Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5737241125

BIOLOGY **9700/51**

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.

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1 A group of six students carried out an experiment to determine their reaction times using a ruler.

Fig. 1.1 shows the basic procedure used for the experiment.

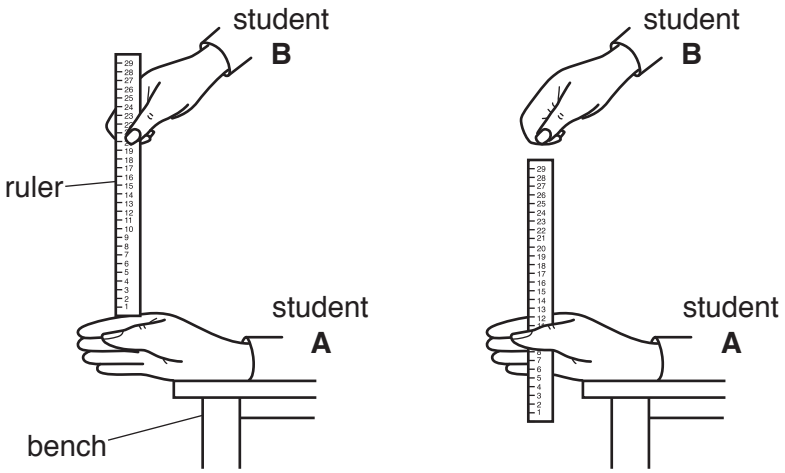


Fig. 1.1

The students worked in pairs.

- Student **A** rested their hand on a bench.
- Student **B** then dropped a ruler from a set height.
- Student **A** had to catch the ruler as quickly as possible.
- The distance the ruler had dropped was measured and recorded.
- The students calculated their reaction times.

The formula for calculating reaction time in seconds is shown in Fig. 1.2.

$$\text{reaction time} = \sqrt{\frac{2 \times D}{g}}$$

D = distance ruler had dropped in metres
$g = 9.8\,\text{m}\,\text{s}^{-2}$

Fig. 1.2

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Table 1.1 shows the results for the six students.

Table 1.1

student	distance ruler had dropped / m	reaction time / s
1	0.17	0.19
2	0.10	0.14
3	0.16	0.18
4	0.08	
5	0.16	0.18
6	0.35	0.27

(a) (i) Use the formula in Fig. 1.2 to complete Table 1.1. [1]

(ii) Predict what would happen to the reaction time if the ruler was held higher than the original set height.

.....

..... [1]

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[Turn over

There was some background noise in the classroom when the students carried out their experiment. The students thought that this noise might have affected their reaction times. They decided to modify their original experiment to find out if the presence or absence of background noise affects reaction time.

(b) (i) Identify the dependent variable in this investigation.

..... [1]

(ii) Using the procedure shown in Fig. 1.1, describe a method that the students could use to find out if the presence or absence of background noise affects reaction time.

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

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..... [7]

Fig. 1.3 shows some results for a reaction time test that the students found on the internet.

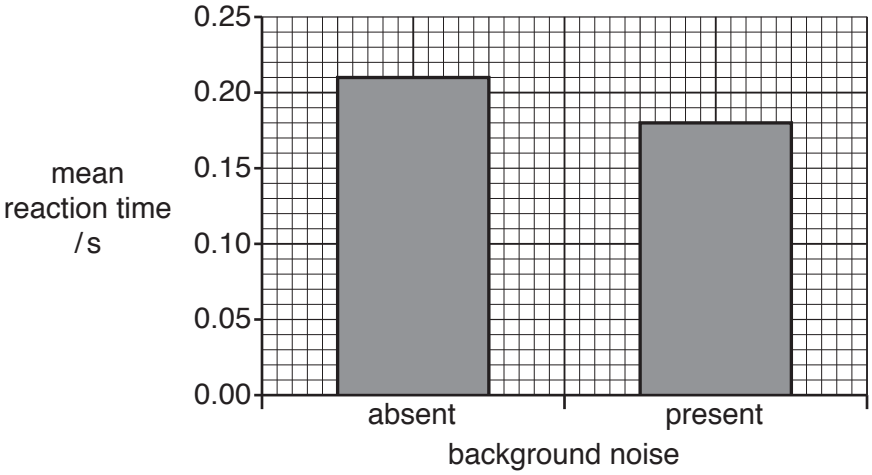


Fig. 1.3

(c) State why a bar chart is a suitable way to show the data.

