Department of Mathematics
University of Notre Dame
Math 10120 – Finite Math.
Spring 2014

Name:________________________________

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Exam I

February 6, 2014

This exam is in two parts on 11 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 $\times$ through your answer to each problem.

The partial credit problems should be answered on the page where the problem is given. The spaces on the bottom right part of this page are for me to record your grades, **not** for you to write your answers.

May the odds be ever in your favor!

1.	(a)	(b)	(c)	(d)	(e)
2.	(a)	(b)	(c)	(d)	(e)
3.	(a)	(b)	(c)	(d)	(e)
4.	(a)	(b)	(c)	(d)	(e)
5.	(a)	(b)	(c)	(d)	(e)
6.	(a)	(b)	(c)	(d)	(e)
7.	(a)	(b)	(c)	(d)	(e)
8.	(a)	(b)	(c)	(d)	(e)
9.	(a)	(b)	(c)	(d)	(e)
10.	(a)	(b)	(c)	(d)	(e)

MC.	________
11.	________
12.	________
13.	________
14.	________
15.	________
Tot.	________

Multiple Choice

1. (4 pts.) Let

$$A = \{x|x \text{ is a whole number between 2 and 10}\}$$

and

$$B = \{x|x \text{ is an even whole number bigger than 2 and less than 10}\}.$$

Which statement is **false**?

(a) $A \cap B = \{4, 6, 8\}$

(b) $B \subseteq A$

(c) $n(A \cup B) = 9$

(d) A and B are disjoint

(e) A has more elements than B

2. (4 pts.) Let A and B be sets such that $n(A) = 16$, $n(B) = 23$ and $n(A \cup B) = 32$. What is $n(A \cap B)$?

(a) 71

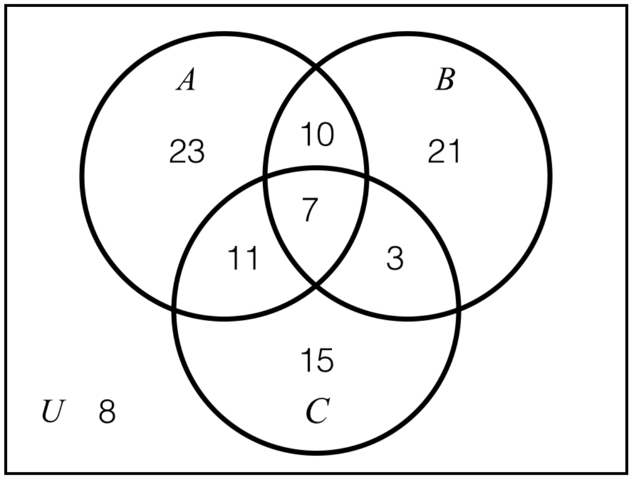
(b) 39

(c) 7

(d) 9

(e) 16

3. (4 pts.) Let A, B, C be sets in some universe set U. The Venn diagram below shows the number of elements in each region of the diagram. What is $n(A \cap (B \cup C)')$?



(a) 23 (b) 28 (c) 7

(d) 44 (e) 31

4. (4 pts.) The FCC (Federal Communications Commission) wants to issue a unique code, consisting of a string of k letters (a through z) and numbers (0 through 9), to each of 65, 000, 000 devices. What's the smallest choice of k that makes this possible?

(a) 7 (b) 4 (c) 6 (d) 3 (e) 5

5. (4 pts.) Compute $P(21, 5) \cdot 3!$.

(a) 14,651,280 (b) 2,441,880 (c) 7,325,640 (d) 61,047 (e) 122,094

6. (4 pts.) A deli offers 4 different types of bread, 5 types of meat and 8 types of vegetables. I want a sandwich that has bread, one meat and two vegetables. How many options do I have?

(a) 1120 (b) 1280 (c) 24 (d) 560 (e) 160

7. (4 pts.) Mario the plumber receives 10 calls from residents of South Bend, concerning burst pipes. He has resources to deal with at most three of the calls. In how many ways can he choose at most three calls to deal with, if the order in which he responds to the calls matters? [Note: he might choose to respond to 0 of the calls].

(a) 176 (b) 120 (c) 720 (d) 821 (e) 721

8. (4 pts.) A student council committee has 7 reps from Carroll Hall, 6 reps Badin Hall and 10 from Pasquerilla East Hall. In how many ways can a sub-committee of three reps be formed, if all three must be from the same hall?

(a) $P(7,3)P(6,3)P(10,3)$

(b) $C(23,3)3!$

(c) $C(7,3)C(6,3)C(10,3)$

(d) $P(7,3)+P(6,3)+P(10,3)$

(e) $C(7,3)+C(6,3)+C(10,3)$

9. (4 pts.) My Combinatorics class has 9 students. I have three different final projects in mind for the class. In how many ways can I split the class into 3 groups of three people each, assigning one group to do the first project, one to do the second, and one to do the third, and choose a group leader for each group?

