AAB Molecular Diagnostics Practice Test (Sample)

Study Guide

BY EXAMZIFY

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Questions

1. **What type of DNA damage does nucleotide excision repair primarily fix?**
   - A. Single-strand breaks
   - B. DNA cross-linking
   - C. Thymine dimers and bulky adducts
   - D. Base pair mismatches

2. **Which of the following statements is true regarding Prader-Willi syndrome?**
   - A. It is caused by an extra chromosome
   - B. It is an example of uniparental disomy
   - C. It is an autosomal dominant disorder
   - D. It exclusively affects males

3. **How do small RNA molecules, like siRNA and saRNA, function in gene regulation?**
   - A. By destroying nucleic acids
   - B. By promoting gene silencing exclusively
   - C. By inducing gene expression or silencing
   - D. By unwinding DNA for transcription

4. **Which component is NOT typically acceptable for molecular diagnostics blood collection?**
   - A. Clotted blood
   - B. EDTA treated blood
   - C. ACD treated blood
   - D. Heparin treated blood

5. **Which RNA type is primarily involved in the synthesis of proteins?**
   - A. Heterogeneous nuclear RNA
   - B. MicroRNA
   - C. Messenger RNA
   - D. Small nuclear RNA

6. Which type of blood collection tube commonly used for molecular diagnostics contains EDTA?

A. Red top tube

B. Green top tube

C. Purple top tube

D. Blue top tube

7. What are PCR products combined with for accurate analysis?

A. Allelic ladders

B. Primers

C. Control samples

D. Synthetic DNA

8. Which of the following is NOT a type of DNA repair mechanism?

A. Mismatch repair

B. Base excision repair

C. Gene amplification

D. Nucleotide excision repair

9. How many possible codons exist in the genetic code?

A. 20

B. 64

C. 256

D. 128

10. Which of the following bases are classified as purines?

A. Adenine and Cytosine

B. Adenine and Guanine

C. Cytosine and Thymine

D. Guanine and Uracil

Answers

1. **C**
2. **B**
3. **C**
4. **A**
5. **C**
6. **C**
7. **A**
8. **C**
9. **B**
10. **B**

Explanations

1. What type of DNA damage does nucleotide excision repair primarily fix?

A. Single-strand breaks

B. DNA cross-linking

C. Thymine dimers and bulky adducts

D. Base pair mismatches

Nucleotide excision repair (NER) is a critical DNA repair mechanism that primarily targets specific types of DNA damage, particularly thymine dimers and bulky adducts. Thymine dimers occur when two adjacent thymine bases bond together due to UV radiation, resulting in a distortion in the DNA structure that can impede replication and transcription. Bulky adducts, on the other hand, can arise from exposure to certain chemicals or environmental factors, leading to significant disruptions in the DNA structure. The NER process involves recognizing the distortion caused by these types of damage, excising the damaged segment of DNA, and then synthesizing a new strand to restore the original sequence. This mechanism is vital for maintaining genomic integrity, as failure to repair such damage can lead to mutations and contribute to various diseases, including cancer. In contrast, single-strand breaks are typically repaired by other mechanisms like base excision repair or homologous recombination. DNA cross-linking involves connecting two DNA strands together in an abnormal manner, which is addressed by a different repair pathway known as the cross-link repair pathway. Base pair mismatches are primarily corrected through mismatch repair mechanisms that specifically target errors that occur during DNA replication. Thus, while these other forms of damage are significant,

2. Which of the following statements is true regarding Prader-Willi syndrome?

A. It is caused by an extra chromosome

B. It is an example of uniparental disomy

C. It is an autosomal dominant disorder

D. It exclusively affects males

Prader-Willi syndrome (PWS) is primarily linked to genetic anomalies affecting chromosome 15, particularly involving the paternal allele. The most common cause of PWS is due to uniparental disomy, where a person inherits two copies of chromosome 15 from one parent and none from the other. In the case of PWS, this often results in the absence of the paternal genes on that chromosome, leading to the development of the syndrome. This genetic mechanism is key to understanding the disorder, as the clinical features of PWS, which include obesity, intellectual disability, and behavioral problems, arise from the lack of these specific paternal genes. Therefore, recognizing that Prader-Willi syndrome is associated with uniparental disomy is crucial to grasping its genetic basis and its inheritance pattern. The other statements do not align with the established understanding of Prader-Willi syndrome. The idea that it is caused by an extra chromosome is incorrect, as there is no involvement of an additional chromosome in PWS. It is also incorrect to classify Prader-Willi syndrome as an autosomal dominant disorder since it does not follow this inheritance pattern; rather, it is linked to the expression of genes based heavily on parental origin. Additionally, Pr

