

Your Name: \_\_\_\_\_

Your ID: \_\_\_\_\_

# of Questions: 11

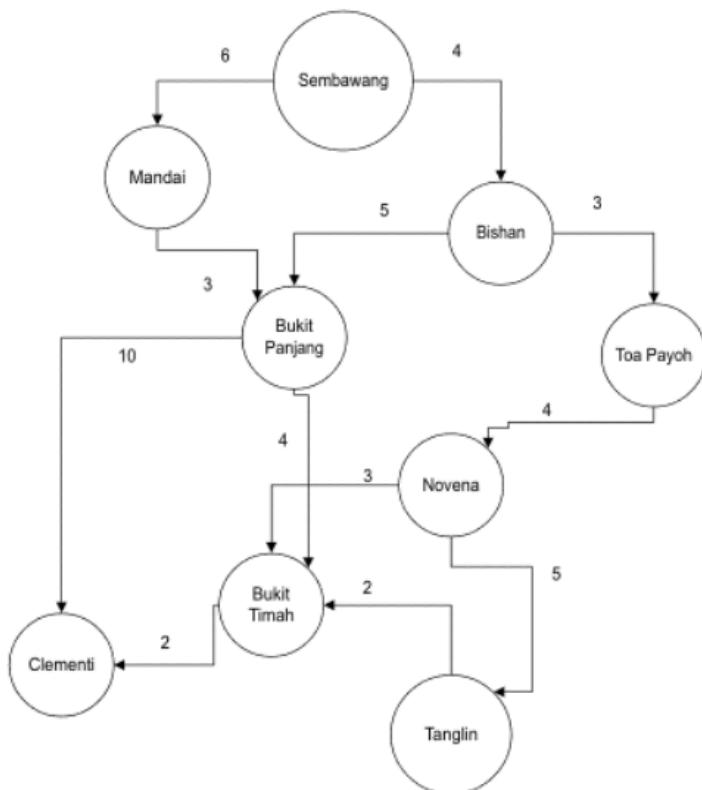
Date and Time of Exam Creation: Tue, May 02, 2023 @ 14:01:30

Total Exam Points: 88.00

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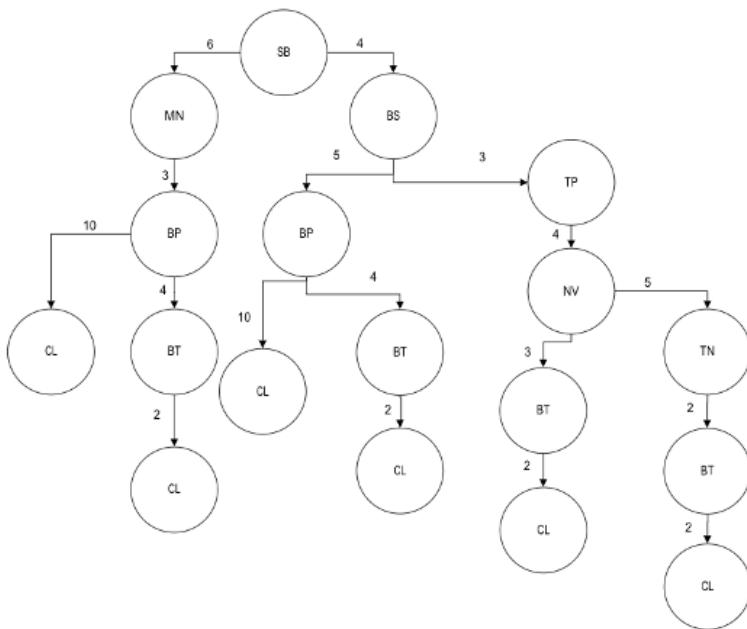
Question #: 1

We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



If we performed breadth first search (BFS), what is the sequence of towns visited? (8 marks)

Eight blanks are provided. Skip Sembawang (SB) (since all routes start from Sembawang), and fill one town name per blank using the two-letter abbreviations in CAPITALS. Fill “UN” for unused boxes, again in CAPITALS.

**If you fill your answers in any other ways it will be marked as incorrect. No partial credits will be awarded.**

Recall: Aiken wants to get from Sembawang to Clementi.

