

PAST PAPERS 2023

Genetics — Question Bank

Jordan University of Medicine · Faculty of Medicine

■ MID TERM — General Genetics

Q1 Which of the following statements about Turner syndrome is correct?

- A. It is an autosomal trisomy
- B. It is caused by a triplet repeat expansion
- C. It is the only viable full monosomy in humans
- D. It is always inherited from the father
- E. It is an X-linked dominant disorder

✓ **Answer: C. It is the only viable full monosomy in humans**

Q2 A heterozygous individual for sickle cell disease has partial protection against malaria. This is an example of:

- A. Epistasis
- B. Pleiotropy
- C. Heterozygote advantage
- D. Variable expressivity
- E. Reduced penetrance

✓ **Answer: C. Heterozygote advantage**

Q3 During meiosis, crossing over occurs during which substage of prophase I?

- A. Leptotene
- B. Zygotene
- C. Pachytene
- D. Diplotene
- E. Diakinesis

✓ **Answer: C. Pachytene**

Q4 A patient presents with tall stature, long limbs, joint hypermobility, lens dislocation, and aortic root dilation. This constellation of findings is best described as:

- A. Epistasis
- B. Pleiotropy
- C. Codominance
- D. Reduced penetrance
- E. Genetic heterogeneity

✓ **Answer: B. Pleiotropy**

Q5 Albinism is an example of:

- A. Pleiotropy
- B. Epistasis
- C. Anticipation
- D. Genomic imprinting
- E. Variable expressivity

✓ **Answer: B. Epistasis**

Q6 A 6-year-old boy presents with progressive muscle weakness. His maternal uncle has a similar condition. What is the most likely mode of inheritance?

- A. Autosomal dominant
- B. Autosomal recessive
- C. X-linked recessive
- D. Mitochondrial
- E. Y-linked

✓ **Answer: C. X-linked recessive**

Q7 Phenylketonuria (PKU) is inherited in which pattern?

- A. Autosomal dominant
- B. Autosomal recessive
- C. X-linked recessive
- D. Mitochondrial
- E. Codominant

✓ **Answer: B. Autosomal recessive**

Q8 A woman with an autosomal dominant condition marries an unaffected man. What is the probability that each child will be affected?

- A. 0%
- B. 25%
- C. 50%
- D. 75%
- E. 100%

✓ **Answer: C. 50%**

Q9 Which statement is always true in X-linked dominant inheritance?

- A. Only males are affected
- B. Affected fathers transmit the trait to all daughters
- C. Carrier mothers never show symptoms
- D. All sons of affected fathers are affected
- E. The trait skips generations

✓ **Answer: B. Affected fathers transmit the trait to all daughters**

Q10 A mother is a carrier of Hemophilia A. What is the probability that she will have a carrier son?

- A. 0%
- B. 25%
- C. 50%
- D. 100%

✓ **Answer: A. 0%**

Q11 What is the probability that a child will be affected with autosomal dominant neurofibromatosis type 1 (NF1) if one parent is affected and the other is unaffected?

- A. 0%
- B. 25%
- C. 50%
- D. 75%
- E. 100%

✓ **Answer: C. 50%**

Q12 Proper segregation of chromosomes during cell division depends primarily on which structure?

- A. Telomere
- B. Centromere
- C. Nucleosome
- D. Histone core
- E. Nuclear envelope

✓ **Answer: B. Centromere**

Q13 High-resolution chromosome analysis is typically performed using which stage of mitosis?

- A. Metaphase
- B. Prometaphase
- C. Anaphase
- D. Telophase
- E. Interphase

✓ **Answer: B. Prometaphase**

Q14 A chromosomal inversion is best defined as:

- A. Loss of a chromosome segment
- B. Duplication of a chromosome segment
- C. Reversal of a chromosome segment within the same chromosome
- D. Exchange between non-homologous chromosomes
- E. Gain of an extra chromosome

