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 8 May 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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Pearson

Answer ALL questions.

1 A class of students did not see many dividing cells (or stages of mitosis) when they examined root tip squash preparations.

Their teacher suggested this might have been because of the time of day that the samples were taken.

Some of the students decided to test the idea that time of day affects the number of cells dividing.

The students used the following method:

- day 1 at 0900 – pea seeds put into a container of moist sawdust.
- day 3 at 0900 – root tips were taken from five randomly chosen germinating seeds.
- day 3 at 0900 – root tips squashes were prepared and observed.
- this was repeated on day 3 every two hours.
- on each occasion, the total number of cells showing evidence of mitosis was recorded for each root tip.

(a) (i) Name a suitable stain for observing chromosomes in a root tip squash.

(1)

.....

(ii) There are variables that could affect the number of dividing cells.

Give **two** variables that would need to be controlled. Describe how each variable could be controlled.

(4)

Variable 1 .....

How it could be controlled .....

.....

.....

Variable 2 .....

How it could be controlled .....

.....

.....

(iii) Explain why five root tips were chosen for each sample.

(2)

(iv) Describe how a random sample of five root tips could have been chosen.

(2)

(b) For each sample of five root tips, the mean number of dividing cells was calculated.

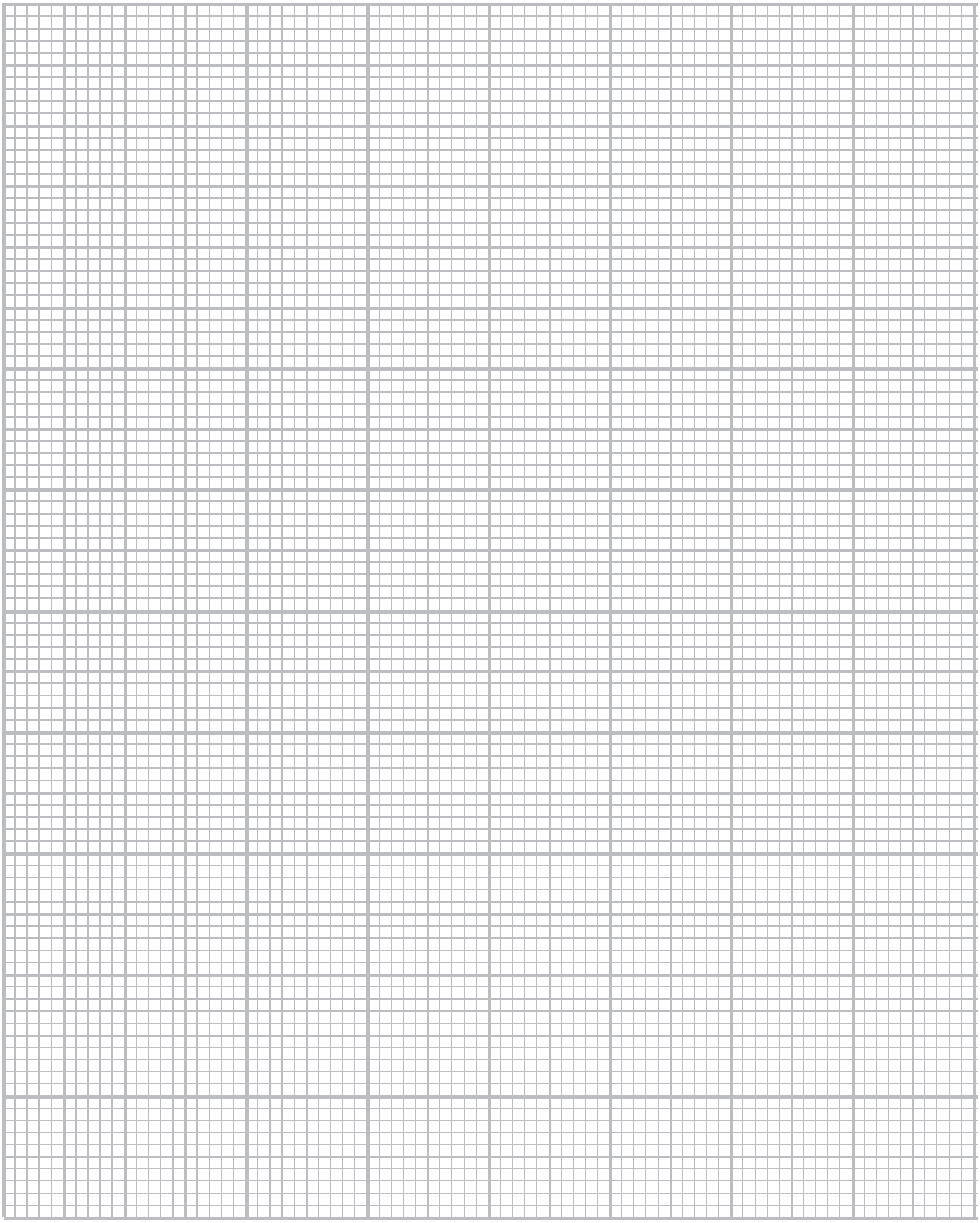
The table below shows the results.

