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Centre Number					Candidate Number				
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General Certificate of Education
2010
Advanced Level Examination



APPLIED SCIENCE
Unit 14 The Healthy Body

SC14

Specimen Paper

For this paper you must have:

- a pencil and a ruler
- a calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the space provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information

- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 80.
- You are expected to use a calculator where appropriate.
- You will be marked on your ability to
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3			
4			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

This specimen paper (based on SC14 – June 2008) has been modified to show how quality of written communication (QWC) and stretch and challenge will be incorporated into operational papers from January 2010.

In this paper QWC is assessed in: **Question 1(c)(i) and Question 5(b)(ii).**

There are no discrete marks for QWC and in the final answer QWC will be one of the criteria used to assign a mark. Please refer to the appropriate mark scheme.

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

1 Julie decided to make use of her knowledge of nutrition while training for a long-distance running race.

The evening before the race, she ate a meal of wholemeal pasta with cheese sauce. She knew that this would provide her muscles with the energy that she would need the following day.

During the race Julie's muscles used energy released from the pasta. This energy was used to phosphorylate ADP, forming ATP. Phosphorylation occurs during both aerobic and anaerobic respiration.

1 (a) (i) Describe what happens to ATP during muscle contraction.

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(2 marks)

1 (a) (ii) Write down a balanced symbol equation that represents aerobic respiration.

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(2 marks)

1 (a) (iii) Compare the amounts of ATP produced by aerobic and anaerobic respiration.

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(1 mark)

- 1 (b) In the table below, put ticks (✓) in the appropriate boxes to show in which of the respiratory pathways the processes given take place, and a crosses (x) where they do not.

Pathway \ Process	Glycolysis	Krebs cycle	Electron transport system
ATP used			
Carbon dioxide produced			
ATP generated			

(3 marks)

- 1 (c) Cells can make use of lipids and proteins as well as glucose to produce ATP.

- 1 (c) (i) People suffering from anorexia nervosa greatly restrict their intake of food.

Use your knowledge of respiratory substrates, heart structure and diet to explain why anorexia nervosa can lead to heart failure and death.

You will be assessed on the quality of written communication in your answer to this question.

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(5 marks)

- 1 (c) (ii) Some patients suffering from anorexia nervosa often repeatedly refuse treatment. Suggest **two** ethical issues that need to be considered when deciding whether to force-feed such a patient.

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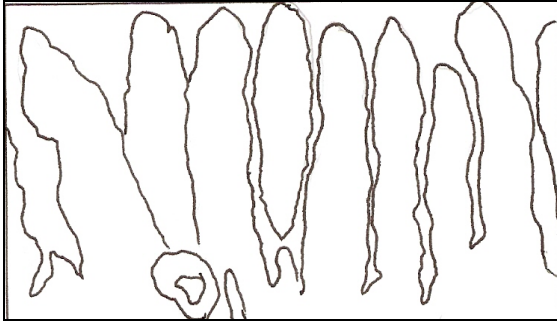
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(2 marks)

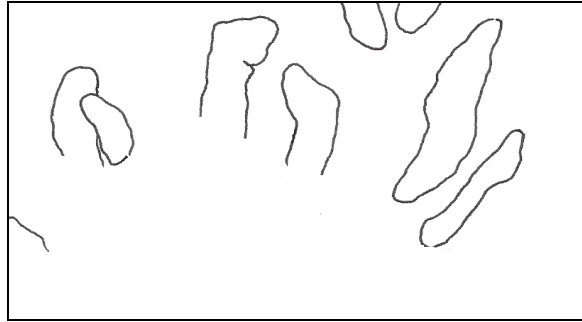
Turn over ▶

2 A surgeon carried out a biopsy on a 3-year-old child who was failing to grow or to gain the weight expected for his age. A small sample of tissue was removed from inside the child's intestine.

The diagrams below show the appearance of the villi in the child's intestine and that of a normal, healthy child of the same age. Both diagrams are to the same scale.



Healthy child



Child patient

2 (a) (i) Compare the villi of the healthy child and that of the patient?

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(2 marks)

2 (a) (ii) Describe and explain **two** other features of a healthy intestine that help to maximise the absorption of digested food.

Feature 1

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Feature 2

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(4 marks)

- 2 (a) (iii) Use the diagrams on **page 4** to help you to explain why the patient was failing to gain weight as expected.

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(1 mark)

- 2 (b) The 3-year-old child was diagnosed as suffering from coeliac disease. This is a condition in which an individual lacks a particular enzyme needed to digest gluten. Gluten is a protein found in wheat. A dietician was asked to advise the family on a suitable diet for the child. The child's parents found it hard to understand why their child could digest proteins such as meat but was unable to digest gluten.

How might the dietician have explained this to them, using his knowledge of enzymes?

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(3 marks)

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Turn over for the next question

Turn over ▶

- 3 In an experiment to investigate the effect of the presence of bile on the activity of lipase, a student set up three tubes, **A**, **B** and **C**. The contents of the tubes are given in the table below.