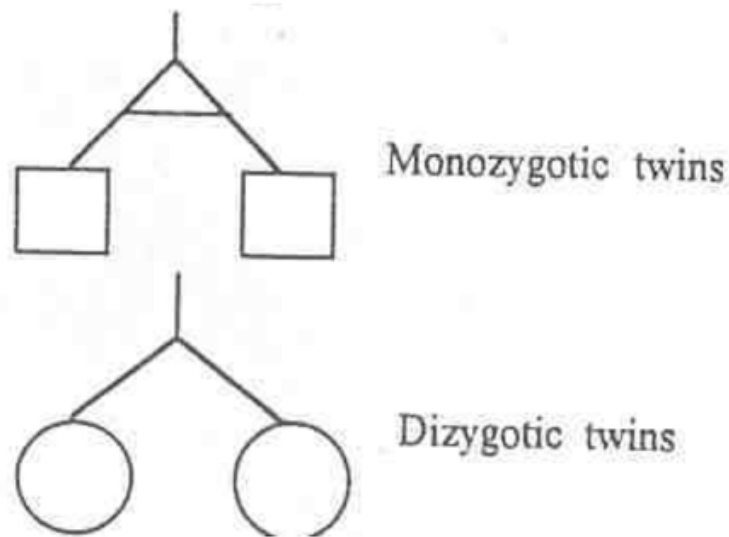
✓ **Answer: C. Reversal of a chromosome segment within the same chromosome**

Q15 During meiosis I, which of the following events occurs?

- A. Sister chromatids separate
- B. Homologous chromosomes separate
- C. DNA replication occurs
- D. Crossing over occurs in metaphase II
- E. Nuclear envelope reforms before alignment

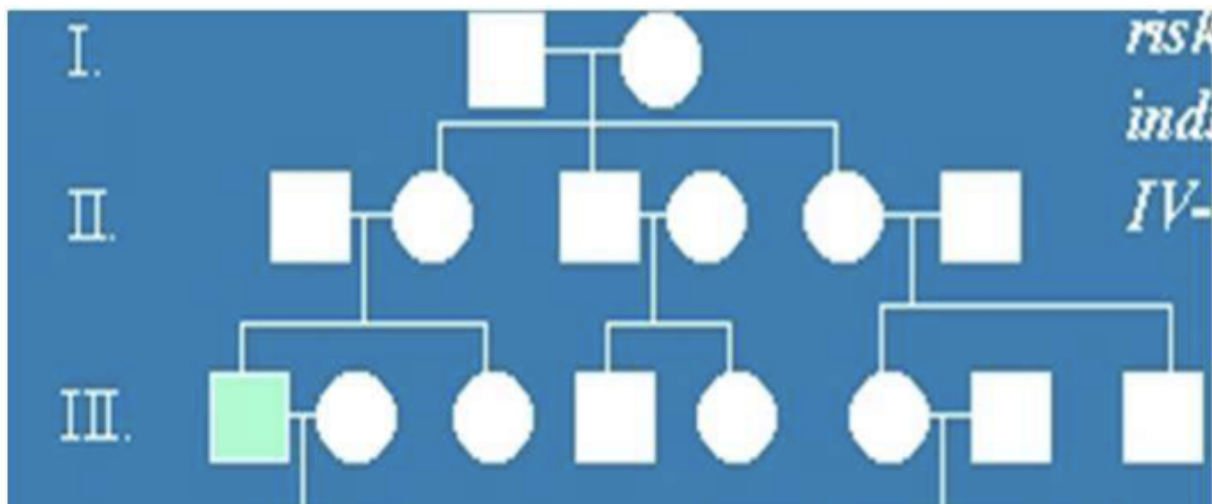
✓ **Answer: B. Homologous chromosomes separate**

NOTE Know how to distinguish Monozygotic vs Dizygotic twin symbols in pedigrees — a past question required this. Reference image below.



Pedigree symbols: Monozygotic twins (connected at top by triangle) vs Dizygotic twins (two separate lines from parents)

Q16 Based on the pedigree below, what is the mode of inheritance, and what is the risk for the individual highlighted (generation III)?



