

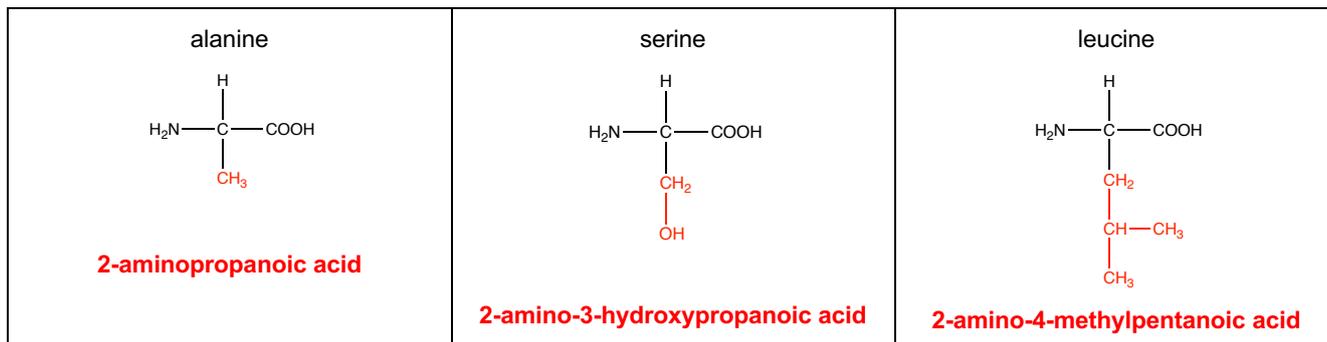
BIOCHEMISTRY



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TASK 1 – Amino acid problems

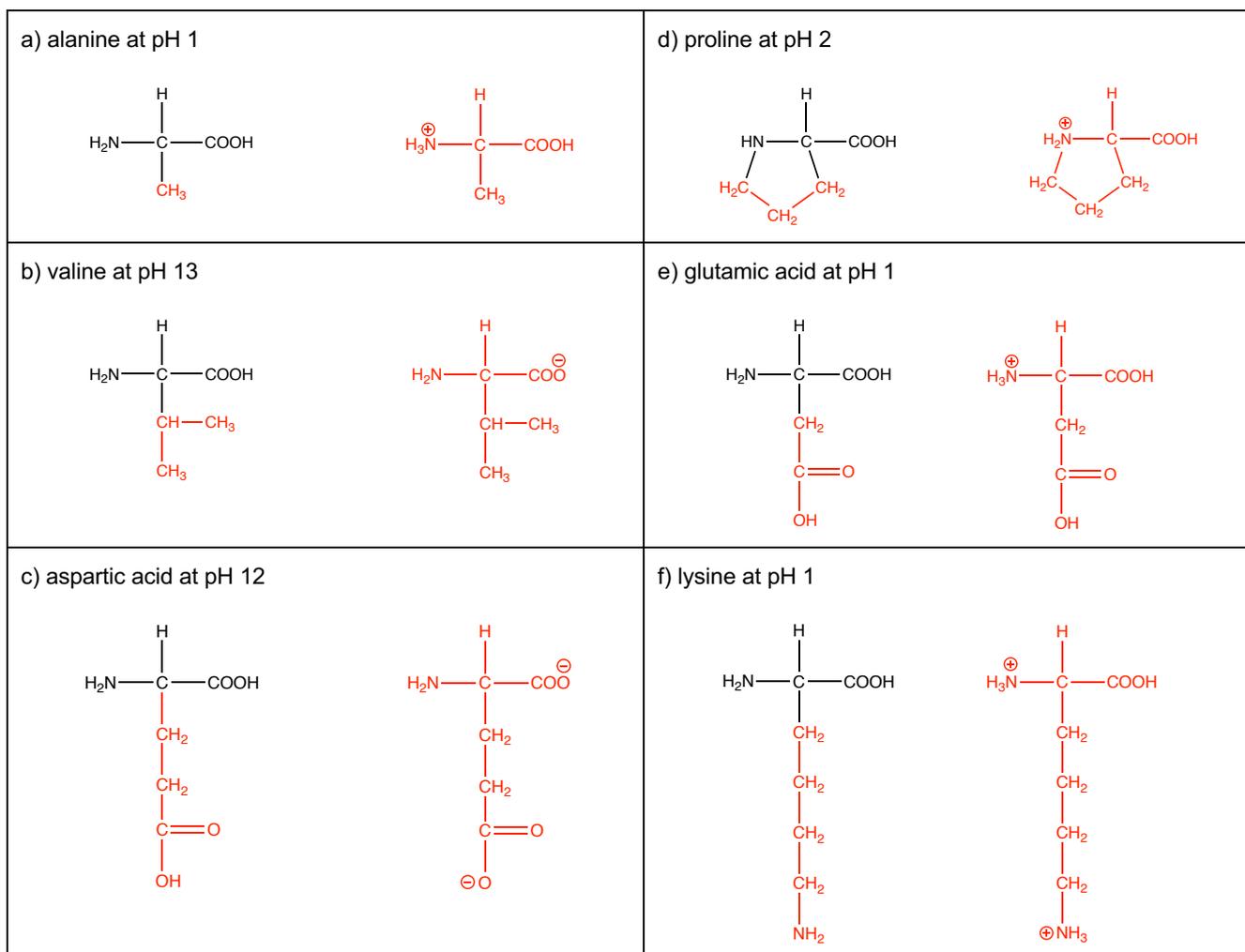
1) Give the IUPAC names for these amino acids:



2) Sketch a 3D diagram to show the two enantiomers of serine.



3) Draw the species formed from each amino acid at the pH shown.



TASK 2 – Reactions of amino acids

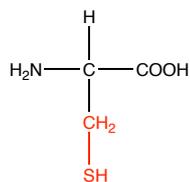
Amino acid	Reaction with NaOH	Reaction with hydrochloric acid	Reaction with methanol in the presence of a small amount of conc H ₂ SO ₄	Reaction with ethanoyl chloride
$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $ <p><i>valine</i></p>	$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COO}^\ominus \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	$ \begin{array}{c} \text{H} \\ \\ \text{H}_3\text{N}^\oplus-\text{C}-\text{COOH} \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	$ \begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{CH}_3 \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	$ \begin{array}{c} \text{O} \quad \text{H} \\ \quad \\ \text{CH}_3-\text{C}-\text{NH}-\text{C}-\text{COOH} \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} $
$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}_2\text{COOH} \end{array} $ <p><i>aspartic acid</i></p>	$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COO}^\ominus \\ \\ \text{CH}_2-\text{COO}^\ominus \end{array} $	$ \begin{array}{c} \text{H} \\ \\ \text{H}_3\text{N}^\oplus-\text{C}-\text{COOH} \\ \\ \text{CH}_2-\text{COOH} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{CH}_3 \\ \\ \text{CH}_2-\text{COOH} \end{array} $	$ \begin{array}{c} \text{O} \quad \text{H} \\ \quad \\ \text{CH}_3-\text{C}-\text{NH}-\text{C}-\text{COOH} \\ \\ \text{CH}_2-\text{COOH} \end{array} $
$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}_2\text{OH} \end{array} $ <p><i>serine</i></p>	$ \begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COO}^\ominus \\ \\ \text{CH}_2-\text{OH} \end{array} $	$ \begin{array}{c} \text{H} \\ \\ \text{H}_3\text{N}^\oplus-\text{C}-\text{COOH} \\ \\ \text{CH}_2-\text{OH} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{CH}_3 \\ \\ \text{CH}_2-\text{OH} \end{array} $	$ \begin{array}{c} \text{O} \quad \text{H} \\ \quad \\ \text{CH}_3-\text{C}-\text{NH}-\text{C}-\text{COOH} \\ \\ \text{CH}_2-\text{OH} \end{array} $

TASK 3 – Formation of dipeptides

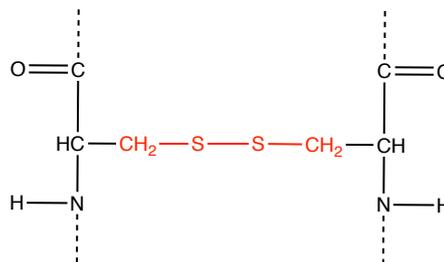
Amino acid	Reaction with alanine (Ala) $\begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}_3 \end{array}$	
	Product 1 (structure and name)	Product 2 (structure and name)
$\begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ <i>valine (Val)</i>	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}-\text{CH}_3 & & & \text{CH}_3 \\ & & & \\ \text{CH}_3 & & & \end{array}$ Val-Ala	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}_3 & & & \text{CH}-\text{CH}_3 \\ & & & \\ & & & \text{CH}_3 \end{array}$ Ala-Val
$\begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}_2\text{COOH} \end{array}$ <i>aspartic acid (Asp)</i>	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}_2-\text{COOH} & & & \text{CH}_3 \end{array}$ Asp-Ala	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}_3 & & & \text{CH}_2-\text{COOH} \end{array}$ Ala-Asp
$\begin{array}{c} \text{H} \\ \\ \text{H}_2\text{N}-\text{C}-\text{COOH} \\ \\ \text{CH}_2\text{OH} \end{array}$ <i>serine (Ser)</i>	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}_2-\text{OH} & & & \text{CH}_3 \end{array}$ Ser-Ala	$\begin{array}{c} \text{H} & \text{O} & \text{H} & \text{H} \\ & & & \\ \text{H}_2\text{N}-\text{C}- & \text{C}- & \text{N}- & \text{C}-\text{COOH} \\ & & & \\ \text{CH}_3 & & & \text{CH}_2-\text{OH} \end{array}$ Ala-Ser