For example if the towns visited are Sembawang, Bishan, Bukit Timah and Clementi, fill in:

Blank 1: BS

Blank 2: BT

Blank 3 CL

Blanks 4 to 8: UN

Towns visited under BFS (skip Sembawang):

1. 1

2. 2

3. 3

4. 4

5. 5

6. 6

7. 7

8. 8

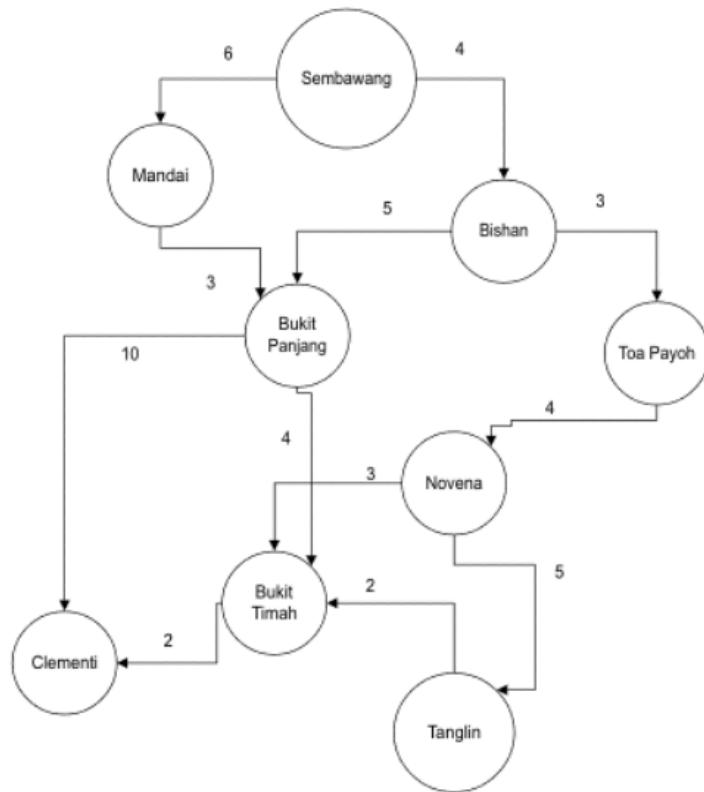
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_

**Item Weight:** 8.0

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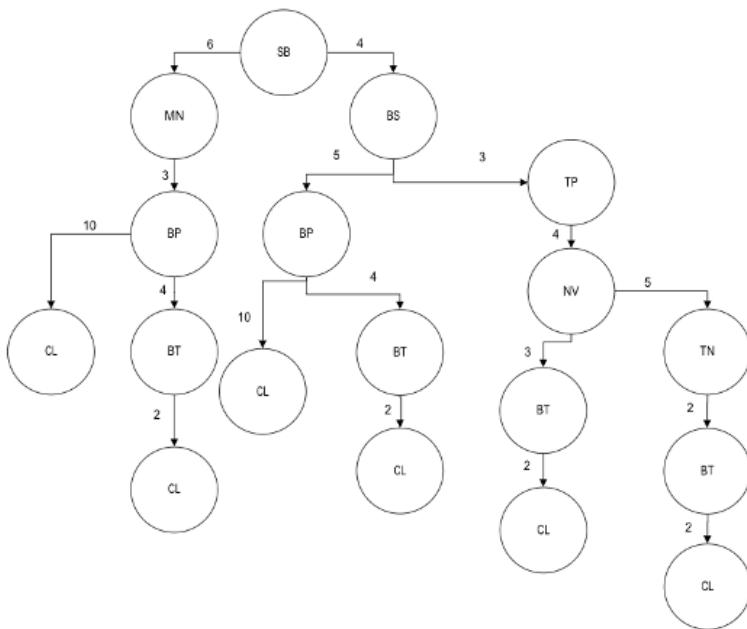
**Question #:** 2

We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



What is the total distance from Sembawang to Clementi with breadth first search (BFS)? Fill in only numbers. E.g. if the answer is 72 kilometers, just fill in 72. **Filling your answers in any other way will be marked as incorrect.**

