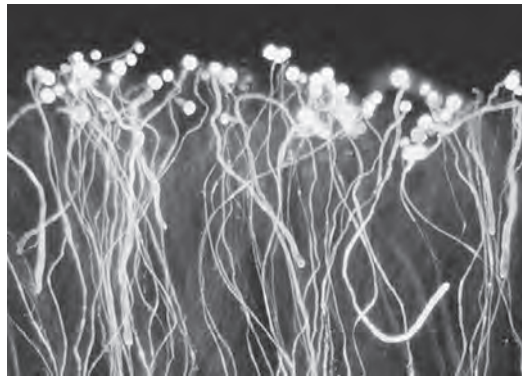


1 The photograph below shows pollen germinating on the stigma of a tomato flower.



Magnification  $\times 100$

(a) Explain how the pollen tubes grow through the style of the flower.

(2)

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(b) Place a cross  in the box next to the correct word or words to complete each of the following statements.

(i) The tip of the pollen tube breaks through the micropyle to enter the

(1)

- A** egg cell
- B** embryo sac
- C** ovary
- D** style

(ii) During fertilisation, nuclei from the pollen tube fuse with (1)

- A the antipodal cells
- B the egg cell and the antipodal cells
- C the egg cell and the polar nuclei
- D the polar nuclei and the antipodal cells

(iii) During fertilisation, the following structures are produced (1)

- A diploid zygote and diploid endosperm
- B diploid zygote and triploid endosperm
- C triploid zygote and diploid endosperm
- D triploid zygote and triploid endosperm

(c) Describe how the structure of a pollen grain differs from that of a sperm cell. (2)

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**(Total for Question 1 = 7 marks)**

2 Fertilisation in flowering plants starts with the growth of a pollen tube.

- (a) An investigation was carried out to study the effect of cycloheximide (CH) on the growth of pollen tubes from pollen. Samples of pollen grains were obtained from *Impatiens glandulifera* (Himalayan balsam).



*Impatiens glandulifera*

Magnification  $\times 0.5$

The pollen samples were exposed to different concentrations of CH.

After one hour, the lengths of the pollen tubes in each sample were measured. A control experiment was also carried out without CH. The results are shown in the table below.

<b>Cycloheximide (CH) concentration / <math>\mu\text{g cm}^{-3}</math></b>	<b>Mean pollen tube length after 1 hour / <math>\mu\text{m}</math></b>
0 (control)	603
1	625
10	678
50	639
100	619
200	543

- (i) Suggest why the temperature was kept constant throughout this investigation. Give an explanation for your answer.

(2)

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(ii) Use the information in the table to describe the effect of cycloheximide (CH) concentration on the growth of pollen tubes.

(3)

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(iii) In the control, after two hours, all the pollen tubes contained gametes.

After two hours in the presence of cycloheximide (CH), none of the pollen tubes contained gametes.

Suggest which process in pollen grains could be inhibited by cycloheximide (CH).

(1)

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\***(b)** Describe the process of fertilisation that takes place in flowering plants.

**(4)**

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**(c)** Explain how meiosis produces genetic variation in gametes.

**(2)**

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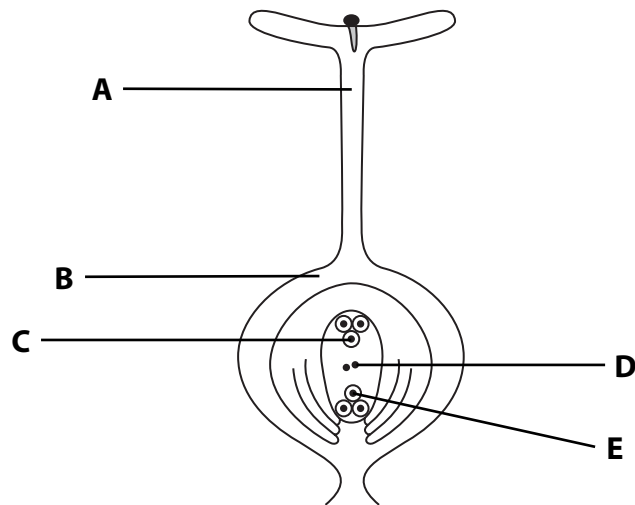
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**(Total for Question 2 = 12 marks)**

3 Pollen germination and pollen tube growth are important stages in plant sexual reproduction.

(a) The diagram below shows a pollen grain on the stigma of a flower.



(i) On the diagram above, draw a line to show the route taken by the pollen tube, from the pollen grain to the micropyle.

(2)

(ii) The table below shows the structures labelled on the diagram. Place a tick (✓) in the box next to each one in which the chromosome number increases at fertilisation.

(2)

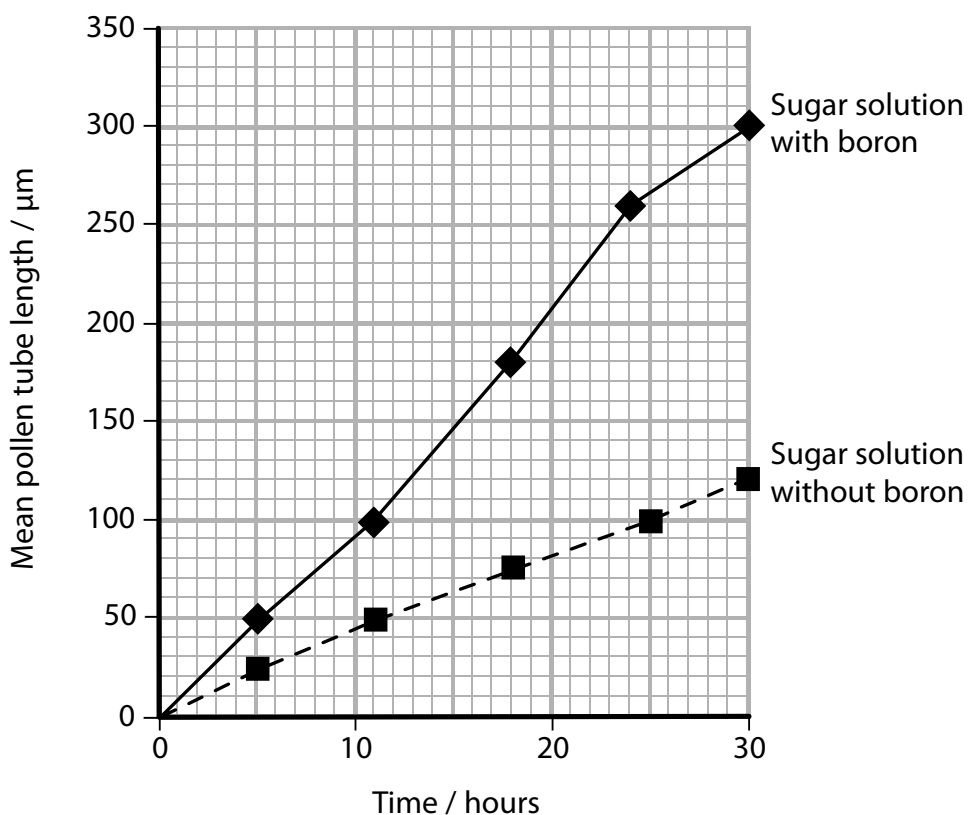
Labelled structure	Tick (✓) if chromosome number increases at fertilisation
A	
B	
C	
D	
E	

(b) An investigation was undertaken to study the effect of the element boron on the growth of pollen tubes.

A large number of pollen grains was placed in a dilute sugar solution. Every six hours, for 30 hours, 500 pollen grains were removed and the length of the pollen tube of each was measured. The mean length of the pollen tubes was then calculated.

This was repeated with boron added to the dilute sugar solution.

The results are shown in the graph below.



(i) Using the information in the graph, compare the mean pollen tube length in these two sugar solutions, over this 30-hour period.

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- (ii) Using the result of this investigation, a student concluded that boron was necessary for pollen tube growth.  
Suggest why another student disagreed with this conclusion.

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- (iii) Using the information in the graph, suggest an appropriate conclusion for the effect of boron on the rate of growth of pollen tubes.

(1)

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- (iv) Suggest the advantages to flowering plants of increased pollen tube growth.

(2)

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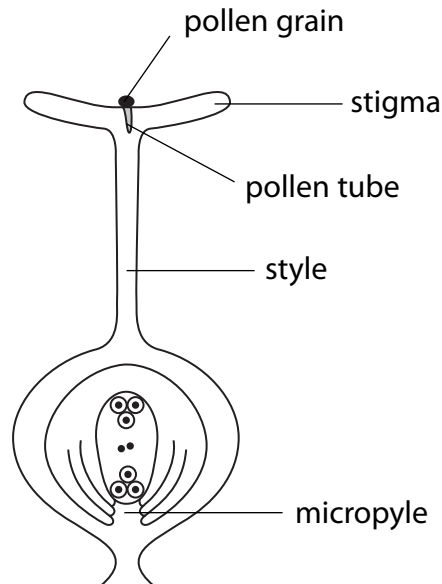
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**(Total for Question 3 = 11 marks)**



4 Water is important for many different processes in plants including successful pollen tube growth.

(a) The diagram below shows a pollen grain growing on the stigma of a flower.



(i) The pollen tube grows from the pollen grain to the micropyle. Suggest **one** stimulus, other than water, that causes the pollen tube to grow towards the micropyle.

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(ii) The tip of the growing pollen tube releases digestive enzymes into the style. Suggest the role of these digestive enzymes in the growth of the pollen tube.

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(b) Give **three** roles of water in a plant other than for pollen tube growth.

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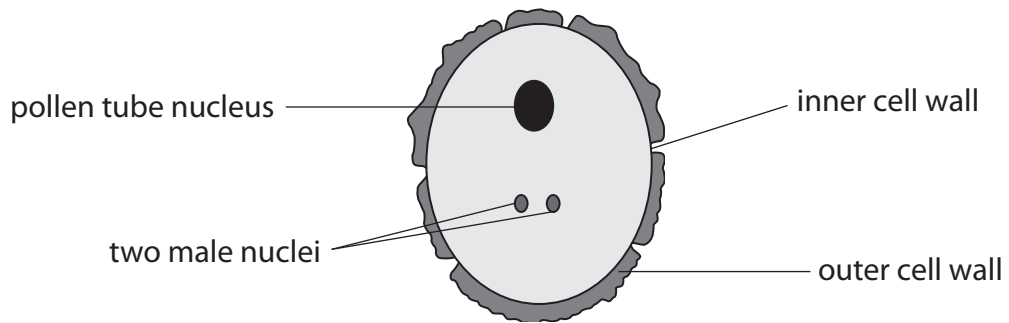
**(Total for Question 4 = 7 marks)**

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5 Analysis of pollen in peat bogs can provide evidence for global warming.

Peat is acidic and has low levels of oxygen. As a result, pollen is preserved in the peat for many years.

The diagram below shows the structure of a pollen grain.



The inner cell wall contains cellulose and the outer cell wall contains sporopollenin. Sporopollenin is chemically stable and very resistant to decomposition.

(a) Describe the structure of cellulose in cell walls.

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(b) Suggest why pollen in peat bogs is preserved for many years.

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(c) Describe the role of each of the male nuclei in the process of fertilisation in flowering plants.

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**(Total for Question 5 = 12 marks)**