3. How do small RNA molecules, like siRNA and saRNA, function in gene regulation?

A. By destroying nucleic acids

B. By promoting gene silencing exclusively

C. By inducing gene expression or silencing

D. By unwinding DNA for transcription

Small RNA molecules, such as small interfering RNA (siRNA) and small activating RNA (saRNA), play a crucial role in gene regulation through their ability to modulate gene expression. siRNAs primarily function by targeting specific messenger RNA (mRNA) sequences for degradation, which effectively silences gene expression. They achieve this through a process known as RNA interference (RNAi), where the siRNA guides the RNA-induced silencing complex (RISC) to the complementary mRNA, leading to its destruction. On the other hand, saRNAs are involved in promoting gene expression rather than silencing it. They can enhance the transcription of specific genes by binding to their promoters, facilitating recruitment of the transcriptional machinery and thus increasing mRNA production. Therefore, the correct choice reflects the dual role that small RNAs can play—they can induce gene expression in some contexts (as with saRNA) while also silencing genes in other contexts (as with siRNA). This versatility in function underlines the complexity of gene regulation mechanisms and showcases the significance of small RNA molecules in cellular functions.

4. Which component is NOT typically acceptable for molecular diagnostics blood collection?

A. Clotted blood

B. EDTA treated blood

C. ACD treated blood

D. Heparin treated blood

Clotted blood is not typically acceptable for molecular diagnostics blood collection primarily because it can interfere with the isolation and integrity of nucleic acids. In molecular diagnostics, especially in tests that rely on PCR (polymerase chain reaction) or other nucleic acid amplification methods, the purity and quality of the DNA or RNA extracted from blood samples are crucial. When blood clots, the solidification process can lead to lysed cells or fragmented nucleic acids, which may diminish the yield and quality of the genetic material. This can complicate the analysis and potentially lead to inaccurate results. In contrast, anticoagulant-treated blood, such as blood treated with EDTA, ACD, or heparin, helps preserve the cells in a non-clotted state and maintains the integrity of the genetic material, making it suitable for molecular diagnostics applications. Such anticoagulants prevent clot formation, allowing for robust extraction and reliable downstream analyses of nucleic acids.

5. Which RNA type is primarily involved in the synthesis of proteins?

A. Heterogeneous nuclear RNA

B. MicroRNA

C. Messenger RNA

D. Small nuclear RNA

Messenger RNA (mRNA) plays a crucial role in the synthesis of proteins. It serves as the primary template transcribed from DNA during the process of gene expression. Once synthesized, mRNA carries the genetic information from the nucleus to the ribosomes, where translation occurs. The ribosomes read the sequence of nucleotides in the mRNA and translate it into a specific polypeptide or protein by matching codons in the mRNA with the appropriate amino acids brought by transfer RNA (tRNA). In contrast, heterogeneous nuclear RNA (hnRNA) is an early precursor of mRNA that undergoes various modifications, such as splicing, before becoming mature mRNA. MicroRNA plays a regulatory role by binding to mRNA molecules and can inhibit protein synthesis, but it is not directly involved in the synthesis itself. Small nuclear RNA (snRNA) is involved in the splicing process of pre-mRNA but does not directly contribute to protein synthesis either. Thus, mRNA is the specific type of RNA whose primary function is to direct the synthesis of proteins.

6. Which type of blood collection tube commonly used for molecular diagnostics contains EDTA?

A. Red top tube

B. Green top tube

C. Purple top tube

D. Blue top tube

The purple top tube is commonly used for molecular diagnostics because it contains EDTA (ethylenediaminetetraacetic acid), which acts as an anticoagulant. EDTA works by chelating calcium, which is necessary for blood clotting. This property helps preserve the integrity of the sample by preventing clot formation, making it suitable for nucleic acid extraction and analysis, which are critical in molecular diagnostics. Additionally, the use of EDTA in these tubes supports the stability of cellular components and makes it easier to isolate DNA or RNA from the blood for testing purposes. This is particularly important in molecular diagnostics where the accurate analysis of genetic material is essential for diagnostics, such as in infections, genetic disorders, and cancer detection. The other blood collection tube types listed have different additives for specific purposes. The red top tube typically has no additive or may contain a clot activator designed for serum collection, the green top tube generally contains heparin (another type of anticoagulant), and the blue top tube contains sodium citrate, which is primarily used for coagulation studies.

