UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0028818786

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2012**

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 ink.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.

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	
2	
Total	

This document consists of **7** printed pages and **1** blank page.

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1 Hybridisation is used by plant breeders to develop new varieties of crop and garden plants. A student investigated the ability of one species of grass, species **A**, to hybridise with two other species of grass, **B** and **C** by studying the chromosomes of the hybrids.

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The diploid number of chromosomes for each species was:

- species **A** 12
- species **B** 20
- species **C** 14

The main steps in the procedure used by the student are described below.

1. The undeveloped anthers of species **A** were removed from 40 immature flowers.
2. Each of the flowers (still attached to the plant) was placed inside a separate plastic bag.
3. When the flowers of species **A** were mature, pollen from species **B** was transferred onto the stigmas of 20 flowers of species **A**.
4. Step 3 was repeated, transferring pollen from species **C** to the stigmas of the other 20 flowers of species **A**.
5. Each of the flowers of species **A** was then replaced inside its plastic bag.
6. All the fruits formed by species **A** were collected and the embryo plants were removed.
7. The number of chromosomes in the cells of the embryo plants was counted.

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

independent variable .....

dependent variable ..... [2]

(ii) State the variable being controlled by the use of plastic bags.

.....

..... [1]

(b) (i) Suggest a method by which the student could have obtained and transferred the pollen from species **B** to species **A**.

.....

..... [1]

(ii) Identify **one** potential safety issue with the experimental method you have described.
State a suitable precaution.

.....

..... [1]

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(c) The fruits of the grass species used by the student are similar in structure to maize fruits.

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In steps 6 and 7 the student collected the fruits formed by species **A** in order to count the chromosomes in the cells of the embryos.

Suggest a procedure by which the student could:

- obtain cells of the embryo plant in which chromosomes would be present
- make the chromosomes visible so that they could be counted.

Outline the main stages of this procedure.

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.....[5]

(d) Table 1.1 shows the results that the student obtained from the investigation.

Table 1.1

number of chromosomes in the embryo plants	
hybrid of species **A** and species **B**	hybrid of species **A** and species **C**
16	26

Explain the results of the student's investigation as shown in Table 1.1.

.....

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.....[3]

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(e) In a second investigation, the student repeated the procedure to hybridise the grasses.

- The fruits were collected and 50 of each hybrid were planted.
- The number of fruits that germinated was counted.
- Pollen was collected from the flowers of the hybrid grass plants that grew from the fruits.
- The chromosomes were counted in a random sample of 30 pollen grains from each hybrid.

Table 1.2 shows the results of this investigation.

Table 1.2

number of fruits that germinated									
hybrids from the crosses between **A** and **B**					hybrids from the crosses between **A** and **C**				
35					46				
number of chromosomes in the pollen grains									
6	6	8	7	10	13	13	13	13	13
16	8	16	9	0	13	13	13	13	13
8	8	16	6	6	13	13	13	13	13
6	10	8	16	9	13	13	13	13	13
13	12	16	8	6	13	13	13	13	13
8	8	16	6	10	13	13	13	13	13

(i) The student also counted the number of chromosomes in the female gametes of each hybrid.

Predict the number of chromosomes you would expect the student to find in the female gametes of each hybrid.

hybrid from the cross **A** × **B** .....

hybrid from the cross **A** × **C** ..... [1]

The student concluded that hybrids from the cross of **A** × **C** could be bred successfully but hybrids from the cross of **A** × **B** could not be bred successfully.

(ii) State the evidence in Table 1.2 that supports this conclusion.

.....

.....

.....

..... [2]

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(f) The student carried out a further investigation to find out if the difference in the germination of the two hybrid grasses was significant. The student counted the number of fruits that germinated from eleven samples of 50 fruits of each hybrid.

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The student collated all the data in order to calculate the mean, mode and median of the fruit germination of both hybrids.

Table 1.3 shows the data.

Table 1.3

sample number	**number of fruits germinated**	
	hybrid **A** × **B**	hybrid **A** × **C**
1	30	41
2	31	42
3	32	44
4	32	45
5	34	45
6	34	46
7	34	47
8	35	48
9	36	48
10	38	49
11	37	48
mean	34	
mode	34	
median	34	

The student recorded the calculations for the hybrid from the cross of **A** × **B** in Table 1. 3.

(i) Complete Table 1.3 by writing in the values of the mean, mode and median for the hybrid from the cross of **A** × **C**. [2]

(ii) State a reason why the student used the *t*-test to find out if the difference in germination of the two hybrids was significant.

.....

.....[1]

(iii) State a null hypothesis for this test.

.....

.....[1]

(iv) State why the student used 20 degrees of freedom for this test.

.....

.....[1]

[Total: 21]

2 The effect of temperature on the permeability of cell membranes was investigated using discs of a plant tissue. When discs of this plant tissue were placed in water, chloride ions were released from the cell vacuoles.

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Discs of this plant tissue were placed in tubes of deionised water in water baths at different temperatures for 30 minutes as shown in Fig. 2.1.

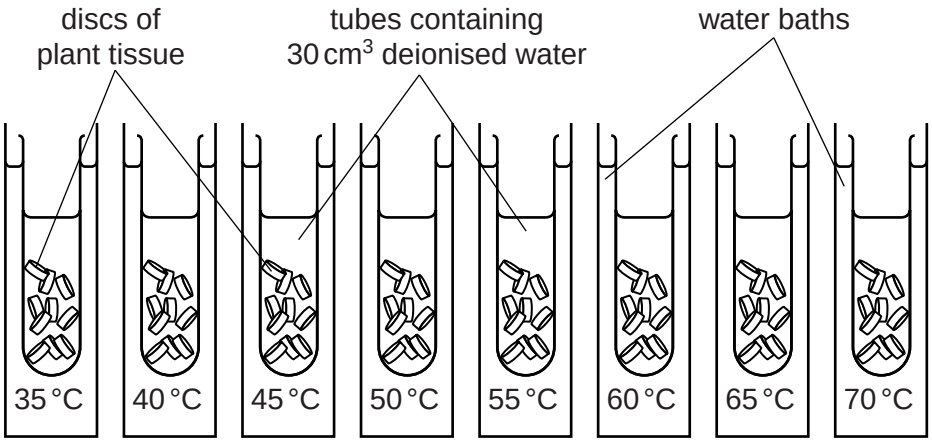


Fig. 2.1

The concentration of chloride ions in the water around the plant tissue was measured using an ion-sensitive electrode.

(a) (i) State how three different variables have been standardised in this investigation.

1. .....

.....

2. .....

.....

3. .....

.....[3]

(ii) Suggest how the reliability of the results could be improved.

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.....

.....[2]

(b) The results of this investigation are shown in Fig. 2.2.

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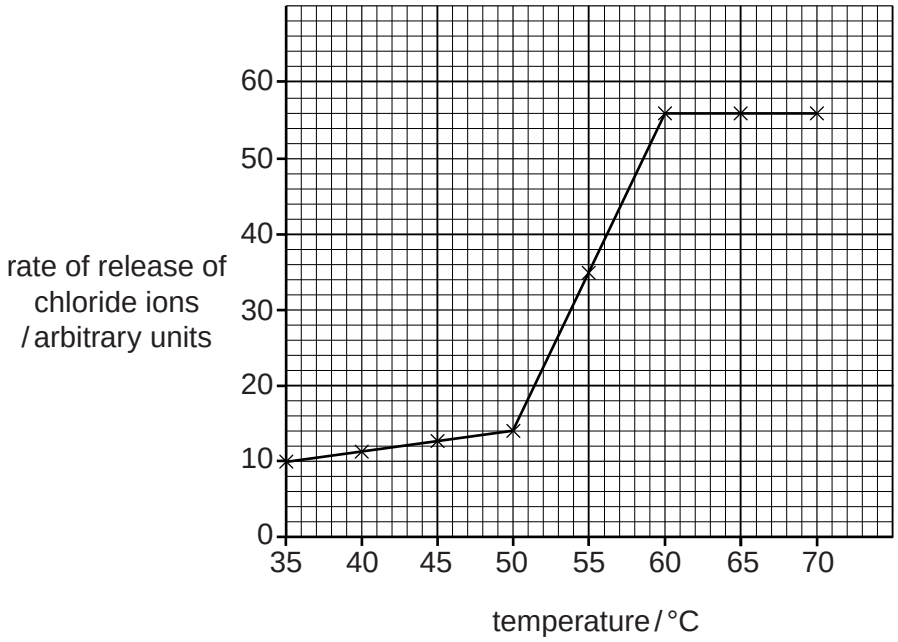


Fig. 2.2

(i) State how the rate of release of chloride ions is calculated for each temperature.

.....[1]

(ii) Calculate the relative increase in the rate of release of chloride ions between 50 °C and 60 °C.
Show your working.

.....[2]

(c) The investigation was repeated, but a solution of 70% ethanol was added to each tube instead of deionised water.

Predict the effect of using ethanol on the rate of release of chloride ions from the discs in all the tubes.

.....

.....[1]

[Total: 9]

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