	Milk added (cm ³)	Bile salts added (cm ³)	Lipase added (cm ³)	Water added (cm ³)
Tube A	10	5	0	2
Tube B	10	0	2	5
Tube C	10	5	2	0

All three tubes were incubated at 40°C for one hour. At 20 minute intervals, the pH values of the contents of the tubes were measured and recorded. The results are given in the table below.

	pH of contents during incubation			
	At start	After 20 minutes	After 40 minutes	After 60 minutes
Tube A	8.3	8.4	8.3	8.3
Tube B	8.3	7.5	6.5	6.5
Tube C	8.5	7.0	6.5	6.5

- 3 (a) What evidence is there that lipase activity is increased by the presence of bile salts?

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(2 marks)

- 3 (b) What is the function of **Tube A**?

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(1 mark)

3 (c) Give **two** possible explanations for the results in **Tube C** at 40 minutes.

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(2 marks)

3 (d) (i) Suggest how this experiment could be changed to improve the accuracy and precision of these data?

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(3 marks)

3 (d) (ii) How could this experiment be changed to improve the validity of these data?

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(2 marks)

4 An 18-year-old student suffers from cystic fibrosis. This condition causes the mucus produced by her body to be unusually thick and sticky.

She regularly attends a clinic where a nurse monitors her lungs in order to assess how effectively her blood is being oxygenated. A pulse oximeter is used to determine the oxygen saturation of her blood at different partial pressures of oxygen.

The table gives the results of her test and also the results for a person who does not suffer from cystic fibrosis.

Partial pressure O ₂ /mmHg	% saturation of blood with oxygen	
	Sufferer	Non-sufferer
20	8	38
40	22	80
60	60	95
80	64	100
100	64	100
120	65	100

4 (a) (i) Cystic fibrosis affects oxygen transfer into the blood.

Use the data in the table to describe **two** of these effects.

Effect 1

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Effect 2

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(2 marks)

4 (a) (ii) Blood of a non-sufferer normally contains 20cm³ oxygen per 100cm³ at a partial pressure of 80mmHg.

Calculate how much oxygen there will be in 100cm³ of the sufferer's blood at the same partial pressure.

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(2 marks)

4 (b) The abnormal mucus also coats the inside of the digestive system. Cystic fibrosis sufferers must always take enzymes with their food. Why is this?

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(2 marks)

4 (c) Cystic fibrosis is caused by a fault in a gene. This results in sufferers losing large amounts of salt from the body. The nurse explains the short-term and long-term consequences to the body of this loss of salt. The nurse emphasises that the lost salt must be replaced.

What information about the long-term and short-term consequences of lack of salt in the body should the nurse include in her explanation?

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(3 marks)

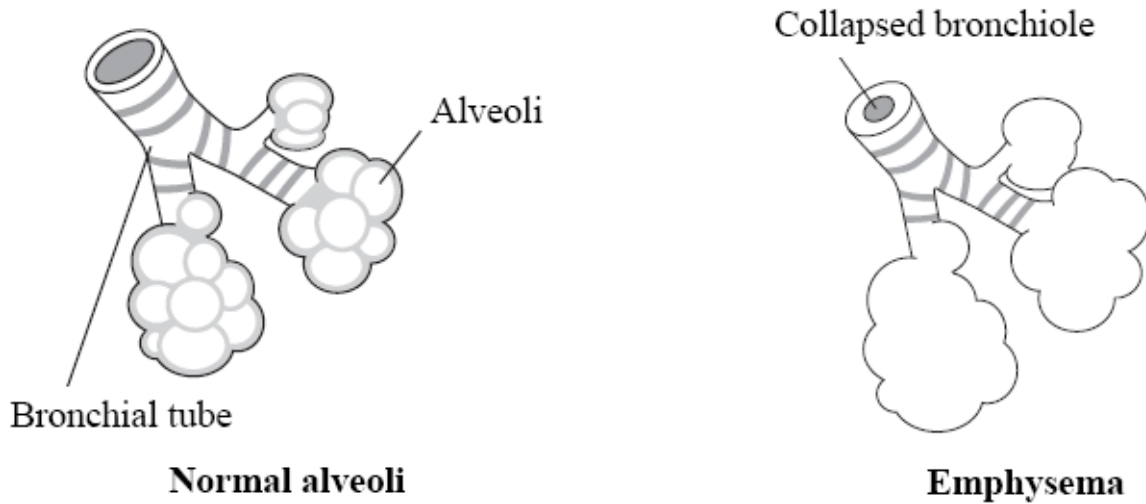
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Turn over for the next question

Turn over ▶

- 5 An elderly man was taken by his daughter to the Accident and Emergency department of their local hospital. He was experiencing extreme difficulty in breathing. The tips of his fingers and his lips were cyanosed (a blueish colour).

The doctor diagnosed emphysema. This is a condition in which the walls of the alveoli are damaged and weakened.



- 5 (a) (i) Use the diagrams to describe how emphysema affects the size and number of the alveoli.

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(2 marks)

- 5 (a) (ii) Explain why these changes significantly reduce the amount of gas exchange that takes place at the alveoli.

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(2 marks)

- 5 (b) A team of scientists used scans to examine the lungs of three groups of people. One group had severe emphysema, the second group had mild emphysema and the third group had no signs of the disease. The table below shows some of their data.

	Without emphysema	Mild emphysema	Severe emphysema
Average total lung volume (cm ³)	4772	6232	6275
Average lung weight (g)	1019	1104	810
Average measured surface area (m ²)	118	97	30

- 5 (b) (i) Calculate the percentage decrease in surface area experienced by a sufferer of severe emphysema compared to what they could expect if they did not have the disease.

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(2 marks)

- 5 (b) (ii) Using these data, together with your biological knowledge, write a paragraph that could be included in a booklet produced by the NHS that aims to inform people of the effects of emphysema on the functioning of their lungs.
 You will be assessed on the quality of written communication in your answer to this question.

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(5 marks)

Turn over ▶

- 6 A fitness instructor was carrying out an induction session with a new client at her health club. Part of the instructor’s role was to ensure that clients understand the reasons for certain recommendations.

The instructor stressed the importance of maintaining hydration during exercise and showed her client a chart listing the ways in which the human body gains and loses water over a 24-hour period. The chart is shown below.

Route	Water gained (dm ³)	Water lost (dm ³)
Drinking	1.45	0.00
Food	0.80	0.00
Metabolism	0.35	0.00
Exhalation	0.00	0.40
Sweat	0.00	0.60
Urine	0.00	1.50
Faeces	0.00	0.10

- 6 (a) (i) Other than eating or drinking, give **two** of these gains or losses that would be expected to increase during strenuous exercise.

1

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(2 marks)

- 6 (a) (ii) Assuming that the client has a skin surface area of 3m², what is the approximate rate of water loss by sweating per hour from each m² of skin?

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Answer dm³ h⁻¹ m⁻²
(2 marks)

- 6 (a) (iii) What assumption did you make about the skin when you worked out your answer to part (a)(ii)?

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(1 mark)

- 6 (b) The client commented that even though she drank an extra 500cm³ of fluid while she was exercising, she had not needed to urinate.
The instructor explained that this was due to the action of a particular hormone.

Explain, by naming the relevant hormone and describing its action, why the client had not needed to urinate while she was exercising.

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(4 marks)

Turn over for the next question

9

Turn over ▶

7 A school nurse was carrying out a health check programme with some 15-year-old pupils. One of the girls appeared pale and rather thin. She weighed 42kg and was 158cm tall. When the nurse talked to her, the girl said that she often felt tired and lacked concentration.

Over the next month, the girl kept a diet diary, in which she recorded everything that she ate. The nurse then helped her to work out the average amounts of energy, protein and some of the important vitamins and minerals that she was eating each day.

They then compared these figures to the expected recommended daily allowance (RDA) for a girl of 15. These data are given in the table below.

	Energy (kJ)	Protein (g)	Vitamin A (µg)	Vitamin C (mg)	Vitamin D (µg)	Iron (mg)	Calcium (mg)
RDA	9000	53	750	60	10*	15	1200
Girl's intake	7200	56	800	180	0	6	1400

* during winter months only, otherwise 5 µg

7 (a) (i) What changes to the girl's diet should the nurse recommend in order to help her feel more energetic?

Change 1

Change 2

(2 marks)

7 (a) (ii) The diet diary revealed that the girl ate plenty of fruit, and a lot of low-fat yoghurt. What is the evidence in the table that supports this?

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(2 marks)

7 (a) (iii) Why does the RDA for vitamin D specify during winter months only?

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(1 mark)

7 (b) A few months later the girl visited the nurse again for a review session. She had gained some weight but was still very pale and did not feel any more energetic.

The nurse decided to refer her to her GP for a blood test.

7 (b) (i) The doctor decided to ask for a haematocrit test.

Describe what the doctor could have said to explain how the test would be carried out, and what the results would show.

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(3 marks)

7 (b) (ii) The blood tests also showed that her haemoglobin level was 10g dl^{-1} . What is the normal level for a girl of 15?

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(1 mark)

7 (b) (iii) What is the name given to the condition in which a person has abnormally low haemoglobin levels?

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(1 mark)

10

8 (a) A young man was visiting the dentist. He had very bad tooth decay. Two molars had to be removed and he needed several fillings. After the treatment, the dental hygienist explained why and how he should maintain good dental hygiene.

What would the hygienist say?

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(3 marks)

8 (b) The loss of the two molars would affect the young man’s ability to process food in his mouth.

Use your biological knowledge of the functions of teeth to explain why having two molars extracted affects his ability to digest and absorb food.

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(3 marks)

END OF QUESTIONS

6

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