Time of day (24-hour clock)	Mean number of dividing cells
0900	259
1100	139
1300	341
1500	267
1700	397
1900	368
2100	237
2300	271
0100	295
0300	301
0500	381
0700	305

(i) Plot a line graph using the data in the table.

Join the points with ruled straight lines.

(4)



(ii) A second set of pea seeds was germinated, starting at 1400 instead of 0900.

These seeds were treated in the same way as the first set.

The maximum numbers of dividing cells in this second set were observed at 1800 and 2200 on the first day and at 1000 on the next day.

Using these two sets of data, the students made the following conclusion:

"The number of dividing cells does not depend on the time of day but it does depend on the length of time after germination started."

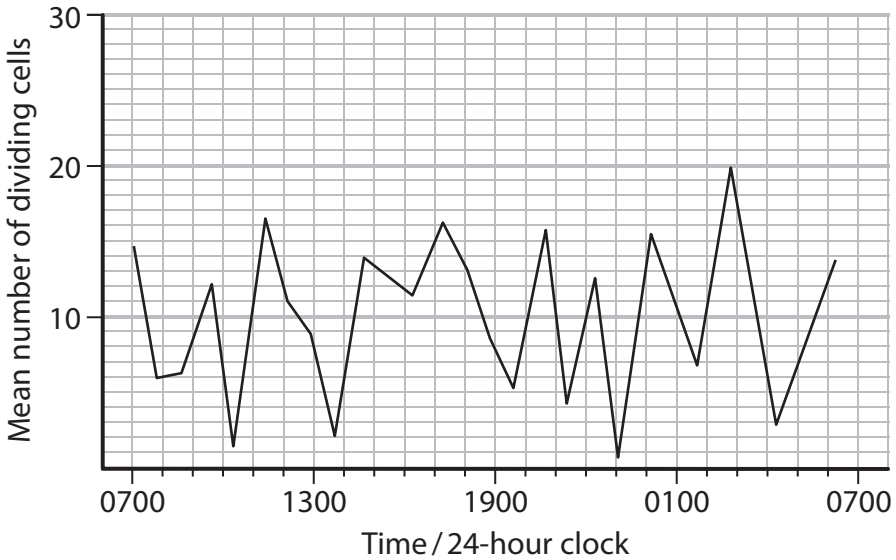
Explain how these two sets of data support this conclusion.

(4)

(c) To check the validity of their study, the students looked for information in the literature about patterns of cell division in other plants.

They found the graph below in a peer-reviewed journal.

The graph shows the effect of time of day on cell division in the shoot tips of a species of grass.



Compare these results with the results for cell division in germinating pea seeds.

(3)

(Total for Question 1 = 20 marks)

2 Read the following account from a student's draft visit or issue report on mercury poisoning.

1. Mercury poisoning is caused by the intake of the heavy metal mercury. An example of this is Minamata disease, which is caused by severe mercury poisoning. It was first discovered in Minamata city in Japan in 1956 in a five-year-old girl who had difficulty walking and speaking. More people began showing similar symptoms and it was reported as an "epidemic of an unknown disease of the central nervous system".