Family pedigree — identify mode of inheritance and risk for highlighted individual (generation III)

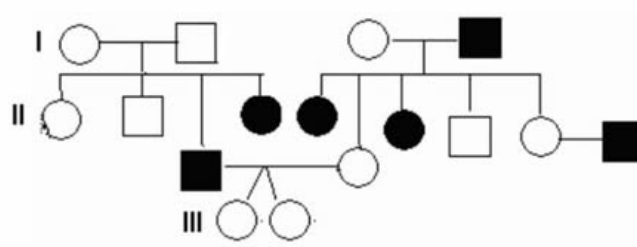
- A. Autosomal Dominant
- B. Autosomal Recessive
- C. X-linked Recessive
- D. X-linked Dominant

✓ **Answer: B. Autosomal Recessive**

Q17 What is the pattern of inheritance shown in this pedigree?

1/1

* ? What is the pattern of inheritance is shown in this pedigree ✓



Pedigree — identify the mode of inheritance

- A. Autosomal Recessive
- B. Autosomal Dominant
- C. Sex-linked Recessive
- D. Sex-linked Dominant

✓ **Answer: A. Autosomal Recessive**

■ Risk Assessment

Q18 A couple are both tested; the father is affected with cystic fibrosis and the mother is a carrier of the cystic fibrosis gene. What is the chance that they will have a HOMOZYGOUS NORMAL MALE?

- a. 1/16
- b. 1/8
- c. 0
- d. 1/2
- e. 1/4

✓ **Answer: C. 0**

■ *Father is affected (FF); mother is a carrier (Ff). No child can be homozygous normal.*

Q19 An unaffected couple who are first cousins request counseling regarding their risk of having a child with alpha-1-antitrypsin deficiency (autosomal recessive). Their parents are unaffected. Their shared grandfather is affected and their shared grandmother is heterozygous. What is the risk to their child of being HOMOZYGOUS FOR A VARIANT FOR THE CONDITION? (Disregard population carrier frequency.)

- a. 1/16
- b. 1/8
- c. 1/32
- d. 0
- e. 1/64

✓ Answer: A. 1/16

Q20 A couple present because of a current female fetus pregnancy and a family history with phenylketonuria (PKU). The mother's sister is affected with PKU and the father's uncle is affected with PKU. What is the risk for the couple to have an UNAFFECTED FEMALE with PKU? Assume a population frequency of 1/100. (PKU is autosomal recessive.)

- a. 1/4
- b. 1/2
- c. 1/18
- d. 1/6
- e. 1/12

✓ Answer: D. 1/6

Q21 A healthy couple seeks genetic counseling regarding cystic fibrosis (CF). The father has an affected brother with CF. There is no family history of CF on the mother's side. The carrier frequency for CF in the general population is 1 in 50. What is the probability that their fetus will be affected with CF?

- A) 1 / 300
- B) 1 / 150
- C) 1 / 180
- D) 1 / 100
- E) 1 / 200

✓ Answer: A. 1/300

Q22 A European couple with a diagnosis of hearing loss in the father's brother (autosomal recessive variant). What is the probability to have an AFFECTED FETUS? The carrier frequency of this variant in the European population is approximately 1/30.

- a. 1/4
- b. 1/90
- c. 0
- d. 1/75
- e. 1/180

✓ Answer: E. 1/180

■ Inheritance Patterns

Q23 A woman carries a pathogenic autosomal dominant variant and is clinically affected. Her grandmother had only mild manifestations of the same condition. The woman has three children who all inherited the variant; one has severe disease, whereas the other two have mild symptoms. Which genetic phenomenon best explains this observation?

- A. Anticipation
- B. Reduced penetrance
- C. Variable expressivity
- D. Genetic heterogeneity
- E. Genomic imprinting

✓ Answer: C. Variable expressivity

Q24 A man carries a pathogenic variant causing an autosomal dominant disorder. All of his affected children have inherited the same variant, but they show different degrees of disease severity. Which concept best explains this finding?

- A. Reduced penetrance
- B. Variable expressivity
- C. Mosaicism
- D. Imprinting
- E. Anticipation

✓ Answer: B. Variable expressivity

Q25 A pathogenic autosomal dominant variant is present in several members of a family. Some individuals carrying the variant develop the disease, while others remain completely asymptomatic. Which concept best explains this observation?

- A. Variable expressivity
- B. Genetic heterogeneity
- C. Reduced penetrance
- D. Anticipation
- E. Pleiotropy

✓ **Answer: C. Reduced penetrance**

Q26 Retinitis pigmentosa (RP) can result from pathogenic variants in many different genes. In contrast, β -thalassemia may result from numerous different pathogenic variants within the same gene (HBB). Which statement is correct?

- A. RP demonstrates allelic heterogeneity; β -thalassemia demonstrates locus heterogeneity
- B. RP demonstrates locus heterogeneity; β -thalassemia demonstrates allelic heterogeneity
- C. Both demonstrate locus heterogeneity
- D. Both demonstrate allelic heterogeneity
- E. Neither demonstrates genetic heterogeneity

✓ **Answer: B. RP demonstrates locus heterogeneity; β -thalassemia demonstrates allelic heterogeneity**

Q27 A XY male child had a biallelic variant causing abnormal sexual development that resulted in reduced testes and internal fallopian tubes. His sister who most likely has the same variant would remain asymptomatic. What pattern of inheritance does this show?

- A. X-linked
- B. Sex limited
- C. Y-linked
- D. Variable expressivity
- E. Reduced penetrance

✓ **Answer: B. Sex limited**

Q28 A 32-year-old woman is evaluated for premature ovarian insufficiency (POI). Genetic testing reveals an FMR1 premutation. Which of the following is the most important implication of this finding?

- A. She is at increased risk of developing Fragile X syndrome
- B. Her children are at risk of inheriting a full FMR1 mutation due to repeat expansion
- C. The premutation will not be transmitted to future generations
- D. She is at increased risk of Prader–Willi syndrome
- E. The condition follows mitochondrial inheritance

✓ **Answer: B. Her children are at risk of inheriting a full FMR1 mutation due to repeat expansion**

Q29 An elderly man develops progressive intention tremor, gait ataxia, and cognitive decline. Molecular testing identifies an FMR1 premutation. Which disorder is most likely responsible for his symptoms?

- A. Fragile X syndrome
- B. Fragile X–associated tremor/ataxia syndrome (FXTAS)
- C. Huntington disease
- D. Prader–Willi syndrome
- E. Angelman syndrome

✓ **Answer: B. Fragile X–associated tremor/ataxia syndrome (FXTAS)**

Q30 A boy presents with hyperphagia, obesity, developmental delay, and intellectual disability. Genetic testing is performed to identify the underlying molecular defect. Which of the following genetic findings is most likely to be demonstrated?

- A. Maternal uniparental disomy of chromosome 15
- B. Paternal deletion of chromosome 13
- C. Maternal deletion of chromosome 15q11–q13
- D. Trinucleotide repeat expansion in the FMR1 gene
- E. Paternal uniparental disomy of chromosome 15

✓ **Answer: A. Maternal uniparental disomy of chromosome 15**

Q31 A woman is suspected to have a mitochondrial disorder based on her family history. Which statement regarding mitochondrial inheritance is correct?

- A. Fathers transmit the mutation only to sons
- B. Fathers transmit the mutation to all children
- C. Mothers transmit the mutation to all children
- D. Only daughters inherit the mutation
- E. The mutation follows autosomal dominant inheritance

✓ **Answer: C. Mothers transmit the mutation to all children**

Q32 A man with Leber hereditary optic neuropathy (LHON) is concerned about passing the disorder to his children. What is the probability that he will transmit the mitochondrial mutation to his offspring?

- A. 100%
- B. 75%
- C. 50%
- D. 25%
- E. 0%

✓ **Answer: E. 0%**

Q33 A woman carries a pathogenic mitochondrial DNA mutation. Which individuals are at risk of inheriting the mutation?

- A. Only her sons
- B. Only her daughters
- C. All of her children
- D. Only her grandchildren
- E. None of her children

✓ **Answer: C. All of her children**

Q34 You observed a patient with a genetic disorder for which there is no previous family history of his disease. Which of the following scenarios could explain this situation?

