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# BIOLOGY

## FOUNDATIONS IN BIOLOGY

Level & Board	OCR (A-LEVEL)
TOPIC:	BIOLOGICAL MOLECULES - PROTEINS
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	06
TOTAL MARKS	/30

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## Biological Molecules – Proteins - 2

1.

The oxygen-carrying protein in all mammal blood is called hemoglobin. Between species, hemoglobin's structure might differ somewhat.

A llama, a relative of the camel, is depicted in Fig. 4.1.



**Fig. 4.1**

- The partial pressure of oxygen is low at high elevations; camels survive at low altitudes and llamas at high altitudes.
- The haemoglobin of camels and llamas has two  $\alpha$  and two  $\beta$  subunits.
- Every subunit has a haem group and can attach to a single oxygen molecule.
- A different amino acid from llama hemoglobin has taken the place of one amino acid from camel hemoglobin in the  $\beta$  subunits.

The dissociation curves for camel and llama hemoglobin are displayed in Fig. 4.2.

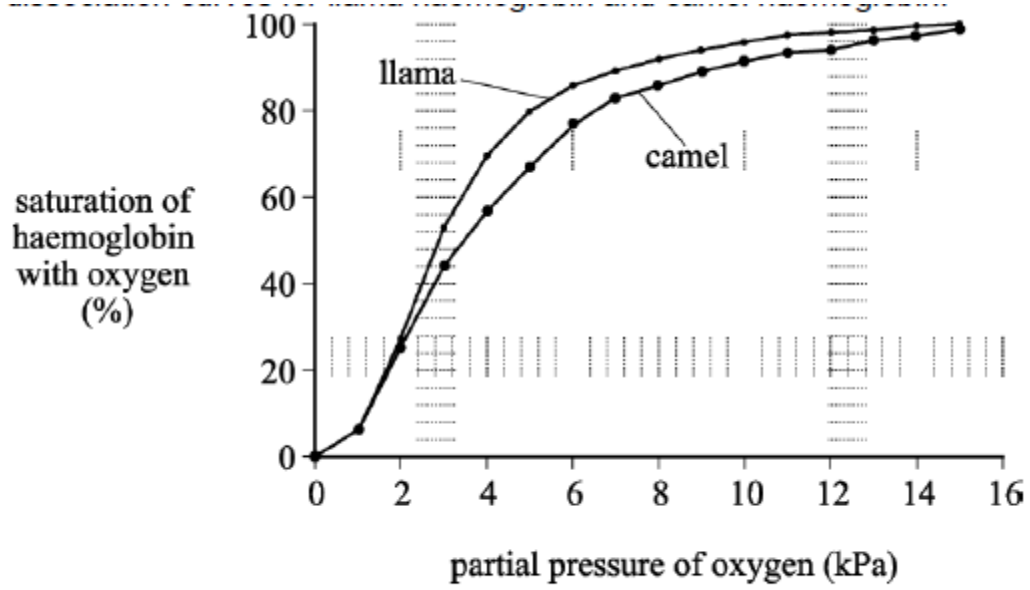


Fig. 4.2

(a) Indicate the partial pressure of oxygen required for llama haemoglobin to reach 50% saturation. (2)

**(b)** Justify the significance of the llama's hemoglobin dissociation curve's location to the left of the camel's for the animal's survival. **(2)**

**2.**

**(a)** One fibrous protein is collagen. Name three characteristics of fibrous proteins that set them apart from globular proteins. **(3)**

**3.**

Gluten is a combination of polypeptides found in bread. Gliadins and glutenins are the two kinds of polypeptides that make up gluten.

**(a)** Statements on the structures of gluten polypeptides are included in the table below. Write the degree of protein structure (primary, secondary, tertiary, or quaternary) that each statement refers to in the boxes next to it.

**(2)**

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

**(b)** An immune response to gliadins in the digestive tract of a person is what causes celiac disease. Inflammation results from the immune system's production of antibodies that attach to gliadin polypeptides in part. Even after cutting off gluten-containing foods, some people periodically still have celiac disease symptoms.

Regarding the structure of the antibody that causes celiac disease and what the antibody attaches to when causing celiac disease symptoms, what conclusions can you draw? **(2)**

**4.**

The protease enzyme pepsin is made up of a polypeptide chain with 327 amino acids.

The biggest known protein is called titin. Compared to pepsin, its polypeptide chain contains at least 92 times more amino acids.

**(a)** Genes contain DNA sequences that code for polypeptide compounds like titin and pepsin.

Describe the necessity of transcription for the synthesis of polypeptides. **(2)**

**(b)** Determine the shortest DNA nucleotide sequence needed to code for titin.

Display your work. **(2)**

**(c)** The protein titin is fibrous. A globular protein is called pepsin.

Examine and contrast the characteristics and roles of globular and fibrous proteins in the human body. **(6)**



## 5.

HIV1 protease is another protease enzyme that is necessary for the human immunodeficiency virus's life cycle (HIV). HIV cannot mature when this protease is inhibited.

The first HIV1 protease inhibitor medication authorized by the US Food and Drug Administration (FDA) was saquinavir in 1995. The number of AIDS diagnoses and fatalities in the United States between 1981 and 2007 is displayed in Fig. 1.3.

