2.3 ALGORITHMS · 2.3.1(F)

Dijkstra's & A* — Mark scheme

30 marks · spec 2.3.1(f)

AO key: AO1 = knowledge · AO2 = application. Shortest-path trace verified (start S).

Q	ANSWER	AO	MARKS
1(a)	The shortest (lowest-weight) path from the start node to other node(s). (1)	AO1	1
1(b)	A weighted graph (with non-negative weights). (1)	AO1	1
1(c)	It picks the unvisited node (1); with the smallest current distance from the start (1). (2)	AO1	2
1(d)	The current shortest distance to each node (1); and each node's previous node on the best route (1). (2)	AO1	2

Q	ANSWER	AO	MARKS
2(a)	<table><tr><td>NODE</td><td>S</td><td>A</td><td>B</td><td>C</td><td>D</td></tr><tr><td>DIST</td><td>0</td><td>2</td><td>3</td><td>5</td><td>6</td></tr></table> A = 2 (1); B = 3 (via A: 2+1) (1); C = 5 (via B: 3+2) (1); D = 6 (via C: 5+1) (1); all consistent / method correct (1). (5)	AO2	5
2(b)	Path S → A → B → C → D (1); length 6 (1). (2)	AO2	2
2(c)	A (distance 2). (1)	AO2	1

Q	ANSWER	AO	MARKS
3(a)	It adds a heuristic estimate of the distance to the goal (1); steering the search towards the goal so fewer nodes are explored (1). (2)	AO1	2
3(b)	`f = g + h`. (1)	AO1	1
3(c)	g = the actual distance from the start so far (1); h = the heuristic estimate of the distance still to go to the goal (1). (2)	AO1	2
3(d)	When the heuristic never overestimates the true remaining distance (it is admissible). (1)	AO1	1

Q	ANSWER	AO	MARKS
4(a)	Any one developed: Dijkstra finds shortest paths to all nodes / A* targets one goal (1); Dijkstra uses only g while A* uses f = g + h (a heuristic) (1). (2)	AO1	2
4(b)	The heuristic guides A* towards the goal (1); so it avoids exploring nodes in the wrong direction, expanding fewer of them (1). (2)	AO2	2

Q	ANSWER	AO	MARKS
5(a)	It finds the shortest/quickest route (1); and the heuristic (towards the destination) makes it fast enough for real-time routing (1). (2)	AO2	2
5(b)	The straight-line ("as the crow flies") distance to the destination. (1)	AO2	1
5(c)	It behaves exactly like Dijkstra's algorithm. (1)	AO1	1
5(d)	If it overestimates, A* may settle the goal via a longer route (1); so it could miss the true shortest path (no longer guaranteed) (1). (2)	AO2	2

Total for paper: 30 marks