OCR ADVANCED SUBSIDIARY GCE IN BIOLOGY (3881)

OCR ADVANCED GCE IN BIOLOGY (7881)

Specimen Question Papers and Mark Schemes

These specimen assessment materials are designed to accompany the OCR Advanced Subsidiary GCE and Advanced GCE specifications in Biology for teaching from September 2000.

The GCE awarding bodies have prepared new specifications to incorporate the range of features required by new GCE and subject criteria. The specimen assessment material accompanying the new specifications is provided to give centres a reasonable idea of the general shape and character of the planned question papers in advance of the first operational examination.

CONTENTS

Advanced Subsidiary GCE

A2

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
BIOLOGY FOUNDATION **2801**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

Total marks for this paper is 90.

Answer **all** questions.

1 Fig. 1.1 is a diagram of a cell surface membrane.

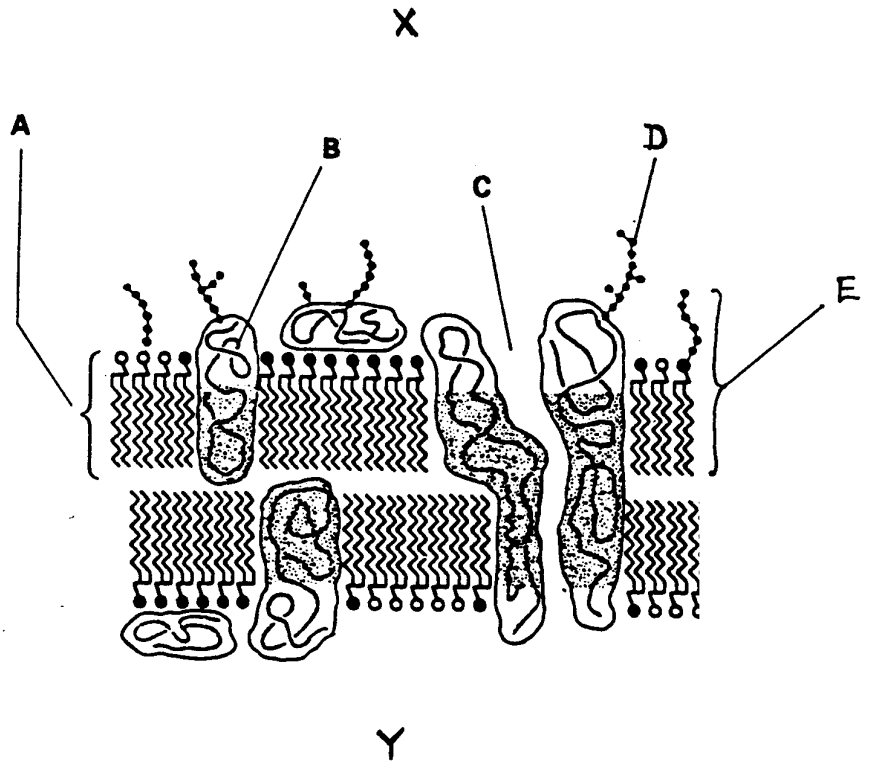

Fig. 1.1

(a) **(i)** Name **A** to **E**.

A……

B……

C……

D……

E……

[5]

(ii) State the width of a cell surface membrane.

……**[2]**

(b) **(i)** On which side of the membrane, shown in Fig.1.1, **X** or **Y**, is the cytoplasm of the cell?

……**[1]**

(ii) Give a reason for your answer based on the evidence in Fig. 1.1.

……..……

……..**[1]**

(c) State the function of **three named** components of the cell surface membrane.

Component 1……..…

Function ……...

……..

Component 2…….

Function……

……..

Component 3……..…….

…….……

Function……

……..

[6]

The properties of the components of cell surface membranes determine whether molecules can pass through membranes.

(d) Explain why cell surface membranes are impermeable to most biological molecules.

……...…...……...

……...…...……...

……...…...……...

……...…...……...

[4]

[Total : 19]

2 **(a)** State **three structural** features of prokaryotic cells.

1……..

2……..

3……..

[3]

(b) Describe the functions in eukaryotic cells of *lysosomes*, *ribosomes*, and *centrioles*.

(In this question, 1 mark is available for the quality of written communication.)

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……...**[7]**

[Total : 10]

3 **(a)** **(i)** Name one fibrous and one globular protein.

fibrous ..……..……..

globular.……..……..…..……

[2]

(ii) Outline the **difference** in structure between a *fibrous* and a *globular* protein.

……

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[4]

Fig. 3.1 shows the effect of temperature on the rate of an enzyme reaction.

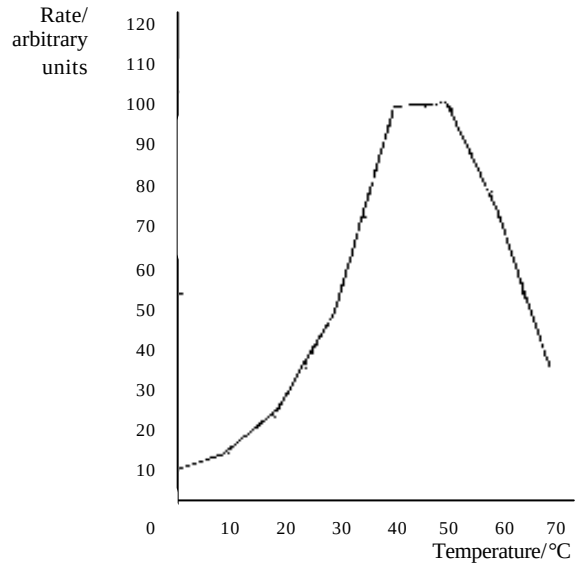

Fig. 3.1

(b) With reference to Fig. 3.1, describe and explain the effect of temperature on the rate of enzyme action.

……..……..…

……..……..

……..……..…

……..……..…

……..……..…

……..……..…

……..……..……..……**[5]**

(c) With reference to molecular structure, explain the specificity of enzymes.

(In this question, 1 mark is available for the quality of written communication.)

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[8]

[Total : 19]

4 Fig. 4.1 shows part of a DNA molecule.

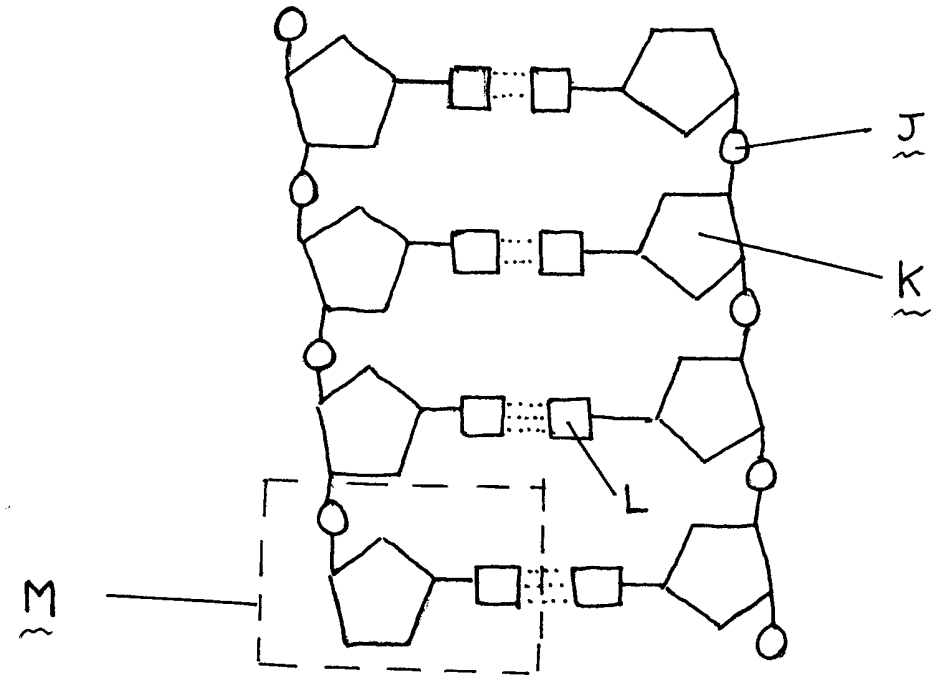


Fig. 4.1

(a) **(i)** Name **J** to **M**.

J……..

K…….

L……..

M……

[4]

(ii) What do the dotted lines in Fig. 4.1 represent?

……

[1]

(b) State **three** ways in which the structure of messenger RNA differs from DNA.

1. ...……..

2. ...……..

3. ...……..

[3]

(c) Explain why exact replication of DNA is necessary.

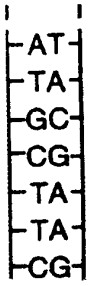
……...……...

……...……...

……...……...

[2]

Part of a DNA molecule is shown below.



(d) In the space provided, show by means of a diagram what happens to this part of DNA during replication;

[4]

(e) Name the enzyme involved in **replicating** the DNA molecule.

……...…….**[1]**

[Total : 15]

5 Humans produce insulin from certain cells in the pancreas. The insulin gene is isolated from a human pancreas cell and then inserted into a plasmid. The DNA responsible for the synthesis of insulin is then inserted into a bacterium. Fig. 5.1, which is **not** drawn to scale, shows how insulin can be produced in this way. Different enzymes function at **X** and **Y**.

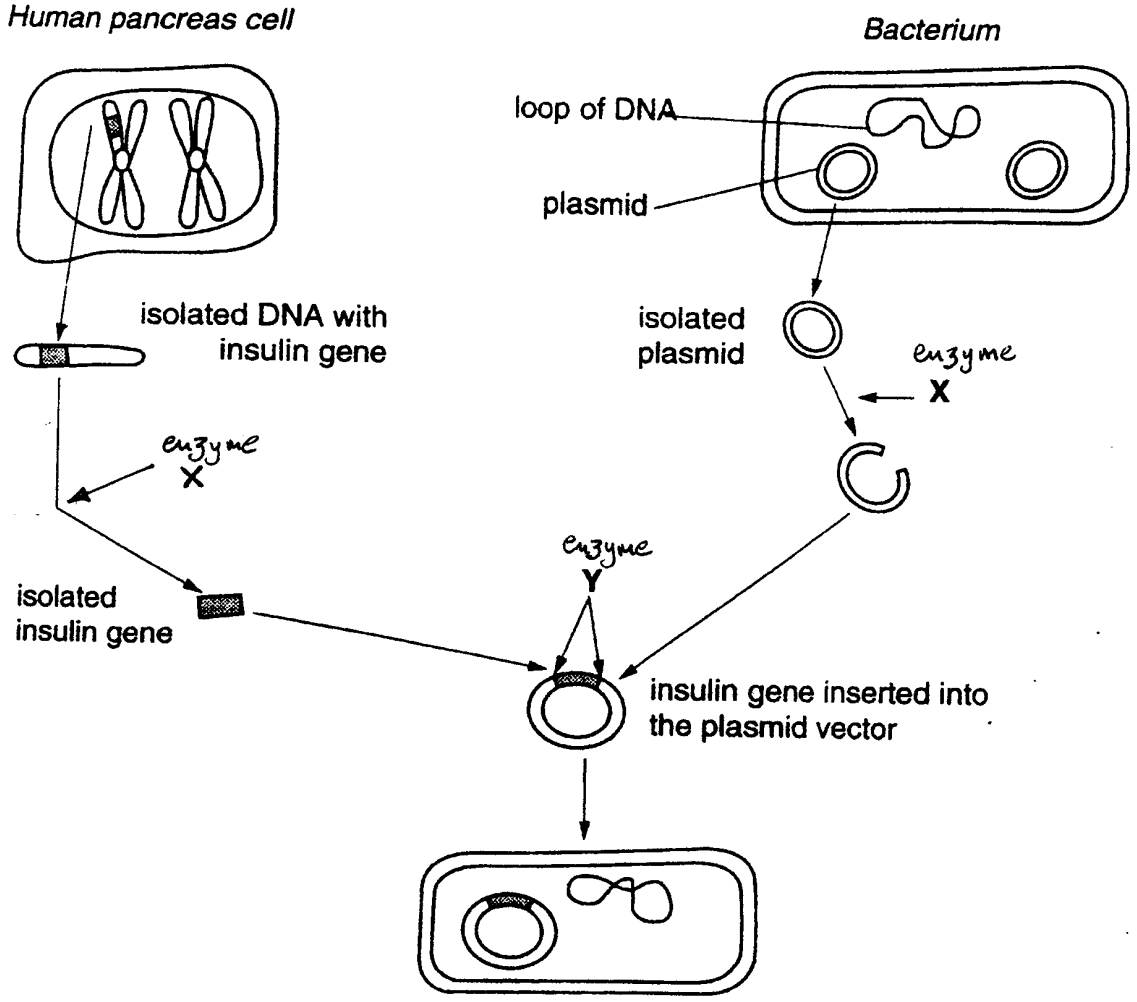


Fig. 5.1

(a) State a general term for the technique shown in Fig. 5.1.

……

[1]

(b) Outline the roles of the enzymes that function at **X** and **Y**.

Role of enzyme at **X**……...

……...

……...

Role of enzyme at **Y**……

……

……

[3]

(c) Explain why the plasmid is described as a *vector*.

……

……

……

[2]

(d) Outline the role of the bacterium in the process once the vector has been inserted into the host cell.

……...

……...

……...

……...

…….. **[4]**

[Total : 10]

6 Fig. 6.1 shows the flow of energy through the trees in a forest ecosystem. The numbers represent inputs and outputs of energy in kilojoules per m^2 per year.

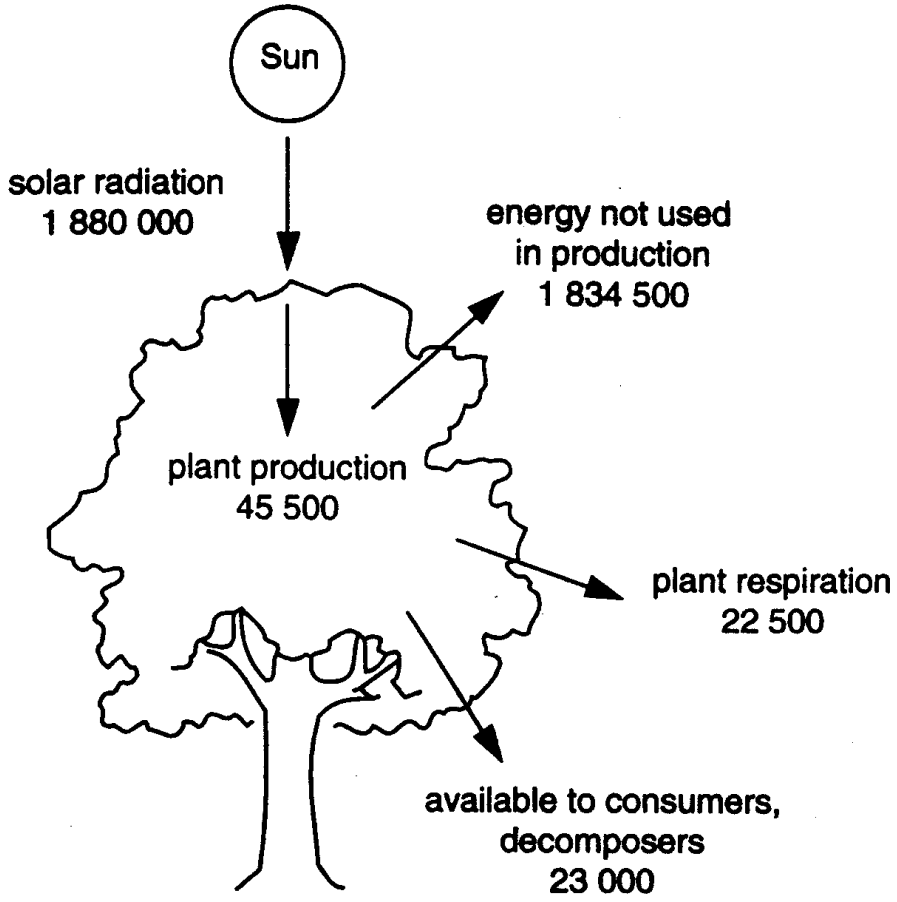


Fig. 6.1

(a) **(i)** On Fig. 6.1, draw a ring around the number which indicates the energy entering the system via photosynthesis. **[1]**

(ii) The total energy available to the plants in the ecosystem is 1 880 000 kJ per m^2 per year.

Calculate the efficiency of photosynthesis. Show your working.

Efficiency = …… **[2]**

(b) Suggest **four** reasons why so much solar energy is **not** used in production in the forest ecosystem.

1……..

……..

2……..

……..

3……..

……..

4……..

……..

[4]

(c) In what form will energy from plant respiration escape from the ecosystem?

……..

[1]

[Total : 8]

7 Fig. 7.1 shows six, stages of mitosis, labelled **A** to **F**, in a plant root tip, as seen under high power of a light microscope.

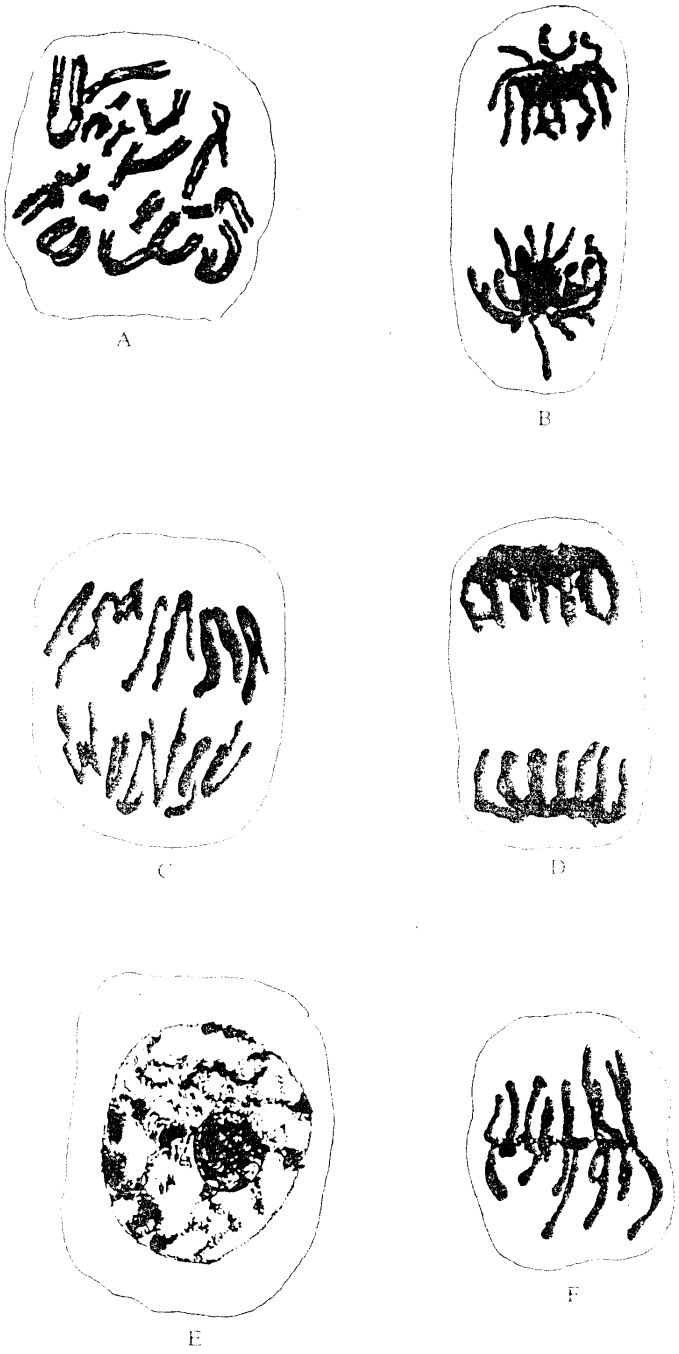


Fig. 7.1

(a) **(i)** Name the stages of mitosis shown in Fig. 7.1.

A……..

B……..

C……..

D……..

E……..

F……...

[6]

(b) Explain the importance of mitosis to living organisms.

……

……

……

……

……

[3]

[Total : 9]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
BIOLOGY FOUNDATION **2801**

Mark Scheme

1 **(a)** **(i)** **A** phospholipids;

B glycoprotein/protein;

C channel/pore;

D sugar chain/carbohydrate/receptor/antigen;

E glycolipid; [5 marks]

(ii) 7mm [2 marks]

(b) **(i)** **Y** [1 mark]

(ii) carbohydrate chains/receptors, on outside [1 mark]

(c) glycolipid
receptor/recognition/cell surface antigen
glycoprotein
receptor/recognition/cell surface antigen
protein
channel/pore
protein
carrier (for facilitated diffusion)
protein
pump (for active transport)
cholesterol
regulates fluidity/stability
enzyme
a **named** type of reaction; (eg ATPase for sodium pump) [6 marks max]

(d) most molecules required are water soluble;
not soluble in fat;
cannot pass through (phospho)lipid bilayer;
some are large;
cannot pass through pores;
some are charged;
AVP; [4 marks max]

[Total : 19]

- -

2 **(a)** naked DNA/DNA without protein;
circular DNA;
small ribosomes/70S ribosomes;
no membrane bound organelles;
mesosome;
very simple form of flagella / flagella not membrane bound; [3 marks max]

(b) Quality of written communication assessed in this answer.

lysosome	digests/breaks down
	food;
	old organelles;
ribosome	site of protein synthesis;
	detail of translation;
	assembly of amino acids;
centriole	organise spindle fibres;
	ref to microtubules;
	movement of chromosomes;
	in nuclear division; [6 marks max]

Q – legible text with accurate spelling, punctuation and grammar; [1 mark]

[7 marks max]

[Total : 10]

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3 **(a)** **(i)** suitable named fibrous protein;
suitable named globular protein; [2 marks]

(ii)

fibrous	long/straight;
	helical/rope-like;
	only secondary structure;
globular	coiled/folded;
	tertiary structure with secondary structure;
	reference to bonding;

globular protein has hydrophilic/polar R groups/side chains outside;
surrounded by water molecules/ref to hydrogen bonding;
(A) opposite points for fibrous protein [4 marks max]

(b) **two** references to figures from graph;
ref to difference in shape;
with temp increase, increase in kinetic energy;
increase in number of collisions;
optimum temperature;
breaking of hydrogen bonds;
denaturation;
change in shape of tertiary structure;
permanent change;
AVP; [5 marks max]

(c) Quality of written communication assessed in this answer.
active site;
with specific shape;
formed by only a few amino acids;
ref to 3D structure;
tertiary structure;
complementary structure of substrate and active site / A/W;
ref to 'lock and key';
induced fit;
only accepts one substrate / type of substrate;
enzyme-substrate complex; [7 marks max]
Q – clear, well organised using specialist terms; [1 mark]
[8 marks max]
[Total : 19]

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4 **(a)** **(i)** **J** phosphate;
K deoxyribose;
L nitrogen containing base;
M nucleotide; [4 marks]

(ii) hydrogen/H, bonds(s); [1 mark]

(b) *mRNA*
single stranded, not double;
uracil, not thymine;
ribose, not deoxyribose;
shorter; [3 marks max]

(c) to have, complete/same/correct, genetic information/code;
ref to appropriate proteins coded for by DNA;
(A) converse statement [2 marks]

(d) *diagram shows*
strands split/'unzipped';
H bonds break;
new separate nucleotides;
base pairing;
two new DNA molecules;
formed of 'new' and 'old' polynucleotides [4 marks max]

(e) DNA polymerase [1 mark]

[Total : 15]

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5 **(a)** genetic manipulation/engineering / recombinant DNA technology/
gene technology; [1 mark]

(b) *enzyme at **X***
DNA cut open;
cut between certain base sequences;
cut to produce 'sticky ends';
*enzyme at **Y***
DNA/insulin gene, attached to plasmid;
to form complete, plasmid/ring;

detail of recombination of pieces of DNA; [3 marks max]

(c) carries/transfers;
gene DNA;
to another, cell/bacterium/place; [2 marks max]

(d) multiplication of bacteria;
multiplication of, plasmids/insulin gene; **(A)** gene cloning
production/synthesis of insulin;
using, metabolic/biochemical materials of bacterium;
detail of protein synthesis; [4 marks max]

[Total : 10]

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6 **(a)** **(i)** ring around 45 500; [1 mark]

(ii) 45 500 divided by 1 800 000;
2.42%; **(A)** 2.4 [2 marks]

(b) not all light/solar energy used/ absorbed in photosynthesis;
some energy dissipated as heat;
some light reflected;
some light misses leaves/chloroplasts;
overlapping leaves/shading;
other named factor may be limiting;
trees not in leaf all year round;
enzymes not 100% efficient; [4 marks max]

(c) heat/thermal; [1 mark]

[Total : 8]

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7 **(a)** **(i)A** prophase;

B telophase;

C anaphase;

D late anaphase/early telophase;

E interphase;

F metaphase; [6 marks]

(b) produces genetically identical cells;

for growth;

for repair;

for asexual reproduction; [3 marks max]

[Total : 9]

Assessment Grid: AS BIOLOGY

Unit Name	Biology Foundation	Unit Code	2801	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (56-60) a (18-20)	b (socet) (18-20)	c (18-20)	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (36-40) a (8/9)	b (8/9)	c (8/9)	d (8/9)	Target grade	QoWL	Total (90)
1(a)(i)	1(c)4(a)	5									
(ii)	1(a) 4(a)	2									
(b) (i)	1(a)	1									
(ii)	1(a)			1							
(c)	1(d) 4(b)	6									
(d)	4(b)			4							19
2(a)	1(e)	3									
(b)	1(d)			6						1	10
3(a) (i)	2 (h)	2									
(ii)	2 (g) (h)			4							
(b)	3(c)				5						
(c)	3(b)				7					1	19
4(a) (i)	5(a)					4					
(ii)	5(a)					1					
(b)	5(a)				3						
(c)	5(b)				2						
(d)	5(b)					4					
(e)	5(b)	1									15
5(a)	5(g)	1									
(b)	5(g)			3							
(c)	5(g)	2									
(d)	5(g)			4							10
6(a)(i)	7(c)					1					
(ii)	7(c)					2					
(b)	7(c)				4						
(c)	7(c)	1									8
7(a)	6(d)	6									
(b)	6(a) (b)				3						9
Totals		**30**	**0**	**22**	**24**	**12**	**0**	**0**		**2**	
Totals for section		**52**			**36**					**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
HUMAN HEALTH AND DISEASE **2802**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

Total marks for this paper is 90.

Answer **ALL** questions.

1 **(a)** Explain the meaning of the following terms as they apply to infectious diseases.

Endemic……..

……..….

Epidemic……..

……..…….

[2]

Table 1.1 shows the diseases which cause death in developing and developed countries.

Table 1.1

developing countries		developed countries	
disease	percentage deaths	disease	percentage deaths
diarrhoea	42	heart diseases	32
respiratory infections:		cancers	23
eg tuberculosis (TB)	25		
malnutrition	10	Strokes	12
malaria	7	bronchitis	6
measles	15	pneumonia	5
others	11	others	22

(b) With reference to Table 1.1,

(i) explain why infectious diseases are leading causes of death in developing countries;

……

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……..…….

[4]

(ii) explain why degenerative diseases are leading causes of death in developed countries.

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……..……

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……..……..

[4]

[Total : 10]

2 **(a)** Complete the table below to show **two** differences between active and passive immunity.

	active immunity	**passive immunity**
1	…… …… ……	…… …… ……
2	…… …… ……	…… …… ……

[4]

(b) Complete the table below by describing how each type of immunity is acquired.

type of immunity	**how acquired**
natural active	…… …… ……
artificial passive	…… …… ……
natural passive	…… …… ……
artificial passive	…… …… ……

[4]

(c) Explain, in terms of the structure of antibody molecules, how the immune system is able to produce large numbers of different types of antibodies.

(In this question, 1 mark is available for the quality of written communication.)

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[7]

[Total : 15]

3 The bacterium, *Vibrio cholerae*, is the causative agent of cholera. The El Tor strain of *V. cholerae* originally occurred only in Indonesia. In 1961, this strain began to spread replacing existing strains in other parts of Asia. El Tor is now widespread throughout Asia, the Middle East, Africa and parts of Eastern Europe, but has never established itself in Western Europe.

El Tor is hardier than the strain it replaced and the bacteria may continue to appear in the faeces for up to three months after patients have recovered. The bacteria may persist in water for up to fourteen days.

(a) State **two** ways in which *V. cholerae* is transmitted from infected to uninfected people.

1. ……

……

2. ……

……

[2]

Some people infected with cholera have mild symptoms, or none at all, and are carriers of the disease.

(b) Suggest how laboratory tests could identify carriers of cholera.

……

……

……

……

[2]

(c) Suggest **four** reasons why El Tor has not become established in Western Europe.

1. ……

……

2. ……

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3. ……

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4. ……

……

[4]

The United Nations, recognising that most of the outbreaks of cholera were the result of polluted water supplies, set up a 'Decade of Water' in 1981. Its aim was to provide safe water for everyone. Over the decade 1981/1990, the number of people lacking a safe water supply in developing countries dropped from 1800 million to 1200 million.

(d) Explain why cholera continues to be a worldwide problem, in spite of the 'Decade of Water' campaign.

(In this question, 1 mark is available for the quality of written communication.)

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[8]

The antibiotic tetracycline is sometimes used as a treatment for cholera.

(e) **(i)** Suggest **two** ways in which tetracycline can affect *V. cholerae*.

……

……

……

……

[2]

(ii) Explain why tetracycline should not be used routinely for all cases of cholera.

……

……

[1]

[Total : 19]

4 **(a)** State **three** components of a balanced diet which provide energy.

……

[3]

Four investigations of the energy intake of 14 and 15 year old boys and girls have been carried out in the UK since the 1930s. These studies show that the average intake of energy has decreased, while the average body masses of both boys and girls have remained the same. The results of these investigations are shown in Table 4.1.

Table 4.1

investigation	**average energy intake / kJ per day**	
	boys	**girls**
1930s	12 873	11 088
1960s	11 739	9 534
1970s	10 962	8 484
1980s	10 478	8 316

(b) **(i)** Calculate the percentage decrease in energy intake for boys between the 1930s and the 1980s. Show your working.

