Grid Navigation and Pathfinding

Standard difficulty · 20 questions · 40 marks · Time: 37 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. Finding the best route from a start to a goal is called:

(a) encryption **(b)** sorting **(c)** clustering **(d)** pathfinding

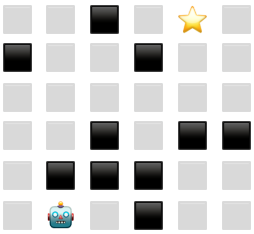
2. A robot is on a 6 × 6 grid. Cells are named (column, row), with (1, 1) at the bottom left. It starts at (1, 4) facing South. F = move forward one cell, F2 = move forward two cells, L = turn left 90°, R = turn right 90° (turning stays in the same cell). It follows: F2 L F2 L F F2. In which cell does it stop? Give (column, row).

(a) (5, 3) **(b)** (4, 5) **(c)** (3, 4) **(d)** (3, 5)

3. A robot is on a 6 × 6 grid. Cells are named (column, row), with (1, 1) at the bottom left. It starts at (1, 3) facing West. F = move forward one cell, F2 = move forward two cells, L = turn left 90°, R = turn right 90° (turning stays in the same cell). It follows: R F2 R F2 F2 F R F2. Which way is it facing at the end?

(a) North **(b)** East **(c)** South **(d)** West

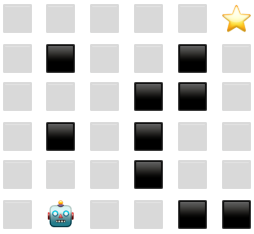
4.



The robot moves one square at a time up, down, left or right (not diagonally), and cannot enter a black square. What is the fewest number of moves to reach the star ?

(a) 9 **(b)** 12 **(c)** 10 **(d)** 11

5.



The robot moves one square at a time up, down, left or right (not diagonally), and cannot enter a black square. The fewest moves to the star is 9. How many different routes use exactly 9 moves?

(a) 8 **(b)** 4 **(c)** 5 **(d)** 3

6. On a street grid you walk from corner (0, 0) to corner (3, 3), moving only right (east) or up (north), one block at a time. The corner (2, 2) is closed for repairs. How many different shortest routes are there?

(a) 20 **(b)** 9 **(c)** 8 **(d)** 6

7. On a grid of streets, a delivery robot goes 8 steps North, then 9 steps South, then 3 steps North, then 3 steps East. It can only move North, South, East or West. What is the fewest number of steps to get back to the start?

(a) 23 **(b)** 1 **(c)** 7 **(d)** 5

8. A robot on a 6 × 6 grid starts at (4, 3) facing East (cells are (column, row), (1, 1) at the bottom left). F = forward one cell, L and R = turn 90° left or right. Which commands take it to (4, 6)?

(a) L F F R L **(b)** L L F F L **(c)** L F F F L **(d)** L F F L L

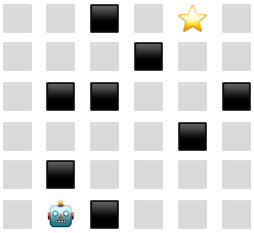
Section B — Short answer 8 × 2 = 16 marks

9. What is pathfinding?

10. A robot is on a 6 × 6 grid. Cells are named (column, row), with (1, 1) at the bottom left. It starts at (3, 4) facing South. F = move forward one cell, F2 = move forward two cells, L = turn left 90°, R = turn right 90° (turning stays in the same cell). It follows: R F F R F2. In which cell does it stop? Give (column, row).

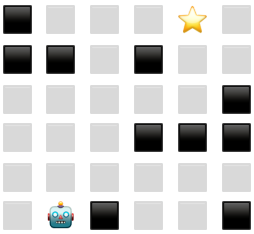
11. A robot is on a 6 × 6 grid. Cells are named (column, row), with (1, 1) at the bottom left. It starts at (3, 1) facing North. F = move forward one cell, F2 = move forward two cells, L = turn left 90°, R = turn right 90° (turning stays in the same cell). It follows: F2 F F2 R F2 F R F. Which way is it facing at the end?

12.



The robot moves one square at a time up, down, left or right (not diagonally), and cannot enter a black square. What is the fewest number of moves to reach the star ?

13.



The robot moves one square at a time up, down, left or right (not diagonally), and cannot enter a black square. The fewest moves to the star is 8. How many different routes use exactly 8 moves?

14. On a street grid you walk from corner (0, 0) to corner (5, 5), moving only right (east) or up (north), one block at a time. The corner (1, 1) is closed for repairs. How many different shortest routes are there?

15. On a grid of streets, a delivery robot goes 7 steps East, then 5 steps North, then 7 steps East. It can only move North, South, East or West. What is the fewest number of steps to get back to the start?

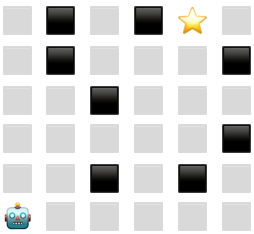
16. On a 9 × 9 grid with no walls, a robot moves one cell at a time across or up and down (never diagonally). What is the fewest number of moves from (5, 5) to (7, 2)?

Section C — Word problems — 4 × 4 = 16 marks

17. On a street grid, moving only right or up from (0, 0) to (3, 2): (a) find the number of shortest routes by labelling corners; (b) how many if (1, 1) is closed?

18. A robot is on a 6 × 6 grid. Cells are named (column, row), with (1, 1) at the bottom left. It starts at (5, 3) facing South. F = move forward one cell, F2 = move forward two cells, L = turn left 90°, R = turn right 90° (turning stays in the same cell). It follows: F F R R F2 F2 L L R. (a) In which cell does it stop? Give (column, row). (b) Which way is it facing at the end?

19.



The robot moves one square at a time up, down, left or right (not diagonally), and cannot enter a black square . The fewest moves to the star is 9. How many different routes use exactly 9 moves?

20. (a) On a street grid you walk from corner (0, 0) to corner (5, 3), moving only right (east) or up (north), one block at a time. The corner (4, 1) is closed for repairs. How many different shortest routes are there?
(b) On a grid of streets, a delivery robot goes 3 steps South, then 1 step South, then 8 steps East, then 6 steps North. It can only move North, South, East or West. What is the fewest number of steps to get back to the start?

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Answer key

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Q	Answer	Working
1	**(d) pathfinding**	—
2	**(d) (3, 5)**	track the cell and the facing after each command; it ends facing North
3	**(c) South**	3 right and 0 left quarter-turns from West
4	**(c) 10**	count outwards from the robot, one ring of squares at a time, until the star is reached
5	**(b) 4**	number each square with the ways to reach it in the fewest moves; add the numbers of the squares just before it
6	**(c) 8**	write at each corner the number of ways to reach it: the corner to its left plus the corner below; the closed corner gets 0
7	**(d) 5**	it ends 3 East and 2 North of the start
8	**(c) L F F F L**	trace each set of commands; only one ends at the goal
9	**Finding a route from a start to a goal, usually the shortest or quickest one, avoiding obstacles.**	—
10	**(1, 6)**	track the cell and the facing after each command; it ends facing North
11	**South**	2 right and 0 left quarter-turns from North
12	**10**	count outwards from the robot, one ring of squares at a time, until the star is reached
13	**6**	number each square with the ways to reach it in the fewest moves; add the numbers of the squares just before it
14	**112**	write at each corner the number of ways to reach it: the corner to its left plus the corner below; the closed corner gets 0
15	**19**	it ends 14 East and 5 North of the start
16	**5**	2 across + 3 up or down
17	**(a) Labels give 10 routes. (b) Routes through (1, 1): 2 ways to reach it × 3 ways from it = 6, so 10 − 6 = 4 routes.**	—
18	**(a) (5, 5); (b) West**	track the cell and the facing after each command
19	**12**	number each square with the ways to reach it in the fewest moves; add the numbers of the squares just before it
20	**(a) 41; (b) 10**	(a) write at each corner the number of ways to reach it: the corner to its left plus the corner below; the closed corner gets 0; (b) it ends 8 East and 2 North of the start

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