Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **11** printed pages and **1** blank page.

Cambridge Assessment International Education

1 One method of testing a person's reaction time is to use an online, computer click timer test. Some students carried out a test using the method described.

- Each student looks at a computer screen and clicks a **start** button on the screen and waits for the background colour to change.
- As soon as the background colour changes the student clicks a **stop** button on the screen.
- The reaction time appears on the screen.

A student in the class thought that boys had a faster reaction time than girls.

A group of students from the class decided to repeat the test to investigate the hypothesis:

Boys have a faster reaction time than girls.

(a) (i) Identify the independent variable **and** the dependent variable in this investigation.

independent .....

dependent ..... [2]

(ii) State the type of qualitative variable which best describes the independent variable.

..... [1]

(iii) Describe a method the students could use to collect the data needed to test their hypothesis.

Your method should be set out in a logical order and be detailed enough for another person to follow.

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(iv) Suggest **one** feature of the online test which may be a source of error.

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..... [1]

Another group of students decided to test the hypothesis:

Right-handed people have a faster reaction time with their right hand than with their left hand.

Table 1.1 shows their results.

Table 1.1

student	reaction time using right hand / s	reaction time using left hand / s
A	0.26	0.28
B	0.23	0.23
C	0.22	0.25
D	0.25	0.22
E	0.26	0.27
F	0.24	0.24
G	0.28	0.26
H	0.25	0.30
I	0.21	0.25
J	0.26	0.29
K	0.27	0.31
mean	**0.25**	**0.26**
mode	**0.26**	
median		**0.26**

(b) Complete Table 1.1 to show the mode and median values. [1]

(c) **(i)** The students decided to carry out a *t*-test to find out if the difference in reaction time was significant.

State why a *t*-test is suitable for these data.

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..... [1]

(ii) State a null hypothesis for this test.

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..... [1]

(iii) State the number of degrees of freedom for this *t*-test.

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..... [1]

Table 1.2 shows the probability values of *t*.

Table 1.2

degrees of freedom	10	12	14	16	18	20	22	24	26	28	30	40	50	60
probability 0.05	2.23	2.18	2.14	2.12	2.10	2.09	2.07	2.06	2.06	2.05	2.04	2.02	2.01	2.00

(iv) The students concluded that the difference in reaction time was **not** significantly different.

State what this tells you about their calculated value of *t*.

.....

..... [1]

[Turn over

One student noticed that the more repetitions of the online test that were carried out, the faster the reaction time. The student decided to carry out a different test to investigate the effect of repetition and feedback on the accuracy of carrying out a task.

Three students each carried out a task which involved drawing straight lines, without using a ruler, on sheets of paper.

The three students did the task in separate rooms.

- Each student drew 20 straight lines, as close as possible to 7.5 cm long, on separate pieces of paper.
- The teacher measured all the lines and recorded the lengths to the nearest 0.1 cm in a table.
- The teacher gave feedback to each student by telling them the actual length of line 20.
- Each student then drew another 20 lines which were measured by the teacher and recorded in the table.

Table 1.3 shows the data that the teacher recorded.

Table 1.3

line	length of measured line before feedback / cm				length of measured line after feedback / cm		
	student 1	student 2	student 3		student 1	student 2	student 3
1	7.2	5.0	7.3		7.9	7.5	5.2
2	7.5	4.3	7.4		7.0	7.2	5.2
3	7.4	4.0	7.7		7.5	7.7	5.2
4	7.5	3.9	7.9		7.3	7.6	4.9
5	8.0	4.2	8.2		7.0	7.3	6.3
6	7.5	4.3	8.8		7.2	7.7	6.5
7	7.5	4.0	8.8		7.0	7.4	6.3
8	7.2	4.0	9.5		7.2	8.0	6.2
9	7.1	4.4	9.3		7.0	7.6	6.2
10	7.4	3.8	9.0		7.1	7.2	5.7
11	7.2	7.9	9.3		7.0	7.5	6.7
12	7.4	4.0	8.8		7.0	6.8	6.6
13	7.5	4.2	9.7		7.6	7.2	6.6
14	7.5	4.0	9.7		8.0	7.6	6.6
15	7.4	4.2	10.0		8.0	7.4	6.4
16	6.5	4.1	10.0		8.2	7.4	6.6
17	6.7	4.4	9.6		7.9	7.0	6.5
18	6.8	4.0	9.8		8.5	7.5	6.2
19	7.9	4.2	9.7		7.8	7.7	6.9
20	7.5	4.0	10.2		7.5	7.6	6.1
mean ± *s*	**7.3 ± 0.36**	**4.2 ± 0.26**	**9.0 ± 0.90**		**7.5 ± 0.47**	**7.4 ± 0.27**	**6.1 ± 0.59**

(d) When one of the students was drawing one of their lines, a person entered the room and distracted them. It was decided this result was anomalous.

