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International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 9 4 0 5 8 2 4 4 3 0 *

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **May/June 2026**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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1 The bacterium *Escherichia coli* is a typical prokaryotic cell.

(a) One key feature of a prokaryotic cell is the absence of organelles surrounded by a double membrane.

Name **one** organelle surrounded by a double membrane that is **not** found in *E. coli*.

..... [1]

(b) Bacteriophages are viruses that infect bacterial cells. They are specific to a bacterial species or to a strain of a bacterium.

Figure 1.1 is a transmission electron micrograph showing a type of bacteriophage, known as a T-phage, attached to the surface of *E. coli.* T-phages are also visible inside the cell.

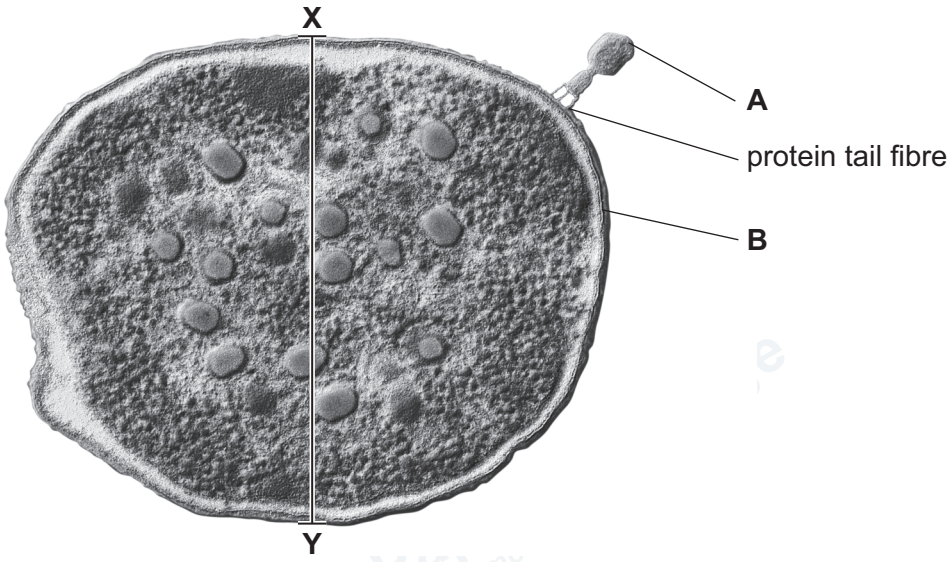


Figure 1.1

Structure **A** of the T-phage in Figure 1.1 contains the nucleic acid core, which is DNA. The DNA is injected into *E. coli* after the T-phage has attached to structure **B**, the outer layer of the cell.

(i) Name structure **A** and structure **B**, shown on Figure 1.1.

A .....

B .....

[2]

(ii) The actual diameter of the *E. coli* cell in Figure 1.1 along the line **X**–**Y** is 0.9 μm.

Calculate the actual length of the T-phage attached to the surface of *E. coli*.

Give your answer in nanometres (nm) to the nearest **whole nm**.

actual length = ... nm [2]

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(c) Suggest why a T-phage can attach to *E. coli*, but cannot attach to cells of other species of bacteria.

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..... [2]

(d) Research has been carried out into the use of bacteriophages as a treatment for infectious diseases (bacteriophage therapy), such as those caused by some strains of *E. coli*.

It has been suggested that bacteriophage therapy may help to solve some of the problems associated with the current treatments for bacterial diseases.

(i) Cholera, malaria and tuberculosis (TB) are three common infectious diseases.

Explain which of these three diseases is **least** likely to be treated with bacteriophage therapy.

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..... [1]

(ii) Suggest the benefits of using bacteriophage therapy for bacterial diseases.

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2 The structural protein collagen is the main component of the extracellular matrix (ECM) of the cells of the gas exchange system. The ECM is the supporting external environment of cells.

In the gas exchange system, the two main cell types that produce and secrete collagen are fibroblasts and chondrocytes.

(a) Fibroblasts are found throughout the gas exchange system, but chondrocytes are localised within a particular type of tissue found in the trachea and in the bronchi.

(i) Name the tissue located in the trachea and bronchi that contains chondrocytes.

..... [1]

(ii) Describe features of the tissue named in **2(a)(i) and** outline the role of this tissue in the trachea and bronchi.

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..... [3]

(b) In certain conditions, fibroblasts divide by mitosis to produce more cells. During this time, there are increased levels of an enzyme that acts to maintain the length of the telomeres.

