

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Friday 19 October 2018

Morning (Time: 1 hour 30 minutes)

Paper Reference **WBI03/01**

Biology

Advanced Subsidiary

Unit 3: Practical Biology and Research Skills

You must have:

Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

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Answer ALL questions.

1 The pH of soil affects the growth of plants. Farmers often add chemicals to soil in order to adjust its pH.

A student investigated the effect of pH on the growth of Kentucky bluegrass (*Poa pratensis*).

An equal mass of soil was placed into each of 25 pots. The pH of the soil in each pot was adjusted to give pH values of: 6.0, 6.5, 7.0, 7.5 and 8.0. There were five pots for each pH value.

Five grass seeds were planted in each of the pots.

The pots were watered every day for the next 14 days. The same volume of water was added to each pot.

The height of each grass plant was measured and recorded after 14 days.

(a) (i) Name the **independent** variable in this investigation.

(1)

(ii) Suggest **two** variables, other than the mass of soil and the volume of water, that should be kept constant in this investigation. Describe how each variable could be controlled.

(4)

Variable 1.....

How it could be controlled.....

Variable 2.....

How it could be controlled.....



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(b) The table below shows the results of this investigation.

pH	Grass plant height / mm						
	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Mean	Standard deviation
6.0	8	9	8	9	8	8.4	0.5
6.5	38	39	36	36	34	36.6	1.9
7.0	38	35	37	39	39	37.6	1.7
7.5	12	10	10	10	11	10.6	0.9
8.0	6	7	7	6	7	6.6	0.5

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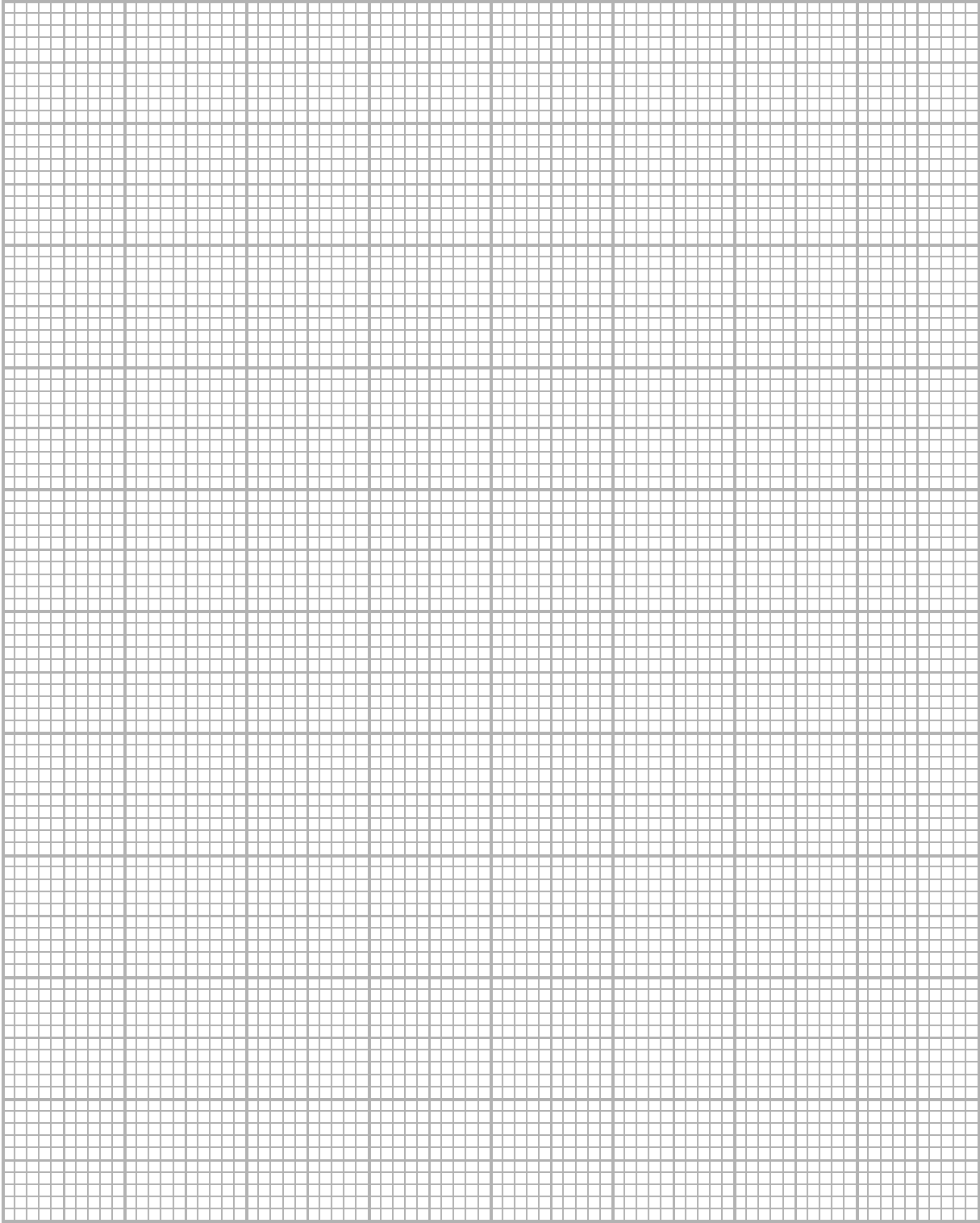
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(i) Plot a line graph to show the effect of pH on the mean height of the grass plants. Include the standard deviations on your graph.

