BIOLOGY

Higher Level

Wednesday 12 May 1999 (morning)

Paper 3

1 hour 15 minutes

A

Candidate name:	Candidate category & number:

This examination paper consists of 5 options.
The maximum mark for this paper is 40.

INSTRUCTIONS TO CANDIDATES

Write your candidate name and number in the boxes above.

Do NOT open this examination paper until instructed to do so.

Answer ALL of the questions from TWO of the Options in the space provided.

At the end of the examination, complete box B below with the details of the Options answered.

B

OPTIONS ANSWERED

C

EXAMINER	TEAM LEADER
/20	/20
/20	/20
TOTAL /40	TOTAL /40

D

IBCA
/20
/20
TOTAL /40

EXAMINATION MATERIALS

Required:
Calculator

Allowed:
A simple translating dictionary for candidates not working in their own language

Option D — Evolution

D1. To investigate the selection pressures acting on the land snail (*Cepaea nemoralis*), 500 of each of the two forms of snail were released into a small forest. One form had a yellow shell, although this appeared green with the animal living inside. The other form had a light brown shell with darker brown bands round the shell. The snails are predated by a bird which hits the snails against a stone to break the shell. The body of the snail inside can then be eaten. By counting the number of broken shells at the stone, the number of snails eaten each day after release was estimated. During the period of the experiment the background colour of the snails' habitat changed from different shades of brown to a single continuous green colour.
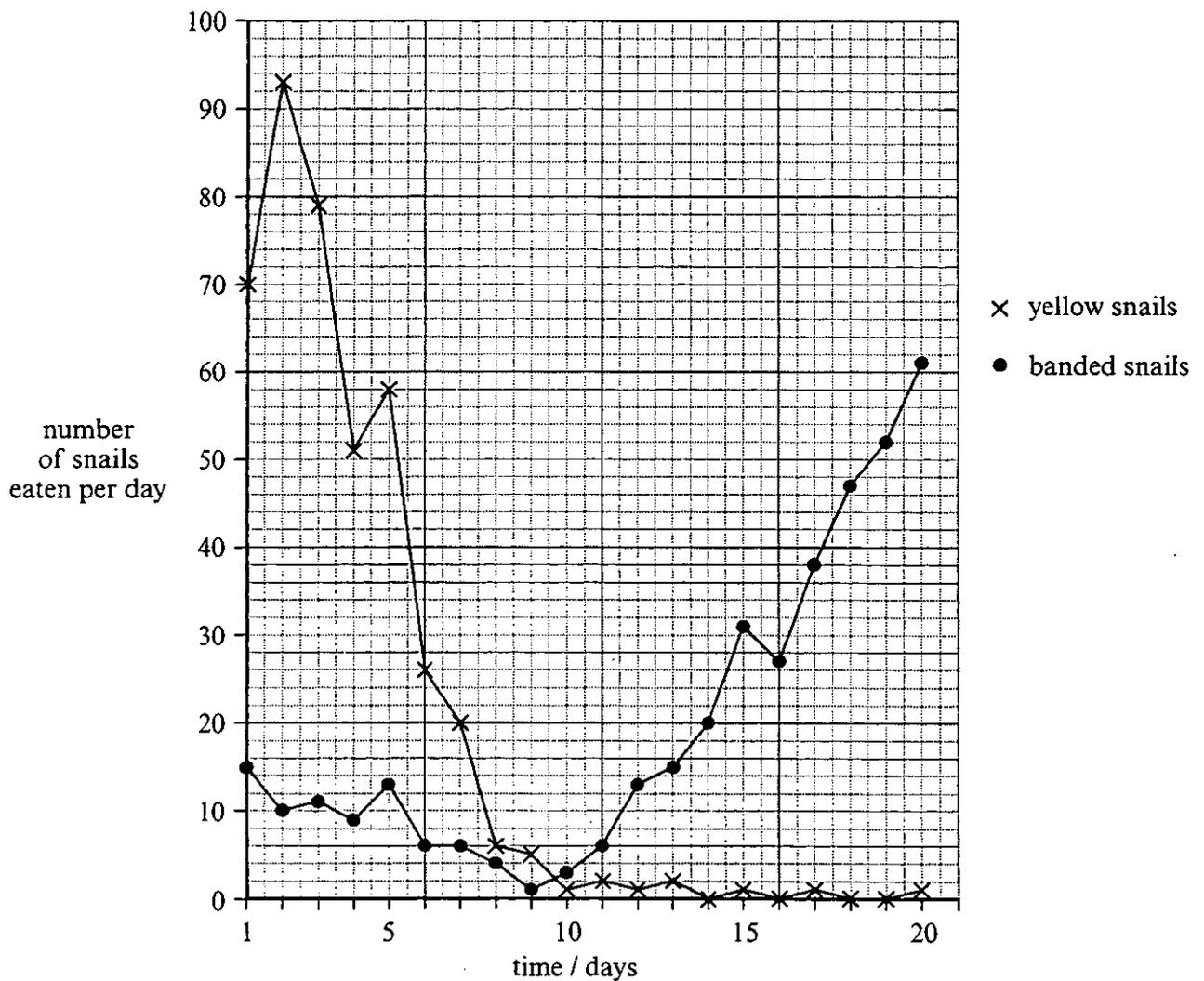
(Question D1 continued)