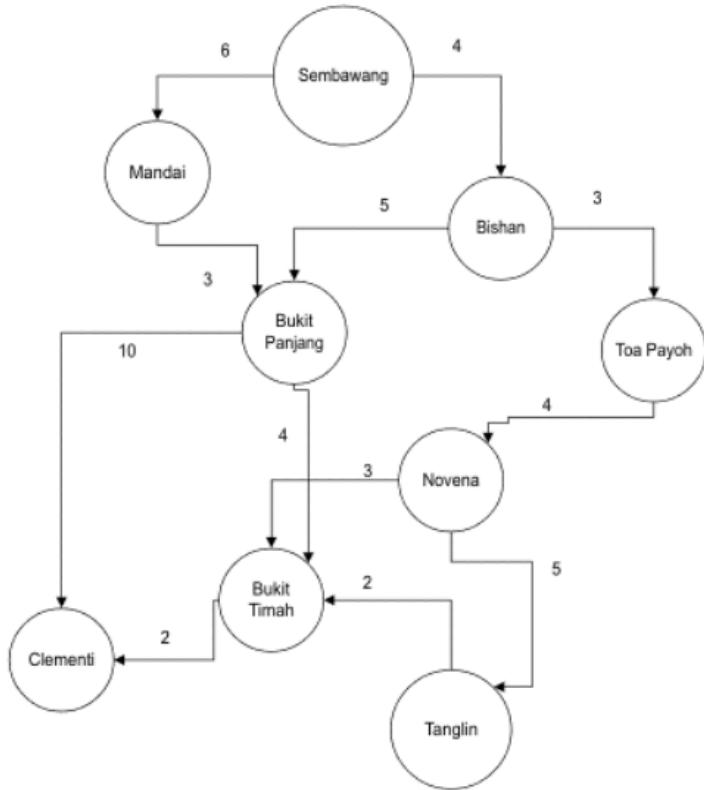
Total distance from Sembawang to Clementi under BFS: 1

1. \_\_\_\_\_

**Item Weight:** 2.0

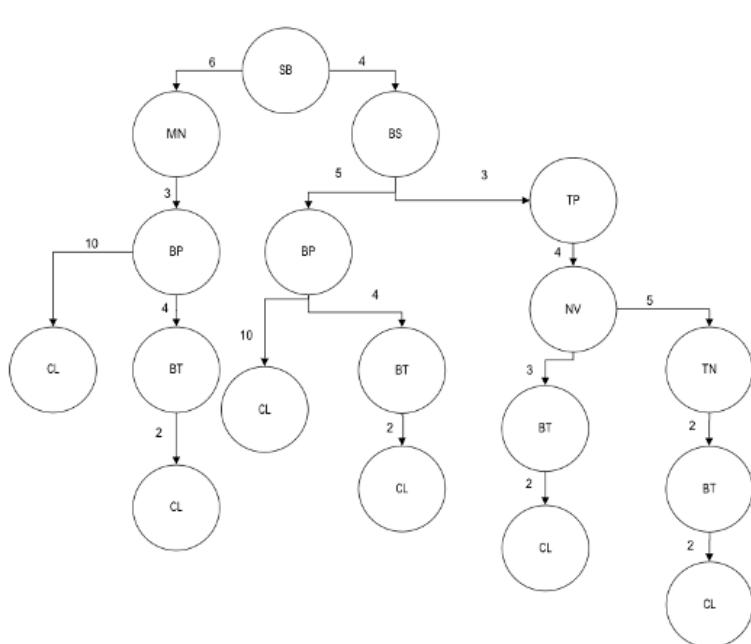
**Question #:** 3

We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



If we performed DEPTH first search (DFS), what is the sequence of towns visited? (8 marks)  
Eight blanks are provided. Skip Sembawang (SB) (since all routes start from Sembawang), and fill one town name per blank using the two-letter abbreviations in CAPITALS. Fill “UN” for unused boxes, again in CAPITALS.

**If you fill your answers in any other ways it will be marked as incorrect. No partial credits will be awarded.**

Recall: Aiken wants to get from Sembawang to Clementi.