(a) $3\frac{9!}{3!3!3!}$ (b) $\binom{9}{3,3,3}3^3$ (c) $\frac{9!}{3!3!3!}$ (d) $\frac{1}{3!}\binom{9}{3,3,3}$ (e) $\binom{9}{3,3,3}3!$

10. (4 pts.) There are 14 men and 9 women in the Jackson family and 12 men and 18 women in the Jones family. If during a charity event, every woman shakes hands with all other women and every man shakes hands with all other men, how many handshakes take place?

(a) $P(27,2)+P(26,2)$ (b) $C(27,2)\cdot C(26,2)$ (c) $C(27,2)+C(26,2)$

(d) $P(27,2)\cdot P(26,2)$ (e) $14\cdot 12+9\cdot 18$

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. (12 pts.) A Notre Dame club has 53 students, of which 18 are juniors, 14 sophomores and 21 freshmen.

(a) In how many ways can you choose a committee of 4 people?

(b) If there has to be exactly 2 juniors, in how many ways can you choose the committee?

(c) If I need to have at least one representative from each class, this is, at least one junior, at least one sophomore and at least one freshman, in how many ways can you choose the committee? 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.

12. (12 pts.) The following three yes/no questions were posed to a class of 68 students in a survey:

- (i) Do You like rap music?
- (ii) Do You like classical music?
- (iii) Do You like 80's music?

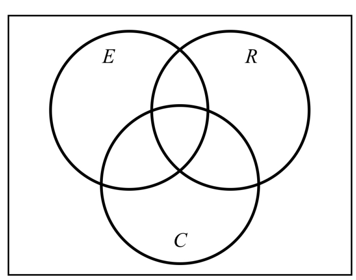
The results showed that 44 liked rap music, 47 liked classical music and 55 liked 80's music. Nineteen students liked all three types of music, 7 liked rap and classical but not 80's, 19 liked classical and 80's but not rap, and 15 liked rap and 80's but not classical.

(a) Present the data given above on a Venn diagram, where R denotes the set of students who like rap, C denotes the set of students who like classical and E denotes the set of students who like 80's music.

(b) How many students don't like any of the above music types?

(c) If a student is in the set $E \cap (R \cup C)'$, what answers did they give to questions (i), (ii) and (iii)?

(d) Shade in the part of the Venn diagram on the right that corresponds to those students who answered "yes" to question (i) and "no" to question (ii).



13. (12 pts.) My after-hours access code for the Hayes-Healy building consists of 5 letters, to be entered in a particular order. I've forgotten the code, but I do remember that it only uses letters from the phrase "ACCESS CODE" (so it might have two S's, but no more, and it can have at most one A, etc.).

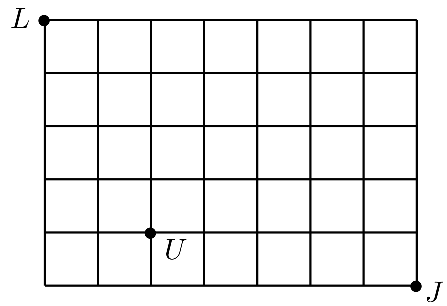
(a) If I also remember that the code has no repeated letters, how many possible codes are there?

(b) If instead I remember that the code has two C's, and no other repeated letters, how many possible codes are there?

(c) If I remember that the code has no repeated letters, and that it begins and ends with a vowel, how many possible codes are there?

(d) If I remember that the code has no repeated letters, that it begins and ends with a vowel, and that all the remaining letters are consonants, how many possible codes are there?

14. (12 pts.) All parts of this problem refer to the following city map, where I have marked the local university (U) and the houses of Luis (L) and John (J). 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 Luis walk from his house (L) to the university (U), in as few blocks as possible (6)? (Ignore "J" at this point.)

(b) In how many ways can Luis walk from his house (L) to John's house (J) stopping first at the university (U), in as few blocks as possible (12)?

(c) In how many ways can Luis walk from his house (L) to John's house (J) **without** passing by the university (U), in as few blocks as possible (12)?

15. (12 pts.) 16 teams enter a basketball tournament. In the first round, the teams are paired off in 8 pairs to play each other.

(a) How many different pairings are possible if neither the order of the pairings nor the order of teams within each pairing matters?

(b) Assume that in each matchup, one team is assigned to be the home team and the other is assigned to be the away team (this is, the order within each pairing matters). How many different pairings are possible if the order of the pairings does not matter?