(5)



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(ii) The student made two conclusions from these results:

- the grass plants grew taller in the soil at pH values 6.5 and 7.0 than in the soil with other pH values
- there was no significant difference in height between pH 6.5 and 7.0.

Using the information in the table, give reasons why the student came to these conclusions.

(3)

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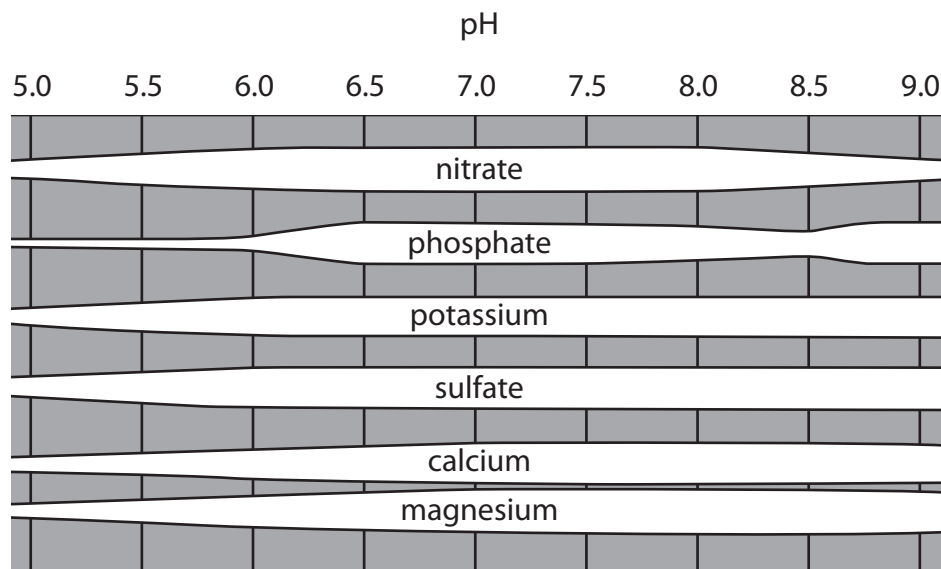
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(c) The student found the following diagram online and suggested that the pH of the soil affected the availability of mineral ions for the growth of the plants.

The diagram shows the availability to the plants of some mineral ions at a range of pH values.

The height of the white bars shows the availability of each mineral ion.



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(i) Using the information in this diagram and the data in part (b), explain why the student suggested that the pH of the soil affected the availability of mineral ions to the plants.

(4)

Dotted lines for writing the answer to part (i).