.....

..... [1]

(d) **(i)** Suggest **one** conclusion the students could have made based on these results.

.....

..... [1]

(ii) 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.

.....

..... [1]

(iii) State a null hypothesis for this test.

.....

.....

.....

..... [1]

Table 1.2 shows some 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 used 16 degrees of freedom and calculated $t = 2.05$.

State **and** explain what the value of *t* indicates about the difference in mean reaction times shown in Fig. 1.3.

.....

.....

.....

..... [1]

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Another student, when carrying out the ruler experiment shown in Fig. 1.1, noticed that the more repetitions carried out, the faster the reaction time became.

The student decided to carry out a different experiment to investigate the effect of repetition on the accuracy of carrying out a task.

Five students, **V**, **W**, **X**, **Y** and **Z** were tested.

- Each student was given a picture of a star, as shown in Fig. 1.4.
- Each student sat at a desk so that the star was only visible in a mirror, as shown in Fig. 1.5.
- Each student was asked to draw between the double lines of the star when looking at it **only** in the mirror. Fig. 1.6 shows a star diagram completed by a student.
- The students recorded the number of times their lines went outside the double line of the star.

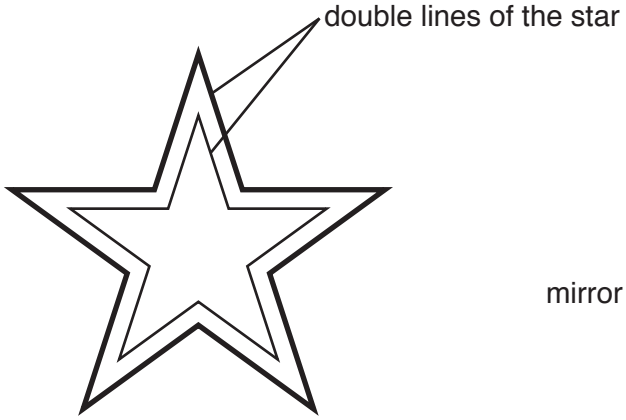


Fig. 1.4

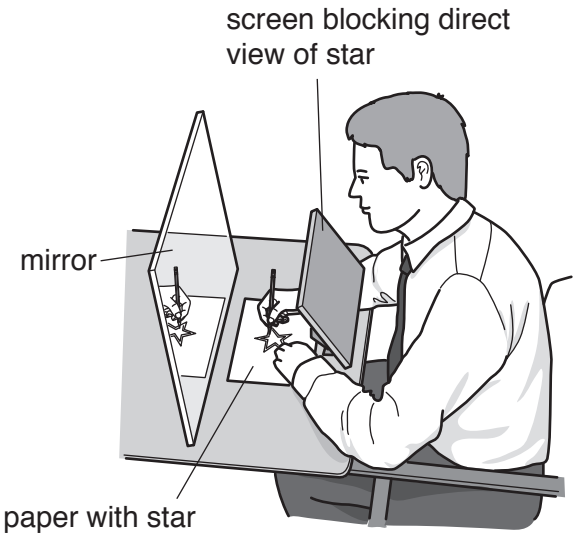


Fig. 1.5

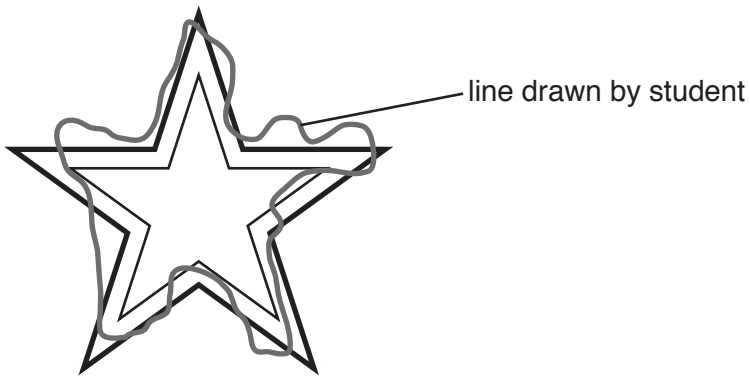


Fig. 1.6

Each student repeated the task nine times on the same day. The results are shown in Table 1.3.

