



Centre Number

71	
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Candidate Number

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ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Biology

Assessment Unit AS 1

assessing

Molecules and Cells

[AB111]

FRIDAY 13 JUNE, AFTERNOON

MV18

TIME

1 hour 30 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

There is an extra lined page at the end of the paper if required.

Answer **all eight** questions.

You are provided with **Photograph 1.3** for use with Question 3 in this paper.

Do not write your answers on this photograph.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.

Section A carries 60 marks. Section B carries 15 marks.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

Use accurate scientific terminology in all answers.

You should spend approximately **20 minutes** on Section B.

This may be longer if you have an additional time allowance.

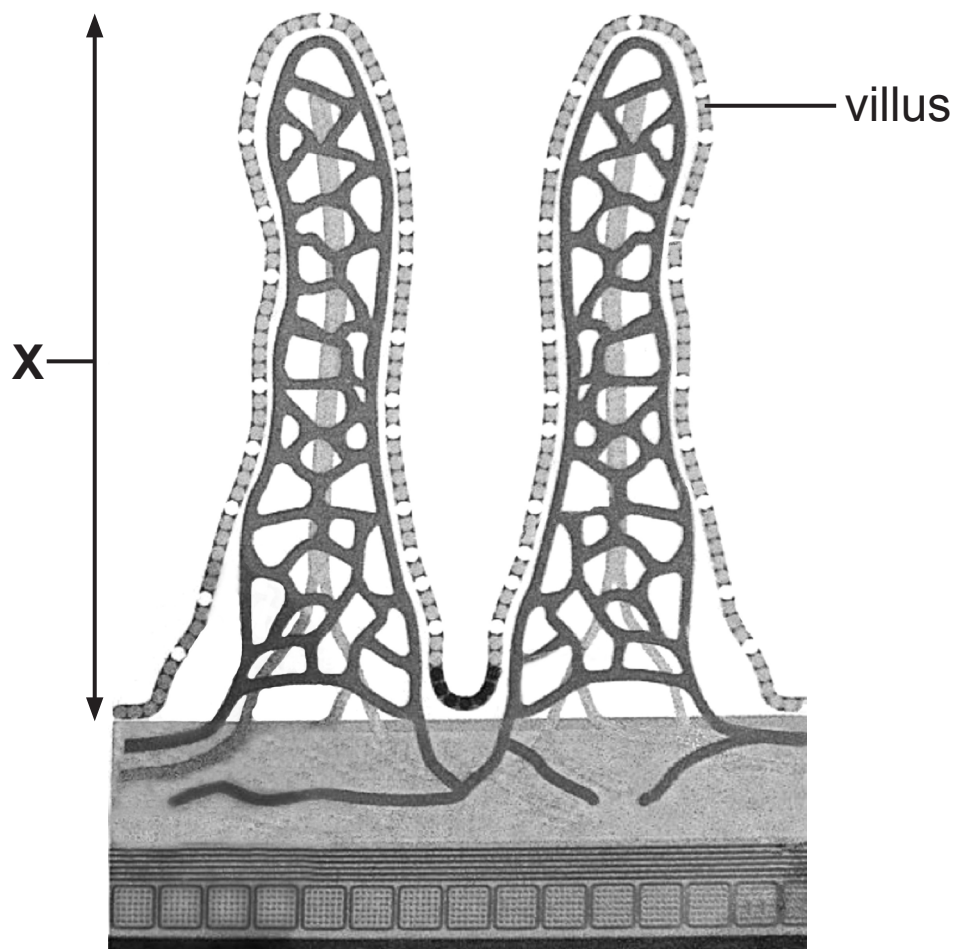
You are expected to answer Section B in continuous prose.

Quality of written communication will be assessed in Section B, and awarded a maximum of 2 marks.

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(Questions start overleaf)

Section A

- 1 The wall of the ileum is made up of several tissue layers, as shown in the diagram below.



Between each villus is a region containing some actively dividing cells called stem cells. These are able to divide and develop into a variety of cell types, each of which becomes a component of the tissue layer labelled **X** in the diagram.

