In how many ways can they line up if everyone has to be standing next to their spouse?

(c) In how many ways can they line up if everyone has to be standing next to their spouse, with **EITHER** each husband always to the right of his wife **OR** each husband always to the left of his wife?

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