| Surname | | Other Names | |
|---|---|---|---|
| Centre Number | | | Candidate Number | | | | |
| Candidate Signature | | | | | | | | | |

For Examiner's Use

General Certificate of Education
January 2010
Advanced Level Examination

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

Wednesday 3 February 2010 1.30 pm to 3.00 pm

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

Time allowed: 1 hour 30 minutes

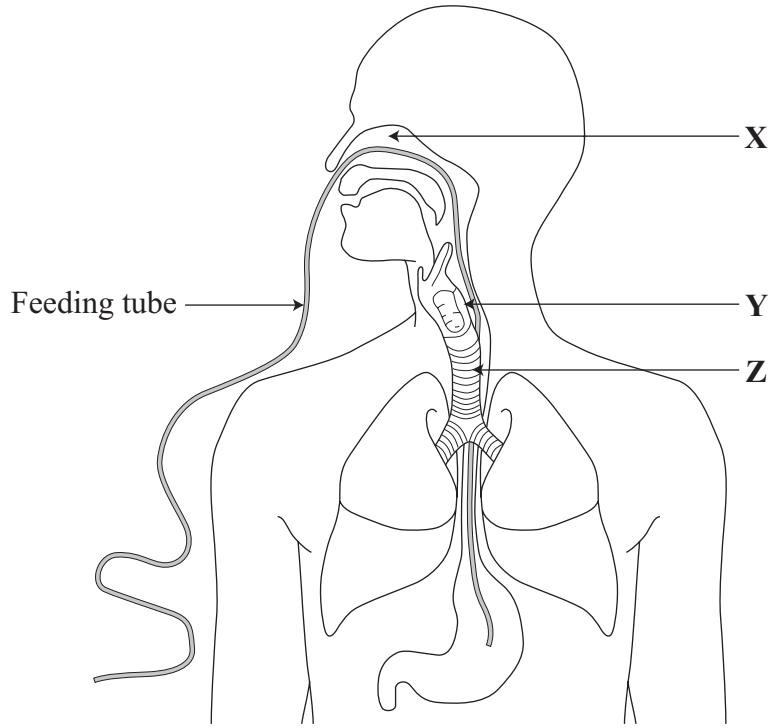
**Instructions**
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- Show the working of your calculations.

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

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

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

**1** Children with cerebral palsy sometimes have difficulty obtaining enough nutrients from food because they are unable to chew and swallow properly. This is because of weakness in the muscles of the jaw and tongue.
Medical equipment manufacturers produce a range of equipment which helps sufferers overcome this problem.
A child with cerebral palsy was fitted with a naso-gastric feeding tube such as the one shown in the diagram. The purpose of the tube was to allow food to enter the stomach directly.




**1** (a) (i) Name the structures labelled **X**, **Y** and **Z**.

**X** .....

**Y** .....

**Z**.....

*(3 marks)*

**1** (a) (ii) The nurse who was fitting the tube gave the child some water to swallow as the tube was passing into the child's throat.

Suggest **two** reasons why swallowing water during this procedure would help the tube to move more easily towards the stomach.

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2 .....

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*(2 marks)*

**1** (b) Explain how and why weakness in the muscles of the jaw and tongue would result in poor nutrition.

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

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*(5 marks)*

**10**

**2** A group of university students was preparing for a Duke of Edinburgh Gold Award expedition, when they would have to walk 20 km each day for four days. A nutritionist talked to them about the diet they would need during the expedition.

The students had to decide on suitable foods to take with them so they had enough energy to complete the expedition. They knew that a healthy diet was composed of different food groups in different proportions.

**2** (a) Pair up the boxes by drawing lines to show three of the major food groups and the approximate proportions in which they should occur in the diet of a moderately active adult.

| **Food group** | **Proportion of diet (%)** |
|---|---|
| Grains and starches | 8 |
| Milk and dairy products | 20 |
| Fats and sugars | 45–65 |

*(2 marks)*

**2** (b) Two food groups in particular should be increased to a greater proportion of the diet if the adult is going to be considerably more physically active than usual.

State which groups these are and explain why their intake should be increased.

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*(2 marks)*

**2** (c) (i) Give the balanced symbol equation for aerobic respiration.

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*(2 marks)*

**2** (c) (ii) Describe how the energy available in glucose is converted to a form that can be used for cell activity.

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*(3 marks)*

**2** (d) The students knew that they would also need to undergo a specific fitness training programme so that their cardiovascular and breathing systems were working as efficiently as possible.

Why did the group need to train in this way? Include in your answer a comparison of the amount of ATP generated by the aerobic and anaerobic pathways.

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*(3 marks)*

**12**

**3** An athlete was preparing for an important race. She knew that it would be essential for her muscles to receive as much oxygen as possible during the race.
People who live at high altitudes have more red blood cells per unit volume of blood than people living at sea level. The athlete decided that she should spend some time training at a high altitude in order to enrich her blood with red cells.

