Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2015

Applied Science SC14

Unit 14 The Healthy Body

Wednesday 10 June 2015 1.30 pm to 3.00 pm

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

Time allowed
- 1 hour 30 minutes

A

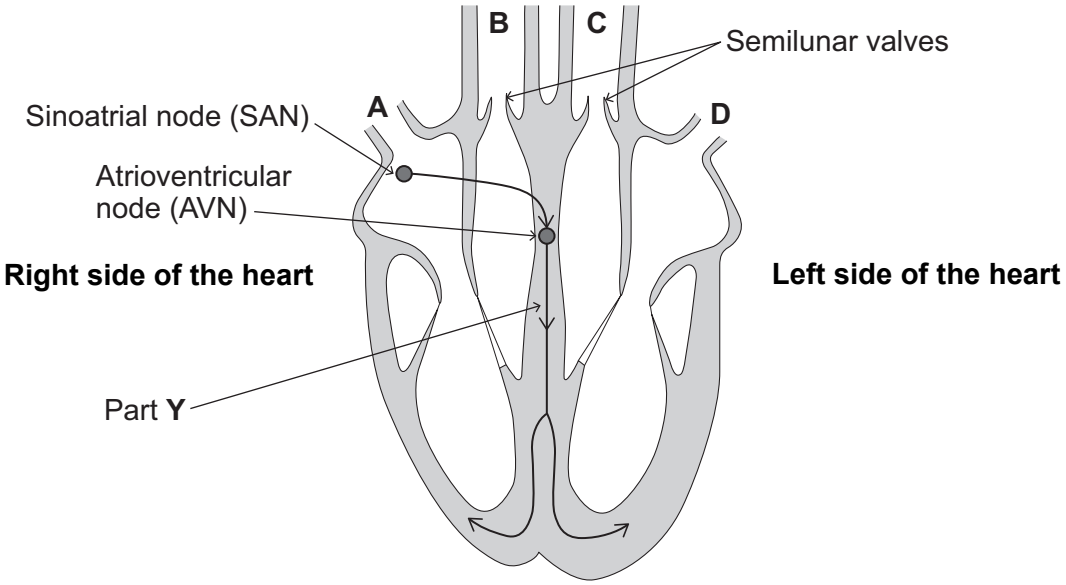
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information
- The marks for 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.

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

1 **Figure 1** shows a diagram of the heart with blood vessels labelled **A**, **B**, **C** and **D**.

Figure 1



1 (a) Write the correct letter **A**, **B**, **C** or **D** in each box to show which of the blood vessels shown in **Figure 1**:

1 (a) (i) carries oxygenated blood to the heart

[1 mark]

☐

1 (a) (ii) carries deoxygenated blood to the heart.

[1 mark]

☐

1 (b) Explain in terms of pressure how the semilunar valves open.

[1 mark]

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1 (c) (i) The human heart has four chambers.

In which one of these does blood pressure reach its highest value?

[1 mark]

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1 (c) (ii) What feature of the structure of this chamber causes the high value of blood pressure to be produced here?

[1 mark]

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1 (d) The wave of electrical activity that coordinates the beating of the heart is delayed slightly at the atrioventricular node (AVN). The wave then passes along part **Y** in **Figure 1** to the base of the ventricles.

Explain the importance of:

1 (d) (i) the slight delay at the AVN

[2 marks]

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1 (d) (ii) the electrical activity being passed to the **base** of the ventricles.

[2 marks]

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9

2 A 15-year-old girl went to her doctor because she often felt tired. The doctor observed that she looked pale and seemed to be rather thin. The doctor asked the girl to use a food diary to record everything she ate for one week.

The doctor then calculated the average daily amounts of energy, protein and important vitamins and minerals the girl was eating each day. He compared these figures with the recommended daily allowances (RDAs). These data are given in **Table 1**.

Table 1

	Energy (kJ)	**Protein (g)**	**Vitamin A (µg)**	**Vitamin C (mg)**	**Iron (mg)**	**Calcium (mg)**
Girl	7000	70	775	160	15	1400
RDA	9000	60	750	60	15	1200

2 (a) (i) The food diary showed that the girl ate lots of low-fat cottage cheese and oranges.

Give **two** pieces of evidence from **Table 1** that support this.

[2 marks]

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2 .....

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2 (a) (ii) State **two** changes the girl could make to her diet to increase her energy levels.

[2 marks]

Change 1 .....

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Change 2 .....

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2 (b) (i) After three months, the girl returned to the doctor. She had gained weight but was still pale and tired. The doctor requested a blood test and this revealed that her haemoglobin level had become abnormally low.

