General Certificate of Education
June 2005
Advanced Subsidiary Examination

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

HUMAN BIOLOGY (SPECIFICATION A) BYA3
Unit 3   Pathogens and Disease

Monday 6 June 2005   Morning Session

In addition to this paper you will require:
- a ruler with millimetre measurements.

You may use 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 in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- 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.

BYA3

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

1 A student investigated the stages of mitosis in a garlic root. The root tip was placed on a microscope slide with a stain. A cover slip was placed on top and the root tip was firmly squashed.

(a) Explain why

(i) a root tip was used;

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(1 mark)

(ii) a stain was used;

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(1 mark)

(iii) the root tip was firmly squashed.

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(1 mark)

(b) The student examined the cells in the garlic root tip under the microscope, and obtained the following data.

Stage	Number of cells
Interphase	872
Prophase	74
Metaphase	18
Anaphase	10
Telophase	8

(i) Calculate the percentage of these cells in which the chromosomes are visible and would consist of a pair of chromatids joined together. Show your working.

Answer ....

(2 marks)

(ii) A different set of results was obtained when the count was repeated on another occasion with a different garlic root tip. Give **two** reasons for the difference in results.

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2 ....

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(2 marks)

TURN OVER FOR THE NEXT QUESTION

2 A test has been developed to determine if a person is infected with variant CJD (vCJD), the human form of BSE (mad cow disease). The test detects the protein which causes vCJD in a urine sample.

The test kit contains the following components.

A test plate with wells containing antibodies to the protein which causes vCJD	Antibodies to the protein which causes vCJD. These antibodies have an enzyme attached to them	Colourless solution which turns blue if the enzyme is present
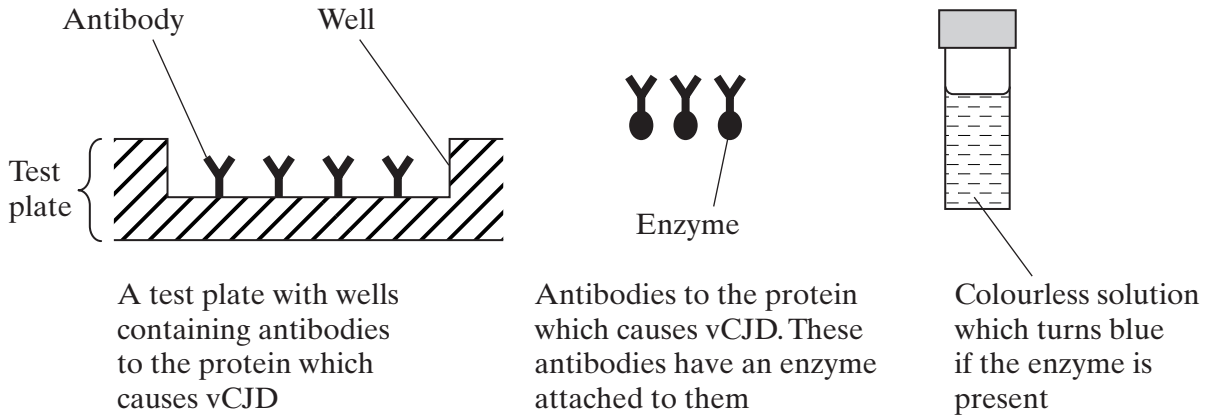
(a) Complete the flow chart to describe how this test would be used.

