



# A' Level Chemistry

## Year 2

### Unit 15: DNA etc.

## Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.



#### Grade Accelerator

*Recall Definitions*  
*Drawing Diagrams*  
*Using Equations*  
*Drawing Graphs*



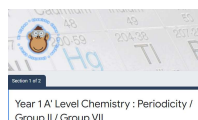
#### Condensed Notes

*Keywords & Definitions*  
*Key Concepts*  
*Application*  
*Key Skills*

#### Quizlet

#### Quizlet Classes

*Flashcard Based*  
*Games*  
*Tests & Quizzes*  
*Keyword Spell Checker*



#### Online Forms

*Take Time to Answer*  
*Use Paper & Calculator*  
*Work It Out*  
*Review Missed Marks*

Use the 3 Wave Process when completing these revision packs.



1. Complete the questions without assistance  
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

#### 1. Having gaps after step 1 is normal, that's why we are doing revision!

2. If your notes don't help during step 2, they are not good enough!  
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy**.



If you struggle with the questions in the pack, **STOP!** and complete some more revision.



If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

|   |   |
|---|---|
| 0 | 6 |
|---|---|

Use the Data Booklet to help you answer this question.

This question is about amino acids and peptide (amide) links.

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 1 |
|---|---|---|---|

Draw the structure of the zwitterion formed by phenylalanine.

**[1 mark]**

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 2 |
|---|---|---|---|

Draw the structure of serine at high pH.

**[1 mark]**

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 3 |
|---|---|---|---|

Draw the structures of both dipeptides formed when phenylalanine reacts with serine.

In each structure show all the atoms and bonds in the amide link.

**[2 marks]**





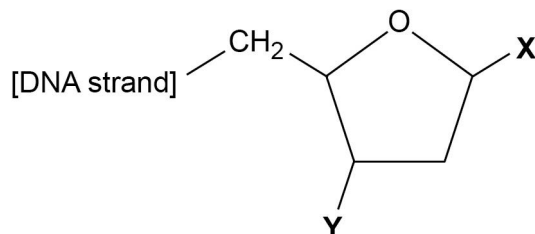
0 9

Use the Data Booklet to help you answer these questions.

DNA exists as two strands of nucleotides in the form of a double helix with hydrogen bonding between the two strands.

0 9 . 1

A deoxyribose molecule in a strand of DNA is shown.



Name the types of group attached to 2-deoxyribose at positions **X** and **Y**.

[2 marks]

X \_\_\_\_\_

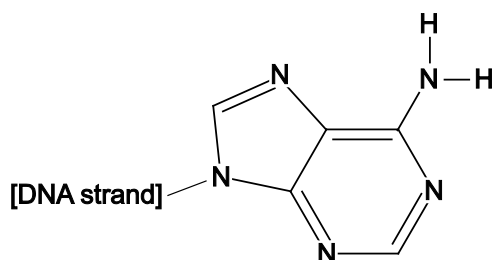
Y \_\_\_\_\_

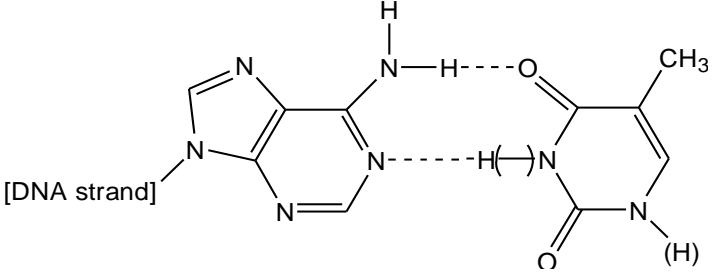
0 9 . 2

In the DNA double helix, adenine is linked by hydrogen bonds to a molecule in the other strand of DNA.

Complete the diagram below to show the other molecule and the hydrogen bonds between it and adenine.

