Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME **Script 3**

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/22**

Paper 2 Structured Questions AS **May/June 2016**

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 pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **15** printed pages and **1** blank page.

DC (ST/FD) 109212/3

CAMBRIDGE International Examinations

[Turn over

Answer **all** the questions.

1 Statements **A** to **E** are about the structure and functioning of enzymes.

State the correct term to match each of the statements **A** to **E**.

A The energy level, lowered by enzyme action, that needs to be overcome by reactants in order for products to be formed.

Activation Energy.

B The mechanism of enzyme action that relies on the active site being partially flexible and changing shape in order to bind the substrate.

Induced fit (hypothesis)

C The term to describe a protein, such as an enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape.

Globular Protein

D The term for enzymes that function outside cells.

Extracellular enzymes.

E The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction.

Km constant (Michaelis-Mendel constant)

[5]

[Total: 5]

2 Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

Fig. 2.1 is a photomicrograph of a section though the leaf of marram grass.

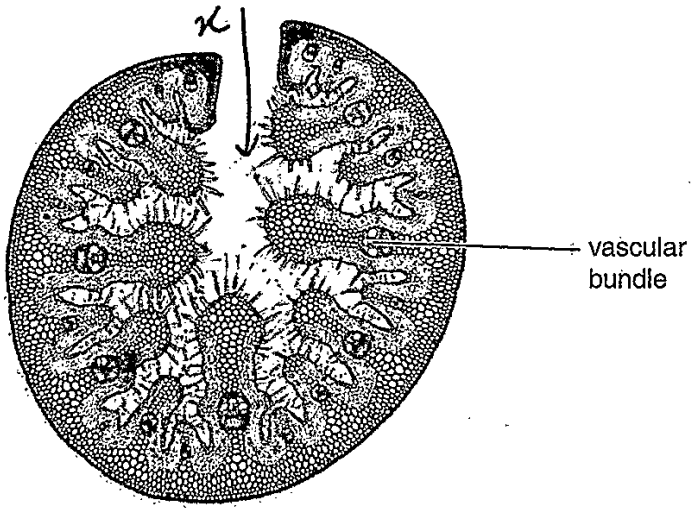


Fig. 2.1

(a) Examples of adaptations to reduce water loss by transpiration include a thick cuticle and no stomata on the outer surface, and stomata in pits on the inner surface.

(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

Small pin like needles and leaf has folded up and only water resistant cuticle is exposed. [1]

(ii) Explain how this adaptation reduces water loss.

Firstly it reduces surface area from which transpiration can occur. As the leaves roll up, the air present in the small gaps b/w the two edges of the leaf is saturated with water vapors, ie humidity at (X) increases thus decreasing rate of transpiration thus reducing water loss [2]

(b) State the term used to describe a plant type that has adaptations to reduce water loss by transpiration.

Xerophytes. [1]

[Total: 4]

3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.
All six countries are classified as low-income countries.

Table 3.1

country	population in 2009	number of cases per 100 000 people			
		2009	2010	2011	2012
Central African Republic	4 266 000	0.26	0.05	15.31	3.12
Chad	11 371 000	1.45	1.66	71.60	0.96
Eritrea	5 558 000	1.48	0.89	0.81	3.16
Ethiopia	84 838 000	1.39	4.86	3.64	4.74
Gambia	1 628 000	0.00	0.12	0.00	0.00
Niger	15 303 000	5.23	2.34	4.67	1.59

(a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.
Show your working.

Ethiopia (2009): In 100,000 people → 1·39 people have measles

1·39 / 100,000 | 1179 cases

In full population of 84,838,000 → number of cases

$= \frac{1.39}{100,000} \times 84,838,000$ [2]

(ii) Use the data for Chad, Eritrea and Ethopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

When using per 100,000 cases, the values are much smaller so they are easier to display in the form of a table.
Also if we showed actual cases we could not make a fair comparison b/w different ~~cont~~ countries as every country has a different population so countries with bigger population would have more cases however %s of people with disease may be less- [3]

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- The percentage vaccinated represents children under one year of age who have been given at least one dose of the vaccine against measles in the given year.
- The data are for the six African countries shown in Table 3.1.

