Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

Advanced Subsidiary

Unit 3: Practical Biology and Research Skills

Monday 25 January 2016 – Morning
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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PEARSON

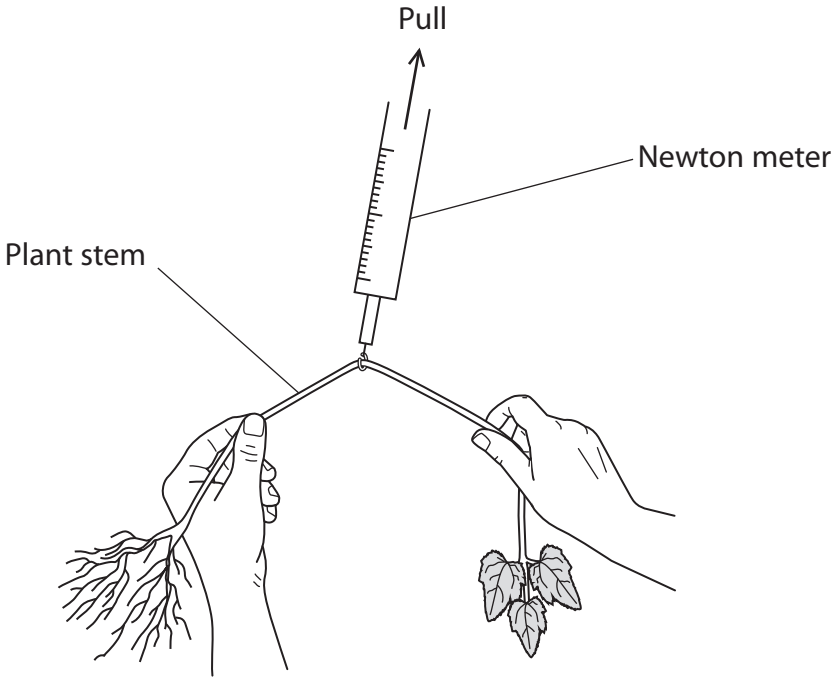
Answer ALL questions.

1 Plants living in rivers and lakes experience pulling forces from water currents and waves. These forces may damage or destroy the plants and it is important to know what forces they can withstand.

Scientists investigated the force needed to break a plant stem. This force is called the breaking strength.

In one series of experiments, they investigated the relationship between the cross-sectional area of stems and the forces needed to break them.

These forces were measured with a newton meter, as shown in the diagram below. The meter was pulled until each stem broke and the forces were recorded.



(a) (i) Name the dependent variable in this experiment.

(1)

(ii) Assuming that the stem is circular, suggest how stem cross-sectional area could be determined accurately.

(2)

(iii) The stems were collected from various lakes and taken back to the laboratory.

Suggest how these stems should be pre-treated before the experiment.

(2)

(iv) Name **one** environmental variable that should be controlled **during** this experiment.

Describe how this variable could be controlled.

(2)

Variable

How controlled

(v) Identify **three** health and safety risks for this experiment.

Explain how each risk could be minimised.

(3)