[2 marks]

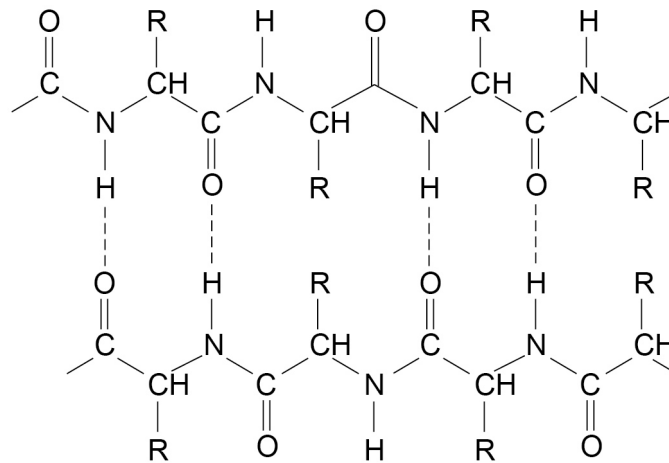


| Question | Answers  | Mark   | Additional Comments/Guidance  |
|----------|--|--------|---|
| 09.1     | X – base<br>Y – phosphate (group)  | 1<br>1 | Ignore organic<br>Any mention of sugar in either loses that mark  |
| 09.2     | <p>If not Thymine CE=0</p>  <p>Correct structure scores 2, penalise by 1 each error in</p> <ul style="list-style-type: none"> <li>• structure of thymine</li> <li>• orientation of thymine</li> <li>• hydrogen bonding</li> </ul> | 2      | <p>Ignore lp on N and O<br/>Don't penalise non-linear H bonds<br/>on RHS of thymine – allow with or without H or – [DNA strand]</p> |
| Total    |  | 4      |   |

0 8

Use the Data Booklet to help you answer this question about amino acids.  
Figure 1 shows parts of two polypeptide chains in a beta-pleated sheet of a protein.

Figure 1



0 8 . 1

The polypeptide chains are held together by hydrogen bonding as shown in Figure 1.

Explain how these hydrogen bonds form.

[2 marks]

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0 8 . 2

A different type of bond can form between two polypeptide chains when the chains each contain the amino acid cysteine.

Complete the structure to show the bond that forms between the side chains of two cysteine molecules.

[1 mark]



**0 8 . 3** The type of bond in Question **08.2** between two polypeptide chains influences the three-dimensional structure of the protein.

Name this type of protein structure.

**[1 mark]**

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**0 8 . 4** Draw the structure of the zwitterion of a dipeptide formed by alanine and serine.

**[2 marks]**

—  
**6**

**Turn over for the next question**

**Turn over ►**



0 9

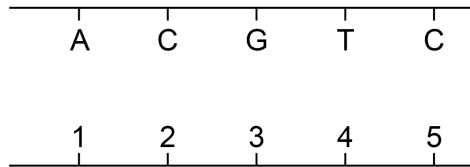
Use the Data Booklet to help you answer this question about DNA.

**Figure 2** shows a fragment of a DNA double helix.

The letters A, C, G and T represent the four bases in one strand.

The numbers 1, 2, 3, 4 and 5 represent the bases in the complementary strand.

**Figure 2**



0 9

1

Complete **Table 4** to show the correct sequence of bases in the complementary strand represented by the numbers 1 to 5

[1 mark]

**Table 4**

|   |   |   |   |   |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
|   |   |   |   |   |

0 9

2

Deduce the total number of hydrogen bonds formed between the five bases in each strand.

Tick (✓) **one** box.

[1 mark]

|    |    |    |    |
|----|----|----|----|
| 10 | 12 | 13 | 15 |
|    |    |    |    |