(a) (i) Outline the variation in number of green snails and brown banded snails eaten during the experiment. [2]

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(ii) Explain **two** reasons for the variation in number of brown banded snails eaten during the experiment. [2]

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Although the two forms of *C. nemoralis* have a very different appearance they are both found in many habitats.

(b) (i) Predict, with a reason, whether or not they interbreed. [1]

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(ii) Suggest briefly why both forms continue to survive. [2]

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D2. (a) Identify which **one** of the five kingdoms of living organism was the first to appear on Earth. [1]

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(b) (i) State **one** organelle, apart from chloroplasts, which is part of the endosymbiotic theory. [1]

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(ii) State **three** kingdoms in which this organelle is found. [1]

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D3. (a) Explain the evidence from homologous anatomical structures that supports the theory of evolution. *[6]*

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(b) Describe the adaptations for tree life which are found both in humans and in other primates. *[4]*

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Option E — Neurobiology and Behaviour

E1. (a)   Explain with examples how psychoactive drugs affect the brain.   *[6]*

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(b)   Outline the effects on people of alcohol abuse.   *[4]*

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E2. Odorants are substances which can be detected by chemoreceptors in the nose. Many different odorants can be detected but each chemoreceptor cell is sensitive to only one type. The diagrams below show the mechanism used in the chemoreceptor.
