



**BIOLOGY**  
**STANDARD LEVEL**  
**PAPER 2**

Monday 5 November 2001 (afternoon)

1 hour

Name

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Number

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**INSTRUCTIONS TO CANDIDATES**

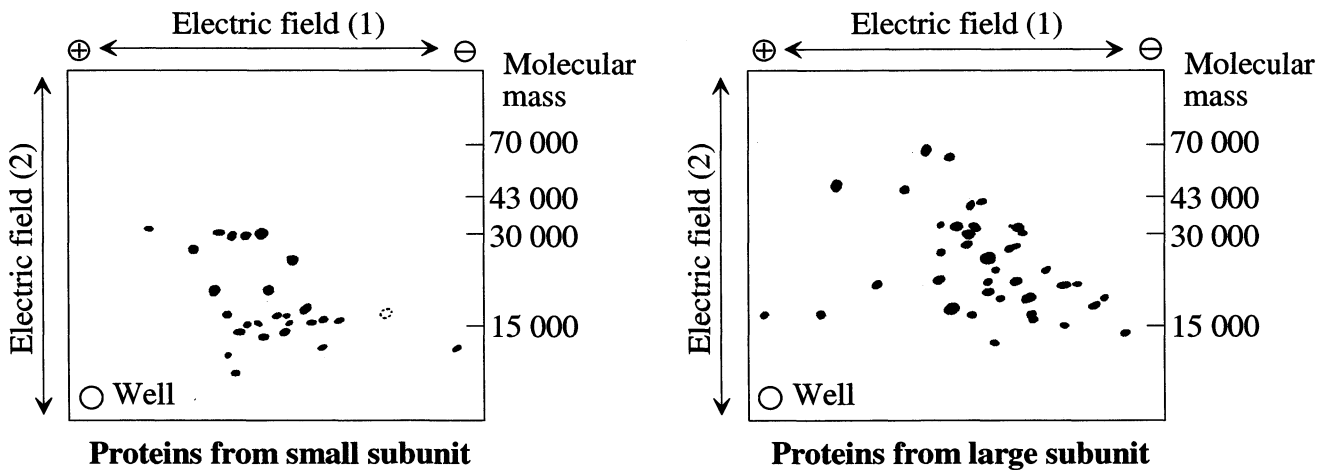
- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: Answer all of Section A in the spaces provided.
- Section B: Answer one question from Section B. Write your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the number of the Section B question answered in the box below.

QUESTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
SECTION A	ALL	/20	/20	/20
SECTION B QUESTION	.....	/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	.....	TOTAL /40	TOTAL /40	TOTAL /40

SECTION A

Candidates must answer all questions in the spaces provided.

1. A ribosome is made up of two subunits, one large and one small. Each subunit contains RNA and protein molecules. A laboratory investigation was performed to study the protein portion of the ribosomes of *Chlamydomonas reinhardi*, a eukaryotic cell. The proteins of the small and large subunits were extracted and then separated by gel electrophoresis. Mixtures of the proteins were placed in a well in the corner of each gel. The conditions used initially caused the proteins to move from left to right across the gel. The conditions were then changed to cause the proteins to move up the gel, to give further separation. Each type of protein appears as one spot on the gels.



(Source: M R Hanson *et al.*, *Mol. Gen. Genet.*, 132 (1974), pages 105-118)

- (a) State the **two** properties of the proteins used to separate them in the gel. [2]

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- (b) Suggest **one** reason for the different sizes of the spots. [1]

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- (c) Compare the protein composition of the subunits in terms of the number of different types of proteins and the range of molecular masses. [2]

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(This question continues on the following page)

(Question 1 continued)

Red blood cells contain a globular protein called haemoglobin. Each haemoglobin molecule contains two beta-globin polypeptides. The amino acid sequence of the beta-globin polypeptide can be represented as:

MVHLTPEEKSAVTALWGKVVNDEVGGGEALGRLLVVYPWTQRFFESFGDLS

TPDAVMGNPKVKAHGKKVLGAFSDGLAHLNLIKGTFFATLSELHCDKLHVD

PENFRLGQVNLVLCVLAHFFGKEFTPPVQAAAYQKVVAGVANALAHKYH

**Key to Amino Acids**

**The Standard Genetic Code in mRNA**

**Name                      Abbreviations**

Glycine	Gly	G	UUU Phe	UCU Ser	UAU Tyr	UGU Cys
Alanine	Ala	A	UUC Phe	UCC Ser	UAC Thr	UGC Cys
Valine	Val	V	UUA Leu	UCA Ser	UAA Stop	UGA Stop
Leucine	Leu	L	UUG Leu	UCG Ser	UAG Stop	UGG Trp
Isoleucine	Ile	I				
Proline	Pro	P	CUU Leu	CCU Pro	CAU His	CGU Arg
Phenylalanine	Phe	F	CUC Leu	CCC Pro	CAC His	CGC Arg
Tyrosine	Tyr	Y	CUA Leu	CCA Pro	CAA Gln	CGA Arg
Tryptophan	Trp	W	CUG Leu	CCG Pro	CAG Gln	CGG Arg
Serine	Ser	S				
Threonine	Thr	T	AUU Ile	ACU Thr	AAU Asn	AGU Ser
Cysteine	Cys	C	AUC Ile	ACC Thr	AAC Asn	AGC Ser
Methionine	Met	M	AUA Ile	ACA Thr	AAA Lys	AGA Arg
Asparagine	Asn	N	AUG Met	ACG Thr	AAG Lys	AGG Arg
Glutamine	Gln	Q				
Aspartate	Asp	D	GUU Val	GCU Ala	GAU Asp	GGU Gly
Glutamate	Glu	E	GUC Val	GCC Ala	GAC Asp	GGC Gly
Lysine	Lys	K	GUA Val	GCA Ala	GAA Glu	GGA Gly
Arginine	Arg	R	GUG Val	GCG Ala	GAG Glu	GGG Gly
Histidine	His	H				

- (d) Calculate the minimum number of nucleotides in DNA which would code for the beta-globin polypeptide. Show your working fully. [2]

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- (e) Suggest a reason why the mRNA sequence of nucleotides for beta-globin is impossible to determine if only the amino acid sequence is known. [1]

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(This question continues on the following page)

*(Question 1 continued)*

- (f) A point mutation in the beta-globin gene causes sickle cell anemia. The mutation occurs when glutamate (glutamic acid) in the seventh amino acid position of the polymer is replaced by valine.

