

EXERCISES ON GENETICS AND CHEMICAL REACTIONS FOR K.O. II

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Tolentino Tuition, Year 10 Science

30 June 2026

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EXERCISE 1

Please observe the mRNA sequences for Gene A, which codes for the protein Enzyme X, extracted from four different individuals:

Figure 1

Normal Gene A	AUC GUU CAU GAU CCC UGA
Individual 1	UAGUC GUU CAU GAU CCC UGA
Individual 2	AUC GUU CAA GAU CCC UGA
Individual 3	AUC GUC CAU GAU CCC UGA
Individual 4	AUC GUU CAU GAU CC UGA

mRNA codons will code for specific amino acids according to the chart below:

Figure 2

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

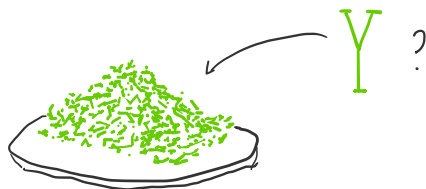
Source

Anisimova M and Ostash B (2020) Visualising Codon Usage Within and Across Genomes: Concepts and Tools. Statistical Modelling and Machine Learning Principles for Bioinformatics Techniques, Tools, and Applications: 213-288.

Using the information in Figure 2, please explain the effect that any mutations found in Figure 1 could have on the final protein structure of Enzyme X for all individuals exhibiting mutations.

EXERCISE 2

Lambert, an undergraduate student, is given a sample of Solid Y by his instructor, who challenges him to identify it.



One of Lambert's identification attempts involves reacting Solid Y with hydrochloric acid. After doing so, Lambert observes that a gas - Gas Q - is produced.

To identify Gas Q, Lambert decides to use Test A, for which Gas Q tests *positive*.

Lambert conducted the following procedure under Test A:

1	Collect Gas Q
2	Bubble Gas Q through calcium hydroxide
3	Observe the result

1. What is Test A, and why might Lambert have tried it?
2. Given Gas Q's result for Test A,
 - A. What was Gas Q?
 - B. What was the result observed by Lambert in Step 3 of Test A's procedure, and why?

EXERCISE 3

Thrilled at his identification of Gas Q, Lambert continues his endeavour to identify Solid Y. His instructor hints that a metal ion with 2 valence electrons is present in Solid Y.

Ecstatic, Lambert brings out the following chart, knowing that the alkali metal and alkaline earth metal ions in Group 2 have two valence electrons:

Ion	Formula	Colour produced when flamed
Lithium	Li	Red
Sodium	Na	Yellow/orange
Magnesium	Mg	Brilliant white
Potassium	K	Lilac/violet
Calcium	Ca	Brick/red
Rubidium	Rb	Pink/red
Strontium	Sr	Pure red
Caesium	Cs	Light blue
Barium	Ba	Green/yellow

When Lambert places Solid Y in a flame, he observes that the flame turns red, and remarks:



"it's not really a pink/red or brick/red, but a pure red."

- What metal ion is present in Solid Y, and what is this ion's charge?
- Please write a worded equation for the reaction between Solid Y and hydrochloric acid.
- Please write a balanced chemical equation, including state symbols, for the reaction between Solid Y and hydrochloric acid.