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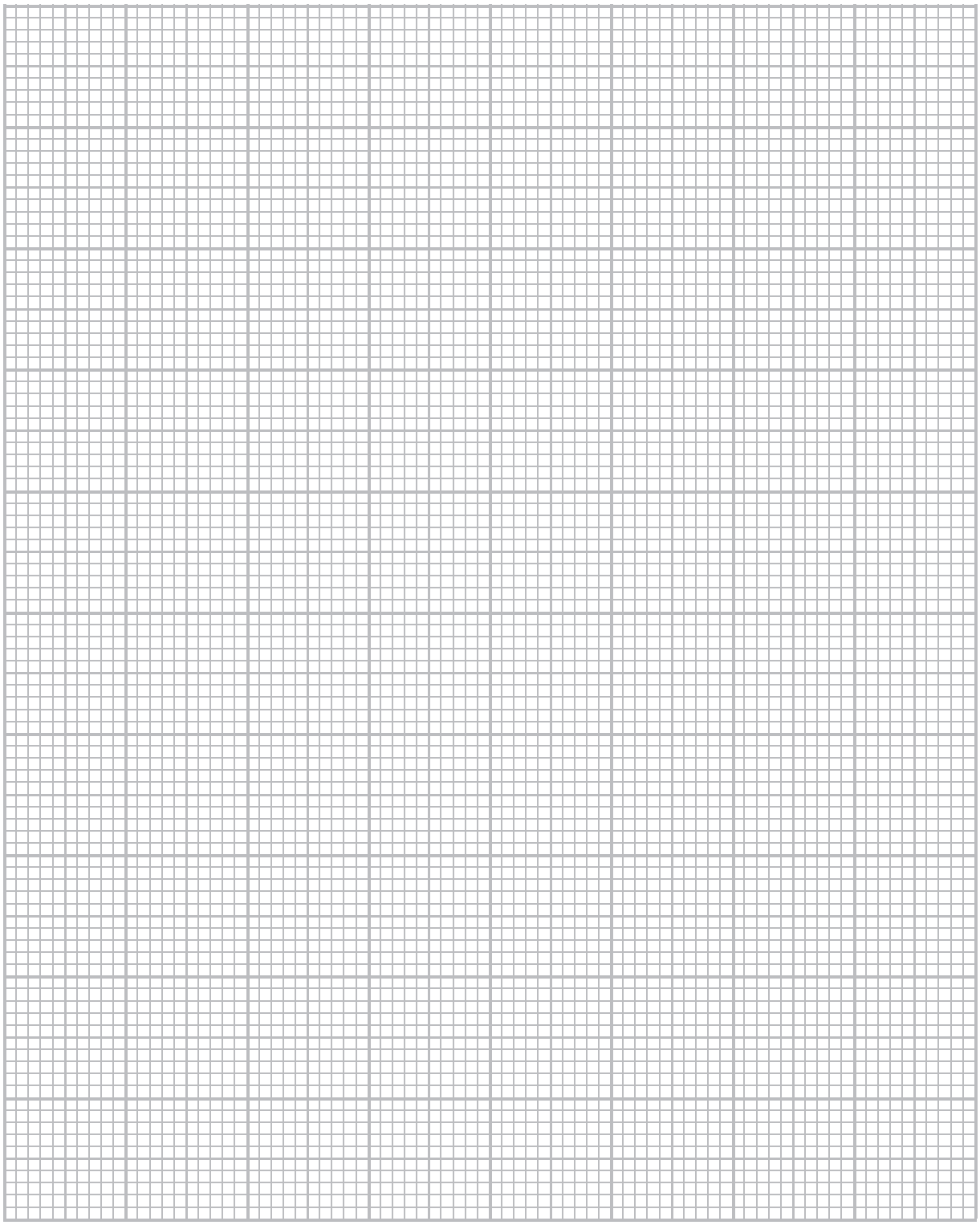
(b) One experiment was carried out using Canadian pondweed, *Elodea canadensis.*

The results of this experiment are shown in the table below.

Cross-sectional area of stem / $m^2 \times 10^{-6}$	**Mean breaking strength / N**	**Standard deviation**
0.4	2.5	0.4
0.7	3.9	0.2
0.9	5.2	0.1
1.5	8.0	0.3
2.0	10.9	0.5
2.5	13.1	0.4

(i) Plot the means and the standard deviations, in a suitable graphical form, on the axes provided below. Draw a line of best fit.

(4)



(ii) What conclusion can be drawn from these results?

(1)

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(iii) With reference to the standard deviations, comment on the validity of this conclusion.

(2)

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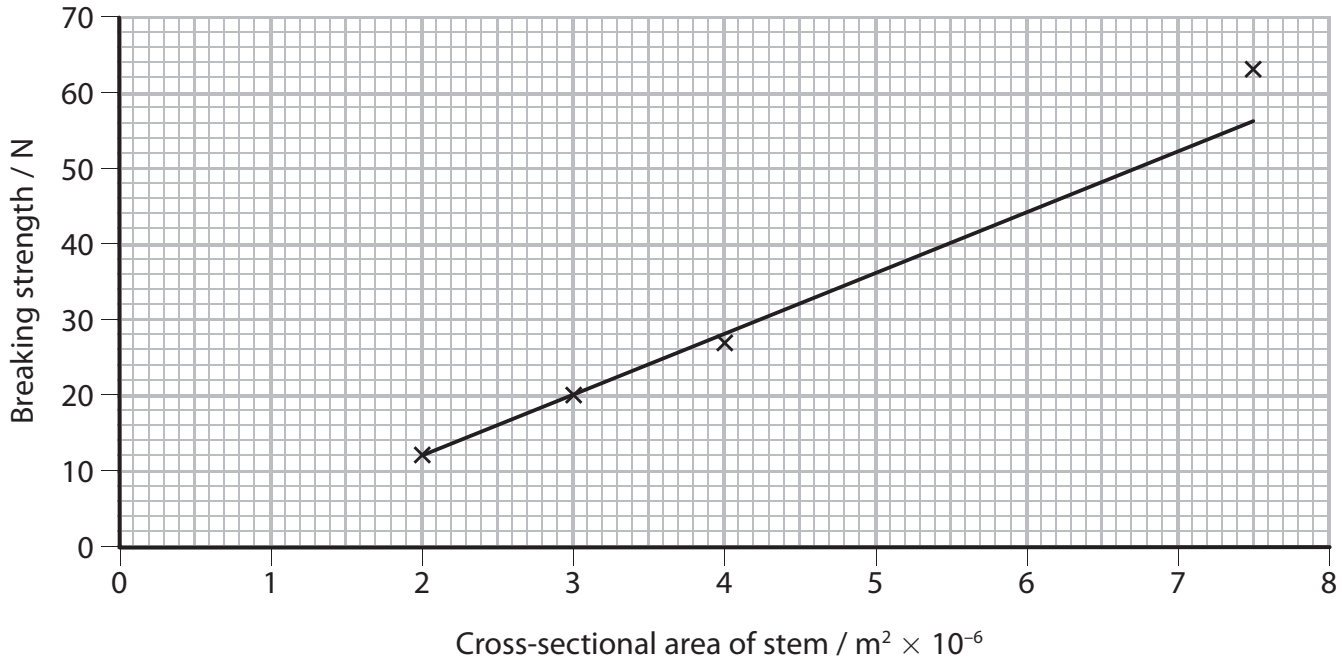
(c) In another experiment, the scientists used stems of bladderwort, *Utricularia vulgaris*. The graph below shows the results of this experiment.



Compare the results shown in these two experiments.

(3)

(Total for Question 1 = 20 marks)

2 Read the following extract from a student's unfinished draft report on the topic of the correct use of contact lenses.

1. Contact lenses correct poor vision. They are a lightweight, almost undetectable alternative to glasses. It is estimated that 125 million people use contact lenses worldwide.

2. However, users face the risk of infections from bacteria and fungi that stick to the lens surface causing severe damage, even blindness. The most commonly used lenses are daily-use disposable lenses that are fresh and sterile each day. Another type are longer-use lenses that require the daily use of disinfectant solutions. Both produce waste, people often exceed the recommended wear time of daily-use lenses and the disinfection method can become tedious.

3. A study in 1997 showed that, of the 141 new lens wearers who had participated, by the end of the study, 70% of the lenses were contaminated by bacteria, fungi, yeasts or amoebae.

4. This report proposes a method that would reduce dependency on disinfectants and develop safer lenses that prevent the accumulation of pathogens.

5. The eye uses several defence mechanisms to protect against harmful infections by microbes. Blinking dislodges bacteria, constantly flushing fresh tear fluid across the eye surface. Unfortunately, soft contact lenses reduce the effect of this process, trapping a stagnant pool of tear fluid underneath the lens. This stops the wiping action of the eyelids and provides an ideal environment for harmful organisms such as *Acanthamoeba,* which may lead to microbial keratitis. This painful condition occurs when the cornea becomes inflamed.

6. Soft contact lenses become coated in deposits, called biofilm. Without this biofilm the bacteria would not be able to attach, build up and cause problems.

7. Protein immobilisation is the attachment of bioactive proteins to surfaces and can be used to make anti-fouling lenses. However, a single protein, suitable for immobilisation on lens surfaces, has not yet been identified. It is likely that there would have to be a variety of such proteins across the lens to deal with the huge variations in proteins sticking to the surface.

8. It is possible that, whilst the use of the proposed techniques are plausible for surface treatment of contact lenses in the future, there may be more appropriate solutions on offer (see below).

9. The wearing of contact lenses would become less tedious and time-consuming. The need for clumsy, fiddly packaging would be reduced. The lenses could consequently be kept in longer; the expense may be reduced, having repercussions on quality of life. Those who have been forced to wear the more heavyweight and conspicuous glasses to avoid infection may be relieved. New jobs may even be created. The reduced use of cleaning fluids and daily lenses may reduce waste.

10. However, the proteins may lead to the possibility of worse optical quality. People become overly relaxed in the care of their lenses. Side effects remain unknown at this stage.

11. There may be a reduced burden on healthcare services from infections due to contact lenses. Consumers could spend less money on cleaning fluids. If the life of each lens is extended, new ones can be bought less often. However, there may be higher initial costs from the more complex production process.

12. The introduction of immobilised proteins on the lens results in poorer quality, defeating the point of the lenses in the first place. There is a possibility that not all the surface is treated and therefore any areas without antimicrobial resistance may increase the risk of infection.

13. In the very delicate environment of the eye it is likely that a foreign body or change in pH could cause severe damage and inflammation. As with the drug trialling process, treated lenses need to go through processes to ensure they are safe to use.

14. Polyethylene glycol (PEG) is a repellent substance known to reduce the attractive forces between surfaces and proteins. It is non-toxic and optically transparent. Fimbrolides are substances that inhibit the signalling mechanisms between bacteria in a colony. In a study, Fimbrolide coated lenses reduced the adhesion of bacteria by between 67 and 92% and for *Acanthamoeba,* 70%.

(a) A visit or issue report requires a problem to be identified.

Identify the problem described in this extract.

(1)

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(b) This unfinished report needs some data, presented in the form of tables or graphs.

The student found the following paragraph in a research paper:

The causative agent for keratitis was identified in 265 patients. Bacteria accounted for 166 cases, Acanthamoeba *for 95 cases and fungi for 4 cases.*

(i) Calculate the percentage of cases of keratitis caused by each group of pathogens.

Present this information in the form of a suitable table.

(3)

(ii) The paragraph was found in a paper called "Contact lens-associated microbial keratitis" by Aline Silvera Moriyama and Anna Louise Hofling-Lima.

It was published in 2008, in a journal called *Arquivos Brasileiros de Oftalmologia*. The volume number was 71, and the pages were 32 to 36.

Write a reference to this paper, in a suitable format, for the bibliography.

(3)

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(c) Advice is given to wearers of contact lenses on the correct way to use them. The student found the table below about the risk of developing keratitis, if the advice is ignored.

The advice given to lens wearers	Risk of developing keratitis if the advice is ignored
always use correct cleaning fluid	2.1
wash hands before touching lenses	4.5
do not wear lenses whilst sleeping	4.0
replace lenses correctly	4.7
rinse lenses before use	3.6
clean lenses case regularly	4.0

Using the information in the table, state **two** ways in which wearers of contact lenses can minimise their risk of developing keratitis.

(2)

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(d) These reports are expected to identify economic implications of the issue being researched.

State **three** economic implications described in this report.

(3)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(e) (i) Using information from the report, explain why alternative solutions to protein immobilisation (Paragraph 7) might be needed.

(3)

(ii) State the main solution to the problem addressed in the report.

(1)

(iii) Describe **two** alternative solutions to the problem mentioned in the report.

(2)

(f) Explain **one** benefit to the environment identified in this report.

(2)

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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