Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Education
January 2009
Advanced Level Examination

APPLIED SCIENCE **SC14**
Unit 14 The Healthy Body

Friday 30 January 2009 9.00 am to 10.30 am

For this paper you must have:
- a pencil and a ruler
- a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- 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 maximum mark for this paper is 80.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1		5	
2		6	
3		7	
4		8	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 A 19-year-old medical student was attending a lecture about diabetes. He realised that he had been experiencing some of the symptoms that the lecturer was describing.

Over the last few weeks he had lost weight, had been feeling extremely tired and was also constantly thirsty. His urine output was also unusually high. Until recently, the student had led an active life and eaten a well-balanced diet. He was not overweight.

When the student visited the health centre, a nurse carried out a simple test on his urine to check his glucose level. The test gave a positive result, so the nurse decided to carry out a glucose tolerance test.

1 (a) (i) Describe how the nurse would have carried out the simple test on the student's urine.
What would the nurse see if the result was positive?

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(2 marks)

1 (a) (ii) Before the glucose tolerance test, the student was told to fast overnight. Why did he need to do this?

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(1 mark)

1 (a) (iii) What is the normal range for blood glucose?

..... mmol $litre^{-1}$

(1 mark)

1 (b) The glucose tolerance test showed that the student's blood glucose level was much higher than normal. The doctor at the health centre diagnosed that the student was suffering from diabetes.

1 (b) (i) To ensure that his blood glucose level was kept as stable as possible, the doctor advised the student that he would have to take special care with his diet. What would the doctor suggest?

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(3 marks)

1 (b) (ii) The student knew that his blood glucose level was controlled by the hormones insulin and glucagon. Later, he explained his condition to his parents.

Write a paragraph that explains clearly how insulin and glucagon work together to regulate blood glucose concentration in a healthy person.

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(6 marks)

13

2 A health visitor was discussing with a young mother the dietary needs of her 4-year-old child. Most of the child's liquid intake had been in the form of a fruit squash, made up according to the instructions given on the bottle.

The fruit squash was advertised as containing apples, strawberries and raspberries. 50 cm^3 of the squash contained 26.1 g of sugar, yielding 455 kJ of energy. The label on the bottle suggested diluting the drink in the ratio 1 part squash to 4 parts water.

2 (a) How much sugar would be present in 125 cm^3 of diluted squash?

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(1 mark)

2 (b) The daily energy requirement for a child of this age is 6100 kJ per day, assuming moderate activity.

The mother estimated that the child was drinking about 1.20 litres of diluted squash each day.

2 (b) (i) What percentage of the child's total daily energy need is being met by the squash?

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(2 marks)

2 (b) (ii) What health risks could there be to the child if she continues to take in this quantity of energy by means of sugary drinks?

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(3 marks)

2 (c) (i) The health visitor was also concerned that the child was not getting enough micronutrients, especially vitamin C and iron.

Describe **two** symptoms that the health visitor would be looking for in the child which would confirm that her diet was deficient in iron.

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(2 marks)

2 (c) (ii) How could the child's diet be adjusted so that the absorption of iron from her food became more efficient?

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(2 marks)

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Turn over for the next question

3 The manager of a care home for elderly people was considering installing a water softener. This would be of benefit by significantly reducing costs to the home for laundry and hot water. The softener works by removing calcium ions from the water and replacing them with sodium ions.

The manager was concerned that the extra sodium ions being ingested by the residents when they drank the softened water could have adverse effects on their health.

3 (a) (i) How is the level of sodium in the blood determined?

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(1 mark)

3 (a) (ii) What is the normal range of sodium ions in the blood of an adult?

..... mmol litre^{-1}

(1 mark)

3 (b) Describe in detail how sodium ions in food and drink enter, travel around and leave the body.

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(4 marks)

3 (c) In their advertising material, the manufacturer of the water softener stated that 200 cm^3 of softened water contained 25 mg of sodium ions. This was compared to the 1.034 g of sodium ions to be found in 200 cm^3 of canned tomato soup.

