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

Wednesday 6 May 2015 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
WBI03/01

You must have:
Ruler, Calculator, HB pencil

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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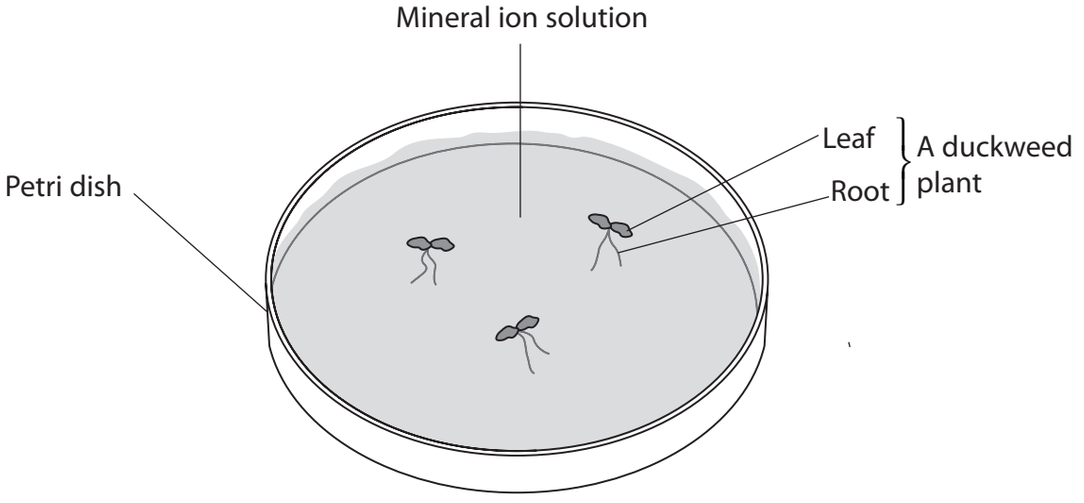
Answer ALL questions.

1 Duckweed (*Lemna* sp.) is a small plant that floats on the surface of water. Duckweed can be used to remove minerals from polluted water.

The plant uses water and carbon dioxide to make carbohydrates in photosynthesis.

To make other chemicals it needs a variety of mineral ions.

The plants grow mainly by vegetative reproduction. Each adult plant produces daughter plants.



A single plant was placed in a Petri dish containing 20 cm^3 of deionised water.

Another plant was placed in a Petri dish containing 20 cm^3 of a solution with all mineral ions present.

This procedure was repeated for a further seven Petri dishes containing solutions with one mineral ion missing. These are shown in the table below.

Mineral ion missing
calcium
iron
potassium
magnesium
nitrate
phosphate
sulfate

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

(1)

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(ii) Suggest **two** variables that should be kept constant in this investigation and describe how each variable could be controlled.

(4)

Variable.....

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Variable.....

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(iii) Explain why deionised water and the solution containing all the mineral ions are included in this investigation.

(2)

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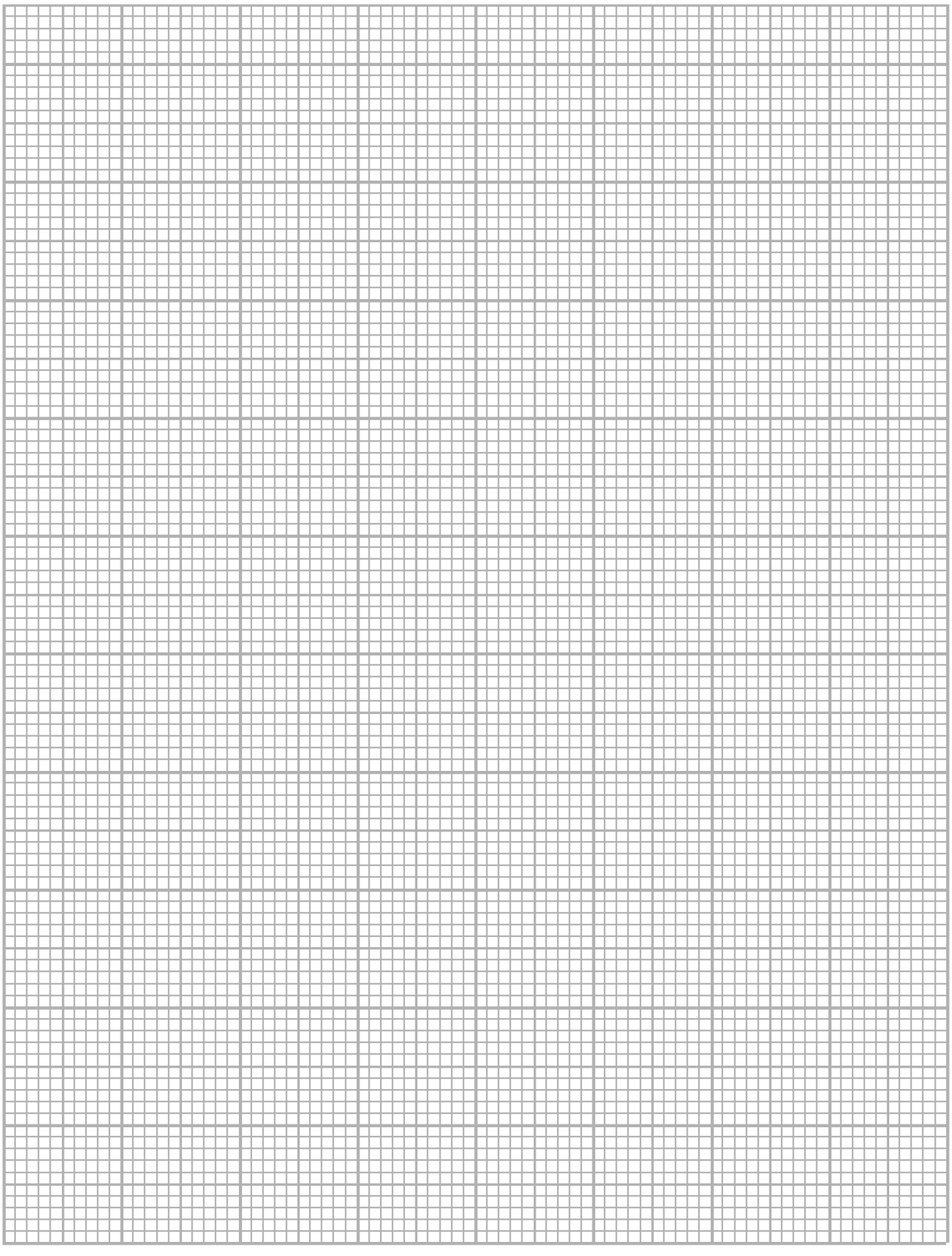
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(b) The number of plants was counted over a two-week period and the results are shown in the table below.