> Urine sample is added to well in test plate

> Plate is washed to remove unbound vCJD protein

> ⬚

> ⬚

> ⬚
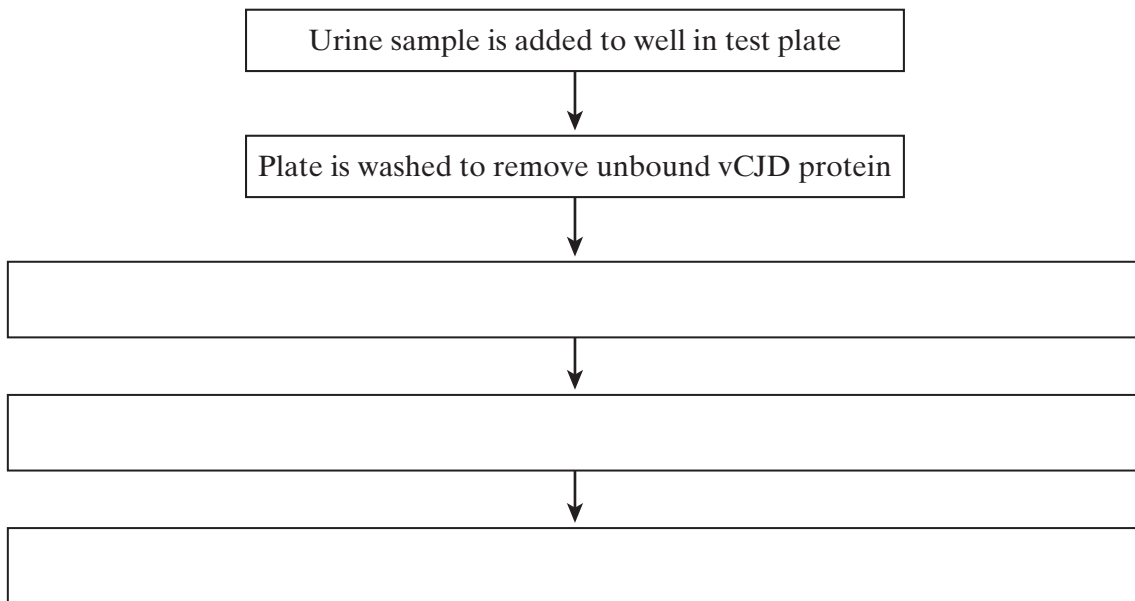
(3 marks)

(b) Explain why this test would detect vCJD, but not other antigens in the urine.

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(2 marks)

3 *Salmonella* bacteria infect the cells lining the small intestine.

(a) Explain why there is usually an interval of several hours between ingesting *Salmonella* bacteria and suffering from diarrhoea and sickness.

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(2 marks)

(b) Two students were given a job working in the kitchen of a small restaurant. They were told that there were some food hygiene rules which they had to observe. These minimised the risk of *Salmonella* food poisoning among the customers. Explain how each of the following rules minimises the risk of *Salmonella* food poisoning.

(i) Keep raw meat at the bottom of the refrigerator and cooked meat at the top.

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(2 marks)

(ii) Use disposable dishcloths and throw them away after use.

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(1 mark)

5

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

4 In a hospital laboratory, a sterile Petri dish of nutrient agar was inoculated with bacteria from a patient with a throat infection. Four discs, each of which had been soaked in a different antibiotic, were placed on top of the bacteria. The dish was incubated at 37°C. **Figure 1** shows the appearance of the dish after incubation.

Disc containing
tetracycline

Disc containing
penicillin

Disc containing
ampicillin

Disc containing
streptomycin
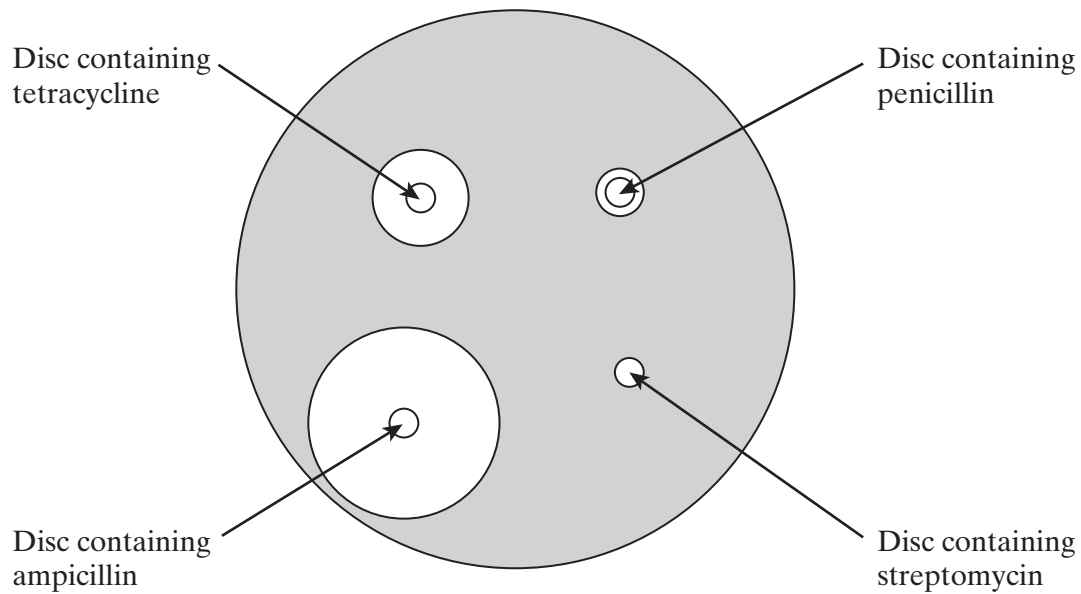
Figure 1

(a) Explain why there are clear zones around some of the discs containing antibiotic.

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(2 marks)

(b) It was suggested that ampicillin might be the best antibiotic to treat the patient's throat infection. Give the evidence from the laboratory test to support this suggestion.

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(1 mark)

(c)   Tetracycline binds to bacterial ribosomes. This is shown in **Figure 2**.
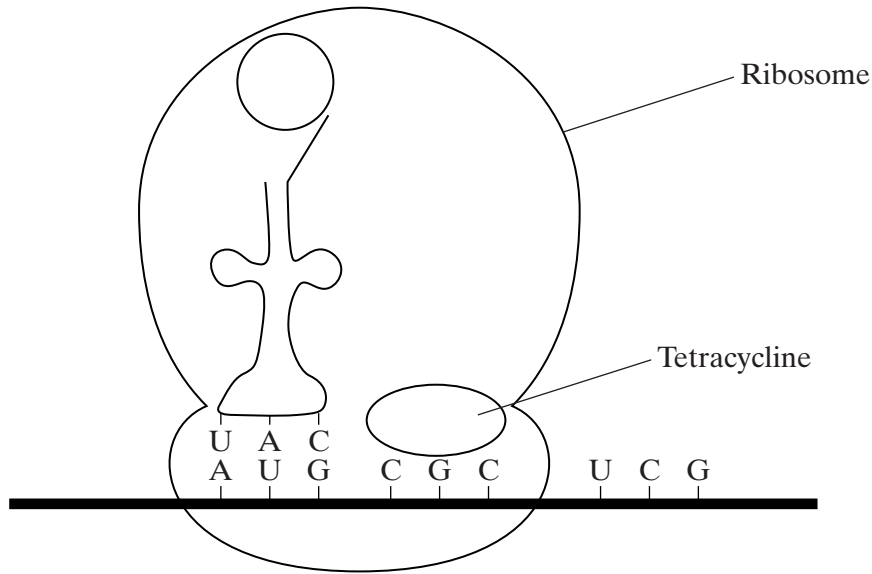
Figure 2

(i)   Explain how tetracycline stops protein synthesis.

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(2 marks)

(ii) Tetracycline prevents bacterial growth by preventing protein synthesis. Give **two** other ways in which antibiotics can prevent bacterial growth.

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2 ....

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(2 marks)

Turn over ▶

5 (a) Nucleic acids, such as DNA, are polymers, made up of many repeating monomer units. Name the monomer from which nucleic acids are made.

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(1 mark)

(b) The table shows the percentage of different bases in the DNA of some organisms.

Organism	Percentage of each base			
	Adenine	Guanine	Cytosine	Thymine
Human	31.2	18.8	18.8	31.2
Cow	27.9	22.1	22.1	27.9
Salmon	29.4	20.6	20.6	29.4
Rat	28.6			
Virus	24.7	24.1	18.5	32.7

(i) Calculate the missing figures for rat DNA and write them into the table.
(2 marks)

(ii) The virus has single-stranded DNA as its genetic material. Explain the evidence from the table which suggests that the DNA is single-stranded.

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(2 marks)

(iii) The virus DNA and messenger RNA are both single-stranded. Give **two** other structural similarities between the virus DNA and messenger RNA.

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(2 marks)

7

6 Malaria is a disease caused by a parasite.

(a) (i) What is a parasite?

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(2 marks)

(ii) Describe and explain **one** adaptation of the malaria parasite which enables it to avoid being affected by the body's immune system.

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(2 marks)

(b) Archaeologists found about fifty Ancient Roman skeletons in Italy in the early 1990s. They used a DNA probe to show that many of these people had died of malaria. What is a *DNA probe*?

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(2 marks)

(c) Many of the skeletons were from children. Children are more vulnerable to malaria than adults. Suggest a reason for this.

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(1 mark)

7

Turn over ▶

7 (a) The Human Immunodeficiency Virus (HIV) contains reverse transcriptase. What is the function of reverse transcriptase?