……

……

……

[3]

(ii) Suggest **two** reasons for the fact that the intake of energy has decreased between the 1930s and the 1980s while the average body mass has remained constant.

1. ……

……

2. ……

……

[2]

(iii) Explain why the energy intake of girls is lower than that for boys of the same age.

……..

……..

[1]

In 1991, the British Government's Committee on Medical Aspects of Food Policy (COMA) published dietary reference values (DRVs). The Estimated Average Requirement (EAR) is the dietary reference value for energy intake. EARs for different age groups are calculated from basal metabolic rates, the amount of energy needed to support growth and the amount of physical activity.

(c) Explain the value of publishing EARs for dietary energy.

……

……

……

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……

……

[3]

(d) Suggest **two** problems that might be encountered in calculating the EAR for any one age group.

1. ……

……

2. ……

……

[2]

The overconsumption of energy-rich food can lead to obesity, which can increase the chances of becoming seriously ill.

(e) **(i)** Explain what is meant by *obesity*.

……

……

[1]

(ii) Suggest **three** ways in which obesity may lead to serious illness.

1. ……

……

2. ……

……

3. ……

……

[3]

[Total : 18]

5 During strenuous exercise, such as long distance running, changes occur as muscles use their stores of glycogen and fat to supply energy. Glycogen can be respired both aerobically and anaerobically whilst fat is respired aerobically.

(a) Describe and explain the changes that occur within muscle during the first few minutes of strenuous exercise.

……

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……

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……

……

[5]

(b) Explain why a person breathes deeply at the end of strenuous exercise.

……

……

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……

……

…… **[4]**

(c) Describe **four** ways in which physical fitness may benefit the body.

1. ……

……

2. ……

……

3. ……

……

4. ……

……

[4]

[Total : 13]

6 Fig. 6.1 shows the death rates from coronary heart disease (CHD) for men aged 35 to 74 between 1968 and 1992 for four countries, Finland, U.K., Australia and Japan.

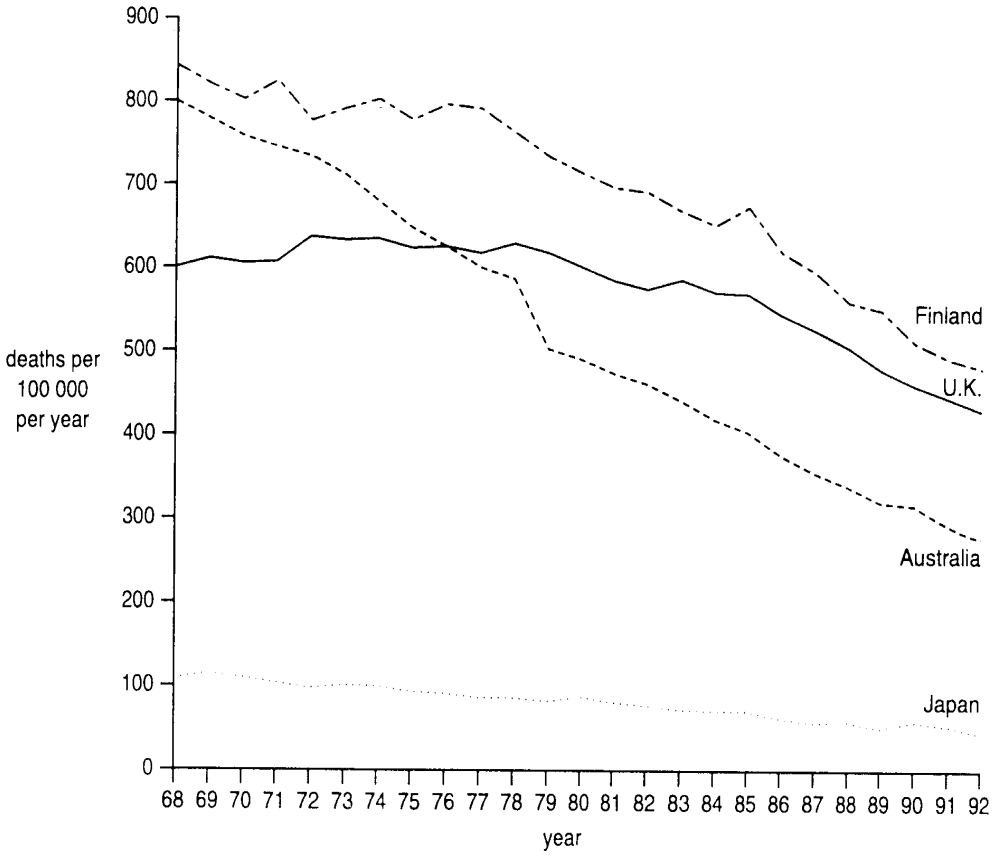

Fig.6.1

(a) With reference to Fig. 6.1, compare the death rates from CHD in the U.K. with those in Australia over the period between 1968 and 1992.

……

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……

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……

……

……

[5]

(b) Suggest **four** reasons for the difference between death rates from CHD in Finland and Japan.

1. …….

2. …….

3. …….

4. …….

[4]

Two of the main targets in the British Government's health strategy are the reduction in the prevalence of smoking and the reduction in the number of cases of CHD.

(c) Explain how smoking contributes to the development of CHD.

……

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……

……

[6]

[Total : 15]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
HUMAN HEALTH AND DISEASE **2802**

Mark Scheme

1 **(a)** *endemic* (disease) always present in a population;
epidemic (disease) spread throughout a population/city/country; [2 marks]

(b) **(i)** living conditions favour spread;
overcrowding, airborne diseases;
ref to measles;
poor, no sewage/water treatment, waterborne diseases;
ref to diarrhoeal diseases;
poor immune system/susceptible to diseases;
ref to malnutrition;
further detail, eg protein needed for growth of
phagocytes/lymphocytes/antibody production etc;
limited vaccination (eg measles);
no (effective) vaccination eg cholera/malaria;
insect vectors (eg mosquito) thrive in tropics;
AVP; [4 marks max]

(ii) infectious diseases are controlled;
effective vaccination programmes;
people live longer, degenerative diseases are common;
take a long time to develop;
eg cancers may take 20 to 30 years;
ref to smoking and disease;
high fat diet and disease;
obesity and disease;
inactivity and disease;
AVP. [4 marks max]

[Total : 10]

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2 **(a)**

ACTIVE	*PASSIVE*
long-term/permanent	temporary;
memory cells	no memory cells;
antigen enters body	antigen not encountered;
antibodies produced/	antibodies injected or given/
immune response	no immune response

[4 marks]

(b) *natural active* illness/disease/infection/antigen, acquired;

artificial active vaccination/given vaccine/type of vaccine/antigens injected;

natural passive antibodies, in colostrum/(breast) milk/cross placenta;

artificial passive (injection of) anti-serum/anti-venom/tetanus antibodies/antibodies made in animal/another human [4 marks]

(c) ***Quality of written communication assessed in this answer.***

variable region/domain;

binding site/receptor site;

different amino acid sequences;

different 3D shapes/**AW**;

complementary to any antigen;

ref to epitope;

lymphocytes/B cells/plasma cells, are present;

which can produce any type of antibody;

ref to antibody genes, in context; [6 marks max]

Q – clear, well organised using specialist terms; [1 mark]

[7 marks]

[Total : 15]

- -

3 **(a)** faeces from infected person;

via drinking water;

via food;

direct to mouth of uninfected person;

carrier not washing hands after using toilet, food preparation etc;

carried by flies to food;

via seafood;

via water used to irrigate vegetables. [2 marks max]

(b) test for antibodies (against *V.cholerae)*;
isolate/grow bacteria from faeces/rectum/intestinal tissue;
some method of identification;
microscopy;
use of monoclonals (® if injected);
fluorescent dye. [2 marks max]

(c) sewage treatment;
water supply not contaminated/clean water supply;
transmission cycle broken/not established;
drinking water, chlorinated/purified;
good sanitation, explained/described;
good food hygiene;
AVP;
® vaccination, antibiotics [4 marks max]

(d) ***Quality of written communication assessed in this answer.***

programme not effective;
still 1200 million who can transmit cholera;
do not have access to clean water;
rural areas not reached;
growth of population;
growth of shanty towns;
poor sanitation;
natural disasters;
new facilities not maintained;
wars/civil unrest;
no effective vaccine;
overcrowding;
AVP. [7 marks max]

Q – legible text with accurate spelling, punctuation and grammar; [1mark]

[8 marks max]

(e) **(i)** bacteriostatic/stop growth/cell wall synthesis/
cell membrane synthesis;
stops division/protein synthesis/transcription;
disrupts cell wall/membrane function;
disrupts translation/DNA replication;
acts as enzyme inhibitor;
causes lysis; [2 marks max]

(ii) resistance of bacterium;
may recover with oral rehydration only;
® immune [1mark]

[Total : 19]

---

4 **(a)** protein;
fat;
carbohydrate/sugar/starch. [3 marks]

(b) **(i)** 12 873 – 10 478 = 2 395;
$\frac{2\ 395}{12\ 873} \times 100$
= 18.6 / 19%; [3 marks]

(ii) less exercise;
less energy used to keep warm/central heating;
AVP; [2 marks max]

(iii) higher proportion of fat/less heat loss/less body mass;
® less active [1 mark]

(c) guidance for interpreting dietary/eating surveys;
useful for interpreting food supply statistics;
informs dietary advice to public;
informs advice given by GPs/dieticians;
useful for planning diets;
useful for food labelling;

if food intake is lower than EAR, likely to be suffering from malnutrition;
means of comparing/analysing national diets;
AVP. [3 marks max]

(d) small sample sizes;
difficulty in calculating BMR;
difficulty in estimating time spent on physical activity;
different levels of activity in population;
growth occurs at different times;
ethnic/racial differences;
AVP. [2 marks max]

(e) **(i)** body mass is 20%(or more) over maximum desirable mass for height;
Body Mass Index greater than 27 – 30. [1 mark max]

(ii) hypertension/ high BP;
atheroma/atherosclerosis;
stroke;
coronary heart disease/heart attack;
angina;
diabetes
(osteo)arthritis;
damage to lung capillaries;
gallstones; [3 marks max]

[Total : 18]

---

5 **(a)** quantity of ATP/creatine phosphate decreases;
rate of respiration increases;
anaerobic respiration increases at first;
more than aerobic/aerobic little increase;

glycogen respired first;
increased demand for energy;
anaerobic because of limited supply of oxygen;
ref to supply of oxygen from myoglobin;
ref to blood flow through muscle;
ref to time taken to adjust heart rate/stroke volume/cardiacoutput;
ref to time taken to increase breathing rate/tidal volume/ventilation rate.

[5 marks max]

(b) oxygen deficit incurred while running/**AW**;
oxygen debt has to be repaid;
removal of lactic acid from blood;
oxidation/respiration;
in the liver;
stored as glycogen;
AVP. [4 marks max]

(c) reduced risk of CHD;
increased resistance to infection;
increased respiratory fitness/efficiency of gas exchange/**AW**;
reduces body mass/ref to obesity/maintains body mass;
improves posture/helps prevent back pain;
improves alertness/coordination/balance/decreases reaction time;
helps relieve stress;
increases life span;
improves strength/endurance/power;
improves flexibility of joints;
ref to effects on muscle tissue. [4 marks max]

[Total : 13]

- -

6 **(a)** lower in UK in 1970s than in Australia/**AW**;
both decline over this period of time;
dramatic/steeper decline in Australia/lower in Australia since 1976/
lower at any time since 1976;

earlier decline in Australia;
steady/uniform decline in Australia;
constant in UK until/decline began in UK in 1980s;
use of figures with units to make comparison. [5 marks max]

(b) saturated fat in Finnish diet/little saturated fat in Japanese diet;
more fish eaten than red meat in Japan;
more fruit/vegetable/fibre eaten in Japan;
higher blood cholesterol in Finnish men;
Finnish men have higher blood pressures;
more people in Finland smoke;
greater proportion of obese people in Finland;
AVP. [4 marks max]

(c) nicotine makes platelets sticky;
reduces ability to remove blood clots;
increases chance of blood clotting;
increases risk of coronary thrombosis;
carbon monoxide combines permanently with haemoglobin/
carboxyhaemoglobin;
less oxygen transported;
as result, heart works harder to provide oxygen to tissues;
constricts coronary arteries/arterioles;
smoking associated with atherosclerosis;
increase in blood cholesterol;
fewer antioxidants;
ref to free radicals;
ref to LDLs/HDLs;
increase in blood pressure;
AVP. [6 marks max]

[Total : 15]

Assessment Grid: AS BIOLOGY

Unit Name	Human health and disease	Unit Code	2802	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (56-60) a (18-20)	b (socet) (18-20)	c (18-20)	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (36-40) a (8/9)	b (8/9)	C (8/9)	d (8/9)	Target grade	QoWL	Total (90)
1(a)	1(f)	2									
(b) (i)	1(e)		4								
(ii)	1(e)		4								10
2(a)	6(f)			4							
(b)	6(b) (f)	4									
(c)	6(e)			6						1	15
3(a)	5(a)	2									
(b)	5(a)				2						
(c)	5(c)						4				
(d)	5(b)		4				3			1	
(e)(i)	5(d)						2				
(ii)	5(d)		1								19
4(a)	2(a)	3									
(b)(i)	2(b)					3					
(ii)	2(b)						2				
(iii)	2(b)						1				
(c)	2(c)			3							
4(d)	2(c)				2						
(e)(i)	2(e)	1									
(ii)	2(e)		3								18
5(a)	3(i)(b)			5							
(b)	3(i)				4						
(c)	3(l)	4									13
6(a)	4(e)					5					
(b)	4(e)					4					
(c)	4(d)			6							15
Totals		**16**	**16**	**24**	**8**	**12**	**12**			**2**	
Totals for sections			**56**			**32**				**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY

TRANSPORT **2803/01**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

Total marks for this paper is 60.

Answer **ALL** questions

1 Fig.1.1 shows the structure of the mammalian heart.

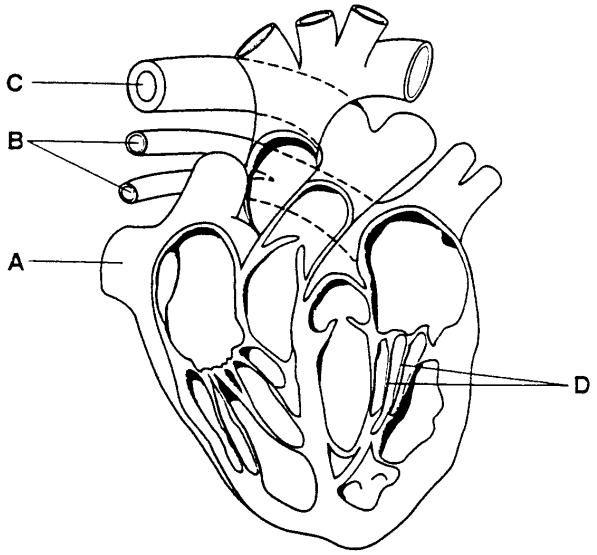

Fig. 1.1

(a) In the table below, name structures **A** to **D** and, for each structure, state its function.

	structure	**function**
A	…… …… ……	…… …… ……
B	…… …… ……	…… …… ……
C	…… …… ……	…… …… ……
D	…… …… ……	…… …… ……

[8]

Each atrium is separated from the ventricle by a valve.

(b) State at which point in the cardiac cycle these valves would be closed, and explain why they would be closed.

……

……

……

[2]

(c) Name the part of the heart that initiates the heart beat.

……

[1]

[Total : 11]

2 **(a)** Name the plant tissue that is mainly concerned with the translocation of organic material.

……

[1]

When discussing the translocation of organic materials in plants, the terms *source* and *sink* are often used.

(b) Explain, using an example, what is meant by the term

(i) *source* ……..

……..

……..

[2]

(ii) *sink* ……..

……..

……..

[2]

(c) Explain why respiratory inhibitors stop translocation.

…….

…….

…….

[2]

[Total : 7]

3 **(a)** Explain what is meant by the term *transpiration*.

……

……

[2]

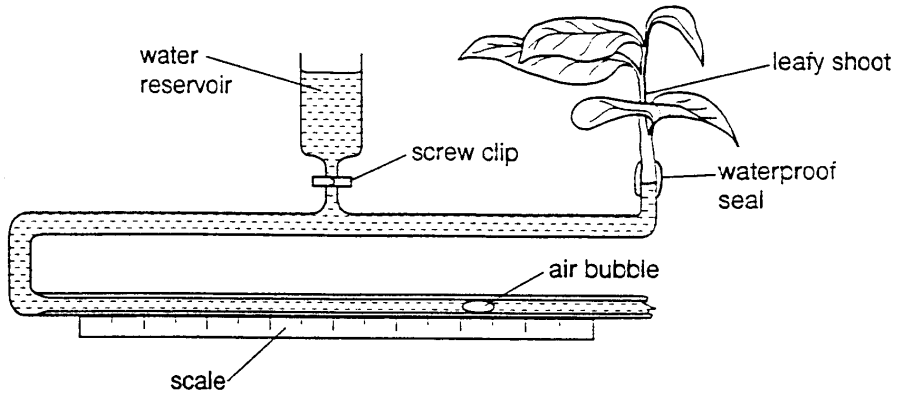

Fig.3.1

Fig. 3.1 shows a potometer which can be used to measure the rate of water uptake in a leafy shoot. The rate of movement of a bubble through the potometer is measured as water is taken up by the shoot. This may be used as a measure of the rate of transpiration by the shoot.

(b) **(i)** List **three** practical precautions which should be taken when using a potometer.

1. ……

……

……

2. ……

……

……

3. ……

……

……

[3]

(ii) Suggest an assumption that has to be made if the potometer is used to measure the rate of transpiration.

……

……

[1]

A lack of water in herbaceous plants results in wilting. Plant cells are no longer turgid and mechanical strength is lost. Fig 3.2 shows the results of an investigation to compare the rates of transpiration and water absorption in a plant during a hot day in summer. There was adequate soil moisture available to the plant throughout the investigation, which began at midnight.

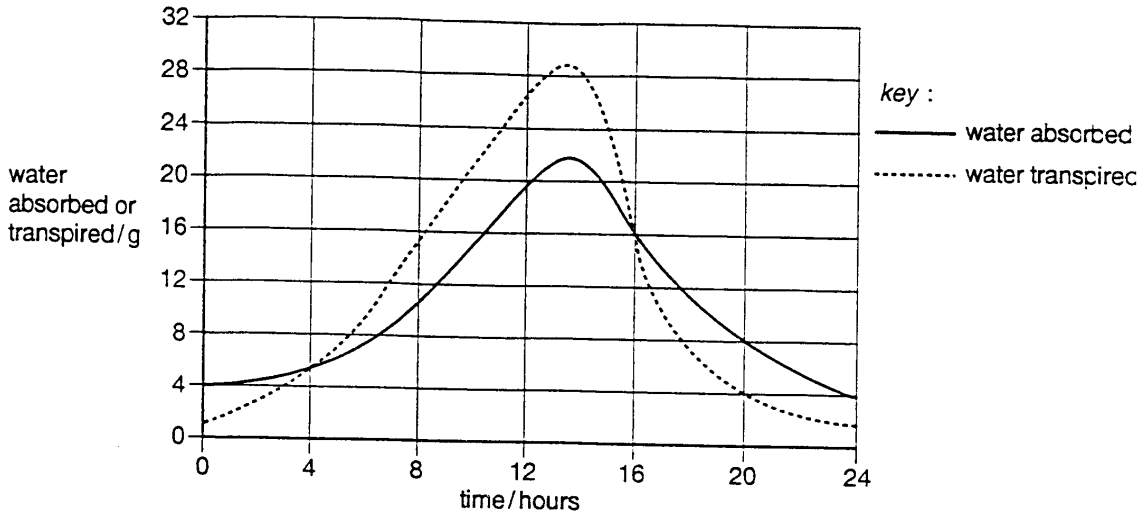

Fig.3.2

(c) With reference to Fig.3.2,

(i) describe how the rate of transpiration varied during the investigation, and compare this with the rate of water absorption.

(In this question, 1 mark is available for the quality of written communication.)

……

……

……

……

……

……

……

……

……

……

……

……

[8]

(ii) suggest, in terms of transpiration and absorption, when wilting would be most likely to occur in this investigation

……

……

[1]

(iii) explain, in terms of water potential, when plant cells will no longer be turgid and wilting may occur.

……

……

……

……

……

[2]

[Total : 17]

4 **(a)** List **four** ways in which arteries **differ in structure** from veins.

1. ……..……..

……

2. ……

……

3. ……

……

4. ……

……

[4]

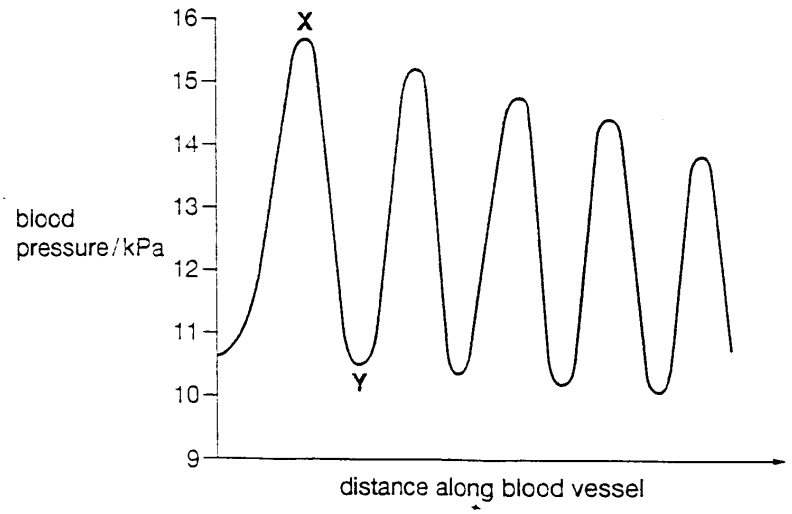

Fig.4.1

Fig.4.1 shows the blood pressure measured at different points along one blood vessel in the human circulatory system.

(b) With reference to Fig. 4.1,

(i) name the type of blood vessel in which the measurements could have been made;

……

[1]

(ii) explain the difference in blood pressure between **X** and **Y**;

……

……

……

[2]

(iii) explain the overall decrease in **maximum** blood pressure along the blood vessel.

……

……

……

[2]

The mammalian circulatory system is described as a closed, double circulatory system.

(c) **(i)** Explain briefly what is meant by a *double circulatory system.*

……

……

……

[2]

(ii) Suggest why having a double circulatory system is advantageous to a mammal.

……

……

……

……

[4]

[Total : 15]

5 Stem cells in the bone marrow divide to form reticulocytes, which are immature red blood cells. They have no nucleus, but retain the remains of some RNA in their cytoplasm. Some of these reticulocytes leave the bone marrow before becoming fully developed red blood cells.

(a) State **two** consequences of red blood cells lacking a nucleus.

1. ……..……..

2. ……

[2]

Samples of blood were taken from two Peruvians, one living at sea level and the other at high altitude (approximately 5000 metres). The number of all red blood cells, including reticulocytes, was counted in each sample of blood. The number of reticulocytes was also counted. The concentration of haemoglobin in the blood samples was measured in mg per 100 mm^3 whole blood. The release of new red blood cells from the bone marrow of each person was estimated.

A small quantity of each blood sample was placed into a capillary tube and spun in a centrifuge to measure the percentage of the total blood volume occupied by red blood cells and reticulocytes. This percentage is known as the haematocrit. The results of this test are shown in Fig. 5.1

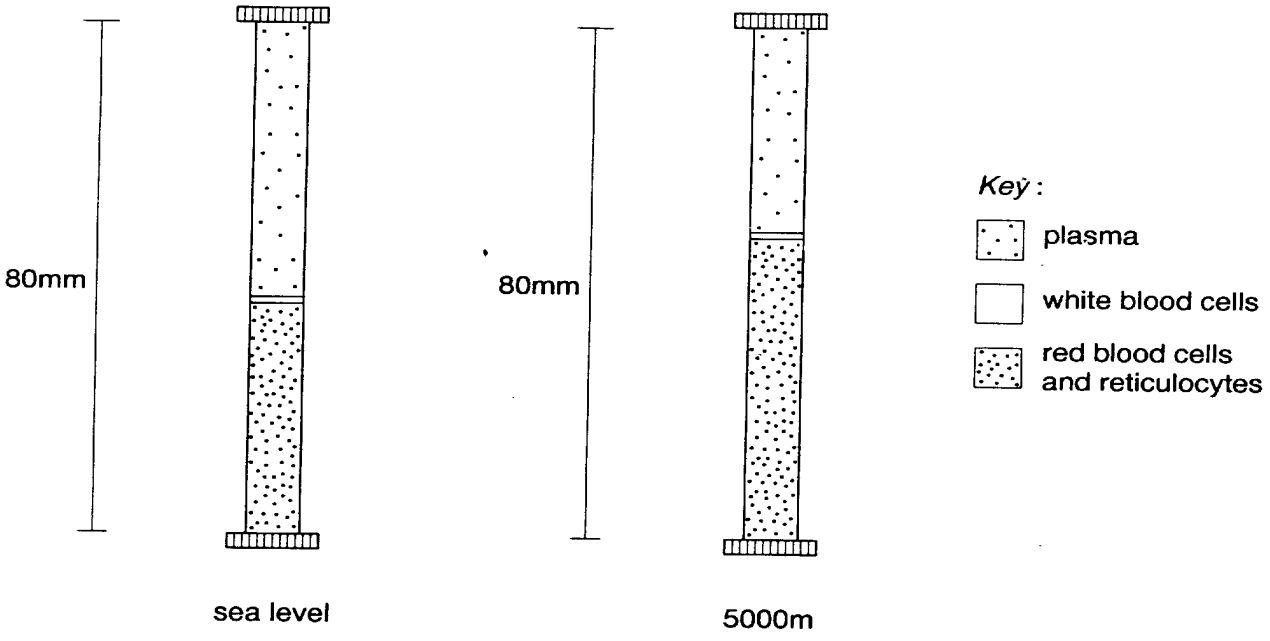

Fig. 5.1

Table 1 compares the results for the blood samples from the two Peruvians.

Table 1

	Peruvian at	
	sea level	*5000 metres*
red cell count/ cells mm^{-3}	5.0×10^6	6.4×10^6
reticulocytes/ cells mm^{-3}	1.8×10^4	4.5×10^4
red cell production/ no. cells produced per day	2.0×10^{11}	2.6×10^{11}
concentration of haemoglobin/ mg 100 mm^{-3} whole blood	15.0	20.0
haemocrit/%	45.0	

(b) Complete Table 1 by calculating the haematocrit of the blood sample for the Peruvian living at 5000 metres. **[1]**

(c) **(i)** With reference to the information given about the two blood samples, explain how the haemoglobin concentration is raised in people living at high altitude.

……

……

……

……

……

……

[4]

(ii) Explain why this high concentration is necessary when living at high altitude.