The manager estimated that, on average, each resident consumed 1.2 litres of tap water each day. He concluded that the amount of sodium ions in the softened water was too small to have a significant effect on the health of the residents.

Do you agree with his conclusion? Explain your decision and support your answer with an appropriate calculation.

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(4 marks)

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Turn over for the next question

4 Human cells can be grown in a laboratory using a technique called in-vitro culture. A technician has been asked to grow new skin cells from a small sample of healthy skin tissue taken from a burns victim. The new cells will be used to repair large areas of the victim's damaged skin.

4 (a) (i) Cells need specific conditions in which to function. How is this usually provided by the body?

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(1 mark)

4 (a) (ii) The in-vitro environment must be as similar as possible to the environment within the body.

Give **three** conditions of the in-vitro environment that the technician must control closely if the cells are to grow successfully.

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(3 marks)

4 (b) Human skin cells double in number every hour when they are growing under optimal conditions. The original sample taken for the start of the growth process contained 800 000 cells.

Calculate the number of cells that would be present after 12 hours.

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(2 marks)

4 (c) (i) It is now possible to grow, by in-vitro methods, the types of tissue that make up important components of the human heart.

Give **two** common heart defects that could be treated using replacement tissues.

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(2 marks)

4 (c) (ii) Following successful treatment, what improvements to his health should a recipient of this heart tissue be able to expect?

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(2 marks)

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Turn over for the next question

5 A group of retired people, whose ages ranged from 63 to 75, arranged to go on an alpine walking holiday together. To check that they were healthy enough for the unusual level of activity, they underwent various physiological tests.

The results for some of these tests are given in the table below.

		Vital capacity (litres)	**Resting pulse rate (beats min^{-1})**	**Diastolic blood pressure (mm Hg)**	**Weight (kg)**	**Height (cm)**
A	Male, aged 75	3.4	80	98	76.2	188
B	Female, aged 72	2.9	69	85	44.4	162
C	Female, aged 63	2.7	82	103	114.3	172
D	Male, aged 69	4.2	84	84	69.8	180

5 (a) Which individual, **A** – **D**, is least likely to be fit enough for a strenuous walking holiday? Give **two** separate pieces of evidence to support your answer.

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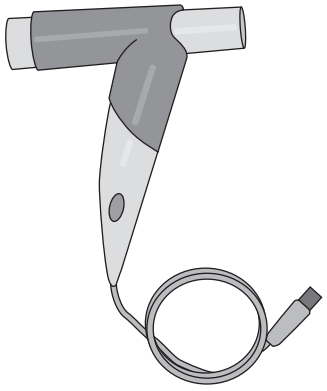
(2 marks)

5 (b) The data for vital capacity was collected using a spirometer. A diagram of a spirometer is shown below.



5 (b) (i) Explain how a spirometer is used to measure a person's vital capacity.

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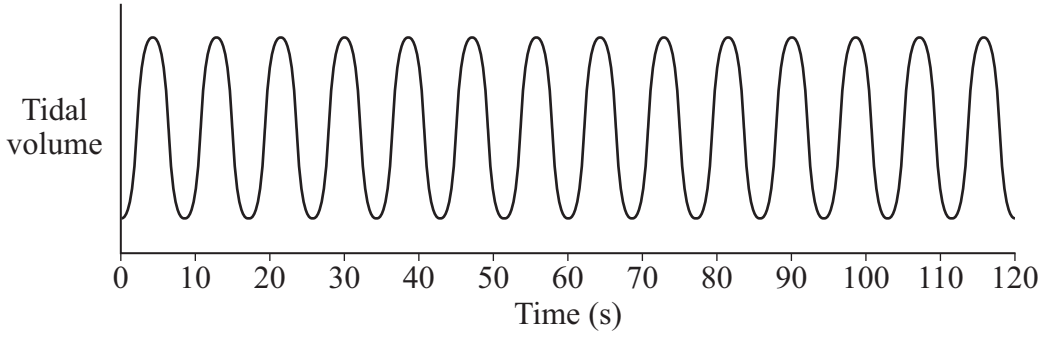
(2 marks)

5 (b) (ii) Person **A** had a tidal volume of 400 cm^3. Look at the trace below, which was taken from person **A**.



