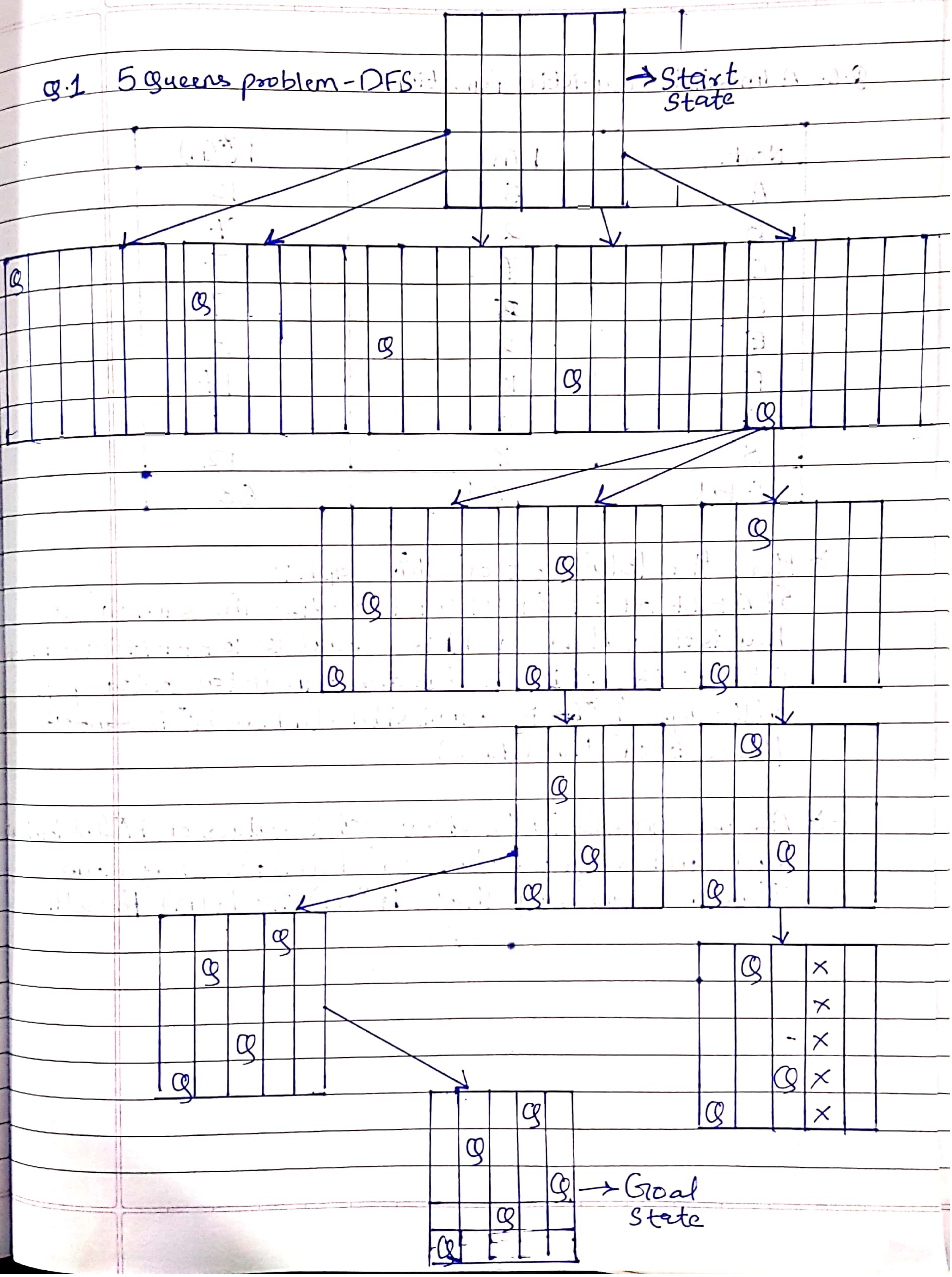
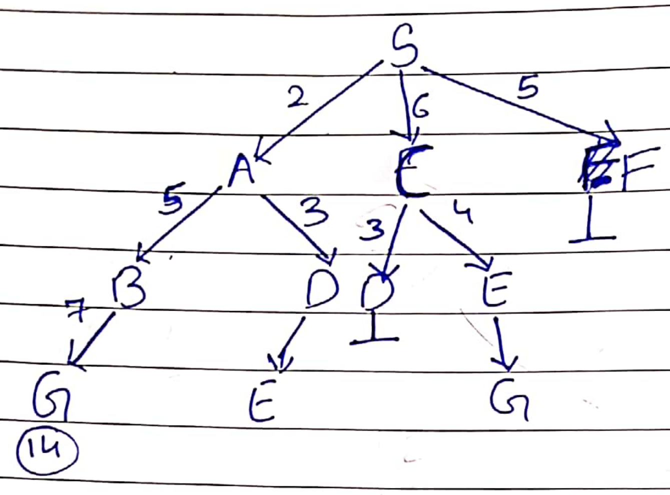
Q.1 5 Queens problem - DFS



