A: $a_{ij} = P(X_{t+1} = j \mid X_t = i)$

$X_t \mid X_{t+1}$	A	B	H	S
A	0.6	0.1	0.1	0.2
B	0.0	0.3	0.2	0.5
H	0.8	0.1	0.0	0.1
S	0.2	0.0	0.1	0.7

B: $b_{ik} = P(O_t = k \mid X_t = i)$

$X_t \mid O_t$	p	e	b	l
A	0.6	0.2	0.1	0.1
B	0.1	0.4	0.1	0.4
H	0.0	0.0	0.7	0.3
S	0.0	0.0	0.1	0.9

$P(X_t = i)$:

A	B	H	S
0.4	0.2	0.1	0.3

Find:

$P(O_t \mid A, B, P(X_t)) = ?$

Compute:

$P(O_t = p) = 0.4 \times 0.6 + 0.2 \times 0.1 + 0.1 \times 0.0 + 0.3 \times 0.0 =$ ____

$P(O_t = e) =$ ___ $\times 0.2 +$ ___ $\times 0.4 + 0.1 \times$ ___ $+ 0.3 \times$ ___ $=$ ____

$P(O_t = b) = 0.4 \times$ ___ $+$ ___ $\times$ ___ $+ 0.1 \times$ ___ $+ 0.3 \times 0.1 =$ ____

$P(O_t = l) =$ ___ $\times$ ___ $+$ ___ $\times$ ___ $+$ ___ $\times$ ___ $+$ ___ $\times$ ___ $=$ ____

$P(O_t) =$

____

____

____

____

most likely $O_t =$ _____

$\pi = P(X_1 = i)$:

A	B	H	S
0.5	0.0	0.0	0.5

observations / emissions: $o_{1:4} = \{ l , p , p , b \}$

Find:

$$P(o_{1:4} \mid A, B, \pi) = ?$$

Element-wise product:

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} \odot \begin{bmatrix} d \\ e \\ f \end{bmatrix} = \begin{bmatrix} ad \\ be \\ cf \end{bmatrix}$$

Compute:

$O_1 =$ ____

$$\alpha_1(i) = \begin{bmatrix} \_\_\_ \\ \_\_\_ \\ \_\_\_ \\ 0.5 \end{bmatrix} \odot \begin{bmatrix} \_\_\_ \\ 0.4 \\ \_\_\_ \\ \_\_\_ \end{bmatrix} = \begin{bmatrix} 0.05 \\ 0 \\ 0 \\ 0.45 \end{bmatrix}$$

$O_2 =$ ____

$$\alpha_2(i) = \begin{bmatrix} 0.05 \times 0.6 + 0.0 \times \_\_\_ + 0.0 \times \_\_\_ + 0.45 \times 0.2 \\ \_\_\_ \times 0.1 + \_\_\_ \times 0.3 + 0.0 \times 0.1 + 0.45 \times \_\_\_ \\ 0.05 \times 0.1 + \_\_\_ \times 0.2 + 0.0 \times \_\_\_ + \_\_\_ \times 0.1 \\ 0.05 \times 0.2 + \_\_\_ \times 0.5 + 0.0 \times 0.1 + \_\_\_ \times 0.7 \end{bmatrix} \odot \begin{bmatrix} 0.6 \\ \_\_\_ \\ \_\_\_ \\ \_\_\_ \end{bmatrix} = \begin{bmatrix} 0.072 \\ \_\_\_ \\ \_\_\_ \\ \_\_\_ \end{bmatrix}$$

O_3 = _____

$\alpha_3(i)$ =

0.072 x ___ + _____ x 0.0 + 0.0 x 0.8 + 0.0 x 0.2	⊙	0.6	= ___
0.072 x ___ + _____ x 0.3 + 0.0 x ___ + 0.0 x 0.0		0.1	___
0.072 x ___ + _____ x 0.2 + 0.0 x ___ + 0.0 x 0.1		0.0	0.0
0.072 x ___ + _____ x 0.5 + 0.0 x 0.1 + ___ x 0.7		0.0	0.0

O_4 = _____

$\alpha_4(i)$ =

_____ x 0.6 + _____ x 0.0 + 0.0 x 0.8 + 0.0 x 0.2	⊙	___	=
_____ x 0.1 + _____ x 0.3 + 0.0 x 0.1 + 0.0 x 0.0		___	
_____ x 0.1 + _____ x 0.2 + 0.0 x 0.0 + 0.0 x 0.1		___	
0.0259 x 0.2 + _____ x 0.5 + 0.0 x 0.1 + 0.0 x 0.7		___	

$\alpha_4(i)$ =

0.0_____	**$P(o_{1:4} \mid A, B, \pi)$ = _____**
0.000_____	
0.0019173	
0.00055515	