(i) Indicate, by drawing a circle on Table 1.3, the length which is an anomalous result. [1]

(ii) Suggest what the students should do with the anomalous result.

.....

..... [1]

(iii) Identify the student who drew lines that were most **inconsistent** in length **and** give a reason for your choice.

student .....

reason ..... [1]

(iv) The student concluded that receiving feedback on performance leads to an improvement in accuracy.

State **one** way in which the data support the conclusion **and** one way in which it does not.

supports .....

.....

.....

does not support .....

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[2]

[Total: 20]

2 For many years, farmers have used artificial insemination (AI) as a method to improve the milk yield of dairy cattle.

In cattle, sperm cells carrying the X chromosome contain 3.8% more DNA than the sperm cells carrying the Y chromosome. Female cattle have the sex chromosomes XX.

Assisted reproduction programmes allow dairy farmers to increase the number of female offspring produced.

One technique used to identify which sex chromosome a sperm cell contains is centrifugation.

Some semen samples were collected from male cattle.

- 10 cm^3 samples of semen were placed in centrifuge tubes with 15 cm^3 of a buffer solution added to each tube.
- The tubes were placed in a centrifuge and left to spin for 20 minutes at 1275 revolutions per minute.
- The spinning causes the sperm cells containing the X chromosome to fall to the bottom of the tubes. The sperm cells containing the Y chromosome remain in the fluid at the top.

Semen samples which have been processed in this way are referred to as sexed samples.

(a) (i) State **three** variables which were standardised in this technique.

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..... [3]

(ii) Suggest **one** reason why it is important that the semen sample is **not** spun at a very high speed.

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..... [1]

Another method of sexing semen samples is to use a technique called flow cytometry as shown in Fig. 2.1.