……

……

……

……

……

[3]

[Total 10]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
TRANSPORT **2803/01**

Mark Scheme

1 **(a)**

STRUCTURE	*FUNCTION*
A = vena cava;	return blood (to heart) from body;
B = pulmonary vein;	return blood (to heart) from lungs;
C = pulmonary artery;	carry blood to lungs (from heart);
D = chordae tendinae/ tendons;	prevent valves inverting;

[8 marks]

(b) ventricular contraction/systole;
pressure is greater in ventricle than in atrium;
to prevent blood going back into atria/ensure blood passes out though aorta/pulmonary artery; [2 marks max]

(c) sino-atrial node; [1 mark]

[Total : 11]

---

2 **(a)** phloem; [1 mark]

(b) **(i)** *SOURCE*
area/region where organic materials/solutes/sucrose produced/ area where photosynthesis occurs;
leaves/storage organs (qualified);
where organic solutes/sucrose loaded into sieve tube/ phloem; [2 marks max]

(ii) *SINK*
area which uses organic solutes/materials/sucrose;
storage organs/meristems/apices of roots/shoots/ developing flowers/fruits/nectaries/young leaves growth areas;
areas where organic solutes/materials/sucrose unloaded/ taken out of sieve tube; [2 marks max]

(c) active process/transport;
requires energy/ATP;
living cells involved; [2 marks max]

[Total : 7]

---

3 **(a)** the loss of water vapour/evaporation of water;
from a plant; [2 marks]

(b) **(i)** constant external/environmental conditions;
shoot put into water as cut/shoot cut under water;
inserted into potometer under water/avoid air bubbles/
shoot in contact with water;
use undamaged/healthy shoot/large number/
several leaves;
allow time for apparatus to settle down;
avoid wetting leaves;
use vaseline/ensure air-tight/no leaks/ensure clip is
tight/closed; [3 marks max]

(ii) water loss by transpiration same as water uptake;
none of water taken in used by plant; [1 mark max]

(c) **(i)** ***Quality of written communication assessed in this answer.***

increased between 0 and 13/14 hours/I pm/2 pm;
from 1/2g to 29g;
reached a peak at 13/14/hours/1 pm/2 pm;
decreased between 13/1 pm and 24 hours/I pm and 2 pm;
from 29g to 2g;
transpiration rises/increases more than absorption;
both transpiration and absorption increase during same period;
both transpiration and absorption fall during same period;
maximum rates of both at same time;
transpiration reduces /falls more than absorption;
correct use of figures from graph to support above points;
any other valid comparison supported by figures; [7 marks max]

Q – clear, well organised using specialist terms; [1 mark]
[8 marks max]

(ii) when transpiration greater than absorption; [1 mark]

(iii) water potential outside cell lower/more negative, than inside;
water movement down water potential gradient/
from high to low water potential;
pressure potential zero; [2 marks max]

[Total : 17]

---

4 **(a)** do not have valves;
small/narrow lumen;
thick/muscular, walls/tunica media;
high elastic content;
small amounts of collagen; [4 marks max]

(b) **(i)** artery; [1 mark]

(ii) ventricular contraction/systole at **X**;
ventricular relaxation/diastole at **Y**;
stretching and recoil of blood vessel wall/elasticity of vessel wall;
[2 marks max]

(iii) ref to distance from heart;
friction/resistance to blood flow; [2 marks]

(c) **(i)** blood passes through heart twice during every circuit;
separate circulation to lungs/pulmonary circualtion;
and to rest of body/systemic circulation;
(A) appropriate diagrams [2 marks max]

(ii) no mixing of oxygenated and deoxygenated blood;
more oxygen reaches tissues/cells/more efficient supply
to tissues/cells;
helps to sustain high blood pressure;
less resistance to blood flow;
easier to get blood back to heart;
allows more rapid circulation;
greater level of activity possible;

high blood pressure does not damage lungs; [4 marks max]

[Total : 15]

- -

5 **(a)** more haemoglobin, more oxygen can be transported per cell;

biconcave disc shape, larger SA/V ratio/better exchange of gases; short life span;

no mitosis/replication/division;

cannot control celluar activities;

no transcription/RNA production;

cannot synthesise proteins;

lighter mass;

one/few functions only;

[2 marks max]

(b) 57.5 – 59% [1 mark]

(c) **(i)** red cell count increases (30%) /A/W;

red cell production increases (by 30%);

red cells form greater proportion of blood/haematocrit increases;

cells released from bone marrow before they are mature;

more that twice as many reticulocytes in the blood/more reticulocytes;

proportion of reticulocytes has doubled;

[4 marks max]

(ii) low partial pressure of oxygen in the air / low air pressure / less oxygen in air;

loading tension in lungs decreases/lower affinity for oxygen by haemoglobin;

decreases volume of oxygen in each breath;

lower concentration gradient between air and blood in lungs;

haemoglobin not fully saturated;

maximum amount of oxygen in blood decreases;

hypoxia;

less oxygen available to tissues;

oxygen needed to support aerobic respiration / A/W;

increase in haemoglobin to maintain oxygen carrying capacity;

more haemoglobin to carry same amount of oxygen;

for inefficient loading of O2 in lungs;

AVP;

[3 marks max]

[Total : 10]

Assessment Grid: AS BIOLOGY

Unit Name	Transport	Unit Code	2803/01	Session: JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (34-38) a (11-13)	b (socet) (11-13)	c (11-13)	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (22-26) a (5-7)	b (5-7)	C (5-7)	d (5-7)	Target grade	QoWL	Total (60)
1 (a)	2 (a) (b)	8									
(b)	2 (d)	2									
(c)	2 (e)	1									11
2 (a)	3 (j)	1									
(b)	3 (i)	4									
(c)	3 (j)				2						7
3 (a)	3 (b)	2									
(b) (i)	3 (c)	3									
(ii)	3 (c)	1									
(c) (i)	3(b) + (c)					7				1	
(ii)	3(b) + (c)				1						
(iii)	3(b) + (c)				2						17
4 (a)	1 (b)	4									
(b) (i)	1 (c)				1						
(ii)	1 (c)				2						
(iii)	1 (c)				2						
(c)(i)	2 (c)	2									
(ii)	2 (c)			4							15
5 (a)	1(d)				2						
(b)	1 (c)					1					
(c) (c)	1 (c)					4					
(ii)	1 (c)				3						10
Total		**28**	**0**	**4**	**15**	**12**	**0**	**0**		**1**	
Total for sections			**32**				**27**				**60**

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY

PRACTICAL EXAMINATION 1 **2803/03**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

Answer **all** questions. (Note: Question 1 is completed before candidates take this practical paper.)

Fasten your answer to question 1 to your answers to questions 2 and 3.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

Total marks for this paper is 60.

SECTION ONE (Planning)

Question 1

You are required to plan a procedure that will allow you to compare quantitatively the glucose concentrations in samples of fresh orange, lemon and grapefruit juice.

Your answers must be expressed in mg cm^{-3} of glucose. You will have access to standard laboratory apparatus and the following materials only:

4% (by mass) glucose solution;

distilled water;

Benedict's solution;

fresh oranges, lemons and grapefruit.

In any Benedict's tests that you intend to perform, you are advised to use 5 cm^3 of Benedict's solution to 0.5 cm^3 samples of all solutions.

Give full details of your procedure and state how you will make your comparison of the juices as reliable as possible.

[16]

SECTION TWO

Question 2

[55 minutes]

You are required to investigate the effect of glucose and sucrose on gas production by yeast in different conditions. You are provided with the following mixtures of a standard yeast suspension.

K1 yeast suspension with an equal volume of 0.2 mol dm^{-3} glucose solution

K2 yeast suspension with an equal volume of 0.2 mol dm^{-3} sucrose solution

K3 yeast suspension with an equal volume of distilled water

Proceed as follows:

Half-fill a beaker or tin with water. Adjust its temperature to between 38 and 42 °C.

Maintain the water bath at this temperature.

Label two boiling tubes **K1** and **K2** respectively.

Stir suspensions **K1** and **K2** thoroughly using a glass rod. To one boiling tube add **20 cm^3** of **K1** and to the other add **20 cm^3** of **K2**. Fit both tubes with a bung and delivery tube. Ensure that the fitting is airtight. Place both tubes in the water bath. Position the test-tubes with water for each of the delivery tubes **outside** the water bath as shown in Fig. 2.1.

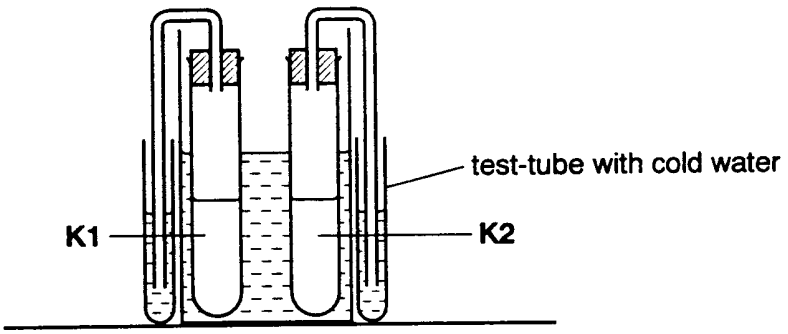

Fig. 2.1

Soon after you have set up the apparatus, bubbles of gas will emerge from the ends of the delivery tubes. After a few minutes, when the bubbles appear regularly, count the number of bubbles produced in **three successive one-minute time intervals** from both tubes. When you make a count, begin timing as soon as a bubble leaves the delivery tube.

(a) **(i)** Record your results in the first two columns of the table provided below. **[1]**

bubbling rate / bubbles per minute				
Reading	**K1** (38 – 42°C)	**K2** (38 – 42°C)	**K1** (plus 10°C)	**K3**
1				
2				
3				
Mean				

(ii) Calculate the mean bubbling rate for both sets of readings (to the nearest whole number) and add them to the table. **[1]**

(b) Remove both tubes from the water bath and put them to one side.

Raise the temperature of the water bath by approximately **10°C** and maintain it at this temperature. Return the apparatus containing **K1** to the water bath. Wait for **two minutes**, then take **three** successive readings of the bubbling rate at this temperature.

Add your results to the table and calculate the mean bubbling rate at this temperature.

[2]

(c) Repeat the procedure using **K3 at the same temperature as in (b)** to obtain three readings with this mixture. You can use either piece of apparatus that you have used before, but wash it thoroughly. **[1]**

(d) **(i)** Account fully for the production of bubbles by **K1** in **(a)**.

……

……

……

[3]

(ii) Explain the effect of raising the temperature by about 10°C on the bubbling rate of **K1**.

……

……

……

……

[3]

(iii) State **two** reasons for waiting two minutes before making the observations in **(b)**.

……

……

[2]

(iv) Explain how you could improve both the practical procedure and the analysis of the results to get a more reliable comparison of bubbling rates at the two different temperatures.

……

……

……

……

……

……

……

……

[6]

(v) What prediction about bubbling rate would you make

1 if you continued to measure the rate in **(b)** for the next hour or so?

2 if you raised the temperature in **K1** to 80°C?

State a reason for your answer in each case.

……

……

……

……

[2]

(e) **(i)** Comment on your results for **K1** and **K2** at 38 – 42°C.

……

……

……

……

[4]

(ii) Explain your results in **(c)**. **[2]**

[Total : 27]

Question 3

[35 minutes]

K4 is a preparation made from a sheep's kidney. White silicone rubber was injected into the renal artery. The artery was then tied and the silicone rubber allowed to harden. The tissue of the kidney was then digested away so that the course of the silicone rubber through the arteries could be seen. **K4** is a small piece of this material.

Mount **K4** on a microscope slide. Gently tease the material apart, add a drop of water and a cover slip. Examine **K4** carefully using your microscope. You may find it helpful to use top illumination or to turn off the substage light.

(a) Make a drawing to record your observations of the structures revealed by this technique. *No labels are required.*

[3]

Slide **K5** is a stained, vertical section through a kidney of a different mammal. A number of different regions make up the section. These are shown in Fig. 3.1.

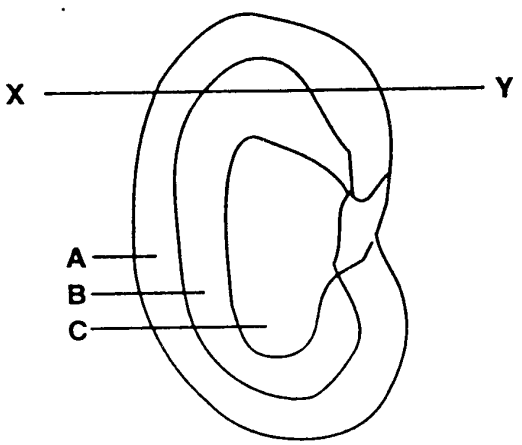

Fig. 3.1

Examine **K5** carefully using a hand lens and your microscope.

(b) For each of the regions **A**, **B** and **C**, labelled in Fig. 3.1, describe the structures which are visible and characteristic of each region.

No details are required of the names of various regions of the tubules.

Region **A**

……

……

Region **B**

……

……

Region **C**

……

……

[5]

In region **A** of the section, structures occur which you also saw in **K4**.

(c) What further details of these structures are shown in region **A** of **K5** compared with those in **K4**?

……

……

[3]

K6 is also a stained section of a mammalian kidney. It has been cut along the plane shown by the line **X-Y** in Fig. 3.1.

(d) What features of this section indicate that it has been taken in the plane stated above?

……

……

[3]

In **K6**, the nuclei and cytoplasm of the cells of the tubules have been stained blue/purple, and red blood cells orange/red. Examine the central region of **K6** under high power. Identify the large numbers of blood capillaries containing red cells. The sections of the tubules in this region are very similar.

(e) Make a high power drawing to show the structure of **one** typical tubule in this region.

No labels are required.

[3]

[Total : 17]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

BIOLOGY
CENTRAL CONCEPTS **2804**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Write your answers on the separate answer paper provided

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of your written communication where an answer requires a piece of extended writing.

The total marks for this paper is 90.

Answer **ALL** Questions.

1 Fig.1.1 shows some of the reactions which occur during aerobic respiration in an animal cell.

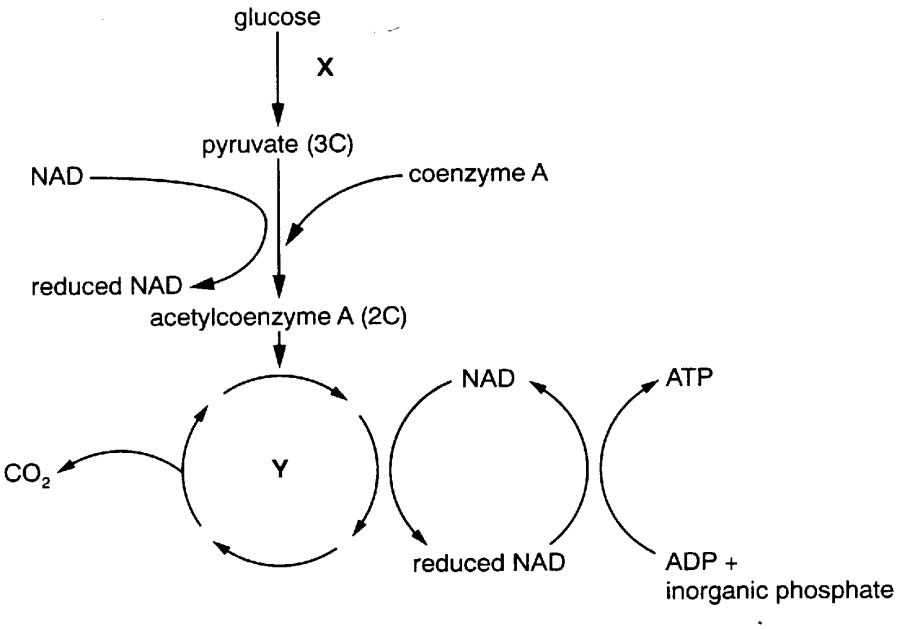

Fig.1.1

(a) (i) Identify pathways **X** and **Y**.

X .....

Y ..... **[2]**

(ii) State precisely where pathway **X** occurs.

..... **[1]**

(b) Explain why one of the enzymes involved in the conversion of pyruvate to acetyl coenzyme A is called pyruvate dehydrogenase.

.....

.....

..... **[2]**

(c) State what is meant by the term decarboxylation.

.....

.....

..... **[1]**

(d) (i) State the site of oxidative phosphorylation in an animal cell.

.....

[1]

(ii) Describe in outline the production of ATP in oxidative phosphorylation.

.....

.....

.....

.....

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.....

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.....

.....

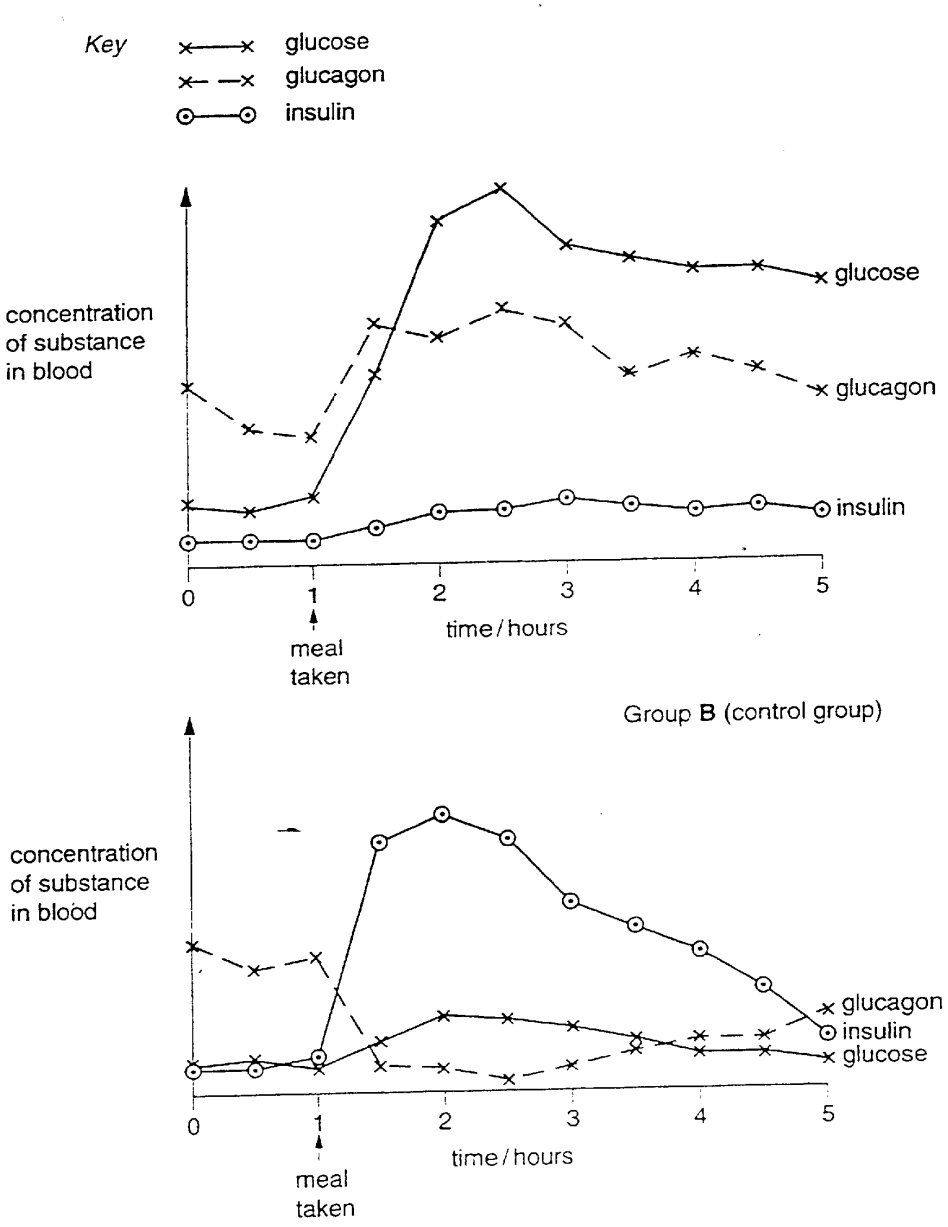
.....

[5]

[Total : 12]

2 In one form of diabetes, the pancreas is unable to make sufficient insulin. In an investigation, twenty people were divided into two groups. Group **A** contained ten people with this form of diabetes, while Group **B** contained ten people without diabetes (control group).

Blood samples were taken from each person at 30 minute intervals, and the amounts of glucose, insulin and glucagon measured. After one hour, each person ate a meal containing a large amount of carbohydrate. Mean concentrations were calculated for each substance at each sampling time. The results are shown in Fig. 2.1.



(a) **(i)** State **one** difference between Groups **A** and **B** in the way in which **glucagon** secretion responds to the intake of carbohydrate.

.....

.....

.....

[1]

(ii) State **two** differences between Groups **A** and **B** in the way in which **insulin** secretion responds to the intake of carbohydrate.

1. .....

.....

.....

2. .....

.....

.....

[2]

(b) Explain the changes in blood glucose concentration in

(i) Group A .....

.....

.....

.....

[3]

(ii) Group B .....

.....

.....

.....

[3]

(c) Suggest what would happen to the blood glucose concentration of people in Group A, if they ate no carbohydrate for another 24 hours. Explain your answer.

.....

.....

.....

.....

[3]

[Total : 12]

3 Fig. 3.1 shows the changes in the size of a bacteria population with time when grown in a flask containing a sterile solution of glucose.

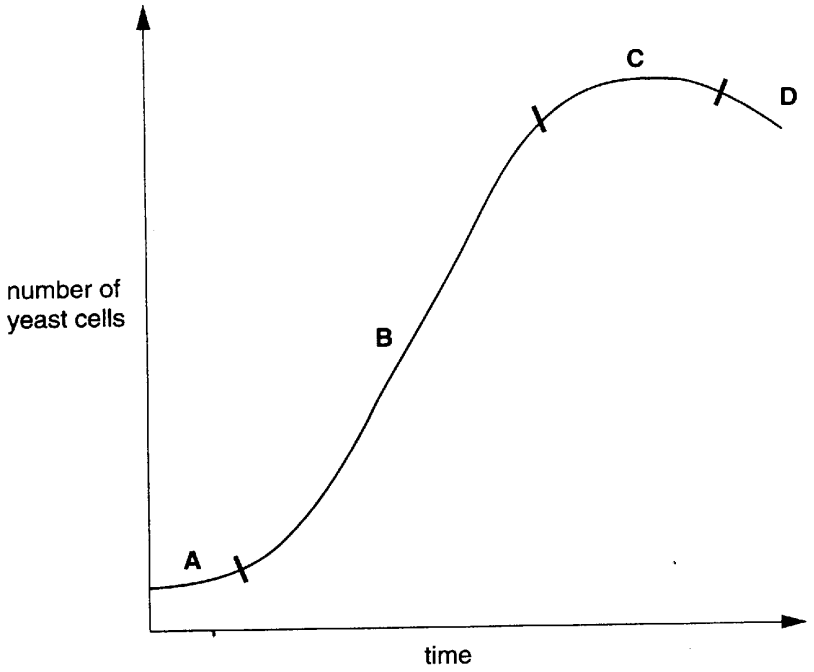


Fig. 3.1

(a) Name the phase of growth and explain the shape of the curve at each of the periods A to C in Fig 3.1.

……

……

……

……

……

……

……

……

…… **[6]**

(b) With reference to a named examples, explain how limiting factors determine the final size of populations in nature.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

[Total : 15]

4 Guinea pigs, which were homozygous for long, black hair were crossed with ones which were homozygous for short white hair. All the F1 offspring had short, black hair.

(a) (i) Using suitable symbols, draw a genetic diagram to explain this result.

Symbols used

……

Genetic diagram

[3]

(ii) Draw a genetic diagram to show the results of interbreeding the F_1 offspring.

Genetic diagram

[5]

(b) State the ratio of phenotypes expected in the F_2 offspring.

……..……..

……..……..

[1]

[Total : 9]

5 **(a)** **(i)** State **three** ways in which meiosis can lead to variation.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(ii) Explain why variation is important in selection.

.....

.....

.....

.....

[2]

Rye, *Secale cereale*, is a cereal crop which is widely cultivated. It is believed to have originated over 2500 years ago in Asia Minor from *Secale ancestralis*, a wild species with a fragile stem but fairly large grains. When the cultivation of wheat, *Triticum sp*., spread, wild rye accompanied the wheat as a weed. The ability of wild rye to thrive on poor soil, and to resist frost and drought better than wheat, resulted in it being subjected to selection pressures such that it yielded a crop when the wheat failed. Climatic and soil factors eliminated the wheat, leaving rye as the sole cereal crop in northern upland regions. Artificial selection of rye has favoured the varieties with the highest grain yield.

(b) Explain why *Secale ancestralis* and *Secale cereale* are classified within the same genus but as separate species.

.....

.....

.....

.....

.....

[2]

(c) With reference to the passage,

(i) Explain what is meant by the term *selection pressure*;

…….....

…….....

…….....

…….....

[2]

(ii) Suggest how natural selection has led to rye becoming 'the sole cereal crop in northern upland regions'.

…….....

…….....

…….....

…….....

…….....

[3]

(d) Explain how artificial selection of rye could have been achieved.

…….....

…….....

…….....

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…….....

…….....

[4]

[Total : 16]

6. One of the effects of gibberellin is to stimulate stem elongation in dwarf pea plants. This forms the basis for a technique (known as bioassay) for measuring the quantity of this plant growth regulator in tissues and organs. To measure the effect of a range of known quantities of gibberellic acid, 42 seeds from pure-bred dwarf pea plants were germinated, grown under identical conditions for two weeks, and then divided into seven batches (A to G). Each batch of seedlings was sprayed with a different dose of gibberellin dissolved in water at weekly intervals for five weeks. A further batch of six seedlings (H) from a pure-bred tall pea plant was grown under identical conditions but these were not sprayed. Two weeks after the final spraying, the stem lengths of all the plants were measured; the mean lengths of batches A to H are shown in Table 6.1.

Batch	Weekly dose of gibberellin / mg	Mean length of stem / mm
A	0.00	152
B	0.05	204
C	0.10	251
D	0.50	408
E	1.00	454
F	5.00	600
G	10.00	623
H	not sprayed	627

Table 6.1

(a) With reference to Table 6.1, describe the effect of spraying gibberellin on pea seedlings.

……

……

……

……

……

[3]

(b) **(i)** Suggest a likely cause of the dwarfism of the pea plants used in this investigation.

……

……

[1]

(ii) State **one** reason for the use of seeds from pure-bred plants.

…….....

…….....

[1]

(c) Make **two** criticisms of the design of this investigation.

1. .....….

.....….

2. .....….

.....….

[2]

(d) Describe the role of gibberellin in the germination of cereals such as wheat and barley.

…….....…..

…….....…..

…….....…..

…….....…..

…….....…..

[3]

Growth retardants are substances which are used to limit the height of both cereals and ornamental species which are grown for their flowers.

(e) Describe two economic advantages of using growth retardants.

1. .....….

.....….....…

2. .....….

.....….....

[2]

[Total : 12]

7 T. W. Engelmann investigated the effect of different wavelengths of light on photosynthesis. He placed a filamentous green alga into a test tube along with a suspension of motile bacteria which move to regions of high oxygen concentration. He allowed the bacteria to use up the available oxygen and then illuminated the alga with light that had been passed through a prism to form a spectrum. After a short time, he observed the results shown in Fig. 7.1. Bacteria, which are indicated by the tiny rectangles, were evenly distributed throughout the test tube at the start of the experiment.

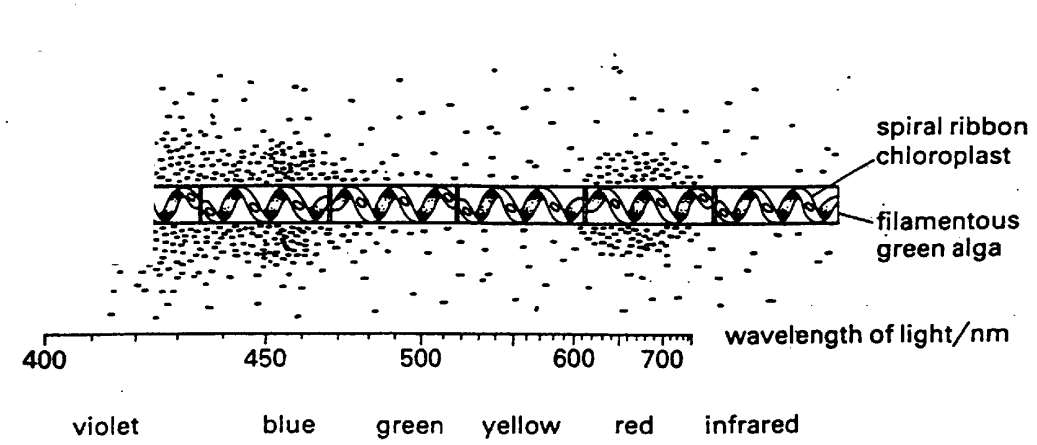

Fig. 7.1

(a) With reference to the passage and to Fig.7.1, sketch a graph on the axes provided below, to show how the rate of photosynthesis varies with the wavelength of light. Label the axes on your graph.

[2]

(b) Explain the reasons for the results observed in Fig.7.1.

……

……

……

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……

……

[4]

(c) Explain the role of the Calvin cycle in fixing carbon dioxide to form carbohydrates.

(In this question, 1 mark is available for the quality of written communication.)