**3** (a) (i) Name a test that would measure the amount of red blood cells in her blood.

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*(1 mark)*

**3** (a) (ii) Suggest why spending time training at a high altitude would increase the number of red blood cells in the athlete's body.

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*(2 marks)*

**3** (b) As a result of the high altitude training, the athlete became ill. Comment on the ethical implications of her decision to train at high altitude.

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*(2 marks)*

**3** (c) Red blood cells are moved around the body by the cardiovascular system. Describe the roles of the following components of the cardiovascular system in the delivery of oxygen to respiring tissues.

**3** (c) (i) Right ventricle

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*(2 marks)*

**3** (c) (ii) Capillaries

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*(1 mark)*

**3** (d) The athlete was born with a heart defect known as aortic stenosis. This is a condition in which the valve at the base of the aorta is unusually narrow and restricts the flow of blood into the aorta.

An operation to rectify the condition was carried out when she was a few months old.

After the surgery she was able to lead a completely normal life.

**3** (d) (i) Describe the function of the valve at the base of the aorta in the normal working of the heart.

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*(1 mark)*

**3** (d) (ii) Children who have aortic stenosis that has not been treated sometimes faint unexpectedly. Use your knowledge of the circulatory system to explain this.

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*(2 marks)*

**3** (e) It was found that the athlete had a stroke volume (the amount of blood that the left ventricle pumps out at each contraction) of 90 $cm^3$.

What volume of blood will pass through the aortic valve each hour if her heart rate averages 80 beats per minute?

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*(2 marks)*

**4** A consultant diagnosed a 56-year-old man to be suffering from mild kidney disease. He was advised to drink 2 litres of water and to take in no more than 6 g of added salt in his food each day.

The consultant explained that these steps were important in order to prevent further damage to his kidneys.

**4** (a) What is the name of the hormone that regulates the level of sodium ions in the blood?

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*(1 mark)*

**4** (b) Describe the homeostatic mechanism that regulates the level of sodium ions in the blood. In your answer include information about the source, role and control of the relevant hormone.

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*(3 marks)*

**4** (c) The man drank much more than 2 litres of water a day. Describe how his body would have reacted in order to maintain his blood volume at the correct level.

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*(3 marks)*

**4** (d) The man bought a can of tomato soup for his evening meal.

He read on the label of the can that the soup contained 2.5 g of salt per serving and 1.8 g of protein.

**4** (d) (i) What percentage of his daily intake of salt would he be taking in if he ate one serving of soup?

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*(1 mark)*

**4** (d) (ii) He had also been told to eat only a small amount of protein each day.

He was to work this out using the following formula:

$$\text{mass of protein (g)} = \text{body mass (kg)} \times 0.75$$

His body mass is 65 kg. How much protein should he be eating each day?

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*(1 mark)*

**4** (d) (iii) The man's son said that this can of soup was not suitable for the main meal of the day. Explain why his son made this comment.

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*(1 mark)*

**10**

**5** When making baby foods, the starch content is often reduced by treating the food with amylase. Amylase is an enzyme found in the human digestive system that digests starch.

**5** (a) State **one** region of the human digestive system in which amylase is active.

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*(1 mark)*

**5** (b) (i) Describe the role of amylase in the process of digestion.

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*(2 marks)*

**5** (b) (ii) Explain why amylase is **not** effective in the digestion of proteins.

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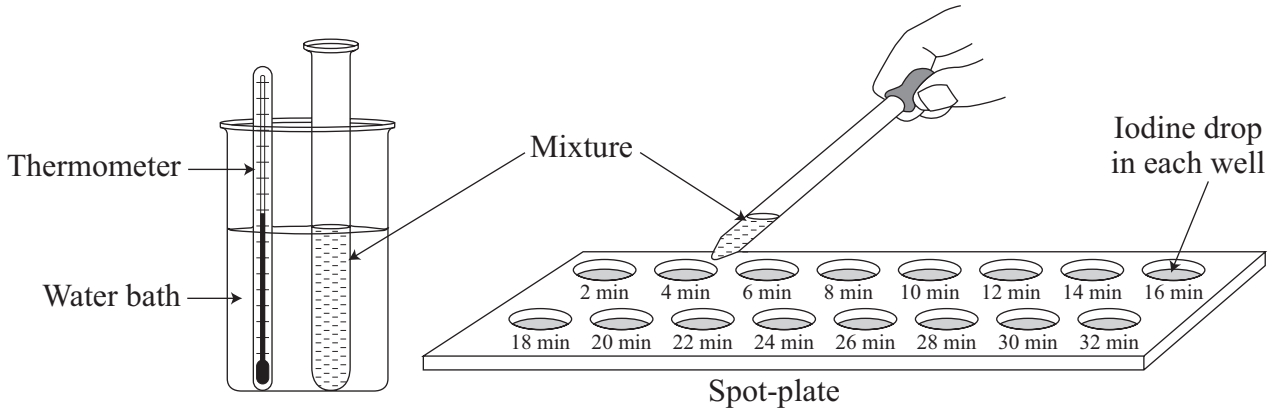
*(1 mark)*

**5** (c) A technician working for a baby food company was asked to find the temperature at which amylase is most active.
She mixed amylase and starch in a tube, which she incubated at a given temperature for 32 minutes.