Petri dish containing	Number of plants					
	day 1	**day 4**	**day 7**	**day 9**	**day 11**	**day 14**
a solution with all mineral ions	3	8	11	15	19	37
no calcium	3	10	10	10	10	10
no iron	3	7	14	16	23	35
no potassium	3	5	7	8	15	24
no magnesium	3	5	6	6	10	12
no nitrate	3	4	4	4	4	5
no phosphate	3	5	5	5	7	14
no sulfate	3	6	9	12	19	27
deionised water	3	4	0	0	0	0

(i) Plot the data for the solution containing all the mineral ions and the solution with no magnesium ions in a suitable graphical form to allow a comparison to be made.

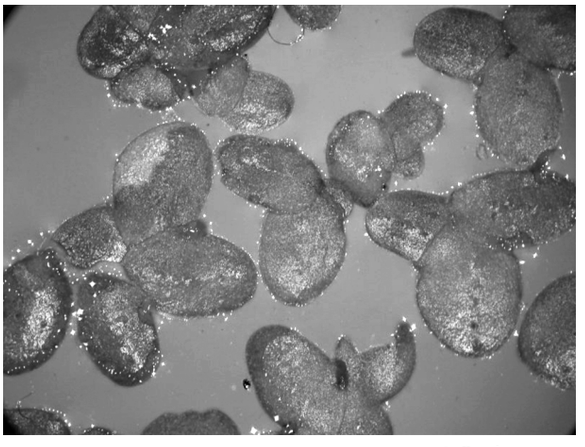
(4)



(ii) Suggest how the method for this investigation could be modified so that the reliability of the data could be shown on the graph.

(3)

(c) The photograph below shows duckweed plants in one of the Petri dishes on day 14.



© Barbarossa

Magnification ×2

(i) Using the information in the photograph, suggest why counting plants will give an inaccurate result for the growth rate of duckweed.

(1)

(ii) Suggest an alternative method for measuring the growth rate of duckweed.

(2)

(d) Duckweed is grown as a source of food for farmed fish. Fish farmers need advice on the best conditions for duckweed growth.

(i) Using the data in the table, state which of the mineral ions has the greatest effect on the growth of the duckweed.

(1)

(ii) Explain why this mineral ion has an effect on the growth of the duckweed.

(2)

(Total for Question 1 = 20 marks)

2 Read the following extract from a student's unfinished visit or issue report on the topic of the giant panda.

1. The giant panda (*Ailuropoda melanoleucal)* is now in decline and there are only about 1 600 giant pandas alive in their natural habitat. However, there are 239 pandas that live in captivity, 27 of them outside China. Of these, 18 are on lease from China, the rest have been bred abroad. There are several reasons why pandas are now classed as endangered; humans have some part to play in this but most of it is to do with natural factors such as poor habitat size and low reproductive rates.

2. Giant pandas struggle to find mates in their natural habitat as they live in a fragmented environment where they are confined to a certain area, this results in limited movement leaving the pandas isolated. It is vital for them to find mates from a wide gene pool to maintain genetic variation throughout the wild population. Because they are often confined to a small area, pandas mate with others from their own family tree, which is very bad as they have a poor genetic make-up. If this were the case for all pandas, it would take only one disease to wipe out the entire wild population due to a poor genetic make-up.

