

# Structure and replication of DNA

## Question Paper 1

<b>Level</b>	International A Level
<b>Subject</b>	Biology
<b>Exam Board</b>	CIE
<b>Topic</b>	Nucleic acids and protein synthesis
<b>Sub Topic</b>	Structure and replication of DNA
<b>Booklet</b>	Theory
<b>Paper Type</b>	Question Paper 1

**Time Allowed :** 71 minutes

**Score :** / 59

**Percentage :** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 Red blood cells are formed from cells called reticulocytes. Stem cells in the bone marrow produce reticulocytes which differentiate into red blood cells. During differentiation haemoglobin is produced.

Fig. 6.1 shows the structure of small sections of DNA and messenger RNA (mRNA) in the nucleus of a reticulocyte during transcription.

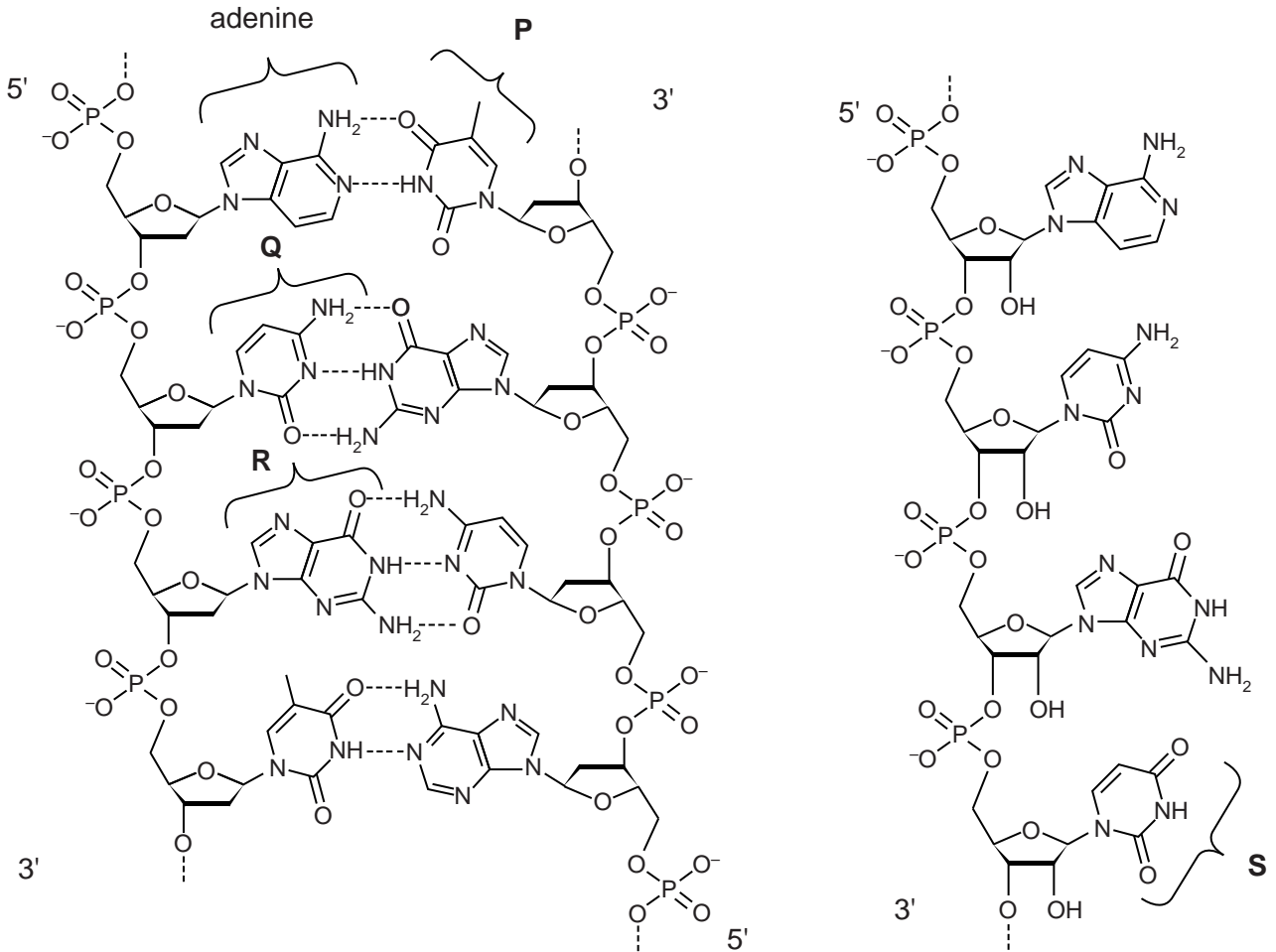


Fig. 6.1

- (a) Name the bases **P** to **S**.

**P** .....

**Q** .....

**R** .....

**S** ..... [4]

**(b)** Describe the role of the mRNA molecule shown in Fig. 6.1.

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.....[3]

[Total: 7]

