

Midterm #1, 10/5  
Math 181 (Discrete Structures), Fall 2022

Each problem is worth 10 points, for a total of 50 points. Remember to *show your work* and *explain your answers* on all problems!

1. In this problem, let the universal set be  $U = \{1, 2, 3, 4, 5\}$  and let  $A = \{1, 3, 4\}$ ,  $B = \{2, 4\}$ . Write the following sets:
  - (a)  $(A \cap B)^c$  (this is also written  $\overline{A \cap B}$  in the book)
  - (b)  $B \setminus A$  (this is also written  $B - A$  in the book)
  - (c)  $(A \setminus B) \cup (B \setminus A)$
2. Write truth tables for  $p \rightarrow q$  and  $q \vee \neg p$ . What does this tell you about the two propositions?
3. Convert this argument to a symbolic form, and determine (with explanation) if it is valid:  
Hypotheses: If I woke up early, then I'll go for a run. I do not go for a run.  
Conclusion: I did not wake up early.
4. Let  $P(x)$  be the propositional formula " $x^2 \geq 1$ ," where the domain of discourse is the set  $\mathbb{R}$  of all real numbers. Write the proposition " $\neg(\forall x P(x))$ " in English words, and determine (with explanation) if it is true or false.
5. Give a direct proof of the following theorem: "The product of an even integer and any integer is an even integer."