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Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Biology

Advanced Subsidiary

Unit 3: Practical Biology and Research Skills

Friday 13 October 2017 – Afternoon

Time: 1 hour 30 minutes

Paper Reference

WBI03/01

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.*

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.

Turn over ►

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Answer ALL questions.

- 1 Black pepper (*Piper nigrum*) is a plant grown for its fruits. These fruits are dried and crushed to produce black pepper. Black pepper is used in many recipes and is also thought to have medicinal properties.

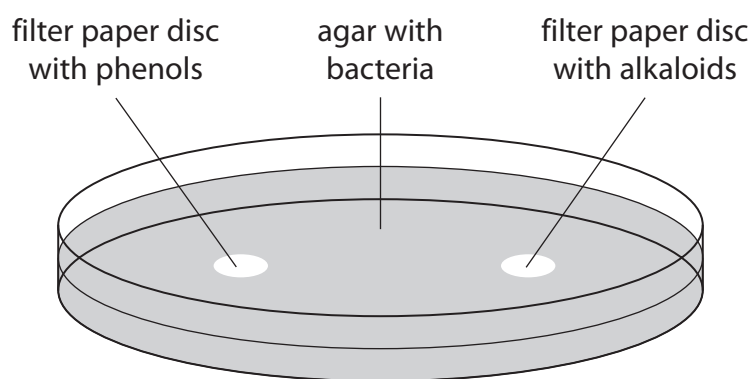
The fruits contain alkaloids and phenols that have antimicrobial properties.

An investigation was carried out in a research laboratory.

Two extracts from black pepper were produced: one containing alkaloids and one containing phenols. Each extract was used to prepare a solution containing 0.4 mg dm^{-3} of the chemicals.

The resulting solutions were then used to investigate the antimicrobial properties of these two chemicals on a range of bacteria, using the following method.

- Each solution was pipetted onto discs of filter paper.
- All the discs were dried.
- Four plates were prepared, using agar, containing the following bacteria:
 - *Escherichia coli*
 - *Staphylococcus aureus*
 - *Streptococcus agalactiae*
 - *Streptococcus pyogenes*.
- A disc containing each chemical was placed on the agar in each of the four agar plates, as shown in the diagram below.



- The agar plates were incubated.
- The size of each zone of inhibition was then measured after 48 hours.

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(a) (i) Name the dependent variable in this investigation and explain how it could be measured accurately.

(2)

Dependent variable.....

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How it could be measured accurately.....

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(ii) Suggest a suitable control for this investigation.

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(iii) Name **one** variable that should be controlled in this investigation.

Describe how this variable could be controlled.

(2)

Variable.....

How this variable could be controlled.....

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

Bacteria	Source of bacteria	Diameter of zone of inhibition / mm	
		disc with alkaloids	disc with phenols
<i>Escherichia coli</i>	urinary tract infection	50	53
<i>Staphylococcus aureus</i>	skin infection	35	48
<i>Streptococcus agalactiae</i>	urinary tract infection	30	53
<i>Streptococcus pyogenes</i>	blood infection	51	52