7. What are PCR products combined with for accurate analysis?

A. Allelic ladders

B. Primers

C. Control samples

D. Synthetic DNA

PCR products are combined with allelic ladders for accurate analysis because allelic ladders serve as a standard reference for determining the sizes and relative quantities of PCR products. An allelic ladder consists of a mixture of PCR products that represent known alleles at specific loci, allowing for precise comparison against experimental samples. By using an allelic ladder, researchers can effectively identify the presence and size of target alleles, ensuring the accuracy and reliability of the genotyping results. In contrast, primers are essential for initiating the PCR process but are not used for analysis after the fact. Control samples are also crucial in validating the PCR process; however, they are typically used to ensure that the amplification is successful rather than for comparing product sizes. Synthetic DNA is sometimes utilized for calibration or in specific experimental designs but does not serve the same purpose as allelic ladders in the analysis phase.

8. Which of the following is NOT a type of DNA repair mechanism?

A. Mismatch repair

B. Base excision repair

C. Gene amplification

D. Nucleotide excision repair

Gene amplification is not a type of DNA repair mechanism. Instead, it refers to the process by which certain genes are duplicated, leading to an increased number of copies within the genome. This mechanism often contributes to genetic changes that can promote cancer or other diseases by enabling the overexpression of certain proteins. In contrast, mismatch repair, base excision repair, and nucleotide excision repair are all essential pathways involved in correcting specific types of DNA damage. Mismatch repair corrects errors that occur during DNA replication when the wrong nucleotide is incorporated. Base excision repair addresses small, non-helix-distorting lesions in the DNA, such as deaminated bases. Nucleotide excision repair is responsible for removing bulky DNA adducts or helix-distorting damage caused by environmental factors, like UV radiation. Each of these repair mechanisms plays a critical role in maintaining genomic stability and preventing mutations that could lead to disease.

9. How many possible codons exist in the genetic code?

A. 20

B. 64

C. 256

D. 128

The correct choice of 64 possible codons in the genetic code is based on the structure of the genetic code itself, which is composed of sequences of three nucleotides, known as triplets. Since there are four different nucleotides in RNA (adenine, uracil, cytosine, and guanine), the calculation for the total number of possible combinations is derived from the formula 4^n, where n is the length of the codon. In this case, when $n = 3$: $$4^3 = 4 \times 4 \times 4 = 64$$ Thus, there are 64 unique combinations of three nucleotides, which correspond to the different codons that can be utilized in the encoding of amino acids. Among these codons, 61 different ones specify amino acids, while the remaining 3 serve as stop codons that terminate translation. The other options do not accurately reflect the number of codons in the genetic code due to the miscalculation of combinations that can be formed using three nucleotide sequences. It is essential to recognize that while there are 20 standard amino acids, this number stems from the codons derived from those

10. Which of the following bases are classified as purines?

A. Adenine and Cytosine

B. Adenine and Guanine

C. Cytosine and Thymine

D. Guanine and Uracil

Purines are one of the two classes of nitrogenous bases found in nucleic acids, the other being pyrimidines. The purines are characterized by their two-ring structure, which distinguishes them from pyrimidines, which have a single-ring structure. In this context, adenine and guanine are the only two nitrogenous bases that are classified as purines. Adenine is a fundamental component of DNA and RNA and plays a critical role in energy transfer through ATP (adenosine triphosphate). Guanine, similarly, is a key component of both DNA and RNA, contributing to the coding of genetic information and the regulation of cellular metabolism. Cytosine and thymine, as well as cytosine and uracil, are classified as pyrimidines. These bases have a single-ring structure, differing from purines in their chemical makeup and properties. This structural distinction helps to categorize them properly within the framework of molecular biology and genetics. Thus, the identification of adenine and guanine as purines is correct because they share the necessary two-ring structure characteristic of purines, making option B the correct choice.