

-- Question --

2 Normal human cells contain proto-oncogenes which control division and differentiation of the cells. Mutations in these genes may turn the genes into oncogenes. Oncogenes can make the cells become cancerous.

- a** Explain why mutations in proto-oncogenes may lead to cancer. (2 marks)
- b** A base substitution occurs in a proto-oncogene so that the 19th amino acid in the resulting polypeptide changes from proline to histidine. The codons coding for these two amino acids are shown in the table below.

Amino acid	Codon			
Proline	CCA	CGU	CCC	CCG
Histidine	CAU	CAC		

- i** Explain why it is possible for some amino acids to be coded by two or more codons. (2 marks)
- ii** State all the possible changes in the codon that result in the replacement of proline by histidine. (2 marks)
- iii** State the position of the nucleotide in the mRNA at which the base substitution occurs. Explain how you arrive at your answer with reference to the features of genetic code. (4 marks)

-- Answer --

- a** Proto-oncogenes control cell division. 1m
Mutations in these genes may lead to uncontrolled cell division, causing cancer. 1m
- b i** There are only 20 amino acids but there are $4^3 = 64$ different codons. 1m
The number of codons is larger than the number of amino acids. 1m
- ii** CCC → CAC 1m
CGU → CAU 1m
- iii** As three bases on the mRNA code for one amino acid, 1m
and there are no gaps between the codons and the codons are read in a non-
overlapping manner, 1m
the 19th amino acid is coded by the 55th to 57th bases on the mRNA. 1m
Therefore, the base substitution occurs at the 56th nucleotide. 1m