Q.2. Breadth-First-Search



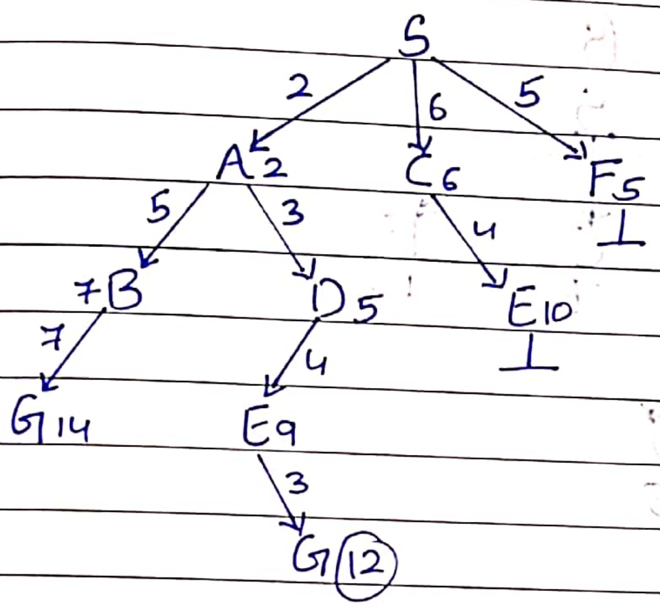
Visited

S
A
C
F
B
D
E

Solution Path:- S → A → B → G
Cost:- 14

→ Here we maintain a visited list so that we donot have to explore the visited node again.
→ Here we do not explore F as S is already visited.

Q.3 Uniform-Cost Search:-

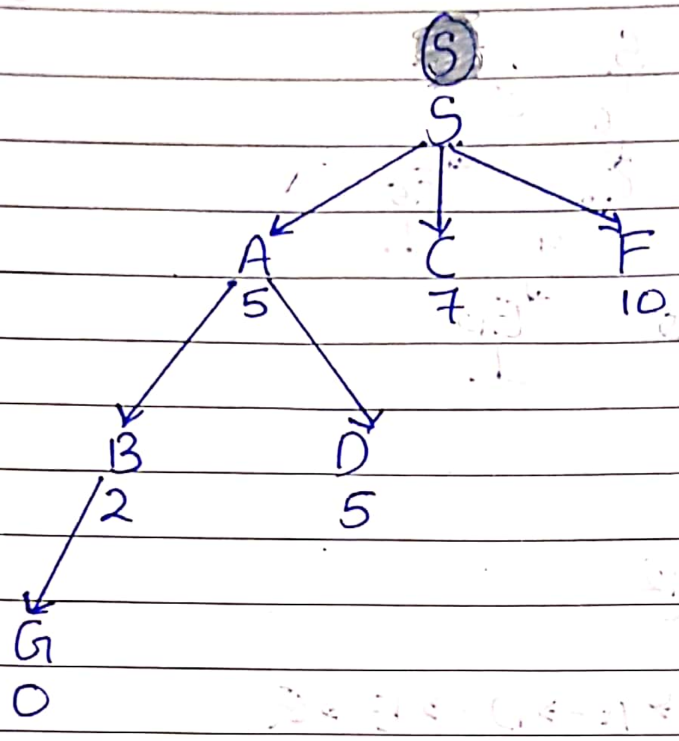


Explore
S
A
D
C
B
E

Solution Path:- S → A → D → E → G
Cost:- 12

→ As 'S' is already explored so F won't be explored again. as S is the only state that F can go to.
→ Similarly 'C' will not explore 'S' & 'D' as they are already explored.
→ E is already visited in previous step so E will become a deadend.
→ Thus there are two paths which reaches the goal state, but out of both path S→A→D→E→G is the solution path with optimal cost of 12.

Q.4. Greedy best first Search.

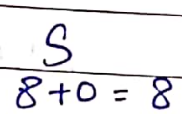


Solution Path :- S → A → B → G
Cost :- 5+2+0 = 7

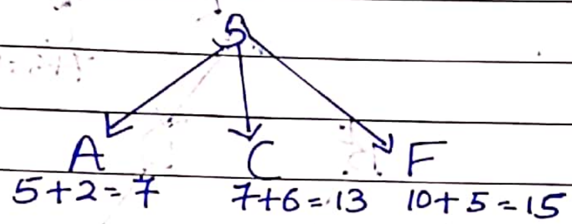
→ Greedy Best First Tree Search takes only h(n) into account and goes on exploring nodes with lowest h(n).
→ In Step 1 'A' has the lowest h(n) so we explore A further.
→ In Step 2 from nodes 'B', 'D', 'C', 'F' we select B as it has the smallest h(n) value.
→ In Step 3 we reach the goal state 'G' with the value of h(n) = 0.