For example if the towns visited are Sembawang, Bishan, Bukit Timah and Clementi, fill in:

Blank 1: BS

Blank 2: BT

Blank 3 CL

Blanks 4 to 8: UN

Sequence of towns visited under DFS (Skip Sembawang):

1.   1
2.   2
3.   3
4.   4
5.   5
6.   6
7.   7
8.   8

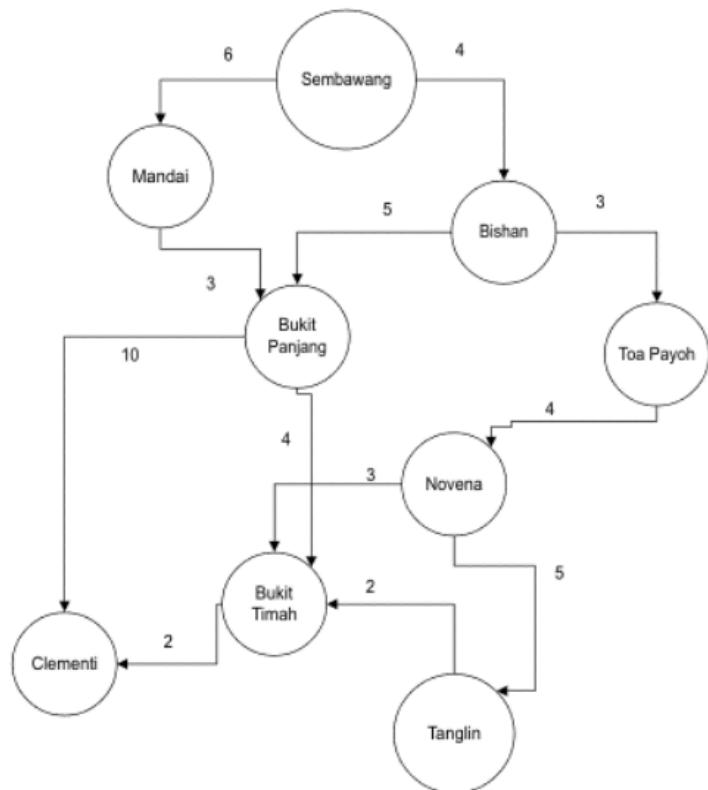
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_

**Item Weight:** 8.0

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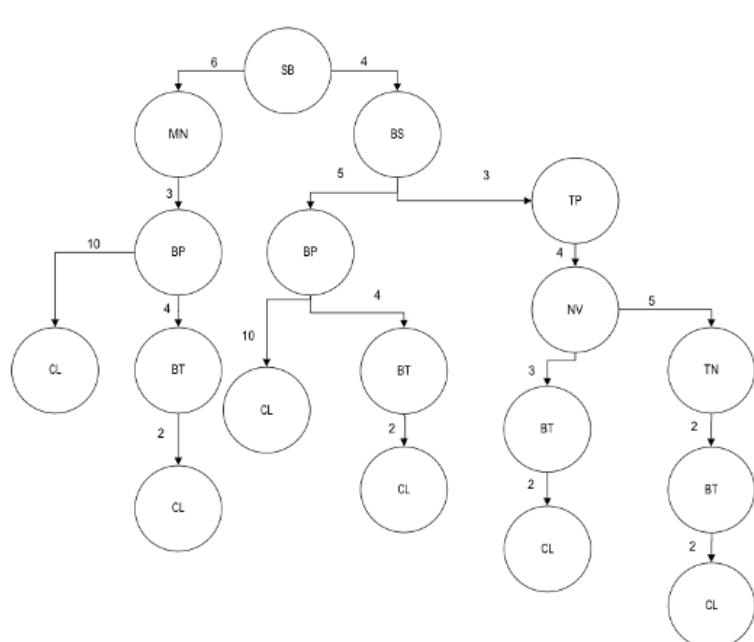
**Question #:** 4

We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



What is the total distance from Sembawang to Clementi with depth first search (DFS)? Fill in only numbers. E.g. if the answer is 72 kilometers, just fill in 72. **Filling your answers in any other way will be marked as incorrect.**