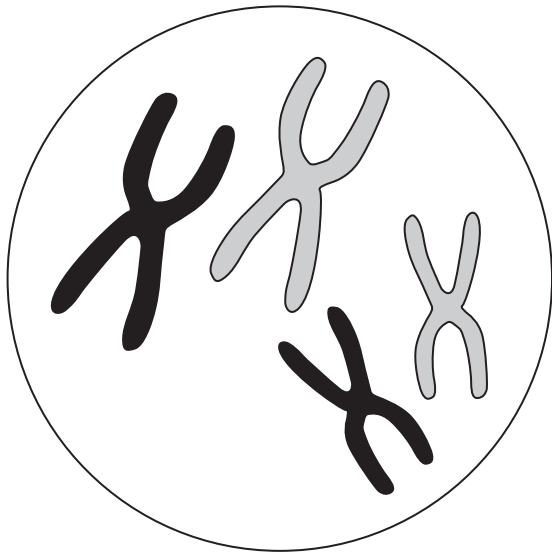
- (a) State the name of tissue layer **X**. [1 mark]

(b) Paneth cells and goblet cells are two types of cell produced by the stem cells. State the functions of Paneth cells and goblet cells in the ileum. [2 marks]

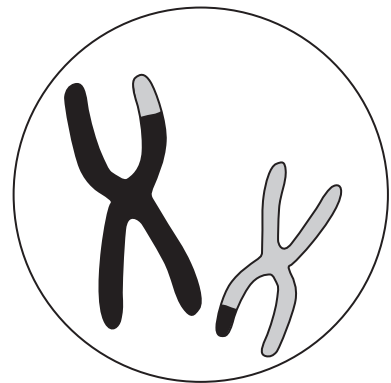
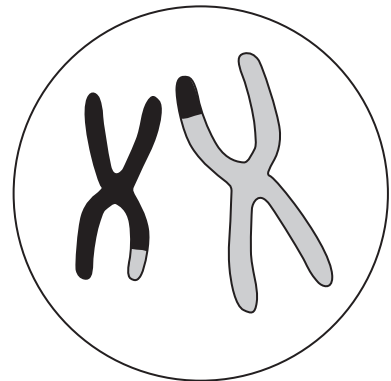
Paneth cells _____

Goblet cells _____

- 2 The diagram below shows two stages in the process of nuclear division by meiosis. The diploid number of the cell shown in stage **A** is 4.



Stage A



Stage B

(a) Identify stage **B**. [1 mark]

(b) Describe the behaviour of the chromosomes between stage **A** and stage **B**. [4 marks]

3 Photograph 1.3 is an electronmicrograph of a plant cell, with some parts of surrounding cells also visible. Some structures in the photograph have already been labelled.

(a) Identify the structures labelled **A** to **C**. [3 marks]

A _____

B _____

C _____

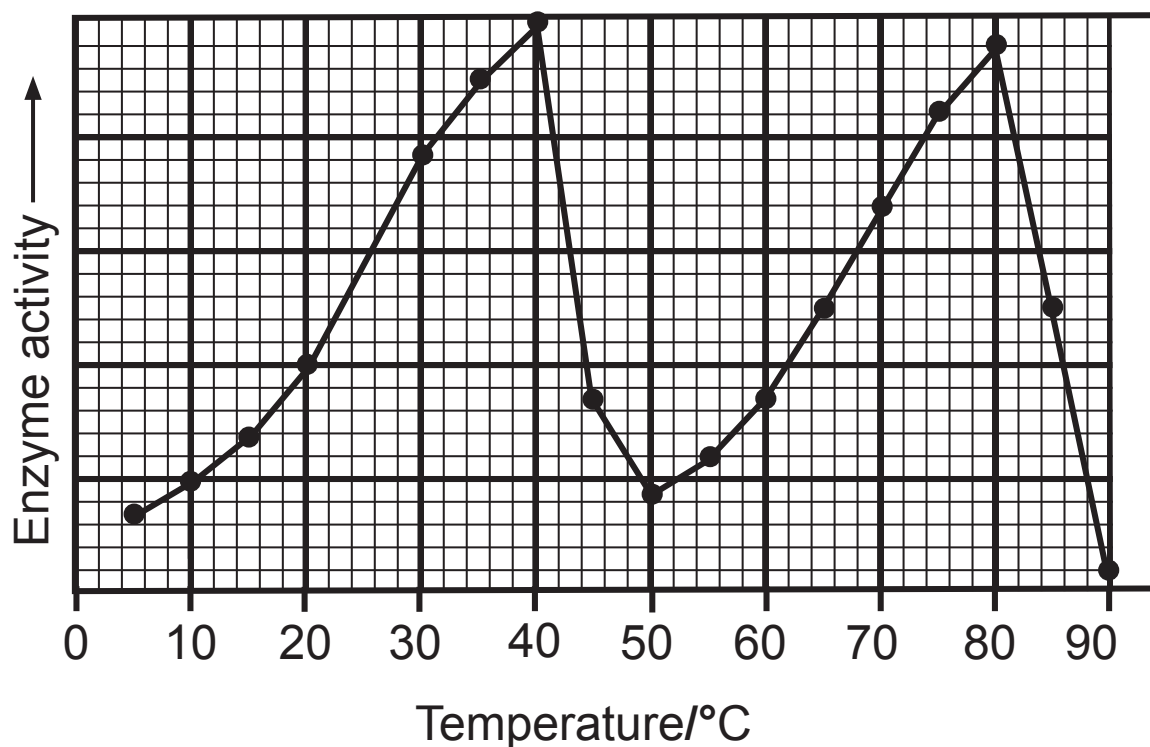
(b) The magnification of this photograph is $\times 7500$. Calculate the width of the cell in μm along the line **X–X**. [3 marks]
(Show your working.)