2 Fig. 6.1 shows part of a DNA molecule.

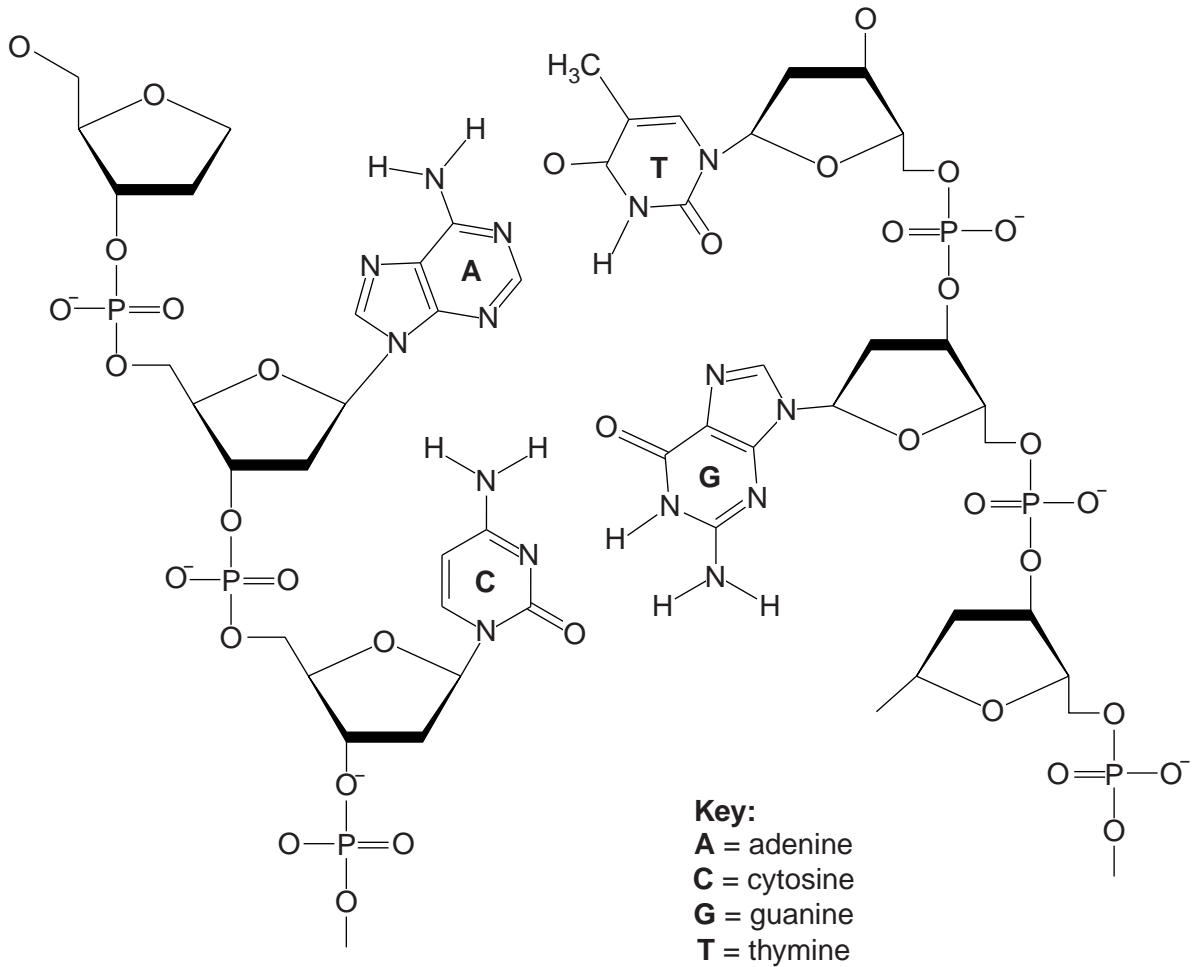


Fig. 6.1

(a) (i) Complete Fig. 6.1 by drawing on the hydrogen bonds between the two base pairs shown. [2]

(ii) State the importance of hydrogen bonding in DNA structure.

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..... [2]



(c) Table 6.2 shows Chargaff's data for a virus.

Table 6.2

organism	percentage of adenine	percentage of thymine	percentage of guanine	percentage of cytosine
a virus	24.0	31.2	23.3	21.5

(i) State how the result for the virus differs from the results for all the organisms given in Table 6.1.

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.....  
..... [1]

(ii) Suggest why the results for the virus are different from all the other organisms.

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..... [1]

[Total: 9]

- 3 (a)** Complete the table to show **three** ways in which the **structure** of DNA differs from RNA.

	DNA	RNA
<b>1</b>		
<b>2</b>		
<b>3</b>		

[3]

- (b)** Table 2.1 shows two messenger RNA (mRNA) codons. Fill in the complementary transfer RNA (tRNA) anticodons in the spaces provided.

**Table 2.1**

mRNA codons	GCG	ACA
complementary tRNA anticodons		

[2]

- (c)** Calculate the minimum number of DNA nucleotides necessary to code for a polypeptide with 238 amino acids.

Show your working.

answer ..... nucleotides [2]

**(d)** Describe the role played by tRNA in polypeptide synthesis.

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..... [4]

[Total: 11]



4 (a) Name the stage during the mitotic cell cycle when replication of DNA occurs.

.....[1]

(b) Fig. 5.1 shows details of DNA replication.