2. It was found that the fish these families were eating were contaminated with mercury in the water and therefore passing the mercury poisoning onto the people.

3. Many different symptoms of the disease are due to nerve damage.
Some people may have numbness in their limbs, difficulty speaking and walking, tremors, uncontrollable shouting and sometimes brain damage. In extreme cases, paralysis, coma and even death could occur. Of the 1422 patients suffering from Minamata disease, 378 had died by the end of 1980. The first death from Minamata disease was in 1972. Babies were born with severe deformities, blindness, mental problems and deafness.

4. Mercury was released into the water from the Chisso Corporation's chemical factory. Nothing was done about the polluted water for a long time, the factory continuing to release chemicals until 1968. This contaminated many generations of fish.

5. Chelation therapy is usually used to treat heavy metal poisoning. A chelating agent works by binding to the heavy metals, making them physiologically inactive. They are then excreted in urine. Several chelating agents are available for different types of treatment. One of these is DMSA, a man-made amino acid. Chelation therapy has been the standard treatment used in the UK and the USA.

6. Chelating agents can be swallowed or injected into the muscle or put into a vein via a drip. Using a drip is the most common method. Although this can cause infection, it is otherwise safe. When swallowed, only about 5% of the chelating agent is absorbed into the blood stream so it is not very effective. Some chelating agent pills can be taken at home. To make them safe, these pills have a very low dosage of the chelating agent. However, they are not very effective and are not appropriate for treating emergency heavy metal poisoning. One advantage of a lower dosage is that there are fewer side effects.

7. In 1998, a family of 9 children all suffered from mercury poisoning caused by mercury vapour from a neighbour's business. The children all underwent chelation therapy and the excretion of mercury in their urine was measured every 24 hours after treatment. The average mercury excreted before treatment was 214.3 μg per g of urine. Once treatment was started, the concentration of mercury increased, showing more mercury was being excreted from the kidneys. On day 5, the average mercury excreted was 668.5 μg per g of urine. The children were given 30 mg per kg per day of DMSA for 5 days. The children were then discharged and continued to receive home treatment of 20 mg per kg per day. After 261 days, the level of mercury had reduced in all the children and was now below the accepted limit published by the World Health Organisation (50 μg per g of urine). No side effects were noted.

8. Chelation therapy can also help to repair damage from the toxic mercury. The earlier chelation therapy is performed, the more effective it is. The longer the mercury is in the blood, the more damage it does to the body and the harder it becomes to reverse the damage. Another benefit of chelation therapy is the cost of the treatment. It is about a third of the cost of surgery.

9. Side effects of chelation therapy include: a burning sensation in the vein at the site of delivery, fever, headaches, nausea, vomiting, convulsions, hypotension and cardiac arrhythmias. These side effects will not usually cause any permanent damage. Mineral deficiency can also be caused; this can be treated with supplements. The main concern of chelation therapy is the risk of kidney failure. If this occurs, it can result in a lifetime of dialysis treatment, or even death.

10. As chelation therapy carries a risk of kidney failure, it could be seen as unethical to treat somebody with it. Some people may not want to take the treatment because of this risk. If the patient did experience kidney failure, this would have a serious impact on their lives and all the people around them.

11. In 2007, an experiment on rats showed that if there was a low level of metal in the rat, the treatment could lead to lasting brain damage. In a person, this could affect their learning ability and behaviour. The use of chelation therapy could have social implications.

12. Surgery can sometimes repair damaged nerves caused by mercury poisoning. One type of surgery is called peripheral nerve reconstruction. This is reconstruction of the nerve so that it can function again. Another type of surgery is nerve grafting. This is used to repair large gaps in the peripheral nerves. It is done by taking segments of the nerves from another part of the body, or using 'man-made nerves' that are inserted. It can take a long time for the nerve to heal after surgery. Some nerves never repair fully so sensation is weakened. Sometimes the surgery will not be successful and the nerve will not repair at all. Regeneration takes up to 12 months. If surgery is not performed in the first 6 months of nerve damage, the chances of recovery are reduced.