Total distance from Sembawang to Clementi under DFS: 1

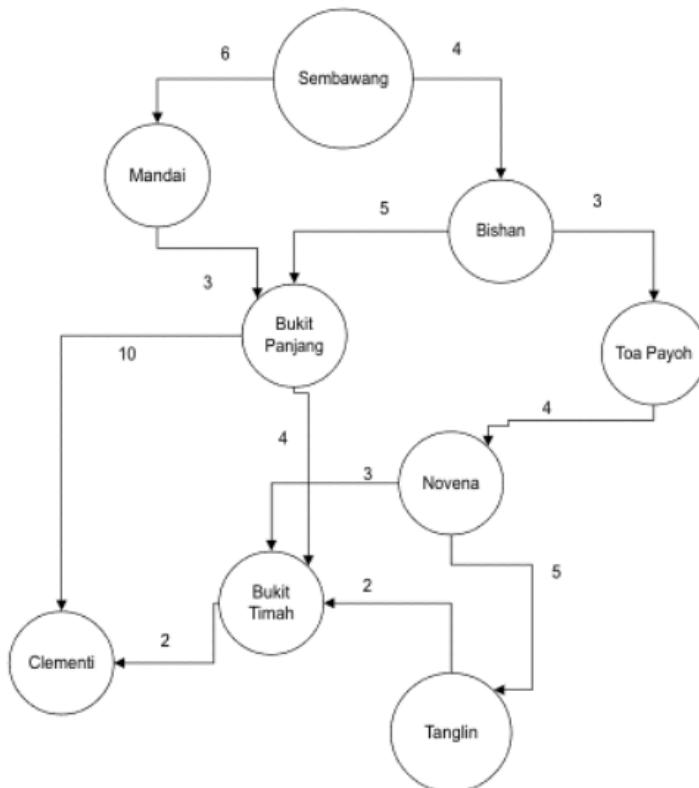
1. \_\_\_\_\_

**Item Weight:** 2.0

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**Question #:** 5

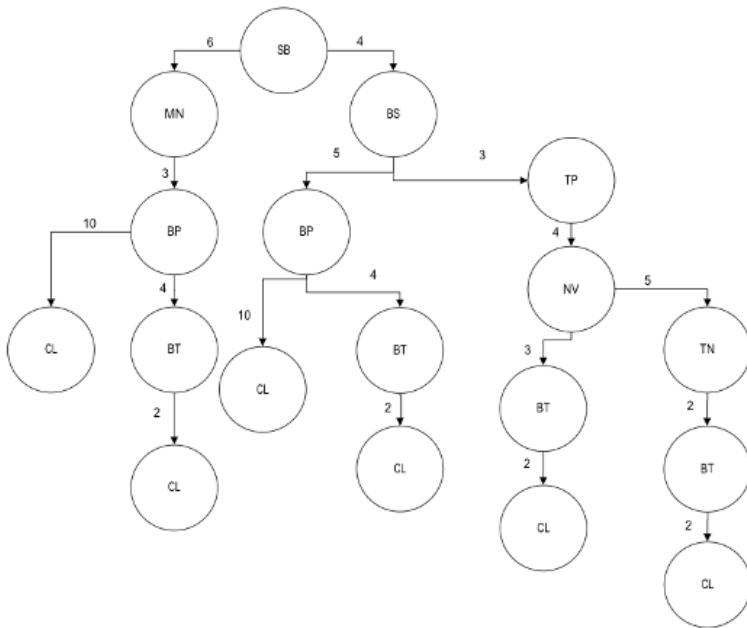
We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



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From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



1. What is the route and total distance from Sembawang to Clementi under **Dijkstra's Algorithm**? You may use either the original map or the tree version to solve this question. Eight blanks are provided.

Skip Sembawang (SB) (since all routes start from Sembawang), and fill one town name per blank using the two-letter abbreviations. Fill "UN" for unused boxes.

Recall: Aiken wants to get from Sembawang to Clementi.

We are asking for **the route from Sembawang to Clementi**, NOT the nodes visited by the algorithm.

For example if **the route** is Sembawang to Bishan to Bukit Timah to Clementi, fill up the blanks like this:

First blank: BS

Second blank: BT

Third blank: CL

Fourth to eighth blanks: UN

**If you write your answers in any other way it will be marked as incorrect.**

**ROUTE** from Sembawang to Clementi (Skip Sembawang):

1.   1
2.   2
3.   3
4.   4
5.   5
6.   6
7.   7
8.   8

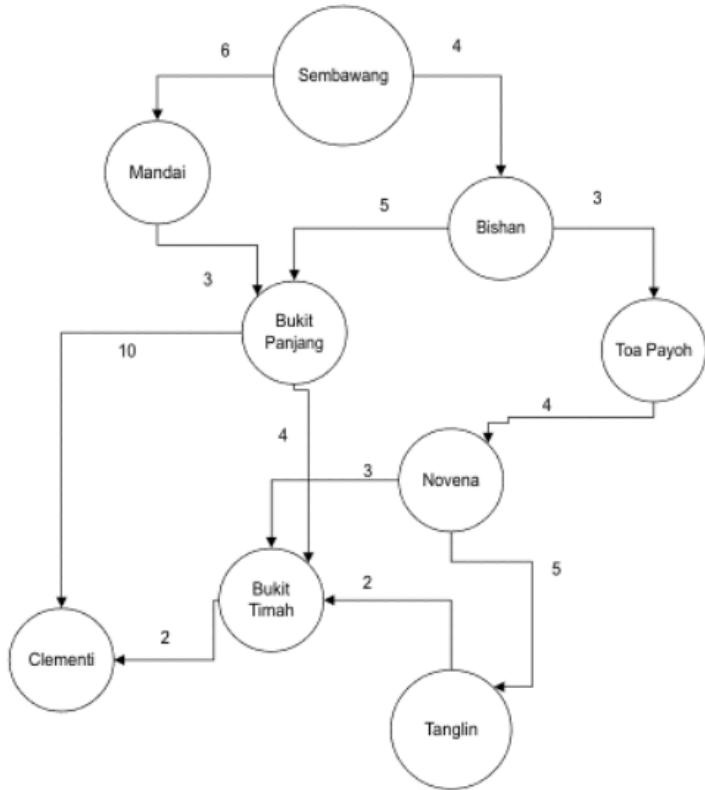
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_

**Item Weight:** 8.0

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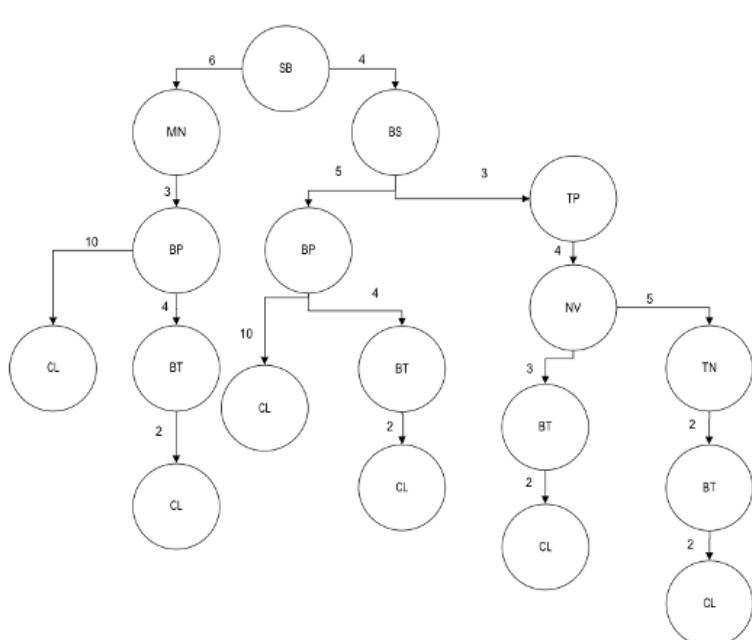
**Question #:** 6

We are given the following map of Singapore. The number shown on the edges are the distances between the towns in kilometers. Our friend Aiken would like travel from Sembawang to Clementi.



From the map above Aiken managed to draw out this tree, shortening the names to just two letters per town:

SB: Sembawang, MN: Mandai, BS: Bishan, BP: Bukit Panjang, BT: Bukit Timah, CL: Clementi, TP: Toa Payoh, NV: Novena, TN: Tanglin



What is the total distance from Sembawang to Clementi with depth Dijkstra's Algorithm? Fill in only numbers. E.g. if the answer is 72 kilometers, just fill in 72. **Filling your answers in any other way will be marked as incorrect.**

Total distance from Sembawang to Clementi under Dijkstra's Algorithm:   1  

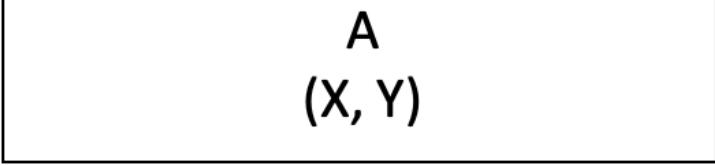
1.   

**Item Weight:** 2.0

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**Question #:** 7

In this question we consider a  $3 \times 3$  Kohonen map initialized as shown below. Each square has the format:



A  
(X, Y)

Where A is the unit number, and X and Y are elements of a 2-element vector, denoting the current weight values for that unit.

