Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

BIOLOGY **9700/31**

Paper 31 Advanced Practical Skills

For Examination from 2007

Specimen Paper

2 hours

Candidates answer on the Question Paper.
Additional Materials: As listed in Instructions to Supervisors.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.
You may use a pencil for any diagrams, graphs or rough working.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **11** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE
International Examinations

[Turn over

1 You are reminded that you have only one hour for this part of the practical examination. You should read carefully through the whole of this question and then plan your use of the time to make sure that you finish all the work that you would like to do.

Respiration is a process which uses enzymes to release energy from biological molecules.

(a) You should spend no longer than five minutes on question **1 (a)**.

You are provided with a solution of a biological molecule, **S1**. You are provided with the following materials that can be used to identify the biological molecule in solution **S1**.

- Ethanol
- Benedict's solution
- Distilled water

Use the materials provided to identify the biological molecule in solution **S1**.

Describe each test that you performed and explain the meaning of the results that you obtained.

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..... [2]

(b) You should spend no more than 25 minutes on question **1 (b)**

You are provided with a suspension of yeast that has been placed in solution S1, labelled **S2**.

Carefully follow the instructions below to use **S2** to investigate the quantitative effect of temperature on the enzymes in the yeast. You should present and record your observations and data in the space provided.

You will need to:

- read through the instructions carefully,
- make some decisions,
- prepare the space on the next page so that it is ready for you to record the readings.

- Place 10 cm^3 of suspension **S2** into the large test-tube.
- Securely fit the bung with the delivery tube into the top of the large test-tube
- Place 5 cm^3 of distilled water in an empty test-tube, **A**.
- Place 150 cm^3 of water in the beaker.
- Measure the temperature of the water.
- Use the beaker as a water bath for the large test-tube, so that the delivery tube is outside the beaker
- Place test-tube **A** so that the end of the delivery tube is near the bottom of the water in test-tube **A**, as shown in Fig 1.1.
-

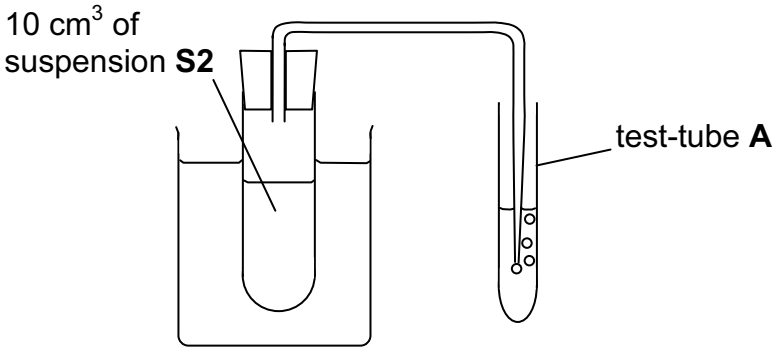

Fig 1.1

Bubbles of gas should come from the end of the delivery tube.

(i) Decide how many readings to take, and for how long to take each reading. Each reading should be made and recorded in the space you have prepared below. [1]

(ii) You can use the Bunsen burner to warm up the water in the water bath. Decide how many different temperatures you will use, and what would be appropriate temperatures to use. Repeat the readings taken in **(ii)** at each of your chosen temperatures.

[6]

(c) (i) pH has a big effect on the rate of enzyme reactions. Suggest how effectively pH was controlled in this experiment.

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..... [1]

(ii) State **two** significant sources of error in this experiment, other than control of pH.

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..... [1]

(d) In a student's investigation the number of bubbles of gas produced in five minutes was measured. The data in Table 1.1 was obtained.

Table 1.1

temperature/^{o}C	bubbles of gas produced in 5 minutes			mean number of bubbles of gas/ bubbles min^{-1}
	first run	second run	third run	
28	10	8	11	1.9
38	19	21	17	3.8
48	24	21	28	
58	11	6	10	1.8

(i) The first time that the student tried this at 38 ^{o}C, the number of bubbles produced in five minutes was 3 cm^{3}. Explain why the student discarded the reading and repeated it.

.....

