

Student's Name : _____

Univ. NetID : _____

CS 173
Spring 2001
Professor L. Pitt

First Exam
Thursday, March 01, 2001
FORM A

Read the following instructions before you start to work.

- Write your name and university NetID on top of this page and your NetID at the top of each page.
- Fill in the administrative portion of your bubble sheet.
- This includes LAST NAME, FIRST NAME INITIAL, NETID, AND TEST FORM
- MAKE ABSOLUTELY SURE YOU DARKEN THE PROPER TEST FORM (A-F)
- This is a closed book exam. No notes of any kind are allowed.
- Do all work in the space provided. See the proctor if you need more paper.
- This exam has 6 pages and 5 sections.
- Mark your responses on your bubble sheet. Only the bubble sheet will be used for grading.
- The test is designed for 50 minutes, although you have up to 75.
- For this exam, \emptyset represents the emptyset, $P(A)$ represents the power set of A , and \mathbb{N} is the set of natural numbers.

Part A All about logic.

In each of the following sets of four items there is one item which does not match the others in some natural way. Once you have found the item which does not belong in the group, darken the corresponding answer on your bubble sheet. There is only one correct answer for each group of items.

1. (a) contrapositive of $a \rightarrow b$ (c) $\neg a \vee b$
 (b) converse of $a \rightarrow b$ (d) $\neg(a \wedge \neg b)$
2. (a) $(x \rightarrow y) \rightarrow z$ (c) $(x \vee \neg y) \vee z$
 (b) $(\neg x \vee y) \rightarrow z$ (d) $(x \vee z) \wedge (\neg y \vee z)$
3. (a) T (c) $(a \vee b) \wedge c$
 (b) $a \vee \neg a$ (d) $(a \wedge b) \rightarrow (a \vee z)$
4. Let $C(x)$ represent “ x is corrupt,” let $P(x)$ represent “ x is a politician,” and let $J(x)$ represent “ x goes to jail.”
 (a) $\forall x(C(x) \wedge P(x) \wedge J(x))$ (c) $\forall x(C(x) \wedge P(x)) \rightarrow J(x)$
 (b) Every corrupt politician goes to jail. (d) There is no politician who is corrupt and who doesn’t go to jail.

5. (a)

r	00	01	11	10
0	1	1	0	1
1	0	1	0	0

 (c) $\bar{p}\bar{r} + \bar{p}q + \bar{q}\bar{r}$
 (b) $\bar{p}\bar{q}\bar{r} + \bar{p}q\bar{r} + \bar{p}qr + p\bar{q}\bar{r}$ (d) $\bar{r} + \bar{p}qr$

Part B All about sets.

Fill in the blanks with the appropriate relationship chosen from the list below. Darken the spot on your answer sheet which corresponds to your selection. You should choose the relationship which *must* be true, not just one which *can* be true. There is only one correct answer for each problem. In these problems, the symbols A , B and C are arbitrary sets.

- (a) =
- (b) \subseteq
- (c) \supseteq
- (d) \in
- (e) none of (a) through (d)

6. $\{1\}$ _____ $\{x : x > 0\}$

7. A _____ $P(A)$

8. $\overline{(B - A)}$ _____ $(A - B)$

9. $A \cup (\overline{B} \cap C)$ _____ $(A \cup C) \cap (A \cup \overline{B})$

Part C All about counting.

Use the following information to answer questions 10 and 11. Select the correct response and mark it on your answer sheet.

A study of 115 people shows that 85 eat breakfast, 58 use dental floss regularly, and 27 subscribe to a morning newspaper. Among those who eat breakfast, 52 floss regularly and 15 get the morning paper. Further, 10 breakfast eaters both floss and get the paper. Finally, of the 115 people surveyed, 14 don't do any of the three morning activities.

10. How many eat breakfast, or floss regularly, or get the morning paper?
- (a) 101
 - (b) 115
 - (c) 125
 - (d) 170
11. How many of those who use dental floss regularly also get the morning paper?
- (a) 2
 - (b) 6
 - (c) 12
 - (d) 54

To answer problems 12 through 14, select the cardinality of the given set from the list below. Mark your answer sheet with the letter corresponding to your choice. There is only one correct answer for each problem.

- (a) finite
- (b) countably infinite
- (c) uncountably infinite

12. $\mathbb{N} \times \mathbb{N}$
13. $\{x : x \text{ is a circle in the plane}\}$
14. $\mathbb{N} - \{x \in \mathbb{N} : x^2 \geq 1024\}$

Part D All about functions.

In each of the problems below, we have defined f on \mathbb{N} (the set of natural numbers) in some way. Select the appropriate description for f from the list below, and mark the corresponding letter on your answer sheet. There is only one correct answer for each problem.

- (a) f is a function which is neither 1-to-1 nor onto.
- (b) f is a function which is 1-to-1 but not onto.
- (c) f is a function which is onto but not 1-to-1.
- (d) f is a function which is both 1-to-1 and onto.
- (e) f is not a function.

15. $f(n) = n^2$

16. $f(n) = \lfloor n/2 \rfloor$

17. $f(n) = \begin{cases} n & \text{if } n \text{ is even,} \\ n - 1 & \text{if } n \text{ is odd.} \end{cases}$

Part E Proof techniques.

Circle the appropriate response. Each question has only one correct answer.

18. Which of the following is sufficient to prove that all Martians love ice cream?
- (a) John is a Martian and John loves ice cream.
 - (b) There are no Martians.
 - (c) Everyone who loves ice cream is a Martian.
 - (d) No non-Martians love ice cream.
19. Which of the following is *not* sufficient to prove that movies are fun?
- (a) Everything is fun.
 - (b) Movies starting before 5pm are fun, and movies starting at 5pm or later are fun.
 - (c) If movies are fun, then volleyball is a thrill. Volleyball is a thrill.
 - (d) Movies are entertainment. Entertainment is fun.
20. Which of the following is sufficient to *disprove* that studying makes everyone brilliant?
- (a) No one studies.
 - (b) No one is brilliant.
 - (c) Pat studies but he's not brilliant.
 - (d) Vanna doesn't study but she's brilliant.