How can abnormally low levels of haemoglobin be detected in the blood?

[1 mark]

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2 (b) (ii) What is the name given to the condition in which a person has an abnormally low haemoglobin level?

[1 mark]

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2 (b) (iii) Give **two** changes to the girl's diet that the doctor may recommend as a result of this diagnosis.

[2 marks]

Change 1 .....

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Change 2 .....

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2 (c) The girl told her doctor that she was suffering from constipation, a condition in which faeces are difficult to pass because they become dry and hard in the gut. The doctor thought that increasing the fibre content of her diet would help.

Fibre is mostly cellulose, an insoluble material found in plants. The human body cannot digest cellulose and cellulose can absorb a significant amount of water.

Suggest why foods with high fibre content make it easier for the muscles of the gut to function properly.

[2 marks]

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Question 2 continues on the next page

2 (d) A vegan's diet contains no food of animal origin at all. Vegans rarely suffer from constipation but may have other difficulties in maintaining a healthy diet.

Suggest **two** of these difficulties.

[2 marks]

Difficulty 1 .....

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Difficulty 2 .....

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12

3 It is estimated that about three million people in the UK are known to have diabetes. It is also thought that a further 850 000 people have the condition and do not know it. Diabetes tests can be carried out in some high-street pharmacies.

3 (a) Name and describe a simple test that could be used to find out if someone has diabetes.

[3 marks]

Name of test .....

Description .....

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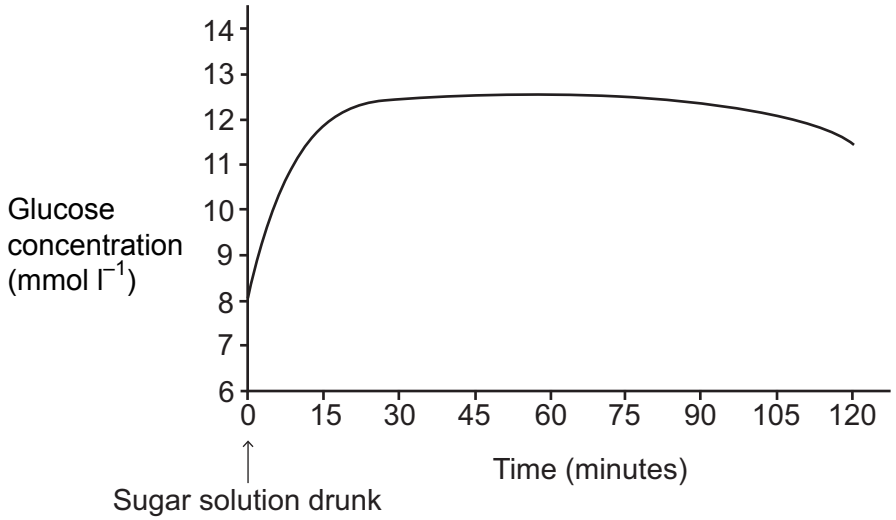
3 (b) A person suspected of having diabetes may be given a glucose tolerance test. This test involves fasting for a few hours and then being given a sugar solution to drink. Blood samples are taken at regular intervals and the glucose concentration in each sample of blood is measured.

Figure 2 shows the results of a glucose tolerance test for someone with diabetes.

Sketch on **Figure 2** the expected response for someone who does not have diabetes.

[2 marks]

Figure 2



Question 3 continues on the next page

3 (c) A man with diabetes visits a specialist nurse for dietary advice. She advises him that he should include complex carbohydrates in his diet.

Explain why someone with diabetes should follow this advice.

[2 marks]

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3 (d) (i) The man also required an insulin injection several times a day. The insulin provided proteins that the man was not making himself.

Suggest why this type of insulin would be ineffective if taken in tablet form.

[2 marks]

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3 (d) (ii) Suggest **two** symptoms the man may experience if he were to inject too much insulin.

[2 marks]

Symptom 1.....

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Symptom 2.....

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11

4 A 17-year-old student suffers from cystic fibrosis. The condition causes the mucus produced by his body to be thicker than normal and also sticky. He attends a clinic where a nurse measures his oxygen saturation levels at different partial pressures of oxygen.

4 (a) What non-invasive piece of equipment could be used to measure the oxygen saturation of his blood?

[1 mark]

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4 (b) Cystic fibrosis can affect oxygen transfer from the lungs to the blood.

Explain briefly how oxygen transfer from the lungs to the blood can be affected by cystic fibrosis.

