

# 3.1 Genes & Chromosomes

## Question Paper

Course	DP IB Biology
Section	3. Genetics
Topic	3.1 Genes & Chromosomes
Difficulty	Hard

**Time allowed:** 10  
**Score:** /5  
**Percentage:** /100

### Question 1

The nucleotide base sequence and the associated sequence of four amino acids can be seen below:

AGG ACA CCT GGA

Serine Tyrosine Glycine Proline

The table shows the mRNA codons and their associated amino acids.

		Second Letter							
		U	C	A	G				
First Letter	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	Third Letter	U		
		UUC } Leu		UCC } Ser			UAC } Tyr	UGC } Cys	C
		UUA } Leu		UCA } Ser			UAA – STOP	UGA – STOP	A
		UUG } Leu		UCG } Ser			UAG – STOP	GGU – Trp	G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg		U		
		CUC } Leu		CCC } Pro			CAC } His	CGC } Arg	C
		CUA } Leu		CCA } Pro			CAA } Gln	CGA } Arg	A
		CUG } Leu		CCG } Pro			CAG } Gln	CGG } Arg	G
	A	AUU } Ile	ACU } Thr	AAU } Asn	AGU } Ser		U		
		AUC } Ile		ACC } Thr			AAC } Asn	AGC } Ser	C
		AUA } Ile		ACA } Thr			AAA } Lys	AGA } Arg	A
		AUG – Met		ACG } Thr			AAG } Lys	AGG } Arg	G
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly		U		
		GUC } Val		GCC } Ala			GAC } Asp	GGC } Gly	C
		GUA } Val		GCA } Ala			GAA } Glu	GGA } Gly	A
		GUG } Val		GCG } Ala			GAG } Glu	GGG } Gly	G

A single mutation occurred in the original base sequence of the DNA which resulted in only one amino acid from the sequence being produced.

Which of the following would represent the correct nucleotide base sequence which was found in the DNA after the mutation occurred?

- A. AGT ACA CCT GGA
- B. AGG ACT CCT GGA
- C. AGG ACC CCT GGA
- D. AGG ACA UGA GGA

[1 mark]

## Question 2

A group of scientists were working on a project to sequence the DNA of an endangered species of gorilla in order to deduce the nucleotide base sequence of a specific gene of interest.

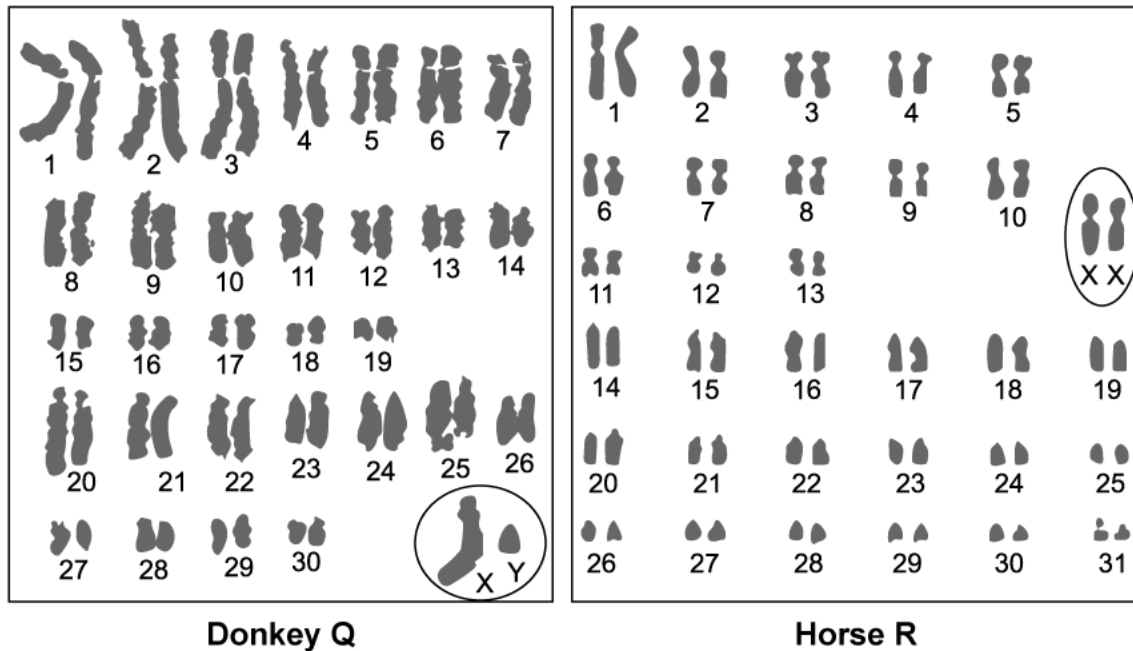
What is the correct process that the scientists may have followed in order to sequence this specific gene from a sample of DNA extracted from a gorilla?

<b>A.</b>	HindIII is added to the sample to cut the DNA on either side of the gene of interest	The double stranded fragments are separated into single strands	Single stranded copies are made using fluorescently labelled nucleotide bases (A, T, C, G)	Capillary electrophoresis is used to separate the DNA by size
<b>B.</b>	A restriction enzyme is added to the sample to cut the DNA on either side of the gene of interest	The double stranded fragments are copied using DNA polymerase	Single stranded copies are made using fluorescently labelled nucleotide bases (A, T, C, G)	Gel electrophoresis is used to separate the DNA by charge
<b>C.</b>	HindIII is added to the sample to cut the DNA on either side of the gene of interest	The double stranded fragments are separated into single strands	Single stranded copies are made using fluorescently labelled nucleotide bases (A, U, C, G)	Capillary electrophoresis is used to separate the DNA by charge
<b>D.</b>	A restriction enzyme is added to the sample to cut the DNA on either side of the gene of interest	Ligase enzyme is used to attach a promotor region to the start of the gene sequence	Single stranded copies are made using fluorescently labelled nucleotide bases (A, U, C, G)	Capillary electrophoresis is used to separate the DNA by size

[1 mark]

### Question 3

The two karyotypes belong to a donkey (Q) and a horse (R).



Breeding these two individuals resulted in the production of a sterile mule (S).

Why would **S** be sterile?

- A. The sex of the mule (**S**) will be undetermined at birth due to the unnatural combination of chromosomes
- B. Different combinations of alleles formed as a result of crossbreeding **Q** and **R** which leads to disadvantageous characteristics in **S**
- C. There are different numbers of chromosomes in the gametes of **Q** and **R** so **S** would not live long enough to breed
- D. The process of meiosis will not be possible in **S** as homologous pairs cannot form

[1 mark]

### Question 4

Which of the following statements are true for the determination of sex?

- I. The chromosomes inherited through the maternal gametes determine the sex of the offspring
- II. Females have a larger quantity of DNA than males
- III. Sex is determined by the 23rd pair of chromosomes in humans
- IV. Sex of an individual can be identified using an image taken of chromosomes during interphase

- A. I and II only
- B. III only
- C. II and III only
- D. I, III and IV only

[1 mark]

### Question 5

Cytochrome C is a protein which is common to all organisms and is therefore a useful gene sequence to study when constructing phylogenetic trees to represent evolutionary relationships.

The table shows the number of nucleotide differences in the cytochrome C genes of several different species.

	Human	Chicken	Mouse	Rat	Yeast	Fruit fly
Human	0	61	32	36	112	89
Chicken	61	0	61	61	119	94
Mouse	32	61	0	10	119	77
Rat	36	61	10	0	115	84
Yeast	112	119	119	115	0	124
Fruit fly	89	94	77	84	124	0

Which of the following shows the correct order of the organisms if arranged from the most closely related to the least closely related compared to humans?

- A. 1. Human  
2. Chicken  
3. Fruit fly  
4. Yeast  
5. Mouse  
6. Rat
- B. 1. Human  
2. Rat  
3. Mouse  
4. Fruit fly  
5. Yeast  
6. Chicken
- C. 1. Human  
2. Mouse  
3. Rat  
4. Chicken  
5. Fruit fly  
6. Yeast
- D. 1. Human  
2. Yeast  
3. Fruit fly  
4. Chicken  
5. Rat  
6. Mouse

[1 mark]