(ii) State how **three** of the mineral ions shown in this diagram are used by plants.

(3)

Mineral.....

Use.....

Mineral.....

Use.....

Mineral.....

Use.....

(Total for Question 1 = 20 marks)

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2 Read the following account from a student's unfinished draft issue report on Ebola.

1. Ebola is a severe and often fatal viral disease. It is caused by a virus in the order Mononegavirales, family Filoviridae and genus Ebola. The normal host species of the virus is currently unknown. However, it is thought that the disease spread through human consumption of the Angolan free-tailed bat, *Mops condylurus*. For this reason, Ebola virus (EBOV) is said to be a zoonotic disease, meaning it can be transferred between humans and animals. Currently, Ebola has no vaccine or cure and, with a high 50 to 90% mortality rate, therapeutic intervention is crucial. However, a study carried out by Dr Xiangguo Qiu suggests monoclonal antibodies as a potential treatment.
2. The incubation period is 2 to 21 days and includes fever, fatigue, muscle pain, headaches and sore throat. Patients rapidly progress to an advanced disease and 50% develop a hemorrhagic fever, producing symptoms such as nausea, vomiting, a shock-like syndrome, diarrhoea, rash and impaired kidney and liver function. Internal and external bleeding arise in some cases, resulting in multiple organ failure. There are also low white blood cell and platelet counts and elevated liver enzymes. Usually, 6 to 16 days after symptoms appear, 90% of hosts develop a sudden and severe infection due to low blood pressure and fluid loss, which rapidly progresses to death. Ebola can be spread to others through direct contact with someone who has developed symptoms of the disease. The virus can be spread through broken skin or mucous membranes between infected fruit bats or primates. The virus can also be spread by objects that have been contaminated with the virus and blood or bodily fluids, including urine, saliva, sweat, faeces, vomit, breast milk and semen. Men can still transmit the virus through their semen for up to seven weeks after recovery from the illness.
3. The average mortality rate for Ebola is about 50%. The three countries most affected by the virus were Guinea, Sierra Leone and Liberia. A total of 8 110 people died from the disease in these three countries up to January 11th 2015. The country with the highest mortality rate was Guinea with 2 806 people infected of which 1 814 died, a mortality rate of approximately 65%. Liberia had the second highest mortality rate of approximately 43%, as 8 331 people were infected of which 3 538 died. Sierra Leone had the lowest mortality rate as 9 446 people were infected and 2 758 died.
4. ZMapp, an antibody cocktail, is an experimental biopharmaceutical drug made up of three monoclonal antibodies (mAbs). The drug is intravenously administered to EBOV-infected patients. Ebola is deadly because it disrupts the human immune system. The antibodies in ZMapp are thought to block or neutralise the virus, by binding directly to the antigen of the virus therefore boosting a patient's ability to fight the virus, which increases their chance of survival.
5. The ZMapp was tested on Rhesus monkeys in three groups of six animals (A, B and C) and one of three animals (D). All treatment groups were infected with the virus and received three doses of 50 mg kg⁻¹ of ZMapp. The drug was firstly administered to group A at 3 days post-infection (dpi), at 4 dpi to group B and at 5 dpi to group C, with two additional identical doses for each group, spaced 3 days apart. Days 14, 21 and 28 post-infection were used as designated sample days for all groups, during which rectal temperatures and clinical scores were measured. The following were also sampled for analysis: blood for serum biochemistry, cell counts and viraemia. Group D had no ZMapp administered and acted as a control. All the animals in groups A, B and C survived the disease and were virus free by 14 dpi in all cases. All animals in the control group D had died by 8 dpi. In all cases in groups A, B and C, lymphocyte counts were raised above those in the control group animals.

