

Exercise walk-through

1.12

Protein synthesis, mutations and screening (statements 2.13–2.18)

Pearson Edexcel · International A-Level · Biology

Read a health study like an examiner

Your turn

Gum disease correlates with endothelial damage. List three checks before claiming causation.

- A. Who was sampled, how selected, how many?
- B. Were confounders like smoking, age, diet controlled?
- C. Is there a mechanism and a dose-response pattern?

Four routes across a membrane

Route	Gradient	Protein	ATP
Diffusion	down	none	no
Facilitated	down	channel or carrier	no
Active transport	against	carrier pump	yes
Osmosis	water, down water potential	partially permeable membrane	no

DNA copies itself semi-conservatively

Unzip : helicase breaks the hydrogen bonds between the strands

Template : each old strand pairs with free nucleotides by complementary base pairing

Join : DNA polymerase links the nucleotides into a new strand

Exercises 2.1·2.3

2.1 Describe the role of mRNA and of tRNA in translation.

[4]

2.2 Explain why a deletion of three bases is often less harmful than a deletion of one base.

[3]

2.3 State two methods of foetal genetic testing and one risk of each.

[4]

Exercises 2.1·2.3

2.1 Describe the role of mRNA and of tRNA in translation. [4]

2.1 mRNA carries the base sequence of the gene (in codon triplets) from nucleus to ribosome and is read there; tRNA molecules each carry a specific amino acid and their anticodons pair with complementary codons, delivering amino acids in sequence.

2.2 Explain why a deletion of three bases is often less harmful than a deletion of one base. [3]

2.2 Three bases = one whole triplet, so only one amino acid is lost and the reading frame is preserved; a single-base deletion shifts every subsequent triplet, changing the entire protein beyond the mutation.

2.3 State two methods of foetal genetic testing and one risk of each. [4]

2.3 Amniocentesis – small miscarriage risk; chorionic villus sampling – miscarriage risk and some results ambiguous for the couple.

Exercises 3.1·3.2

3.1 The mRNA sequence 5'–AUG UUU GGC UAA–3' is translated. Write the anticodons that pair with the first three codons, state what the final codon does, and name the bond that forms between the first two amino acids. [5]

3.2 A couple both have a family history of cystic fibrosis and neither is a carrier by testing (both FF). Another couple are both carriers. Compare the genetic risks for their children, and explain why the carrier couple may still choose to have children naturally rather than use PGD. [5]

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3.1 Anticodons: UAC (pairs AUG), AAA (pairs UUU), CCG (pairs GGC). UAA is a stop codon: it ends translation and releases the polypeptide. A peptide bond forms between the two amino acids.

3.2 A couple both have a family history of cystic fibrosis and neither is a carrier by testing (both FF). Another couple are both carriers. Compare the genetic risks for their children, and explain why the carrier couple may still choose to have children naturally rather than use PGD. [5]

3.2 FF × FF couples can only have FF children – no CF risk. Carrier couple (Ff × Ff): each child has 1/4 chance affected, 1/2 carrier. Reasons to proceed naturally: PGD requires IVF, which is physically demanding, costly and mostly unsuccessful per cycle; 3/4 of natural conceptions are unaffected and prenatal or newborn care has improved; personal, religious or ethical views about embryo selection.

Exercise 3.3

3.3 Hunter syndrome is caused by a dominant allele; a heterozygous father and an unaffected mother have three children. Determine the probability that all three are unaffected, showing your working, and explain how the answer would change if the allele were recessive and the mother were a carrier. [6]

Exercise 3.3

3.3 Hunter syndrome is caused by a dominant allele; a heterozygous father and an unaffected mother have three children. Determine the probability that all three are unaffected, showing your working, and explain how the answer would change if the allele were recessive and the mother were a carrier. [6]

3.3 Dominant, father Hh $\times$ mother hh: each child independently has $1/2$ chance unaffected. $P(\text{all three unaffected}) = (1/2)^3 = 1/8$. If the allele were recessive and the mother a carrier: father Hh (if heterozygous) $\times$ Hh – each child $1/2$ unaffected homozygous dominant, $1/4$ carrier, $1/4$ affected; $P(\text{all three unaffected including carriers}) = (3/4)^3 = 27/64$ – much higher than $1/8$; (accept $1/8$ for "no allele at all" with clear working).

Note: if the recessive father were homozygous affected (HH), all children would be carriers and none affected – state the parental genotypes you assume.