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……

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[8]

[Total : 14]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
CENTRAL CONCEPTS **2804**

Mark Scheme

1 **(a)** **(i)** X = glycolysis;
Y = Krebs / TCA / citric acid, cycle; [2 marks]

(ii) cytoplasm / ground cytoplasm / cytosol [1 mark]

(b) removal of hydrogen (ions);
from, pyruvate / pyruvic acid;
to acceptor / to coenzyme / not directly to oxygen; [2 marks max]

(c) removal of, carbon dioxide / carboxyl group; ® carbonyl [1 mark]

(d) **(i)** inner membrane of mitochondrion [1 mark]

(ii) ref to ATPase / ATP synthetase;
final acceptor is oxygen;
ref to redox reactions / energy levels;
hydrogen / proteins, moved across inner membrane;
proton pump in membrane;
electrons passed along a series of carriers;
to generate proton gradient/electrochemical gradient;
across inner membrane;
[5 marks max]

[Total : 12]

---

2 **(a)** **(i)** glucagon secretion <u>increases</u> in **A** *and*
glucagon secretion <u>decreases</u> in **B** [1 mark]

(ii) rise in insulin secretion is less than **A** than in **B** / converse;
rise in insulin secretion occurs more slowly in **A**
than in B / converse; [2 marks]

(b) **(i)** glucose rises as carbohydrate absorbed into the blood;
glucose slowly drops as absorbed by cells;
used in respiration / other named process;
glucose rise encouraged by increased glucagon secretion
/ release;

causes glucose to be released from cells;
glucose lost in urine/lost from kidneys; [3 marks max]

(ii) rise in blood glucose detected by pancreas / islets;
insulin secreted / released;
increases uptake of glucose by liver/muscle (cells);
converted to/stored as glycogen;
detail of insulin action;
detail of glucagon role [3 marks max]

(c) would fall below normal/crash/below that of Grp **B;**
fall linked with coma;
because few glycogen stores to mobilise / **AW**;
no insulin to stimulate conversion of glucose to glycogen;
energy/glucose being used in respiration;
glucose excreted in urine. [3 marks max]

[Total : 12]

- -

3 **(a)** **A** – lag phase;
time of production of enzymes to use substrate;
acclimatising / adjusting to new environment;
taking up nutrients;

B – exponential phase / log / geometric phase;
cells dividing at fastest rate / high rate of reproduction;
now using plentiful food supplies;

C – stationary phase / plateau / static phase;
nutrients depleted / limiting, so growth slows;
toxins / wastes starting to build up / reaches carrying capacity /
cell division = cell death;
reference to carrying capacity;
environmental resistance; [6 marks max]

(b) ***Quality of written communication assessed in this answer.***
example of organisms;

examples of limiting factors;
competition for, resource;
named resources;
refs to predation;
refs to disease;
leads to differential survival;
ref to population numbers being held in check;
increase in death rate / slowing in reproduction rate; [8 marks max]

Q – legible text with accurate spelling, punctuation and grammar [1 mark]

[9 marks max]

[Total : 15]

---

4 **(a)** **(i)** *suitable symbols*

for black/short – dominant = upper case

recessive = lower case (same letter)

parental genotypes;

F_1 [3 marks]

(ii) *F_1 parents*

eg SsBb x SsBb;

gametes

labelled/in circles/in Punnett square

eg SB Sb sB sb;

use of Punnett square/suitable layout;

F2 phenotypes linked to genotypes; [5 marks]

(b) 9 black short : 3 white short :3 black long

1 white short [1 mark]

[Total : 9]

---

5 **(a)** **(i)** halves number of chromosomes;
segregation of alleles/described;
independent/random assortment of chromosomes;
chiasmata/crossing over of chromatids;
in meiosis I;
ref to chromosome mutation [3 marks max]

(ii) (variation) can be inherited;
some individuals more/less suited/**AW**;
only better suited, pass on alleles/reproduce;
AVP [2 marks max]

(b) (many) common features;
do not interbreed;
to produce fertile offspring;
ref to isolated gene pools [2 marks max]

(c) **(i)** factor which favours certain variation/phenotype/genotype/converse;
factor which increases the chance of alleles being passed on/ converse;
frost/drought/poor soil/abiotic/environmental;
so changes gene frequency;
ref to gene pool [2 marks max]

(ii) rye can cope with frost/drought /poor soil;
many rye plants survive;
these conditions/pressures do not favour wheat survival;
few/no wheat plants survive; [3 marks max]

(d) selective breeding/breeding programme;
choose parents with desirable characteristics/eliminate undesirable parents;
eg of characteristic;
inspect/test offspring;
ref to field trials;
ref to time/many generations;
ref to genetic engineering;

with detail;
AVP [4 marks max]

[Total : 16]

- -

6 **(a)** increase in concentration of gibberellin, increase in stem length;
smaller effects at higher concentrations;
Batch **G /** 10 μg, similar response to tall pea plant;
ref to figs from the table; [3 marks max]

(b) **(i)** mutation;
genetically determined;
gene for dwarfism;
no gibberellin produced [1 mark]

(ii) no genetic variation / all genetically identical [1 mark]

(c) no controls for each treatment with gibberellin / tall plants should be sprayed with all concentrations of gibberellin / water;
only small number of plants used;

no record of variation in results / no standard deviation calculated;
spray may have, dripped off / not reached leaves;
AVP [2 marks max]

(d) secreted by seed when soaked in water;
stimulates protein synthesis;
enzymes;
amylases;
breakdown of food reserves stored in seed;
starch → glucose;
to provide energy for respiration [3 marks max]

(e) more production in to, harvestable material / flowers / fruit / seed / grain (less growth which is not of any economic importance / value;

plants, more sturdy / less likely to fall over / can support larger, blooms, fruits, seeds;

reduced cutting of hedges etc [2 marks max]

[Total : 12]

- -

7 **(a)** correctly drawn curve;

blue peak higher [2 marks]

(b) more photosynthesis;

in certain wavelengths;

red and blue light;

results in more oxygen produced;

more bacteria attracted;

no photosynthesis in green / yellow light [4 marks max]

(c) ***Quality of written communication assessed in this answer.***

RuBP, carbon acceptor;

5 carbon compound;

enzyme, Rubisco / carboxylase;

carboxylation;

temporary 6 carbon compound forms;

glycerate-3-phosphate / GP;

reduction / use of reduced NADP;

NADP from light dependent stage;

phosphorylation / use of ATP;

ATP from light dependent stage;

triose phosphate / 3 carbon sugar;

synthesised into 6 carbon sugars;

e.g.;

synthesis of sucrose;

polysaccharides / starch / cellulose;

regeneration of RuBP;

uses more ATP [7 marks max]

Q – clear, well organised, using specialist terms [1 mark]

[8 marks]

[Total : 14]

- -

Assessment Grid: A2 BIOLOGY					
Unit Name	**Central Concepts**	**Unit Code**	**2804**	**Session: JAN / JUNE**	**Year:**

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (52-56) a (17-19)	b (socet) (17-19)	c (17-19)	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (34-38) a (8-9)	b (8-9)	c (8-9)	d (8-9)	Target grade	QoWL	Total (90)
1(a)(i)	1(e)(g)	2									
(ii)	1(e)	1									
(b)	1(h)				2						
(c)	1(h)				1						
(d)(i)	1(d)	1									
(ii)	1(i)				5						12
2(a)(i)	6(n)					1					
(ii)	6(n)					2					
(b)(i)	6(n)				3						
(ii)					3						
(c)	6(n)						3				12
3(a)	3(a)	6									
(b)	3(b)			8						1	15
4(a)(i)	4(d)				3						
(ii)	4(d)						5				
(b)	4(d)	1									9
5(a)(i)	4(b)	3									
(ii)	5(q)			2							
(b)	5(b)(c)			2							
(c)(i)	5(g)			2							
(ii)	5(g)						3				
(d)	5(i)			4							16
6(a)	6(r)					3					
(b)(i)	4(g)				1						
(ii)	6(r)				1						
(c)	6(r)							2			
(d)	6(r)	3									
(e)	6		2								12
7(a)	2(a)(f)					2					
(b)	2(f)						4				
(c)	2(d)			7						1	14
Total		**18**	**2**	**25**	**19**	**8**	**14**	**2**		**2**	
Total for sections			**45**			**43**				**2**	**90**

RECOGNISING ACHIEVEMENT

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY

GROWTH, DEVELOPMENT AND REPRODUCTION **2805/01**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 90.

Answer **ALL** Questions.

1 Table 1.1 gives examples of asexual reproduction in organisms from three different kingdoms.

Table 1.1

Kingdom	Type of asexual Reproduction	Named organism
Prokaryotae	Binary fission	
		Yeast (*Saccharomyces*)
Protoctista		

(a) Complete each of the blank spaces in Table 1.1, using suitable names or terms. **[5]**

Yeast has both sexual and asexual methods of reproduction.

(b) State **one** advantage and **one** disadvantage of asexual reproduction for the yeast.

Advantage .....

.....

Disadvantage .....

.....

[2]

[Total : 7]

2 *Read the passage, and then answer the questions which follow.*

Sorghum and millet are very important food crops in tropical and subtropical parts of the world. Yields of sorghum and millet can be severely reduced by high temperatures, particularly during germination and early growth of seedlings. Research is being carried out into the ways in which some varieties of these crops resist this environmental stress, in the hope of producing new varieties, which will give reliable yields in a wide range of climates.

When sorghum and millet seedlings are exposed to temperatures above 37 °C, they produce a set of proteins called heat shock proteins, or HSPs. Sorghum seedlings are most easily damaged by high temperatures during the first few hours of germination, when their ability to synthesise HSPs is at its lowest. In millet, however, ability to synthesise HSPs declines over the first 12 days after sowing, as does its ability to survive high temperatures. It is now possible to measure HSP synthesis in plants quickly and easily, which will permit rapid screening and evaluation of heat tolerance of different genotypes.

(a) Suggest how high temperatures may severely reduce yields from plants, such as sorghum and millet.

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.....

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[4]

(b) Summarise **two** pieces of evidence, from the passage, which support the hypothesis that HSPs help sorghum and millet seedlings to survive high temperatures.

.....

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.....

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[4]

(c) Explain how the ability to measure HSP synthesis could be used to develop more heat-tolerant varieties of sorghum or millet.

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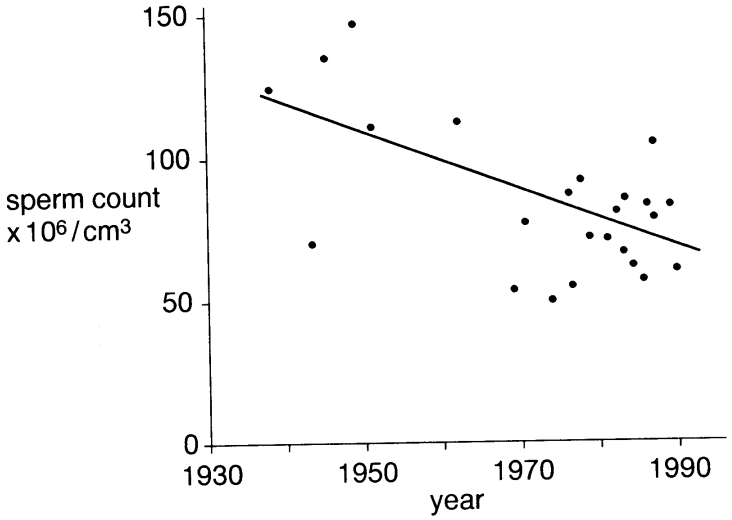
.....

[4]

[Total : 12]

3 A recent study has analysed sperm counts of human males taken between 1938 and 1990. The results are shown in Fig. 3.1.



©Adapted by permission from *BMJ*, 1992.

Fig. 3.1

(a) Using the information in Fig. 3.1, describe the changes in sperm count between 1938 and 1990.

.....

.....

.....

.....

[2]

(b) Suggest **one** reason why two sperm counts taken at different times, from the same man, might vary.

.....

.....

.....

[1]

(c) Describe the passage of sperm from the testes to the oviduct until fertilisation has been completed.

(In this question, 1 mark is available for the quality of written communication.)

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.....

[8]

Some scientists have attributed the changes in sperm counts to the effects of oestrogens in the environment, which can bind to oestrogen receptors in the body. The pesticide DDT is one of many chemicals that have been shown to act in this way. Other chemicals can act as anti-oestrogens and block the activity of oestrogen receptors.

(d) Explain what is meant by the following.

(i) *can bind to oestrogen receptors*

.....

.....

.....

.....

[2]

(ii) *block the activity of oestrogen receptors*

.....

.....

.....

.....

[2]

(e) Suggest **three** sites in the body where oestrogen receptors may be found.

1. ……..

2. ……

3. ……..

[3]

[Total : 18]

4 **(a)** Describe the functions of the testa and cotyledons in a seed.

.....

.....

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.....

.....

.....

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.....

.....

.....

[6]

Lettuce seeds are surrounded by a tough coat. In an investigation, seeds of the 'Grand Rapids' variety of lettuce were subjected to four different treatments as shown in Table 4.1. In each treatment, 100 seeds were placed on moist filter paper in a petri dish and left for 30 hours to allow germination to take place.

Table 4.1

treatment	**pretreatment**	**experimental conditions**	
		temperature / °C	**light or dark**
1	none	25	dark
2	none	25	light
3	none	2 for hours 0 – 4 25 for hours 4 - 30	dark
4	seed coat scratched	25	dark

After 30 hours, the percentage germination in each batch of seeds was determined. The results are shown in Fig. 4.1.

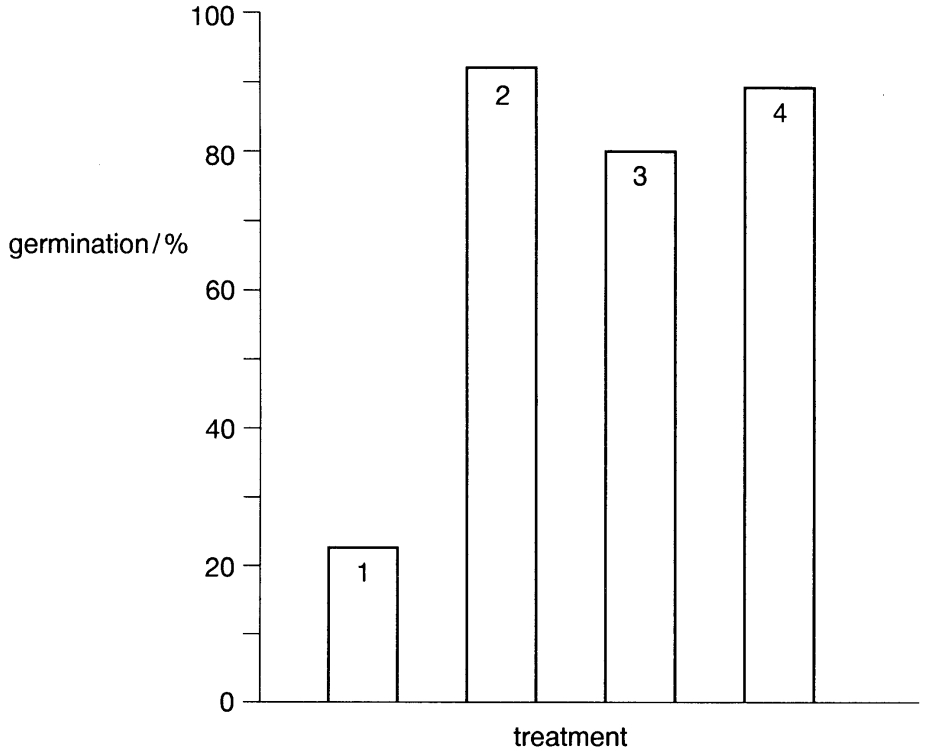

Fig. 4.1

(b) With reference to Table 4.1 and to Fig. 4.1,

(i) describe the effect of light on the germination of Grand Rapids lettuce seeds;

.....

.....

.....

.....

[1]

(ii) suggest an explanation for the difference between the germination rates in

treatments 1 and 3 .....…

.....….....

.....….....

treatments 1 and 4 .....…

.....….....

.....….....

[4]

[Total : 11]

5 Fig. 5.1 shows a diagram of the human female reproductive tract, indicating the position of the endometrium.

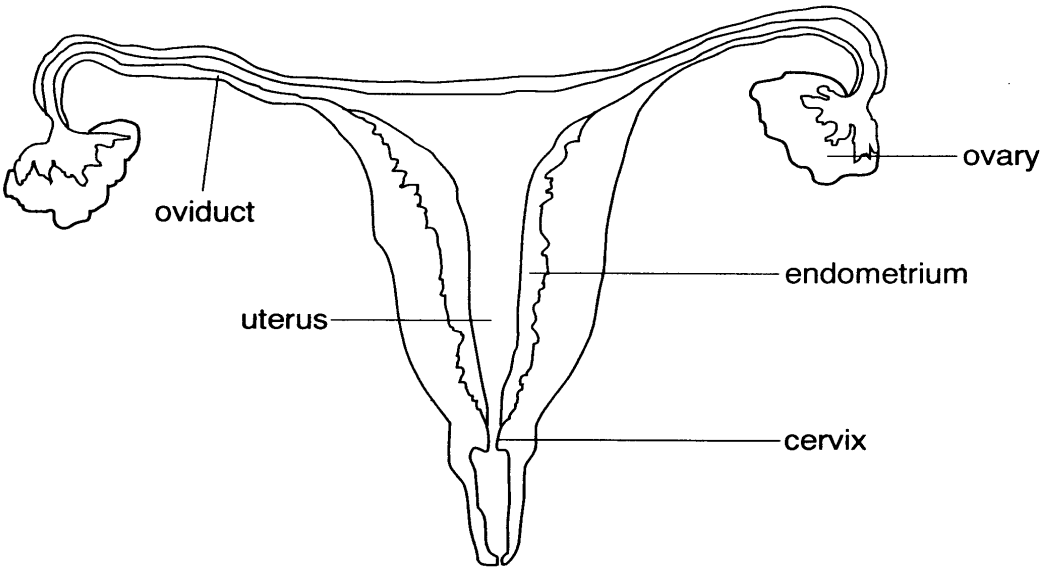

Fig. 5.1

(a) **(i)** Describe the changes which take place in the endometrium during the menstrual cycle.

.....

.....

.....

.....

.....

[3]

(ii) List **three** ways in which the normal sequence of events of the menstrual cycle, in sexually mature females, may be altered.

1. .....

2. .....

3. .....

[3]

Endometriosis is a condition which arises when cells from the endometrium pass into the oviducts and implant around the ovaries. The condition can result in damage to ovarian tissue, causing reduced fertility.

Fig. 5.2 shows the results of a three-year study to compare the levels of successful conception in couples in which the female was either normal or affected by endometriosis.

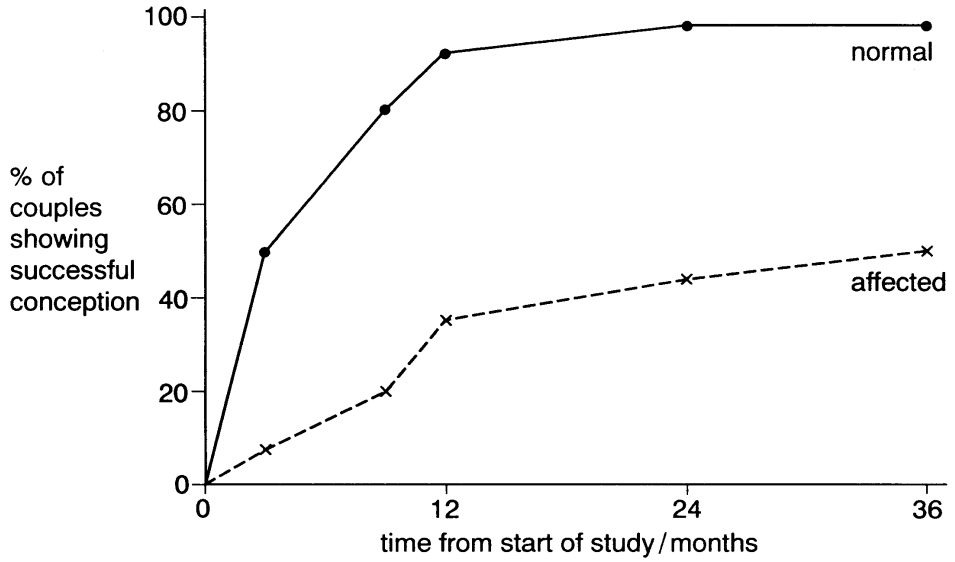

Fig. 5.2

(b) With reference to Fig. 5.2 and the information given, state the effect that the condition has on the chances of successful conception.

1. ……

2. ……

3. ……

[2]

Women with a severe form of endometriosis are unlikely to conceive naturally and may be offered *in vitro* fertilisation (IVF).

(c) State **three** ethical objections to IVF.

1. ……

2. ……

3. ……

[3]

[Total : 11]

6 Fig. 6.1 shows a diagram of an ovule from a dicotyledonous plant, immediately *after* self-fertilisation has occurred. The structures within the ovule are haploid (n), diploid (2n) or triploid (3n).

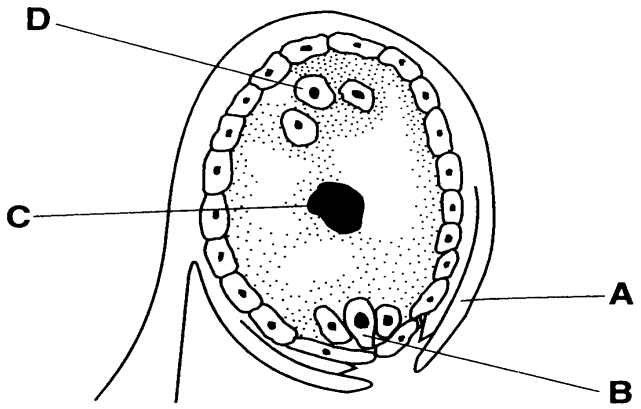

Fig. 6.1

(a) Complete the table below, naming the structures **A** to **D**, indicating the number of chromosome sets present and the percentage contribution to each structure made by the male and/or female parts of the parent plant.

name of structure	number of chromosome sets	% contribution made to each structure by	
		male part of parent plant	female part of parent plant
A			
B			
C			
D			

[6]

(b) Describe the structural changes that occur after fertilisation, leading to the development of the seed and fruit.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

[Total : 15]

7 **(a)** Explain how the structure of the placenta allows for efficient exchange of gases between the maternal and foetal circulations.

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.....

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.....

.....

.....

[3]

Foetal red cells are nucleated and contain foetal haemoglobin, which is a conjugated protein with four haem prosthetic groups linked to two α and two β polypeptide chains. As birth approaches, adult red cells containing adult haemoglobin are produced. Fig. 7.1 shows the oxygen dissociation curves for foetal haemoglobin (**A** and **B**) and for maternal (**C** and **D**) at different values of pH.

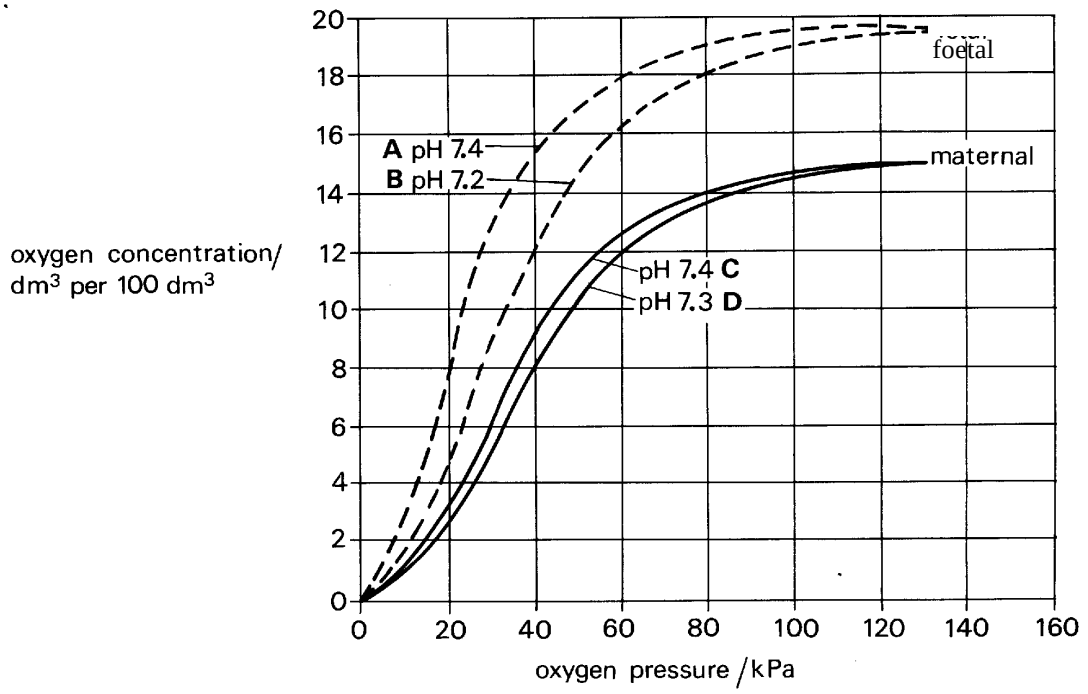

Fig. 7.1

(b) **(i)** Describe how adult haemoglobin differs from foetal haemoglobin.

.....

.....

[1]

(ii) Suggest what must happen to the genetic material of blood-producing cells in order to change from producing foetal haemoglobin to producing adult haemoglobin.

.....

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[2]

(c) By reference to curve A on Fig. 7.1 alone, explain how foetal haemoglobin carries and releases oxygen efficiently.

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[4]

(d) With reference to Fig. 7.1, explain the significance of the following statements.

(i) The oxygen dissociation curves for both the foetal and maternal haemoglobin shifts to the right with a lowering of pH.

.....

.....

.....

.....

[2]

(ii) The oxygen dissociation curve for foetal haemoglobin is to the left of the curve maternal haemoglobin.

.....

.....

.....

.....

[2]

(e) Suggest an explanation for the observation that babies born to mothers who smoke may be underweight.

.....

.....

.....

[2]

[Total : 16]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
GROWTH, DEVELOPMENT AND REPRODUCTION **2805/01**

Mark Scheme

1 **(a)** *Escherichia coli/E. coli/*any named bacterium; ® 'bacteria'
fungi;
budding;
(binary) fission/spore formation;
Paramecium/Amoeba/any named protoctist [5 marks]

(b) ADVANTAGES
only one parent required;
isolated cells can reproduce;
successful genotypes maintained/AW [1 mark max]

DISADVANTAGES
limited genetic variation for evolution;
limited ability to adapt to environmental/other changes [1 mark max]

[Total : 7]

---

2 **(a)** may cause excessive water loss;
detail;
may damage proteins;
detail;
ref to enzymes;
detail;
enzyme damage causes disrupted metabolism/AW [4 marks max]

(b) HSPs made in response to high temperatures;
ability to synthesise HSPs correlates with ability to withstand high temps/AW

SORGHUM
seedlings in early germination most easily damaged;
when least able to synthesise HSPs

MILLET
ability to synthesise HSPs and to withstand high temps
both decline;
over first 12 days [4 marks max]

(c) expose plants/cells to high temps;
ref to selection;
those showing greatest HSP synthesis;
breed from these;
repeat for several generations;
AVP [4 marks max]

[Total : 12]

- -

3 **(a)** average sperm count drops;
ref to figures;
less variability in later counts/converse [2 marks max]

(b) recent ejaculation/intercourse;
presence of STD;
ref to age [1 mark max]

(c) ***Quality of written communication assessed in this answer***

from (site of storage) in epididymis;
via vas deferens;
receives secretions of, seminal vesicles/prostate gland/
Cowper's gland;
to aid sperm motility/adjust pH/AW;
pass through urethra;
semen ejaculated into vagina;
pass through cervix;
aided by, muscular contraction/cilia, of uterus/lashing
of flagella;
capacitation;
further detail of capacitation;
acrosome reaction/enzymes released;
named enzyme released;
penetrates zona pellucida/follicle cells/granulosa cells/
corona radiata;

meiosis completed/triggers meiosis II, in oocyte;
fusion of nuclei [7 marks max]
Q – clear, well organised, using specialist terms [1 mark]
[8 marks]

(d) **(i)** receptors are protein/glycoprotein molecules;
on cell surface membranes/in cytoplasm;
which recognise/fit with/specific to oestrogen [2 marks max]

(ii) anti-oestrogen molecules similar shape to / mimic oestrogen;
attach to receptors cell membranes;
prevent oestrogen being recognised/acting on cells [2 marks max]

(e) pituitary gland;
endometrium;
breast/alveolar cells;
site of any 2° sexual characteristic [3 marks max]
[Total : 18]

---

4 **(a)** TESTA
protects seed;
ref to mechanical damage;
ref to attack by microorganisms;
makes the seed dormant;
restricts entry of oxygen;

COTYLEDONS
store food reserves;
named nutrients;
for early growth of embryo;
before photosynthesis starts [6 marks max]

(b) **(i)** (light) increases % germination [1 mark]

(ii) *T1 AND 3*
T3 involves chilling the seeds;
chilling ends dormancy;
hence germination increase
T1 AND 4
T4 involves scratching seed coats;
which ends dormancy;
coat more permeable to oxygen/water;
easier for expanding embryo to break through [4 marks max]

[Total : 11]

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5 **(a)** **(i)** shedding/loss/breakdown of endometrium;
thickening/proliferation;
increased blood vessels/loops/**AW**;
maintained, following ovulation/under influence of progesterone;
glandular activity stimulated;
ref to mucus [3 marks max]

(ii) pregnancy/conception/implantation;
the (contraceptive) pill/injection/patch/IUS/HRT/ taking oestrogen/progesterone;
menopause;
abnormally low body weight/anorexia/starvation/ malnutrition/**AW**;
disease/ovarian cancer/ovarian cyst/ill health/ anaemia;
lactation/breast feeding;
stress;
AVP [3 marks max]

(b) reduces chances of success/halves the chance;
ref to specific comparative figs;
% success related to time [2 marks max]

(c) ® rhetorical questions
fate of unused embryos;
unnatural, qualified;
against religious beliefs, qualified;
costly qualified/prevents other cheaper treatments;
children in need of adoption;
low success rate/disappointment for many couples/AW;
multiple births more likely;
selective abortion may occur/embryo reduction;
ref to eugenics/designer babies/AW;
psychological effect on child;
AVP [3 marks max]

[Total : 11]

- -

6 (a)

name of structure	number of chromosome sets	% contribution made to each structure by	
		male part of parent plant	female part of parent plant
A integument(s)	2/diploid	0%	100%
B zygote	2/diploid	50%	50%
C endosperm nucleus	3/triploid	33.3% (1/3)	66.7% (2/3)
D antipodal, cell/ nucleus;	1/haploid	0%	100%

(*1/2 marks round up)* [6 marks]

(b) ***Quality of written communication assessed in this answer.***

zygote divides to become embryo;

SEED

cotyledons, plumule, radicle;

mitosis;

ref (single) basal cell;

suspensor/foot, forms;

endosperm nucleus forms endosperm;

endosperm develops into food store of cotyledons;

(A) nutrients

endosperm persists in some cases;

nucellus disappears;

changes in micropyle/described;

integuments become testa;

aleurone layer develops;

becomes, dry/harder/waterproof [4 marks max on seed]

FRUIT

ovary wall becomes pericarp;

modified for dispersal;

dries/becomes fleshy/any appropriate change [4 marks max on fruit]

Q – clear, well organised using specialist terms [1 mark]

[9 marks]

[Total : 15]

---

7 **(a)** large surface area;

(chorionic) villi;

permeable;

short diffusion pathway / close contact between maternal and fetal blood;

maternal blood spaces / lacunae [3 marks max]

(b) **(i)** 2 βpolypeptide chains, not γ [1 mark]

(ii) foetal haemoglobin genes switched off / adult haemoglobin genes switched on;
ref to genes for β and γ polypeptide chains;
transcription of gene;
regulation of transcription [2 marks max]

(c) sigmoid / S-shape curve;
shows high affinity;
suitable figs from Fig. 7.1 (e.g. x dm^3 per 100 dm^3 at ykPa);
small change in pO_2 causes large change in oxygen carried;
oxygen released in tissues / reduced affinity in tissues / **A/W**;
suitable figs from Fig. 7.1 (e.g. x dm^3 per 100 dm^3 at ykPa);
ref to steep part of curve [4 marks max]

(d) **(i)** low pH, high CO_2 / lactic acid;
ref to increase in rate of respiration;
decrease in affinity / use of figs;
release of oxygen linked to need in tissue; [2 marks max]

(ii) foetal haemoglobin has higher affinity for oxygen;
will be fully/highly saturated in placenta;
ensures diffusion across placenta;
use of figs to compare foetal and adult at same pO2 [2 marks max]

(e) carbon monoxide, combines with haemoglobin;
reduces oxygen carrying capacity of blood [2 marks]

[Total : 16]

- -

Assessment Grid: A2 BIOLOGY

Unit Name	Growth, Development and Reproduction	Unit Code	2805/01	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (32-40) a 11/12	AO1 b (socet) 11/12	AO1 c 11/12	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (24-32) a 6/7	AO2 b 6/7	AO2 c 6/7	AO2 d 6/7	AO4, synthesis of knowledge + understanding (32-40) a 14/16	AO4 b 14/16	Target grade	QoWL	Total (100)
1 (a)	2 (a)	5											
(b)	2 (b)				2								7
2 (a)	3 (i)1.3(c)								4				
(b)	3 (i)							4					
(c)	3 (i) 4.5(i)								4				12
3 (a)	4 (c)					2							
(b)	4 (c) (e)						1						
(c)	4 (g)			7								1	
(d)(i)	4 (e)1.4(e)									2			
(ii)	4 (e)1.4(e)									2			
(e)	5 (j)1.4, 4.6								3				18
4 (a)	3 (i)	6											
(b) (i)	5 (c)					1							
(ii)	3 (i)									4			11
5 (a) (i)	4 (j)	3											
(ii)	5 (j) 4 (j)	3											
(b)	4 (j)					2							
(c)	4 (i)		3										11
6 (a)	3 (e) (j)	3		3									
(b)	3 (g)			8								1	15
7 (a)	4 (j)(k)				3								
(b)(i)(ii)	4(k)3.1(h)									3			
(c)	4(k)3.1(h)									4			
(d)(i)(ii)	4(k)3.1(h)									4			
(e)	4(m)		2										16
Total		**20**	**5**	**18**	**5**	**5**	**1**	**4**	**11**	**19**		**2**	
Total for sections			**43**				**15**			**30**		**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
APPLICATION OF GENETICS **2805/02**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 90.