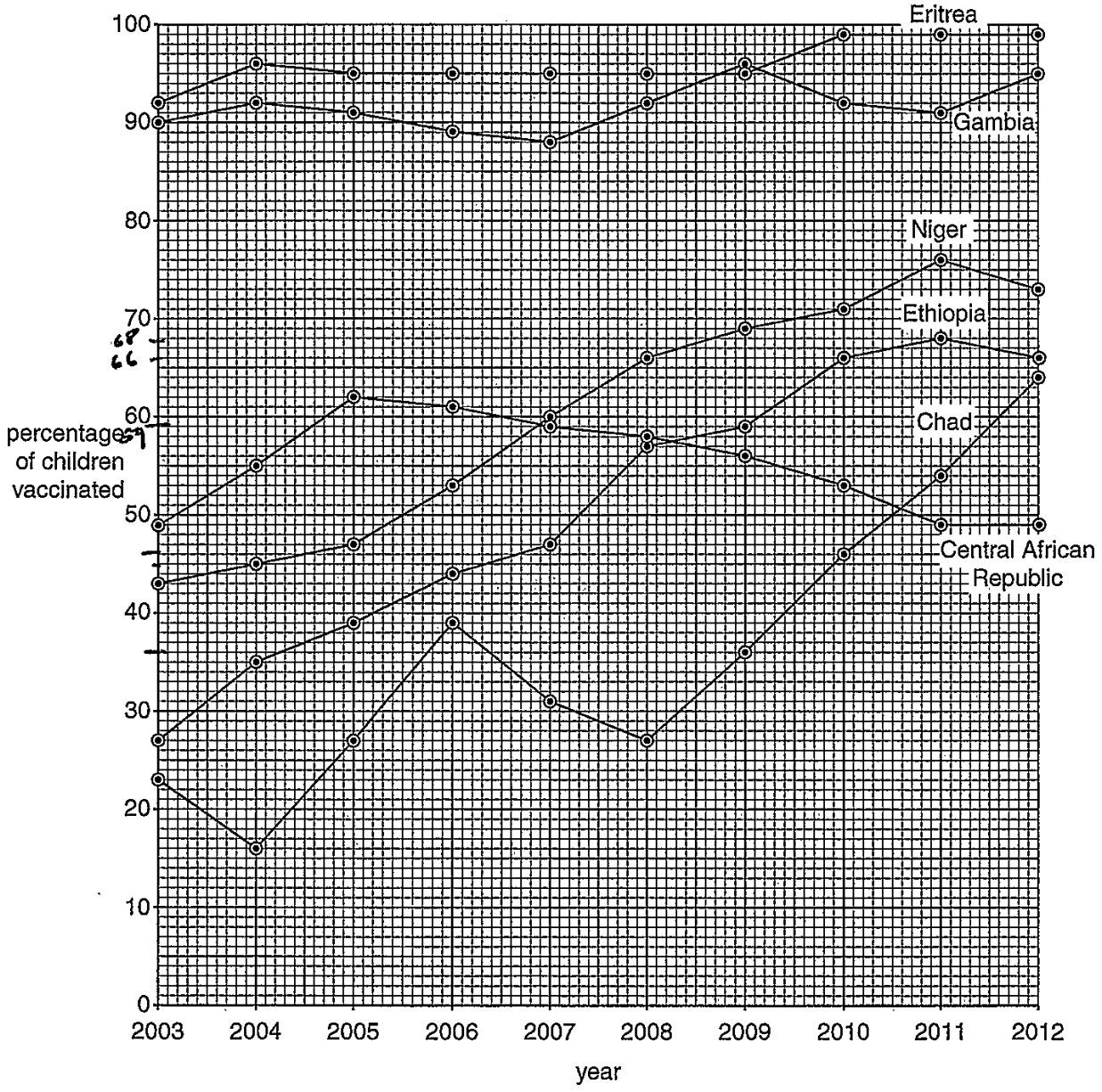


Fig. 3.1

(b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement **and** comment on the data that do **not** support this statement.

In 2009, in Chad, 36% of children were vaccinated and in 2010 46% of children were vaccinated however from 2009 to 2010 cases per thousand increased and in 2011 71.6 / 100,000 people were infected even though 54% children were vaccinated

In Ethiopia in 2009 5~~7~~%. 2010, 2011 and ~~2012~~ % of children vaccinated were increased from 59% to 66% to 68% respectively lower measles cases per 100,000 still increases 1.39 to 4.86 This maybe due to to negligence of docta or resistance because wrong usage of [4]

(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline **two** features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

→ ~~Its~~ The variola virus which causes smallpox does not show mutation and is stable, thus the vaccine can be successfully used.