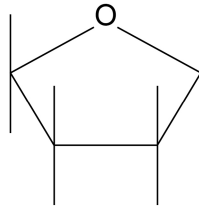




0 9 . 3

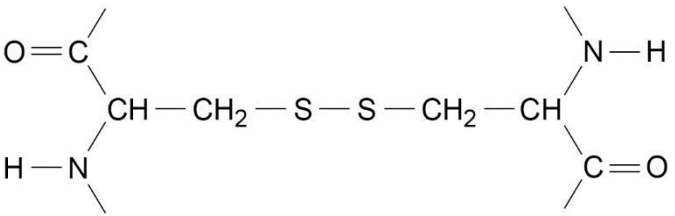
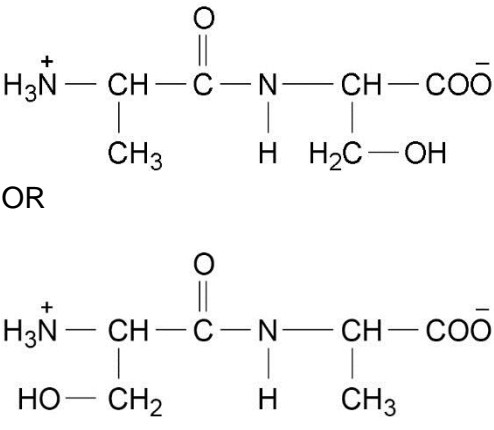
Base A is part of a nucleotide in the DNA strand shown in **Figure 2**.  
A nucleotide contains a 2-deoxyribose molecule.  
An incomplete 2-deoxyribose molecule is shown.

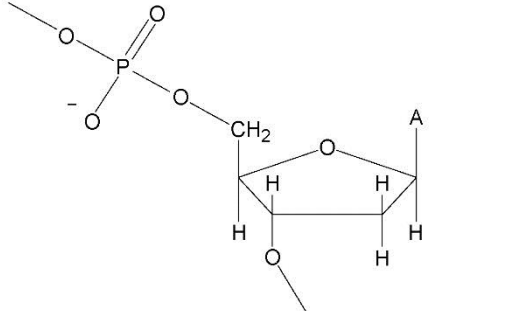
Complete the structure to show the nucleotide that contains base A.  
You should represent base A by the letter A.

**[2 marks]**

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4**Turn over for the next question****Turn over ►**

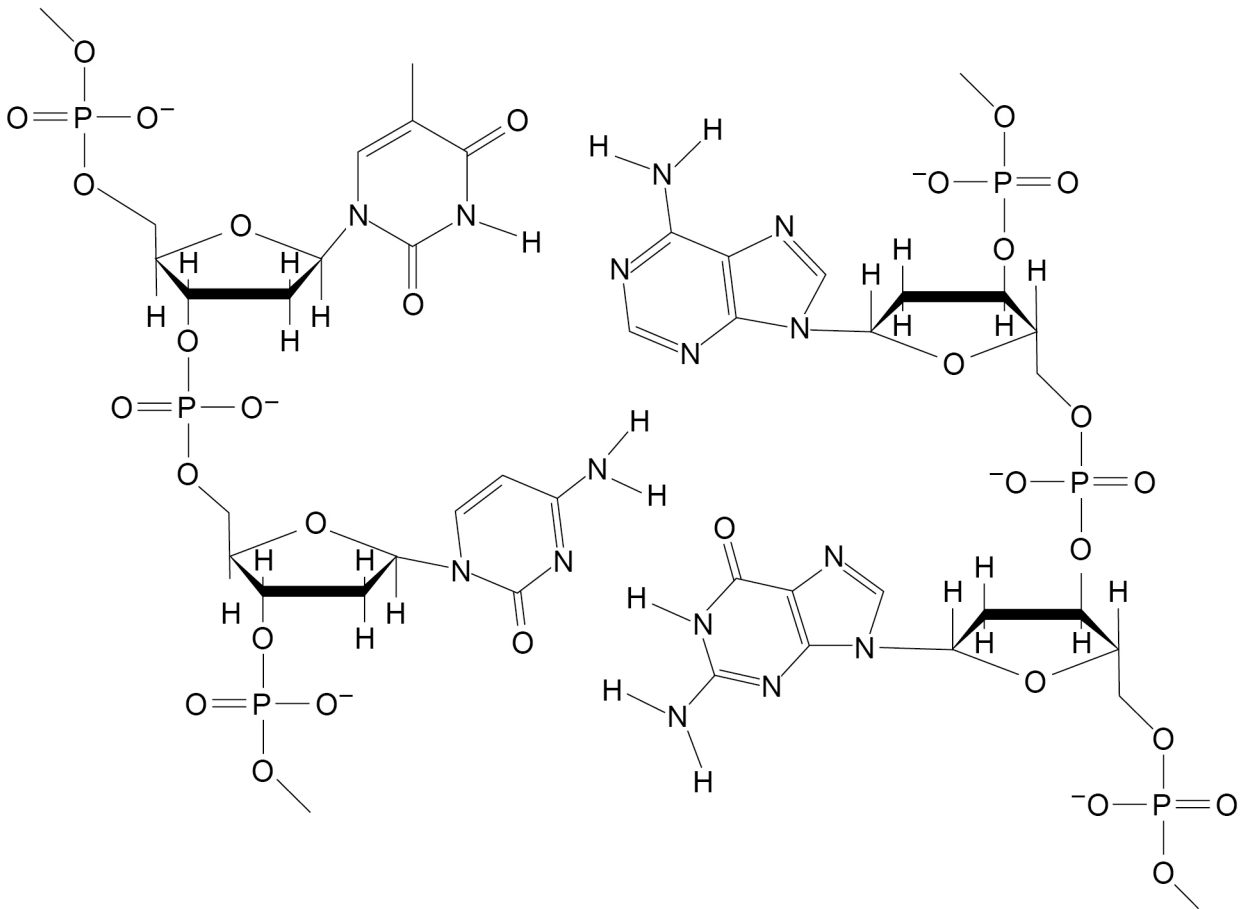
| Question      | Answers  | Mark     | Additional Comments/Guidance  |
|---------------|--|----------|---|
| 08.1          | electron deficient H<br>(Which attracts) lone pair/electron pair on O              | M1<br>M2 | Allow H delta plus / slightly positive<br>Penalise lone pair/electron pair donation   |
| 08.2          |   | 1        | Penalise dashed/dotted S—S<br>Ignore extra additions to structures  |
| <b>G</b> 08.3 | Tertiary or Quaternary   | 1        | Allow 3° or 4°<br>do not penalise minor error in spelling e.g. Quarternary  |
| 08.4          |  | 1<br>1   | Incorrect peptide bond CE=O<br>M1 for correct dipeptide<br>M2 for correct charges<br>Ignore additional dipeptide in working<br>Allow –CONH– or –COHN– |
| Total         |  | 6        |   |