Q.5 A* Tree Search

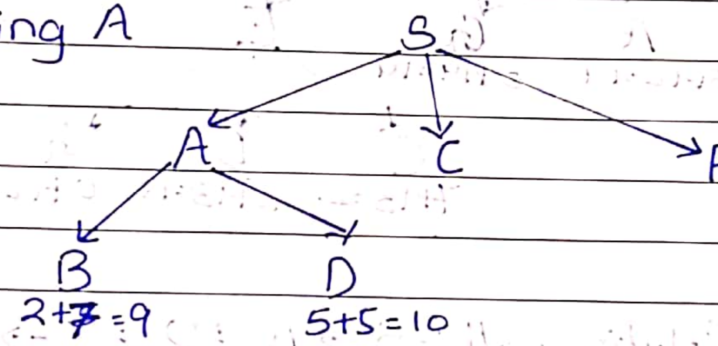
a. The initial state



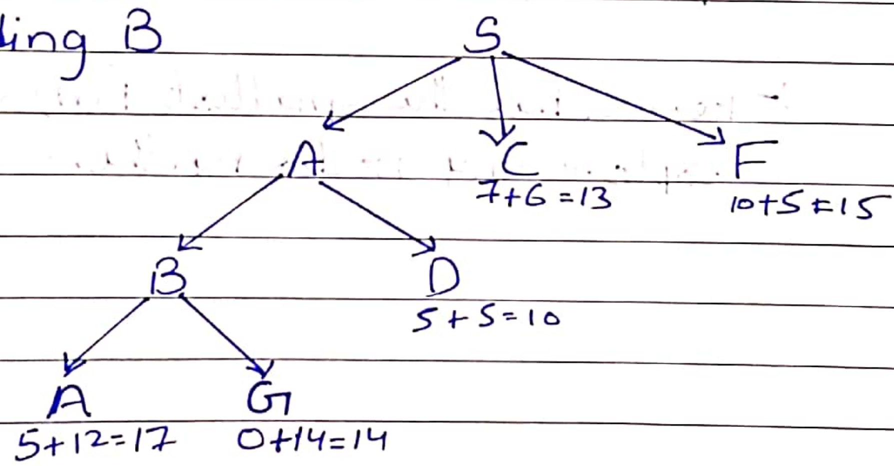
b. After expanding S



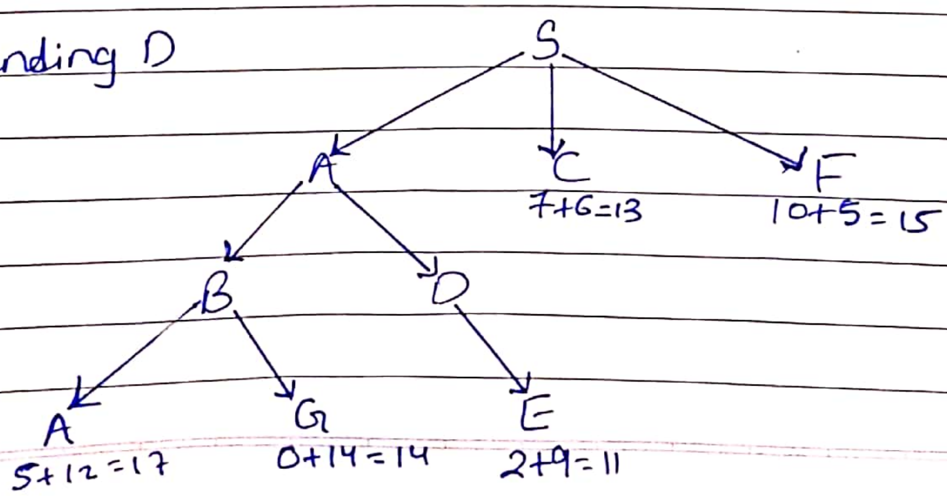
c. After expanding A



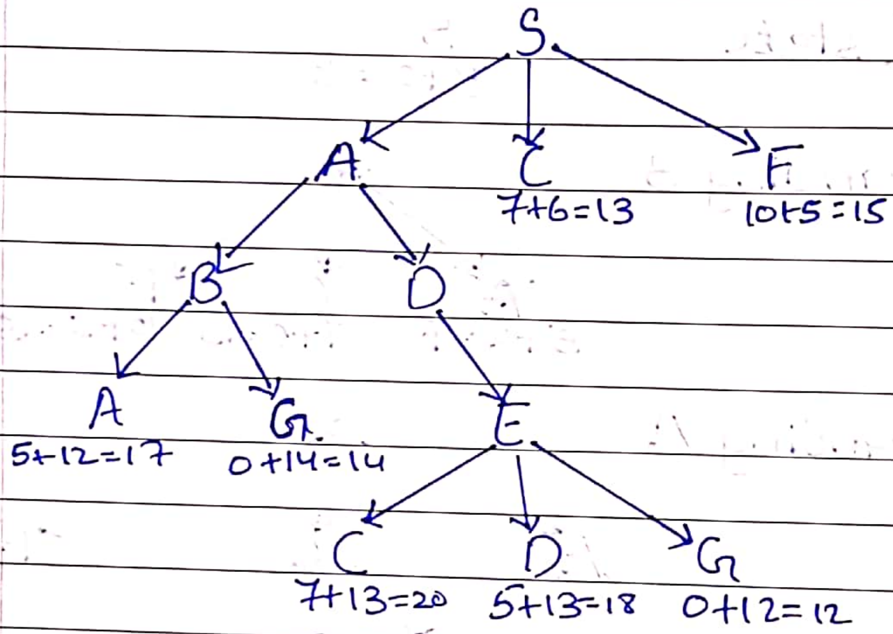
d. After expanding B



e. After expanding D



f.After expanding E



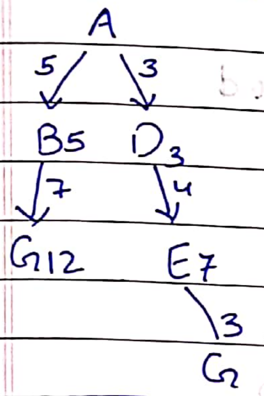
Solution path:- S → A → D → E → G

Optimal cost:- 12

→ Here G has the smallest f(n) value, so we don't explore any nodes further.

Q.6. We run Uniform Cost Search for every node to find heuristic value of each node.