Answer _____ μm

- (c) Within the chloroplast a membrane system is clearly visible. Outline how this membrane system increases the amount of light energy absorbed. [2 marks]

- (d) Suggest a reason why a nucleus is not visible in the photograph. [1 mark]

- 4 Biological washing powders contain enzymes which help to break down stains on fabric. The enzyme activity in a biological washing powder at a range of different temperatures was investigated. The graph below shows the results.



- (a) Describe and explain the trend shown in the graph between 5°C and 45°C. [4 marks]

- (b) (i)** Suggest an explanation for the two different peaks observed in enzyme activity. [2 marks]

- (ii)** Suggest why such a pattern of enzyme activity would be useful in biological washing powders. [1 mark]

- (c)** Suggest an explanation for the enzyme activity observed between 45 °C and 55 °C. [2 marks]

5 (a) A student tested five solutions (**A–E**) with Benedict's reagent, Biuret reagent, iodine solution and Clinistix. The student recorded the results in the following manner:

- When tested with Benedict's reagent, solutions **A** and **C** both produced a brick-red precipitate.
- When tested with Biuret reagent, only solution **B** produced a purple colour.
- When tested with iodine solution, only solution **D** turned blue-black.
- Solution **E** produced no colour change with any of the reagents.
- When tested with Clinistix, only solution **A** gave a positive result.

(i) In the space below, construct a table of the results obtained by this student. Your table should include the following:

- appropriate column headings
- positive test results recorded with a ✓ and negative results with an ✗. All boxes should be filled. [3 marks]

No caption is required.

(ii) Suggest a possible identification for each of the substances present in solutions **A** to **D**. [4 marks]

A _____

B _____

C _____

D _____

(iii) Describe how the test with Benedict's reagent would have been carried out. [1 mark]

- (b) After carrying out the tests outlined in (a), the student wished to identify substance **E**. After hydrolysis of **E**, it was found that the resulting solution now tested positive with both Benedict's reagent and Clinistix.

Suggest which substance was originally present in solution **E** and give a reason for your answer. [2 marks]

Substance **E** _____

Reason _____

6 Proteins comprise a large group of organic molecules with a wide variety of functions. The specific function of a protein depends on its shape which is determined by its sequence of amino acids.

(a) (i) Identify the elements which are present in all proteins. [1 mark]

(ii) Explain what is meant when a protein is said to have a quaternary structure. [1 mark]

Some features of four human proteins are described below.

Keratin is the major component of hair and nails. Its structure consists of a repeating pattern of a sequence of seven amino acids.

Trypsin is an enzyme found in the small intestine, where it is involved in the digestion of proteins in food.

Collagen is found in skin, where it maintains elasticity, and in tendons, where it provides strength.