- a. Any of those choices could explain the patient's situation
- b. A de novo variant
- c. Germline mosaicism in one of the parents
- d. Reduced penetrance
- e. Anticipation

✓ **Answer: A. Any of those choices could explain the patient's situation**

■ Cancer Genetics

Q35 Which of the following features best distinguishes a malignant neoplasm from a benign neoplasm?

- A. Increased mitotic activity
- B. Cellular pleomorphism
- C. Invasion of lamina propria and ability to metastasize
- D. Large tumor size
- E. Rapid growth

✓ **Answer: C. Invasion of lamina propria and ability to metastasize**

Q36 Genomic analysis of a tumor identifies numerous non-recurrent mutations that do not contribute to tumor initiation or progression. These mutations are best classified as:

- A. Driver mutations
- B. Founder mutations
- C. Passenger mutations
- D. Germline mutations
- E. Gatekeeper mutations

✓ **Answer: C. Passenger mutations**

Q37 Which of the following tumors is characteristically associated with Multiple Endocrine Neoplasia Type 2A (MEN2A)?

- A. Medulloblastoma and neuroblastoma
- B. Medullary thyroid carcinoma and pheochromocytoma
- C. Pituitary adenoma and pancreatic neuroendocrine tumor
- D. Colorectal carcinoma and osteomas
- E. Retinoblastoma and osteosarcoma

✓ **Answer: B. Medullary thyroid carcinoma and pheochromocytoma**

Q38 Different pathogenic variants in the RET gene may result in either Hirschsprung disease or MEN2. Which statement best explains this observation?

- A. RET exhibits genomic imprinting
- B. RET mutations demonstrate anticipation
- C. RET may undergo either gain-of-function or loss-of-function mutations
- D. RET is inherited in a mitochondrial pattern
- E. RET mutations are always somatic

✓ **Answer: C. RET may undergo either gain-of-function or loss-of-function mutations**

Q39 Which statement regarding oncogenes and tumor suppressor genes is correct?

- A. Both require biallelic inactivation to promote tumorigenesis
- B. Oncogenes require activation of only one allele, whereas tumor suppressor genes usually require loss of both alleles
- C. Oncogenes and tumor suppressor genes behave identically at the cellular level
- D. Tumor suppressor genes require activation of only one allele
- E. Oncogenes are always inherited

✓ **Answer: B. Oncogenes require activation of only one allele, whereas tumor suppressor genes usually require loss of both alleles**

Q40 A 4-month-old infant develops multiple bilateral retinal tumors. Another child develops a single unilateral retinal tumor at 4 years of age. Which statement is most likely correct?

- A. Both tumors are typically sporadic
- B. The infant most likely carries a hereditary RB1 mutation
- C. The older child most likely carries a hereditary RB1 mutation
- D. Bilateral disease excludes a germline mutation
- E. Age at diagnosis has no significance

✓ **Answer: B. The infant most likely carries a hereditary RB1 mutation**

Q41 A woman with a pathogenic BRCA1 variant develops breast cancer. This mechanism is known as:

- A. Genomic imprinting
- B. Anticipation
- C. Loss of heterozygosity resulting in the second somatic mutation
- D. Trinucleotide repeat expansion
- E. Uniparental disomy

✓ **Answer: C. Loss of heterozygosity resulting in the second somatic mutation**

Q42 A woman is found to carry a pathogenic BRCA1 variant. How is susceptibility to hereditary breast and ovarian cancer syndrome inherited?

- A. Autosomal recessive with complete penetrance
- B. X-linked dominant
- C. Mitochondrial
- D. Autosomal dominant with high penetrance
- E. Multifactorial

✓ **Answer: D. Autosomal dominant with high penetrance**

Q43 A 21-year-old woman is found to carry a pathogenic BRCA1 mutation and currently has no evidence of malignancy. Which management strategy is most appropriate?

