

國立中山大學 115 學年度 碩士班考試入學招生考試試題

科目名稱：離散數學【資工系碩士班甲組】

—作答注意事項—

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

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題號：434004

※本科目依簡章規定「不可以」使用計算機(問答申論題)

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Simple-Answer Questions

Write down simple answers in answer sheet, e.g. (A1) Answer. with one line for each Question-Answer pair.
7 points per question for a subtotal of 70 points.

- (A1) How many arrangements of the letters in ENGINEERING have no adjacent E's?
- (A2) How many triplets (x, y, z) satisfy $x + y + z = 10$ with $x, y, z \in \{1, 2, 3, 4, 5\}$?
- (A3) How many 3-digit numbers (i.e. from 100 to 999) are divisible by 3 or 5 or 7?
- (A4) What is the greatest common divisor of 1,066,601 and 343,033?
- (A5) Suppose a stone is allowed to move from a square to an adjacent square in the direction of Right, Up, or Right-and-Up. For example, from $(1, 1)$, it can move to $(1, 2)$, $(2, 1)$, or $(2, 2)$. Consider a board of 5×5 squares. What is the number of possible paths that the stone can move from lower-left corner $(1, 1)$ to upper-right corner $(5, 5)$?
- (A6) Let $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. What is the total number of 3-member subsets of S without consecutive integers, e.g. $\{1, 3, 5\}$ but not $\{1, 2, 8\}$?
- (A7) What is the smallest positive integer x such that $2^x \equiv 1 \pmod{13}$?
- (A8) Let $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. How many functions $f : A \rightarrow A$ satisfy $f^{-1}(\{1, 3\}) = \emptyset$, $f^{-1}(\{4, 6\}) = \{1, 3, 7\}$, and $f^{-1}(\{7, 9\}) = \{8, 9\}$ simultaneously?
- (A9) Let $\Sigma = \{a, b, x, y\}$ and $L = \bigcup_{k=1}^5 \Sigma^k$. How many strings in L have substring *bay*?
- (A10) Adam and Eve gamble with fair games. The winner takes 1 dollar from the loser in each game. Initially, each has 5 dollars. What is the expected number of games until the first time that one of them has no money left?

Computation Questions

Write down the answer and the inference/deduction process, e.g. (B1) Answer. Inference/deduction process. for each question attempted. 10 points per question for a subtotal of 30 points.

- (B1) A fair die has 6 faces $1, \dots, 6$. Find the probability that the sum of 5 throws of this die is 15.
- (B2) Let p, q, r be primitive statements. Construct the truth table for the statement

$$p \leftrightarrow [(q \wedge r) \rightarrow \neg(p \vee r)]$$

(Explanation is not required for this question.)

- (B3) (Proof question) In PleasantVille, every pair of people *either* know each other *or* are strangers. Adam, Bill, Chad, Dan, Elon, and Fred live in PleasantVille. In this group of 6 people, prove that there is a subgroup of 3 people such that *either* they totally know each other *or* they are totally strangers.