

Problem #4 (20 points). One of the major achievements in genetics was the decipherment of the genetic code—the creation of an mRNA–polypeptide dictionary. Polypeptides (proteins) are building blocks of all living organisms. Polypeptide molecules are chains that consist of amino acids (denoted as *Arg*, *Leu*, *Phe* etc.), and it is the sequence of amino acids in the polypeptide that determines its properties. When cells synthesize polypeptides, they follow instructions written in molecules of messenger ribonucleic acid (mRNA), chains that consist of four nucleotides (denoted as U, C, A, G).

If a cell uses as a template the following mRNA sequence:

AUGUCGAGAAGUCACACCCACCUUCCGAAUUCUAGCCUCAAGAAUCUAGCUCGUGGCCGGAUCUAUACACGAU
GAAUGAGGUGGUGUCUUGUGUGCGAGUUAUUCUAAAUGAACCGCUAGAUGGGUCAUGCGCCGGACGUAGGAUU
GUUUCAGGCACCCACUAUUCUGUACGUCCAAUAGAUAAGUUGCCUCA,

the following polypeptides will be synthesized:

- *Met-Ser-Arg-Ser-His-Thr-Pro-Pro-Ser-Glu-Ser-Ser-Leu-Lys-Asn-Leu-Ala-Arg-Gly-Arg-Ile-Tyr-Thr-Arg*
- *Met-Arg-Trp-Cys-Leu-Val-Cys-Glu-Leu-Phe*
- *Met-Asn-Arg*
- *Met-Gly-His-Ala-Pro-Asp-Val-Gly-Leu-Phe-Gln-Ala-Pro-Thr-Ile-Leu-Tyr-Val-Gln-Ile-Asp-Lys-Val-Ala-Ser*

(a) A cell uses the following mRNA sequence:

AUGUUAACGUUCUAAAUGUGGGGGGACACCAG

What polypeptide(s) will it synthesize?

(b) A cell synthesized the following polypeptide:

Met-Lys-Cys-Ile

What mRNA sequence(s) could it have used?

(c) The nucleotide pairs are sometimes called **roots** and classified into two groups: strong roots and weak roots. Examples of strong roots are CU, GU, AC, GG. Examples of weak roots are AU, UA, UG, AA. Classify all the other roots.

⚠ The data presented here are slightly simplified.

—Alexander Berdichevsky