

# Gold Paper

## Question Paper 10

Level	A Level
Subject	Biology
Exam Board	OCR
Paper	Gold Paper
Booklet	Question Paper 10

**Time allowed:** 82 minutes

**Score:** /61

**Percentage:** /100

### Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

## Question 1

Haemoglobin is a protein that carries oxygen in the blood of all mammals. The structure of haemoglobin can vary slightly between species.

Fig. 4.1 shows a llama, a relative of the camel.



Fig. 4.1

- Llamas live at high altitudes and camels live at low altitudes.
- At high altitudes the partial pressure of oxygen is low.
- Llama and camel haemoglobin consists of 2  $\alpha$  subunits and 2  $\beta$  subunits.
- Each subunit contains a haem group and is able to bind to one molecule of oxygen.
- In the  $\beta$  subunits, one amino acid present in camel haemoglobin has been replaced by a different amino acid in llama haemoglobin.

Fig. 4.2 shows dissociation curves for llama haemoglobin and camel haemoglobin.

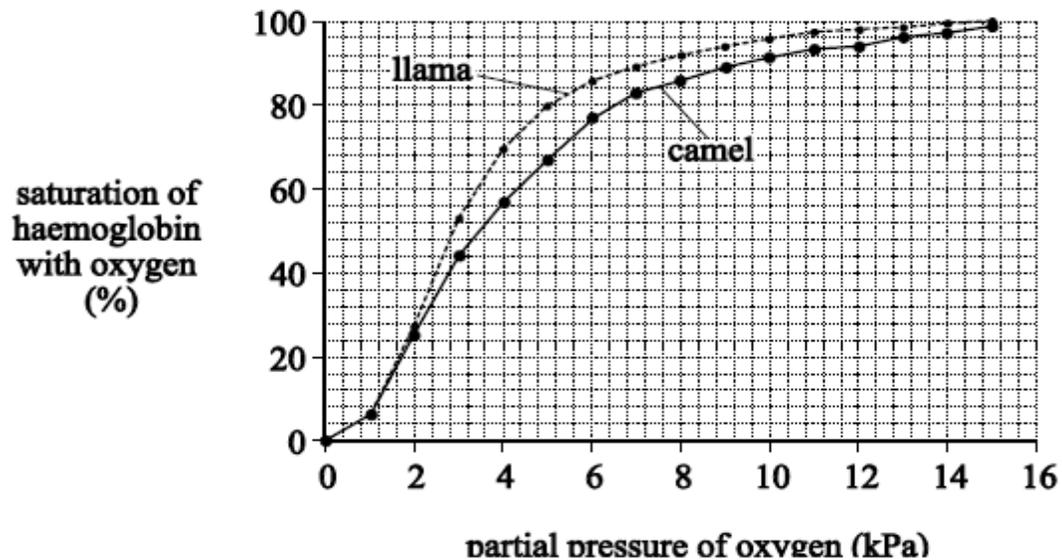


Fig. 4.2

- (a) (i) State the partial pressure of oxygen that results in a saturation of 50% in llama haemoglobin.

[1]

- (ii) Explain why it is important for the survival of the llama that the llama haemoglobin dissociation curve is to the left of the camel haemoglobin dissociation curve.

[2]

- (b)\* Describe how the structure of llama haemoglobin is likely to be different from that of camel haemoglobin with reference to the four levels of protein structure.

[6]

- (c) Collagen is a fibrous protein.  
State three **properties** of a fibrous protein that are different from those of a globular protein. [3]

- (d) A vet is concerned that a llama is unwell. The vet suspects there may be haemoglobin in the urine of the llama.

