



## Protein synthesis: practice questions

5 questions · 15 marks · mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name .....

Total ..... / 15

**1** PAPER 1A STYLE [1 mark]

During transcription, which base on the RNA strand pairs with adenine on the DNA template strand?

- A. ☐ Thymine
- B. ☐ Uracil
- C. ☐ Guanine
- D. ☐ Cytosine

**2** PAPER 1A STYLE [1 mark]

The codons GAA and GAG both code for glutamic acid. Which feature of the genetic code does this show?

- A. ☐ Universality
- B. ☐ It is a triplet code
- C. ☐ Degeneracy
- D. ☐ It is non-overlapping

**3** PAPER 1B STYLE

[5 marks]

The table shows part of the mRNA codon table. A short section of mRNA has the sequence AUG UUU CAU GAG UGG UAA. (a) Deduce the sequence of amino acids coded by this mRNA. [2] (b) Deduce the base sequence of the DNA template strand for the first two codons. [1] (c) A mutation changes the fourth codon from GAG to GUG. Using the table, state the effect on the polypeptide and suggest how this could affect the protein's function. [2]

| Part of the mRNA codon table |             |
|------------------------------|-------------|
| Codon                        | Amino acid  |
| AUG                          | Met (start) |
| UUU                          | Phe         |
| CAU                          | His         |
| GAG                          | Glu         |
| GUG                          | Val         |
| UGG                          | Trp         |
| UAA                          | stop        |

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**4** PAPER 2A STYLE

[2 marks]

Explain why the genetic code must be a triplet code.

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Describe how a polypeptide is elongated during translation.

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## Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

**1. [1]**

**B** B;

**2. [1]**

**C** C;

**3. [5]**

- (a) Met – Phe – His – Glu – Trp;
- (a) translation ends at UAA / stop codon (no amino acid added); Award [1] for four correct amino acids in order
- (b) TAC AAA; Accept 3'-TAC AAA-5' or 5'-AAA CAT-3'
- (c) glutamic acid replaced by valine (at that position) / one amino acid changed;
- (c) different R group / hydrophobic instead of charged, so the polypeptide folds differently / changes shape;
- (c) protein may lose function / function altered, e.g. as in haemoglobin S; OWTTE
- max 5

**4. [2]**

- there are 20 (types of) amino acids (to be coded for) and 4 bases;
- a doublet code gives only  $4^2 = 16$  combinations, which is not enough;
- a triplet code gives  $4^3 = 64$  combinations, which is enough (with some to spare for start/stop or degeneracy);
- max 2

**5. [6]**

- mRNA binds to the small subunit of the ribosome;
- mRNA is read in codons / triplets of bases;
- tRNA carries a specific amino acid;
- tRNA anticodon pairs with the complementary codon on mRNA;
- by hydrogen bonding / complementary base pairing (A-U, C-G);
- two tRNAs bind (to the large subunit) at the same time;
- a peptide bond forms between the amino acid and the growing polypeptide;
- the polypeptide is transferred to the (amino acid on the) second tRNA;
- the ribosome moves along the mRNA by one codon;
- the first tRNA (without an amino acid) is released;
- process repeats, adding one amino acid at a time in the order set by the codons;
- max 6