How much air passes into this person's lungs in 1 minute?

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(2 marks)

5 (c) Explain how the muscles of the thorax and diaphragm bring about the movement of air into the lungs.

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(4 marks)

Turn over ▶

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

6 A trainee physiotherapist was asked to investigate the effects of increasing levels of exercise on the cardiovascular system.

She decided that jogging for different lengths of time would be a good way of changing the amount of exercise.

She used an electronic wrist monitor (shown below) that could detect both pulse and blood pressure to measure the effects of exercise.

The trainee contacted her friends and relatives to see if they would be willing to take part in her investigation.

6 (a) (i) How should the trainee select her subjects so that her data will be valid?

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(2 marks)

6 (a) (ii) State **two** other factors that she should consider to ensure that her data will be valid and reliable.

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(2 marks)

Question 6 continues on the next page

6 (b) The table shows some data obtained from one of the subjects.

Time spent jogging (s)	**Measured pulse rate (beats min^{-1})**
0	80
20	86
60	101
100	115
120	120
160	88

6 (b) (i) Plot a graph of these values on the grid on **page 15**. *(3 marks)*

6 (b) (ii) Draw a circle around **one** of the points on the graph that does not fit the trend. Suggest an explanation for this anomaly.

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(2 marks)

6 (b) (iii) Describe the trend shown by the graph.

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(1 mark)

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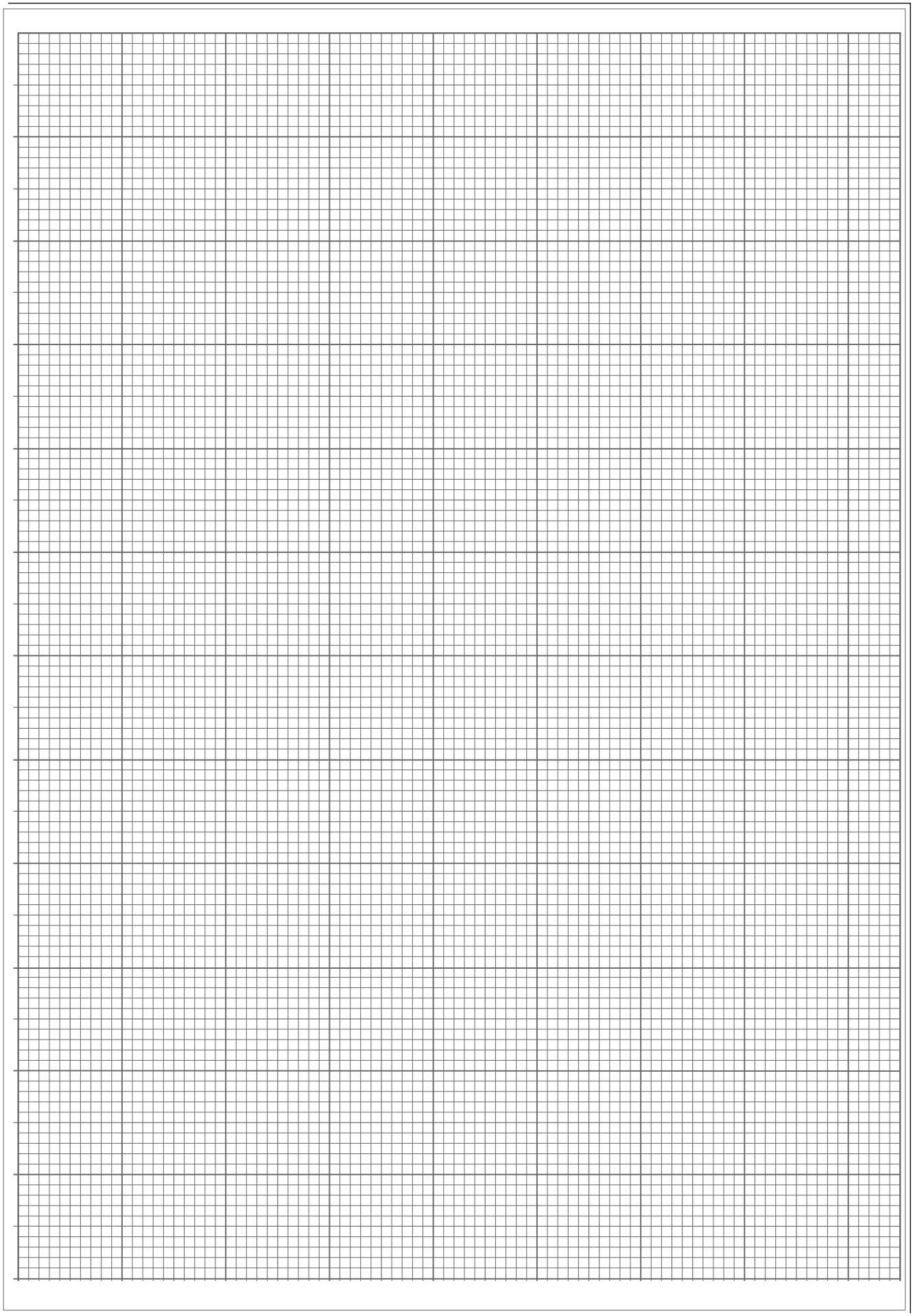
Turn to page 16 for the next question



7 People with stomach ulcers are often advised to avoid alcoholic drinks. This is because some alcoholic drinks stimulate the release of the hormone gastrin.

7 (a) (i) How does the digestive system control the sequence of digestive activity?

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(1 mark)

7 (a) (ii) Explain the effect of gastrin on stomach pH.

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(2 marks)

7 (b) A team of scientists decided to investigate the effects of different alcoholic drinks on plasma gastrin levels. They used a group of student volunteers.

The students drank measured quantities of the different drinks. The portions that they drank contained equal amounts of alcohol. The scientists then took blood samples from the students, from which gastrin levels could be measured.

The table shows some common drinks, their alcohol content and their effect on plasma gastrin levels.

Drink	**Alcohol content (%vol/vol)**	**Mean % change in plasma gastrin**	**Method of alcohol production**
Beer	4.9	+95	Fermentation
White wine	10.0	+60	Fermentation
Champagne	12.0	+95	Fermentation
Cognac	40.0	0	Distillation
Water	0.0	0	–

7 (b) (i) The research team originally believed that it was the amount of alcohol in the drink that caused the change in gastrin release.

Use information from the table to explain why they decided that their first hypothesis was unlikely to be true.

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(2 marks)

7 (b) (ii) Why did the team include water as one of the drinks in their investigation?

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(1 mark)

7 (c) The research team then considered the possibility that the method of alcohol production had a more significant effect on gastrin levels than the alcohol content of the drink.

Does the information in the table support this second hypothesis? Explain your answer.

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(2 marks)

Question 7 continues on the next page

7 (d) Before they began their investigation, the research team was required to submit their plan to an ethics committee, which would decide whether they would be allowed to go ahead with their proposal.

Why is it important that investigations of this kind are monitored and evaluated by groups of people other than the investigators themselves?

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(2 marks)

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8 A dental nurse wondered why so many people need orthodontic treatment, such as braces, to correct the way their teeth function. She read an article in a scientific journal that suggested that the modern western diet of soft food could be a factor in the misalignment of teeth because it did not stimulate the jaw bones to grow to their fullest extent.

8 (a) Explain the contribution of chewing to the efficient digestion of food.

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(2 marks)

8 (b) A 14-year-old girl had just visited the surgery to have a brace fitted to her teeth. The nurse was asked to give her advice on how to maintain good dental hygiene while the brace was in place.

What key points should the nurse include in her advice?

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(2 marks)

Question 8 continues on the next page

8 (c) Later the nurse visited her sister, whose young son had recently begun to cut his first teeth. She suggested that when he was ready for a mixed diet he should be offered milk, plenty of crunchy, raw vegetables and oily fish such as sardines.

Explain why these foods in particular would help the little boy to develop healthy teeth.

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(3 marks)

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END OF QUESTIONS