TASK 5 – Tertiary structure of protein interactions

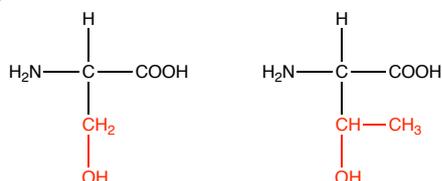
1 The structure of cysteine is shown.



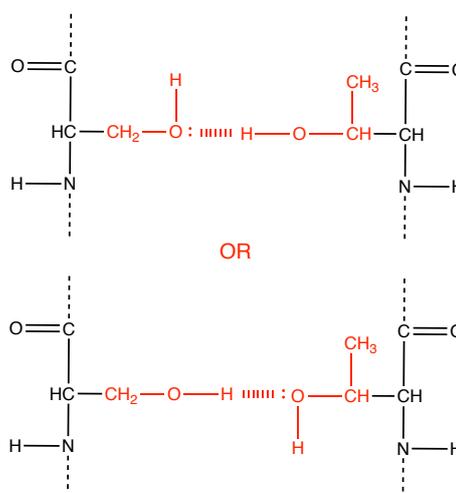
Complete the diagram to show the disulfide bond that can form between two cysteine units in separate parts of the protein structure.



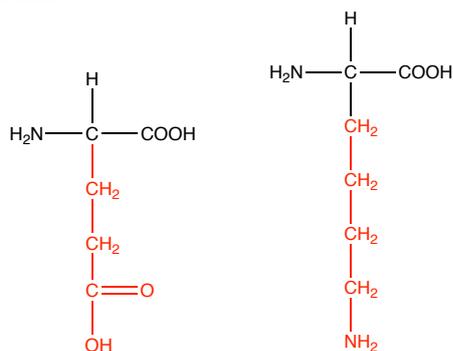
2 The structure of serine and threonine are shown.



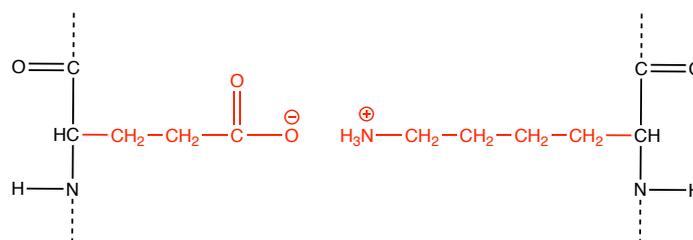
Complete the diagrams to show the two ways in which a hydrogen bond that can form between serine and threonine in separate parts of the protein structure.



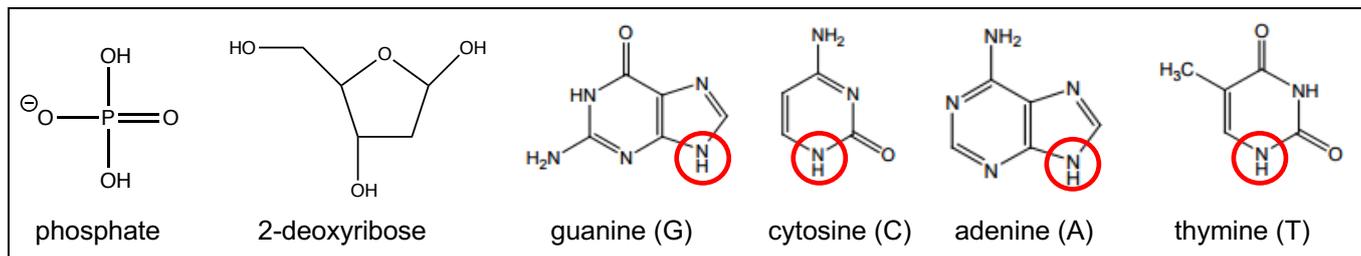
3 The structure of aspartic acid and lysine are shown.



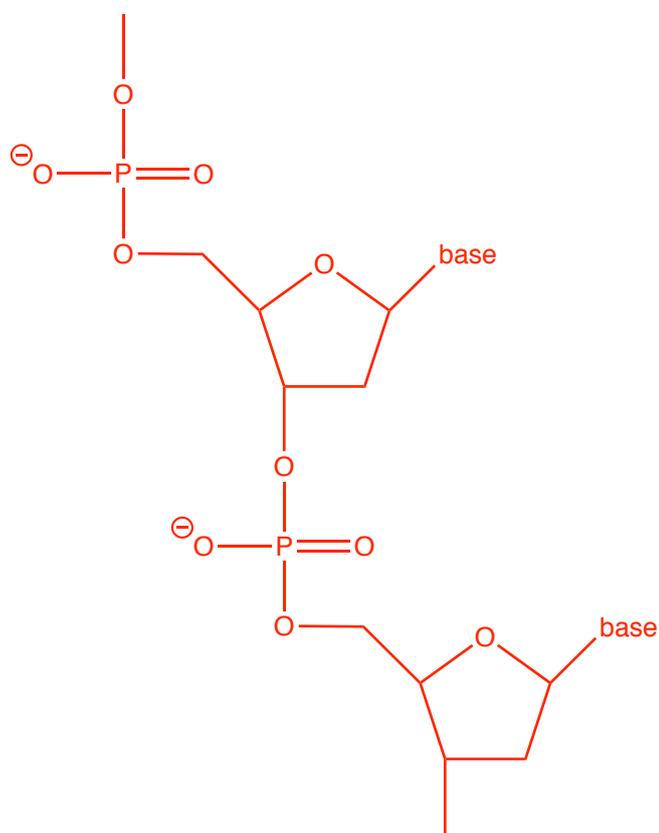
Complete the diagram to show the ionic attraction that can form between aspartic acid and lysine in separate parts of the protein structure.



TASK 6 – DNA Problems

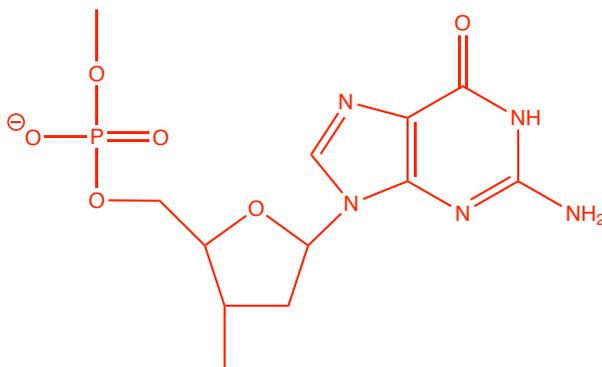


- 1 Sketch part of the DNA backbone showing two phosphate units joined to two 2-deoxyribose units.

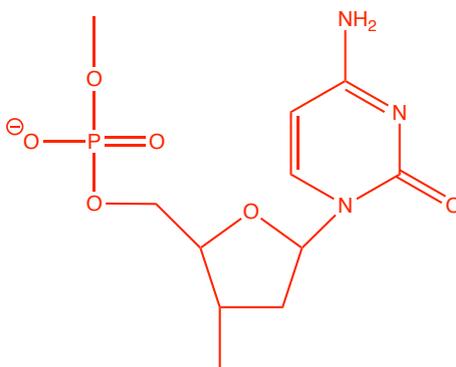


- 2 At the top of the page, circle the N atoms on the four bases through which they bond to the 2-deoxyribose units.

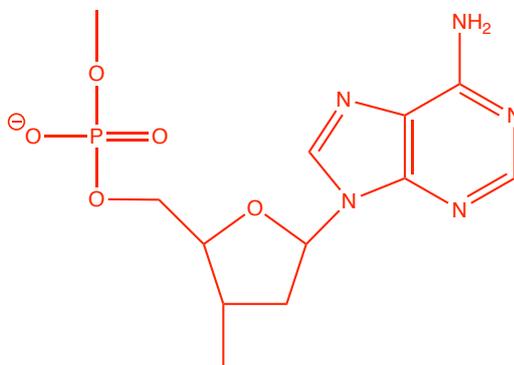
3 Sketch the nucleotide containing one phosphate, one 2-deoxyribose and one guanine unit.