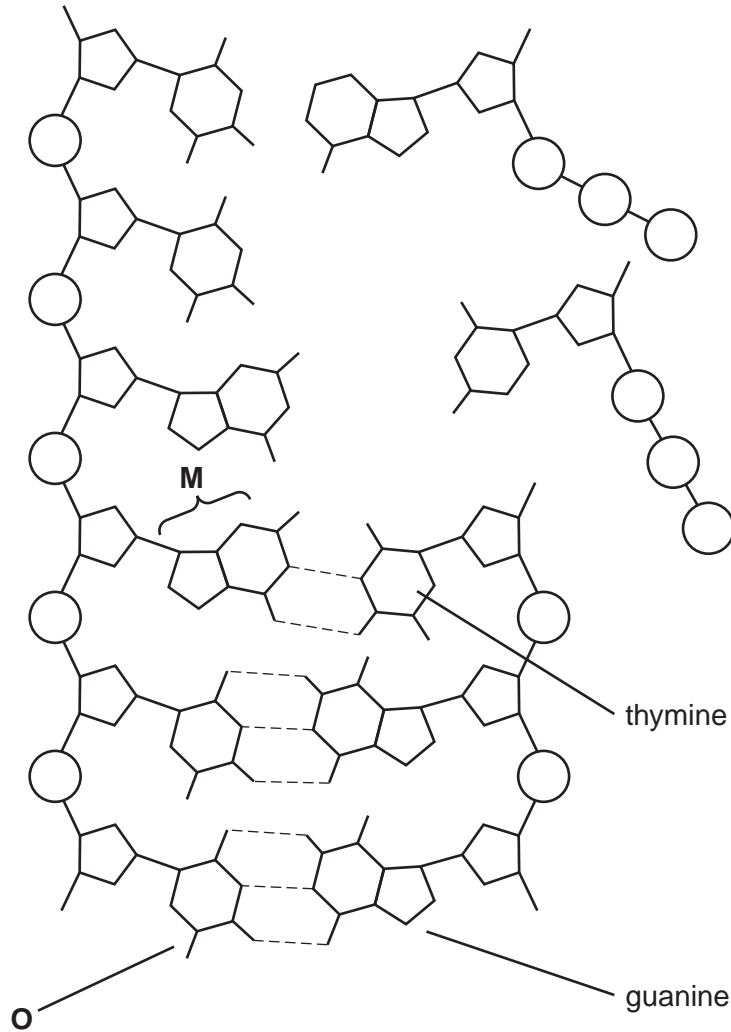


Fig. 5.1

(i) Name the bonds shown by the dashed lines on Fig. 5.1.

.....[1]

(ii) Name the nitrogenous bases, **M** and **O**.

**M** .....

**O** .....[1]

**(c)** Explain why DNA replication is described as *semi-conservative*.

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..... [2]

**(d)** The enzyme that catalyses the replication of DNA checks for errors in the process and corrects them. This makes sure that the cells produced in mitosis are genetically identical.

Explain why checking for errors and correcting them is necessary.

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..... [2]

[Total: 7]