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(2 marks)

(b) (i) Tenofovir may be used to treat patients with HIV. A tenofovir molecule has a similar shape to a DNA nucleotide. Suggest how this drug may be effective in delaying the spread of HIV round the body.

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(2 marks)

(ii) People with HIV are usually given a combination of several drugs, rather than just one drug. Suggest a reason for this.

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(1 mark)

(c) Tuberculosis is more common among people who are infected with HIV than in people who are not infected with HIV. Explain why.

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(2 marks)

7

8 (a) Describe how an atheroma is formed and how it can lead to a myocardial infarction.

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(6 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ▶

(b) Warfarin is a drug that inhibits blood clotting. A trial was carried out using 508 patients aged 30 or over who were at risk of thrombosis. They were randomly assigned to two groups. One group received warfarin and a control group received a dummy pill containing no medication (a placebo). The results obtained were as follows:

Treatment	Number in group	Number developing thrombosis after treatment was started
Warfarin	255	14
Placebo	253	37

(i) Explain what is meant by *randomly* assigning patients into two groups.

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(1 mark)

(ii) Why is it necessary for the control group to receive a placebo instead of warfarin?

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(1 mark)

(iii) Calculate the reduction in percentage risk of thrombosis for the patients given warfarin. Show your working.

(2 marks)

(c) The graph shows the clotting time for samples of blood which have had different amounts of heparin added.
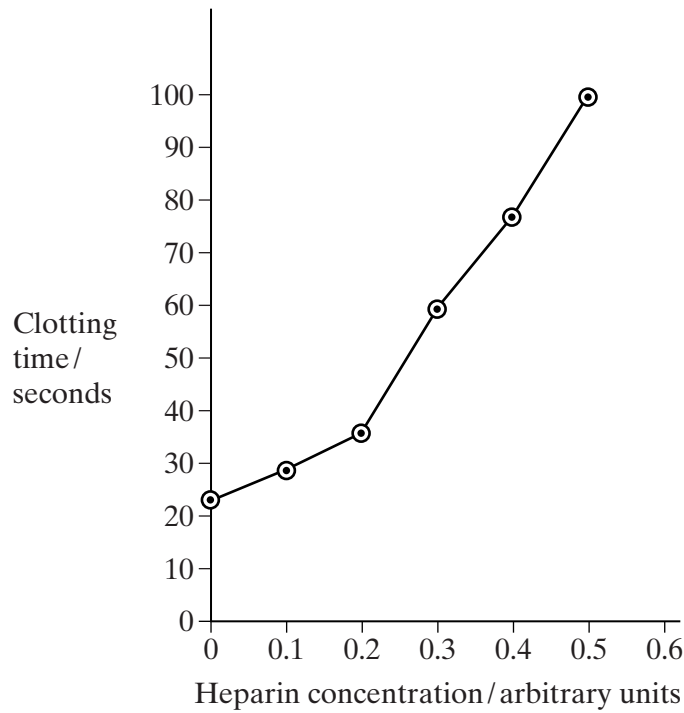
(i) Describe the effect of adding heparin to samples of blood.

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(2 marks)

(ii) Heparin is added to samples of blood used for blood transfusion. This stops clots forming. Explain why it is important that blood used for transfusion does not introduce blood clots into the patient.

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(1 mark)

(iii) Blood samples which are low in calcium ions are very slow to clot. Use your knowledge of blood clotting to explain why.

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(2 marks)

Turn over ▶

15

9 Read the following passage.

Herpes viruses cause cold sores and, in some cases, genital warts. Scientists are well on the way to producing an antibody which will counteract herpes infection. This antibody works by sticking to the virus and blocking its entry into cells. It has proved very effective in animal tests.

5 One drawback with this approach, however, is that antibodies are at present produced using hamster ovary cells. This method is expensive and only produces limited amounts. A new technique is being developed to produce antibodies from plants. It involves introducing the DNA which codes for the required antibody into crop plants such as maize.

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

(a) (i) What is an antibody?

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(2 marks)

(ii) Describe how antibodies are produced in the body following a viral infection.

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(6 marks)

(b)   Describe how the antibody gene could be isolated from an animal cell and introduced into a crop plant such as maize (lines 7-8).

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(4 marks)

(c)   Taking a course of these antibodies from plants to treat a herpes infection would not produce long-term protection against disease. Explain why.

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(2 marks)

(d)   Explain **one** advantage of using antibodies from plants to treat a disease, rather than antibodies produced in an experimental animal (lines 5-6).

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(1 mark)

15

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE