1 Proteins are made up of amino acids.

(a) The table shows the DNA bases that code for some of the amino acids found in proteins.

DNA bases	AAA	AAC	CAA	TAC	TTC
Amino acid	phe	leu	val	met	lys

Part of the DNA coding for a protein is:

T A C C A A T T C

(i) State the order of amino acids coded for by this sequence of DNA.

(1)

.....

(ii) These amino acids will be joined together during protein synthesis.

During which stage of protein synthesis will this take place?

(1)

.....

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Amino acids are joined together

(1)

☐ **A** at the membrane

☐ **B** in the mitochondria

☐ **C** in the nucleus

☐ **D** at the ribosome

(b) DNA can code for the amino acids in the active site of an enzyme.

Explain the role of the active site of an enzyme.

(2)

(c) Mutations can occur in DNA.

Describe what effect a mutation could have on the action of an enzyme.

(3)

(Total for Question 1 = 8 marks)

2 (a) DNA is composed of four different DNA nucleotides.

(i) Which diagram represents the arrangement of the sugar, phosphate and the base in a DNA nucleotide?

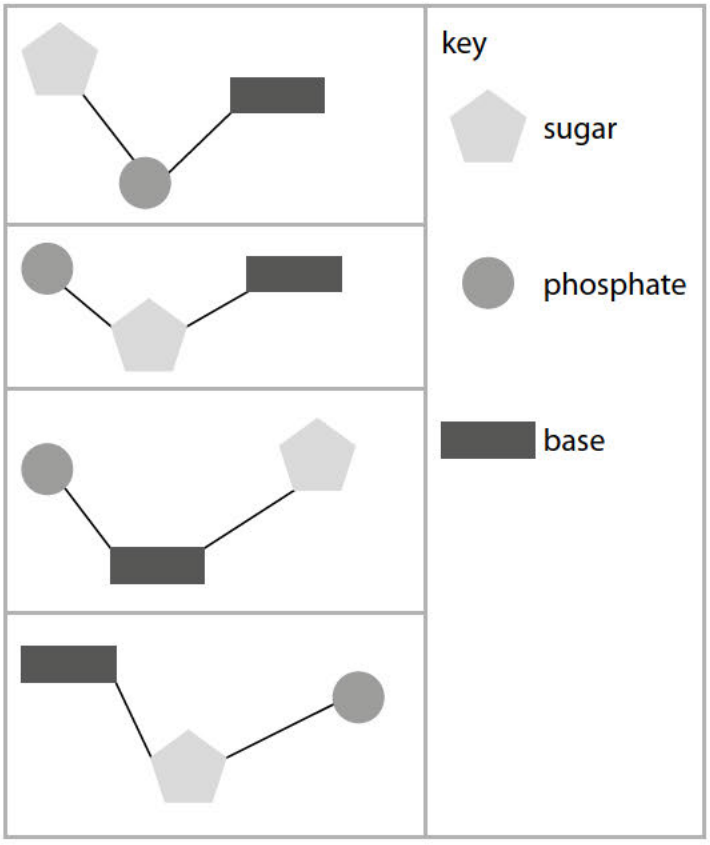
(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**



(ii) An allele starts with the DNA sequence ATGCATGTACCG.

Give the sequence of the complementary DNA sequence.

(1)

.....

.....

(iii) The length of one DNA nucleotide was measured at 3.3×10^{-10} metres.

Calculate the approximate length of a gene containing 250 nucleotides in nanometres.

(2)

..... nm

(b) The DNA of an organism determines its phenotype.

White tigers are produced because of a mutation of a single allele which usually produces the normal orange and yellow fur pigmentation.

The mutated allele is recessive.

Samba, a male white tiger, was bred with Rani. They had three offspring; two offspring have white fur and one has a normal fur pigmentation.

(i) State the genotype of Rani.

(1)

.....

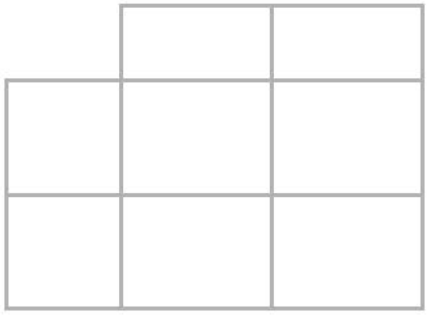
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(ii) The offspring with normal fur pigmentation was bred with a tiger that was heterozygous.

Use A/a to represent the alleles for fur pigmentation.

Predict, using the Punnett square, the percentage probability of the offspring from this cross having normal fur pigmentation.

(2)



percentage probability = ... %

(c) Explain how two parents with a dominant phenotype can produce offspring expressing a recessive characteristic.

(2)

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(Total for Question 2 = 9 marks)

3 There are different types of white blood cell in the body. One type is called CD4+ T-Helper cells.

The normal range of these cells in the blood is between 5×10^8 and 1.2×10^9 cells/dm^3

An AIDS patient has a CD4+ T-Helper cell count of 1.5×10^8 cells/dm^3

(a) Explain why the CD4+ count of 1.5×10^8 cells/dm^3 has led to the diagnosis of AIDS.

(2)

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*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

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(c) The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

(4)

(Total for Question 3 = 12 marks)