Explain why maintaining telomere length is important for fibroblasts that carry out mitosis.

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(c) Name the cell structures involved in the formation of the mitotic spindle in a fibroblast that are **not** present for the formation of the mitotic spindle in a plant cell.

..... [1]

(d) The structure of a chromosome changes during mitosis.

Describe the structure of a chromosome as it appears at **telophase** of mitosis.

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..... [2]

(e) Figure 2.1 shows part of an alveolus and an alveolar capillary separated by a very thin ECM space known as the interstitium.

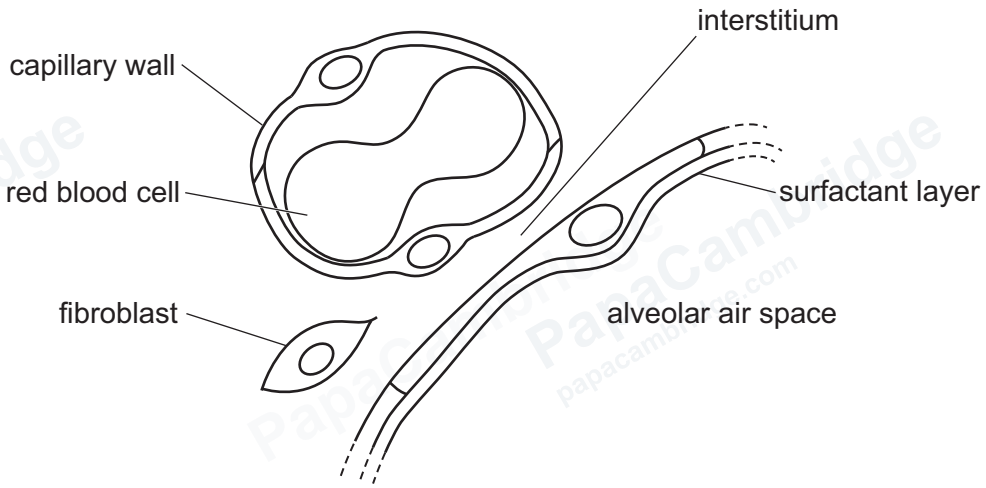


Figure 2.1

(i) Name the type of cell shown in Figure 2.1 that forms the capillary wall.

..... [1]

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(ii) When damage occurs to the alveolar wall or capillary wall, fibroblasts become more active and increase the production of ECM components.

Suggest the change that will occur to the interstitium owing to an increased fibroblast activity **and** explain how this will result in less oxygen being transported away from the capillary.

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..... [2]

(f) A collagen molecule is composed of more than one collagen polypeptide.

The primary structure of the collagen molecule contains a repeat sequence of three amino acid residues (amino acid triplet). Each amino acid triplet contains glycine (gly), as shown in Figure 2.2.

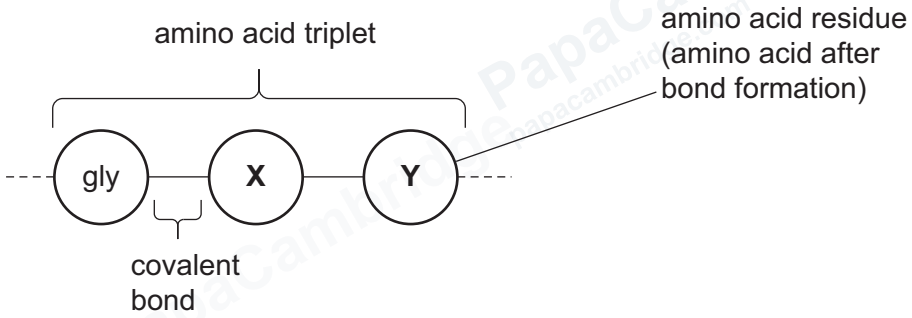


Figure 2.2

(i) Name the type of covalent bond that links the amino acid residues shown in Figure 2.2.

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(ii) Three different amino acids are commonly found in the **X** and **Y** positions of the amino acid triplet. One of these amino acids, alanine, has a similar role to glycine in the structure of a collagen molecule.

The molecular structure of alanine is shown in Figure 2.3.

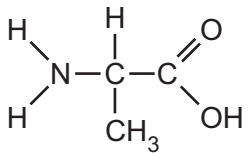


Figure 2.3

With reference to Figure 2.2 and Figure 2.3, explain why a high proportion of glycine and alanine residues is important for the structure of a collagen molecule.

