Q2.
a.
$P_{x,y}(t)$ is initial probability of (x,y) containing target.
Since (x,y) is blocked, $P_{x,y}(t+1) = 0$
$P_{i,j}(t+1) = \frac{P_{i,j}(t)}{1-P_{x,y}(t)}$ <- answer

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b. Initial assumption in agent's gridworld is that all the cells are unblocked. So if we enter a cell (x,y) and find it unblocked, it will not affect other cells because this doesn't give any information on the position of the target.
So $P_{i,j}(t+1) = P_{i,j}(t)$ for all (i,j) <- answer

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c, d, e.
All of the calculations are for t+1, we know $P_{i,j}(t)$ of all cells.

i. When (i,j) ≠ (x,y) :

A: Target in (i,j)
B: Failed to find target at (x,y) , here (x,y) ≠ (i,j)

Let terrain type of (x,y) be T, where T = "flat","hilly","forrest"

We need to calculate P(A|B) for parts c,d,e

$P(A|B) = \frac{P(A)*P(B|A)}{P(B)}$

$P(A) = P_{i,j}(t)$ -> We already know the initial probabilities ---(1)
$P(B|A)$ = P(Failed to find target at (x,y) | (i,j) contains target) = **1** ---(2)
P(B) = P(Failed to find target at (x,y))
$= \Sigma_{(i,j)=All\ (i,j)\ ,\ (x,y)}$ P(Failed to find target at (x,y) AND target is in (i,j))
$= \Sigma_{(i,j)=All\ (i,j)}$ P(Target in (i,j))*P(Failed to find target in (x,y)| Target in (i,j)) +
P(Failed to find target in (x,y)| Target in (x,y))
$P(B)=\Sigma_{(i,j)=All\ (i,j)}$ P(Target in (i,j))*1 + $P_{x,y}(t)$*FN(x,y) ---(3)

Using (1),(2),(3) we can calculate P(A|B) for all (i,j) where (i,j) ≠ (x,y)

$P_{i,j}(t+1) = \frac{P_{i,j}(t)}{\Sigma_{all(i,j)} P_{i,j}(t) + P_{x,y}*FN(x,y)}$ <- answer

ii. When (i,j) = (x,y)

A: Target in (x,y)
B: Failed to find target at (x,y)

Everything is same except P(B|A), which is FN(x,y) now.
So
$P(A) = P_{x,y}(t)$
$P(B|A)$ = FN(x,y)
$P(B) = \Sigma_{(i,j)=All\ (i,j)}$ P(Target in (i,j))*1 + $P_{x,y}(t)$*FN(x,y)

So we can calculate P(A|B) for (x,y) using above equations.

$P_{x,y}(t+1) = \frac{P_{x,y}(t) * FN(x,y)}{\Sigma_{all(i,j)} P_{i,j}(t) + P_{x,y} * FN(x,y)}$ <- answer

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f. If we find target at (x,y) the $P_{x,y}(t+1) = 1$ all other $P_{i,j}(t+1) = 0$

Ans 3.

a,b,c. $P_{x,y}$(finding the target in cell (x,y)) = ?

$P_{x,y}$(finding the target in cell (x,y)) = $P_{x,y}(t)*(1-FN(x,y))$

if x,y is
hilly -> $P_{x,y}(t)*(1-0.5) = P_{x,y}(t)*(0.5)$ <- answer
flat -> $P_{x,y}(t)*(1-0.2) = P_{x,y}(t)*(0.8)$ <- answer
forrest -> $P_{x,y}(t)*(1-0.8) = P_{x,y}(t)*(0.2)$ <- answer

d. P(finding target in (x,y) where (x,y) is univisited)

P(finding target in cell (x,y)) = $\Sigma_{all\ t}$ P(finding target in cell (x,y) AND terrain = t)
$=\Sigma_{all\ t}$ P(terrain = t)P(finding target in cell (x,y) | terrain = t)
=P(terrain = flat)P(finding target in (x,y) | (x,y) is flat) + P(terrain = hilly)P(finding target in (x,y) | (x,y) is hilly) + P(terrain = forrest)P(finding target in (x,y) | (x,y) is forrest)
$= 0.7*1/3*P_{x,y}(t)*(1-0.2) + 0.7*1/3*P_{x,y}(t)*(1-0.5) + 0.7*1/3*P_{x,y}(t)*(1-0.8)$
$=0.35*P_{x,y}(t)$ <- answer