PRACTICE EXAMS

ON CLINICAL

GENETICS & CANCER

MODEL ANSWERS INCLUDED

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MCQ & SAQ QUESTIONS

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A Message From Our Team

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In this series of **PRACTICE EXAMS** we have used our medical experience to create a comprehensive set of quizzes that are tailored just right to help you to ACE your exams and maximize retention. We have created numerous mini-quizzes (both multi-choice and short-answer) on all the subtopics relating to this subject. That way you can do them at your own pace and correct the questions you get wrong there and then!

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What's included: A comprehensive set of university-level multiple-choice (MCQ) and short-answer (SAQ) exam questions covering everything to do with **Genetics and Cancer**. All answer keys are provided directly after each quiz so that you can revise and reassess as you go, helping you learn better and improve retention.

Quizzes in this booklet:

MCQ Quiz: Overview of DNA - Composition, Packaging into Chromosomes, and Replication

1. Which of the following nitrogenous bases is not found in DNA?
    A. Adenine
    B. Cytosine
    C. Guanine
    D. Uracil

2. The sugar found in the backbone of DNA molecules is:
    A. Ribose
    B. Deoxyribose
    C. Glucose
    D. Fructose

3. Which of the following correctly describes the structure of DNA?
    A. Double helix
    B. Single helix
    C. Triple helix
    D. Quadruple helix

4. In DNA, adenine pairs with:
    A. Adenine
    B. Cytosine
    C. Guanine
    D. Thymine

5. Which enzyme is responsible for unwinding the DNA double helix during replication?
    A. DNA polymerase
    B. RNA polymerase
    C. DNA helicase
    D. DNA ligase

6. What is the primary function of DNA?
    A. Energy storage
    B. Catalyzing chemical reactions
    C. Storing genetic information
    D. Providing structural support

7. The process of copying DNA to produce two identical daughter molecules is called:
    A. Transcription
    B. Translation
    C. Replication
    D. Splicing

8. During DNA replication, which enzyme is responsible for synthesizing the new DNA strand?
    A. DNA polymerase
    B. RNA polymerase
    C. DNA helicase
    D. DNA ligase

9. Which of the following statements about DNA replication is correct?
    A. It occurs in the 5' to 3' direction on both strands simultaneously
    B. It occurs in the 3' to 5' direction on both strands simultaneously
    C. It occurs in the 5' to 3' direction on one strand and the 3' to 5' direction on the other strand
    D. It occurs in the 3' to 5' direction on one strand and the 5' to 3' direction on the other strand

10. Which of the following best describes the function of histones in the cell nucleus?
    A. DNA replication
    B. Transcription
    C. Translation
    D. DNA packaging

11. Chromosomes are composed of:
    A. DNA only
    B. DNA and histones
    C. DNA and RNA
    D. RNA only

12. Which of the following is a characteristic of the lagging strand during DNA replication?
    A. It is synthesized continuously
    B. It is synthesized in the 5' to 3' direction
    C. It is synthesized in short, discontinuous fragments
    D. It is synthesized without a primer

Answer Key:

1. D
2. B
3. A
4. D
5. C
6. C
7. C
8. A
9. A
10. D
11. B
12. C

SAQ Quiz: Overview of DNA - Composition, Packaging into Chromosomes, and Replication

1. Briefly describe the difference between the structure of a DNA nucleotide and an RNA nucleotide.

2. Explain the process of DNA replication, including the roles of helicase, primase, and DNA polymerase.

3. What is the role of DNA ligase in DNA replication?

4. Describe the structure and function of telomeres in human chromosomes.

5. How does DNA packaging into chromatin and chromosomes help regulate gene expression?

6. Briefly explain the difference between the leading and lagging strands during DNA replication.

7. What is the difference between euchromatin and heterochromatin?

Model Answers:

1. A DNA nucleotide is composed of a nitrogenous base, a phosphate group, and a deoxyribose sugar. In contrast, an RNA nucleotide has a ribose sugar instead of a deoxyribose sugar.

2. DNA replication begins with the unwinding of the DNA helix by helicase, separating the two DNA strands. RNA primase then synthesizes a short RNA primer on each template strand, providing a starting point for DNA polymerase. DNA polymerase adds new nucleotides to the growing DNA strand, complementary to the template strand, in a 5' to 3' direction.

3. DNA ligase is responsible for joining the Okazaki fragments on the lagging strand, thus ensuring the continuity of the newly synthesized DNA strand.

4. Telomeres are repetitive sequences of DNA located at the ends of linear chromosomes. They protect the ends of chromosomes from degradation and prevent the fusion of chromosomes. As cells divide, telomeres gradually shorten, which is associated with aging and cellular senescence.

5. DNA packaging into chromatin and chromosomes helps regulate gene expression by controlling the accessibility of genes to the transcription machinery. Tightly packed heterochromatin is less accessible, and therefore genes within these regions are less likely to be transcribed, whereas genes in more loosely packed euchromatin regions are more accessible for transcription.