Answer ALL Questions.

1 In *Primula sinensis* two unlinked gene loci are responsible for the main variation in flower colour. The dominant allele **K** results in the production of a red pigment, whilst the recessive allele **k** results in the production of a pink pigment. The dominant allele **B** produces a co-pigment, whereas the recessive allele **b** results in no such production. The co-pigment forms complexes with the pigments which are bluer in colour than the pigments alone.

A homozygous pink-flowered plant, **kkbb**, was crossed with a homozygous blue-red-flowered plant, **KKBB**, and the resulting F_1 generation interbred to produce an F_2 generation.

(a) Draw a genetic diagram in the space below to show the genotypes and phenotypes of the F_1 and F_2 generations of this cross. (Take care that the symbols **K** and **k** cannot be confused in your answer.)

[10]

2 Only one strand of the DNA of a gene (the 'sense' strand) is normally transcribed to mRNA. The complementary strand of DNA is the 'antisense' strand, which is not normally transcribed. By inserting a promoter at the end of the antisense sequence, this forming an antisense gene, RNA transcription can occur from it. This anti-mRNA bonds to normal mRNA to form double-stranded RNA (duplex RNA), which cannot be translated by ribosomes. This technique can be used to suppress specific genes. The sequence of events is shown in Fig. 2.1.

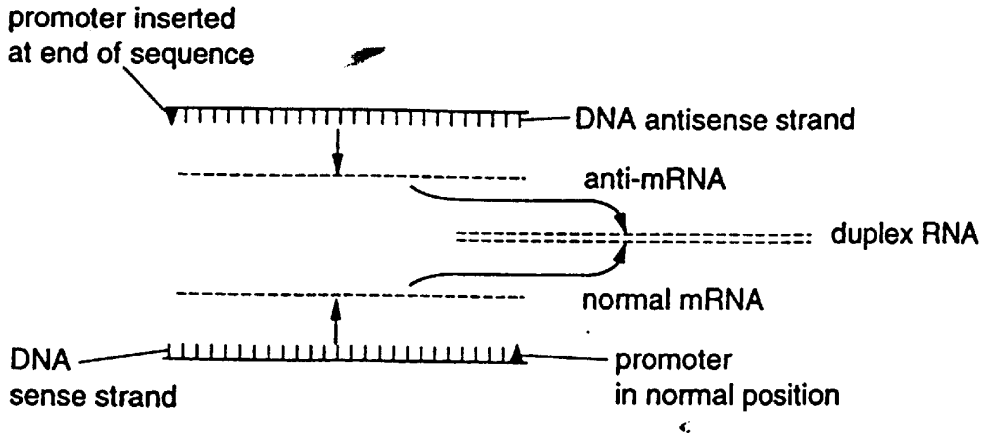

Fig. 2.1

(a) Explain

(i) The bonding of anti-mRNA with normal mRNA to form duplex RNA

.....

.....

.....

[3]

(ii) Why the resulting duplex RNA cannot be translated

.....

.....

.....

[3]

A promoter sequence was inserted into the antisense strand of DNA.

(b) Outline how the promoter sequence may have been inserted into the antisense strand of DNA.

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[5]

A recently identified gene (pTOM13) in tomato plants is expressed during the ripening of tomato fruits.

Tomato plants were transformed by adding an antisense gene to pTOM13 to the normal genome. Antisense genes, once introduced, are inherited. When transformed plants that each contain one antisense gene are crossed, the offspring include plants with no antisense gene, one antisense gene and two antisense genes in a 1:2:1 ratio.

Ethene production during fruit ripening was measured in plants with one and with two antisense genes, and in normal plants. The results are shown in Fig. 2.2.

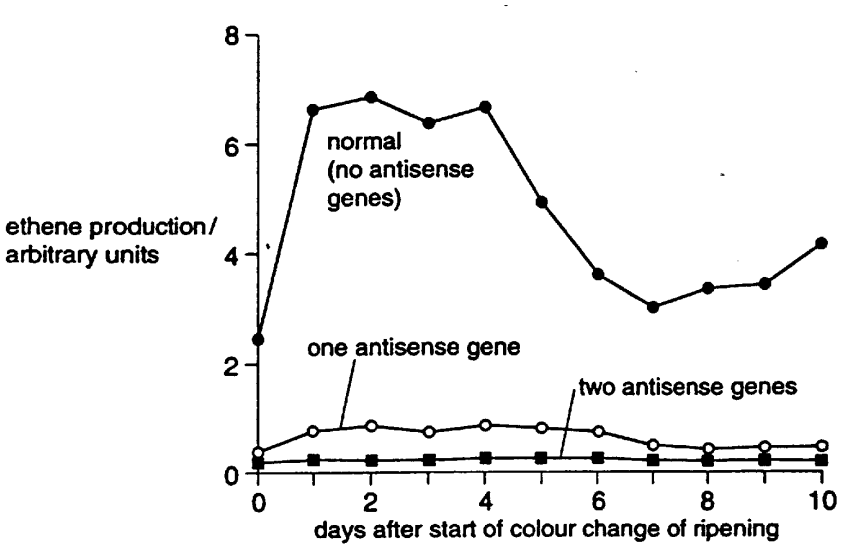

Fig. 2.2

(c) Suggest:

(i) a function of the protein encoded by pTOM13

.....

.....

.....

.....

[2]

(ii) a reason for the difference in ethene production between transformed plants with one antisense gene and those with two antisense genes.

.....

.....

.....

.....

[2]

(d) Explain how two plants, each with an antisense gene added to the normal genome, can produce offspring with no antisense gene, one antisense gene and two antisense genes in a 1:2:1 ratio.

.....

.....

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.....

.....

[3]

(e) Suggest **one** benefit and **one** hazard of the genetic engineering of plants.

benefit .....

.....

hazard.....

.....

[2]

[Total : 20]

3 (a) (i) Distinguish between continuous variation and discontinuous variation.

Continuous variation.....

.....

.....

Discontinuous variation.....

.....

.....

[4]

(ii) Explain the genetic basis of **continuous variation**.

.....

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.....

.....

[2]

In the production of hybrid maize (sweetcorn) with large, uniform cobs, carried at a similar height on the plant, the following procedure may be used.

inbred line **A** x emasculated (detasselled) inbred line **B** pollen

↓

'single cross' plants (**AB**)

emasculated (detasselled) inbred line **D** x inbred line **C** pollen

↓

'single cross' plants (**CD**)

→ ←

'double cross' seed for commercial crop

(b) Explain why two different **inbred** lines of maize were used to produce the 'single cross' plants.

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.....

.....

[3]

In 1995, the International Rice Research Institute (IRRI) in the Philippines, which holds the rice gene bank, announced the results of a 5 year breeding programme to produce a variety of rice with an increased yield. The new variety has not yet given its expected yield as it still lacks the alleles for disease and pest resistance.

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

.....

.....

.....

.....

[2]

(ii) Explain briefly how selective breeding might be used to incorporate disease resistance into the new variety of rice.

.....

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[3]

[Total : 14]

4 When breeding cattle for increased milk yield, the sequence of events shown below may be used.

pedigree bull

↓

sperm samples are collected and stored

↓

pedigree cow with high milk yield is induced to superovulate

↓

artificial insemination

↓

embryos are collected

↓

embryos are implanted into surrogate cows

↓

high milk yield female offspring

(a) **(i)** Describe how samples of sperm are stored.

.....

.....

.....

.....

[2]

(ii) Discuss the advantages and disadvantages of the use of artificial insemination in animals.

(In this question, 1 mark is available for the quality of written communication.)

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[8]

(b) **(i)** Describe how the embryos are collected after artificial insemination.

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[2]

(ii) Explain how the surrogate cows are prepared to ensure successful implantation.

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[4]

(c) Explain how the breeder knows that a bull carries genes for high milk yield.

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[2]

[Total : 18]

5 All the living affected individuals in a family were found to have a mutation in the gene locus coding for a kinase enzyme. DNA profiles of the same part of the normal and mutant alleles of the gene are shown in Fig. 5.1. Such profiles could form the basis of genetic screening for the condition.

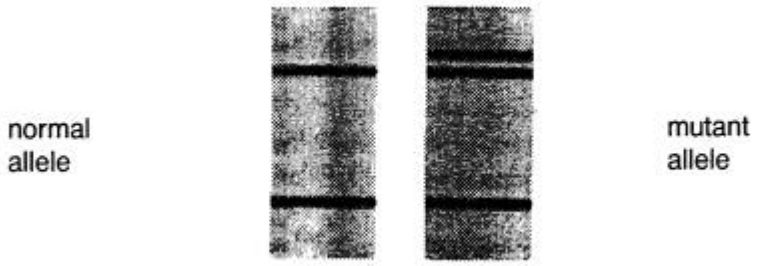

Fig. 5.1

(a) Explain how such DNA profiles are produced.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

(b) **(i)** Describe how genetic screening is carried out

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[4]

(ii) Explain the advantages and disadvantages of genetic screening in humans.

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[4]

[Total : 17]

6 A transcription factor is a protein that promotes transcription at a particular locus. The gene *Ets 2* codes for a transcription factor, and is located on human chromosome 21. The gene is expressed in cartilage and bone tissues during development. In mice, *Ets 2* is located on chromosome 16 and mice with trisomy 16 show similar skeletal abnormalities to humans with Down's syndrome.

(a) Explain

(i) the genetic basis of Down's syndrome in humans;

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[3]

(ii) what is meant by the term *trisomy*;

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[1]

(iii) how a trisomy, such as trisomy 16 in mice, can occur in a zygote.

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[5]

In order to investigate the possible role of *Ets 2* in Down's syndrome, transgenic mice have been produced which carry an extra copy of mouse *Ets 2* These mice show similar skeletal abnormalities to mice with trisomy 16. Tissues from the transgenic mice produced up to 1.8 times more *Ets 2* messenger RNA than control mice.

(b) Suggest why these transgenic mice and mice with trisomy 16 show similar abnormalities.

.....

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.....

[2]

[Total : 11]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
APPLICATIONS OF GENETICS **2805/02**

Mark Scheme

1 **(a)** pink blue-red

kkbb x **KKBB** [no mark]

Gametes **kb** **KB**;

F$_1$ **KkBb**;

blue-red;

F$_1$ x F$_1$ **KkBb** x **KkBb**;

Gametes **KB** **Kb** **kB** **kb**;

(or shown on sides of punnett square)

punnett square workings ;

[minus 1 mark for each of first two mistakes in genotypes]

F$_2$ correct genotypes and phenotypes identified

either **K-B-** = blue-red;

K-bb = red;

kkB- = blue-pink;

kkbb = pink;

(or clearly identified in punnett square)

*[No marks if **K** and **k** could not be distinguished]*

correct ratio 9 : 3 : 3 : 1 [10 max]

- **[Total : 10]**

2 **(a)** **(i)** two mRNAs are complementary / shown in diagram;

bases H-bond;

base pairing;

A-U and C-G [3 marks max]

(ii) no exposed bases / binding sites blocked;

cannot bind to, ribosomes/rRNA;

cannot bind tRNA;

no ‘start’ signal;

so no protein produced [3 marks max]

(b) restriction enzyme / named restriction enzyme;
both DNAs cut with same enzyme;
sticky ends;
DNAs join by complementary sticky ends;
nucleotides added to make sticky ends;
phosphate-sugar backbones sealed;
ligase [5 marks max]

(c) **(i)** enzyme;
involved in ethene production / other sensible suggestion;
[2 marks max]

(ii) antisense gene blocks pTOM13;
antisense gene not expressed as rapidly as 'normal' gene;
with 1 copy not all mRNA duplexed;
greater chance that with 2 copies of antisense gene;
if even a small quantity of enzyme produced it will have a detectable effect;
ref partial/incomplete/co-dominance [2 marks max]

(d) gene added to one (strand of DNA of) one chromosome;
plant (effectively) heterozygote;
chromosomes segregate in meiosis;
two types of gamete;
shown in diagram [3 marks max]

(e) one sensible benefit e.g. slows ripening / increases keeping time;
one sensible hazard e.g. inherited so passed to other tomatoes and ruin ripening / very difficult to 'contain' [2 marks max]

[Total: 20]

- -

3 **(a)** **(i)** *CONTINUOUS*

phenotype has range between limits;
usually akin to a normal distribution curve;
cannot be divided into discrete categories;
quantitative character [2 marks max]

DISCONTINUOUS

phenotypes fall into discrete classes;
with no intermediates;
akin to/drawn bar chart;
qualitative character [2 marks max]

(ii) many genes/polygenes;
which may in turn have many alleles;
may be linked or not linked;
additive effect;
detail [2 marks max]

(b) individual inbred line homozygous;
but may be homozygous dominant at some loci/recessive at others;
different lines homozygous dominant (desirable allele) at different loci;
product has dominants (desirables) at more loci;
reduces risk of inbreeding depression/promotes hybrid vigour/heterosis;
product genetically uniform;
heterozygous at many loci [3 marks max]

(c) **(i)** store of genes as genomes/total genetic material;
can be stored as cells/tissues/whole organisms/seeds/sperm/embryos/zoo/botanic garden;
not a store of lengths of DNA/individual genes [2 marks max]

(ii) new rice crossed with resistant variety;
offspring inspected for resistance;
resistant offspring chosen;

(back) crossed with new rice;
to maintain high yield/desirable characteristics [3 marks max]

[Total : 14]

- -

4 **(a)** **(i)** in extender medium/medium described;
in 'straws'/thin tubes;
liquid nitrogen/frozen to very low temperature/-196 °C [2 marks max]

(ii) ***Quality of written communication assessed in this answer.***

ADVANTAGES
proven bull;
no need to run bull with herd;
no need to keep bull;
transport semen not animals;
AVP

DISADVANTAGES
excessive use of bull leads to loss of variation;
expensive;
freezing process can damage sperm
AVP [7 marks max]

Q – legible text with accurate spelling, punctuation and grammar 1

[8 marks max]

(b) **(i)** non-surgical flushing;
stored temporarily in vitro/in rabbit;
deep frozen [2 marks max]

(ii) hormone treatment;
to ensure common timing of oestrus;
and prepares uterus wall;
transplanted via surgery;
several (2+) embryos implanted [4 marks max]

(c) progeny testing;
inspect daughters for yield [2 marks]

[Total : 18]

- -

5 **(a)** ***Quality of written communication assessed in this answer.***
source of DNA sample;
gene/chromosome/DNA, cut up;
by restriction enzyme/endonuclease;
separate fragments of different sizes;
by electrophoresis;
samples in wells at, one / cathode end;
fragments move different distances;
migrate to anode;
shortest, furthest distance; ® ref to charge
transfer via Southern Blotting;
description;
bands invisible;
(incubate) with radioactive probe;
or use stain;
autoradiograph/expose to photographic plate;
final banding pattern / ref to bands in Fig. 5.1 [8 marks max]
Q – clear, well organised answer using specialist terms [1 mark]
[9 marks max]

(b) **(i)** **(A)** screening of adult or foetus

method of obtaining sample;
detail;
source of sample;
ref to gene probe/karyotype/enzyme etc;
detail of test [4 marks max]

(ii) *ADVANTAGES*

known risk for next generation;
allows possible abortion of affected fetus;
allows sorting of IVF embryos;
AVP

DISADVANTAGES
loss of hope;
insurance company problems;
employment problems;
miscarriage risk;
trauma of knowledge;
AVP [4 marks max]

[Total : 17]

---

6 **(a)** **(i)** chromosome 21;
times 3/trisomy/extra copy;
translocation fragment 21;
on to another chromosome [3 marks max]

(ii) 3 example of a particular chromosome/
homologous pair + 1 / 2n + 1 [1 mark]

(iii) homologous chromsomes;
fail to separate/nondisjunction;
at metaphase I /anaphase 1 /meiosis 1;
in oogenesis;
secondary oocyte;
has both members of homologous pair of chromosomes;
third chromosome added;
(from sperm) at fertilisation;
(A) converse nondisjunction in spermatogenesis [5 marks max]

(b) both have, three/an extra copy of Ets 2;
both produce more Ets 2 messenger RNA than normal;
both have more transcription factor than normal [2 marks max]

[Total : 11]

- -

Assessment Grid: A2 BIOLOGY

Unit Name	APPLICATIONS OF GENETICS	Unit Code	2805/02	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (34-38)			AO2, application of knowledge, understanding, analysis, synthesis + evaluation (22-26)				AO4, synthesis of knowledge + understanding (28-32)		Target grade	QoWL	Total (90)
		a 11/12	b (socet) 11/12	c 11/12	a 6/7	b 6/7	c 6/7	d 6/7	a 14/16	b 14/16			
1(a)	1, 4.4(d)									10			10
2(a)(i)(ii)	4,1.5(a)									6			
(b)	4(b)1.5(e)								5				
(c)(i)(ii)	4(b)1.5(g)									4			
(d)	4(c)skills									3			
(e)	4(d)		2										20
3(a)(i)	1(b)	4											
(ii)	1(b)				2								
(b)	2(a)						3						
(c)(i)	3(b)	2											
(ii)	2(a)		3										14
4(a)(i)	2(j)	2											
(ii)	2(j)			7								1	
(b)(i)	2(g)	2											
(ii)	2(g)	4											
(c)	2(e)				2								18
5(a)	5(d)			8								1	
(b)(i)	5(b)	4											
(ii)	5(b)		4										17
6(a)(i)	5(a)1(a)				3								
(ii)	5(a)	1											
(iii)	5(a)						5						
(b)	5(a)1(a)				2								11
Total		**19**	**9**	**15**	**9**	**0**	**8**	**0**	**5**	**23**		**2**	
Total sections			**43**			**17**				**28**		**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
ENVIRONMENTAL BIOLOGY **2805/03**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 90.

Answer ALL questions.

1 Fig.1.1 shows data collected from a coastal area. A belt transect was used from the high tide line, inland across sand dunes, to a woodland behind the dunes. Quadrats were taken at five metre intervals. The dominant species in each quadrat was recorded.

quadrat number	sand couch grass	marram grass	lichens and mosses	heather	rye grass	birch	oak
1	+						
2	+++	+					
3							
4	++	++					
5		+					
6		+++					
7		+++					
8		++	+				
9			++	+			
10			+++	+			
11			+++	+++			
12			+++	+++			
13			+++	+++			
14					+++		
15					+++		
16					+++		
17					+++		
18						+	
19						+	
20						++	+
21						+	+
22							++

Fig. 1.1

Key:

\+

++ Increasing abundance of plants concerned.

+++

(a) The plants recorded at this site illustrate a succession. With reference to Fig. 1.1, explain what is meant by the term *succession*.

.....

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[4]

The quadrats containing rye grass are in an area used for agriculture. This section of the transect illustrates a deflected succession.

(b) **(i)** Explain what is meant by a *deflected succession.*

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.....

.....

[2]

(ii) Suggest how the deflected succession at this site may be maintained.

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.....

[2]

The numbers of a certain species of ground beetle in the woodland were estimated using a *capture-recapture* method. This involves catching a sample, counting the number caught, marking them in some way and releasing them (sample 1). After a period of time, a second sample (sample 2) is then captured and the number again counted, making a note of the number which are marked from the first sample. At one time of year, in the habitat under investigation, the figures recorded for samples of beetles were as follows:

number in sample 1	:	284
number in sample 2	:	267
number found marked in sample 2	:	63

(c) Use these figures to estimate the population size of beetles at this time. Show your working.

.....

.....

.....

.....

[2]

(d) Suggest how the beetles in sample 1 might have been marked.

.....

.....

[1]

(e) State two assumptions that are made when interpreting data from the capture-recapture method.

1. .....

.....

2. .....

.....**[2]**

[Total : 13]

2 Fig.2.1 shows the concentration, in parts per million, of carbon dioxide from the atmosphere which has dissolved in glacier ice over the last 250 years. The carbon dioxide in the ice provides a relevant indicator for conditions in areas far from where these measurements were taken.

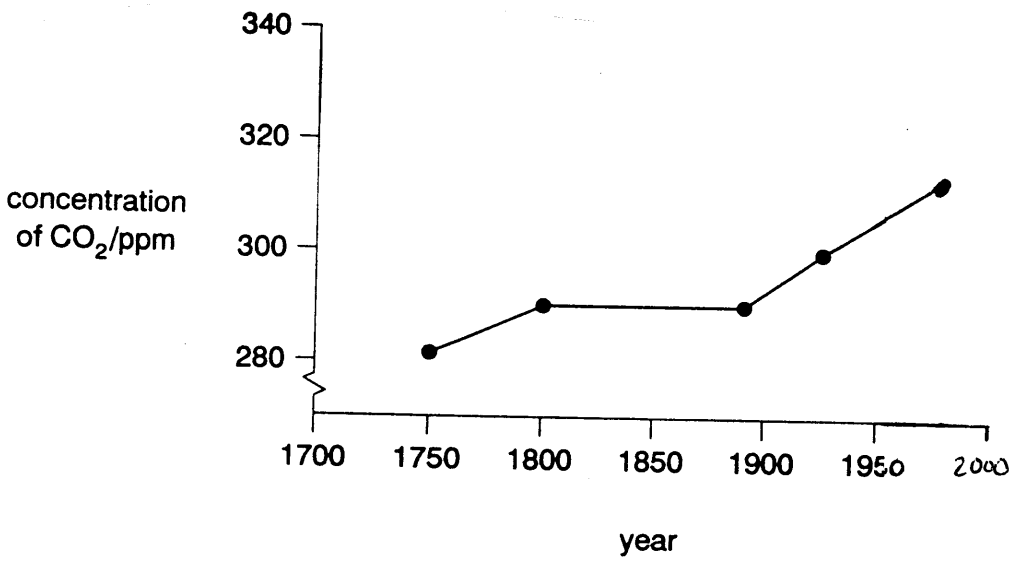

Fig.2.1

(a) **(i)** With reference to Fig. 2.1, describe the changes in concentration of carbon dioxide in the glacier ice since 1750.

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[3]

(ii) Explain how carbon dioxide produced far away from the glacier may become dissolved in glacier ice.

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[2]

(iii) Explain the likely cause of the changes in the concentration of carbon dioxide shown in glacier ice since 1990.

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[3]

(b) Suggest **three** measures that could be taken by countries to reduce carbon dioxide emissions. For each measure, explain why it might prove difficult to implement.

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[6]

(c) Explain how an increase in the carbon dioxide concentration of the atmosphere may affect the temperature of the air above the surface of the earth.

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[3]

[Total : 17]

3 *Read carefully the following passage and answer the questions that follow.*

The peach potato aphid, *Myzus persicae,* attacks a wide range of host plants such as potatoes and chrysanthemums. In Britain, the aphid overwinters on peach and nectarine trees. Alternatively, it can survive as active breeding populations in heated glasshouses and protected situations outdoors, especially in mild winters.

Like other aphids, *M. persicae* feeds by inserting its stylets (mouthparts) into phloem sieve tubes, and then relying on the pressure of the phloem sap to force food through its stylets and into the intestine. Phloem sap is rich in sugars, but poor in amino acids which the aphid needs to support growth. Aphids ingest a very large amount of food but as much of it is sugar, they egest this as a sugary solution known as honeydew.

The peach potato aphid spreads through a crop very quickly, although there are never many individuals on any one plant. While feeding on potatoes, the aphid picks up viruses from the host. These are often just transferred from one host to another on the stylets, but the potato leaf roll virus passes through the wall of the intestine of *M. persicae*, through the blood, and then enters the salivary glands. The aphid can carry potato leaf roll virus for a long time.

Field crops, such as potatoes, are protected against aphids by non-specific organo-phosphorus insecticides. These interfere with synaptic transmission in the aphid resulting in paralysis.

Biological control is used in glasshouses. The parasitic wasp, *Aphidius matricariae,* is used to control peach potato aphid in glasshouses where all-year-round chrysanthemums are grown.

(a) Explain why M. persicae spreads very quickly through potato crops.

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[3]

(b) Describe the ways in which M. persicae may reduce the yield of potato crops.

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[3]

(c) Suggest **two** disadvantages of using organo-phosphorus insecticides in controlling aphids in fields of potatoes.

1. .....

.....

2. .....

.....

[2]

(d) **(i)** Define the term *biological control.*

.....

.....

[1]

(ii) State **two** features of biological control agents, such as *A. matricariae*, that make them effective at controlling pests.

1. .....

.....

2. .....

.....

[2]

(e) Explain why a low population of the peach potato aphid has to be tolerated in glasshouses if Aphidus matricariae is used as a means of control.

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[2]

(f) Suggest **two** problems that might be encountered be encountered in using *A. matricariae* in the control of peach potato aphids on field crops, such as potatoes.

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[2]

[Total : 15]

4 **(a)** **(i)** Distinguish between preservation and conservation.

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.....

[2]

(ii) Outline **two economic** reasons for the conservation of species.

1. .....

.....

2. .....

.....

[2]

In Devon and Cornwall, a large area of land has been made derelict by the extraction of china clay. Once this had been extracted for use in chinaware and paper making, the waste is left as huge tips of white sand. The tips are low in nutrients, such as nitrogen, phosphorus and potassium, and are also low in silt and clay. The natural colonisation of the tips by plants is very slow. It takes about twenty years for even the base of a tip to develop a plant community.

(b) **(i)** Suggest two reasons why the base of a china clay tip is the first part to become colonised by plants.

1. .....

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2. .....

.....

[2]

(ii) Outline the methods by which china clay tips could be reclaimed.

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[3]

[Total : 9]

5 Fig. 5.1 shows a section of a river that flows through rural and urban areas.

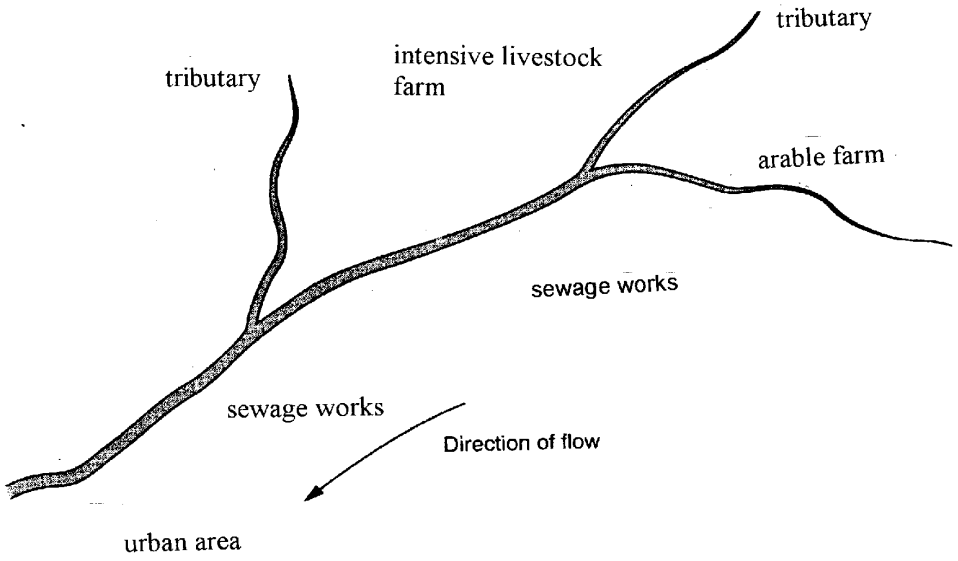

Fig. 5.1

(a) Explain how the biological oxygen demand (BOD) of water samples taken from the river depicted in Fig. 5.1 could be measured.

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[4]

(b) Outline **three other** ways in which the quality of the water in the river may be assessed.

1. .....

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2. .....

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3. .....

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[6]

(c) Explain the sequence of events that may lead to the eutrophication of the river shown in Fig. 5.1.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

[Total : 19]

6 The National Parks and Access to the Countryside Act, 1949, made provision for the setting up of different types of conservation areas in England and Wales. These included National Parks and Sites of Special Scientific Interest (SSSIs). Under this Act, about 2600 sites were given the status of being an SSSI.

(a) State **three** features used in determining whether a site should be given SSSI status.

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[3]

(b) Explain how a National Park **differs** from a Site of Special Scientific Interest.

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[4]

There are conflicts of interest within National Parks between farmers, foresters, conservationists and visitors.

(c) Discuss these conflicts and the measures that can be taken to resolve them.

(In this question, 1 mark is available for the quality of written communication.)

