MOLECULAR GENETICS PRACTICE EXAM (SAMPLE)

STUDY GUIDE



SAMPLE STUDY GUIDE WITH LIMITED QUESTIONS



VISIT US ONLINE FOR THE FULL VERSION STUDY GUIDE

https://moleculargenetics.examzify.com



Copyright © 2026 by Examzify - A Kaluba Technologies Inc. product.

ALL RIGHTS RESERVED.

No part of this book may be reproduced or transferred in any form or by any means, graphic, electronic, or mechanical, including photocopying, recording, web distribution, taping, or by any information storage retrieval system, without the written permission of the author.

Notice: Examzify makes every reasonable effort to obtain accurate, complete, and timely information about this product from reliable sources.

SAMPLE

Table of Contents

Copyright 1

Table of Contents 2

Introduction 3

How to Use This Guide 4

Questions 5

Answers 9

Explanations 11

Next Steps 17

SAMPLE

Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- Practice answering questions under realistic conditions,
- Improve accuracy and speed,
- Review explanations to strengthen weak areas, and
- Approach the exam with greater confidence.

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

SAMPLE

How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here's how to get the most out of your Examzify study guide:

1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Your goal is to identify knowledge gaps early.

2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations.

3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

6. Repeat and Review

Don't just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning. Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There's no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly, adapt the tips above to fit your pace and learning style. You've got this!

SAMPLE

Questions

SAMPLE

1. A group of three nucleotides on mRNA that codes for a specific amino acid.

A. Codon

B. Anticodon

C. tRNA

D. mRNA

2. What technique is used to amplify DNA by repeated cycles of heating and cooling?

A. PCR

B. RAPD

C. Sanger Sequencing

D. RFLP

3. Define PCR; describe the three main steps and the importance of primer design and melting temperature considerations.

A. Polymerase chain reaction amplifies a DNA segment by cycling through denaturation, annealing, and extension; primers define the target; optimal annealing temperature depends on primer Tm (roughly Tm-5) and primer sequences to avoid dimers.

B. PCR amplifies RNA segments by reverse transcription.

C. PCR cycles through replication, elongation, and termination.

D. Primers are optional in PCR.

4. Which nitrogenous base is found only in RNA?

A. Uracil

B. Adenine

C. Cytosine

D. Thymine

5. DNA's charge?

A. Positive

B. Negative

C. Neutral

D. Undefined

SAMPLE

6. Which technique separates DNA fragments by size using electrical charges?

A. Electrophoresis

B. PCR

C. Chromatography

D. Spectroscopy

7. Which statement best describes how epigenetic marks influence X chromosome inactivation and imprinting?

A. XIST coats both X chromosomes and initiates silencing across both.

B. Imprinting silences both paternal and maternal alleles equally.

C. XIST lncRNA coats one X chromosome to initiate silencing; DNA methylation and histone modifications reinforce silencing; imprinting relies on parent-specific DNA methylation to silence an allele.

D. X-inactivation requires rapid RNA polymerase II turnover and imprinting relies on RNA editing.

8. What is promoter-proximal pausing and what is required for the transition into productive elongation?

A. RNA Pol II initiates transcription and immediately terminates.

B. Promoter-proximal pausing occurs after the promoter and before the gene body, but it has no effect on elongation.

C. Promoter-proximal pausing occurs near the promoter; release into productive elongation requires factors like P-TEFb.

D. Promoter-proximal pausing occurs only in prokaryotes.

9. Describe the mechanism of DNA replication on the leading and lagging strands, including the roles of DNA polymerase, primase, ligase, and Okazaki fragments.

A. Leading strand is synthesized in short fragments by DNA polymerase.

B. Leading strand is synthesized continuously 5′ to 3′ by DNA polymerase; lagging strand synthesized in Okazaki fragments with primers; primase lays primers; ligase seals.

C. Primase synthesizes the leading strand.

D. Ligase seals nick only on the lagging strand.

SAMPLE

10. In DNA structure, the two strands run in opposite directions, a property known as what?

A. Antiparallel

B. Parallel

C. Complementary

D. Helical

SAMPLE

Answers

SAMPLE

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

SAMPLE

Explanations

SAMPLE

1. A group of three nucleotides on mRNA that codes for a specific amino acid.

A. Codon

B. Anticodon

C. tRNA

D. mRNA

The unit of three nucleotides on mRNA that specifies a particular amino acid is a codon. During translation, the ribosome reads mRNA codons in sequence, and each codon directs which amino acid should be added next to the growing protein. The codon is recognized by the anticodon on tRNA, which brings the correct amino acid to the ribosome. The anticodon is on the tRNA and pairs with the codon, but the three-nucleotide group on mRNA itself is the codon, not the anticodon. The mRNA carries the message of successive codons, while tRNA is the adaptor molecule that delivers amino acids. Start and stop codons are special codons that mark the beginning and end of translation.