→ Vaccine of smallpox could be freeze dried and preserved and easy to transport

→ Easy to administer [2]

(d) State precisely the type of immunity gained by receiving a measles vaccine.

Artificial Active Immunity [1]

(e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

1 The cost of producing on the vaccine and all its booster shots that must be administered later.

2 Travelling to far fetched rural area to check for any cases and to educate villages on symptoms of measles and how deadly it can be. [2]

[Total: 14]

4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

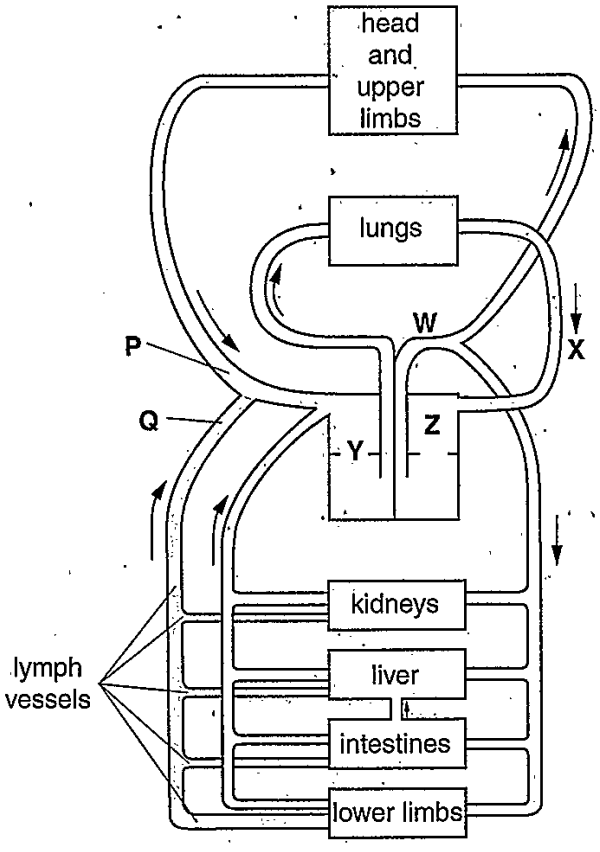


Fig. 4.1

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

Explain what is meant by a *closed double circulation.*

Closed means blood Travels inside ~~closed~~ blood vessels and ~~=~~ double circulation means blood Travels through heart twice during one complete circuit

.....[2]

(b) With reference to Fig. 4.1, name:

blood vessel **W** ..... Aorta .....

blood vessel **X** ..... Pulmonary Vein .....

valve **Y** ..... Tricuspid valve .....

heart chamber **Z** ..... Right Atrium ..... [4]

(c) State the component present in the blood at location **P** that is **not** present in the lymph at location **Q** in Fig. 4.1.

Red Blood Cells or Hydrogen carbonate ions .....[1]

(d) As blood passes through the capillary network in the lungs, gas exchange occurs.

Describe the process of gas exchange between the alveolus and the blood.

Alveoli contain high partial pressure of O_2 and RBC's contain low partial pressure of O_2. Inner lining of Alveoli ~~are~~ have a small layer / film of water so O_2 diffuses through alveolar wall and into the blood by passing the tissue fluid and into the capillary. ~~#~~ Here it goes into RBC and combines with Haemoglobin To form oxy haemoglobin.
CO_2 is present in blood in the form of HCO_3^- ions and carbaminohaemoglobin etc, it all converts into CO_2 gass and diffuses down conc. gradient into the alveoli .....[4]

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

Fig. 4.2 is a transmission electron micrograph of intestinal epithelial cells.