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[10]

[Total : 17]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
ENVIRONMENTAL BIOLOGY **2805/03**

Mark Scheme

1 **(a)** sequence / change of communities / plants;
which replace one another;
in a given area;
over a period of time;
one sere changes / prepares environment for the next sere;
until a climax community is reached;
which is in equilibrium with local conditions;
ref to data from Fig 1.1 [4 marks max]

(b) **(i)** succession which does not proceed to the expected climax community for the locality; caused by a particular factor / by human intervention;
plagioclimax [2 marks max]

(ii) grasses planted / re-seeded;
maintained by grazing / cutting / burning;
shrubs / trees, do not establish [2 marks max]

(c) $\frac{\text{number in sample 1 x number in sample 2}}{\text{number marked in sample 2}}$

$= \frac{284 \times 267}{63} \longrightarrow \frac{1203}{1204}$ [2 marks max]

(d) small dot of (non-toxic) paint / other suitable material, on thorax / abdomen / wing case; **R** wings [1 mark max]

(e) minimal births / deaths during investigation;
minimal immigration / emigration during investigation / members of the population remain within the area;
marked individuals mix thoroughly and freely with rest of population;
marking does not affect individuals in any adverse manner;
marks have not remained in place [2 marks max]

[Total : 13]

- -

2 **(a)** **(i)** general increase;
over whole period;
(significant) increase 1750 – 1800;
no increase 1800 – 1880/90;
rapid/greater/large, increase 1880/90 – 1995/2000 [3 marks max]

(ii) CO_2 produced by, burning/respiration/other relevant process;
atmospheric circulation/**AW**;
soluble;
so present in, precipitation/rain/snow;
freezing [2 marks max]

(iii) increase in industrialisation;
<u>rapid</u> increase in population;
therefore increased energy demand;
more fossil fuel used;
example;
better extraction of fossil fuels;
example;
increased burning of forest/deforestation/rubbish;
ref to transport/more cars;
AVP [3 marks max]

(b) *SUGGESTIONS MIGHT INCLUDE*

measure reduce amount of fossil fuel burned;
difficulty opposition to named alternative;

measure recycle rubbish;
difficulty expensive to set up/much rubbish cannot be recycled;

measure reduce emissions from cars etc;
difficulty expensive to set up/problem with older cars;

measure reduce speed of traffic;

difficulty congestion;

measure (legislate for) greater use of public transport
fewer cars;

difficulty politically unpopular [6 marks max]

(c) enhances/increases, greenhouse effect/global warming;
CO_2 'transparent' to, short wave/UV, radiation from Sun;
ground warmed by radiation;
emits long wave/infra red radiation; **(A)** *heat radiation*
CO_2 layer prevents this radiation from leaving atmosphere;
more radiation trapped in air;
therefore causes warming [3 marks max]

[Total : 17]

---

3 **(a)** no limiting factors;
plenty of food;
few / no, predators;
no / little, competition;
ref to interspecific / intraspecific;
rapid rate of reproduction [3 marks max]

(b) damages, cells / phloem;
absorbs, sugars / amino acids / food / nutrients / assimilates;
less growth / storage;
infects plants with virus;
virus spreads through plant in phloem;
virus kills cells / energy used to produce viral particles / idea;
AVP; (e.g. effects of honeydew, such as growth of fungi) [3 marks max]

(c) may select resistant strain of aphid;
may enter food chain;
become concentrated up food chain;

may be left in food / residue;
kill, non-pest species / predators;
accumulate in animals' bodies;
may enter water courses and harm aquatic animals;
may harm, humans / domestic animals;
may paralyse animals making them easy prey;
may damage nervous systems [2 marks max]

(d) **(i)** use of a predator / parasite / parasitoid / pathogen, to control a pest [1 mark]

(ii) feeds exclusively on pest / ref to specificity;
self perpetuating / reproduces;
population of control agent rises, as / just after, population of pest;
hunt / seek out, pest;
safe, no chemical residues [2 marks max]

(e) predator / control agent, needs food;
otherwise predator / control agent, dies;
food needed to maintain population of control agent / reproduction of control agent;
prevent resurgence of pest [2 marks max]

(f) wasp may disperse over a wide areas / flies away;
difficult for wasp to find aphid hosts;
wasp may itself be the victim of a predator;
external climate may not suit wasp;
wasp may eat something else [2 marks max]

[Total : 15]

---

4 **(a)** **(i)** preservation means keeping things as they are / A examples;
conservation requires active management / A example [2 marks]

(ii) genetic resources / example / explanation;
medicines / drugs / example / explanation;

biological control / balance of nature;

money from tourism / zoos;

AVP [2 marks max]

(b) **(i)** more water at the base;

less erosion / greater stability at base;

underlying material / soil within reach of plant roots;

upward diffusion of nutrients

AVP [2 marks max]

(ii) add fertiliser;

nitrogen, phosphate, potassium;

sow / plant legumes / named legume;

reason for planting legumes;

cover tip with soil;

cover tip with clay / silt;

add humus / organic matter / sewage sludge;

sow / plant, drought tolerant species / grasses;

contour / terrace / level;

plant trees / other plants to stabilise slope;

AVP [3 marks max]

- **[Total : 9]**

5 **(a)** sample at intervals along river / identified sites from Fig. 5.1;

known volume of water (e.g. 1 dm^3);

determine oxygen concentration of water;

oxygen electrode / Winkler method;

water kept in dark (no photosynthesis) for 5 days;

at $20^{O}C$;

oxygen concentration remeasured;

BOD is volume of oxygen used;

by bacteria in the water decomposing organic matter;

alternative method:

add small drop of methylene blue;

so does not mix with oxygen;

leave in dark for 5 days;

at $20^{O}C$;
time how long to go colourless [4 marks max]

(b) suspended solids;
filter, dry;
centrifuge;

pH;
pH meter / other valid method;

oxygen concentration;
oxygen meter / probe / sensor / sensor and data logger;

salinity / conductivity;
concentration of ions / named ions;
conductivity meter / other appropriate method;

turbidity;
colorimeter;

bacteria;
viable count / direct count / other appropriate method [6 marks max]

(c) ***Quality of written communication is assessed this answer.***

fertilisers from arable farms;
surface run off;
heavy rainfall;
nutrients for plant growth;
not absorbed by crop / ref to timing of application of fertiliser;
algal bloom;
if other conditions favourable, e.g. light;

properly treated sewage;
effluent may contain high concentration of ions;
nitrate / phosphate;

poorly treated sewage;
organic matter;
putrefaction / decomposition;
release of nutrients;

livestock units;
urea / ammonia / phosphate (in slurry);

nitrification;
Nitrobacter / Nitrosomonas;
$NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$;
oxidation / action of chemosynthetic bacteria [8 marks max]

Q – clear, well organised answer using specialist terms [1 mark]

[9 marks max]

[Total : 19]

.....

6 **(a)** site with animal/plant species/communities of interest;
habitat of rare species/endangered species;
important breeding site;
overwintering site;
site with geological/physiographical feature of special interest [3 marks max]

(b) much larger area;
containing wide diversity of habitats;
of a wide diversity of species;
people live (and work) in National Parks;
permanently staffed;
presence of Wardens/Guides/Education;
sign-posted;
own planning authority [4 marks max]

(c) ***Quality of written communication is assessed this answer.***
credit references to any aspect of visitor pressure
pressure of visitors / cars / coaches etc;

Park and Ride schemes;
charge entry fees;
restrict access;
divert foot paths;
rebuild eroded areas;
construct wooden walkways;
control pollution / educate / erect notices about pollution;
more organised picnic areas / more provision of litter bins;
impose fines;
disturbance of wildlife habitats;
specific references to disturbance to agriculture / forestry;
increase public awareness;
provide, protection / fencing;
dangers of fire;
firebreaks / fire watchers / signs;
conservation of habitats / species / biodiversity;
conflicts with economic forestry;
conflicts with intensive agriculture;
pay farmers / landowners, for care of countryside to make up for loss of earnings;
extensive agriculture;
maintenance of certain aspects of park, e.g. stone walls;
planting broadleaved woodlands;
AVP [9 marks max]

Q – legible text with accurate spelling, punctuation and grammar [1 mark]

[10 marks]

[Total : 17]

Assessment Grid: A2 BIOLOGY

Unit Name	Environmental Biology	Unit Code	2805/03	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (34-38) a	b (socet)	c	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (22-26) a	b	c	d	AO4, synthesis of knowledge + understanding (28-32) a	b	Target grade	QoWL	Total (90)
1 (a)	4.3 (g)									4			
(b)(i)	3 (b)	2											
(ii)	3 (b)						2						
(c)	1 (e)					2							
(d)	1 (e)	1											
(e)	1 (e)	2											13
2 (a)(i)	2 (e)					3							
(ii)	2 (e)						2						
(iii)	2 (e)				3								
(b)	2 (f)		6										
(c)	2 (e)		3										17
3 (a)	4.3 (b)									3			
(b)	3.3									3			
(c)	2 (c)	2											
(d)(i)	3 (e)	1											
(ii)	3 (e)	2											
(e)	3 (e)				2								
(f)	3 (e)				2								15
4 (a)(i)	4 (a)	2											
(ii)	4 (c)		2										
(b)(i)	4 (f)				2								
(ii)	4 (f)		3										9
5 (a)	2 (b)	4											
(b)	2 (b)	6											
(c)	2 (a) 1.7(d) 4.3(i)								8			1	19
6 (a)	5 (a)	3											
(b)	5 (a)	2		2									
(c)	5 (c)4.3(i)(j)								9			1	17
Totals		**27**	**14**	**2**	**9**	**5**	**4**		**17**	**10**		**2**	
Total for sections		**43**			**18**				**27**			**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
MICROBIOLOGY AND BIOTECHNOLOGY **2805/04**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 90.

Answer ALL Questions.

1 Fig. 1.1 show a labelled diagram of a bacteriophage.

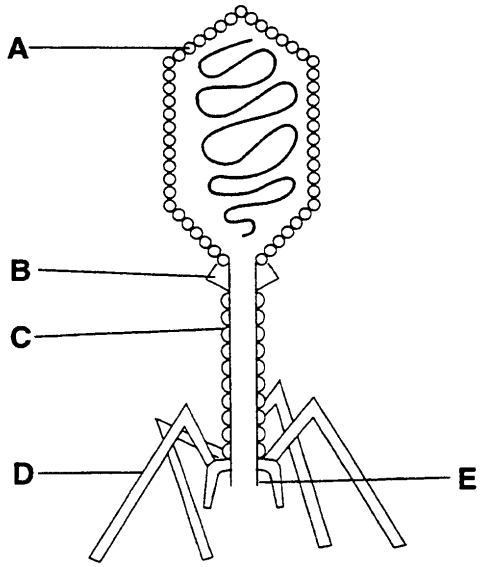

Fig. 1.1

(a) Name the group of microorganisms which includes bacteriophages.

.....

[1]

(b) Using the letters on Fig. 1.1, identify the region

(i) involved in the attachment to bacteria;

.....

[1]

(ii) involved in penetrating bacterial cells;

.....

[1]

(iii) containing genetic information.

.....

[1]

(c) Describe the life cycle of a **named** bacteriophage.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

The number of bacteriophages in a liquid medium can be determined by serial dilution of the medium, followed by plating a small volume, 0.5 cm^3, on to an agar plate that has been covered in bacteria. Each bacteriophage is capable of infecting a bacterium. When the agar plates are incubated, a bacterial lawn results in which there are clear areas known as plaques. A plaque is produced when a single bacteriophage infects a bacterium, and eventually results in the death of a large number of bacteria. The clear areas are due to lysis of these bacteria.

The number of plaques produced from a serial dilution of the medium on two sets of plates, inoculated with the same bacterium, are shown in Table 1.1.

Table 1.1

	dilution		
	10^{-6}	10^{-7}	10^{-8}
number of plaques	956 948	98 94	7 3

(d) With reference to Table 1.1,

(i) suggest why the values at the dilutions of 10^{-6} and 10^{-8} are inaccurate and should not be used to estimate bacteriophage numbers

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[5]

(ii) estimate the number of bacteriophage particles per cm^3 in the original liquid medium. Show your working.

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[3]

[Total : 21]

2 For many years, Britain has disposed of much of its domestic waste in landfill sites. Occasionally there have been reports of explosions. These have been due to the production of gases in the buried waste.

(a) Explain the sequence of events that may have led to these explosions.

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[4]

(b) **(i)** Explain how the gas produced might be used.

.....

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.....

.....

[3]

(ii) Suggest why the gas produced is only likely to be used locally.

.....

.....

[1]

(iii) Suggest **two** areas of human activity for which the production and use of biogas might be an advantage.

1. .....

2. .....

[2]

[Total : 10]

3 *Bacillus thuringiensis* produces a protein that is toxic to leaf-eating caterpillars. This protein has been used by farmers as a natural insecticide. Recently, the gene that codes for the toxin has been genetically engineered into several crop plants.

(a) Describe how the gene that codes for the toxin could have been isolated.

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[7]

The gene, once isolated, is inserted into a host plant cell, either by using the bacterium *Agrobacterium tumefaciens* as a vector to infect the plant cell, or by using a particle gun which shoots DNA-coated pellets into the plant cell.

(b) **(i)** Suggest why a plasmid vector cannot be used to insert the gene into plant cells.

.....

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.....

[1]

(ii) Explain why it is important to insert the gene into a single isolated plant cell, rather than into a cell within a whole plant.

.....

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.....

.....

[2]

(c) Outline **three environmental** implications of genetically engineered pest resistance in plants.

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[3]

It has been suggested that the integration of the gene for toxin production from *B. thuringiensis* into a wide range of crop plants could result in a loss of the effectiveness of the toxin.

(d) Explain how this loss of effectiveness of the toxin might occur.

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[3]

[Total : 16]

4 Fig. 4.1 shows a large scale fermenter of a type that might be used in the production of an antibiotic.

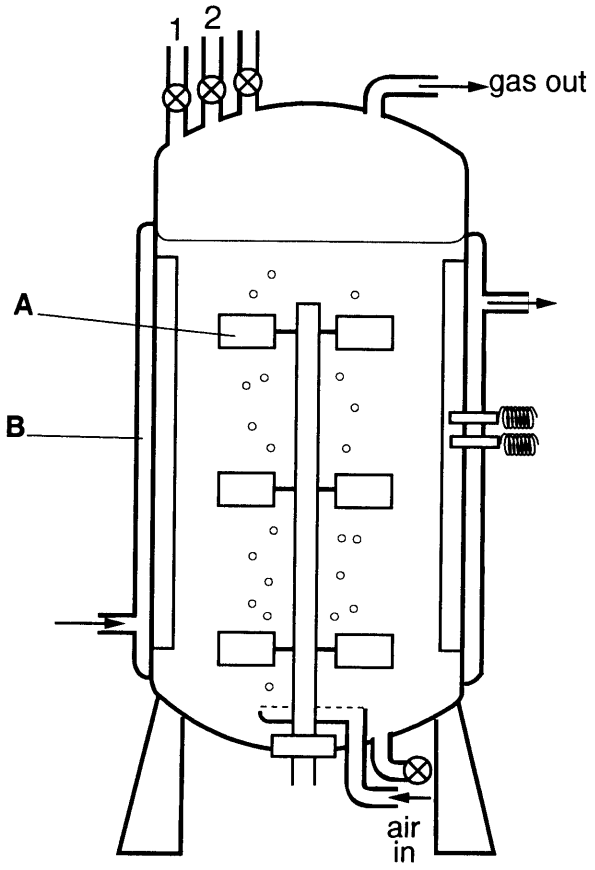

Fig. 4.1

(a) **(i)** Name parts **A** and **B**.

A.....

B.....

[2]

(ii) Suggest **two** substances that might be added through taps **1** and **2** during a fermentation.

1. .....

2. .....

[2]

(iii) Explain the function of part **B**.

.....

.....

.....

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[2]

(b) Describe how the fermenter and substrates are prepared before use.

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[5]

The antibiotic penicillin is produced in batch fermenters.

(c) Explain how a *batch* fermentation differs from a *continuous* fermentation.

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[3]

[Total : 14]

5 Fig. 5.1 shows a biosensor that makes use of the enzyme urease to measure urea in either blood or urine.

$$\text{urea + water} \xrightarrow{\text{urease}} \text{carbon dioxide + ammonium ions}$$

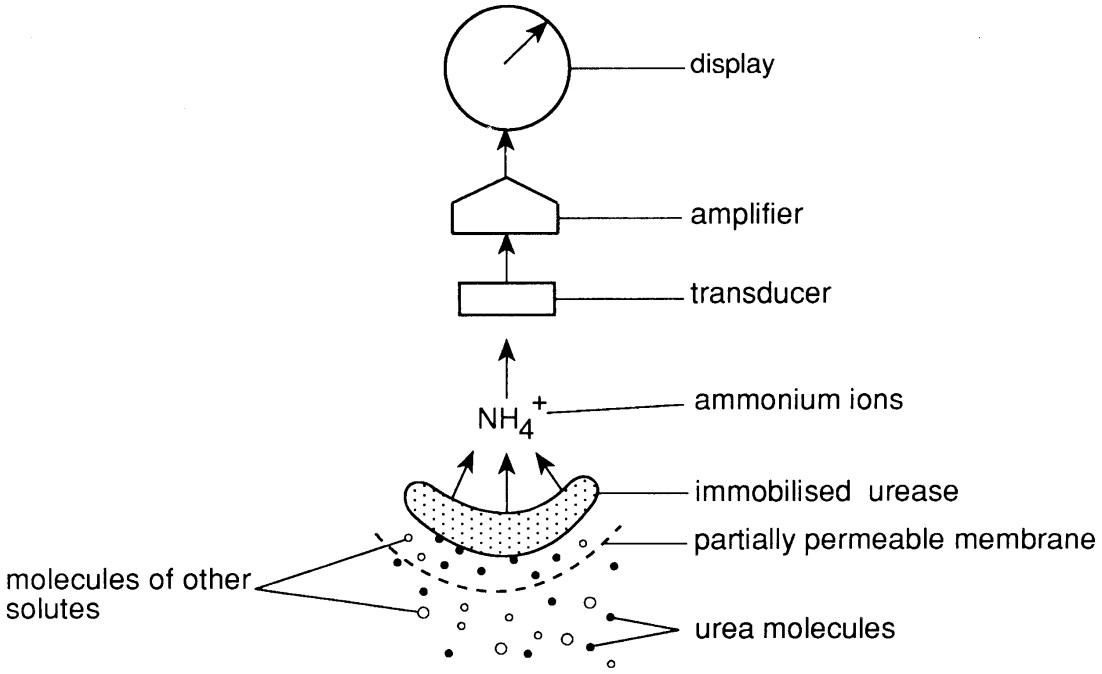

Fig. 5.1

(a) **(i)** Suggest a substance that could be used to immobilise the enzyme.

.....

[1]

(ii) Explain the presence of the partially permeable membrane.

.....

.....

.....

.....

[1]

(iii) Explain why other solutes do not affect the results.

.....

.....

[2]

(iv) Describe the function of the transducer.

.....

.....

.....

.....

.....

.....

[2]

(b) State **two** advantages of using a biosensor, rather than a chemical method, to measure the concentration of urea.

1. .....

2. .....

[2]

(c) Discuss the use of a biosensor in the monitoring of blood glucose.

(In this question, 1 mark is available for the quality of written communication.)

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[8]

[Total : 16]

6 In the brewing industry, barley grains are allowed to germinate. As they germinate, stored starch is converted to reducing sugars. These sugars are then extracted and used in the fermentation process.

The rate of starch breakdown by the barley grains is determined by measuring the rate at which reducing sugars are formed, using a colorimetric method. A colorimeter is calibrated by measuring the amount of light absorbed by known concentrations of glucose. A standard curve is shown in Fig. 6.1. The absorbance caused by the reducing sugars in 2 cm^3 of solution extracted from some germinating barley grains was then measured. The results are shown in Table 6.1.

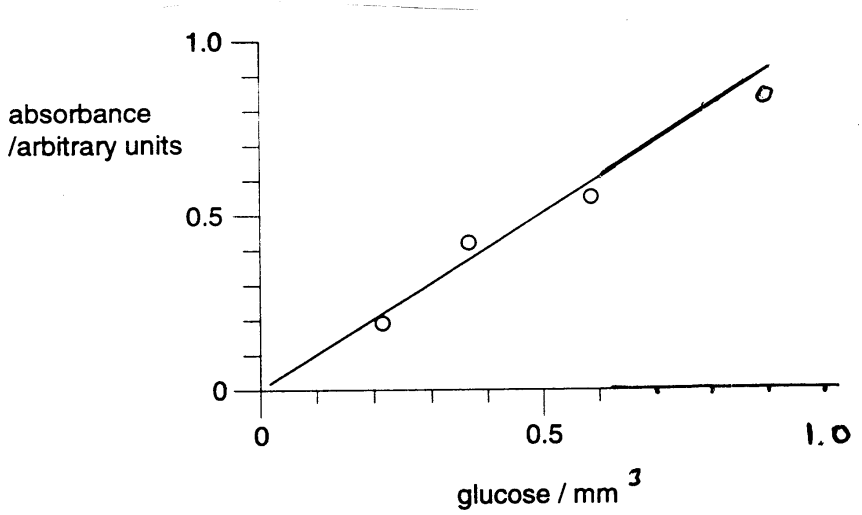

Fig. 6.1

Table 6.1

solution	absorbance
extract made at start of germination	0.10
extract made after 2 days germination	0.90

(a) Describe how you could test for the presence of reducing sugars.

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.....

[3]

(b) **(i)** Explain why an extract was tested at the start of germination.

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.....

[2]

(ii) Calculate the increase in concentration of reducing sugar after 2 days germination, expressing your answer in mmol of glucose per cm^3 of extract. Show your working.

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[2]

(c) **(i)** Describe how starch is converted to reducing sugars.

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[3]

(ii) Explain why this conversion is stopped when the barley grains are heated.

.....

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.....

.....

[2]

(iii) Suggest a suitable temperature to stop the conversion.

.....

[1]

[Total : 13]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
MICROBIOLOGY AND BIOTECHNOLOGY **2805/04**

Mark Scheme

1 **(a)** viruses [1 mark]

(b) **(i)** **D**;

(ii) **E**;

(iii) **A** [3 marks]

(c) ***Quality of written communication assessed in this answer.***

suitable named bacteriophage;
ref to lysogeny;
adsorption;
described;
ref to latent phase;
detail;
take over protein synthesis;
detail;
synthesis of viral nucleic acid;
synthesis of new protein coat/capsid;
production of enzymes for lysing host cell;
packaging of viral nucleic acid;
lysis of host cell;
formation of envelope as leaves host cell [8 marks max]

Q – cle ar, well organised, using specialist terms [1 mark]

[9 marks max]

(d) **(i)** 10^{-6} plaques overlapping;
not possible to count accurately;
10^{-8} pipetting errors;
ref to dilution errors;
uneven distribution of viral particles;
10^{-8} very small numbers;
lead to greater statistical errors [5 marks max]

(ii) 94 + 98 ÷ 2 ;
96 ;
96 x 10^{-7} x 2 ;
1.92 x 10-9 [3 marks max]

[Total : 21]

2 **(a)** *Methanobacteria/Methanococcus/ Methanospirillum*;
anaerobic conditions/ref to waterlogging;
breakdown of waste;
ref to fermentation;
by bacteria;
produces methane/natural gas;
ignited by spark/AW [4 marks max]

(b) **(i)** as fuel;
to generate electricity
for heating/lighting;
to power machinery;
AVP [3 marks max]

(ii) difficult/expensive to transport [1 mark]

(iii) farming;
sewage treatment plants [2 marks]

[Total : 10]

3 **(a)** restriction enzymes;
cut bacterial chromosome;
to separate DNA fragments;
use protein structure to make cDNA;
using radiolabelled nucleotides;
and reverse transcriptase;
hybridise synthetic DNA to bacterial chromosome fragments;
gel electrophoresis;
detail;
cut identified DNA out of gel;
purify [7 marks max]

(b) **(i)** cannot penetrate,
cellulose cell wall [1 mark]

(ii) only one cell in whole plant will produce toxin;
from isolated cells, can clone/produce new plants;
all cells in new plants produce toxins [2 marks max]

(c) less indescriminate use of organic pesticides/**AW**;
more specific, so harmless/beneficial species unaffected;
do not enter food chains;
less easy for pests to develop resistance than with spraying;
fewer allergies/safer for farmers/public than spraying;
AVP [3 marks max]

(d) insects develop resistance to toxin;
ref to mutations;
detail;
ref to natural selection;
toxin acts as an agent of natural selection [3 marks max]

[Total : 16]

- -

4 **(a)** **(i)** **A** stirrer/paddle;
B water jacket [2 marks]

(ii) glucose/energy source;
acid/base/buffer [2 marks]

(iii) to heat up fermenter;
to required temperature/stated temperature;
to remove excess heat produced;
to maintain steady temperature [2 marks max]

(b) wash fermenter;
steam sterilise fermenter;
steam sterilise medium;
sterilise anti-foaming agents;
filter air;
adjust temperature;
adjust pH to optimum/**AW**;
AVP [5 marks max]

(c) *BATCH*
set amount of medium;
microorganism grown in medium until certain OD
before harvesting;
shows three stages of growth curve;
CONTINUOUS
new medium added;
to maintain log growth phase;
cells/medium harvested throughout;
AVP [3 marks max]

[Total : 14]

- -

5 **(a)** **(i)** alginate/cellulose [1 mark]

(ii) allows small size molecules access;
ref to urea vs other solutes [1 mark]

(iii) no reaction with enzyme;
ref to enzyme specificity;
further detail [2 marks max]

(iv) absorbs ions;
transforms chemical energy;
into electrical energy;
produces electrical current/signal [2 marks max]

(b) ref to speed;
detection of small quantities/low levels [2 marks]

(c) ***Quality of written communication assessed in this answer.***
uses (immobilised) glucose oxidase;
produces acid/protons/H^+ ions;
attract electrons/produces electrical current;
proportional to amount of glucose;
hence measurement;
quick diagnosis;
better treatment for diabetes;
saves money;
important in preventative medicine;
easier to maintain stable blood glucose level;
use of infusion pump with biosensor;
feedback controls release of insulin;
improves quality of diabetic's life [7 marks max]

Q – legible text with accurate spelling, punctuation and grammar [1 mark]

[8 marks]

[Total : 16]

---

6 **(a)** use Benedict's test/reagent;
ref to suitable quantities/ how heated;
colour change;
precipitate formation;
ref to positive result [3 marks max]

(b) **(i)** need to know residual sugar levels;
to act as a control;
to assess sugar produced in germination [2 marks max]

(ii) $\frac{0.10\ (+\ 0.02)}{2\ cm^3}$ (= 0.05 mmol per cm^3)

$\frac{0.90\ (+\ 0.02)}{2\ cm^3}$ (= 0.45 mmol per cm^3) ;

0.45 – 0.05
= 0.40 (mmol per cm3) [2 marks max]

(c) **(i)** by hydrolysis;
of glycosidic bonds;
α - 1,4 links;
amylases;
glucose [3 marks max]

(ii) reaction catalysed by enzymes;
enzymes denatured by heat;
further detail [2 marks max]

(iii) greater than 50°C [1 mark]

[Total : 13]

- -

Assessment Grid: A2 BIOLOGY

Unit Name	MICROBIOLOGY AND BIOTECHNOLOGY	Unit Code	2805/04	Session: JAN / JUNE	Year:

Question number	Outcomes assessed	AO1, knowledge + understanding (32-40)			AO2, application of knowledge, understanding, analysis, synthesis + evaluation (24-32)				AO4, synthesis of knowledge + understanding (32-40)		Target grade	QoWL	Total (90)
	(spec. ref.)	a	b (socet)	c	a	b	c	d	a	b			
		11/12	11/12	11/12	6/7	6/7	6/7	6/7	14/16	14/16			
1(a)	1(a)	1											
(b)	1(b)	3											
(c)	1(c)			8								1	
(d) (i)	1(j)					5							
(ii)						3							21
2(a)	6(d)4.1(j)								4				
(b) (i)	6(d)		3										
(ii)			1										
(iii)			2										10
3(a)	4(a)1.5(g)								7				
(b)(i)	4(a)1.5(g)									1			
(ii)	4(a)1.5(g)									2			
(c)	4(d)		3										
(d)	4(d)4.5								3				16
4(a)(i)	3(b)	2											
(ii)	3(b)						2						
(iii)	3(b)	2											
(b)	3(b)				5								
(c)	3(a)			3									14
5(a)(i)	5(a)	1											
(ii)	5(a)1.4(b)									1			
(iii)	5(a)1.4(b)									2			
(iv)	5(a)		2										
(b)	5(a)	2											
(c)	5(a)			7								1	16
6(a)	4(b)1.2(a)									3			
(b)(i)	4(b)1.2(a)									2			
(ii)	4(b)					2							
(c)(i)	4(b)1.3(c)									3			
(ii)	4(b)1.3(c)									2			
(iii)	4(b)1.3(c)									1			13
Total		11	11	18	5	10	2	0	14	17		2	
Total for sections		**40**			**17**				**31**			**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
MAMMALIAN PHYSIOLOGY AND BEHAVIOUR **2805/05**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 90.

Answer ALL Questions

1 Fig. 1.1 shows a diagram of a longitudinal section of a villus, from the small intestine, highly magnified.

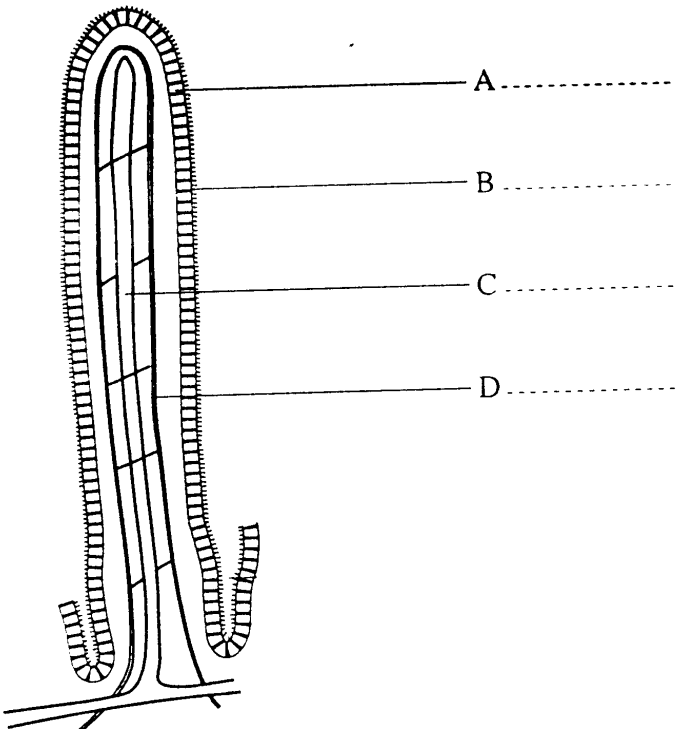

Fig. 1.1

(a) **(i)** On Fig. 1.1, label structures **A** to **D**. **[4]**

(ii) Put a ring around the figure below which is the most appropriate for the actual length of the villus.

2.5 mm 15 mm 2.5 μm 0.75 mm 250 μm **[1]**

(b) **(i)** State in which tissue would you expect to find goblet cells.

