P1. P(<s>) = 1; P(I| <s>) = 1/5; P(do| <s>) = 1/5; P(Batman| <s>) = 3/5; P(am|I) = 2/5; P(fight|I) = 2/5; P(do|I) = 1/5; P(Batman |am) = 1/2; P(</s> |am) = 1/2; P(I|Batman) = 3/5; P(</s> |Batman) = 2/5; P(I|do) = 1/2; P(fight|do) = 1/2; P(Batman|fight) = 1/3; P(</s> |fight) = 2/3;

1. a) P(</s>|Batman) = 2/5 < P(I|Batman) = 3/5, P(wi|Batman) = 0 (wi not “I” or “</s>”)
So the next word is likely “I”.
b) P(I|do) = 1/2 = P(fight|do) = 1/2, P(wi|do) = 0 (wi not “I” or “fight”)
So the next word is likely either “I” or “fight”.
c) P(</s>|Batman) = 2/5 < P(I|Batman) = 3/5, P(wi|Batman) = 0 (wi not “I” or “</s>”)
So the next word is likely “I”.
d) P(Batman|fight) = 1/3 < P(</s>|fight) = 2/3, P(wi|fight) = 0 (wi not “Batman” or “</s>”)
So the next word is likely “</s>”.

2. P(a) = P(<s>)*P(Batman|<s>)*P(I|Batman)*P(do|I)*P(I|do)*P(fight|I)*P(</s>|fight) = 1*3/5*3/5*1/5*1/2*2/5*2/3 = 0.0096
P(b) = P(<s>)*P(Batman|<s>)*P(I|Batman)*P(am|I)*P(</s>|am) = 1*3/5*3/5*2/5*1/2 = 0.072
P(c) = P(<s>)*P(I|<s>)*P(do|I)*P(fight|do)*P(Batman|fight)*P(I|Batman)*P(am|I)*P(</s>|am) 1*1/5*1/5*1/2*1/3*3/5*2/5*1/2 = 0.0008

Ranking them from highest to lowest is (b) > (a) > (c).

P2. perplexity = 6√ 1/(P(I|<s>)*P(do|I)*P(fight|do)*P(Batman|fight)*P(</s>|Batman))
= 6√ 1/(1/5*1/5*1/2*1/3*2/5) = 6√375 = 2.685

P3.
1. |V| = 7
P(do | <s>) = (1+1)/(5+7) = 1/6
P(do | Batman) = (0+1)/(5+7) = 1/12
P(Batman | <s>) = (3+1)/(5+7) = 1/3
P(Batman | do) = (0+1)/(2+7) = 1/9
P(I | Batman) = (3+1)/(5+7) = 1/3
P(I | do) = (1+1)/(2+7) = 2/9
P(fight | I) = (2+1)/(5+7) = 1/4

2. P(a) = P(<s>)*P(do|<s>)*P(Batman|do)*P(I|Batman)*P(fight|I)*P(</s>|fight) = 1*1/6*1/9*1/3*1/4*3/10 = 0.000463
P(b) = P(<s>)*P(Batman|<s>)*P(do|Batman)*P(I|do)*P(fight|I)*P(</s>|fight) = 1*1/3*1/12*2/9*1/4*3/10 = 0.000463

Two sentences have the same probability.