Using the list of amino acid names with abbreviations and the genetic code

- (i) deduce the point mutation in **DNA** which would result in the production of valine instead of glutamate. *[1]*

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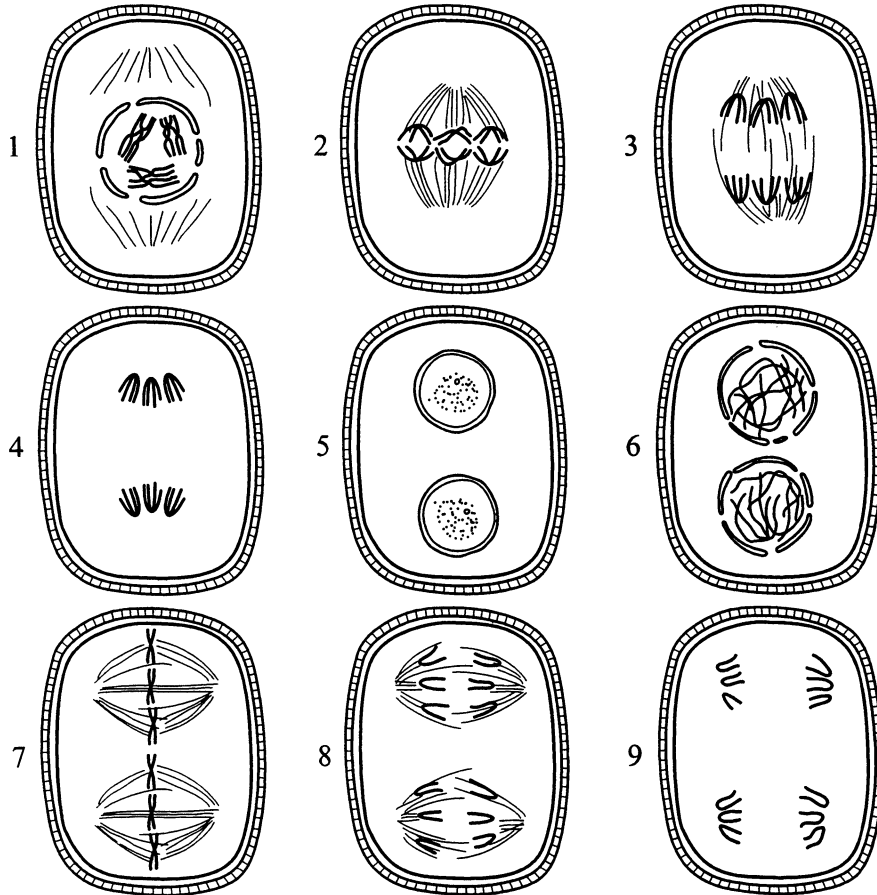
- (ii) identify **two** codons for valine which could replace glutamate. *[1]*

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2. (a) Eukaryotic chromosomes consist of DNA and one other substance. State the other substance. [1]

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The diagrams below show a process involving the chromosomes of a cell.



- (b) Identify the process illustrated in the diagrams. [1]

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- (c) (i) Deduce the diploid number of chromosomes of the cell type shown in the diagrams. [1]

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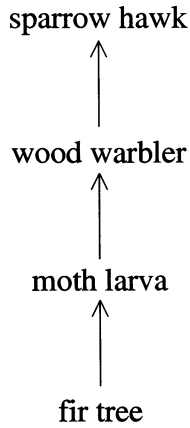
- (ii) Deduce, with a reason, whether the nuclei in stage five are haploid or diploid. [1]

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- (iii) Identify, with a reason, whether the cell type in the diagrams is plant or animal. [1]

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3. The diagram below shows a food chain from a woodland community.



(a) State the trophic level of the wood warbler in the food chain. [1]

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(b) By adding links to the food chain given above, draw a food web using the following information:

- Mice feed on grass seeds;
- Goshawks feed on mice and wood warblers;
- Wood warblers also feed on berries and nectar feeding insects;
- Nectar is produced by flowers;
- Sparrow hawks also feed on mice.

[2]

(c) Explain what is meant by the term *biosphere*. [2]

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**SECTION B**

*Answer one question. Up to two additional marks are available for the construction of your answer. Write your answers in a continuation answer booklet. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.*

4. (a) Outline the structure of cell membranes, including the substances contained within them and how they are arranged. [5]
- (b) Explain how the properties of phospholipids help to maintain the structure of the cell membrane. [8]
- (c) Compare active transport across membranes with passive transport across membranes. [5]
5. (a) Outline **one** technique used to estimate the population size of an animal that does not remain in a fixed position. [5]
- (b) Compare the conditions which allow exponential growth of a population with those that cause the population to remain at a plateau. [5]
- (c) Explain how species can evolve by natural selection. [8]
6. (a) Outline the features of alveoli which allow efficient gas exchange. [5]
- (b) Explain the concept of homeostasis with reference to body temperature. [8]
- (c) Outline the role of the nervous system in controlling the breathing rate during exercise. [5]
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