Surname	Centre Number	Candidate Number
Other Names		2

GCE A LEVEL

1400U50-1E

S18-1400U50-1E

BIOLOGY – A2 unit 5
Practical Analysis Task

FRIDAY, 4 MAY 2018 – MORNING

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**20**	
2.	**10**	
Total	**30**	

1400U501E
01

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

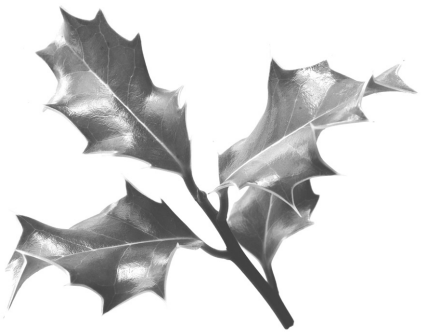
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
The maximum mark for this paper is 30.

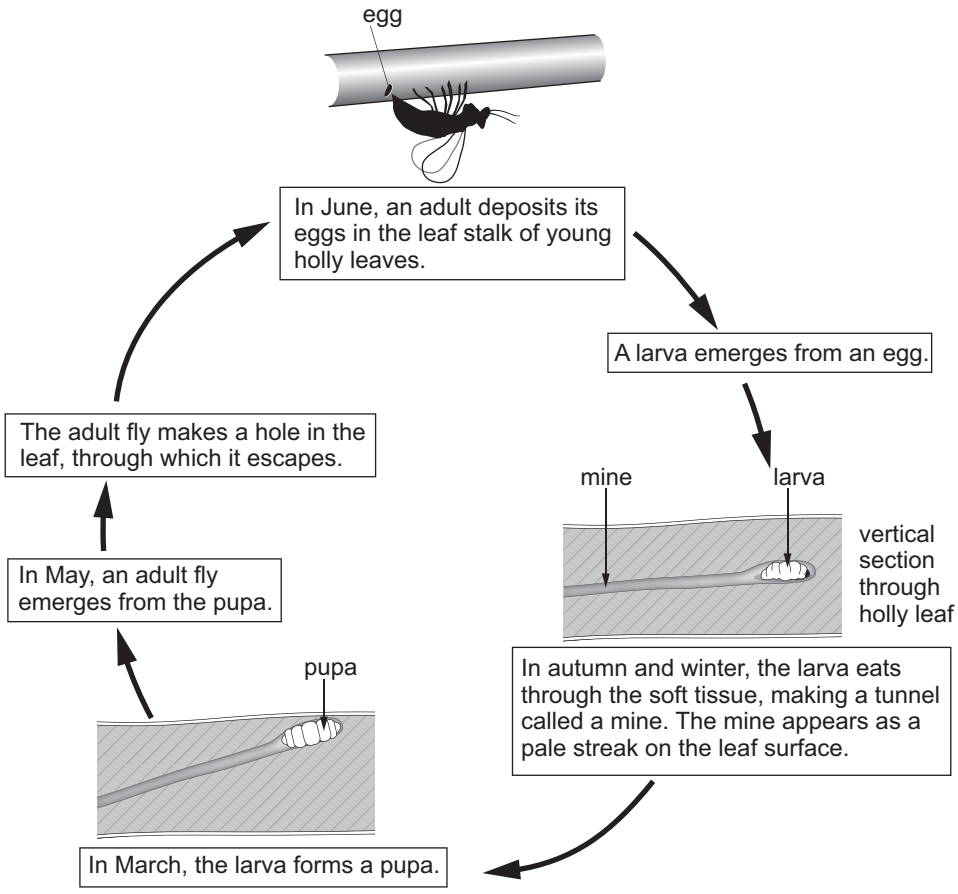
Answer **all** *questions.*

1. The European holly, *Ilex aquifolium*, is an evergreen tree. The image below shows isolated holly leaves, with their characteristic sharp, pointed spines. These leaves are approximately 40 mm long.



Holly leaves

Leaf miners are insects that lay their eggs inside leaves, including holly leaves. The holly leaf miner, *Phytomyza ilicis*, is common in several parts of central Wales. Its life cycle is depicted in the diagram below:



After a leaf miner egg is deposited one of the following events may happen:

- The leaf miner pupa forms in March and the new adult emerges in May through a circular hole at least 1 mm in diameter.
- Birds may make an irregular hole in the leaf, at least 2 mm in diameter, through which they remove the leaf miner larva and eat it.
- A parasitic wasp may lay its egg within the leaf miner larva. When this wasp egg hatches, the wasp larva kills the leaf miner. The wasp larva then pupates. Eventually, the adult wasp emerges from the leaf through a very small circular hole, less than 1 mm diameter.

In an investigation to determine if there is a stage of the life cycle at which most holly leaf miners die, affected holly leaves were collected from a single tree. The fate of individual leaf miners was determined using the key shown below.

1. Is there a hole in the leaf surface?

(a) No ..... Larva or pupa still inside

(b) Yes ..... Go to 2

2. Is the hole irregular?

(a) Yes ..... Larva eaten by a bird

(b) No ..... Go to 3

3. Is the hole diameter 1.0 mm or more?

(a) Yes ..... Adult fly has emerged

(b) No ..... Larva killed by a parasitic wasp

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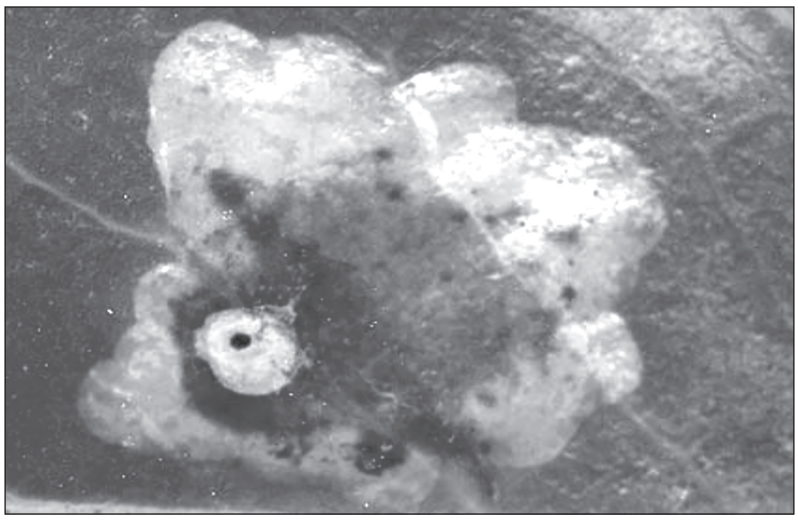
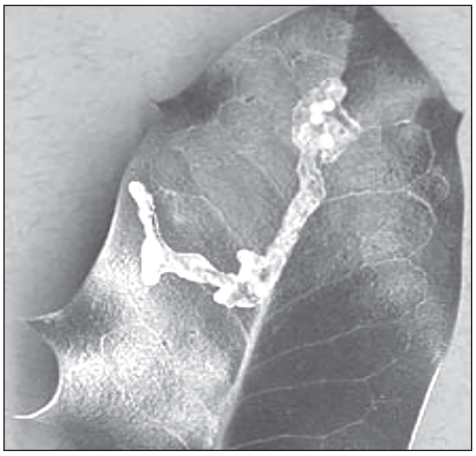
(a) Use the key to identify the fate of the holly leaf miners in the close-up photographs of mined holly leaves below. [2]

A



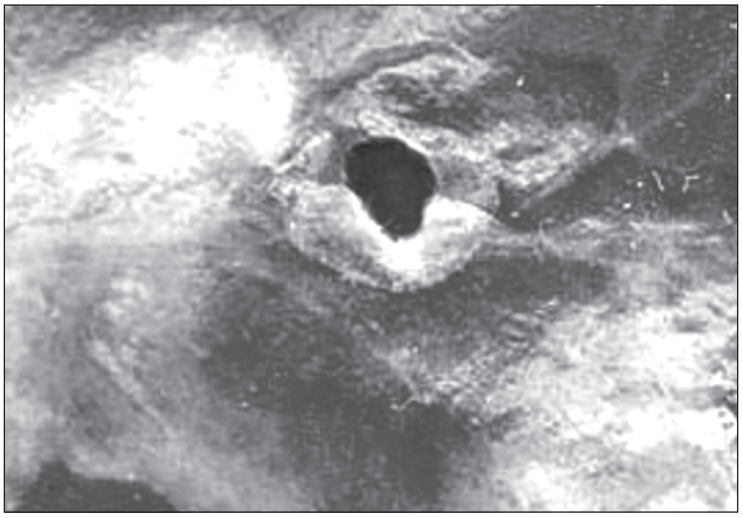
1 mm

B



1 mm

C



1 mm

A .....

B .....

C .....

Examiner only

(b) (i) Identify a risk factor in carrying out the investigation mentioned on page 4 and explain how you would take a precaution to reduce its harm. [2]

Risk factor .....

Precaution .....

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(ii) Holly leaves were collected from a single tree, rather than several trees; these leaves were genetically identical. Suggest **one** reason why this was important in the investigation. [1]

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(c) The null hypothesis for the investigation was that there is no significant difference between the proportions of holly leaf miner populations that die at each stage – as eggs, larvae or pupae. Of those that die, equal numbers are expected to die at each stage before becoming an adult.

The table below shows the observed and expected number of holly leaf miners at each life cycle stage, given that 39 out of 43 eggs did not survive to become adults.

Developmental stage	Number seen in stage	Observed number dying in stage (O)	Expected number dying in stage (E)	$(O - E)$	$(O - E)^2$	$\frac{(O - E)^2}{E}$
Egg	43	23	13	.....		.....
Larva	20	8	13	.....		.....
Pupa	12	8	13	.....		.....
Adult	4					

(i) **Complete the table above** by filling in the gaps, and calculate the value of χ^2 to two decimal places. [3]

$$\chi^2 = \sum \frac{(O - E)^2}{E} = \text{.....}$$

(ii) How many degrees of freedom should be considered when using the χ^2 test in this experiment? [1]

Number of degrees of freedom = ...

(iii) Use your calculations and the probability table opposite to conclude whether to accept or reject the null hypothesis, giving a reason for your answer. [4]

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Degrees of freedom	Probability (p)									
	0.90	**0.80**	**0.70**	**0.60**	**0.30**	**0.20**	**0.10**	**0.05**	**0.02**	**0.01**
1	0.03	0.06	0.15	0.46	1.07	1.64	2.71	3.84	5.41	6.64
2	0.21	0.45	0.71	1.39	2.41	3.22	4.61	5.99	7.82	9.21
3	0.58	1.01	1.42	2.37	3.67	4.64	6.25	7.82	9.84	11.34
4	1.61	2.34	3.00	4.35	6.06	7.29	9.24	11.07	13.39	15.09

(d) How could this investigation be made more valid? [3]

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(e) (i) In an experiment to compare the survival of holly leaf miners at different stages in two different parts of Wales, certain factors must be kept constant when leaves are collected from the two sites. State **two** environmental factors that can be kept constant when carrying out this experiment. [2]

Factor 1 .....

Factor 2 .....

(ii) More holly leaf miner eggs are deposited than survive to adulthood and individuals may die at any of the various stages in their life cycle. In a stable environment, this production of more offspring than can survive is a common strategy, used by both plants and animals. It is one of the many biotic and abiotic factors that keep the numbers in a population constant. Suggest **two** density-dependent factors that may give different results for the populations at the two different sites. [2]

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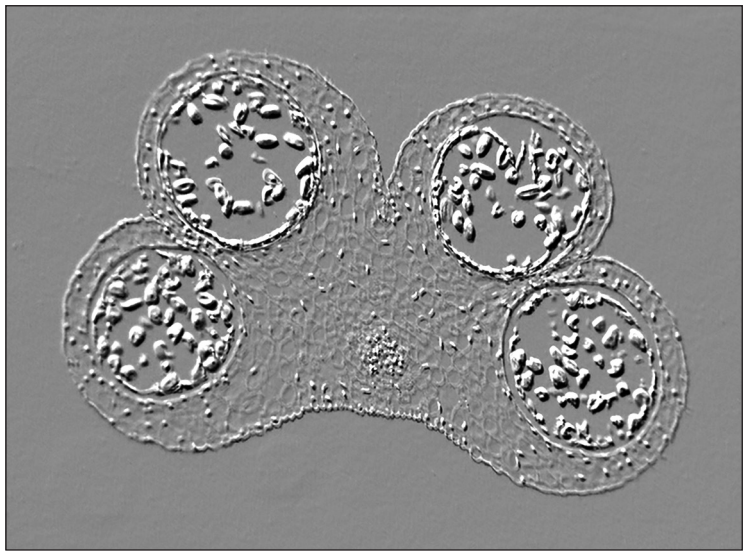
2. *Alstroemeria* is a member of the lily family. Its flowers are shown in the photograph below.

(a) The photomicrograph below shows a transverse section through a lily anther, viewed in a microscope that shows differences in the density of the material.



T.S. lily anther

On the photomicrograph, label clearly:

A. a pollen sac
B. the line of dehiscence
C. the vascular tissue [3]

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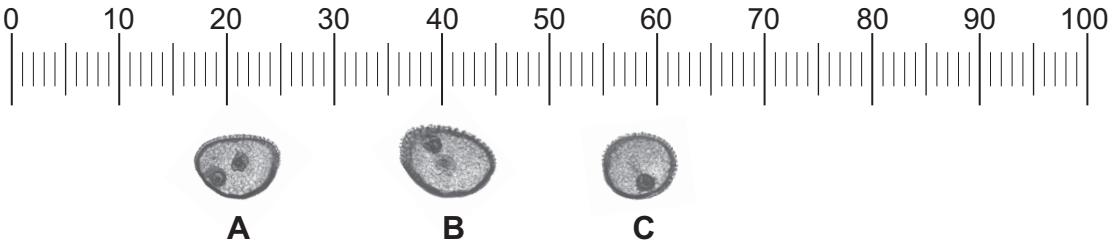
The photomicrographs below show three pollen grains of *Alstroemeria* as they appear under a x10 objective in a light microscope. The scale shows the graduations of the eyepiece graticule.



(b) (i) Using the image of the eyepiece graticule, measure the maximum diameter, in eyepiece units, of the pollen grains labelled **A**, **B**, and **C**, and calculate the mean diameter, to one decimal place. [2]

Mean diameter = ... e.p.u.

(ii) For the objective lens used to take this photomicrograph:
100 eyepiece units = 96 stage micrometer units
1 stage micrometer unit = 10 µm.

Calculate the length of **one** eyepiece unit, to an appropriate number of decimal places. [1]

Length of one eyepiece unit = ... µm

(iii) Use your answers to 2*(b)* (i) and 2*(b)* (ii) to calculate the actual mean diameter of the pollen grains, expressing your answer to a suitable number of decimal places. [1]

Actual mean diameter of pollen grain = ... µm

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(c) The photograph below shows flower heads of bread wheat, *Triticum aestivum*, a cereal grown widely around the world. The pollen grains of *Triticum aestivum* are much smaller than those of *Alstroemeria*, and have a diameter of about 20 µm.

(i) Suggest a suitable magnification of objective lens for observing *Triticum aestivum* pollen grains using a light microscope. [1]

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(ii) Using the information provided, suggest how *Triticum aestivum* flowers are pollinated. Explain your answer. [2]

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END OF PAPER