

NATIONAL UNIVERSITY OF SINGAPORE
CS1231S – DISCRETE STRUCTURES
 (Semester 2: AY2022/23)

Final Assessment Answer Sheet

Time Allowed: 2 Hours

INSTRUCTIONS

1. Write your **Student Number** on the right AND, using pen or pencil, shade the corresponding circle **completely** in the grid for each digit or letter. **DO NOT WRITE YOUR NAME!**
2. Zero mark will be given if you write/shade your Student Number incompletely or incorrectly.
3. Write your Student Number at the top of pages 3 and 5.
4. This answer sheet comprises **SIX (6) pages**.
5. All questions must be answered in the space provided; no extra sheets will be accepted as answers.
6. You must submit only this **ANSWER SHEET** and no other documents.
7. An excerpt of the question may be provided to aid you in answering in the correct box. It is not the exact question. You should still refer to the original question in the question paper.
8. You may write your answers using pencil (at least 2B) or pen as long as it is legible (no red ink, please).
9. The maximum mark for this paper is 100.
10. **Marks may be deducted** for (i) illegible handwriting, and/or (ii) excessively long explanations.
11. Each multiple choice question is intended to have only one answer. Shade the appropriate bubbles using pencil only.

STUDENT NUMBER										
	A									
U	<input type="radio"/>	0	0	0	0	0	0	0	A	N
A	<input checked="" type="radio"/>	1	1	1	1	1	1	1	B	R
HT	<input type="radio"/>	2	2	2	2	2	2	2	E	U
NT	<input type="radio"/>	3	3	3	3	3	3	3	H	W
		4	4	4	4	4	4	4	J	X
		5	5	5	5	5	5	5	L	Y
		6	6	6	6	6	6	6	M	
		7	7	7	7	7	7	7		
		8	8	8	8	8	8	8		
		9	9	9	9	9	9	9		

For Examiner's Use Only		
Question	Marks	Remarks
Q1-20	/ 40	
Q21	/ 5	
Q22	/ 20	
Q23	/ 20	
Q24	/ 9	
Q25	/ 6	
Total	/ 100	

Part A: Multiple Choice Questions (Total: 40 marks)Please shade only ONE bubble for each question. Please use ONLY pencil to shade.

- | | (A) | (B) | (C) | (D) | (E) |
|-------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 1. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 2. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
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| 5. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 6. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 7. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 8. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
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| 9. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 10. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 11. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 12. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <hr/> | | | | | |
| 13. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 14. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 15. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 16. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <hr/> | | | | | |
| 17. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 18. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 19. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 20. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| | (A) | (B) | (C) | (D) | (E) |

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Part B (Total: 60 marks)**21. Mathematical induction.** [5 marks]

1. For each $n \in \mathbb{N}$, let $P(n) \equiv (\text{Even}(F_n) \Leftrightarrow \text{Even}(F_{n+3}))$.

22. Graphs and trees. [20 marks]

(a) Which of C_4, S_4, W_4 are complete graphs? [1]

(b) Which of $C_{1231}, S_{1231}, W_{1231}$ are planar graphs? [1]

(c) C_{1231} has an Euler circuit. True or false? [2]

 W_{1231} has an Euler circuit. True or false?

(d) colours for C_5 ; colours for S_5 ; colours for W_5 . [3]

22. **Graphs and trees. (continue...)** [20 marks]

(e) All non-isomorphic spanning trees of C_5, S_5, W_5 .

[4]

(f) Possibility tree to determine the number of Hamiltonian paths in W_4 with initial vertex at v_1 .

[2]

(g) Number of unique open-loop Hamiltonian paths in W_4 :

[1]

(h) Length-2 walks from v_4 to v_2 :

; Length-3 walks from v_2 to v_4 :

[2]

(i) Height of binary tree is

[2]

(j) $\{V_1, V_2, \dots, V_k\}$ is always a partition of V . True or false?

[2]

 $\{E_1, E_2, \dots, E_k\}$ is always a partition of E . True or false?

23. Counting and probability. [20 marks]

(a) [1] <input style="width: 100%; height: 40px;" type="text"/>	(b) [2] <input style="width: 100%; height: 40px;" type="text"/>	(c) [2] <input style="width: 100%; height: 40px;" type="text"/>	(d) [2] <input style="width: 100%; height: 40px;" type="text"/>
(e) (i) [1] $c =$ <input style="width: 150px; height: 40px;" type="text"/>	(ii) [1] $P(X = 2) =$ <input style="width: 200px; height: 40px;" type="text"/>	(iii) [3] $E(X) =$ <input style="width: 500px; height: 40px;" type="text"/>	
(f) (i) $ S_{1v} $ [2] <input style="width: 350px; height: 40px;" type="text"/>		(ii) $ S_{2v} $ [2] <input style="width: 350px; height: 40px;" type="text"/>	
(f) (iii) $ S_{\geq 1v} $ [2] <input style="width: 350px; height: 40px;" type="text"/>		(iv) $ S_{\geq 2v} $ [2] <input style="width: 350px; height: 40px;" type="text"/>	

24. Relations and functions. [9 marks]

(a)
[4]

(b)
[2]

24. **Relations and functions. (continue...)** [9 marks]

(c)

[3] Order of $f =$; order of $g =$; order of $(f^{-1} \circ g) =$

25. **Cardinality.** [6 marks]

=== END OF PAPER ===