[2 marks]

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Question 4 continues on the next page

4 (c) A cystic fibrosis sufferer may lose more salt from their body than a non-sufferer would. The nurse describes the short-term and long-term consequences of this loss to the student.

Suggest what the consequences of the loss of salt to the body could be.

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

[5 marks]

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Extra space (if needed) .....

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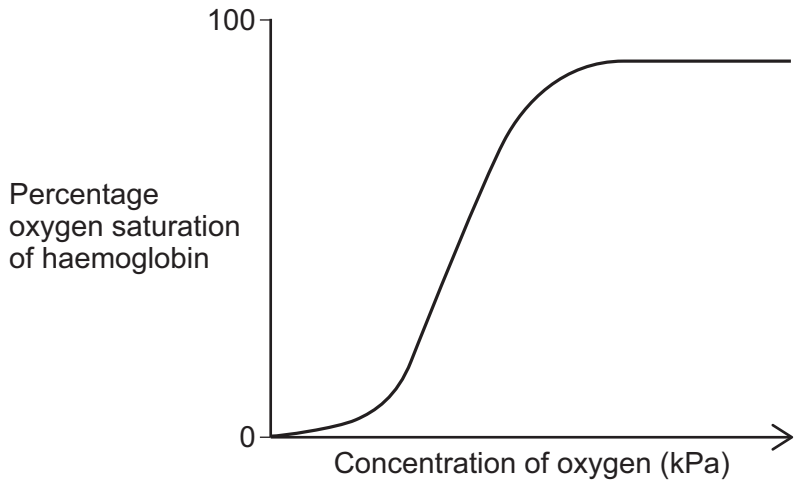
4 (d) **Figure 3** shows the percentage oxygen saturation of haemoglobin at different concentrations of oxygen.

Figure 3



4 (d) (i) Mark a letter **X** on the curve in **Figure 3** to show the region that represents the oxygen concentration in the lungs.

[1 mark]

4 (d) (ii) Any physical activity increases the production of carbon dioxide.

Draw a curve on **Figure 3** to show the effect of an increased carbon dioxide level on the percentage of oxygen saturated with haemoglobin.

[1 mark]

4 (d) (iii) Describe how the body detects and responds to increased carbon dioxide levels in the blood.

[4 marks]

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14

Turn over ▶

5 A 60-year-old woman was suffering from kidney stones. To help kidney function, her consultant advised her to drink 2 litres of water a day, and to reduce her salt intake to 5 g per day.

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

[1 mark]

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5 (b) The woman drank much more than the 2 litre daily requirement.

Describe how her body would detect this and respond to maintain her blood volume at the correct level.

[4 marks]

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5 (c) The woman bought an apple pie. It contained 2.8 g of salt.

5 (c) (i) What percentage of her daily intake of salt would she be taking in by eating the whole apple pie?

[1 mark]

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5 (c) (ii) Why is it important that the woman did not try to eliminate salt from her diet altogether?

[1 mark]

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6 Digestion relies on the activity of enzymes in the stomach and the intestine. A biochemist analysed the rate of activity of pepsin, an enzyme found in the stomach that helps to digest proteins.

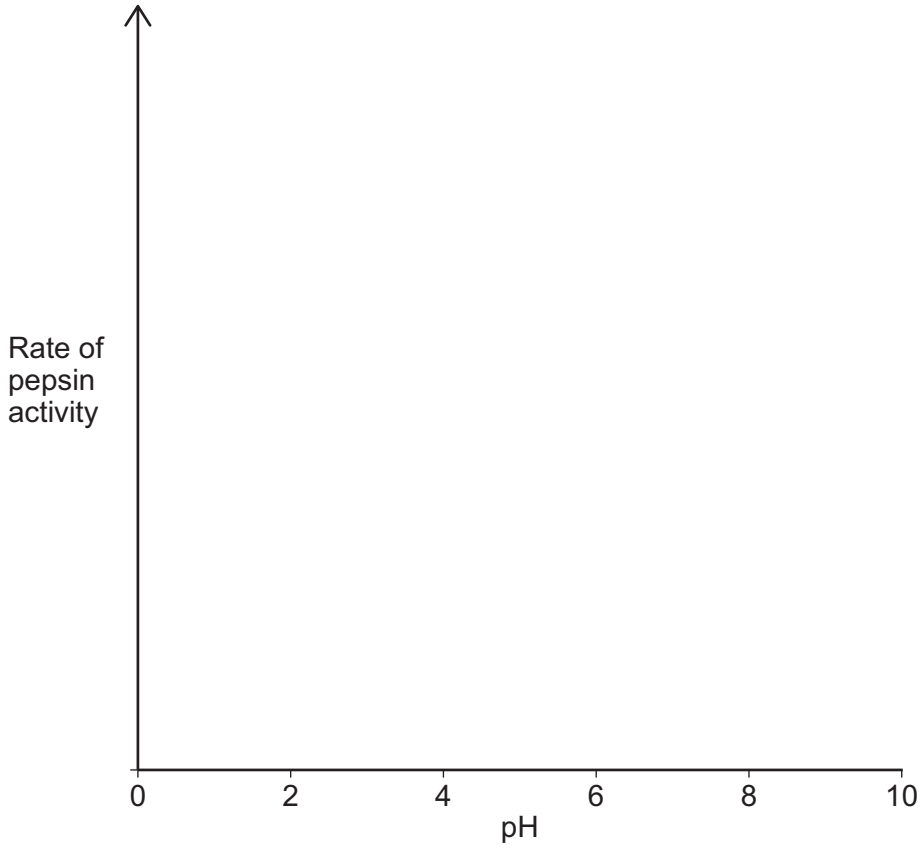
Firstly the biochemist wanted to determine the effect of pH on pepsin activity. He added pepsin to some milk and observed how long it took for the protein to be digested. This was seen when the milk changed from white to colourless. From this he plotted a graph linking pepsin activity with pH.