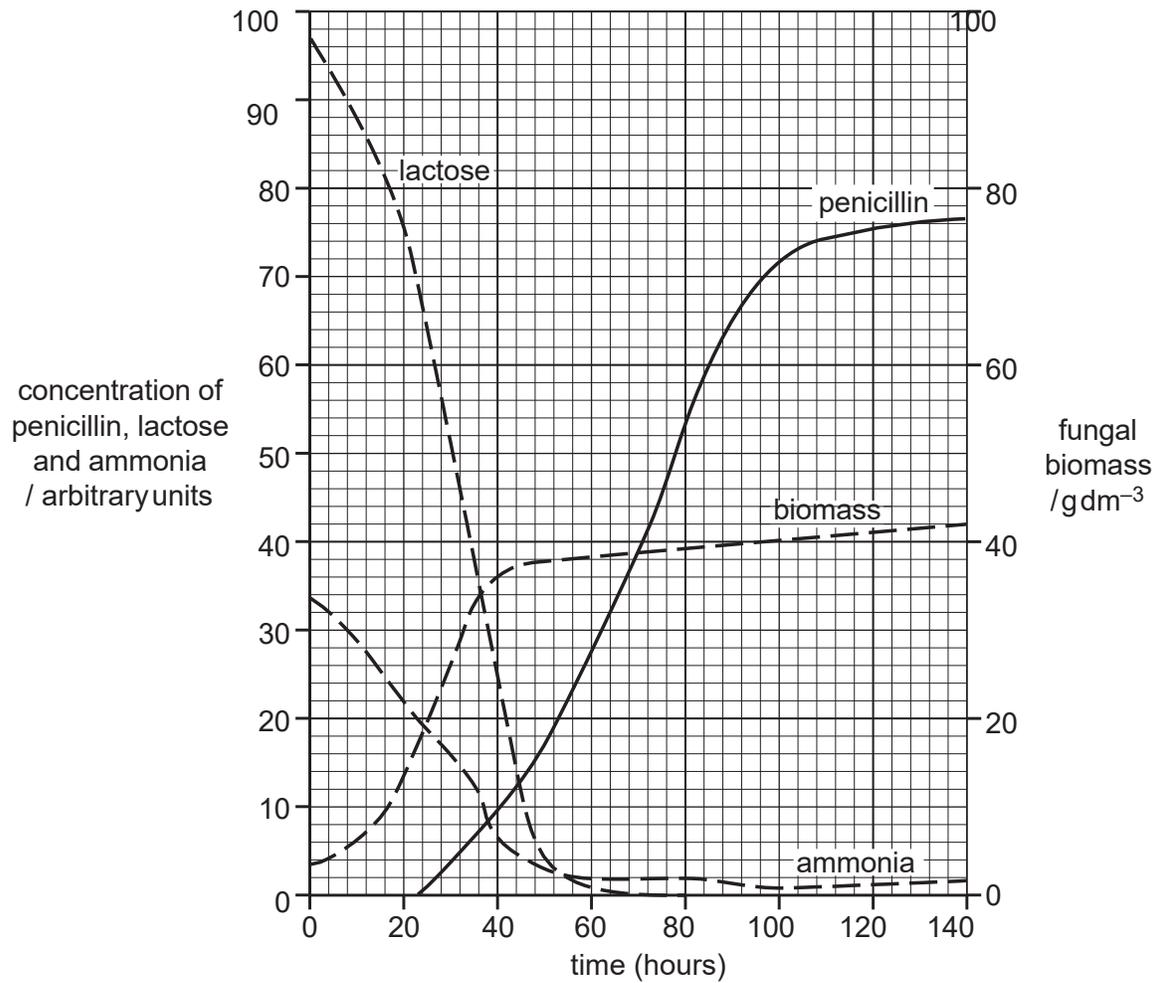
Explain how the vet could confirm this suspicion? [2]

[Total: 14]

## Question 2

The antibiotic penicillin is produced by batch culture of the fungus *Penicillium chrysogenum*.

- (a) Fig. 4.1 shows the concentration of penicillin, lactose and ammonia as well as the fungal biomass over time when penicillin is being produced by batch culture.



**Fig. 4.1**

- (i) With reference to Fig. 4.1, describe and explain the changes in concentration of lactose and ammonia. **[4]**

description

explanation

- (ii) A student incorrectly suggested that penicillin might be produced by continuous culture fermentation instead of by batch culture.

Suggest how the curves for lactose, ammonia and biomass on Fig. 4.1 might differ in continuous culture.

**[2]**

- (iii) A second student said that continuous culture would not be suitable, as penicillin is a secondary metabolite.

What evidence is there in Fig. 4.1 that penicillin is a secondary metabolite?

**[2]**

- (b) (i) Explain the importance of maintaining aseptic conditions in manufacturing penicillin by fermentation.

[3]

- (ii) State **three** physical or chemical factors within the fermenter, other than nutrient levels, that need to be monitored and controlled.

For each factor, explain **why** it must be controlled.

[3]

[Total: 14]

### Question 3

(a) Human populations have herded cattle for milk for around 9 000 years. Artificial selection over this time has resulted in the modern dairy cow.

(i) State **three** phenotypic traits (characteristics) that have been selected for in dairy cows.

[2]

(ii) Fig. 1.1 shows the pattern of variation of a phenotypic trait in a herd of dairy cows. The shaded part of the graph indicates those cows that are chosen to breed.

Draw, on Fig. 1.1, a second curve to show the pattern of variation in the next generation.

[2]

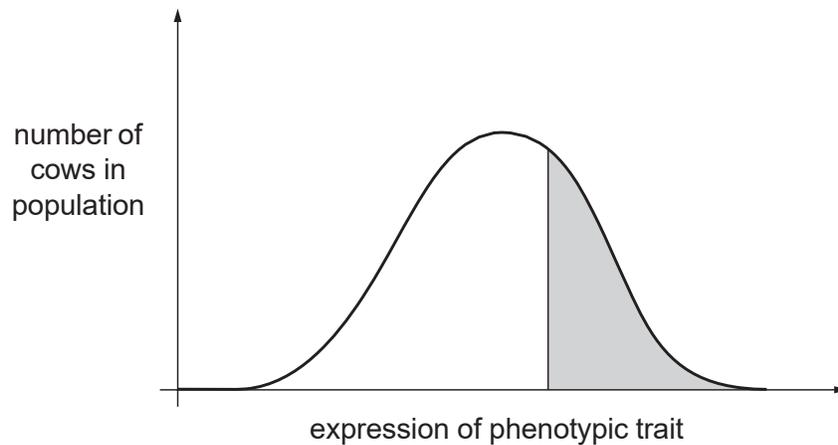


Fig. 1.1

(iii) In recent years, artificial selection of dairy cows has been helped by modern reproductive technology.