Mucin is found in saliva, where it makes food slippery and thus assists its passage from the mouth to the stomach. Its structure includes many carbohydrate chains attached to the protein.

(b) (i) From the list on page 16, select a protein which could be categorised as follows.
(Each protein may be used once, more than once, or not at all.) [4 marks]

- a conjugated protein_____
- a fibrous protein_____
- a globular protein_____
- a protein which catalyses hydrolysis

(ii) Shampoo manufacturers sometimes state that their product contains amino acids.

Suggest why amino acids in shampoo are unlikely to be of use in the production of keratin in hair. [1 mark]

(c) Several cell structures play a role in protein synthesis. Describe the role of each of the following structures in the synthesis of a functional protein. [3 marks]

- Ribosomes

- Rough endoplasmic reticulum

- Golgi body

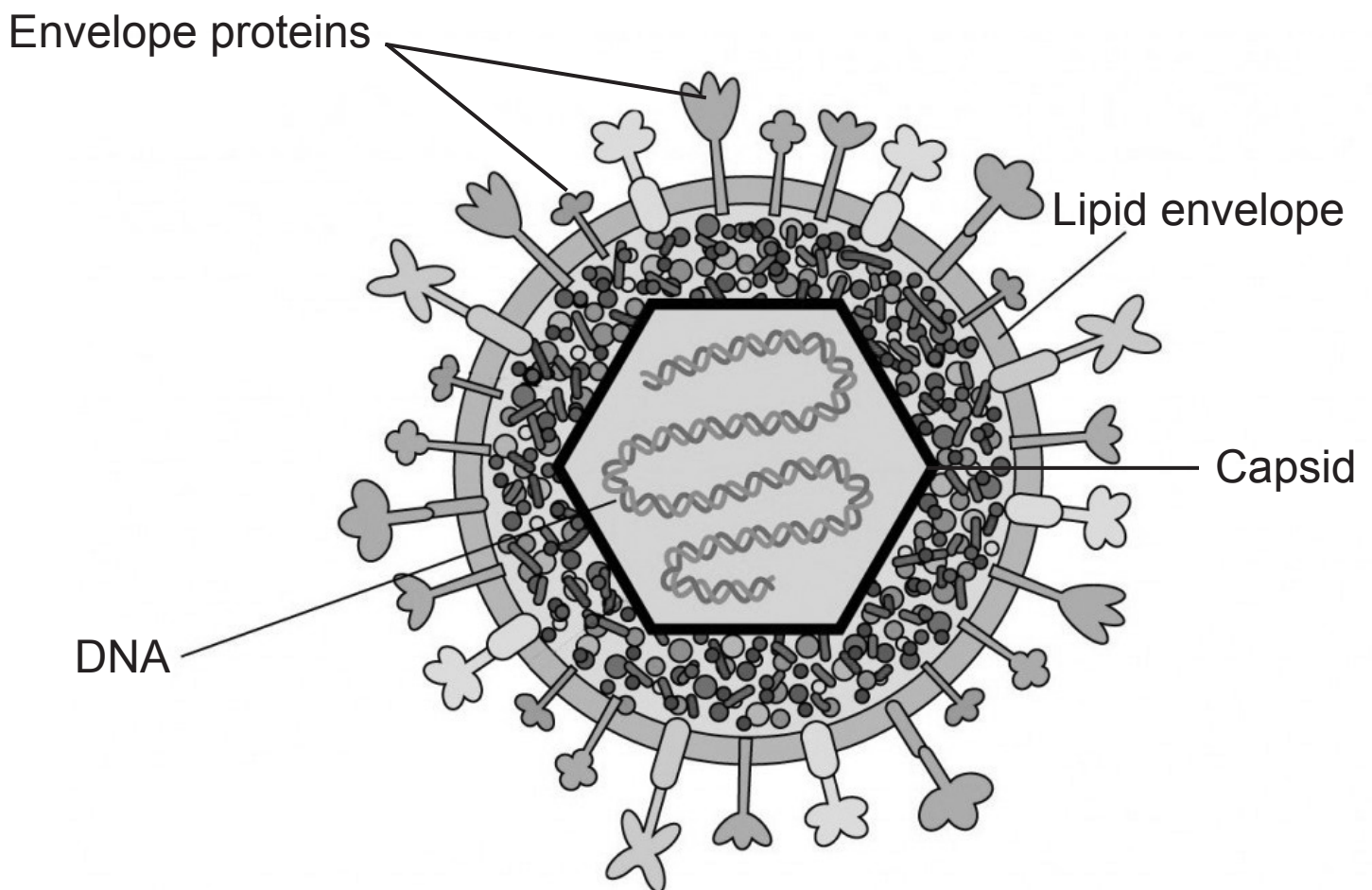
(d) Some proteins are secreted out of the cell in which they are produced, via vesicles which fuse with the plasma membrane. Name this process of secretion out of a cell. [1 mark]