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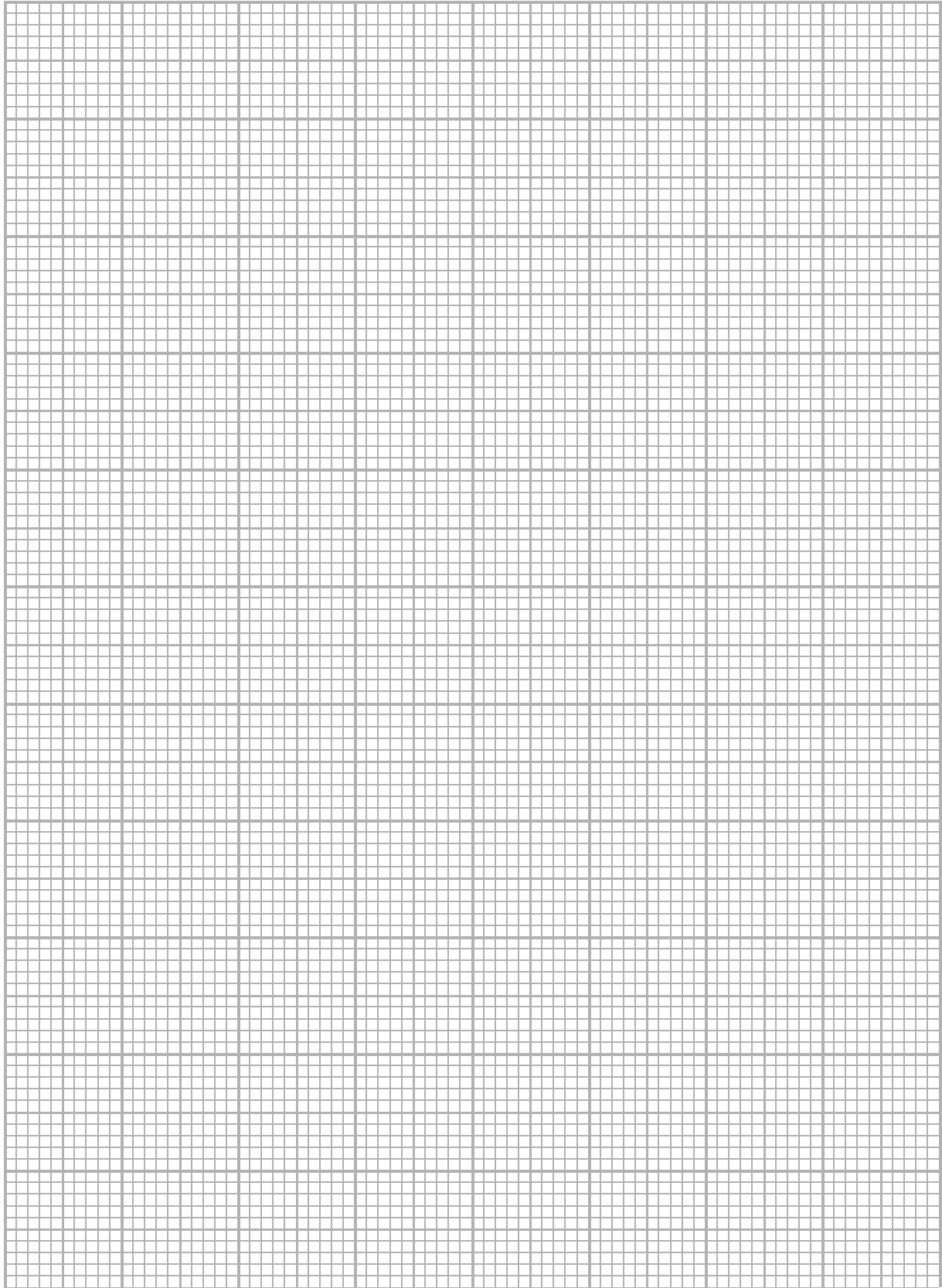
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(i) Plot the information in the table in a suitable graphical form.

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(ii) Using the results of this investigation, compare the effectiveness of these two extracts.

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(iii) Describe how this investigation could be modified to measure the variability in the effects of these extracts.

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(iv) Describe how the measure you described in (iii) could be shown on a graph.

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(c) Bacteria are becoming resistant to many antibiotics.

Suggest the advantages and disadvantages of using plant extracts instead of antibiotics to treat infections caused by bacteria.

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(Total for Question 1 = 20 marks)

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2 Read the following extract from a student's draft report on the topic of anti-ageing.