| Question         | Answers   | Mark  | Additional Comments/Guidance   |
|------------------|---|---|--|
| <b>G</b> 09.1    | 1    2    3    4    5<br>T    G    C    A    G                                    | 1   |  |
| <b>Auto</b> 09.2 | 13  | 1   |  |
| 09.3             |  | 1 for completed<br>2-deoxyribose plus A<br><br>1 for correct phosphate<br>joined to CH <sub>2</sub> | Allow either OH or trailing bonds<br><br>Don't penalise 'sticks' in 2-deoxyribose.<br><br>If two phosphates shown CE=0<br><br>If CH <sub>2</sub> missing award 1 if no further errors<br><br>If phosphate attached to oxygen on C3 award 1<br>if no further errors |
| Total            |   | 4   |  |

1 2

Figure 4 shows two complementary strands in part of a DNA double helix structure.

Figure 4



1 2 . 1

Draw all the hydrogen bonds between the complementary strands shown in Figure 4.

Use dashed lines to show the hydrogen bonds.

You do **not** need to show lone pairs of electrons or partial charges.

[2 marks]

1 2 . 2

Draw a ring around each of the component parts that make up the cytosine nucleotide in the section of DNA shown in Figure 4.

[2 marks]

1 2 . 3

State the meaning of the term complementary when it is used to refer to DNA strands.

[1 mark]