- (e) Research in protein biochemistry has been greatly enhanced by the use of molecular modelling software which allows users to view the three-dimensional structure of a protein. Often, scientists researching a particular protein will make the molecular modelling file for that protein available to download via the internet.

Suggest an advantage of this file-sharing for scientific research. [1 mark]

- 7 During the summer of 2013, it was reported that large numbers of oysters had died in Carlingford Lough in County Down. Tests on the dead oysters showed the presence of a virus called Ostreid Herpes Virus (OsHV). It is thought that the extended period of warm weather triggered increased infection rates in oyster populations.

The diagram below shows the structure of a Herpes Virus, similar to that which infects oysters.



(a) Using the information in the diagram, state **one** way in which the structure of this virus is similar to the structure of:

- HIV _____

- a bacteriophage _____

[2 marks]

(b) Various methods are used to diagnose infection by this virus. Each method has been classified, according to its appropriateness and ease of use. The table below summarises this.

Table removed due to copyright issues.

The table described different methods of diagnosing infection and a classification of each method's use in OsHV diagnosis.

The methods given were:

- obvious signs (dead or open oysters) – classification c
- Light microscopy – classification b
- Electron microscopy – classification c
- PCR (and subsequent DNA analysis) – classification a

The classifications used in the table are summarised as follows:

a – the recommended method for reasons of specificity and sensitivity

b – a standard method with moderate diagnostic sensitivity and specificity

c – a method which is useful in some situations, but factors including cost and/or accuracy severely limit its application.

Initially, tissue from dead oysters is examined using a light microscope, since the virus causes changes in the appearance of the nucleus of an infected cell. If a viral infection is suspected, then PCR can be carried out.

- (i) Suggest why PCR is not undertaken until tissue samples have been examined with a light microscope. [1 mark]

- (ii) Suggest why 'obvious signs' is classified as **c**. [2 marks]

- (iii) Suggest why 'PCR' is classified as **a**. [2 marks]

(c) In order to carry out PCR, tissue from a dead oyster is ground up and mixed with buffer. It is then incubated with primers, an enzyme and deoxyribonucleotides.

(i) Name the enzyme used in PCR. [1 mark]

(ii) How many types of deoxyribonucleotides should be included? [1 mark]

Below are the sequences of one primer pair which can be used when testing for OsHV.

C9: 5'-GAG-GGA-AAT-TTG-CGA-GAG-AA-3'

C10: 5'-ATC-ACC-GGC-AGA-CGT-AGG-3'

(iii) Give the base sequence to which primer **C10** would bind. [1 mark]

(iv) Explain why primers are added in pairs. [1 mark]

(v) Knowledge of the DNA of oysters was necessary for the scientists who developed this test for OsHV. Suggest why. [1 mark]

8 Give an account of the process of osmosis in cells and explain the effect of changing external solute concentrations on both animal and plant cells. [13 marks]

Quality of written communication [2 marks]

[illegible]

Extra lined page

Lined area for writing, consisting of 25 horizontal lines.