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[Total: 16]

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3 The growth of the oil-seed crop plant, *Brassica napus*, is affected by high concentrations of salt (sodium chloride) in the soil solution, a condition known as salinity stress.

Methyl jasmonate (MeJA) is a cell-signalling molecule found in plants.

Scientists researched the ability of MeJA to increase the tolerance of seedlings (young plants) of *B. napus* to salinity stress.

- Seedlings were grown in normal conditions for 15 days and then transferred to soils with different concentrations of salt (NaCl), to continue their growth.
- On day 16, the leaves and stems (shoots) of the seedlings were sprayed with 100 μmol dm^{-3} MeJA solution.
- On day 44, the seedlings were removed and growth measurements were made.
- Control experiments were carried out to measure the growth of the seedlings in the different salt concentrations with **no** MeJA treatment.

Table 3.1 shows the growth measurements for the roots and the shoots of the seedlings in each of the different salt concentrations.

Table 3.1

treatment		mean root dry mass / g	mean shoot dry mass / g
MeJA / μmol dm^{-3}	**NaCl / mmol dm^{-3}**		
0 (control experiments)	0	0.53	0.24
	110	0.14	0.09
	220	0.04	0.04
	330	0.02	0.02
100	0	0.19	0.12
	110	0.21	0.12
	220	0.13	0.06
	330	0.06	0.04

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Table 3.1 shows that the tolerance to salinity stress after spraying with MeJA solution was increased in the roots as well as in the shoots of the seedlings of *B. napus*.

State the conclusions shown by the results in Table 3.1 **and** explain how MeJA sprayed on the leaves and stems of the seedlings can have an effect on growth in root tissue.

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[Total: 4]

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4 The hybridoma method is one way to produce large quantities of monoclonal antibody.

(a) Name the type of cell of the immune system (immune cell) that produces antibody.

..... [1]

(b) Figure 4.1 outlines five steps involved in the hybridoma method. The steps are **not** in the correct sequence.

P	screen cells for production of desired monoclonal antibody
Q	remove immune cells from spleen and fuse with myeloma cells
R	culture cells on a special medium to obtain only hybridoma cells
S	allow time for an immune response to occur
T	inject small mammal with antigen

Figure 4.1

Using the letters **P**, **Q**, **R**, **S** and **T** in Figure 4.1, state the correct sequence of steps for the production of monoclonal antibody by the hybridoma method.

..... → ..... → ..... → ..... → ..... [2]

(c) Myeloma cells that have not fused with immune cells live for only a few days in the culture medium. The myeloma cells cannot synthesise purine nucleotides and cannot divide.

(i) Explain why a myeloma cell is **not** able to divide if it cannot produce purine nucleotides.

.....

.....

..... [2]

(ii) The gene *HPRT* codes for an enzyme involved in the synthesis of purine nucleotides. Myeloma cells produce a non-functioning enzyme because they have a mutation in *HPRT*.

Explain **one** way in which a mutation in gene *HPRT* can lead to the synthesis of a non-functioning enzyme.

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..... [3]

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(d) Research has been carried out into the use of a monoclonal antibody, known as VRC01, for the prevention of HIV infection in people who are at high risk of infection.

- VRC01 was infused (injected) into volunteers once every eight weeks for 80 weeks.
- If a volunteer became infected, the strain of HIV was identified.
- For each of the different strains of HIV identified, scientists tested the effectiveness of VRC01 to prevent HIV infection of cells grown in culture.

The results showed that the effectiveness of VRC01 varied depending on the strain of HIV.

VRC01 binds to one part of a viral glycoprotein, gp120, which is located in the HIV envelope. HIV attaches to host cells using gp120.

(i) HIV is the abbreviation used for the enveloped virus that causes HIV/AIDS.

State the full name of the virus that causes HIV/AIDS.

..... [1]

(ii) Explain why an infusion with monoclonal antibody needs to be repeated at intervals to protect a person from HIV infection.

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..... [2]

(iii) Suggest **and** explain why infusions containing a mixture of monoclonal antibodies could be more successful in preventing HIV infection than using **only** VRC01.

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[Total: 14]

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5 Long-distance transport in mammals and plants requires a transport system and a transport medium.

(a) The double circulatory system of mammals, which is summarised in Figure 5.1, includes the heart and blood vessels.