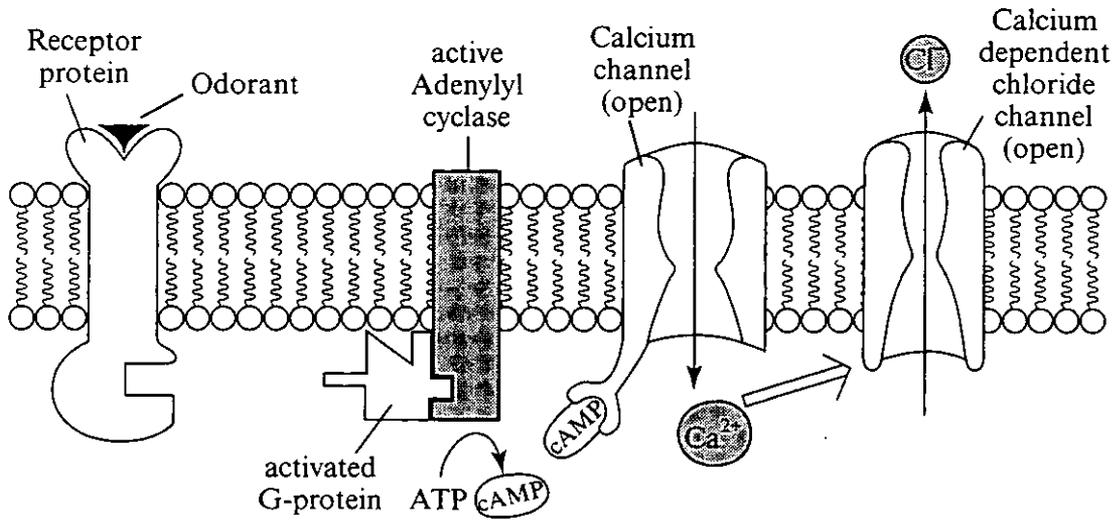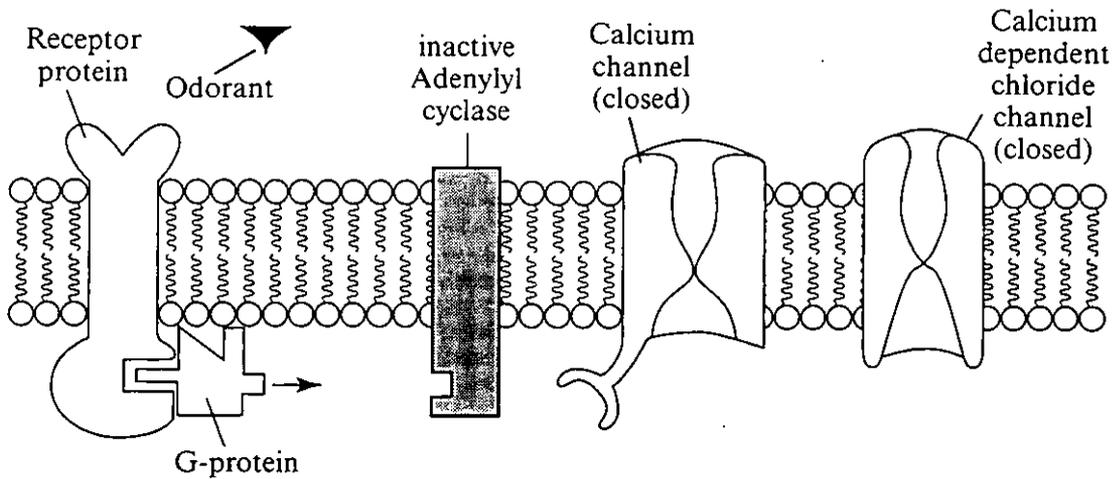
[Source of data: Gold *et al*, *Nature*, (1997), 385, page 677]

(a) Deduce which part of the mechanism is different in chemoreceptor cells that are sensitive to different odorants. [2]

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(This question continued on the following page)

(Question E2 continued)

(b) When the odorant binds to the receptor protein, the receptor protein starts activating G protein. Using the data shown in the diagrams, outline the effects of activated G protein. *[3]*

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(c) Predict the effect of entry of calcium ions and exit of chloride ions on the chemoreceptor cell. *[1]*

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E3. (a) Define *kinesis*. *[2]*

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(b) Explain using **one** example how kinesis might improve an animal's chance of survival. *[2]*

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Option F — Applied Plant and Animal Science

F1. The table below shows the relationship between wheat yield and application of nitrogen fertiliser for a farm in England between 1940 and 1990.

Year	Wheat yield / tonnes hectare^{-1}	Nitrogen fertiliser applied / kg hectare^{-1}
1940	2.3	16
1950	2.6	25
1960	3.5	50
1970	4.5	90
1980	6.3	125
1990	7.0	150

1 tonne = 1000 kg   1 hectare = 10 000 m^2

(a)   Using only the data in the table, outline the changes in wheat yield between 1940 and 1990.   *[2]*

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(b)   (i)   To produce one tonne of wheat in 1940, 7.0 kg of fertiliser was used. Calculate this ratio (amount of fertiliser used per tonne of wheat grown) for 1990.   *[1]*

Answer: . . . .