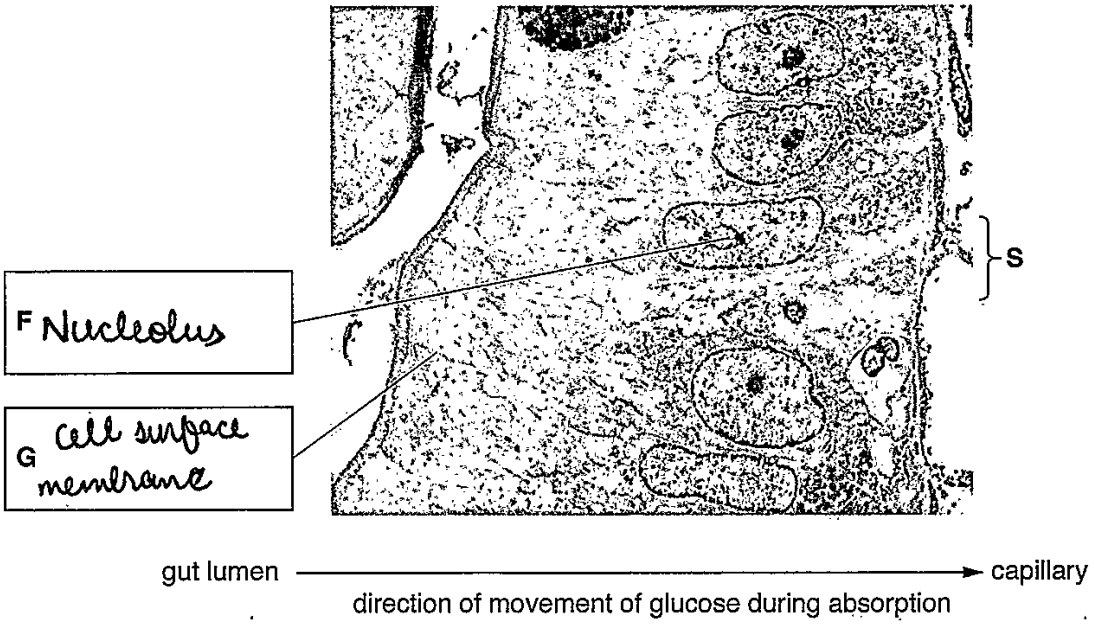


Fig 4.2

(i) Write the name of cell structures **F** and **G** in the boxes provided on Fig. 4.2. [2]

(ii) At the surface labelled **S**, movement of glucose molecules out of the intestinal epithelial cell occurs by facilitated diffusion.

Outline the features of facilitated diffusion of glucose molecules.

Facilitated diffusion is a passive process in which a substance diffuses down the concentration gradient through channel and carries proteins.
Channel proteins are gated and open up when their specific substance (ie glucose) comes, but they have fixed shape.
Carries proteins however do change shape, when glucose molecule gets attached to outside of a carries protein, it changes shape and lets glucose move through [3]

[Total: 16]

5 Fig. 5.1 shows plant cells in stages of mitosis.

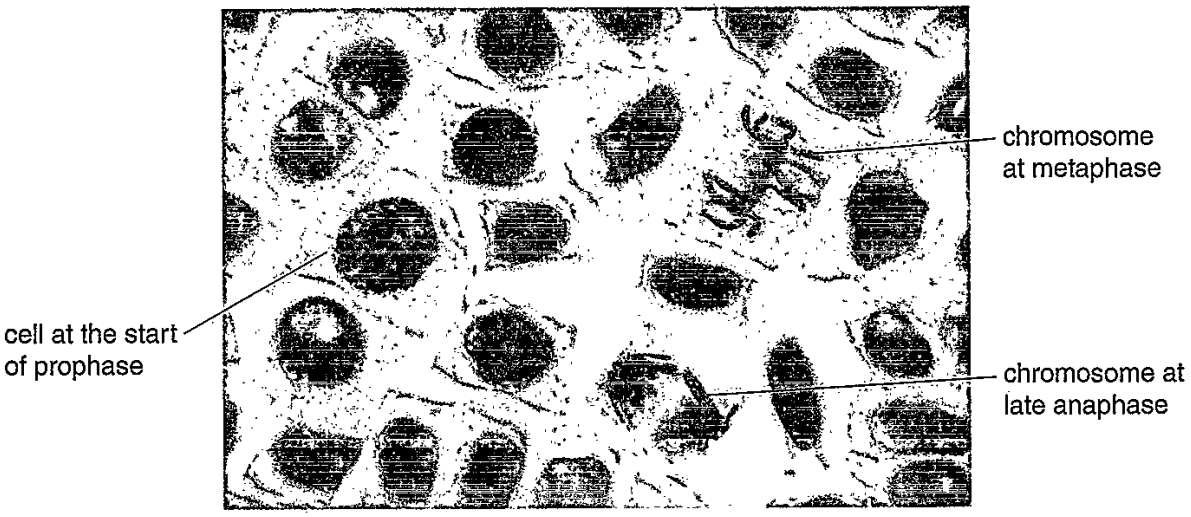


Fig. 5.1

(a) Individual chromosomes cannot be seen in the cell at the start of prophase. Changes to the chromatin occur so that by late prophase chromosomes are clearly visible.

