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Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2002
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

HUMAN BIOLOGY (Specification A) BYA9/W
Unit 9 (Written Synoptic)

Thursday 20 June 2002 Afternoon Session

No additional materials are required.
You may use a calculator.

Time allowed: 1 hour 45 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in the spaces provided but note that **Question 3** offers a choice of essays.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.
- This unit assesses your understanding of the relationship between the different aspects of Biology.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
Total (Column 1) →			
Total (Column 2) →			
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Examiner's Initials			

Answer **all** the questions in the spaces provided.

1 **Table 1** shows the concentration of some different proteins and essential amino acids in samples of human milk.

Substance	Concentration in sample of milk / mg 100 cm^{-3}	
	3 days after birth	**30 days after birth**
Proteins		
casein	140	187
lactalbumin	218	161
antibodies	364	142
lipase stimulated by bile salts	10	10
Essential amino acids		
histidine	57	31
isoleucine	221	110
lysine	163	79
methionine	33	19
phenylalanine	105	44

Table 1

(a) (i) Describe how you could use a biochemical test to show that a milk sample contained protein.

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(2 marks)

(ii) The amino acids in a sample of milk were separated by chromatography. Explain how you could show that one of the amino acids present was lysine.

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(2 marks)

(b) At birth an infant's intestine secretes relatively small amounts of digestive enzymes.

(i) Explain the advantage of milk containing lipase stimulated by bile salts.

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(2 marks)

(ii) Explain the advantage to the infant of the concentration of essential amino acids in the milk sample 3 days after birth.

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(2 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

Figures 1 and **2** show some results from a study of lipid concentration in breast milk produced by women living in rural parts of Africa. The bars on the graph represent standard deviations.

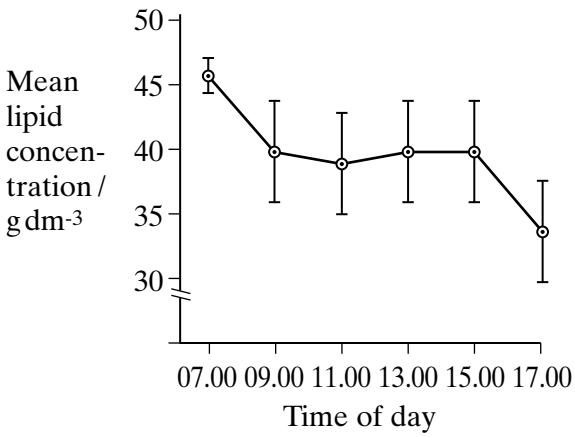

Figure 1 The effect of time of day on lipid concentration

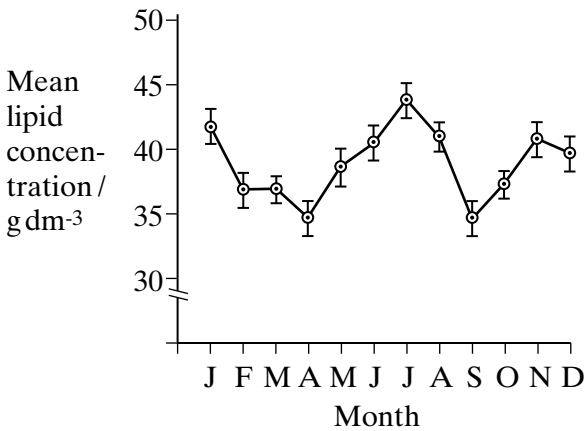

Figure 2 The effect of time of year on lipid concentration

(c) (i) Explain why the points on the graphs were joined to each other with straight lines rather than using a line of best fit.

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(1 mark)

(ii) Explain why a statistical test would be useful in interpreting the results of this study.

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(2 marks)

(d) (i) Describe how the lipid concentration of milk varies with the time of day.

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(2 marks)

(ii) In **Figure 2**, the milk samples collected each month were taken from women who had given birth four weeks previously. The women live in rural Africa. Suggest how the lipid concentration of milk at different times of the year could be explained by variation in food intake during pregnancy.