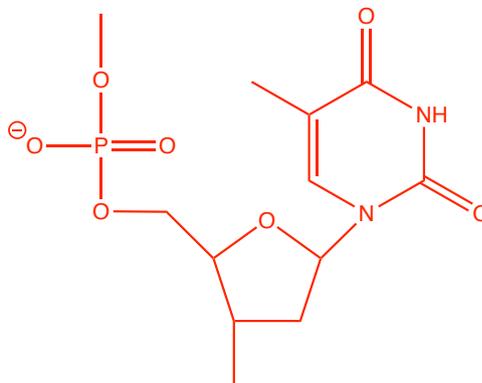
4 Sketch the nucleotide containing one phosphate, one 2-deoxyribose and one cytosine unit.

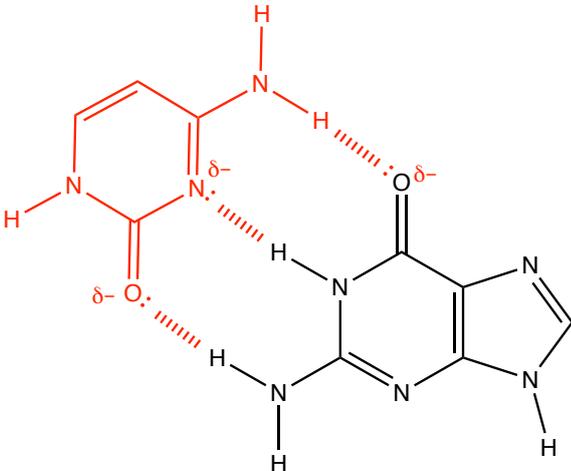
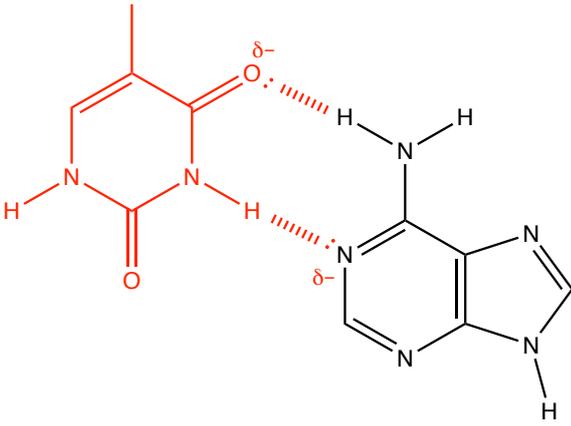


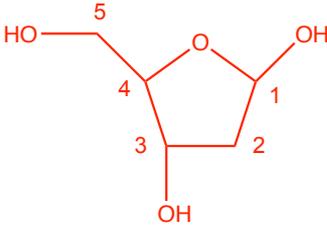
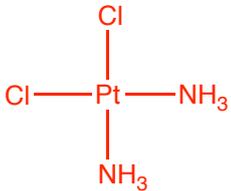
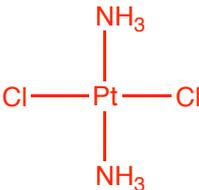
5 Sketch the nucleotide containing one phosphate, one 2-deoxyribose and one adenine unit.



6 Sketch the nucleotide containing one phosphate, one 2-deoxyribose and one thymine unit.



7	<p>DNA consists of two strands each made of nucleotides. What holds the two DNA strands together?</p> <p>Hydrogen bonds between base units on the nucleotides</p>
8	<p>Explain why the interaction between cytosine and guanine units is stronger than that between an adenine and a thymine unit.</p> <p>3 hydrogen bonds between C & G, but only 2 hydrogen bonds between A & T</p>
9	<p>Sketch how a cytosine unit hydrogen bonds to this guanine unit.</p> 
10	<p>Sketch how a thymine unit hydrogen bonds to this adenine unit.</p> 

11	<p>Draw one 2-deoxyribose unit and show how the C atoms are numbered.</p> 
12	<p>Scientists talk about '3 prime' and '5 prime' ends in DNA. What do these terms refer to?</p> <p>The number of the C atom that the phosphate group is bonded to</p>
13	<p>Draw <i>cis</i>-platin.</p> 
14	<p>Explain how <i>cis</i>-platin stops DNA replication and so can act as an anti-cancer drug.</p> <p>Pt binds to N in two guanines in DNA (in place of chloride ligands) – this prevents cell replication</p>
15	<p>Draw <i>trans</i>-platin and explain why this would not stop DNA replication.</p>  <p>Wrong geometry to bind to two guanines on DNA chain(s)</p>