5 Fig. 3.1 shows seven biological molecules, labelled D to K.

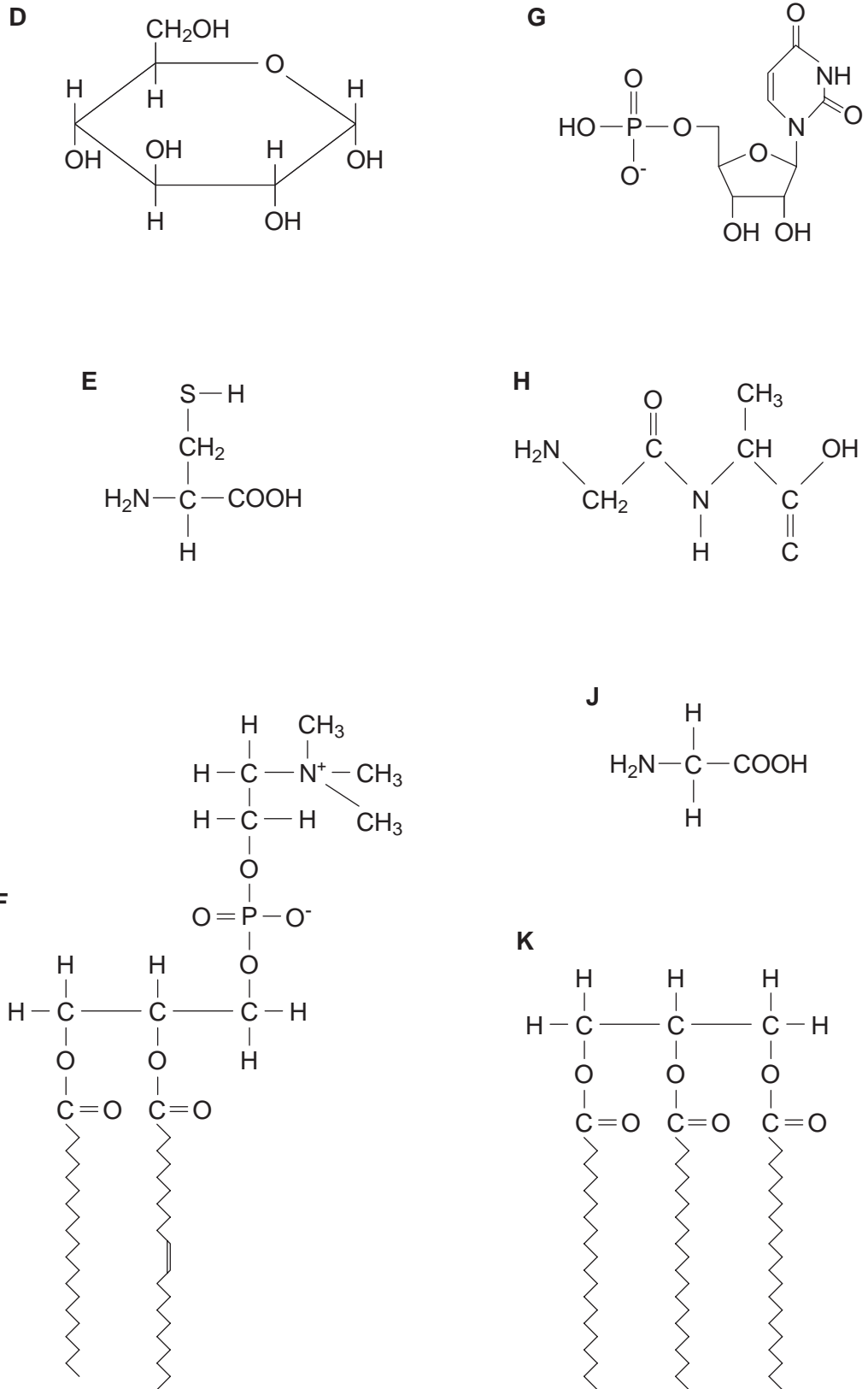


Fig. 3.1

(a) Table 3.1 contains statements about the biological molecules in Fig. 3.1.

Complete the table by selecting the biological molecule from Fig. 3.1 that matches each of the statements. Write the appropriate letter from Fig. 3.1 in the table. The first one has been done for you.

You may use each letter once, more than once or not at all.

**Table 3.1**

statement	letter
an amino acid that is a major constituent of collagen	<b>J</b>
a component of RNA	
a molecule that is polymerised to form glycogen	
a molecule with a peptide bond	
an important store of energy, insoluble in water	
a molecule with hydrophilic and hydrophobic regions	
an amino acid that forms disulfide (disulphide) bonds in proteins	

[6]

(b) Describe two ways in which the **structure** of DNA differs from the **structure** of collagen.

1 .....

.....

2 .....

..... [2]

[Total: 8]

- 6 (a) Complete the table by indicating with a tick (✓) or a cross (✗) whether the statements apply to proteins, DNA, messenger RNA and cellulose.

You should put a tick or a cross in each box of the table.

statement	protein	DNA	messenger RNA	cellulose
hydrogen bonds stabilise the molecule				
glucose is the subunit molecule				
subunits are joined by peptide bonds				
may be hydrolysed to amino acids				
contains uracil				

[5]

During an immune response, B-lymphocytes become plasma cells and begin to make polypeptides that are assembled into antibodies.

Fig. 3.1 is a diagram showing the formation of a polypeptide at a ribosome in a plasma cell.