.....

[1]

(ii) Explain their function.

.....

.....

[1]

(c) Explain how the products of digestion pass across the outer membrane of the cells labelled **A** in Fig. 1.1.

(In this question, 1 mark is available for the quality of written communication.)

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[9]

[Total : 16]

2 **(a)** Outline the functions of the *cerebrum*, *cerebellum* and *medulla oblongata* in the brain.

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.....

[7]

Fig. 2.1 shows neurones from the brain of a healthy 75 year old (**A**), and from the brain of a 75 year old suffering from Alzheimer's disease (**B**).

Fig. 2.1

(b) State **two** differences between the neurones from **A** and **B**.

1. .....

.....

.....

2. .....

.....

.....

[2]

(c) Name the region of the brain from which the neurones in **B** might have come.

.....

[1]

(d) Suggest **three** symptoms of Alzheimer's disease likely to arise from the appearance of the neurones in individual **B**.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(e) Describe what other changes might occur in the brain of a patient suffering from Alzheimer's disease.

.....

.....

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.....

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[3]

[Total : 16]

3 Menière's disease is a disorder of the inner ear characterised by fluctuating hearing loss, attacks of vertigo (a sensation of movement when standing or sitting still), and tinnitus (ringing in the ears). It is thought to be caused by under- or over-production of endolymph in the cochlear duct.

Treatment for the condition may be medical or surgical. Medical treatment aims to reduce the volume of endolymph. This may be achieved by administering diuretics, which increase the volume of urine produced. In extreme cases, inhaling a mixture of 5% carbon dioxide and 95 % oxygen for 10 minutes, four times a day, produces relief by causing dilation of the cerebral blood vessels.

Fig. 3.1 represents the structures of the inner ear.

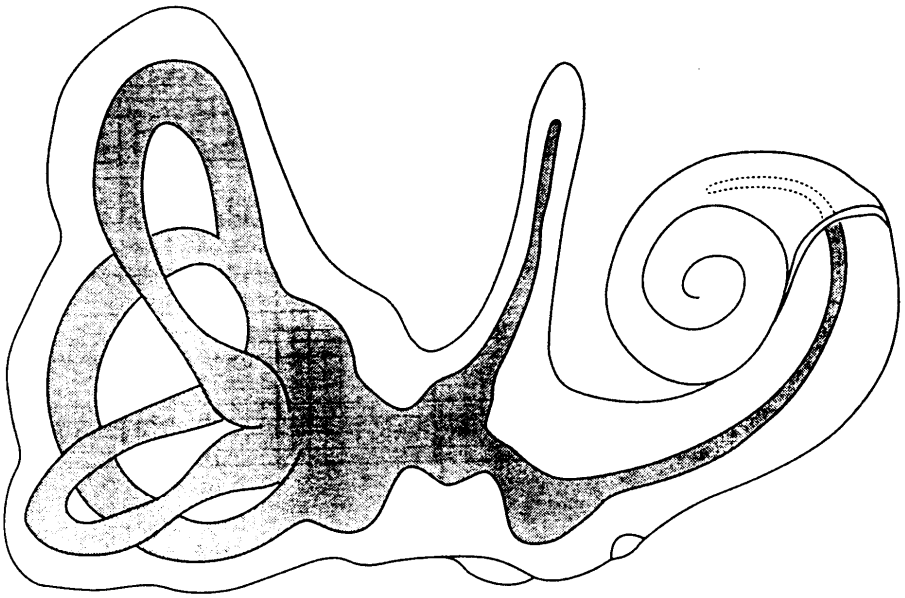

Fig.3.1

(a) On Fig. 3.1, label the position of the following, using the appropriate letters.

A the cochlear duct (scala media)

B endolymph **other than** in the cochlear duct

C one ampulla **[3]**

(b) Name the structure in the cochlear responsible for perception of sound waves.

.....

[1]

(c) **(i)** Suggest how an increase in endolymph may cause hearing loss.

.....

.....

.....

.....

[3]

(ii) Suggest how treatment with diuretics, which increase the volume of urine produced, may improve this condition.

.....

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.....

.....

[3]

An alternative treatment for Menière's disease is to reduce the dietary intake of salt.

(d) State **two** other advantages of reducing salt intake.

1. .....

.....

2. .....

.....

[2]

(e) Suggest what may occur in the ear to cause the sensation of movement when sitting still.

.....

.....

.....

[1]

[Total : 13]

4 The liver is unusual in having a double blood supply, from the hepatic portal vein and the hepatic artery. The liver receives over 1 dm^3 of blood every minute when the body is at rest.

(a) Suggest why the liver has a double blood supply.

.....

.....

.....

.....

[2]

(b) Outline the role of the liver in the control of blood glucose.

(In this question, 1 mark is available for the quality of written communication.)

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[8]

(c) **(i)** Explain why it is important that the liver regulates blood cholesterol.

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[4]

(ii) State **two** possible consequences of having a high blood cholesterol concentration.

1. .....

.....

.....

2. .....

.....

.....

[2]

(d) Suggest why a person suffering from liver damage is often prescribed smaller doses of any medication required for other complaints.

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.....

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[2]

Jaundice is frequently an indication of liver damage. In this condition, the skin takes on abnormal yellow colouration because bile pigments are circulating in the blood.

(e) Explain why the bile pigments are circulating in the blood of a person suffering from jaundice.

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[2]

[Total : 20]

5 Fig. 5.1 represents a section through the back of the eye to show details of the nervous connections in the mammalian retina.

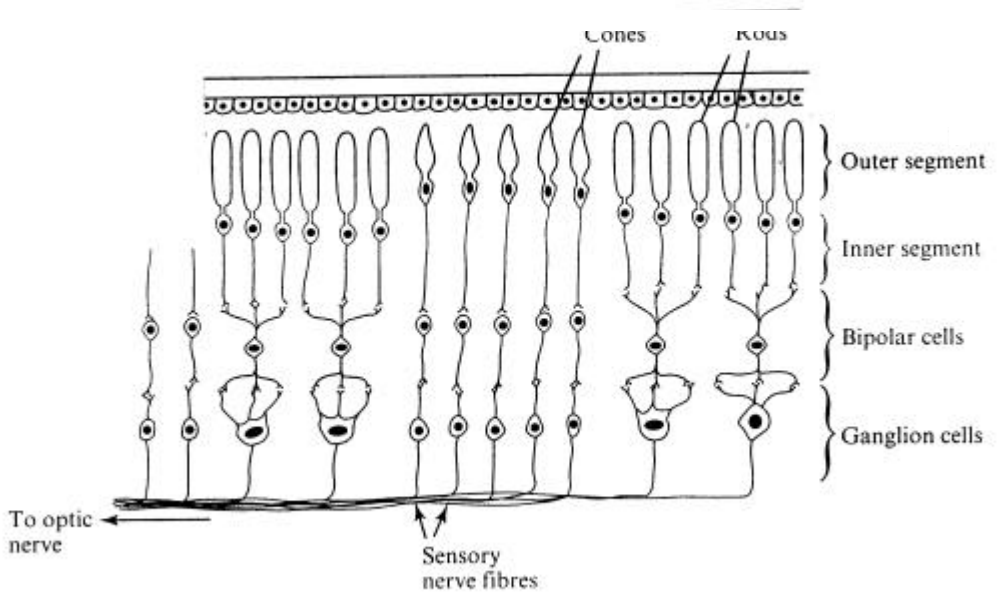

Fig. 5.1

(a) Draw an arrow beside Fig. 5.1 to show the direction that light takes through the retina. **[1]**

(b) Name the light sensitive pigment present in the rod cells, and describe the effect that light has on this pigment.

Pigment .....

Effect of light .....

.....

.....

[2]

(c) Explain how the different neural connections of the rods and the cones, shown in Fig. 5.1, account for the following.

(i) cones can transmit information to form a more accurate image than rods

.....

.....

.....

.....

[2]

(ii) rods can transmit information in dimmer light conditions than cones

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.....

[2]

Fig. 5.2 shows a graph of the numbers of rods and cones at different distances across the retinal of the eye, passing through the fovea and the optic nerve.

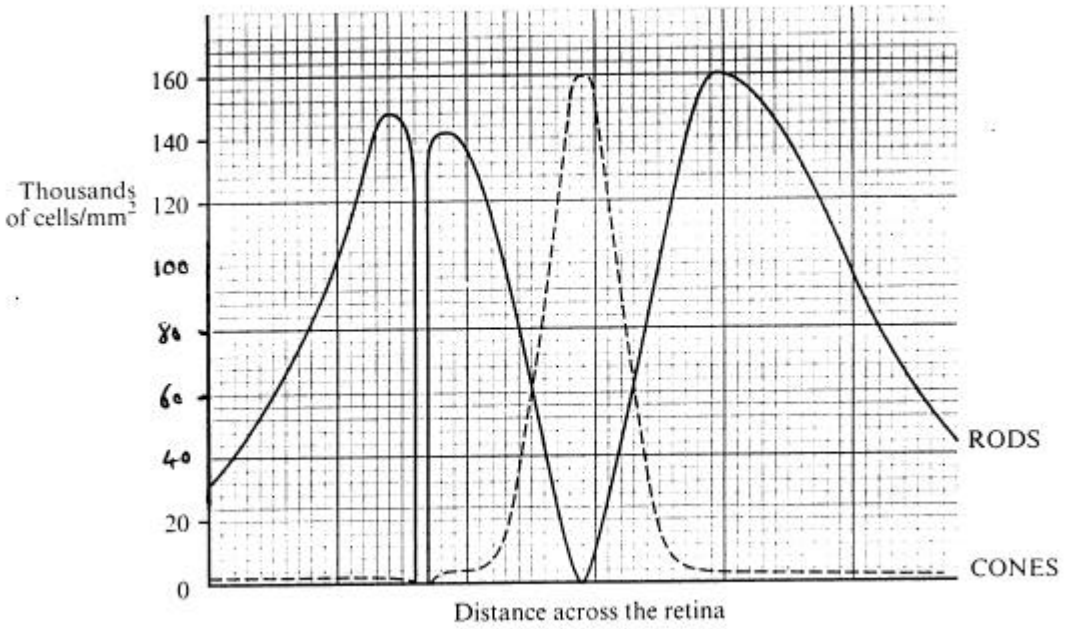

Fig. 5.2

(d) **(i)** Use the information in Fig. 5.2 to calculate the density of cones at the fovea.

.....

.....

.....

[1]

(ii) On Fig. 5.2, mark with an arrow labelled **B**, the point representing the position of the blind spot. **[1]**

Looking out of the 'side' of the eye at a very dim object improves the chances of seeing it.

(e) On Fig. 5.2, mark with an arrow labelled **X**, the best place on the retina for the image to fall to make it most likely to be seen. **[1]**

[Total : 10]

6 Fig. 6.1 shows a reflex arc which results in the lower leg being kicked forwards.

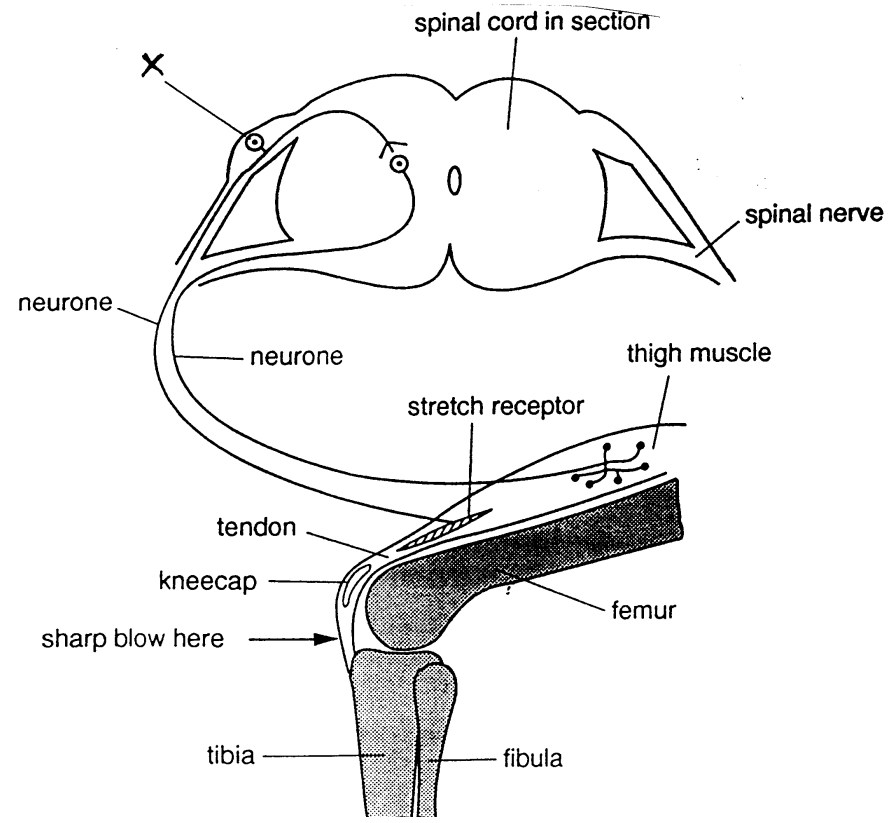

Fig. 6.1

(a) **(i)** State the common name for the reflex action shown in Fig. 6.1.

.....

[1]

(ii) Draw **two** arrows on Fig. 6.1 to show the direction of nerve conduction. **[1]**

(iii) Describe the role of neurone **X** in this reflex arc.

.....

.....

.....

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.....

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.....

.....

[3]

Simple human reflex actions, such as the one shown in Fig. 6.1, are examples of innate behaviour.

(b) Explain the meaning of the term *innate.*

.....

.....

.....

.....

[2]

It has been estimated that osteoporosis-related bone fractures will have occurred in 33% of all women, by the time they reach the age of 70. However, only 8.5% of men will have suffered such fractures by the same age.

(c) **(i)** Explain what is meant by the term *osteoporosis***.**

.....

.....

[1]

(ii) Explain why osteoporosis-related bone fractures are significantly more common in women than men of this age.

.....

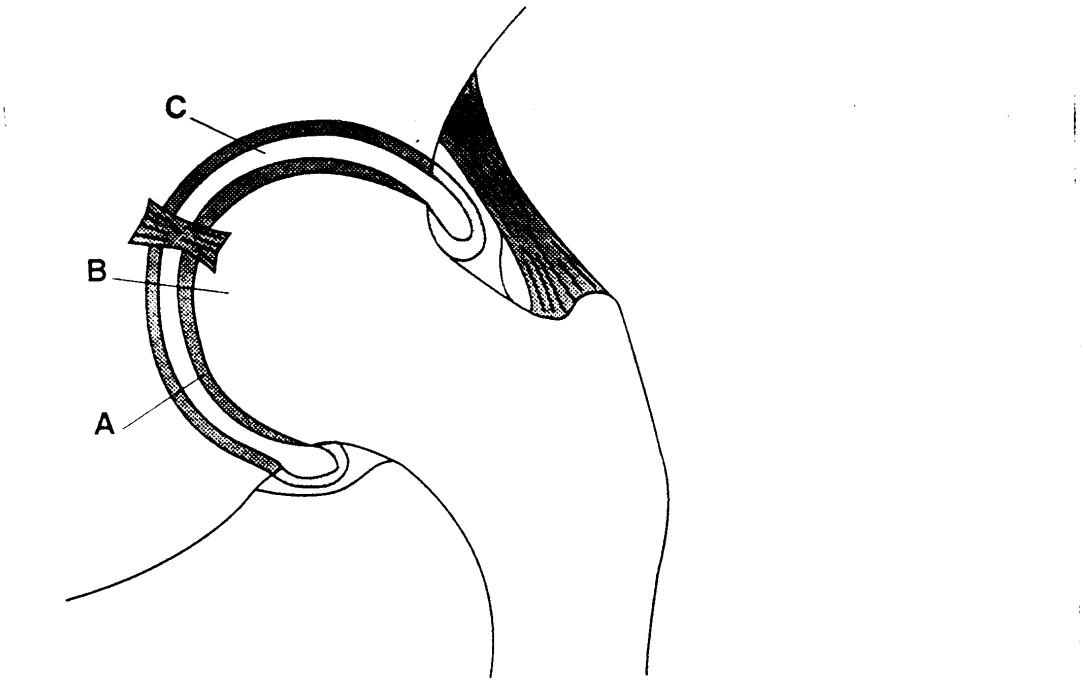
.....

.....

.....

[2]

Osteoarthritis is another effect of ageing. Fig. 6.2 shows a normal, healthy hip joint. The joint is the most commonly affected by osteoarthritis as a result of ageing.



TIM TURVEY, *Nuffield Co-ordinated Sciences - Biology*. Longman. © Nuffield-Chelsea Curriculum Trust. 1988

Fig. 6.2

(d) With reference to Fig. 6.2,

(i) describe the changes which are likely to have taken place at **A**, **B** and **C** in a person suffering from osteoarthritis;

A. .....

.....

B. .....

.....

C. .....

.....

[3]

(ii) explain how the changes which take place at **B** result in the person feeling pain.

.....

.....

.....

.....

[2]

[Total : 15]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
MAMMALIAN PHYSIOLOGY AND BEHAVIOUR **2805/05**

Mark Scheme

1 **(a)** **(i)** **A** columnar epithelial cells;

B microvilli/brush border;

C lacteal/lymphatic vessel;

D blood capillary [4 marks]

(ii) 0.75 mm [1 mark]

(b) **(i)** epithelial layer [1 mark]

(ii) produce alkaline mucus [1 mark]

(c) ***Quality of written communication is assessed in this answer.***

passive diffusion;
e.g.;
facilitated diffusion;
ref to carriers;
e.g.;
cotransport with Na+
e.g.;
active transport;
ref to ATP;
ref to gradients
e.g.;
ref to membrane pumps;
ref to selective uptake;
e.g.;
pinocytosis [8 marks max]

Q – legible text with accurate spelling, punctuation and grammar [1 mark]

[9 marks max]

[Total : 16]

- -

2 **(a)** CEREBRUM

primary sense area;

awareness of touch/pain;

ref to vision/hearing;

primary motor area;

controls activity of skeletal/voluntary muscles;

controls conscious behaviour;

association area;

ref to higher intellectual faculties; [3 marks max]

CEREBELLUM

balance control;

posture;

receives information from inner ear;

ref to muscle spindles/proprioceptors;

muscle co-ordination [2 marks max]

MEDULLA OBLONGATA

homeostatic control processes;

control of heart rate;

control of blood pressure;

control of ventilation rate [2 marks max]

[7 marks max]

(b) dendrite/axons in **B** are shorter than in **A**/converse;

fewer dendrites/axons in **B** than in **A**/converse [2 marks]

(c) hippocampus; [1 mark]

(d) memory loss/impairment;

loss of cognitive function/described;

deterioration in language;

loss of social skills/described [3 marks max]

(e) fibrous protein;
in nerve cell bodies;
(amyloid) plaques between nerve cells;
neurones lost;
ventricles enlarge;
deficiency of choline acetyltransferase;
ref to limbic system;
dissociated from rest of brain [3 marks max]

[Total : 16]

---

3 **(a)** **A** cochlear duct labelled in coiled area;
B any correct location except cochlear duct;
C ampulla correctly labelled [3 marks]

(b) organ of Corti/hair cells [1 marks]

(c) **(i)** increased volume in median canal;
displaces/moves basilar/tectorial membrane(s);
loss of contact with nerve endings;
variable pressure on nerve endings;
causes varying levels of stimulation/over-stimulation
under-stimulation/AW [3 marks max]

(ii) causes reduction in volume of endoymph;
therefore reduction in pressure;
ref to osmosis;
ref to water potential [3 marks max]

(d) lowers blood pressure;
reduces risk of coronary heart disease [2 marks]

(e) pressure of endolymph on cupola/hair cells pushed over/ displaced/AW

® ref to movement of endolymph/ref to cochlea [1 mark]

[Total : 13]

- -

4 **(a)** hepatic artery supplies liver with oxygen/oxygenated blood;
hepatic portal vein brings products of digestion/nutrients;
ref to homeostatic role of liver [2 marks max]

(b) ***Quality of written communication assessed in this answer.***

when blood glucose level rises, insulin secreted;
causes conversion of glucose to glycogen/glycogenesis;
increased respiration/uptake of glucose in liver cells;
when blood glucose level falls, glucagon secreted;
causes conversion of glycogen to glucose/glucogenesis;
production of glucose from non-carbohydrate/ gluconeogenesis;
named non-carbohydrate source;
adrenaline secretion causes conversion of glycogen to glucose;
ref islets of Langerhans;
α, β cells / pancreas, in secreting hormones/detecting blood glucose;
ref to homeostasis;
ref negative feedback [7 marks max]

Q – clear, well organised using specialist terms [1 mark]

[8 marks max]

(c) **(i)** available to cells;
maintain constant blood concentration;
for membrane synthesis;
ref to role of cholesterol in cell membranes;
for steroid/hormone synthesis;
ref to vitamin D synthesis [4 marks max]

(ii) gall stones;
atherosclerosis;
CHD;
stroke [2 marks max]

(d) liver processes/detoxifies/eliminates drugs;
drug may build up in body/not broken down as quickly;
increased side/toxic/harmful effects if full dose given;
therapeutic/beneficial effects will last longer [2 marks max]

(e) haemoglobin broken down/converted to bile pigments;
ref to bilirubin and biliverdin;
bile pigments not excreted;
because liver cells not able to remove from blood [2 marks max]

[Total : 20]

- -

5 **(a)** arrow passing from bottom to top [1 mark]

(b) rhodopsin/visual purple;
causes 'bleaching'/conversion to cream/yellow (inactive) form
ref cis to trans retinene;
retinene changes shape, no longer 'fits' into opsin;
broken down to retinene and opsin/scotopsin [2 marks max]

(c) **(i)** one cone to one sensory fibre/ratio 1:1/AW;
light falling on 2 or more cones stimulates separate nerves;
brain receives separate/individual pieces of information [2 marks max]

(ii) several/three rods share one sensory fibre;
actually c300:
stimulation of any one may stimulate nerve/
possibility of spatial stimulation [2 marks max]

(d) **(i)** 160 000 mm^2 [1 mark]

(ii) B at position with neither rods nor cone [1 mark]

(iii) X at maximum on red graph/on axis [1 mark]

[Total : 10]

---

6 **(a)** **(i)** knee jerk [1 mark]

(ii) one arrow along sensory neurone from stretch receptor
to spinal cord and one arrow from cord to thigh muscle [1 mark]

(iii) sensory;
conducts impulses;
from stretch receptor;
when stimulated by blow/stretch receptor;
to motor neurone/spinal cord/CNS [3 marks max]

(b) present at birth/genetically determined;
no learning required/AW [2 marks]

(c) **(i)** loss of bone tissue/mass;
bones become more brittle/more prone to fracture [1 mark max]

(ii) after the menopause;
deficiency of oestrogen increases risk;
PTH removes calcium;
pregnancy may lead to loss of bone calcium;
osteoblasts do not make more bone;
ref to imbalance of bone formation and resorption [2 marks max]

(d) **(i)** A thinning/deterioration of cartilage
B damage/changes to bone;
C reduced amount of (synovial) fluid [3 marks]

(ii) bone deformities/spurs/AW;
rub against ligaments/soft tissues/other bones;
receptors/nerves are stimulated;
send impulses to brain [2 marks max]

[Total :15]

Assessment Grid: A2 BIOLOGY

Unit Name	MAMMALIAN PHYSIOLOGY AND BEHAVIOUR	Unit Code	2805/05	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding (32-40) a 11/12	AO1 b (socet) 11/12	AO1 c 11/12	AO2, application of knowledge, understanding, analysis, synthesis + evaluation (24-32) a 6/7	AO2 b 6/7	AO2 c 6/7	AO2 d 6/7	AO4, synthesis of knowledge + understanding (32-40) a 14/16	AO4 b 14/16	Target grade	QoWL	Total (90)
1(a)	1(d)(j)	4											
(ii)	1(j)(d)1.1(h)									1			
(b)(i)	1(j)(d)	1											
(ii)	1(j)	1											16
(c)	1(j)1.4(b)(c)									8		1	
2(a)	4(e)			7									
(b)	4(j)					2							
(c)	4(j)	1											
(d)	4(j)				3								
(e)	4(d)(j)			3									16
3(a)	5(j)	3											
(b)	5(j)	1											
(c)(i)	5(j)						3						
(ii)	5(j)4.6(d)									3			
(d)	5(j)2.2(f)								2				
(e)	5(j)				1								13
4(a)	2(a)3.1									2			
(b)	2(c)4.6(n)								7			1	
(c)(i)	2(d)2.2(f)								4				
(ii)	2(d)2.2(f)2.4e								2				
(d)	2(h)				2								
(e)	2(j)				2								20
5(a)	5(a)(b)	1											
(b)	5(c)	2											
(c)(i)	5(d)			2									
(ii)	5(d)			2									
(d)(i)	5(d)					1							
(ii)	5(b)	1											
(e)	5(c)					1							10
6(a)(i)	6(b)4.6(g)									1			
(ii)	6(b)4.6(g)									1			
(iii)	(6(b)4.6(g)									3			
(b)	6(a)	2											
(c)(i)	3(k)	1											
(ii)	3(k)		2										
(d)(i)	3(k)					3							
(d)(ii)	3(k)						2						15
Total		**18**	**2**	**14**	**8**	**7**	**5**	**0**	**15**	**19**		**2**	**90**
Total for sections		**34**			**20**				**34**			**2**	**90**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
UNIFYING CONCEPTS IN BIOLOGY **2806/01**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 60.

Answer **ALL** questions.

1 *Read the passage and answer the questions which follow.*

Red and Grey Squirrels

The red squirrel, *Sciurus vulgaris,* is not as common in Britain as it was a century ago. The grey squirrel, *Sciurus carolinensis,* is now extremely common.

One suggestion for the relative success of the grey squirrel in Britain is that it is able to out-compete the red squirrel. The popular view is that the larger grey squirrels attack the red squirrels. In fact, the two species take very little notice of each other.

Grey squirrels spread slowly and wherever they have been established for more than 15 years, reds squirrels were usually missing. Detailed studies have shown that in some areas the two species have coexisted for 16 years or more, but in other areas the reds had disappeared before the greys arrived.

Comparisons of the two species suggest ways in which their ecologies differ so that red squirrels probably do better in coniferous woodland and grey squirrels better in deciduous woods. For instance, reds spend much more time in the canopy and less time on the ground than greys, this matches the fact that they are lighter, more nimble and put on less fat for the winter. Most conifers take two years to ripen their cones, so there are always cones available in the canopy for a squirrel which is light and nimble enough to reach them. The grey squirrel is something of a specialist, feeding mainly on large seeds, such as acorns and beechnuts, that are abundant on the ground in autumn in broad-leaved woodlands. Both squirrels can produce two litters a year; a female grey squirrel, which has the ability to exploit the rich autumn seed crop, will be better placed to produce a strong litter of young early in the year.

Grey squirrels have a further advantage which has probably been decisive. They can digest acorns more efficiently than red squirrels who do eat acorns but they cannot digest them properly. Reds lose weight when given a diet consisting only of acorns. Conservationists have criticised the extensive use of alien conifers by commercial forestry in Britain and have asked for more native conifers and broad-leaved trees to be planted. This is just what grey squirrels prefer. Serious consideration is now being given to felling oaks in areas which are red squirrel strongholds.

Adapted from: D.W. Yalden, Squirrel Dynamics. Biological Sciences Review, Vol.6 No.2

(a) State **three** pieces of evidence that support the idea that grey squirrels have not **actively** displaced the native red ones.

.....

.....

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.....

.....

[3]

(b) Explain whether there is any evidence for the idea that the two species of squirrel occupy the same niche.

.....

.....

.....

.....

.....

[3]

(c) Explain why

(i) red squirrels are better adapted than grey squirrels to live in coniferous woodland.

.....

.....

.....

.....

[2]

(ii) grey squirrels are better adapted than red squirrels to live in deciduous woodland.

.....

.....

.....

.....

[2]

(d) Describe the measures that may be taken to encourage the red squirrel to gain an advantage over the grey squirrel.

.....

.....

.....

.....

.....

[3]

[Total : 13]

2 Sickle cell anaemia is a condition where the haemoglobin in the red blood cells can no longer carry oxygen efficiently at low oxygen concentrations. Heterozygous individuals show some symptoms of anaemia and appear to be at a potential disadvantage, but they have some resistance to malaria.

In Fig. 2.1, **A** shows the distribution of the malarial parasite in parts of East Africa below 1500 metres, whilst **B** shows the area in which more than 15% of the adults in the population are heterozygous for the sickle cell condition.

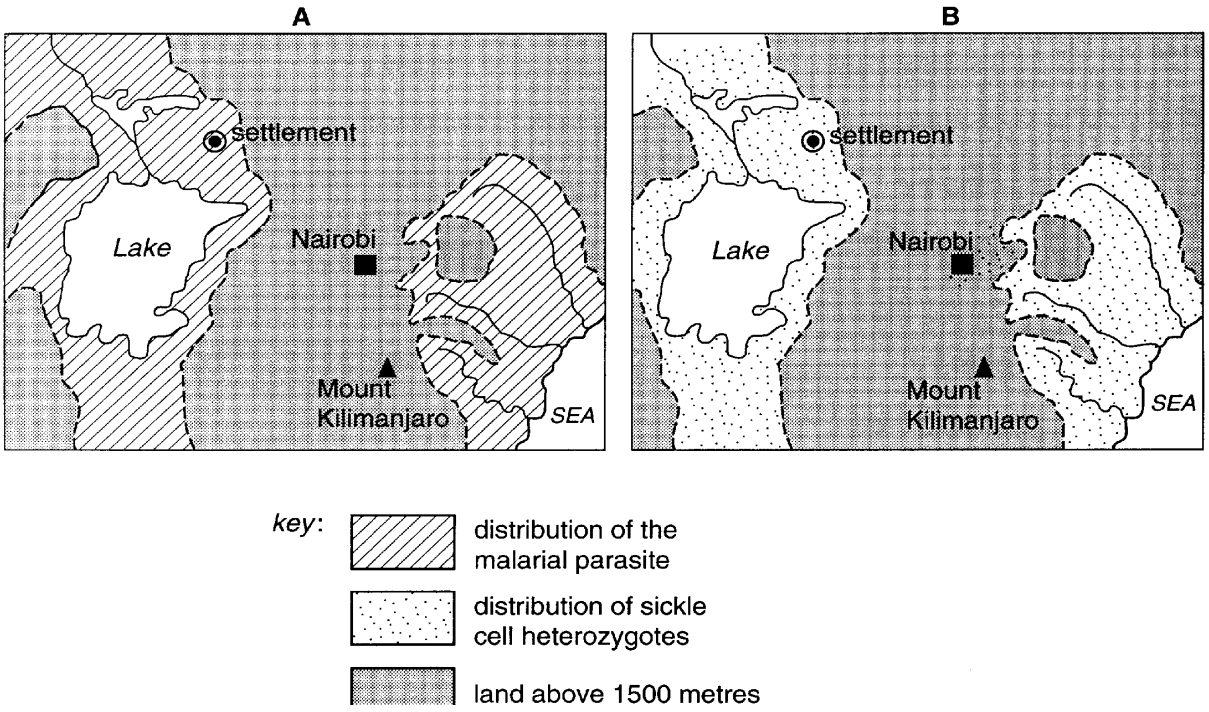

Fig. 2.1

(a) With reference to Fig. 2.1,

(i) describe, with reasons, the distribution of the sickle cell heterozygotes;

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(ii) explain why this distribution of heterozygote individuals has been shown in this area for many generations.