2. What technique is used to amplify DNA by repeated cycles of heating and cooling?

A. PCR

B. RAPD

C. Sanger Sequencing

D. RFLP

Amplification of DNA through repeated cycles of heating and cooling is PCR, which stands for polymerase chain reaction. In PCR you repeatedly denature the double-stranded DNA with heat, allow short primers to bind to the target region during a cooling step, and then extend new DNA strands from those primers with a DNA polymerase. Doing this over many cycles multiplies the target DNA exponentially, so a tiny amount of starting material becomes millions of copies. This requires a thermostable DNA polymerase so the enzyme can survive the high temperatures used to separate the strands. That combination of cycles and primers that specify the region to copy is what makes PCR the go-to method for DNA amplification. Other techniques don't fit this description as their primary purpose or mechanism isn't about cycling to amplify a specific DNA fragment. Sanger sequencing reads the sequence of DNA, not its amplification; RFLP analyzes fragment sizes after restriction digestion rather than expanding copies by cycles; RAPD is a PCR-based fingerprinting approach using random primers, but the defining feature in the question is the general, targeted amplification by repeating heating and cooling cycles, which points to PCR.

SAMPLE

3. Define PCR; describe the three main steps and the importance of primer design and melting temperature considerations.

A. Polymerase chain reaction amplifies a DNA segment by cycling through denaturation, annealing, and extension; primers define the target; optimal annealing temperature depends on primer Tm (roughly Tm-5) and primer sequences to avoid dimers.

B. PCR amplifies RNA segments by reverse transcription.

C. PCR cycles through replication, elongation, and termination.

D. Primers are optional in PCR.

PCR is about making many copies of a specific DNA segment by cycles of three steps: denaturation, annealing, and extension. First, the DNA is heated to separate the two strands (denaturation). Then short DNA primers bind to sequences flanking the target region (annealing); the temperature is chosen based on the primers' melting temperature, typically a bit below that value (roughly Tm minus 5°C) to favor specific binding. Finally, a DNA polymerase extends from the primer's 3' end, copying the target sequence and creating new DNA strands (extension). The primers are what define exactly which DNA region gets amplified, so their sequences must flank the intended target and be chosen to bind specifically without forming unintended interactions. Primer design matters a lot: aim for similar Tm for both primers, about 40–60% GC content, 18–25 nucleotides in length, and sequences that avoid self-dimers, hairpins, or strong complementarity between primers. These factors help ensure specific, efficient amplification with minimal non-specific products. PCR amplifies DNA, not RNA (which would require reverse transcription), and the cycle steps use standard terms; primers are not optional.

4. Which nitrogenous base is found only in RNA?

A. Uracil

B. Adenine

C. Cytosine

D. Thymine

RNA uses uracil in place of thymine, so uracil is the base found only in RNA. Adenine and cytosine appear in both RNA and DNA, while thymine is specific to DNA. This distinction is what distinguishes RNA from DNA. In base pairing, uracil pairs with adenine in RNA, whereas thymine pairs with adenine in DNA.

5. DNA's charge?

A. Positive

B. Negative

C. Neutral

D. Undefined

DNA carries a negative charge because of its sugar–phosphate backbone. Each phosphate group is acidic and loses protons in solution, leaving a negative charge. With many nucleotides lined up in the molecule, these negative charges accumulate, making DNA a polyanion under physiological conditions. This negative charge is why DNA migrates toward the positive electrode in gel electrophoresis and why it interacts with positively charged proteins like histones to form chromatin. In short, the phosphate groups ensure DNA is negatively charged, not positive or neutral.

SAMPLE

6. Which technique separates DNA fragments by size using electrical charges?

A. Electrophoresis

B. PCR

C. Chromatography

D. Spectroscopy

DNA fragments are separated by size with an electric field in a gel, a process known as electrophoresis. DNA's phosphate backbone gives it a strong negative charge, so when an electric field is applied, the fragments move toward the positive electrode. The gel matrix acts like a sieve: smaller fragments navigate the pore spaces more easily and thus travel faster than larger ones, creating a size-based separation. This technique is routinely used with agarose gels for typical DNA fragment sizes, often alongside a DNA ladder to estimate relative sizes. Other options do different things—PCR amplifies selected DNA regions, chromatography relies on interactions with a stationary phase rather than an electric-field sieve, and spectroscopy analyzes how molecules interact with light rather than physically separating them by length.

7. Which statement best describes how epigenetic marks influence X chromosome inactivation and imprinting?

A. XIST coats both X chromosomes and initiates silencing across both.

B. Imprinting silences both paternal and maternal alleles equally.

C. XIST lncRNA coats one X chromosome to initiate silencing; DNA methylation and histone modifications reinforce silencing; imprinting relies on parent-specific DNA methylation to silence an allele.

D. X-inactivation requires rapid RNA polymerase II turnover and imprinting relies on RNA editing.

Epigenetic marks control gene expression by changing the chromatin state rather than the DNA sequence itself. For X chromosome inactivation, the XIST long noncoding RNA is expressed from the X chromosome that will be silenced and coats that chromosome to start the shutdown of gene transcription. After this initiation, DNA methylation and histone modifications solidify the silent state so the chromosome remains inactive through many cell divisions. Imprinting uses parent-specific DNA methylation marks established during gamete formation to silence either the paternal or the maternal allele of certain genes, producing monoallelic expression depending on the parent of origin. The described scenario—XIST coating one X to initiate silencing, with DNA methylation and histone modifications reinforcing the silenced state, and imprinting relying on parent-specific DNA methylation to silence an allele—fits these mechanisms precisely.

SAMPLE

8. What is promoter-proximal pausing and what is required for the transition into productive elongation?

A. RNA Pol II initiates transcription and immediately terminates.

B. Promoter-proximal pausing occurs after the promoter and before the gene body, but it has no effect on elongation.

C. Promoter-proximal pausing occurs near the promoter; release into productive elongation requires factors like P-TEFb.

D. Promoter-proximal pausing occurs only in prokaryotes.

Promoter-proximal pausing is a regulatory step where RNA polymerase II begins transcription but quickly pauses a short distance downstream of the transcription start site. This pause is stabilized by the factors NELF and DSIF, keeping Pol II in a poised state before entering productive elongation. Transition into elongation requires P-TEFb, a kinase complex that phosphorylates the RNA Pol II CTD and the pausing factors. Phosphorylation of NELF causes it to dissociate, while DSIF is converted into a positive elongation factor, and CTD Ser2 phosphorylation promotes processive elongation through the gene body. This mechanism allows timing and coordination of transcription with RNA processing and regulatory signals. It's a eukaryotic feature, not something seen in prokaryotes.

9. Describe the mechanism of DNA replication on the leading and lagging strands, including the roles of DNA polymerase, primase, ligase, and Okazaki fragments.

A. Leading strand is synthesized in short fragments by DNA polymerase.

B. Leading strand is synthesized continuously 5' to 3' by DNA polymerase; lagging strand synthesized in Okazaki fragments with primers; primase lays primers; ligase seals.

C. Primase synthesizes the leading strand.

D. Ligase seals nick only on the lagging strand.

DNA replication hinges on the fact that DNA polymerases can only extend DNA in the 5' to 3' direction, starting from a pre-made primer. On the leading strand, the template is oriented so polymerase can add nucleotides continuously toward the replication fork, producing a smooth, uninterrupted strand. On the lagging strand, the template runs the opposite way relative to fork movement, so synthesis occurs in short bursts called Okazaki fragments, each starting from an RNA primer laid down by primase. Primase provides these starting points because DNA polymerase cannot initiate synthesis on its own. After each fragment is extended, ligase seals the nicks to fuse the fragments into a continuous strand. This description captures how polymerase builds the new DNA, how primase creates primers, how Okazaki fragments form on the lagging strand, and how ligase completes the chain. The other statements misstate the leading strand as fragmentary, assign primase to making the leading strand, or imply ligase acts only on the lagging strand.

SAMPLE

10. In DNA structure, the two strands run in opposite directions, a property known as what?

A. Antiparallel

B. Parallel

C. Complementary

D. Helical

Antiparallel arrangement describes the orientation of the two DNA strands: they run in opposite directions, with one 5′ to 3′ and the other 3′ to 5′. This opposite directionality is crucial because DNA polymerases can only add nucleotides to the 3′ end, so copying both strands requires one template read in each direction. It explains why replication occurs with a leading strand synthesized continuously in the 5′ to 3′ direction and a lagging strand made in short fragments. The term complementary refers to base pairing between strands, not their directional arrangement, and helix describes the overall shape, not the direction of each strand. Parallel would imply the strands run in the same direction, which isn't the case.

SAMPLE

Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we'd love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

https://moleculargenetics.examzify.com

We wish you the very best on your exam journey. You've got this!

SAMPLE