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- 6. In the testing, one monkey had a flushed face and severe rash on more than 40% of its body surface. Another monkey had a flushed face as well as a rash on its arms and legs.
- 7. The UN Office for the Coordination of Humanitarian Affairs (OCHA) announced it needed \$988m to fight the disease in Liberia, Guinea and Sierra Leone. In addition, the UN Secretary-General, Ban Ki-moon, asked for a \$1bn trust fund to be set up to act as a 'rapid, flexible spending reserve'.
- 8. Ebola is deadly because it disrupts the human immune system. An Ebola survivor still has antibodies specific to the antigen of the virus remaining in their bloodstream from the previous infection. Blood plasma transfusion therefore allows sufferers of the disease to have the same antibodies as the survivor present in the bloodstream. This results in a strengthened immune system and thus a more efficient elimination of the virus. However, the treatment is yet to be tested on a wider scale. Currently, there are no data on the effectiveness of this treatment in curing EBOV-infected patients. Survivors would need to give consent for blood to be taken and this might be a problem for them and/or the sufferer to be treated with the transfusion. For example, some religions do not approve of blood transfusions.

(a) The visit or issue report needs to describe a main solution and one or more alternative solutions to the problem identified.

(i) State the problem that is identified in this report.

(1)

(ii) Describe the main solution and **one** alternative solution discussed in this report.

(4)

Main solution.....

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Alternative solution.....

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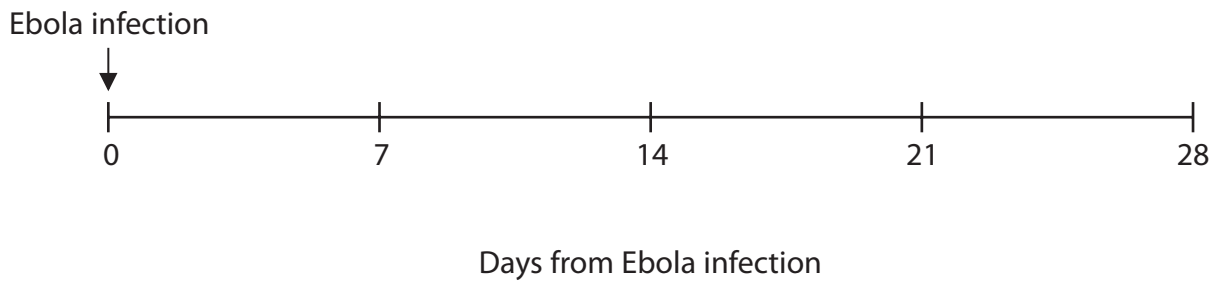
(b) State **one** way in which the Ebola virus can be transmitted from person to person. (1)

(c) The student wanted to add some visuals to this report and started one to show the timeline of the treatment of the Rhesus monkeys described in paragraph 5.

This paragraph is shown again below.

'The ZMapp was tested on Rhesus monkeys in three groups of six animals (A, B and C) and one of three animals (D). All treatment groups were infected with the virus and received three doses of 50 mg kg⁻¹ of ZMapp. The drug was firstly administered to group A at 3 days post-infection (dpi), at 4 dpi to group B and at 5 dpi to group C, with two additional identical doses for each group, spaced 3 days apart. Days 14, 21 and 28 post-infection were used as designated sample days for all groups, during which rectal temperatures and clinical scores were measured. The following were also sampled for analysis: blood for serum biochemistry, cell counts and viraemia. Group D had no ZMapp administered and acted as a control. All the animals in groups A, B and C survived the disease and were virus free by 14 dpi in all cases. All animals in the control group D had died by 8 dpi. In all cases in groups A, B and C, lymphocyte counts were raised above those in the control group animals.'

Using this information, complete the timeline below to show how monkeys in groups A, B and C were treated. (4)



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(d) In the student's bibliography, there is a reference to the paper reporting the Rhesus monkey study. This paper is by Xiangguo Qiu and others, published in the journal Nature in 2014.

State the further information needed to write a complete reference.

(3)

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(e) Give **three** ethical implications that might arise from the studies and treatments outlined in this report.

(3)

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- (f) (i) Using the information in paragraph 3, calculate the percentage mortality rate from Ebola in Sierra Leone.
Show your working.

(2)

.....%

- (ii) Draw a table to show the information in paragraph 3. Include the numbers infected, the numbers who died and the percentage mortality rates for all three countries.

(2)

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