- A. Routine population screening only
- B. Bilateral mastectomy and oophorectomy immediately
- C. Enhanced surveillance and risk-reducing salpingo-oophorectomy after completion of childbearing
- D. No intervention until age 50 years
- E. Colonoscopic surveillance every year

✓ **Answer: C. Enhanced surveillance and risk-reducing salpingo-oophorectomy after completion of childbearing**

Q44 A man carries a pathogenic BRCA2 mutation. Which malignancies are associated with an increased risk in this individual?

- A. Lung and bladder cancer
- B. Colon and gastric cancer
- C. Breast and prostate cancer
- D. Thyroid and liver cancer
- E. Melanoma and osteosarcoma only

✓ **Answer: C. Breast and prostate cancer**

Q45 Which finding is most suggestive of a hereditary cancer syndrome rather than a sporadic cancer?

- A. Tumor occurring after age 80 years
- B. Single isolated tumor
- C. Low-grade histology
- D. Multiple primary tumors in the same individual
- E. tumor shown has stable microsatellite regions

✓ **Answer: D. Multiple primary tumors in the same individual**

Q46 A patient develops right-sided colon cancer at a young age. Genetic testing identifies a pathogenic variant in MLH1. MLH1 normally functions in which DNA repair pathway?

- A. Base excision repair
- B. Nucleotide excision repair
- C. Mismatch repair
- D. Homologous recombination repair
- E. Non-homologous end joining

✓ **Answer: C. Mismatch repair**

Q47 How do mutations in mismatch repair genes promote carcinogenesis?

- A. They directly activate oncogenes
- B. They increase mutation rates throughout the genome
- C. They inhibit apoptosis exclusively
- D. They increase telomerase activity directly
- E. They cause chromosome loss during meiosis

✓ **Answer: B. They increase mutation rates throughout the genome**

Q48 A woman develops colorectal cancer and is found to have multiple osteomas and desmoid tumors. Which syndrome is most likely?

- A. Lynch syndrome
- B. Peutz–Jeghers syndrome
- C Gardner syndrome variant of FAP with APC MUTATION.
- D. Li–Fraumeni syndrome
- E. Cowden syndrome

✓ **Answer: C Gardner syndrome variant of FAP with APC MUTATION.**

Q49 Which gene is most commonly mutated in Familial Adenomatous Polyposis (FAP)?

- A. TP53
- B. RET
- C. APC
- D. RB1
- E. BRCA1

✓ **Answer: C. APC**

Q50 The APC gene contributes to tumor development in FAP through which mechanism?

- A. Gain-of-function mutation
- B. Trinucleotide repeat expansion
- C. Loss-of-function mutation of a tumor suppressor gene
- D. Gene amplification
- E. Mitochondrial mutation

✓ **Answer: C. Loss-of-function mutation of a tumor suppressor gene**

Q51 Which gene is most commonly associated with Lynch syndrome?

- A. APC
- B. RB1
- C. RET
- D. MSH2
- E. BRCA2

✓ **Answer: D. MSH2**

Q52 A colorectal tumor demonstrates microsatellite instability (MSI-high). Additional testing identifies a mutation affecting the TGFBR2 signaling pathway. What is the most likely consequence?

- A. Increased growth inhibition
- B. Increased apoptosis
- C. Loss of growth-inhibitory signaling and increased cellular proliferation
- D. Reduced mutation rate
- E. Enhanced DNA mismatch repair

✓ **Answer: C. Loss of growth-inhibitory signaling and increased cellular proliferation**

■ Genetic Variation & Mutation Nomenclature

Q53 A de novo variant occurs due to an error in:

- a. DNA replication
- b. Post translational modification
- c. DNA transcription
- d. Translation
- e. Reverse transcription

✓ **Answer: A. DNA replication**

Q54 Which allele frequency most appropriately defines a rare pathogenic mutation versus a common polymorphism?

- A. 0.3% = polymorphism; 3% = mutation
- B. 0.3% = mutation; 3% = polymorphism
- C. Both are mutations
- D. Both are polymorphisms
- E. Classification does not depend on frequency

✓ **Answer: B. 0.3% = mutation; 3% = polymorphism**

Q55 Why is the term 'variant' now preferred over 'mutation' or 'polymorphism' in genetic terminology?