3. Giant pandas have very low reproductive rates and a very short breeding season. Another problem the panda faces with breeding is that they take six years – longer than most other animals – to grow into mature adults that can reproduce. Pandas are also very fussy about choosing their mates.

4. Another obstacle for pandas to overcome is bamboo, their main source of food. Shortages across their habitat are common. Bamboo is the most important plant in a giant panda's life. In cold and rainy bamboo forests high in the mountains of western China, they spend at least 12 hours a day eating. Bamboo is low in nutrients and pandas eat as much as 84 pounds (38 kilograms) of it each day. However, shortages can occur which can have devastating effects on the panda population as they could potentially wipe out the whole of their main food source in that area; this would result in most pandas in that area dying from starvation/ malnutrition.

5. When bamboo plants reach maturity, they flower and produce seeds, and then the mature plant dies. The seeds grow slowly into plants large enough for pandas to eat. Giant pandas can eat 25 different types of bamboo, but they usually eat only the 4 or 5 kinds that grow in their home range. An unusual thing about bamboo is that all of the plants of one species growing in an area will bloom and die at the same time. If the bamboo plants die out, pandas move to another area full of bamboo. Unfortunately, pandas now struggle to do this as humans have taken up much of their habitat and divided it in to several small areas across China.

6. The giant panda is in decline due to the destruction and separation of its habitat. Destruction of the panda's natural habitat is now the major threat to its survival. In the 11 years from 1973 to 1984, suitable panda habitat shrunk by 50 per cent in the six areas where pandas live. Human activity – logging, animal grazing, and agriculture – is the major source of habitat destruction.

7. There are methods to help boost populations, the main one being artificial insemination. Male panda sperm is inserted into the female panda artificially.

8. Semen is collected from the male by the use of electro ejaculation. The probe is inserted via the rectum and placed over the glands of the male's reproductive tract. A brief electrical stimulus is applied several times to induce ejaculation. In the giant panda a rectal probe has been used in successful semen collections. The average collection time is around nine minutes. To reduce stress on the animal during the procedure, and also to increase the safety of the procedure, the male is always anaesthetised during the process. Next the panda's semen is inserted into the female panda so that her egg is fertilised.

9. The target number of pandas to be bred in captivity was 300 and, as of 2010, this has been achieved. The slow process of releasing pandas back in to the wild can begin. The release process has to be done slowly so as not to overpopulate the pandas' habitat.

10. There are some problems with this breeding solution. The semen used to fertilise female pandas may come from only a few males. This creates very low genetic variation, which can lead to the pandas inbreeding in their natural habitat. This puts future generations at risk from mass wipe out due to various diseases as they all carry some of the same genetic make-up, thus having the same susceptibility to disease/viruses.

11. Due to the use of artificial insemination, pandas may have never bred naturally with another panda. So, when released in to the wild they may have no real idea how to reproduce naturally. This would be a problem as pandas would be in the same situation as they are in at the moment; not able to breed and boost their own population to a sustainable level without human intervention.

12. The use of artificial insemination to breed more pandas can be seen as an advantage to China's economy. China leases each panda for 10 years at a price of $1 million per year. The government will keep funding the programme as long as money is coming in. This is also good publicity for China and its tourism; if people can't see a giant panda in their home country then they may go to China to see one.

13. Although the main solution to saving the giant panda at the moment is artificial insemination there are alternatives. One alternative is the use of cloning, which is where an organism is produced without sexual reproduction occurring. Taking an animal cell and inserting its DNA into an egg cell from a female make a cloned animal. However, there is a problem with cloning mammals at the moment, they often die soon after birth or suffer from various diseases in later life and die young.

(a) The report lacks data. The student found the following information in a published paper about the quality of habitats for pandas.

Between 1965 and 1997 the area of high quality habitat decreased from 14 250 hectares to around 11 500 hectares. The biggest decrease was between 1975 and 1997 when high quality habitat was reduced from 14 000 hectares to 11 500 hectares. Over the same dates the amount of unsuitable habitat rose from 116 000 hectares to 126 000 and then 134 000 hectares.

(i) Make a sketch to show how the data for high quality habitat could be compared with the data for unsuitable habitat.

(3)

(ii) State the number of the paragraph in the report where this sketch would support the information given and explain why.

(2)

Paragraph number.....

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(b) 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 this extract identifies.

(1)

(ii) Describe the main solution and **one** alternative solution that are discussed in the extract.

(4)

(iii) Suggest the risks to giant panda populations of the use of these solutions.

(4)

(c) This report has made reference to the economic benefits to China of leasing pandas to foreign countries.

Using the information in the report, calculate how much China will make from leasing pandas over a 10-year period. Assume the number of pandas in captivity remains the same.

Show your working.

(3)

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(d) When checking the student's bibliography his teacher noticed a reference to a paper by Andreas Kontoleon and Timothy Swanson. This paper was published in a journal called *Land Economics*.

What further information would the student need to write a full and complete reference?

(3)

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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