Table 1.3

student	number of times the students' lines went outside the double lines of the star								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
V	48	48	46	44	42	40	41	41	41
W	45	42	43	40	38	35	36	35	35
X	38	37	34	32	31	30	28	28	28
Y	31	30	31	29	44	28	26	25	25
Z	41	40	38	37	35	35	33	33	32

(e) (i) Identify the independent variable in this experiment.

..... [1]

(ii) Suggest the hypothesis that was tested in this experiment.

.....

.....

..... [1]

(iii) A person walked into the room and started talking to one of the students who was carrying out the test.

Circle the result in Table 1.3 that was affected by this. [1]

(iv) One of the students had previously carried out a similar task.

Identify this student **and** give a reason for your answer.

student .....

reason .....

..... [1]

(f) State **two** conclusions based on the data in Table 1.3.

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..... [2]

[Total: 21]

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2 Artificial insemination (AI) is one method used in assisted reproduction programmes for large mammals.

For many years, horse breeders have collected semen samples from male horses and used these to inseminate female horses. Success rates have been good. However, due to the sample containing live sperm cells, the process needed to be carried out quickly.

New technologies exist to allow horse semen to be frozen in small plastic straws. Semen samples can now be stored for many years and transported all over the world.

- Each 0.5 cm^3 straw can hold 7.5×10^7 sperm cells.
- A typical sample of horse semen contains 7.5×10^9 sperm cells.

(a) (i) Calculate the volume of a typical horse semen sample.

..... cm^3 [1]

(ii) To inseminate one female horse, 5.0×10^8 sperm cells are needed.

Calculate the minimum number of straws needed to carry out this process.

minimum number = ... [1]

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[Turn over

The semen from a horse is analysed by technicians to determine its quality before the horse is accepted onto the assisted reproduction programme.

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

Fig. 2.1 shows the surface view of a haemocytometer used to estimate the number of sperm cells in a sample.
Each number represents a sperm cell which was counted in the sample.
Each star (*) represents a sperm cell **not** counted in the sample.

The depth of the haemocytometer is 0.1 mm.

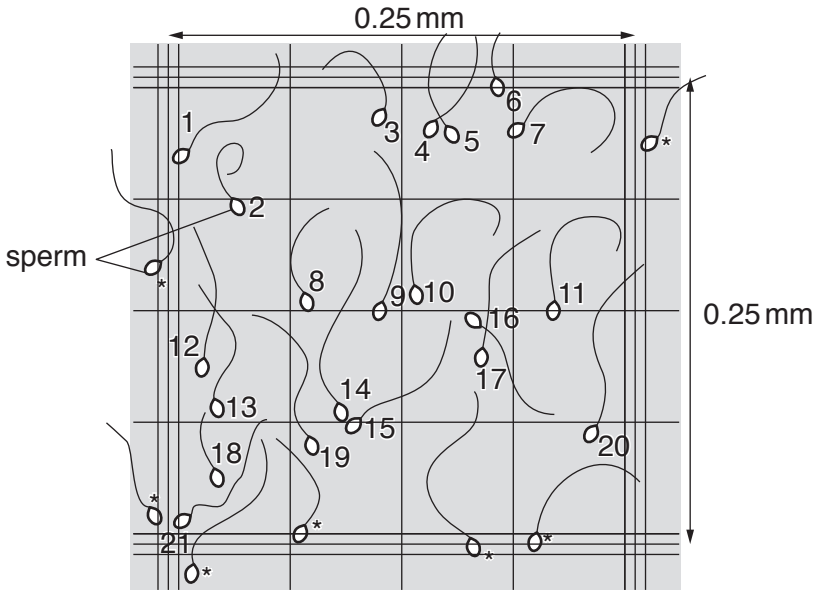


Fig. 2.1

(b) 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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..... [4]

(c) To ensure that the sperm cells remain viable after they have been frozen, a solution is added to the sample **before** freezing the semen in the straws.

The solution contains:

- a sugar
- a buffer to maintain pH
- antibiotics.

Explain why it is necessary for the solution to contain these three substances.

sugar .....

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buffer .....

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antibiotics .....

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[3]

[Total: 9]

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