- A. Because all mutations are benign
- B. Because polymorphisms are always pathogenic
- C. Because 'mutation' and 'polymorphism' lead to misconceptions — that mutations are disease-causing while polymorphisms are benign
- D. Because DNA sequencing is inaccurate
- E. Because variants cannot be inherited

✓ **Answer: C. Because 'mutation' and 'polymorphism' lead to misconceptions**

Q56 Why are many large-scale chromosomal or genomic mutations rarely observed in live births?

- A. They occur very rarely during meiosis
- B. They are always repaired by DNA polymerase
- C. They are often incompatible with survival or normal reproduction
- D. They only occur in somatic cells
- E. They are always silent mutations

✓ **Answer: C. They are often incompatible with survival or normal reproduction**

Q57 Which statement best explains why C→T transitions are the most common type of point mutation?

- A. methylation then Spontaneous deamination resulting in DNA Polymerase seeing thymine-adenine as normal and failing to correct it.
- B. acetylation then Spontaneous deamination resulting in DNA Polymerase seeing thymine-adenine as normal and failing to correct it.
- C. Cytosine is the most abundant nucleotide
- D. Thymine is unstable under physiological conditions
- E. DNA polymerase preferentially inserts thymine

✓ **Answer: A. Methylation then spontaneous deamination**

Q58 A mutation is described as c.35delG. What does this mutation represent?

- A. Substitution of guanine at position 35
- B. Deletion of guanine at coding DNA position 35
- C. Insertion of guanine at position 35
- D. Splice site mutation
- E. Chromosomal duplication

✓ **Answer: B. Deletion of guanine at coding DNA position 35**

Q59 A GJB2 variant is described as c.857+1 G>A. What is the most likely effect of this mutation?

- A. Synonymous substitution
- B. Missense mutation
- C. Frameshift mutation
- D. A substitution at the 5' donor splice site
- E. Nonsense mutation

✓ **Answer: D. A substitution at the 5' donor splice site**

Q60 A mutation occurs at position c.79+2T>A. What is the most likely consequence?

- A. Normal protein function
- B. Missense mutation
- C. Splice donor site disruption
- D. Promoter activation
- E. Silent mutation

✓ **Answer: C. Splice donor site disruption**

Q61 A mutation occurs at c.79–18A>G in a gene. What is the most likely affected region?

- A. Exonic coding region
- B. 5' splice donor site
- C. Branch point region involved in splicing
- D. Polyadenylation signal
- E. Translation start site

✓ **Answer: C. Branch point region involved in splicing**

Q62 Which statement regarding the spliceosome is correct?

- A. U1 binds the branch point sequence
- B. U2 binds the 5' donor site
- C. U1 binds the 5' splice donor site and U2 binds the branch point
- D. U2 binds the 3' splice site only
- E. Spliceosome does not involve RNA

✓ **Answer: C. U1 binds the 5' splice donor site and U2 binds the branch point**

Q63 A frameshift mutation produces the protein notation p.Arg97ProfsTer23. What does this indicate?

- A. Amino acid substitution at position 97
- B. Premature stop codon after 23 amino acids in the shifted reading frame
- C. Silent mutation
- D. Splice site mutation
- E. Gene duplication

✓ **Answer: B. Premature stop codon after 23 amino acids in the shifted reading frame**

Q64 Which of the following is NOT a synonymous mutation?

- A. A codon change that does not alter the amino acid
- B. A silent mutation
- C. A change resulting in the same amino acid
- D. A mutation altering amino acid identity
- E. No change in protein sequence

✓ **Answer: D. A mutation altering amino acid identity**

Q65 A mutation alters mRNA secondary structure. What is the most likely consequence?

- A. Increased DNA replication speed
- B. Increased transcription accuracy
- C. Altered translation initiation efficiency
- D. Increased chromosome number
- E. Enhanced splicing fidelity

✓ **Answer: C. Altered translation initiation efficiency**

Q66 Which statement best describes why most new germline mutations are not passed through generations?