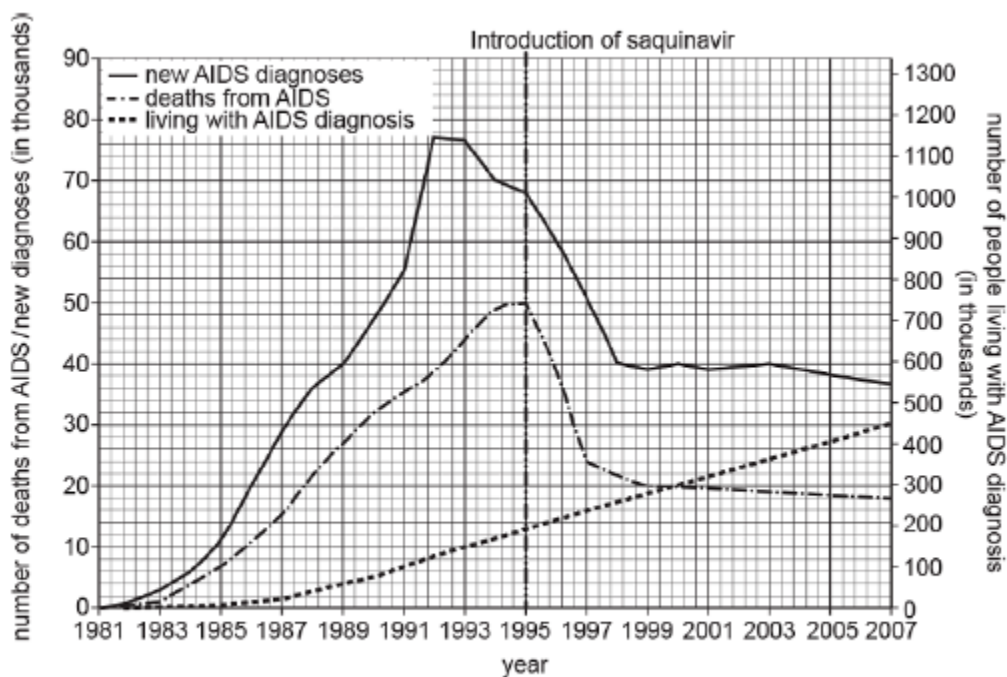


Fig. 1.3

**(a)** Determine the percentage of AIDS-related mortality that decreased between 1995 and 1998. Provide a response to two important numbers. Display your work. **(2)**

**(b)** After examining the data in Fig. 1.3, a student came to the following conclusion:

*"The decrease in deaths from AIDS after 1995 is because of the use of saquinavir by HIV patients."*

Explain why the information in Fig. 1.3 could lead one to conclude otherwise.

**(2)**

**6.**

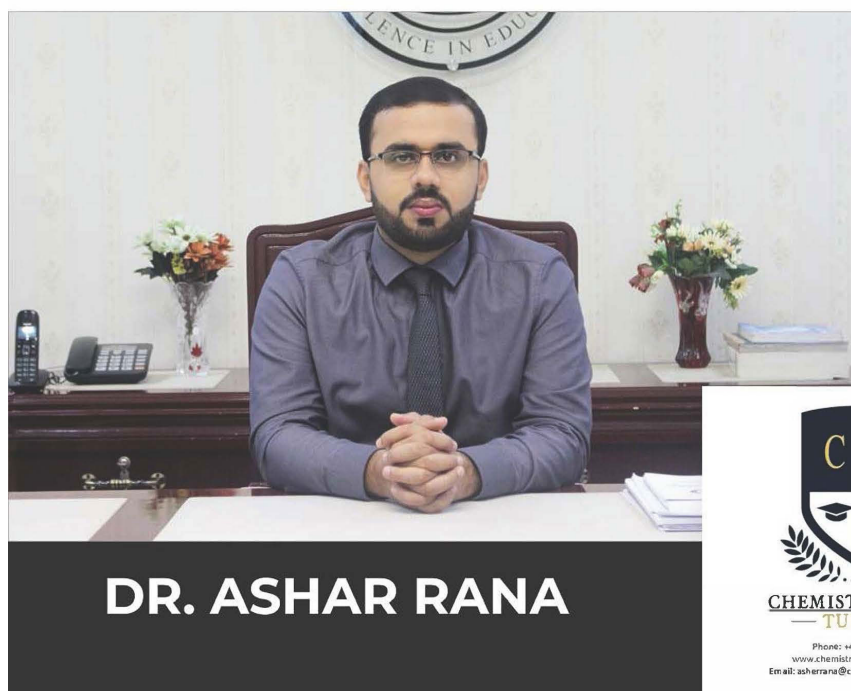
Arterial walls contain a protein called collagen. Three polypeptide chains, each containing 1050 amino acids, are twisted into a triple helix to form a collagen molecule. Every polypeptide chain has a repeating sequence of the amino acids proline and glycine. The side chains of these amino acids are non-polar.

**(a)** Describe and clarify the nature of collagen's fibrous protein status. **(2)**

(b) Explain the strength of collagen molecules. (3)

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