(i) Outline what occurs during early prophase so that chromosomes become visible in late prophase.

Chromatin threads start to coil and condense forming thick chromosomes which are visible in late prophase. [1]

(ii) Describe the structure of the chromosome in late prophase.

→ Chromatin threads have fully condensed into chromosomes by late prophase.
→ Each chromosome has two identical sister chromatids. They are attached to each other
→ ~~Two~~ ~~st~~ by a centromere. Over the centromere there is a protein, kinetochore to which spindle fibres will be attached [3]

(b) State **two** differences between the chromosome at metaphase and the chromosome at late anaphase.

1) At metaphase chromosomes have two identical sister chromatids but at anaphase they have been pulled apart. At metaphase all chromosomes are arranged at centre of cell and attached to spindle fibres but in late telophase the chromatids are at opposite poles and spindle fibreses have been detached [2]

(c) One of the functions of a plant hormone known as cytokinin is to act as a cell signalling molecule and promote cytokinesis.

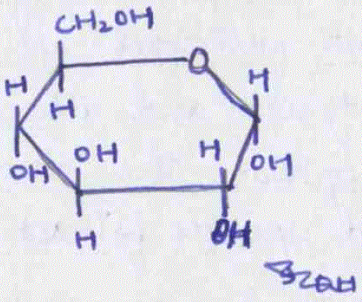
Suggest how cytokinin acts as a cell signalling molecule.

Cytokinin comes outside cell and gets attached to its specific receptor on the cell surface membrane on the plant cell. The receptor then causes a "G protein" to act as a switch and activate an enzyme. This enzyme then releases secondary messengers which further activate more enzymes to produce a signal cascading effect which probally ativate enzyme which causes cytokinesis [3]

[Total: 9]

6 One of the enzymes involved in glycogen synthesis is glycogen synthase. The monomer of the glycogen polymer is α-glucose.

(a) (i) Draw the ring form of α-glucose in the space provided.



[2]

(ii) Glycogen synthase catalyses the formation of a covalent bond between two α-glucose molecules during glycogen synthesis.

Name the type of bond formed.

Glycosidic bond (α 1-4) [1]

(iii) Glycogen branching enzyme is another enzyme that is required for glycogen synthesis.

Suggest why glycogen branching enzyme is needed in addition to glycogen synthase.

Because glycogen is a heavily branched structure and has both (1-4) and (1-6) linkages (1-6) bonds are responsible for branching which is why branching enzyme is required for (1-6) linkage formation [1]

(b) The gene coding for glycogen synthase in muscle cells is known as *GYS1*.

(i) Explain what is meant by a *gene*.

A gene is a sequence of nucleotides on a DNA strand that codes for a specific protein such as an enzyme.
ie A length on a strand of DNA which is responsible for coding of some protein or responsible for some characteristic trait [2]

(ii) There are a number of known mutations for *GYS1*.

Outline how a mutation in *GYS1* can lead to the formation of an altered polypeptide where one amino acid is replaced by a different amino acid.

The sequence of nucleotides coding for GYS1 may be altered, ie just One nucleotide may be substituted. Thus when transcription is occuring, the mRNA will recieve an abnormal codon at that point. which will result in a different tRNA being attached at that specific codon ~~abt~~ during Translation thus resulting in a different amino acid being attached to the polypeptide chain [3]

(c) Table 6.1 shows three functions of cell structures that are involved in the synthesis of glycogen synthase.

Complete Table 6.1 by naming the cell structure that carries out the function listed.

Table 6.1

function	name of cell structure
assembles ribosomes for polypeptide synthesis	Nucleolus. (makes (mRNA)
synthesises ATP to provide a supply of energy for transcription of *GYS1*	Mitochondria
folds and modifies synthesised polypeptide to produce functioning glycogen synthase	Golgi body.

[3]

[Total: 12]