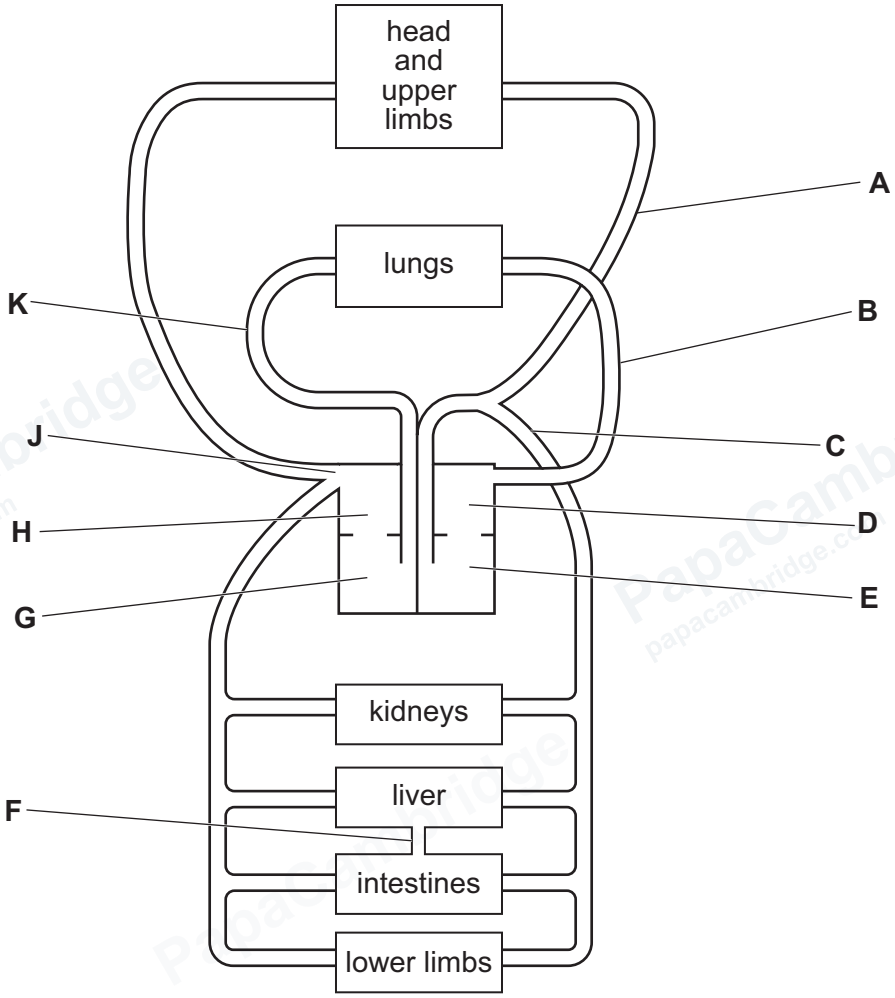


Figure 5.1

Complete Table 5.1 by stating a correct letter from Figure 5.1 that matches each of the descriptions listed.

Table 5.1

description	letter
the chamber of the heart that receives blood from the vena cava	
the chamber of the heart that pumps blood directly into the pulmonary artery	
an artery with a large quantity of elastic fibres and proportionately very little smooth muscle in the tunica media	
a vein transporting oxygenated blood	

[4]

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(b) Water is the main component of the transport medium in mammals and in plants.

(i) Describe how a high specific heat capacity makes water suitable as the main component of blood.

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(ii) Explain the importance of water in the mass flow of substances in phloem sap.

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[Total: 9]

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6 Lactate dehydrogenase (LDH) is an enzyme used in some blood tests to help diagnose liver disease.

In liver disease, an enzyme known as ALT can leak out from damaged liver tissue and enter the blood.

The presence of ALT can be confirmed by testing a blood sample at room temperature:

- ALT reacts with substances that are added to the blood sample to produce substrates for the reaction catalysed by LDH
- the rate of reaction of LDH can be used to estimate the concentration of ALT in the blood.

Scientists investigated the activity of LDH extracted from the bacterium *Lactobacillus delbrueckii* at different pH values and at different temperatures.

Figure 6.1 shows the effect of pH on the activity of LDH from *L. delbrueckii*.

Figure 6.2 shows the effect of temperature on the activity of LDH from *L. delbrueckii*.