6 (a) Pepsin works best at pH 2 and is fully denatured at pH 6.

Sketch a curve on **Figure 4** to show the shape of the graph the biochemist drew.

[2 marks]

Figure 4



Question 6 continues on the next page

6 (b) Secondly the biochemist wanted to determine the effect of temperature on pepsin activity. He added pepsin to some milk and measured how long it took for the protein to be digested. This was seen when the milk changed from white to colourless.

6 (b) (i) Design an experiment in which you could investigate the effect of temperature on pepsin activity. You should include the equipment used and a method, and consider reliability in your answer.

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

[5 marks]

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Extra space (if needed) .....

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6 (b) (ii) How would you know if you had completely denatured the pepsin enzyme at any stage of your experiment?

[1 mark]

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8

Turn over for the next question

7 A scientist was studying respiration in muscle cells. She was interested in comparing aerobic respiration with anaerobic respiration. Both processes produce adenosine triphosphate (ATP).

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

[2 marks]

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7 (b) Compare the amounts of ATP produced by aerobic respiration and by anaerobic respiration.

[1 mark]

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7 (c) Where in the cell does the electron transport chain take place?

[1 mark]

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7 (d) $FADH_2$ and $NADH_2$ are coenzymes that enter the electron transport chain.
In the electron transport chain, every molecule of $FADH_2$ can generate two ATP molecules, and every molecule of $NADH_2$ can generate three molecules of ATP.

In total, ten $NADH_2$ and two $FADH_2$ molecules are generated from one molecule of glucose in aerobic respiration.

How many molecules of ATP would this generate?

[1 mark]

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7 (e) In the absence of glucose, the body uses fat in respiration.

Explain how the body uses fat as a respiratory substrate.

[4 marks]

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Turn over for the next question

8 Some foods contain substances called polyphenols. Polyphenols lower cholesterol concentration and reduce the risk of developing coronary heart disease (CHD).

Apples have a high concentration of polyphenols. A scientist investigated the effect of eating apples on the risk of developing CHD. The scientist divided the volunteers into two random groups. One group was given apples containing polyphenols to eat and the other group acted as a control.

The scientist measured the diameter of the main artery in the arms of each volunteer every week. At the end of one month, the diameter of this artery had increased for the volunteers who had eaten apples.

Use the information in the passage and your own knowledge to answer these questions.

8 (a) Increased blood cholesterol concentration is a risk factor associated with CHD.

Give **two** other factors which could increase the risk of developing CHD.

[2 marks]

Factor 1.....

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Factor 2.....

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8 (b) (i) The scientist used healthy volunteers in this investigation.

Why was it important that the volunteers were **healthy**?

[1 mark]

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8 (b) (ii) The scientist divided the volunteers into two random groups.

What is the advantage of dividing the volunteers into **random** groups?

[1 mark]

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8 (c) (i) Why was it important to have a control group in this investigation?

[1 mark]

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8 (c) (ii) Describe how the control group should have been treated.

[2 marks]

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8 (d) Suggest why an increase in the diameter of the main artery in the arm is associated with a reduced risk of CHD.

[3 marks]

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10

END OF QUESTIONS

There are no questions printed on this page

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