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# VCE Biology ¾

## Nucleic Acids & the Structure of Genes [1.2]

## Homework

### Homework Outline:

| | |
|---|---|
| **Compulsory** | Pg 2 – Pg 12 |
| **Solutions** | Pg 2 – Pg 12 |

## Section A: Compulsory (25 Marks)

### Sub-Section [1.2.1]: Identify and Compare the Characteristic Features of the Structures of Nucleic Acids and Their Monomers, Including DNA, mRNA, tRNA and rRNA, Including Base Pairing

**Question 1**

Definitions:

**a.** Nucleic acids.

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**b.** DNA.

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**c.** mRNA.

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**d.** tRNA.

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**e.** rRNA.

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**Question 2** (1 mark)

A strand of RNA contains the sequence 5′-AUGGCUAUC-3′. Which of the following corresponds to the tRNA anticodons that would bind to this strand during translation?

**A.** 5′-UACCGATAG-3′

**B.** 5′-UACCGAUAG-3′

**C.** 5′-AUGGCUAUC-3′

**D.** 5′-GCUAUGUAG-3′

**Question 3** (1 mark)

Which of the following would be most affected by a mutation that damages rRNA?

**A.** The transcription of DNA to mRNA.

**B.** The assembly of ribosomes and protein synthesis.

**C.** The stability of the mRNA transcript.

**D.** The transport of amino acids to the ribosome.

**Question 4** (1 mark)

Which one of the following correctly compares DNA and RNA?

| | DNA | RNA |
|---|---|---|
| **A.** | Contains deoxyribose | Contains ribose |
| **B.** | Is a shorter molecule | Is a longer molecule |
| **C.** | Found only in the nucleus in eukaryotes | Found in the nucleus and a variety of cytoplasmic locations in eukaryotes |
| **D.** | Contains four different monomers | Contains five different monomers |

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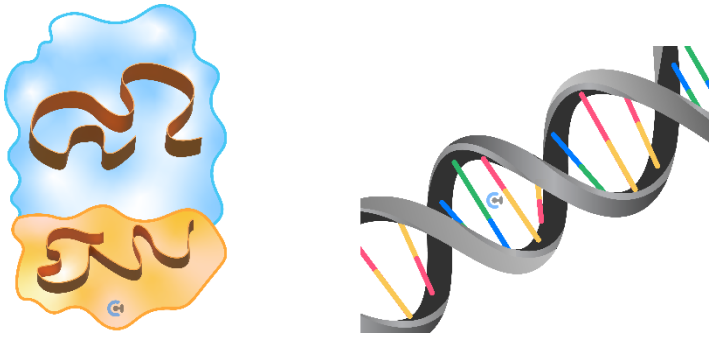
**Question 5** (6 marks)

The image below shows 2 different molecules found within cells, rRNA and DNA.



**a.** Name the location within a eukaryotic cell where each molecule would be found. (1 mark)

_____

_____

**b.** Complete the following table comparing molecules of rRNA and DNA. (2 marks)

| | **rRNA** | **DNA** |
|---|---|---|
| **Difference** | | |
| **Similarity** | | |

**c.** How would DNA differ in prokaryotic and eukaryotic organisms? (1 mark)

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**d.** Adenine and guanine are both classified as purines, double-ringed structures of nucleic acids. A cell was found to contain 10% guanine. What percentage of thymine would be found in the cell? Explain. (2 marks)

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# Sub-Section [1.2.2]: Identify and Describe the Structure of a Nucleotide in DNA and RNA

**Question 6**

Definitions:

Nucleotide.