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(3 marks)

Table 2 shows the fatty acid content of samples of human milk obtained from women in the United Kingdom in 1953 and 1977.

Fatty acid	Number of double bonds in hydrocarbon chain of fatty acid	Percentage of fatty acid in milk in	
		1953	1977
lauric	0	5.5	3.8
myristic	0	8.5	5.2
palmitic	0	23.2	22.5
palmitoleic	1	3.0	4.1
oleic	1	36.5	39.5
linoleic	2	7.8	14.4

Table 2

(e) Complete the diagram below to show the molecular structure of lauric acid.

(2 marks)

(f) Describe and suggest an explanation for the difference between the saturated fatty acid contents of the 1953 and 1977 samples.

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(2 marks)

2 Read the following passage.

Despite its bad press, cholesterol is essential. We cannot manage without it. It is an important component of plasma membranes. Myelin, the substance surrounding many nerve fibres, is involved in the rapid conduction of nerve impulses and myelin is rich in cholesterol.

Being insoluble in water, cholesterol cannot be transported in solution in the blood plasma. Instead, it is packaged in lipoprotein particles. The main carrier of cholesterol is low-density lipoprotein (LDL). Each LDL particle has a cholesterol core protected by an outer coat and topped by a special protein molecule.

How is LDL-packaged cholesterol taken up by cells? Plasma membranes are studded with binding sites for this "topping" protein. These LDL receptors are made of protein with some sugar chains attached, and their numbers increase or decrease according to the cell's needs for cholesterol. After latching on to LDL receptors, LDL particles are pulled into the cytoplasm and processed in various ways. This regulatory mechanism, however, cannot control cholesterol concentrations outside cells when large amounts of cholesterol are present in the blood. The excess cholesterol is eventually deposited in artery walls. This leads to an increased risk of thrombosis.

In the 1980s, researchers purified the LDL receptor molecule and determined the sequence of its 839 amino acids. They also isolated the LDL receptor gene. Mutation of this gene gives rise to a condition known as familial hypercholesterolemia (FH). All the evidence we have, such as that all affected individuals have at least one affected parent, and that male to male transmission is possible, indicates that the mutant allele is dominant and located on one of the autosomes.

The FH allele is found in a high frequency in some populations. Among South African Afrikaners, for example, 1 in 100 are FH heterozygotes while 1 in 30 000 are homozygous for the FH allele. These people are all at risk of premature death from coronary heart disease.

Source: adapted from MANGE and MANGE, *Basic Human Genetics* (Sinaeur Associates Inc.) 1994

Use information from the passage and your own knowledge to answer the following questions.

(a) Explain how myelin is involved in the rapid conduction of nerve impulses (lines 2-3).

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(2 marks)

(b) Describe how negative feedback is involved in controlling the concentration of cholesterol in the cytoplasm of a cell.

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(3 marks)

(c) (i) Explain how a mutation of the LDL receptor gene can lead to a high concentration of cholesterol in the blood.

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(2 marks)

(ii) Describe how excess cholesterol deposited in artery walls can lead to an increased risk of thrombosis (lines 14-15).

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(2 marks)

(d) What is the minimum number of nucleotides in the mRNA molecule that codes for the LDL receptor? Explain how you arrived at your answer.

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(1 mark)

QUESTION 2 CONTINUES ON THE NEXT PAGE

(e) All individuals affected with FH have at least one affected parent (line 19). Explain how this shows that the FH allele is *not recessive* to the normal allele.

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(2 marks)

(f) Use the data in the last paragraph to estimate the number of people in the South African Afrikaner population at risk from premature death from coronary heart disease because of FH. Give your answer per 100 000 of the population. Show your working.

Answer ..... per 100 000

(3 marks)

15

3 Write an essay on **one** of the following topics. You should select and use information from different parts of the specification. Credit will be given not only for the biological content, but also for the selection and use of relevant information, and for the organisation and presentation of the essay.

EITHER **A** The different ways in which organisms use ATP *(25 marks)*

OR **B** How the structure of cells is related to their function *(25 marks)*

END OF QUESTIONS

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