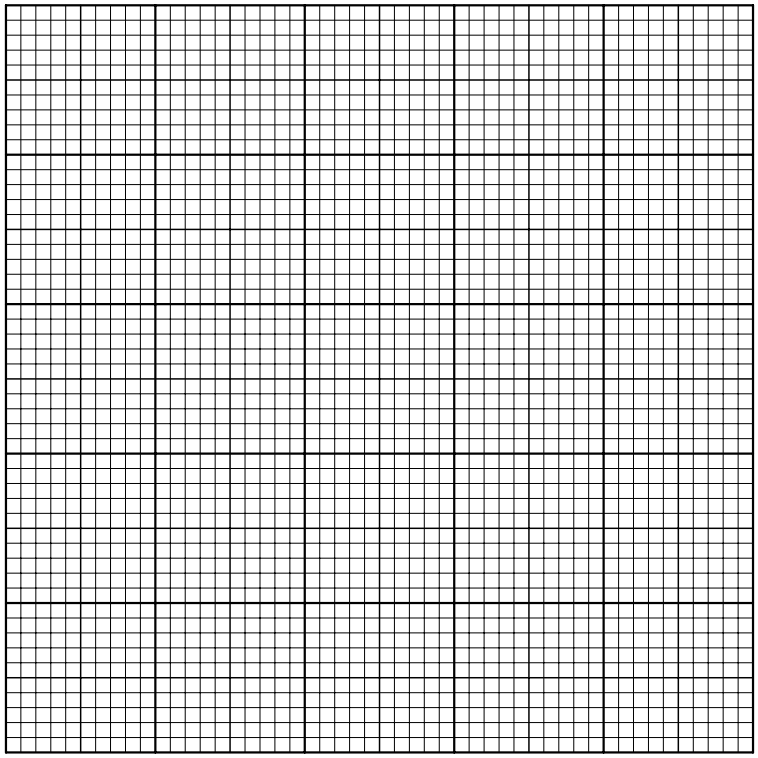
..... [1]

(ii) Complete Table 1.1 by calculating the missing value for the mean number of gas bubbles produced per minute, at 48 ^{o}C.

Show your working in the space below

[1]

(iii) Plot a graph to show the effect of temperature on the mean number of gas bubbles produced, using the data in Table 1.1.



[3]

(e) Briefly outline the main features of the relationship between temperature and mean volume of gas produced.

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.....

..... [1]

(f) The student's hypothesis was

- as the temperature increases, the rate of production of gas will increase

Draw an appropriate conclusion to the student's experiment, including

- whether the experimental data supports the student's hypothesis,
- a revised or new prediction.

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..... [2]

(g) Suggest how the experiment in question **1 (a)** could be improved.

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..... [2]

2 You are reminded that you have only one hour for this part of the practical examination. You should read carefully through the whole of this question and then plan your use of the time to make sure that you finish all the work that you would like to do.

(a) (i) Draw a low power plan diagram of the specimen on slide **S4**

[2]

(ii) Use a ruler to measure the actual size of the specimen on slide S4 and the size of your drawing across the same point. Draw a line on your drawing to show the size that you have measured. Calculate the magnification of your drawing.

Show your working

magnification ..... [2]

(iii) Estimate the uncertainty in the measurement of the actual size of the specimen on slide **S4**.

Actual size measured = ...

Uncertainty = ... [1]

(iv) Suggest how a systematic error in measuring the size could occur.

.....

.....

..... [1]

(b) Starch is stored as granules in some of the cells in the specimen on slide **S4**. Starch is stained purple during preparation of slide **S4**.

In the space below, show your observations of enough of these food storage cells to give a representative sample of the range of their structure.

[6]

(c) (i) Prepare the space below so that it is suitable for you to compare, using a hand lens and microscope, specimen **S3** and the specimen on slide **S4**.

[1]

(ii) Compare specimen **S3** and the specimen on slide **S4**, recording your observations in the space that you prepared in question **2 (c) (i)**. [3]

(iii) Both specimens are involved in transport of materials. State one key point of your observations that relates to this function.

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..... [1]

(d) The photomicrographs, Fig. 2.1 and Fig. 2.2 are taken from a different part of an unfamiliar plant. Fig. 2.1 is a transverse section across the structure, and Fig. 2.2 is a longitudinal section along it.

Mature xylem vessels are large tubes with thick cell walls and no cytoplasm within them. As they mature the cells die, the end walls of the cells break down and they become a continuous tube. They are found within vascular bundles that run along roots, stems and inside the veins of leaves. They do not have companion cells. The cell walls of the xylem vessels or the cells next to them may have rings or spirals of thickening, and may have pits, which are holes through the cell walls connecting cells with the cell next to them.

Use clear labels and label lines to show the xylem in each of the photomicrographs using the information provided. Explain the reasons for your choice in the space provided.

Reasons for choice .....