(ii)   Suggest **two** reasons for the difference in the ratios.   *[2]*

1. . . . .

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2. . . . .

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(This question continues on the following page)

(Question F1 continued)

(c) Predict with reasons whether the amount of fertiliser used on the farm to grow wheat will be higher in the year 2000 than in 1990. *[2]*

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F2. (a) State **one** example of a plant growth substance. *[1]*

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(b) Outline **two** uses of plant growth substances in agriculture or horticulture. *[2]*

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F3. (a) Explain why more than half of the world's population suffers from malnutrition or starvation. *[6]*

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(b) Outline the ethical issues involved with eating meat and dairy products. *[4]*

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Option G — Ecology and Conservation

G1. (a) Discuss the ways in which the problem of acid rain can be reduced. *[6]*

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(b) Outline the process of chemoautotrophy. *[4]*

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G2. Three species of closely related spiders live in a forest in eastern Austria. They build similar webs to catch similar sizes of prey in them. The box-plot below shows the height above ground level of webs constructed by the three species in each month from March to October. In months when no measurements are shown, the spiders were too young to build webs.

KEY
F. frutetorum □
N. radiata ▨
L. triangularis ▩

4th quartile
3rd quartile
2nd quartile
First quartile

web height / m

2.0
1.5
1.0
0.5

March   April   May   June   July   August   September   October
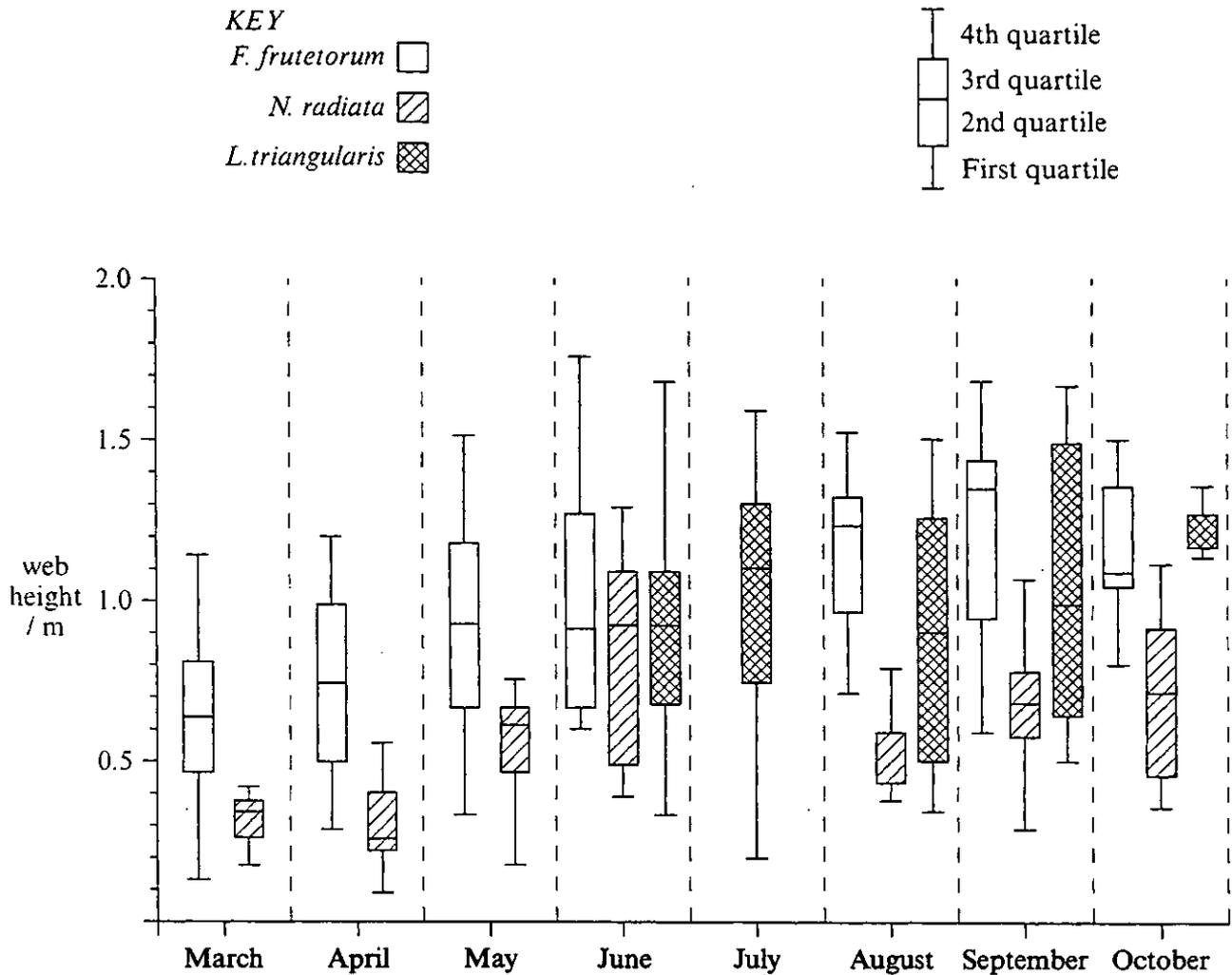
[Source of data: Herberstein, *Bulletin of the British Arachnological Society*, (1977), 10, pages 233-38]

(a)   State in which month

(i)   the median web height of the three spiders is most similar.   *[1]*

. . . .

(ii)   there was least competition between the species for prey.   *[1]*

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(This question continues on the following page)

(Question G2 continued)

(b) (i) Identify which species, in which month, builds webs over the greatest range of heights. *[1]*

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(ii) Suggest **one** reason for this. *[1]*

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(c) Using the data in the box-plot explain **two** ways in which the ecological niches of the three spiders differ. *[2]*

1..

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2..

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G3. (a) State the name of **one** plant species and **one** animal species that have become extinct. *[2]*

animal species ....

plant species ....

(b) For each example you have given, outline the factor which caused the extinction. *[2]*

animal species..

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plant species ....

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Option H — Further Human Physiology

H1. The electron micrograph printed on the following page shows part of three exocrine gland cells in the pancreas and a ductule that carries away secretions from these cells. The black dots are a label which identifies where the enzyme trypsin is synthesised, stored and secreted.

The line drawing below shows the position of the cell surface membranes of the cells shown in the micrograph.

cell A

ductule

cell C   cell B
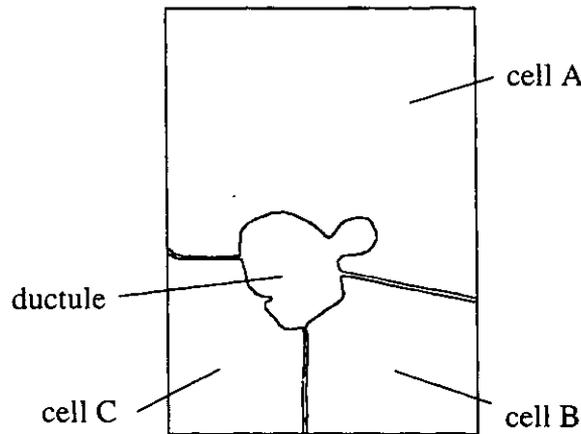
[Source of data: Dr G Newman, EM unit, University of Wales College of Medicine]

Using the table below, identify the structures labelled I, II and III and deduce what function each of them is carrying out. *[6]*

	Name of structure	Function
I		
II		
III		

(This question continues on the following page)

(Question H1 continued)
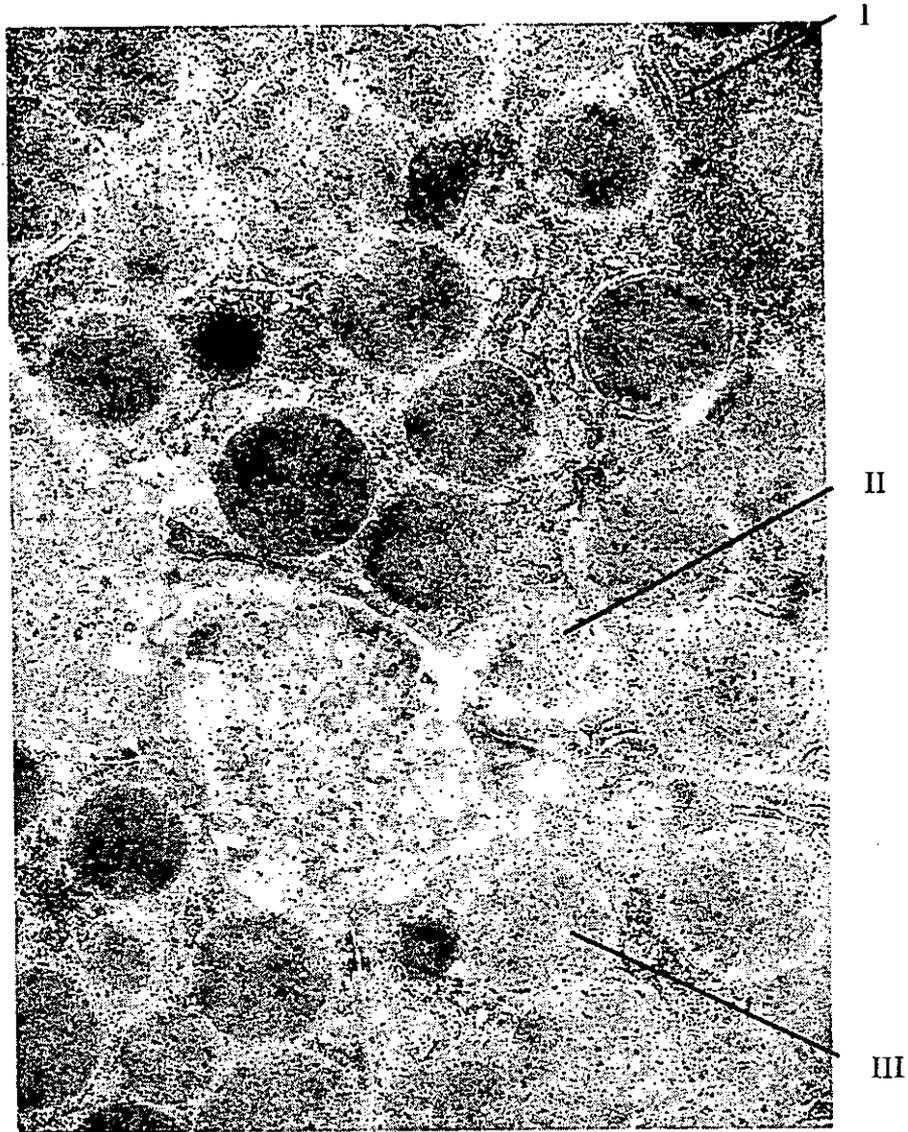
H2. (a) Saliva consists of water with substances dissolved or suspended in it. State **two** substances
dissolved or suspended in saliva. *[2]*

1. . . . .

2. . . . .

(b) The salivary glands and pancreas secrete digestive juices into the alimentary canal. State **two**
other glands that secrete digestive juices into the alimentary canal. *[2]*

1. . . . .

2. . . . .

H3. (a) Explain how air is exhaled from the lungs. *[6]*

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(b) Outline the technique of mouth to mouth resuscitation. *[4]*

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