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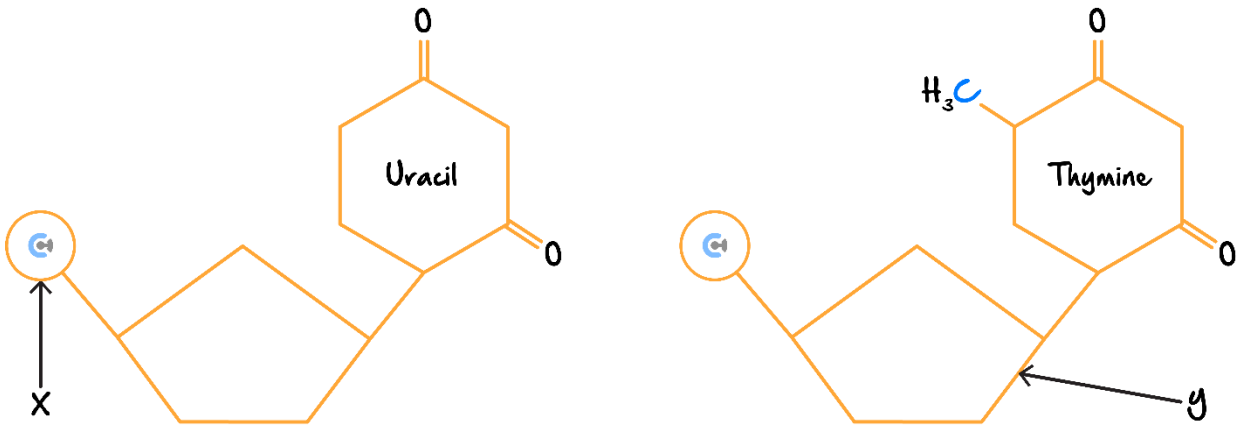
**Question 7** (1 mark)

The basic structure of two nucleotides is shown below. Each nucleotide has three subunits.




It can be concluded that the:

**A.** Subunit labelled *X* is a nitrogen base.

**B.** Subunit labelled *Y* is a ribose sugar.

**C.** Nucleotide with the subunit labelled uracil can be found in DNA.

**D.** Nucleotide with the subunit labelled thymine will have a pentose sugar subunit.

**Question 8** (5 marks)

Draw the structure of a nucleotide chain, labelling the key features. In your diagram, make sure to label the bonds between nucleotides and the components of the nucleotide.

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# Sub-Section [1.2.3]: Define the Key Components of a Gene, Including a Comparison Between the Structure of Genes in Eukaryotes and Prokaryotes

**Question 9**

Definitions:

**a.** Gene.

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**b.** Key Components of a Gene.

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**c.** Gene Structure in Eukaryotes vs. Prokaryotes.

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**Question 10** (1 mark)

A researcher isolates a gene with introns and exons and observes that RNA processing is required before translation. From which type of organism is this gene most likely derived?

**A.** A eukaryotic organism, because only eukaryotic genes contain introns and undergo RNA processing.

**B.** A prokaryotic organism, because prokaryotes require RNA processing to remove non-coding regions.

**C.** Either a eukaryotic or prokaryotic organism, because introns are found in both.

**D.** A viral genome, because introns and exons are characteristic of viruses.

**Question 11** (2 marks)

Explain the role of the promoter region in gene expression.

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## Sub-Section [1.2.4]: Identify and Practically Apply the Characteristics of the Genetic Code - Universal, Unambiguous, Degenerate, Triplet - to Real-Life Examples

**Question 12**

Definitions:

**a.** Universal.

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**b.** Unambiguous.

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**c.** Degenerate.

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**d.** Triplet Code.

_____

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**Question 13** (1 mark)

A mutation changes the codon UUU (phenylalanine) to UUC. What is the most likely effect on the resulting protein?

**A.** The mutation is silent, and the protein remains unchanged.

**B.** The mutation introduces a stop codon, prematurely ending translation.

**C.** The mutation changes the structure of the protein by replacing phenylalanine with leucine.

**D.** The mutation causes the ribosome to stall during translation.

**Question 14** (1 mark)

Which of the following examples illustrates the degenerate nature of the genetic code?

**A.** AUG functions as the start codon in both humans and bacteria.

**B.** UAA, UAG, and UGA are all stop codons that terminate translation.

**C.** A single codon always specifies only one amino acid.

**D.** Some amino acids, like leucine, are coded for by multiple codons.

**Question 15** (1 mark)

A pharmaceutical company tests a drug on human cells and bacterial cells. Both show the same response to the drug, which binds to mRNA codons during translation. What property of the genetic code is most relevant to this finding?

**A.** The genetic code is unambiguous.

**B.** The genetic code is unambiguous.

**C.** The genetic code is degenerate.

**D.** The genetic code is universal.

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**Question 16** (4 marks)

**a.** A mutation changes a codon in a human gene from GGU to GGC. There is no effect on the protein produced. Why is this the case? (2 marks)

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**b.** Why is the universal nature of the genetic code important in modern biotechnology? Provide one example of its application. (1 mark)

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**c.** A pharmaceutical researcher is designing a drug that binds specifically to the mRNA codon AUG in a bacterial cell. Why would this drug potentially affect protein synthesis in humans? (1 mark)

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