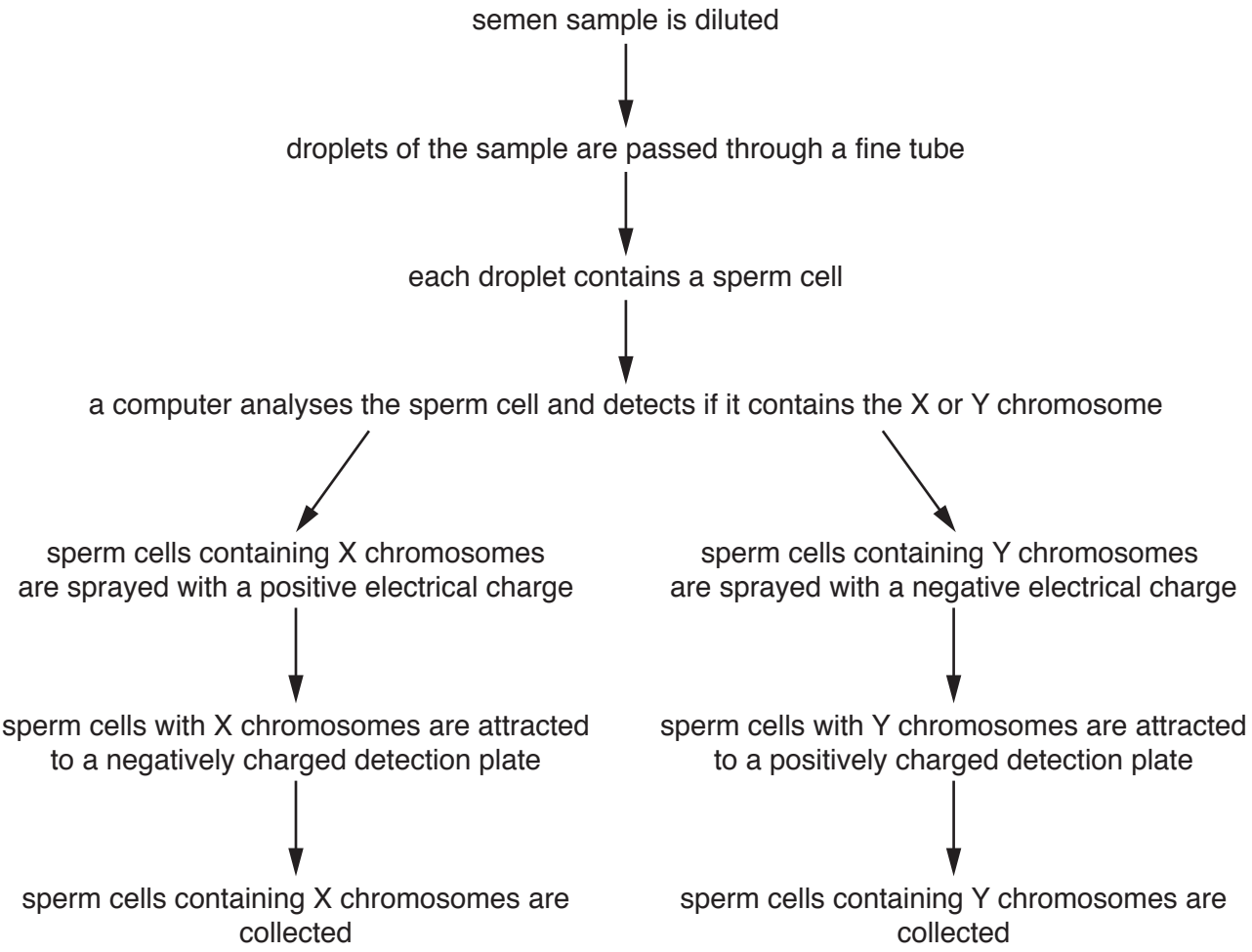

Fig. 2.1

The samples containing X chromosomes are frozen in small plastic straws, allowing semen samples to be stored for many years and transported all over the world.

- Flow cytometry can process 8000 sperm cells every second.
- One straw can hold 2.0×10^6 sperm cells.

(b) Calculate how many straws can be filled every hour by flow cytometry.

Number of straws filled every hour = ... [1]

The semen is analysed by technicians to determine its quality before it is sexed.

Technicians use microscopy to look at the appearance and motility of the sperm cells and to estimate the sperm count.

Fig. 2.2 shows the surface view of a haemocytometer used to estimate the number of sperm cells in a sample.

The depth of the haemocytometer is 0.1 mm.

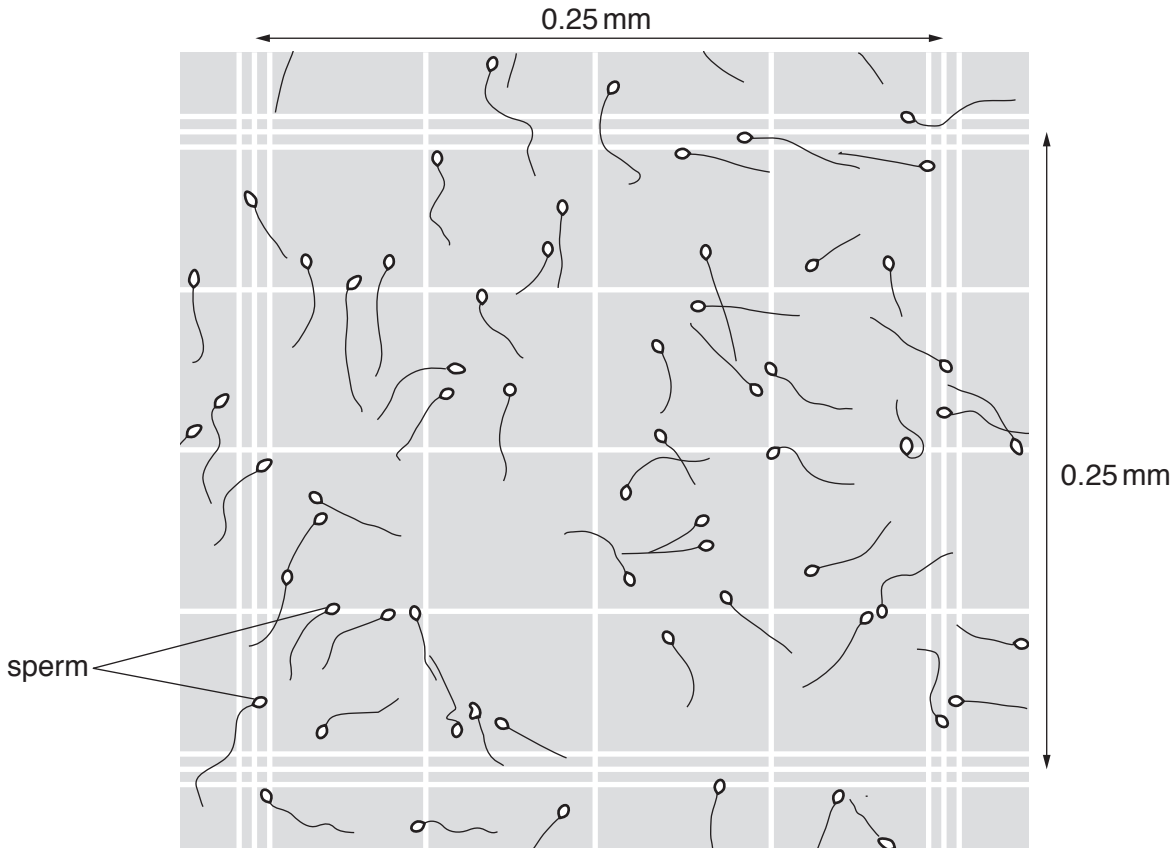

Fig. 2.2

(c) Suggest how this apparatus could be used to estimate the number of sperm cells per cm^3 of semen **and** describe how the technician decided which sperm cells to include in the count.

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..... [5]

[Total: 10]

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