6. The leading strand is synthesized continuously in the 5' to 3' direction, while the lagging strand is synthesized discontinuously in the form of short fragments called Okazaki fragments, which are later joined by DNA ligase.

7. Euchromatin is the less condensed form of chromatin that is transcriptionally active, allowing genes to be expressed. Heterochromatin is a more condensed form of chromatin, which is transcriptionally silent or has low gene expression levels.

MCQ Quiz: Genes, Gene Expression, Transcription, and Translation

1. What is the central dogma of molecular biology?
    A. DNA → RNA → Protein
    B. Protein → RNA → DNA
    C. RNA → DNA → Protein
    D. Protein → DNA → RNA

2. Which enzyme is responsible for transcribing DNA to RNA?
    A. RNA polymerase
    B. DNA polymerase
    C. Helicase
    D. Reverse transcriptase

3. During transcription, which strand of DNA serves as the template for RNA synthesis?
    A. Coding strand
    B. Non-coding strand
    C. Both strands
    D. Neither strand

4. In eukaryotic cells, transcription occurs in the:
    A. Nucleus
    B. Cytoplasm
    C. Mitochondria
    D. Endoplasmic reticulum

5. In eukaryotes, what modification is added to the 5' end of the pre-mRNA molecule?
    A. Poly-A tail
    B. 5' cap
    C. Spliceosome
    D. Exon

6. Which process removes introns from pre-mRNA and joins exons together?
    A. Capping
    B. Polyadenylation
    C. Splicing
    D. Translation

7. The genetic code is:
    A. Overlapping
    B. Non-overlapping
    C. Redundant
    D. Both B and C

8. How many nucleotides make up a codon?
    A. One
    B. Two
    C. Three
    D. Four

9. Which of the following codons serves as a start codon in mRNA?
    A. UAA
    B. UAG
    C. AUG
    D. UGA

10. What is the role of tRNA in translation?
    A. Carrying amino acids to the ribosome
    B. Providing the template for protein synthesis
    C. Initiating translation at the start codon
    D. Terminating translation at the stop codon

11. In which cellular structure does translation occur?
    A. Nucleus
    B. Mitochondria
    C. Ribosome
    D. Endoplasmic reticulum

12. The process of translation can be divided into three main steps: initiation, elongation, and termination. Which of the following events occurs during the elongation phase?
    A. Formation of the initiation complex
    B. Peptide bond formation between amino acids
    C. Recognition of the stop codon
    D. Release of the completed polypeptide chain

Answer Key:

1. A
2. A
3. B
4. A
5. B
6. C
7. D
8. C
9. C
10. A
11. C
12. B

SAQ Quiz: Genes, Gene Expression, Transcription, and Translation

1. Explain the process of transcription, including the role of RNA polymerase and the steps involved in initiation, elongation, and termination.

2. Describe the differences between prokaryotic and eukaryotic mRNA processing.

3. What is the role of the ribosome in translation, and how does it ensure the correct amino acid sequence is formed?

4. Explain the concept of "wobble" in the genetic code and its significance for translation.

5. Describe the roles of the three types of RNA involved in translation (mRNA, tRNA, and rRNA).

6. What is the function of the Shine-Dalgarno sequence in prokaryotic translation initiation?

7. What is alternative splicing, and how can it contribute to protein diversity in eukaryotic cells?

Model Answers:

1. Transcription is the process of synthesizing RNA from a DNA template. RNA polymerase binds to a specific promoter sequence on the DNA template strand and initiates transcription. During elongation, RNA polymerase adds nucleotides complementary to the template strand. Termination occurs when RNA polymerase reaches a specific termination sequence, releasing the newly formed RNA molecule.

2. Prokaryotic mRNA is not processed, whereas eukaryotic mRNA undergoes capping, polyadenylation, and splicing. The 5' end of eukaryotic pre-mRNA receives a 5' cap, and the 3' end receives a poly-A tail. Introns are removed, and exons are joined together during splicing.

3. The ribosome is responsible for translating the mRNA sequence into a polypeptide chain. It ensures the correct amino acid sequence by matching the codons on the mRNA with the corresponding anticodons on the tRNA molecules, which carry the appropriate amino acids.

4. "Wobble" refers to the flexibility in base-pairing between the third base of a codon and the first base of its corresponding anticodon. This allows some tRNAs to recognize more than one codon, contributing to the redundancy of the genetic code and reducing the potential impact of point mutations.

5. mRNA serves as the template for protein synthesis, containing the codon sequence that determines the amino acid sequence of the polypeptide. tRNA carries specific amino acids to the ribosome and contains an anticodon that pairs with the mRNA codon. rRNA is a structural component of the ribosome and plays a role in catalyzing peptide bond formation.

6. The Shine-Dalgarno sequence is a ribosome binding site on prokaryotic mRNA, located upstream of the start codon. It helps recruit the ribosome to the correct position for translation initiation.

7. Alternative splicing is the process by which different combinations of exons can be joined together during mRNA splicing, resulting in multiple mRNA variants from a single gene. This increases protein diversity by allowing a single gene to produce multiple protein isoforms with different structures and functions.

MCQ Quiz: Chromosomes, Human Sex Determination, Chromosomal Errors, and Abnormal Karyotypes

1. Which of the following statements about chromosomes is true?
    A. Chromosomes are composed of DNA and protein
    B. Chromosomes are composed of RNA and protein
    C. Chromosomes are composed of DNA and lipids
    D. Chromosomes are composed of RNA and lipids

2. In humans, what combination of sex chromosomes results in a female?
    A. XX
    B. XY
    C. XXY
    D. XYY

3. In humans, what combination of sex chromosomes results in a male?
    A. XX
    B. XY
    C. XXY
    D. XYY

4. Which of the following chromosomal errors occurs when a chromosome fails to separate properly during meiosis?
    A. Deletion
    B. Inversion
    C. Duplication
    D. Nondisjunction

5. What type of mutation results in Down syndrome?
    A. Monosomy
    B. Trisomy
    C. Polyploidy
    D. Aneuploidy

6. Klinefelter syndrome is caused by which of the following chromosomal abnormalities?
    A. 45, X
    B. 47, XXY
    C. 47, XYY
    D. 46, XY

7. Turner syndrome is caused by which of the following chromosomal abnormalities?
    A. 45, X
    B. 47, XXY
    C. 47, XYY
    D. 46, XY

8. What type of chromosomal error is responsible for Cri-du-chat syndrome?
    A. Deletion
    B. Duplication
    C. Translocation
    D. Inversion

9. What is the term used to describe an individual with three copies of a particular chromosome?
    A. Monosomy
    B. Disomy
    C. Trisomy
    D. Polyploidy

10. Which of the following factors can increase the risk of chromosomal errors?
    A. Advanced maternal age
    B. Advanced paternal age
    C. Exposure to certain environmental factors
    D. All of the above

11. What is the significance of the SRY gene in human sex determination?
    A. It is responsible for the development of female traits
    B. It is responsible for the development of male traits
    C. It is involved in the formation of Barr bodies
    D. It is involved in X-inactivation

12. Which of the following chromosomal abnormalities involves the presence of an extra X chromosome in males?
    A. Turner syndrome
    B. Klinefelter syndrome
    C. Triple X syndrome
    D. XYY syndrome

Answer Key:

1. A
2. A
3. B
4. D
5. B
6. B
7. A
8. A
9. C
10. D
11. B
12. B

SAQ Quiz: Chromosomes, Human Sex Determination, Chromosomal Errors, and Abnormal Karyotypes

1. Describe the process of meiosis and how it can lead to chromosomal errors.

2. Explain the role of the SRY gene in human sex determination and its association with sex reversal.

3. Describe the differences between autosomes and sex chromosomes.

4. What is the difference between aneuploidy and polyploidy?

5. What is the cause of Down syndrome, and what are the common physical and cognitive characteristics associated with this condition?

6. Explain the significance of X-inactivation in female mammals.

7. What is a reciprocal translocation, and how can it lead to genetic abnormalities?

Model Answers:

1. Meiosis is the process by which gametes (sperm and eggs) are formed, resulting in cells with half the number of chromosomes (haploid) compared to the original parent cell (diploid). Meiosis involves two rounds of cell division: meiosis I and meiosis II. Chromosomal errors can occur during meiosis when chromosomes fail to separate properly (nondisjunction) or when structural abnormalities, such as deletions or translocations, arise.

2. The SRY gene, located on the Y chromosome, is responsible for initiating male sex determination. It triggers the development of testes and the production of male hormones. In cases of sex reversal, mutations in the SRY gene or its absence from the Y chromosome can lead to individuals with XY karyotype developing female traits, while the presence of the SRY gene on an X chromosome can lead to individuals with XX karyotype developing male traits.

3. Autosomes are the non-sex chromosomes found in both males and females and are responsible for the majority of genetic traits. Sex chromosomes, X and Y, determine an individual's sex. Females typically have two X chromosomes, while males have one X and one Y chromosome.

4. Aneuploidy refers to an abnormal number of chromosomes, such as the presence of an extra or missing chromosome. Polyploidy is the presence of extra complete sets of chromosomes, resulting in an organism with more than two sets of homologous chromosomes.

5. Down syndrome is caused by the presence of an extra copy of chromosome 21, resulting in trisomy 21. Common physical characteristics include distinct facial features, such as a flattened face and upward-slanting eyes, a short stature, and low muscle tone. Cognitive characteristics include intellectual disability, delayed language development, and learning difficulties.

6. X-inactivation is the process by which one of the two X chromosomes in female mammals is inactivated, ensuring that both males and females have a similar level of gene expression from their X chromosomes. This inactivation occurs randomly in each cell during early embryonic development, leading to a mosaic pattern of gene expression from the two X chromosomes.

7. A reciprocal translocation is a chromosomal abnormality where two non-homologous chromosomes exchange segments. While individuals carrying a balanced reciprocal translocation may be phenotypically normal, they can have an increased risk of producing gametes with unbalanced chromosomal content, potentially leading to genetic abnormalities in their offspring.

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