Name **two** modern techniques or procedures that can be used in the selective breeding of dairy cows.

[2]

(b) Lactase is an enzyme that is necessary to digest lactose sugar in milk.

In some parts of the world, animals are not farmed for milk and no dairy products are eaten. Adult humans that are native to these parts of the world do not produce lactase.

In areas where animals are farmed for milk, native adult humans do produce lactase. In these populations, a new allele has arisen by gene mutation.

(i) State what is meant by gene mutation. [1]

(ii) Over time, the frequency of this new allele increased in the gene pool of the human populations whose diet included milk.

Name the process by which this increase occurred. [1]

(c) (i) All human babies produce the enzyme lactase. The genetic change that allows adults to produce this enzyme is thought to involve a mutation in a regulatory gene. This mutation causes the structural gene to be expressed in adults.

Distinguish between the terms 'regulatory gene' and 'structural gene'. [2]

(ii) Adult humans who cannot produce the enzyme lactase are described as lactose-intolerant and cannot drink milk without experiencing health problems. However, lactose-intolerant people can safely eat yogurt.

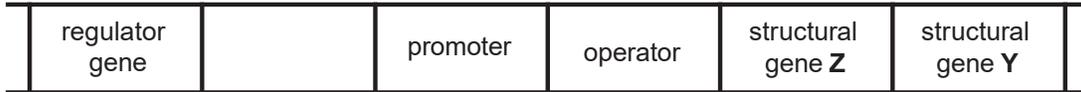
Yogurt is produced from milk that is fermented by bacteria. These bacteria perform anaerobic respiration, using carbohydrate as their respiratory substrate.

Suggest why yogurt is a suitable food for lactose-intolerant people.

[2]

- (d) The control of the expression of the *lac* operon genes, which allow uptake and digestion of lactose in the bacterium *Escherichia coli*, is well known.

Fig. 1.2 shows the arrangement of the elements of the *lac* operon.



**Fig. 1.2**

Describe how genes **Z** and **Y** are switched on in bacteria that are moved to a nutrient medium that contains lactose.

**[3]**

**[Total: 16]**

## Question 4

- (a) Animal behaviour is controlled by the brain and may be innate or learned. Behaviour can be modified by exposure to different environmental conditions.

In Africa, the lion population is under threat.

- The lions' natural habitat is changing as land is used increasingly for cattle farming.
- The increase in cattle farming drives away the lions' natural prey.
- Lions that remain in their habitats then prey on cattle.
- Farmers poison or shoot lions that kill the cattle, thus threatening the survival of the remaining lion population.

Research was carried out on the behaviour of lions that were known to prey on cattle. The lions were fed with beef that had been treated with a chemical that caused stomach upset. After a few meals of this treated beef, the lions refused to eat beef offered to them, even beef that had not been treated.

Discuss why this might be considered to be an example of classical conditioning or operant conditioning rather than habituation.

[5]

- (b) The sport of boxing and certain martial arts involve blows to the head. Repeated blows to the head can cause injury to the brain, particularly the cerebrum.

- (i) Which of the following **two** functions might be impaired by injury to the cerebrum?

Insert a tick [✓] in the table to indicate the **two** functions.

[2]

Functions impaired by injury	Insert a tick [✓]
Coordination of antagonistic muscles	
Memory	
Regulation of heartbeat	
Speech	
Temperature regulation	

- (ii) The central nervous system is composed of nerve cells which form 'grey matter' and 'white matter'.

In the peripheral nervous system in mammals, the nerve cells form 'white matter'.

Name the structural feature that makes nerve cells appear white **and** explain the role of this feature in the transmission of action potentials.

[3]

(c) In boxing or martial arts, a person needs to be able to bend and straighten the arm at the elbow repeatedly.

(i) Name the **two** muscles involved in bending and straightening the arm and describe how they achieve this.

[2]

(ii) When training or fighting, these actions may be repeated forcefully over many seconds. Such effort needs a continuous supply of ATP.

How is ATP regenerated from ADP in muscles **other than from respiration**? [1]

(d) The following steps, **A** to **H**, take place during muscle contraction. The steps are not in the correct order.

- A. ADP (+P<sub>i</sub>) detaches from myosin
- B. ATP hydrolysed to ADP (+P<sub>i</sub>)
- C. Myosin head changes shape
- D. Myosin head attaches to actin at binding site
- E. Energy is released
- F. ATP binds to myosin head
- G. Myosin head detaches from actin
- H. Actin pulled past myosin

Place the steps, **A** to **H**, in the correct order. [4]

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[Total: 17]