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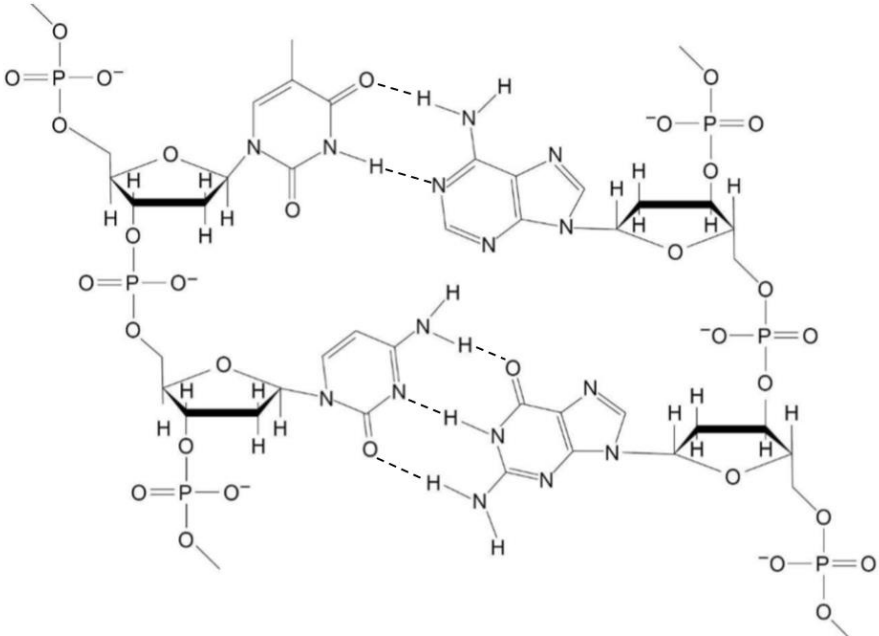


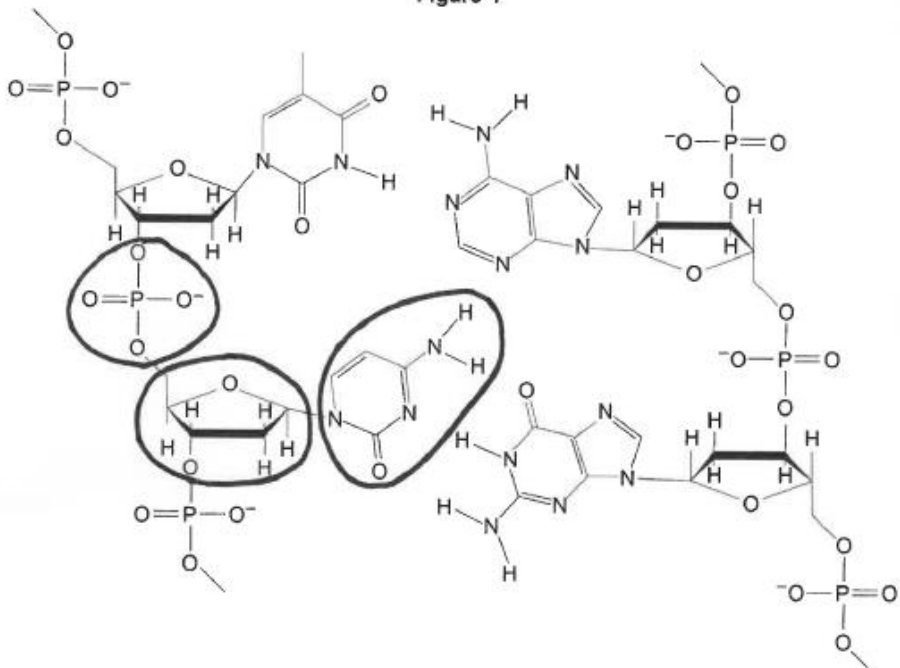
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5

Turn over ►

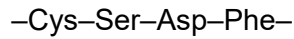


| Question | Answers  | Additional Comments/Guidelines   | Mark              |
|----------|--|--|-------------------|
| 12.1     |  | <p>M1 scored for the 2 H 'bonds' between A and T</p> <p>M2 scores for the 3 H 'bonds' between C and G</p> <p>Lose 1 for each extra 'bond'</p> <p>H bonds must be linear</p> <p>Penalise the use of full bonds instead of dashed lines once only</p> <p>Ignore lone pairs and partial charges even if wrong</p> | <p>1</p> <p>1</p> |

|      |   |  |                   |
|------|---|--|-------------------|
| 12.2 | <p style="text-align: center;"><b>Figure 4</b></p>  | <p>M1 scored for correct selection of cytosine and associated sugar</p> <p>M2 scored for selection of <u>correct</u> (upper) phosphate</p> <p>M1 &amp; M2 can be scored with one 'ring'<br/>Allow ring either side of the top O of either phosphate</p> <p>If wrong base circled, can score M2 for correct phosphate conseq to their base, i.e.</p> <p>top left, Thymine it's the upper phosphate<br/>top right, Adenine it's the lower phosphate<br/>bottom right, Guanine it's the lower phosphate</p> | <p>1</p> <p>1</p> |
| 12.3 | (Complementary means the two strands must have base sequences) that match (all) <u>A to T and C to G</u>                              | Ignore reference to (hydrogen) bonding   | 1                 |

**0 4**

Proteins are polymers made from amino acids.  
Part of the structure of a protein is shown.