(a) The problem identified in this report is mercury poisoning.

Explain why mercury poisoning is a problem.

(3)

(b) To include a visual, the student obtained all the data from the study in paragraph 7.

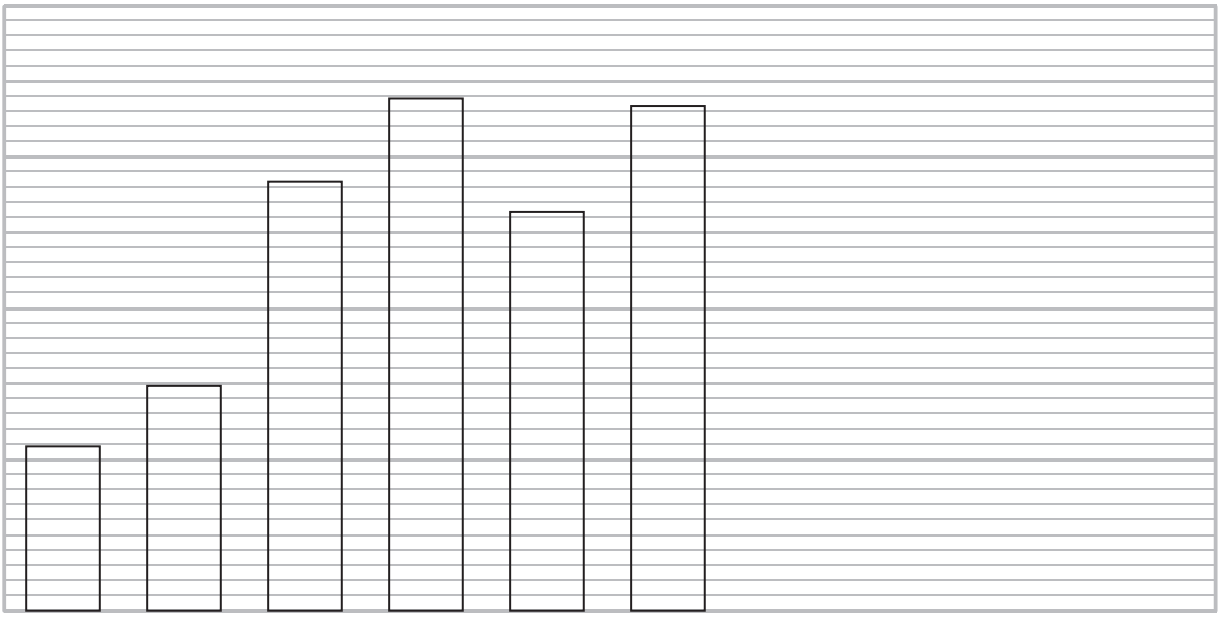
These are shown in the table below.

Days from start of treatment	Mean mercury excretion of the 9 children / µg per g urine
0	214.3
1	304.6
2	571.8
3	683.9
4	527.5
5	668.5
54	102.0
261	27.0

(i) Use the information in the table to complete the graph below.

On the graph, draw and label a line to show the World Health Organisation's accepted limit for mercury in the urine (paragraph 7).

(4)



(ii) Give a suitable title for this graph.

(1)

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(c) The data for this visual came from a paper in a journal called *Environmental Health Perspectives*.

The student's notebook contained the following information about it:

"Ref 11 was in a paper called A Cluster of Pediatric Metallic Mercury Exposure Cases Treated with DMSA in a journal called Environmental Health Perspectives it was VOL 108 part 6 and publ. in 2000. Joel Forman and Jacqueline Moline"

(i) State the piece of information that is needed to complete this reference.

(1)

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(ii) Write as full a reference to this paper as possible, to include in a bibliography.

(4)

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(d) State **four** side effects of chelation therapy.

(2)

1 .....

2 .....

3 .....

4 .....

(e) Describe **one** possible social implication of using chelating agents in cases of mercury poisoning.

(2)

(f) Identify **one** alternative solution to the problem of mercury poisoning.

Compare this solution with chelation therapy.

(3)

(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS