Q1.

Read the following passage.

DNA is a stable molecule but, even under normal cell conditions, spontaneous changes occur to the DNA nucleotide sequence. One example of a spontaneous change occurs when a cytosine base in a guanine–cytosine nucleotide pair is changed to a uracil base. This produces a guanine–uracil nucleotide pair in the DNA molecule. Scientists estimate this type of spontaneous change occurs to 100 guanine–cytosine nucleotide pairs in the genome of healthy human cells every day.

In healthy cells, enzyme-controlled processes repair these spontaneous changes in the DNA molecule by changing uracil bases back to cytosine bases. If these repairs do **not** happen, the uracil DNA nucleotide attracts an adenine DNA nucleotide when the DNA is replicated in the cell cycle. A mutation of the original DNA has now occurred.

Healthy cells with damaged DNA produce enzyme **X**. This enzyme slows the cell cycle by delaying the start of DNA replication. People with the disease ataxia telangiectasia (AT) do not produce functional enzyme **X**. Mutations occur at a higher rate in people with AT.

Use the information in the passage and your own knowledge to answer the following questions.

(a) Give **one** similarity in structure between a guanine–cytosine nucleotide pair and a guanine–uracil nucleotide pair in a DNA molecule (lines 3–5).

Do **not** refer to guanine in your answer.

_____

_____

_____

(1)

(b) The DNA in a human genome contained 3×10^9 nucleotide pairs.

Assume 40% of these nucleotide pairs are guanine–cytosine nucleotide pairs.

Use this information and lines 5–7 to calculate the percentage of guanine–cytosine nucleotide pairs that change to guanine–uracil nucleotide pairs in this genome every day.

Give your answer in standard form.

Show your working.

Answer _____ %

(2)

(c) The type of mutation that occurs when 'repairs do **not** happen' (lines 10–11) may still produce a functional protein.

Suggest and explain why.

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(4)

(d) Suggest and explain why ‘mutations occur at a higher rate’ in people with AT (lines 15–16).

(3)

(Total 10 marks)

Q2.

(a) Give **three** structural differences between an mRNA molecule and a tRNA molecule.

mRNA	tRNA

(3)

(b) The table below shows mRNA codons and the amino acid coded by each codon.

First base	Second base				Third base
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Figure 1 shows the mRNA base sequence produced when part of a gene coding for an enzyme is transcribed.

Figure 1

UUU	CGG	GCG

Use the table above to give the amino acids coded by the mRNA base sequence in **Figure 1**.

(1)

(c) A mutation occurred in the part of the gene transcribed in part **(b)**.

Figure 2 shows the mRNA base sequence produced when the identical part in the mutated gene is transcribed.

Figure 2

UUU	**AGG**	**GCG**

The amino acids coded by this mRNA base sequence form part of the enzyme's active site.

Use all the information in this question to:

- name the type of mutation that occurred to produce the mutated gene
- give the change in **DNA** caused by this mutation
- explain the effect this mutation will have on the function of the enzyme.

Type of mutation _____

Change in DNA _____

Explanation of effect on function of enzyme _____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q3.

Write an essay on phosphorus-containing substances and their importance in biological systems.

(Total 25 marks)

Q4.

(a) Outline the similarities in, and the differences between, the structures of DNA and RNA molecules.

(6)

(b) Outline the similarities in, and the differences between, the structures of chloroplasts and mitochondria.

(4)

(Total 10 marks)

Q5.

(a) Describe how a quaternary protein is formed from its monomers.

Do not include the process of translation in your answer.

(5)

(b) Describe the structure of DNA and the structure of a chromosome.

(6)

(c) Mutation can result in an increase in genetic variation within a species.

Describe and explain the **other** processes that result in increases in genetic variation within a species.

(4)

(Total 15 marks)

Q6.

(a) Give the **two** types of molecule from which a ribosome is made.

1 _____

2 _____

(2)

(b) Complete the table to give **four** structural differences between a DNA molecule and an mRNA molecule.

	DNA structure	**mRNA structure**
1		
2		
3		
4		

(4)

(Total 6 marks)

Q7.

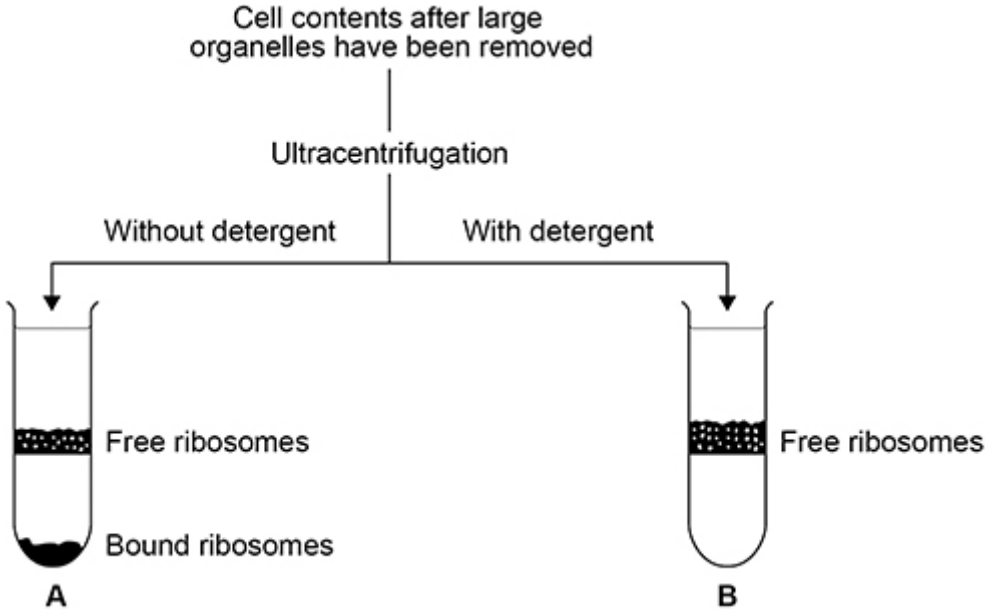
(a) Complete the table below to give **three** differences between DNA molecules and tRNA molecules.

DNA molecules	tRNA molecules

(3)

Scientists investigated ribosomal RNA in liver cells.

The diagram below shows the method they used to isolate the ribosomes from the liver cells. The detergent dissolves lipids.



(b) The scientists broke open the cells to produce a suspension of cell contents.

Describe how the scientists would remove large organelles from this suspension of cell contents.

(2)

(c) Explain the position of the bands of ribosomes in tubes **A** and **B** in the diagram above.

A

B

(3)

(Total 8 marks)