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.....

.....

[3]

(b) If the inhabitants of the settlement indicated on Fig. 2.1 were moved to an area where malaria did not exist, suggest what might happen to the population of heterozygotes in future generations. Explain your answer.

.....

.....

.....

.....

.....

.....

[3]

[Total : 9]

3 Fig. 3.1 illustrates energy flow diagrams for **A** a deciduous forest and **B** a marine community. The units on the flow charts are kJ m^{-2} day^{-1}. The major plants in the marine community are phytoplankton.

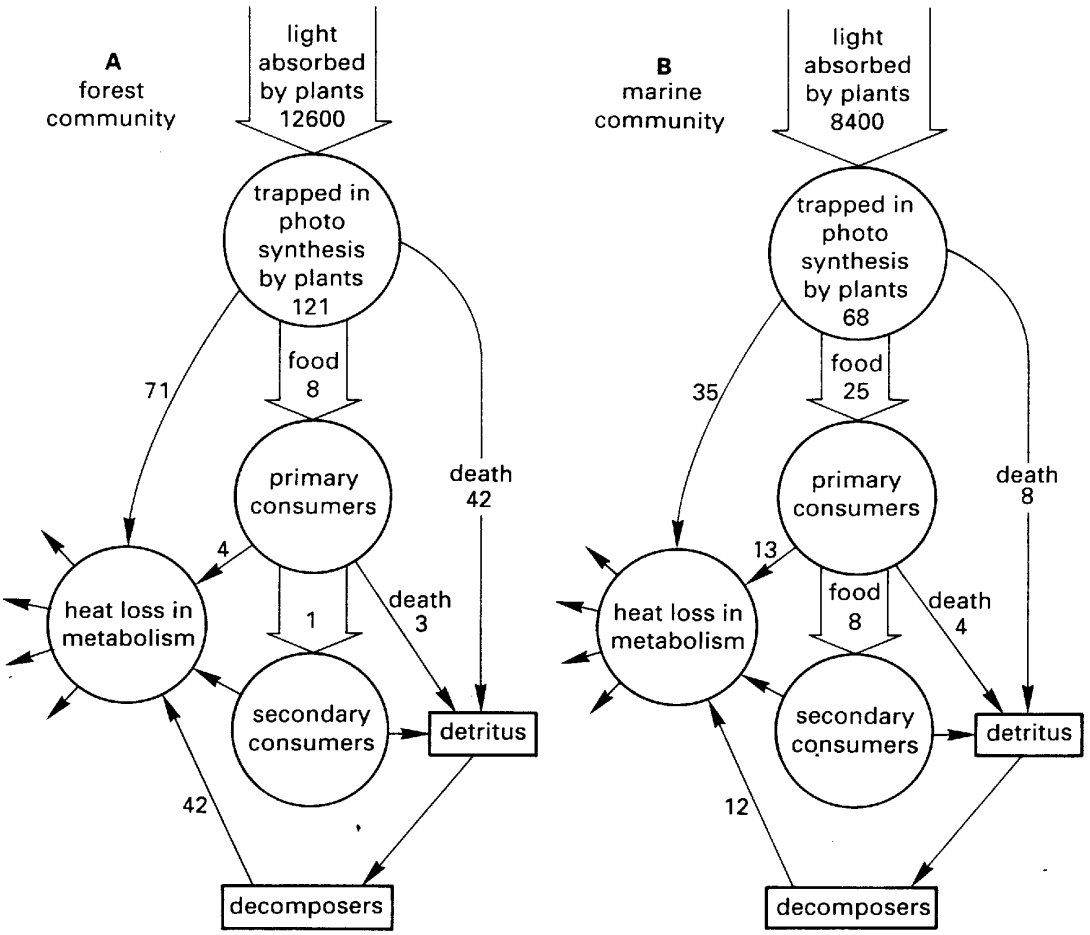

Fig. 3.1

(a) Calculate the efficiency with which solar energy is trapped by the forest plants.

.....

[1]

(b) With reference to Fig. 3.1, describe and explain the major differences between the energy flow in these two communities.

.....

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[8]

(c) Suggest **two** ways in which the deciduous forest may be managed for timber production.

1. .....

.....

2. .....

.....

[2]

[Total : 11]

4 Table 4.1 shows the rate of phosphate absorption by barley roots in a solution aerated with different mixtures of nitrogen and oxygen.

Table 4.1

percentage of oxygen in aeration mixture	phosphate absorption/ $\mu mol\ g^{-1}\ h^{-1}$
0.1	0.07
0.3	0.15
0.9	0.27
2.1	0.32
21.0	0.33

(a) State the conclusions that can be drawn about phosphate absorption from the data in Table 4.1

.....

.....

.....

.....

.....

.....

.....

[3]

Fig. 4.1 shows the rate of phosphate absorption by barley roots placed in solutions containing different concentrations of DNP (2,4-dinitrophenol). DNP is an uncoupler of the electron transport chain. Each solution was aerated with 21% oxygen.

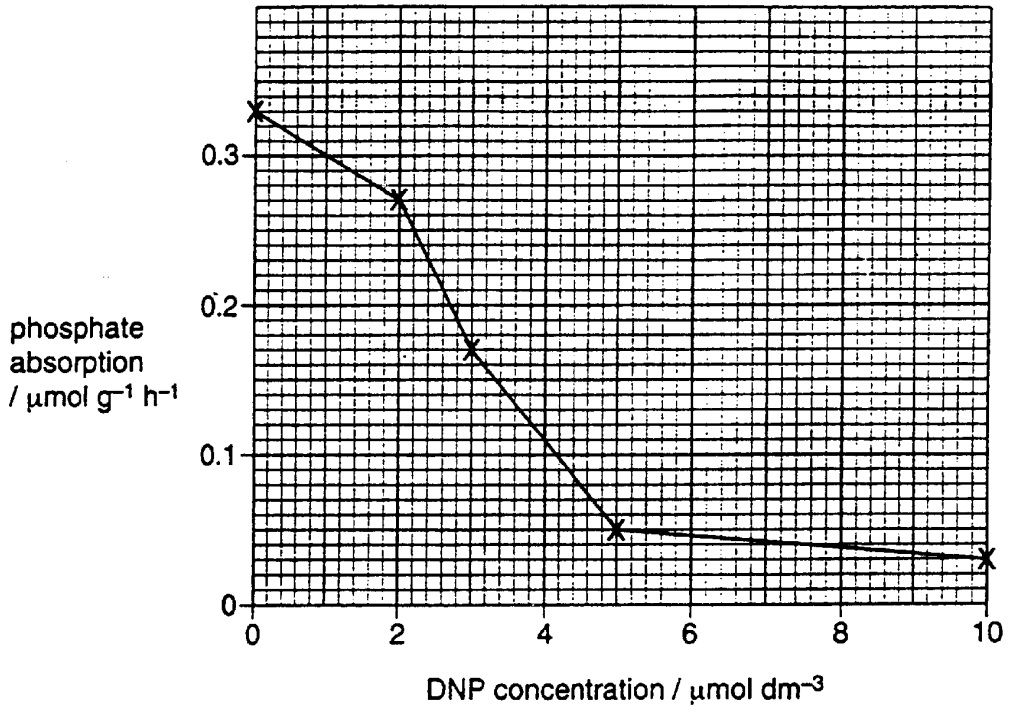

Fig. 4.1

(b) With reference to Fig. 4.1, describe and explain the effect on phosphate absorption of adding DNP to barley roots.

.....

.....

.....

.....

.....

.....

.....

[4]

Malonate is an inhibitor of the Krebs cycle.

(c) **(i)** Predict the effect of adding malonate instead of DNP, on the uptake of phosphate by the barley roots.

.....

.....

[1]

(ii) Explain your answer to **(i)**.

.....

.....

.....

.....

[3]

(d) Discuss the significance of phosphate for living organisms.

.....

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[6]

[Total : 17]

5 Living organisms exchange materials with their environment. These exchanges occur across surfaces which have special features. With reference to **named** examples, discuss how these surfaces are adapted for efficient exchange.

(In this question, 1 mark is available for the quality of written communication.)

[10]

[Total : 10]

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
UNIFYING CONCEPTS IN BIOLOGY **2806 /01**

Mark Scheme

1 **(a)** can live together for 16 years;
ignore each other;
in some areas reds disappeared before greys arrived [3 marks max]

(b) *no*
reds, coniferous woods and greys, deciduous woods;
grey feeds on large seeds, e.g. acorns;
red feeds on small seeds, e.g. confier seeds;
red spends more time in the canopy than grey;
coexist together in same areas [3 marks max]

(c) **(i)** light;
nimble;
put on less fat in the winter [2 marks max]

(ii) can digest acorns;
lots of acorns in autumn increases body reserves;
increased breeding success [2 marks max]

(d) cull / kill, greys;
feed reds;
plant trees with small seeds;
remove oaks
use contraceptives on greys [3 marks max]

[Total : 13]

2 **(a)** **(i)** distribution same as / very similar to, the malarial parasite;
resistant to malaria;
some migration into Nairobi;
allele carried by, immigrants / urban commuters;
similar to breeding grounds of the mosquito;
act as a vector / carries malarial parasite;
(sickle cell) not found above 1500 m;
no malaria / no mosquitoes / low oxygen [3 marks max]

(ii) selective advantage of heterozygote;

(those showing) resistance to (severe) malaria / heterozygotes, survive;

to pass on allele;

resistance passed on from generation to generation;

sickle cell allele selected for;

in preference to normal allele;

balancing selection / frequency of allele kept at a certain level;

little migration of population [3 marks max]

(b) heterozygote population / proportion of sickle cell allele / gene frequency falls;

no longer advantage to be resistant to malaria;

disadvantage of suffering from anaemia / oxygen deprivation;

ref to selective advantage, disadvantage [3 marks max]

[Total : 9]

- -

3 **(a)** 0.96% [1 mark]

(b) any two valid differences between the energy flow in A and B supported by figures;

ref to differences between leaves and phytoplankton in absorbing light;

ref to limiting factors of photosynthesis and effects on energy flow in two communities;

higher energy flow through consumer food chain in B;

higher energy flow through detritus food chain in A;

larger population of decomposers in forest;

inedible material produced in forest, e.g. wood;

smaller, number / biomass, of secondary consumers in A;

ref to efficiency of transfer of energy between trophic levels;

AVP [8 marks max]

(c) large trees felled, replanted;

coppicing, described [2 marks]

[Total 11]

- -

4 **(a)** oxygen needed;
positive correlation/more oxygen more absorption;
aerobic respiration/ oxygen needed for respiration;
ref to oxidative phosphorylation;
active transport involved;
energy needed for absorption;
only 2% oxygen needed;
little increase above 2% [3 marks max]

(b) absorption reduced;
figures to support;
ref to small change between 5 and 10;
DNP allows electrons down the chain;
no ATP produced by ETC;
therefore less ATP;
therefore less active transport [4 marks max]

(c) **(i)** less absorption [1 mark]

(ii) Krebs cycle produces NADH;
NADH supplies energy/H/e- ;
for oxidative phosphorylation;
less energy/ATP for active transport [3 marks max]

(d) information, storage / retrieval;
DNA / RNA;
energy transfer;
ATP / ADP
sugar phosphates;
ref to respiration / glycolysis;
ref to photosynthesis;
secondary messenger;
cyclic AMP;
membranes;
phospholipids
skeleton;

bone / teeth;

AVP [6 marks max]

[Total : 17]

- -

5 ***Quality of written communication assessed in this answer.***

large surface area;

way(s) in which achieved;

layer(s) of cells e.g. squamous epithelium;

internal surface of leaf mesophyll;

root hairs;

any structural detail of surfaces;

permeable / thin;

selectively permeable;

ref to gaseous exchange;

gills / alveoli;

well ventilated;

any detail;

well supplied with blood;

maintenance of diffusion gradients;

ref to uptake of organic molecules;

ref to uptake of ions;

channel proteins;

carrier molecules;

active uptake;

AVP

credit other examples such as tracheoles in insects, surface of protoctists, fungi, bacteria – any examples taken from the optional modules [9 marks max]

Q – legible text with accurate spelling, punctuation and grammar [1 mark]

[10 marks max]

[Total : 10]

- -

Assessment Grid: A2 BIOLOGY

Unit Name	Synoptic Paper	Unit Code	2806/01	Session: JAN / JUNE	Year:

Question number	Outcomes assessed (spec. ref.)	AO1, knowledge + understanding a	b (socet)	c	AO2, application of knowledge, understanding, analysis, synthesis + evaluation a	b	c	d	e	AO4, synthesis of knowledge + understanding (59) a	B	Target grade	QoWL	Total (60)
1 (a)	4.3(f)									3				
(b)	1.7(a)									3				
(c)	4.5(f)									4				
(d)	4.3(f)									3				13
2 (a)(i)	4.5(e) 2.5									3				
(ii)	4.5(e) 2.5									3				
(b)	4.5(e) 2.5									3				9
3 (a)	1.7 (c)									1				
(b)	1.7, 4.2									8				
(c)	4.3 (j)									2				11
4 (a)	1.4(c) 4.1(a)									3				
(b)	4.1 (a)									4				
(c)	4.1 (g) 1.3 (e)									4				
(d)	1.2 (j) 1.4 (a) 1.5 (a) 4.1 & 4.2										6			17
5	1.4 2.3 3.1 3.3 4.6										9		1	10
Totals										**44**	**15**		**1**	
Totals for sections										**59**			**1**	**60**

Oxford Cambridge and RSA Examinations

Advanced GCE

BIOLOGY
PRACTICAL EXAMINATION 2 **2806/03**

Specimen Paper

Additional materials:

Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.

Write all your answers on the separate answer paper provided.

Answer **all** questions. (Note: Question 1 is completed before candidates take this practical paper).

Fasten your answer to question 1 to your answers to questions 2 and 3.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

In this paper you are expected to show your knowledge and understanding of different aspects of Biology and the connections between them.

Total marks for this paper is 60.

SECTION ONE (Planning)

Question 1

Fig.1.1 shows a diagram of a respirometer that can be used to measure the respiratory rate of small organisms. The apparatus works in the following way:

oxygen absorption by the respiring material, e.g. a germinated Mung bean, causes a volume reduction to occur in the apparatus because the carbon dioxide given out is absorbed by the soda lime.

The reduction in volume causes the manometer fluid to move towards the syringe. Movement of the manometer fluid, e.g. in millimetres per minute, provides a measure of the oxygen uptake by the respiring material.

The manometer fluid can be returned to its original position by moving in the syringe plunger.

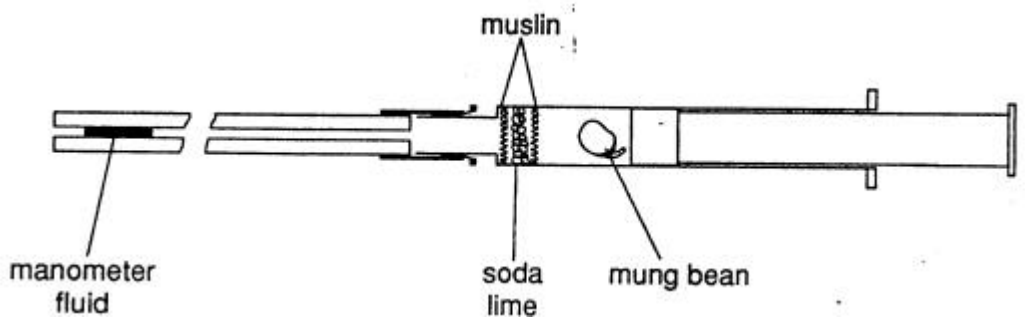

Fig. 1.1

Design and describe a procedure that would allow you to compare the respiratory rate of Mung bean seedlings that have been germinated for 2 days and for 4 days.

In your account refer to

- any variables you would need to consider, in addition to the age of the seedlings
- the data you would collect and how that would be done
- any procedures you would adopt to ensure that the data you collect, and the deductions you draw from them, are as reliable as possible
- how the data would be used to make the comparison in respiratory rate.

[16]

SECTION TWO

Question 2 [55 minutes]

You are required to estimate the water potential (Ψ) of the cells of the plant material with which you have been provided.

Proceed as follows:

Using a sharp scalpel cut a **5 cm** long, straight piece, from near the middle region, of one of the specimens provided. Hold this piece of plant in a vertical position and cut it longitudinally downwards for a distance of approximately **4 cm**, as shown in Fig. 2.1 below.

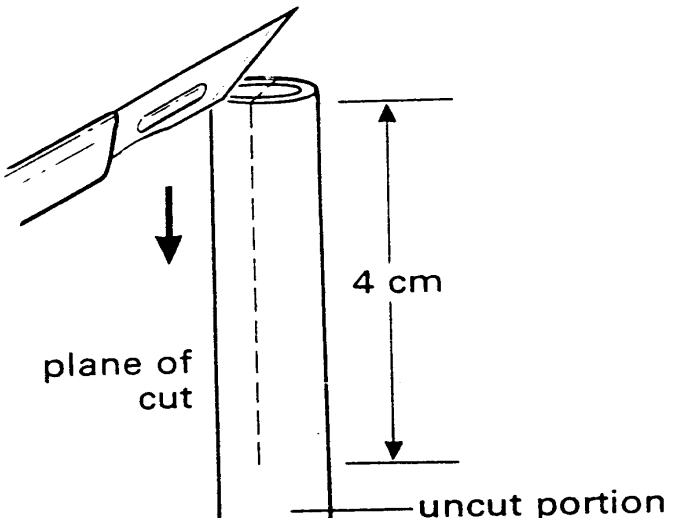

Fig. 2.1

You should find that the specimen has curved, as shown in Fig. 2.2 below. Check that the distance **A**, between the cut pieces is *at least 1 cm.* If not, repeat the procedure using another specimen.

Place the piece of plant tissue horizontally in the base of a clean, dry Petri dish. Taking care not to squash the plant material, gently but firmly fix it to the dish using a small roll of plasticine, which you press down at **X** and **Y**, as shown in Fig. 2.2.

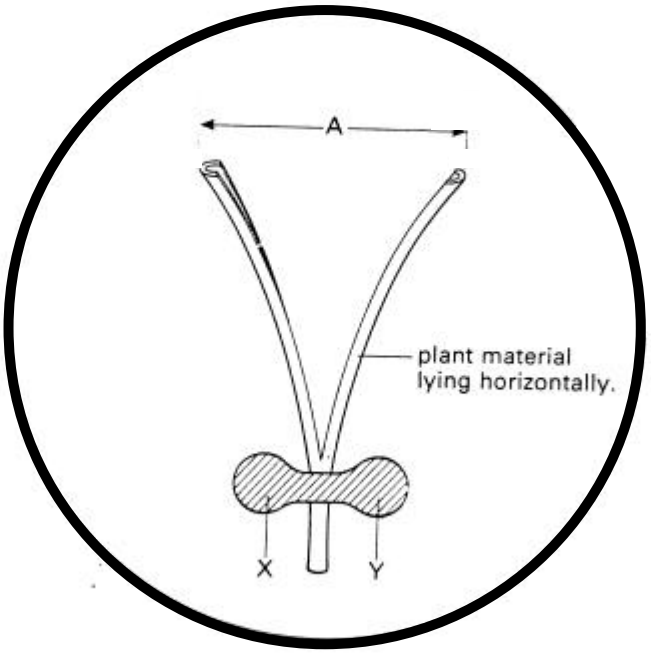

Fig. 2.2

Prepare **three** further dishes, using 5 cm long pieces of tissue, cut from roughly corresponding positions of three other 'stalks'. Label your dishes **1**, **2**, **3** and **4**.

(a) Place the four dishes on the separate sheet of graph paper provided and measure, to the nearest millimetre, the distance **A** in each dish. Record these observations in the table below. **[1]**

	dish 1 (for S1)	**dish 2 (for S2)**	**dish 3 (for S3)**	**dish 4 (for S4)**
initial value of A				
value of A after 10 minutes				
difference between 1 and 2				
percentage change				

You have been provided with the following sucrose solutions:

S1 is **0.2** mol dm^{-3}

S2 is **0.4** mol dm^{-3}

S3 is **0.6** mol dm^{-3}

S4 is **0.8** mol dm^{-3}

Gently, in order to avoid dislodging the plant tissue, pour **S1** into **dish 1**, so that the piece of plant is completely covered by the solution. As quickly as possible, pour the other solutions into their respective dishes.

Leave the dishes for **10 minutes**. During this time you may begin **(c)**.

(b) **(i)** After 10 minutes, measure (to the nearest mm) the distance **A** in each of the dishes. Record these measurements in the table. **[2]**

(ii) For each dish, calculate the percentage change in **A** as follows:

$$\textit{percentage change} = \frac{\textit{change in distance } \mathbf{A}}{\textit{initial value of } \mathbf{A}} \times 100$$

[1]

(iii) Record your calculations in the table (to the nearest whole number) and state, in each case, if the value is positive or negative. **[1]**

(iv) Plot a graph of the percentage change in **A** against molarity of sucrose solution.

[4]

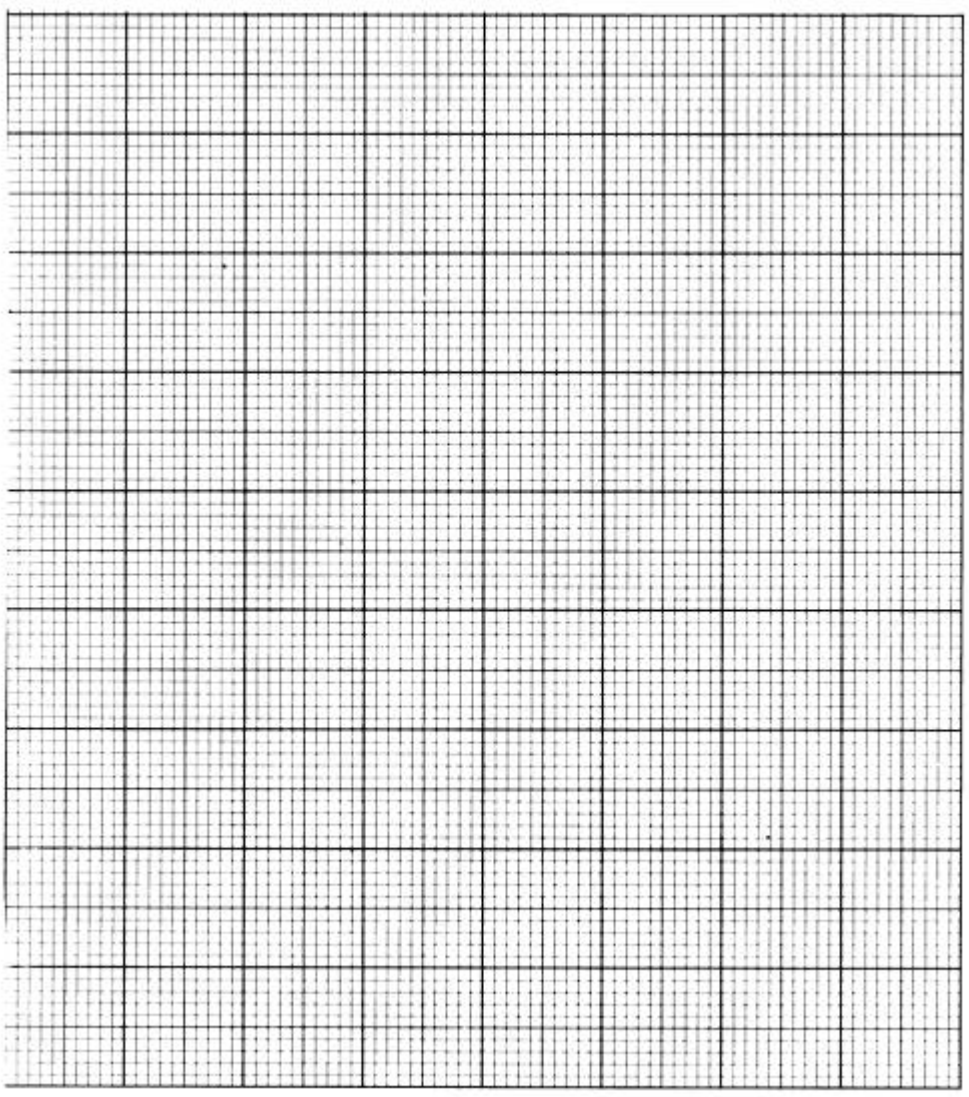

Table 1.1 shows the solute potentials (Ψ_s) of different concentrations of sucrose solutions, at the approximate temperature at which you have been working.

Table 1.1

concentration/ mol dm^{-3}	solute potential (Ψs)/ kilopascals
0.1	-260
0.2	-540
0.3	-820
0.4	-1120
0.5	-1450
0.6	-1700
0.7	-2170
0.8	-2580

(v) Use the graph you have drawn, and Table 1.1, to estimate the water potential of the cells of this plant material. Explain fully how you arrived at your answer.

Answer .....

Explanation

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[4]

(vi) Comment on any advantages and/or disadvantages in this procedure of using pieces of plant, taken from four *different* 'stalks', rather than from *one* 'stalk'.

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[4]

Slide **K2** is a transverse section through a piece of plant tissue, very similar to that which you have been using in **(a)** and **(b)**. Examine **K2** carefully using your microscope.

(c) **(i)** Make large, high power drawings, to show the structure of **three** adjoining epidermal cells of this specimen. Indicate by means of an arrow, which is the **outer** surface of these cells.

[3]

(ii) Make large, high power drawings, **to the same scale as in (b) (i)**, to show the structure of **three** adjoining cells that are next to the central cavity of the section.

[4]

(iii) Suggest how the different structures of these two types of cells might account for any changes in shape of the pieces of plant tissue which you observed in **(b)**.

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[3]

[Total : 27]

Question 3 **[35 minutes]**

K3 is a stained, transverse section through the small intestine of a mammal. Examine **K3** carefully using your microscope. The layers making up the wall of the organ are shown diagrammatically in Fig. 3.1.

You are not expected to have seen this specimen before.

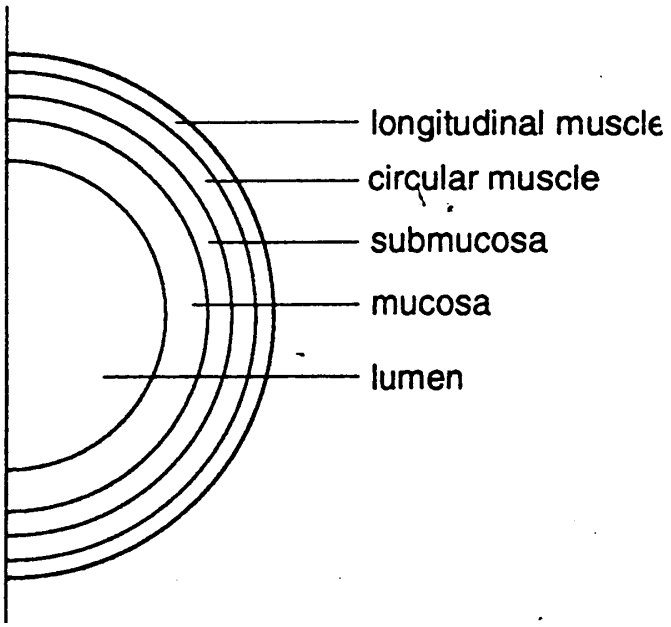

Fig. 3.1

(a) **(i)** Make a plan drawing of **K3** to show accurately the **shape** of the section of the organ and the **distribution** of the tissues in it.

Do **not** *draw individual cells. It is* **not** *necessary to draw large numbers of the structures projecting into the centre of the section.*

[4]

(ii) State the magnification of your plan drawing and the method of calculating it.

Method .....

Method of calculation

.....

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[1]

(iii) Suggest why the muscles are arranged in circular and longitudinal layers.

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[2]

(iv) What do you think is the significance of the presence of the large number of structures that project into the lumen of the organ?

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[2]

Find a region of the section where one of the projections has been cut along its entire length. Use the high power of your microscope to find a region along this projection where you can see clearly the structure of the **two** different types of cells which make up the surface layer of the projection. The **less** abundant cells, which are stained blue, are mucus-secreting cells.

(b) **(i)** Make a high power drawing to show the detailed structure of **three** adjoining cells which are typical examples of the **more abundant** of the two types of cells.

[3]

(ii) State **two** ways in which the structure of the mucus-secreting cells differs from that of the cells you have drawn in **(b) (i)**.

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[2]

(iii) Suggest why the secretion of mucus is important in this organ.

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[2]

In an investigation, the numbers of mucus-secreting cells that occurred on 20 complete projections were counted in two different regions of the small intestine. Means were calculated and compared.

(c) What test would you use to decide if the difference between mean scores was statistically significant?

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[1]

[Total : 17]

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