1. Immortality has been a dream for humans for thousands of years. The average life expectancy of all the people in the world is around 66.3 years; 64.3 years for men, 68.4 years for women.
2. Stopping ageing will lead to an increase in economic growth, but will not cause overpopulation. Millions of dollars are spent every year trying to extend the lives of people who are close to death. It would make more sense to look for interventions that will prevent ageing.
3. It is thought that, over a person's life, cells accumulate random mutations due to such things as UV radiation from the Sun. However, not all cells are affected in the same way. In order to sustain tissue health and reduce ageing, affected cells will need to be removed, leaving behind those less affected.
4. To study this hypothesis, fruit flies were used. The team firstly had to find out within the organs which cells were the healthiest. The team identified a gene and named it *ahuzotl* or *azot* after an ancient story of an Aztec creature, which selectively targeted fishing boats in order to protect the population of fish in lakes. The *azot* gene selectively targets weaker cells, called loser cells, protecting the organs. This is because it is expressed only in that type of cell.
5. Two copies of the gene are found in each cell. In one experiment, the scientists generated an *azot* knockout fly. In these fruit flies, loser cells were not destroyed and formed over 20% of the tissue within 72 hours.
6. In another experiment, the scientists inserted a third copy of the *azot* gene into the cells. This helped to destroy the weaker cells and seemed to result in the organs becoming healthier and slowed down ageing. The median lifespan rose to 55% longer than for normal fruit flies. The results show that *azot* is necessary to accelerate loser cell death.
7. Richard Kalish, a psychologist who investigated the possible social effects of life extension technologies, believes a longer lifespan may change views on marriage. For example, a married couple in their 60s who are in a loveless marriage might decide to stay together for the remaining years of their lives out of inertia or familiarity. If that same couple knew they might have to suffer each other's company for another 60 or 80 years, their choice might be different.
8. Furthermore, if life extension also increases a woman's period of fertility, siblings could be born 40 or 50 years apart. Such a large age difference would radically change the way siblings, or parents and their children, interact.
9. People aged 60 and above have different needs from younger individuals. They work less and offer less input to the economy. The necessity for healthcare increases and, in many countries, elders rely hugely on pensions for their income.
10. Some benefits of longer living include that since we have a higher life expectancy, time for study is longer. This means there is more time to learn and to produce. This will have benefits for the economy as people will become more experienced as they gain more knowledge throughout their longer lifespan. Society benefits from increased life expectancy too. When people have more leisure time, depression and stress are reduced, people's health is improved, and hence people feel more satisfied.

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11. The idea of genetically engineering people to have extra azot genes, as was done with fruit flies, raises issues with many religious people and others.
 12. Also, there are no results to show it would work on humans. It has been tested on other animals but not humans. Some may feel it could be unethical to test it on humans.
 13. Some other suggestions for anti-ageing strategies have been studied. The painkiller, ibuprofen, has been found to increase lifespan in yeast and some insects. In all cases the treatment increased the average lifespan by 15%, equivalent to around 12 years if applied to humans.
 14. Work in Spain showed that the lifespan of a mouse could be extended by a single treatment acting directly on the animal's genes. The researchers treated mice with a modified virus. The viral genes were replaced by those of a telomerase enzyme, which has a key role in ageing. When the mouse was infected with this modified virus, the telomerase gene was deposited in the mouse cells. The enzyme, telomerase, made from this gene, repairs the tips of chromosomes known as telomeres. At the age of one, treated mice lived longer, on average, by 24%, and those treated at the age of two, by 13%.



P 5 0 7 4 8 A 0 9 1 6

(a) The problem identified in this report is that of trying to extend the human lifespan.
Give the main solution suggested and **one** alternative solution.

(1)

Main solution

Alternative solution

(b) A visit or issue report should contain visuals.

In the space below, produce a visual that shows the following information about the percentage increase in lifespan:

- fruit flies with an extra azot gene (paragraph 6)
- yeast and insects given ibuprofen (paragraph 13)
- one- and two-year-old mice given telomerase treatment (paragraph 14).

Give your visual a suitable title.

(4)

Title

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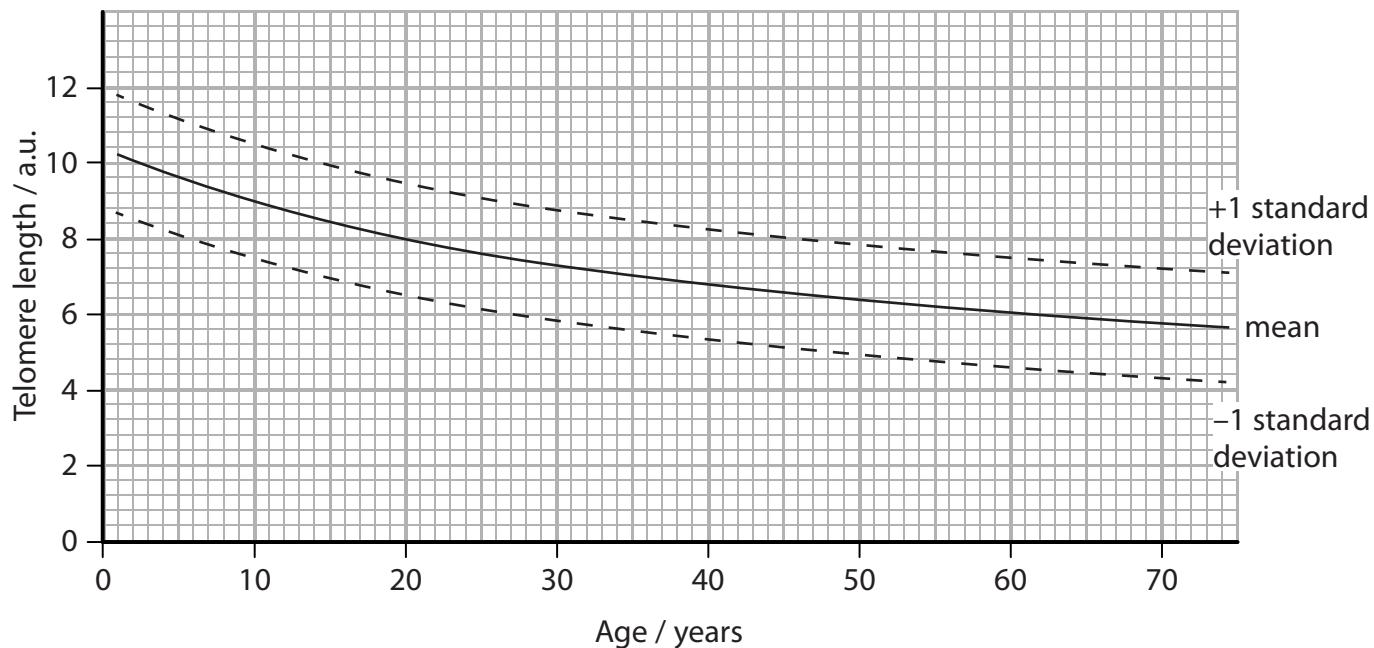
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(c) The student also found some information about telomere length and age in humans, shown in the graph below.



(i) Using the graph, find the mean telomere length of a person aged 22 years.

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(ii) Use the graph to find the age range of this person if the standard deviation is taken into account.

Explain how you reached your answer.

(3)

Age range

Explanation

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(d) The student found the graph in part (c) in a peer-reviewed paper.

(i) Explain what is meant by the phrase peer-reviewed paper.

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(ii) The student's bibliography contained the following reference to this paper.

Genetics in Medicine published in 2010 Volume 12 pages 753–764. The genetics and clinical manifestations of telomere biology disorders, by Sharon A Savage and Alison A Bertuch.

Rewrite this reference in the standard format.

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(e) A visit or issue report should contain some ethical, social, economic or environmental implications.

(i) List **three** social implications of the research described in this extract.

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(ii) Discuss the ethical implications of research into anti-ageing.

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS



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