THIS IS THE END OF THE QUESTION PAPER

SOURCES

Pg 4, Q1 Diagram showing how the ileum is made up of several tissue layers - Adapted from: © Biology for CCEA AS Level by Dr J Napier, page 105, published by Colourpoint Educational, 2012. ISBN 976 1 78073 010 3

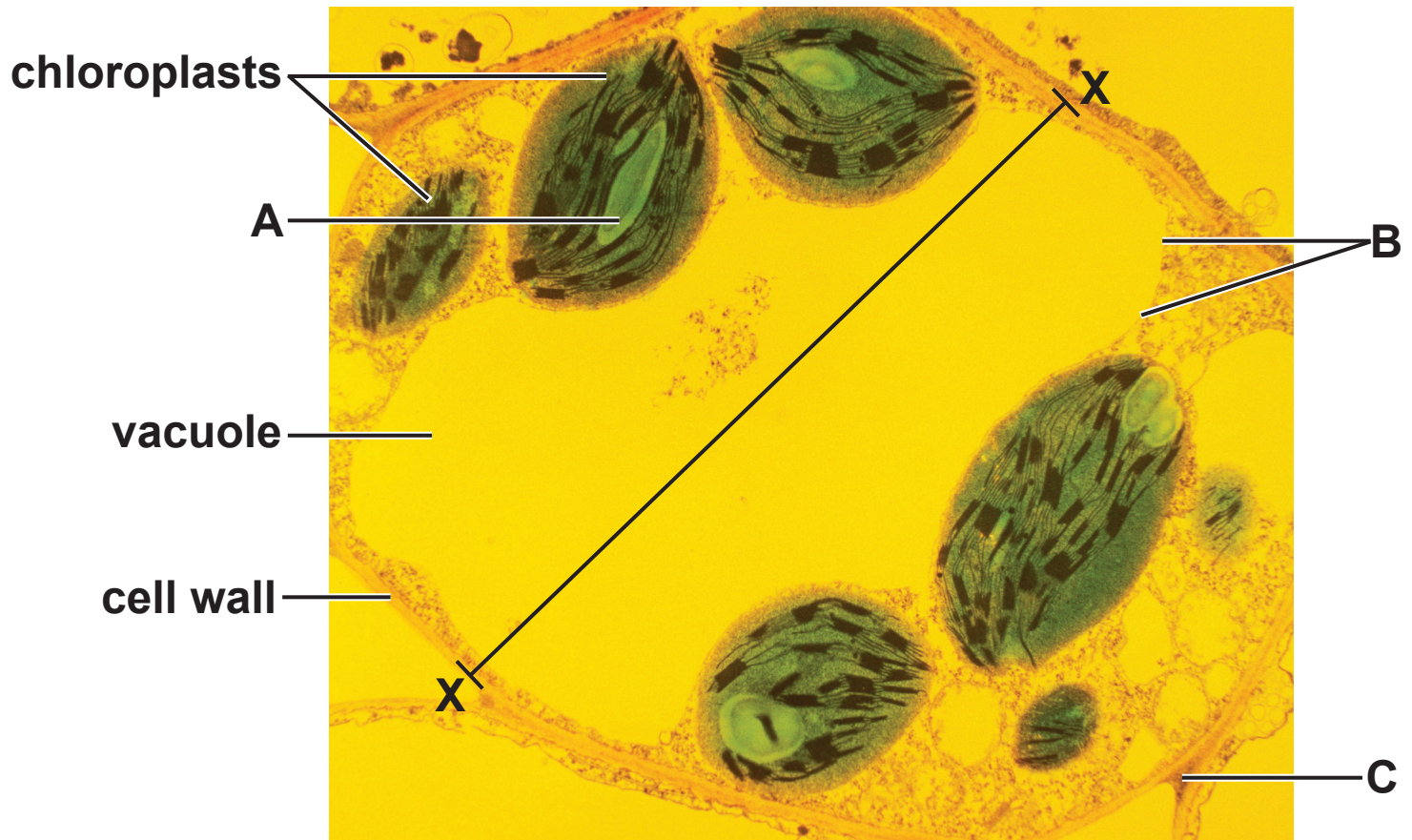
Pg 20, Q7 Diagram showing the structure of a Herpes Virus - © TWiV – This Week in Virology with Vincent Racaniello and friends. www.twiv.tv/virus-structure/ (adapted) Creative Commons Attribution 3.0 License

Insert: Photograph of an electronmicrograph of a plant cell © Biophoto Associates / Science Photo Library

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GCE Biology Advanced Subsidiary (AS)
Assessment Unit AS 1
Molecules and Cells
Summer 2014

Photograph 1.3
(for use with question 3)



Magnification $\times 7500$