- A. They are always repaired
- B. They are usually lethal or reduce reproductive fitness
- C. They only occur in somatic cells
- D. They never affect coding regions
- E. They are always silent

✓ **Answer: B. They are usually lethal or reduce reproductive fitness**

Q67 Which of the following is a possible consequence of a nonsense mutation?

- A. Increased protein length due to readthrough
- B. No change in protein sequence
- C. Nonsense-mediated mRNA decay, truncated protein, or altered splicing
- D. Increased DNA replication speed
- E. Synonymous amino acid substitution

✓ **Answer: C. Nonsense-mediated mRNA decay, truncated protein, or altered splicing**

Q68 What is the most likely effect of a frameshift mutation?

- A. No change in amino acid sequence
- B. Single amino acid substitution
- C. Premature termination codon downstream of the mutation
- D. Increased transcription efficiency
- E. Silent mutation with no protein effect

✓ **Answer: C. Premature termination codon downstream of the mutation**

Q69 During each round of DNA replication, a large number of potential errors can occur (10,000 to 100,000). Despite this, genetic stability is maintained in human cells. What best explains this?

- A. Mutation rate is high but biologically irrelevant
- B. Cells tolerate most replication errors without correction
- C. DNA replication is completely error-free
- D. Proofreading and DNA repair mechanisms correct >99.9% of replication errors, resulting in extremely rare permanent mutations
- E. Mutations only occur in non-coding DNA

✓ **Answer: D. Proofreading and DNA repair mechanisms correct >99.9% of replication errors**

Q70 Why do mutations arising from DNA damage (mutagens) or DNA repair processes tend to become permanent more often than replication errors?

- A. Because DNA replication has no error correction mechanisms
- B. Because mutagens directly prevent DNA synthesis
- C. Because replication errors are always lethal and removed
- D. Because DNA replication has proofreading, while damage-induced lesions may become permanent if repair mechanisms incorrectly fix or fail to correct the lesion
- E. Because all DNA damage is automatically repaired without errors

✓ **Answer: D. Because DNA replication has proofreading, while damage-induced lesions may become permanent if repair mechanisms fail**

Q71 A single nucleotide variant occurs in the second intron of a gene. The genomic coordinate is g.45210G>A. Which of the following best represents its coding nomenclature?

- A. c.234+67 G>A
- B. c.234 G>A
- C. c.235-67 G>A
- D. c.45210 G>A
- E. c.234+67 A>G

✓ **Answer: A or C (intron region — solve by elimination of impossible options)**

■ *This type of question can only be solved through elimination of impossible/wrong options.*

■ Genetic Testing Methods

Q72 A researcher wants to detect uniparental disomy and regions of homozygosity in a patient. Which technique is most appropriate?

- A. Karyotyping
- B. FISH
- C. Chromosomal microarray (CMA)
- D. PCR only
- E. Western blot

✓ **Answer: C. Chromosomal microarray (CMA)**

Q73 A newborn in the NICU presents with multiple congenital anomalies. A rapid, comprehensive method is needed to identify potential genetic causes. Which is the best test?

- A. Karyotyping
- B. FISH
- C. Whole exome sequencing
- D. Whole genome sequencing
- E. Sanger sequencing

✓ **Answer: D. Whole genome sequencing**

Q74 Which genetic alteration is NOT detectable by standard FISH analysis?

- A. Chromosomal duplication
- B. Chr 21 microdeletion
- C. Fragile X syndrome
- D. Large chromosomal deletion
- E. Aneuploidy

✓ **Answer: C. Fragile X syndrome**

Q75 Which method is best for detecting large chromosomal deletions or duplications?

- A. Karyotyping
- B. PCR
- C. Western blot
- D. ELISA
- E. RNA sequencing

✓ **Answer: A. Karyotyping**

Q76 A clinician wants to confirm a known specific single-gene mutation in a patient with a suspected inherited disorder. Which is the most appropriate genetic testing method?

- A. Karyotyping
- B. Chromosomal microarray (CMA)
- C. Whole genome sequencing
- D. FISH
- E. Sanger sequencing

✓ **Answer: E. Sanger sequencing**