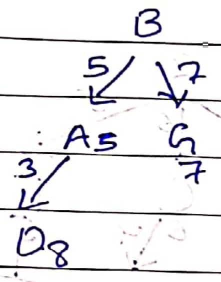
1. For node A



Visited
A
D
B
E

$\boxed{\therefore h(A) = 10}$

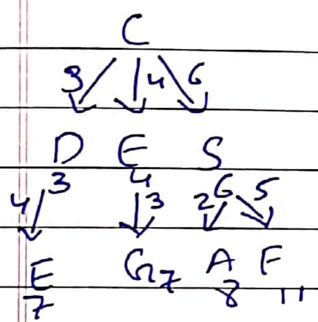
2. For node B



Visited
B
A

$\boxed{\therefore h(B) = 7}$

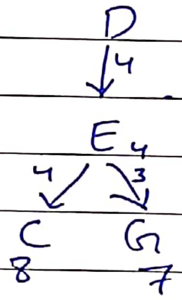
3. For node C



Visited
C
D
E
S

$\boxed{\therefore h(C) = 7.}$

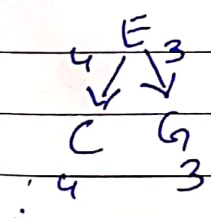
4. For node D



Visited
D
E

$\boxed{\therefore h(D) = 7}$

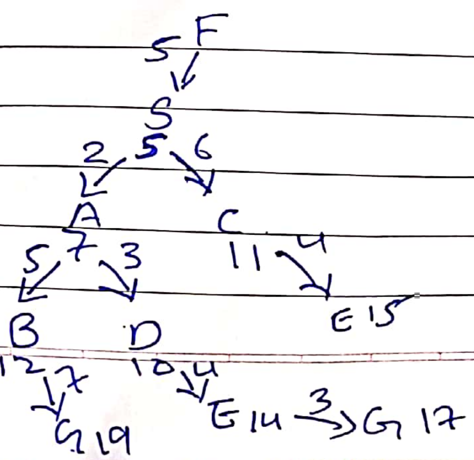
5. For node E



Visited
E

$\boxed{\therefore h(E) = 3}$

6. For node F



Visited
F
S
A
D
C
E
B

$\boxed{\therefore h(F) = 17}$

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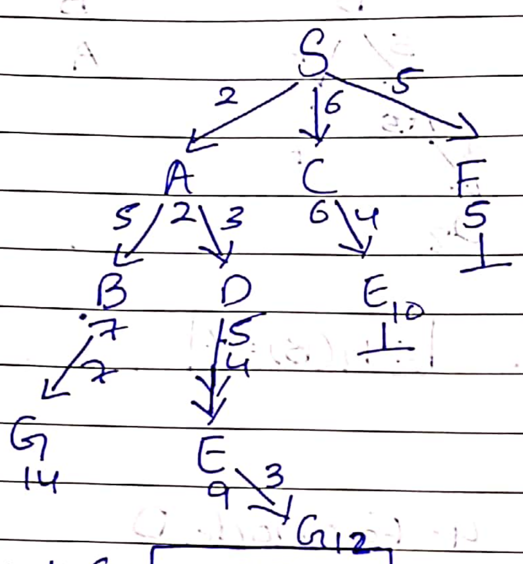
7. For node G
As node G is already goal state.
Therefore $h(G)=0$

8. For node S



Visited
S
A
D
C
B
E

~~h(G~~ $\boxed{\therefore h(S)=12}$

Q.6. Admissible heuristic function.

Node	h(n)	$h^*(n)$
A	5	10
B	2	7
C	7	7
D	5	7
E	2	3
F	10	17
G	0	0
S	8	12
Total	39	63

→ Here the total cost of the graph is $5+6+2+3+3+5+4+4+7+3=42$. The sum of the heuristic values of h^* is equal to $10+7+7+7+3+17+0+12=63$, which is larger then total cost of graph although h^* is admissible. (where h^* is ~~sum of~~ the costs of the edges)

→ As we can see in the above table values of $h^*(n)$ dominate each and every value of $h(n)$ for every node. Thus we can say that $h^*(n) \geq h(n)$ for all n.