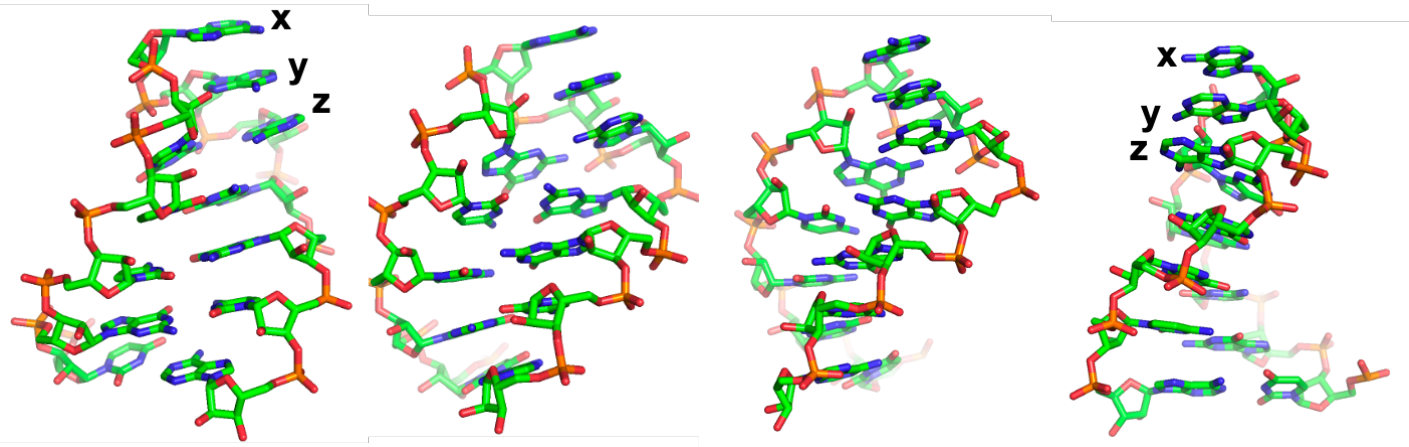
The pictures below show the structure of an RNA molecule visualized at slightly different angles such that the view on the right and the view on the left are viewed from opposite sides.




A – Write the sequence of the RNA molecule below (including the polarity) – 4pts

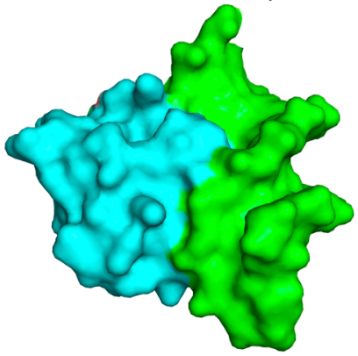
B – What type of interactions can you **see** between the nucleotides x, y and z? Describe briefly below – 3pts.

C – What type of RNA structure does this molecule form? 3pts.

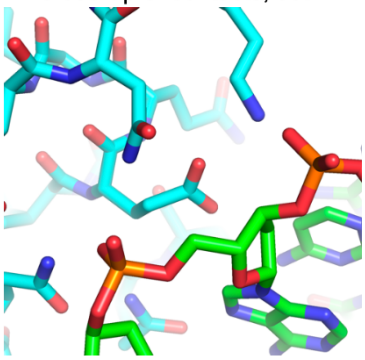
C – Write out the secondary structure of this molecule in dot bracket notation. 6pts.

**Question 4** (21.5 pts) – Researchers solved the structure of a sequence-specific DNA-binding protein (cyan) bound to its target sequence (green). On the left is a surface representation, and in the middle and right are atomic representations of two sets of contacts (termed set 1 and set 2) observed in this structure.