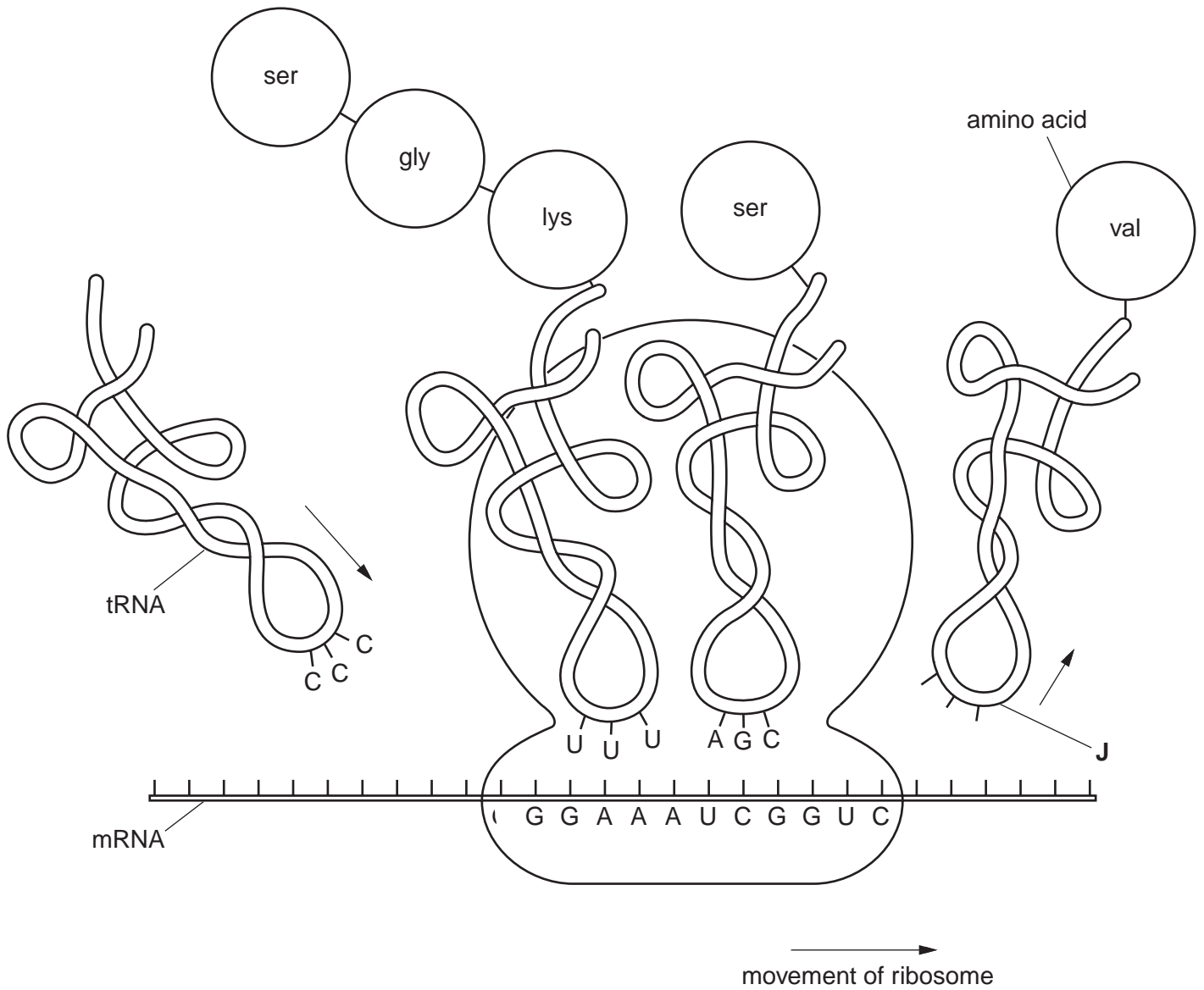


Fig. 3.1

(b) State the sequence of bases at J.

.....[1]

- (c) Use the information in Fig. 3.1 to describe the role of transfer RNA molecules in translation.

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.....[5]

The bacterium that causes cholera, *Vibrio cholerae*, releases a toxin known as cholera toxin. During an immune response to cholera some B-lymphocytes produce antibodies that combine with cholera toxin so inactivating it. Antibodies that inactivate toxins are called antitoxins.

- (d) Explain how the structure of an antibody, such as the antitoxin for cholera toxin, makes it specific to one substance.

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.....[3]

- (e) Explain why cholera remains a significant infectious disease in some parts of the world.

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.....[3]