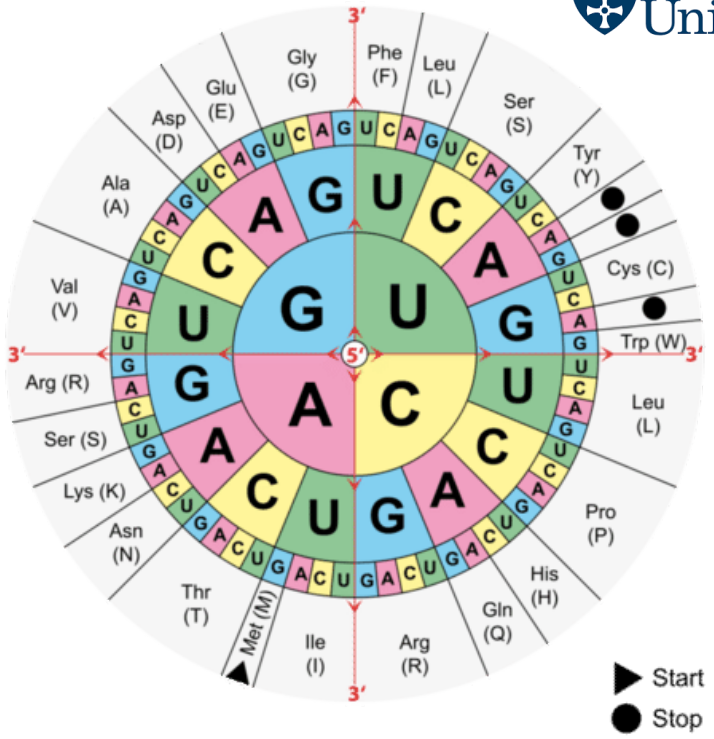
Protein Synthesis - ANSWERS

Complete this worksheet alongside this presentation: https://prezi.com/view/ynRObkHUNckcPvqCyI5o/

DNA	RNA
A	U
T	A
C	G
G	C

Step 1: Transcription: convert the DNA code to mRNA code.

Step 2: Translation: translate your mRNA code into an amino acid sequence using the circular chart on the right. Find the



DNA:	TAC	GTG	AGA	CGG	CTA	TTG	GGG	ACC	AAA	CTC	AAG	CCC	TCT
mRNA	AUG	CAC	UCU	GCC	GAU	AAC	CCC	UGG	UUU	GAG	UUC	GGG	AGA
Amino acid:	M	H	S	A	D	N	P	W	F	E	F	G	R

CAG	CTG	GTA	TGT	CTT	ACA	ATG	GTC	CTC	GAC	ACC	GGA	CTA	TTT	CAA	ACG
GUC	GAC	CAU	ACA	GAA	UGU	UAC	CAG	GAG	CUG	UGG	CCU	GAU	AAA	GUU	UGC
V	D	H	T	E	C	Y	Q	E	L	W	P	D	K	V	C

Exam Questions – Try these relevant questions from past AQA and OCR exams. Answers are included in the answer document

1 Bread contains a mixture of polypeptides known as gluten.

Gluten consists of two types of polypeptide: gliadins and glutenins.

The table below contains statements about the structures of gluten polypeptides. In the boxes next to each statement, write the level of protein structure (primary, secondary, tertiary, or quaternary) to which the statement refers.

[2 marks]

Statement	Level of protein structure
Short α-helical sections are present in both polypeptides because of their high proline content	secondary
Intermolecular bonds form between glutenin and gliadin polypeptides	quaternary
Up to 45% of the amino acids in gliadins are glutamine	primary
Hydrophobic amino acids such as glutamine and proline are not found on the surface of gluten proteins	tertiary

2 Human breast milk is produced and secreted by gland cells. These gland cells have adaptations that include many mitochondria and many Golgi vesicles. The milk contains a high concentration of protein.

Explain the role of these cell adaptations in the production and secretion of breast milk.

[2 marks]

The many mitochondria are needed to **release energy**/ATP for the movement of vesicles. The many Golgi vecicles

are needed to **transport the protein (milk) out of the cell**. [no marks for "produce energy"]

3.1 Describe how a peptide bond is formed between two amino acids to form a dipeptide

[2 marks]

Peptide bonds are formed from a **condensation reaction** between the **amine and carboxyl groups** (or NH2 and COOH)

3.2 The secondary structure of a polypeptide is produced by bonds between amino acids. Describe how.

[2 marks]

Hydrogen bonds form between the **NH group** on one amino acid and the **C=O group** on another.

OR the secondary structure comes from the formation of **beta-pleated sheets and alpha-helix**

3.3 Two proteins have the same number and type of amino acids but different tertiary box structures. Explain why.

[2 marks]

They may have a **different sequence of amino acids** (or **different primary structure**), therefore form ionic, hydrogen and disulphide **bonds in different places**.

4.1 The genetic code is described as degenerate. What is meant by this? Use an example from Table 1 to illustrate your answer

[2 marks]

Degenerative means that more than one codon codes for a single amino acid. For example, the amino acid Arg, may come from the codon CGU, CGC, CGA, CGG, AGA or AGG. [You must include an example from the table.]

Table 1 shows mRNA codons and the amino acids coded for by each codon. It also shows some properties of the R group of each amino acid.

Table 1

1st base	2nd base U	2nd base C	2nd base A	2nd base G	3rd base
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
			Lys	Arg	A
	Met				G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Key to the properties of the R group of each amino acid

No overall charge | Positively charged | Negatively charged

A scientist investigated changes in the amino acid sequence of a human enzyme resulting from mutations. All these amino acid changes result from single base substitution mutations.
This enzyme is a polypeptide 465 amino acids long.

Table 2 shows the result of three of the base substitutions.

Table 2

Amino acid number	Correct amino acid	Amino acid inserted as a result of mutation
203	Val	Ala
279	Glu	Lys
300	Glu	Lys

4.2 What is the minimum number of bases in the gene coding for this polypeptide?

[1 mark]

1395 [comes from 465 x 3. There are 465 amino acids, and each relates to 3 bases]

4.3 Use information from Table 1 to tick one box that shows a **single base substitution** mutation in DNA that would result in a change from Val to Ala at amino acid number 203. This question requires you to convert the mRNA in table 1 to DNA

[1 mark]

CAA -> CGA [X] GUU -> GCA [ ] GUU -> GUC [ ] CAC -> CGG [ ]

4.4 A change from Glu to Lys at amino acid 300 had no effect on the rate of reaction catalysed by the enzyme. The same change at amino acid 279 significantly reduced the rate of reaction catalysed by the enzyme.

Use all the information and your knowledge of protein structure to suggest reasons for the differences between the effects of these two changes.

[3 marks]

Both changes involved a **negatively charged amino acid changed to a positively charged** amino acid.

The change at amino acid 300 does not change the shape of the **active site**, as the tertiary structure remains the same.

Amino acid 279 may have been involved in an **ionic/disulphide/hydrogen bond** and so the active site/tertiary structure changed.

5 There are different types of gene mutation. Put a tick in the box next to the statement which describes INCORRECTLY the effect of the mutation in an exon of a gene.

[1 mark]

A substitution may not result in a change to the encoded amino acid.		An inversion will result in a change in the number of DNA bases.	X	A deletion will result in a frame shift.		An addition will result in a frame shift.	