Each amino acid in the protein is shown using the first three letters of its name.

**0 4 . 1**

Identify the type of protein structure shown.

**[1 mark]**

Tick (✓) **one** box.

Primary

Secondary

Tertiary

**0 4 . 2**

Draw a structure for the  $\text{--Cys--Ser--}$  section of the protein.  
Use the Data Booklet to help you answer this question.

**[2 marks]**

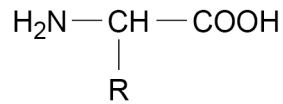
**Question 4 continues on the next page**

**Turn over ►**

**0 4 . 3** Name the other substance formed when two amino acids react together to form part of a protein chain.

**[1 mark]**

The general structure of an amino acid is shown.



R represents a group that varies between different amino acids.  
R groups can interact and contribute to protein structure.

**0 4 . 4** Explain why the strength of the interaction between two cysteine R groups differs from the strength of the interaction between a serine R group and an aspartic acid R group.

Use the Data Booklet to help you answer this question.

**[4 marks]**

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**0 4 . 5** Deduce the type of interaction that occurs between a lysine R group and an aspartic acid R group.

**[1 mark]**

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|---|
|   |
| 9 |





| Question | Answers   | Additional Comments/Guidelines   | Mark  |
|----------|---|--|---|
| 04.1     | Primary   |  | 1<br>(AO1)  |
| Question | Answers   | Additional Comments/Guidelines   | Mark  |
| 04.2     | $  \begin{array}{ccccccc}  & \text{H} & \text{H} & & \text{O} & & \text{H} & \text{O} \\  &   &   & &    & &   &    \\  - & \text{N} & - \text{C} & - & \text{C} & - & \text{N} & - \text{C} & - & \text{C} & - \\  & &   & & & &   & & & & \\  & & \text{CH}_2\text{OH} & & & & \text{H} & & & & \text{CH}_2\text{SH}  \end{array}  $ OR<br>$  \begin{array}{ccccccc}  & \text{H} & \text{H} & & \text{O} & & \text{H} & \text{O} \\  &   &   & &    & &   &    \\  - & \text{N} & - \text{C} & - & \text{C} & - & \text{N} & - \text{C} & - & \text{C} & - \\  & &   & & & &   & & & & \\  & & \text{CH}_2\text{SH} & & & & \text{H} & & & & \text{CH}_2\text{OH}  \end{array}  $ | M1 for correct peptide link (Allow -CONH- as a minimum)<br><br>M2 for the correct amino acid R groups<br><br>Dipeptide can only score M1<br><br><br><br><br><br>Trailing bonds <b>not</b> needed | M1<br><br><br><br><br><br><br><br>M2<br>(2 x AO2) |
| Question | Answers   | Additional Comments/Guidelines   | Mark  |
| 04.3     | Water   | Allow H <sub>2</sub> O   | 1<br>(AO1)  |

| Question | Answers  | Additional Comments/Guidelines                           | Mark                        |
|----------|--|--|-----------------------------|
| 04.4     | Two Cys R groups form a <u>disulfide</u> bridge/link stated or described   | Could score via a correct diagram showing minimum -S-S-  | M1                          |
|          | Ser and Asp R groups form <u>Hydrogen bonds</u>                            | Allow H bonds  | M2                          |
|          | Disulfide bridges are stronger <u>er</u> than Hydrogen bonds               | Interactions between cys R groups are stronger <u>er</u> | M3                          |
|          | Because disulfide bridges are covalent bonds (while Hydrogen bonds aren't) | Because covalent bonds are stronger (than H bonds)       | M4<br>(2 x AO1,<br>2 x AO3) |

| Question | Answers      | Additional Comments/Guidelines | Mark       |
|----------|--------------|--------------------------------|------------|
| 04.5     | Ionic (bond) |                                | 1<br>(AO3) |