PROBLEM-1

Optimal Plan (LENGTH: 6**):-**
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)

Below is summarization of different runs for problems 1.

	Expansion	GoalTests	New Nodes	Plan Length	Time Elapsed
breadth_first_search	43	56	180	6	0.0277
depth_first_graph_search	21	22	84	20	0.01258
uniform_cost_search	55	57	224	6	0.03477
A star (h_ignore_preconditions)	41	43	170	6	0.04647
A star (h_pg_levelsum)	11	13	50	6	1.3126

PROBLEM-2

Optimal Plan (LENGTH: 9**):-**
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Load(C3, P3, ATL)
Fly(P2, JFK, SFO)
Unload(C2, P2, SFO)
Fly(P1, SFO, JFK)
Unload(C1, P1, JFK)
Fly(P3, ATL, SFO)
Unload(C3, P3, SFO)

Summary of results:-

	Expansion	GoalTests	New Nodes	Plan Length	Time Elapsed
breadth_first_search	3343	4609	30509	9	11.205
depth_first_graph_search	624	625	5602	619	2.85345
uniform_cost_search	4853	4855	44041	9	37.3826
A star (h_ignore_preconditions)	1506	1508	13820	9	13.6395
A star (h_pg_levelsum)	86	88	841	9	129.6868

PROBLEM-3

Optimal Plan (LENGTH: 12**):-**
Load(C1, P1, SFO)
Load(C2, P2, JFK)
Fly(P2, JFK, ORD)
Load(C4, P2, ORD)
Fly(P1, SFO, ATL)
Load(C3, P1, ATL)
Fly(P1, ATL, JFK)
Unload(C1, P1, JFK)
Unload(C3, P1, JFK)
Fly(P2, ORD, SFO)
Unload(C2, P2, SFO)
Unload(C4, P2, SFO)

Results:-

	Expansion	GoalTests	New Nodes	Plan Length	Time Elapsed
breadth_first_search	14663	18098	129631	12	89.352
depth_first_graph_search	408	409	3364	392	1.5163
uniform_cost_search	18222	18224	159608	12	346.0776
A star (h_ignore_preconditions)	5118	5120	45650	12	90.6803
A star (h_pg_levelsum)	404	406	3718	12	913.6788

ANALYSIS

We can find following points of note in above results.
1) We are able to find optimal paths through breadth first search and other cost based searches. As breadth first search explore nodes in order of their distance from start, we are able to reach goal with minimal distance from start. As depth first search try to search deeper first before exploring other nodes at same distance, we get deeper length but reach goal quickly for bigger problems like 2nd and 3rd problems. [REFERENCE: Lesson-7 on Search for Term-1 in AIND]
2) Time taken by uniform cost search is more than breadth first search as in breadth first search we check for goal before adding it into frontier list due to which less number of nodes are being explored in BFS.
3) We see that h_pg_levelsum heuristic is better that h_ignore_preconditions in terms of count of nodes explored as it is closer to actual cost of reaching different goals but downside of this heuristic is that it takes longer due to actual calculations of different levels.