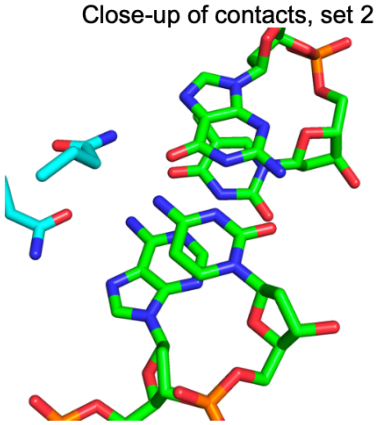
Surface view, entire complex



Close-up of contacts, set 1



Close-up of contacts, set 2



**4.1:** On the right image (set 2 contacts), draw all hydrogen bonds between the protein and nucleic acid, and also draw the hydrogens involved in the hydrogen bonds (4.5 pts).

**4.2**: Which groove is the protein engaging in the right image? (2 pts)

**4.3:** Of the two sets of contacts (set 1 shown in middle image, set 2 shown on right image), which set is more likely to contribute to affinity in this interaction? Justify your answer in one sentence (3.5 pts).

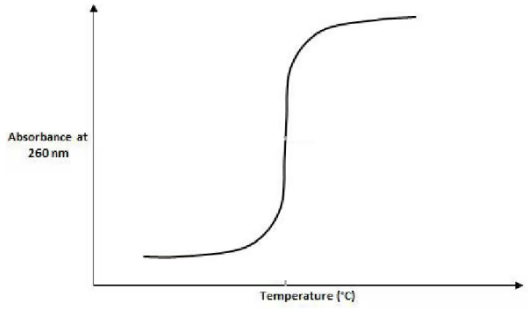
**4.4:** Of the two sets of contacts (set 1 shown in middle image, set 2 shown on right image), which set is more likely to contribute to sequence specificity in this interaction? Justify your answer in one sentence (3.5 pts).

**4.5:** Of the two sets of contacts (set 1 shown in middle image, set 2 shown on right image), which set helps the protein select nucleic acids in this conformation (A vs. B vs. Z)? Justify your answer in one sentence (3.5 pts).

Researchers then set out to study the stability of the target DNA shown in the structure above (without the protein), and they obtained the melting curve shown on the bottom right.

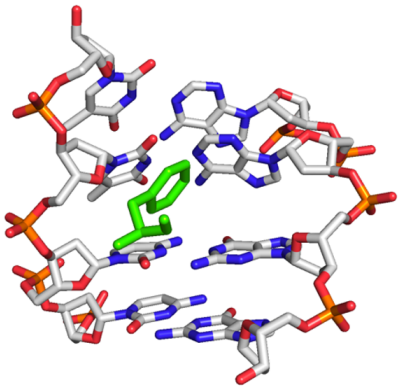
**4.6:** The DNA sequence corresponding to the melting curve shown to the right has a 50% G/C content. On that same diagram, draw a melting curve that could be seen with a DNA that is 75% G/C (and 25% A/T) using a dashed line (3 pts)

**4.7:** Explain the basis of the shape of the curves seen in the plot to the right in 1-3 words (1.5 pts).



**Question 3 – 12pts**

The structure of a protein bound to DNA has been solved. The pictures below show the details of one amino acid (green) of this protein interacting with the DNA.



**A** – What grooves of the DNA are we looking at on the top and bottom pictures? - 2pts

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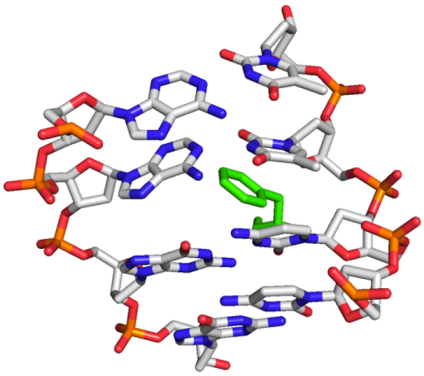
|---|
| Top:<br><br>Bottom: |

**B** – On the bottom picture, indicate the main interaction that this amino acid makes with one of the components of the DNA. 2pts.



**C** – Use one word to describe the type of interaction that this amino makes with the DNA. 2pts.

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**D**- Explain below <u>in one sentence</u> why or why not the interaction between this amino acid contributes to the sequence recognition of this DNA. 2pts

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|---|
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**E**- Explain below <u>in one sentence</u> the consequences of the binding of this amino acid for the structure of this DNA.4pts.

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