1 (1, 3)	2 (10, 9)	3 (7, 12)
4 (8, 2)	5 (17, 5)	6 (21, 8)
7 (9, 21)	8 (14, 32)	9 (6, 12)

We define the LR distance for two  $n$  element vectors X and Y given by:

$$L2(X, Y) = \sqrt{\sum_i^n (x_i - y_i)^2}$$

Fill in the LR distances for each unit given the input vector  $U=(17, 32)$ . Choose Y in the BMU box if that unit is the BMU, otherwise choose N.

Due to limits in Examplify, we will cover units 1 to 7 here. Units 8 and 9 will be in the next question

Round your answers to the nearest 2 decimal places. For example, if your answer is 3.5, enter 3.50. If it is 2.485, enter 2.49. If it is 6.53. **If you write your answer in any other format you will be marked as incorrect.**

**Unit 1 (1, 3)**

LR Distance: 1

BMU? 2

**Unit 2 (10, 9)**

LR Distance: 3

BMU? 4

**Unit 3 (7, 12)**

LR Distance: 5

BMU? 6

**Unit 4 (8, 2)**

LR Distance: 7

BMU? 8

**Unit 5 (17, 5)**

LR Distance: 9

BMU? 10

**Unit 6 (21, 8)**

LR Distance: 11

BMU? 12

**Unit 7 (9, 21)**

LR Distance: 13

BMU? 14

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

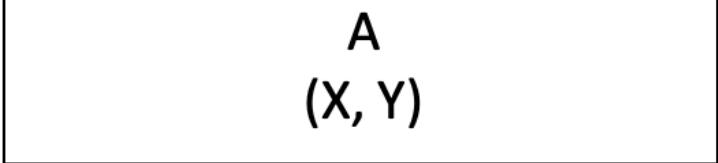
7. \_\_\_\_\_  
 8. \_\_\_\_\_  
 9. \_\_\_\_\_  
 10. \_\_\_\_\_  
 11. \_\_\_\_\_  
 12. \_\_\_\_\_  
 13. \_\_\_\_\_  
 14. \_\_\_\_\_

**Item Weight:** 14.0

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**Question #:** 8

In this question we consider a  $3 \times 3$  Kohonen map initialized as shown below. Each square has the format:



A  
(X, Y)

Where A is the unit number, and X and Y are elements of a 2-element vector, denoting the current weight values for that unit.

1 (1, 3)	2 (10, 9)	3 (7, 12)
4 (8, 2)	5 (17, 5)	6 (21, 8)
7 (9, 21)	8 (14, 32)	9 (6, 12)

We define the LR distance for two  $n$  element vectors X and Y given by:

$$L2(X, Y) = \sqrt{\sum_i^n (x_i - y_i)^2}$$

Fill in the LR distances for each unit given the input vector U=(17, 32). Choose Y in the BMU box if that unit is the BMU, otherwise choose N.

Due to limits in Examplify, we will cover units 8 and 9 here. Units 1 to 7 were covered in the previous question.

Round your answers to the nearest 2 decimal places. For example, if your answer is 3.5, enter 3.50. If it is 2.485, enter 2.49. If it is 6.53. **If you write your answer in any other format you will be marked as incorrect.**

**Unit 8 (14, 32)**

LR Distance: 1

BMU? 2

**Unit 9 (6, 12)**

LR Distance: 3

BMU? 4

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

**Item Weight:** 14.0

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**Question #:** 9

We are given the following constraint satisfaction problem (CSP) for 3 integer variables X, Y and Z, subject to the following constraints:

$$Y = 2X$$

$$Z = 5Y - 2$$

We are initially given the following domains:

$$D_X = D_Y = D_Z = \{0,1,2,\dots,20\}$$

Apply the AC3 algorithm to find suitable domains of X, Y and Z that are arc-consistent. List the elements of the domains individually. For example if you find that

$$D_X = \{1..8\},$$

Write your answer as 1,2,3,4,5,6,7,8 **without any spaces**. Leave out the { and } braces. **If you write your answer in any other format you will be marked as incorrect.**