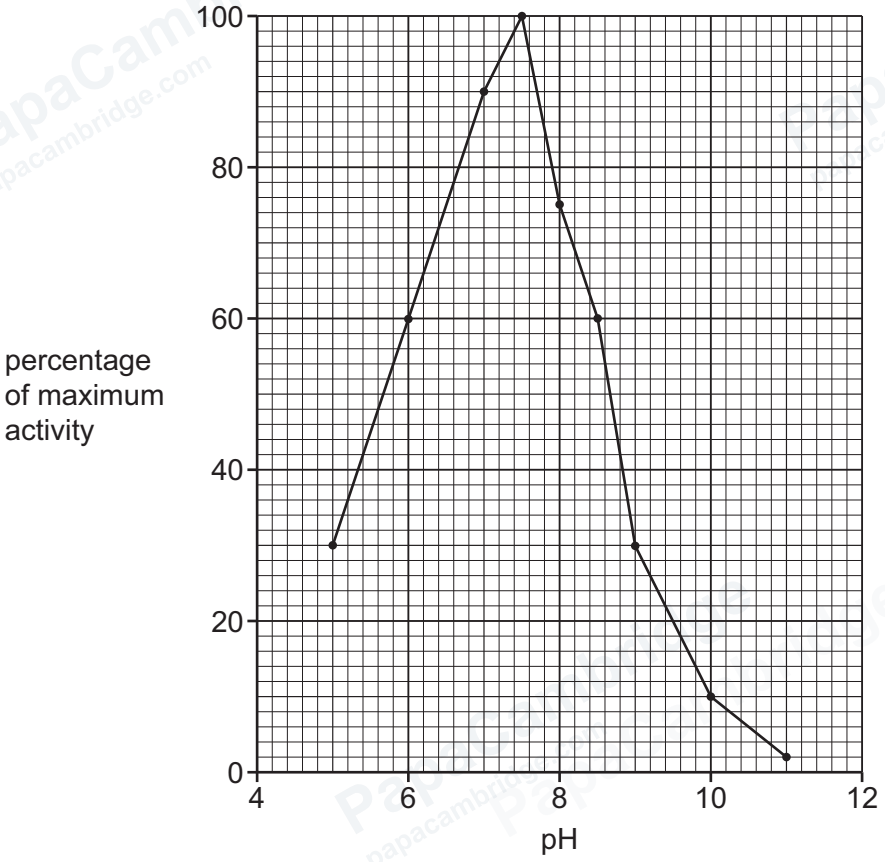


Figure 6.1

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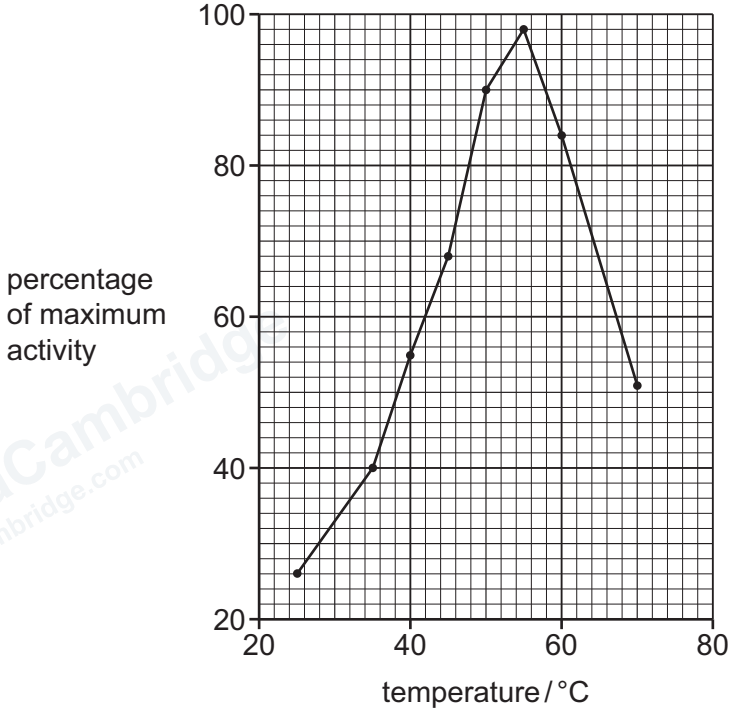


Figure 6.2

(a) With reference to Figure 6.1 and Figure 6.2, state the optimum pH and the optimum temperature for LDH.

optimum pH .....

optimum temperature .....

[2]

(b) With reference to Figure 6.1, explain how pH can affect the activity of an enzyme such as LDH.

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..... [3]

(c) Suggest why the recommended temperature for performing the test on the blood sample is not the same as the optimum temperature for LDH activity.

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..... [1]

[Total: 6]

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