During the incubation time the technician removed a small sample of the mixture every two minutes and tested the sample with iodine solution on a spot plate.

This was repeated at a number of different temperatures.



Starch turns blue-black in the presence of iodine solution.

When the technician saw that a sample of the mixture tested with iodine did not turn blue-black, she assumed that all the starch had been digested and she noted the time taken.
The whole experiment was repeated several times and mean times calculated.

The mean results are given in the table.

| **Temperature of incubation ($^{o}$C)** | **Mean time after which mixture stopped turning blue-black (minutes)** |
|---|---|
| 10 | Remained blue-black |
| 15 | 26 |
| 20 | 18 |
| 25 | 12 |
| 30 | 9 |
| 35 | 6 |
| 40 | 8 |
| 50 | Remained blue-black |

**5** (c) (i) Describe the pattern that appears in these results.

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*(2 marks)*

**5** (c) (ii) The samples from the tube at 10°C remained blue-black. Suggest and explain what result might have been obtained for this tube if the experiment had continued for two hours instead of 32 minutes.

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*(2 marks)*

**5** (c) (iii) Suggest the optimum temperature at which the baby food should be processed.

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*(1 mark)*

**5** (c) (iv) The technician realised that her experiment had several sources of error in the design. For example, the removal of the samples would have changed the volumes of the mixtures in the tubes.

Other than the effect of removing the samples, describe the other sources of error in the design of this experiment and suggest how the technician could modify her experiment to reduce or eliminate the sources of error you have described.

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

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*(5 marks)*

**14**

**6** A young man was taken ill and became semi-conscious. His friends took him to the accident and emergency department of his local hospital. He was wearing a bracelet like the one shown that indicated he suffered from diabetes.

The doctor carried out several tests on the young man's blood and urine. These confirmed that he was diabetic and that his blood glucose levels were very high. The tests also showed that the pH of his blood was abnormal.

**6** (a) (i) What is the normal range of pH values of the blood of a healthy person?

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*(2 marks)*

**6** (a) (ii) Suggest the most likely abnormality in the young man's blood pH given that he is diabetic.

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*(1 mark)*

**6** (a) (iii) Describe how blood pH is usually maintained within safe limits.

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*(3 marks)*

**Question 6 continues on the next page**

**6** (b) The young man recovered within a few days, but a dietician warned him that he should modify his diet to ensure that his body was able to function as healthily as possible.

Bearing in mind that he is diabetic, give **three** important aspects of dietary control that would help him to manage his condition.

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*(3 marks)*

**6** (c) In order to control his blood glucose levels, the young man must inject himself with insulin.

Suggest the symptoms that he might experience if he were to inject too much of this hormone.

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*(2 marks)*

**11**

**7** A student saw an advertisement for a chewing gum that contained a non-sugar sweetener called Supasweet.

The advertisement claimed that Supasweet is 'an all-natural sweetener which helps to keep teeth healthy'.

Supasweet has fewer calories than sugar and is less easily respired by living organisms, including bacteria.

**7** (a) Explain how chewing gum could help to reduce dental decay.

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*(3 marks)*

**7** (b) Suggest **two** health benefits to the student of using chewing gum sweetened with Supasweet rather than with sugar.

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2 .....

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*(2 marks)*

**Question 7 continues on the next page**

**7** (c) The student read in a newspaper that scientists were trying to prove that Supasweet could not only help to reduce tooth decay but might also help to repair small areas of dental caries in children.

The scientists studied 600 children. 300 children had been given gum containing Supasweet, and the other 300 had been given ordinary, sugar-free gum.

The table summarises the results.

| | **Children given gum with Supasweet** | **Children given ordinary sugar-free gum** |
|---|---|---|
| Number developing decay in their teeth during the experimental period | 27 | 33 |

**7** (c) (i) Calculate the difference between the percentages of children who developed tooth decay.

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*(2 marks)*

**7** (c) (ii) The scientists said there was not enough evidence to support the claim that Supasweet 'keeps teeth healthy'. Suggest how they came to this conclusion.

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*(3 marks)*

**10**

**END OF QUESTIONS**