$$D_X = \{ \underline{1} \}$$

$$D_Y = \{ \underline{2} \}$$

$$D_Z = \{ \underline{3} \}$$

1. \_\_\_\_\_

2. \_\_\_\_\_

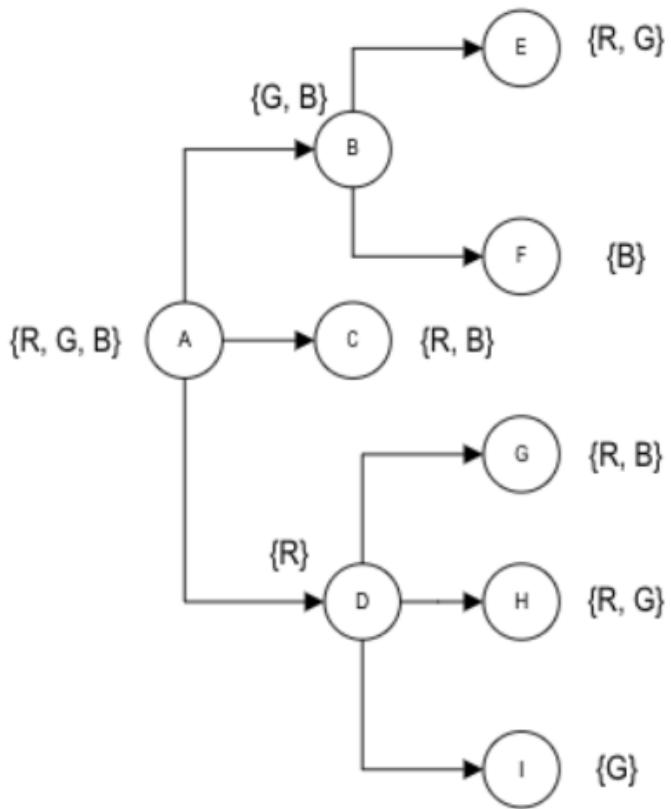
3. \_\_\_\_\_

**Item Weight:** 6.0

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**Question #:** 10

We are given the following constraints graph, and our goal is to colour each node either red (R), green (G) or blue (B). Adjacent nodes (i.e. nodes with edges between them) must not have the same colour. Solve this constraint problem by picking the colours for each node A to I. The set of possible colours is shown in the labels near each node.



Choose the correct color for each node

Color for node A: 1

Color for node B: 2

Color for node C: 3

Color for node D: 4

Color for node E: 5

Color for node F: 6

Color for node G: 7

Color for node H: 8

Color for node I: 9

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_  
8. \_\_\_\_\_  
9. \_\_\_\_\_

**Item Weight:** 9.0

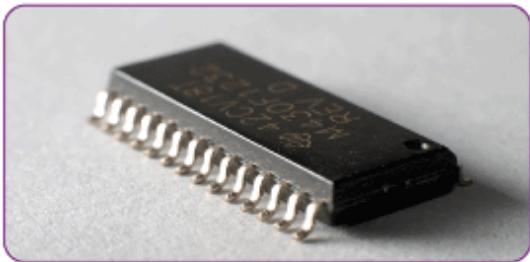
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**Question #:** 11

You have been given two large consignments of integrated circuits (ICs) to test. The picture below shows an example of an IC.

**INTEGRATED CIRCUIT**

 BYJU'S  
The Learning App



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ICs are either faulty, meaning that they don't work, or good, meaning that they work.

The first consignment is labelled "FAULTY", and the second is labelled "GOOD". For every 100 ICs in the FAULTY consignment, 95 will actually be faulty. For every 100 ICs in the GOOD consignment, 93 will actually be good.

You are given a test machine and your job is to test the ICs to see whether they are actually faulty or good.

Unfortunately your test machine itself is not 100% reliable. Out of every 1000 faulty ICs that are actually faulty, your machine will mis-identify 5 of them as good. Out of every 1000 ICs that are actually good, your machine will mis-identify 8 of them as faulty.

Find the following, expressing your answer rounded to the nearest 4 decimal places. For example, an answer of 0.95 should be entered as 0.9500, and answer of 0.94483 should be entered as 0.9448, and answer of 0.94438 should be entered as 0.9444, etc. **If you enter your answers in any other way, it will be marked as incorrect.**

If you take an IC from the "FAULTY" consignment and the test machine identifies it as "FAULTY", what is the probability that it is actually faulty?

Answer: 1

If you take an IC from the "GOOD" consignment and the test machine identifies it as "GOOD", what is the probability that it is actually good?

Answer: 2

If you take an IC from the “FAULTY” consignment and the test machine identifies it as “GOOD”, what is the probability that it is actually good?

Answer: 3

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

**Item Weight:** 15.0