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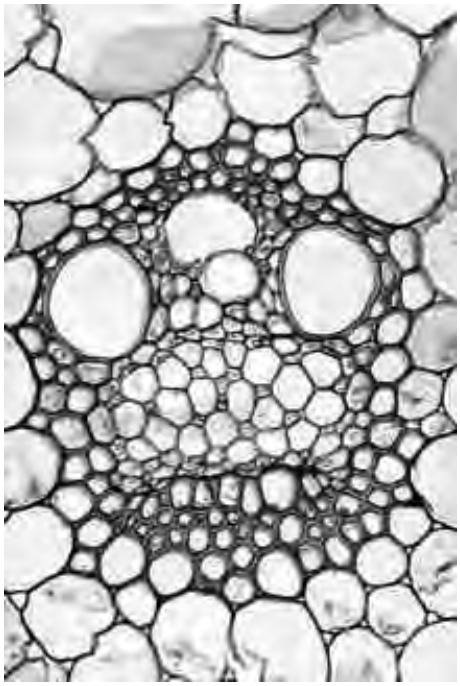

Fig. 2.1

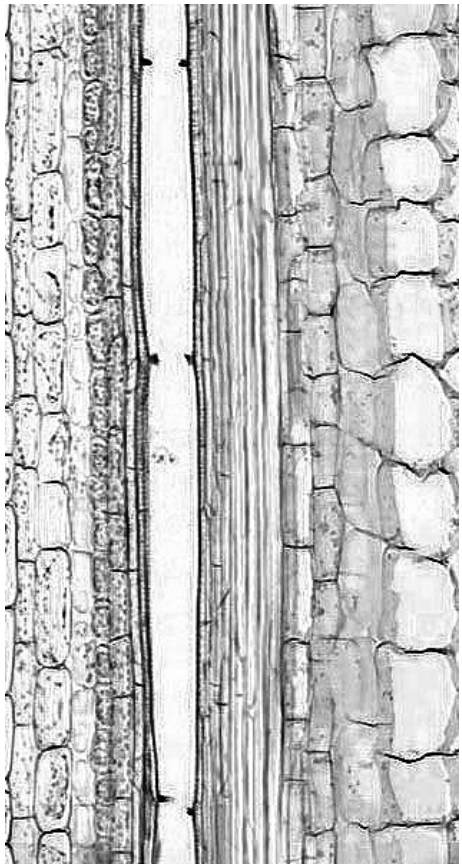

Fig. 2.2

Reasons for choice .....

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.....

[2]

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Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

BIOLOGY

9700/31

Paper 31 Advanced Practical Skills

For Examination from 2007

SPECIMEN INSTRUCTIONS

Great care should be taken that any information given does not reach the candidates either directly or indirectly.

This document consists of **4** printed pages.

UNIVERSITY of CAMBRIDGE
International Examinations

[Turn over

Instructions for preparing apparatus

These instructions give details of the apparatus and materials required by each candidate for this paper. Sufficient information is given to permit the Centre to set up and test the apparatus and materials so that the candidates can be fairly assessed.

If a candidate breaks any of the apparatus, or loses any of the material supplied, the matter should be rectified.

Candidates must be provided with a microscope with:

- Low-power objective lens, e.g. X10 (equal to 16 mm or ⅔")
- High-power objective lens, e.g. X40 (equal to 4 mm or ⅙")
- Eyepiece graticule fitted within the eyepiece and visible in focus at the same time as the specimen.

Each candidate should have sole, uninterrupted, use of the microscope for at least 55 minutes.

Supervisors are advised to remind all candidates that **all** substances in the examination should be treated with caution. Pipette fillers and safety goggles should be used when necessary.

In accordance with the COSHH (Control of Substances Hazardous to Health) Regulation, operative in the UK, a hazard appraisal of the examination has been carried out.

The following codes are used where relevant.

C = corrosive substance
H = harmful or irritating substance
F = highly flammable substance
O = oxidising substance
T = toxic substance

Centres are reminded that they are **not** permitted to open any question paper envelopes before the examination. Centres are also referred to the Handbook for Centres 2007, and in particular Section 3.1.2 (c), Security of Question Papers and Examination Materials, as well as 3.3.11.1, Practical Examinations in Science Subjects.

Instructions to Supervisors

Each candidate must be provided with the following apparatus and materials.

To be supplied by the Centre

Question 1

Each candidate will require:

(i) 20 cm^3 of solution S1, labelled **S1**. This should be a 0.5 mol dm^{-3} glucose solution. It could be made by dissolving 9 g of glucose in 80 cm^3 of water and making up to 100 cm^3.

(ii) A small volume (e.g. 10 cm^3) of Benedict's solution in a suitable dispensing bottle, labelled **Benedict's solution**.

(iii) A small volume (e.g. 10 cm^3) of ethanol or industrial methylated spirit ('meths') in a suitable dispensing bottle, labelled **ethanol**.

(iv) At least 20 cm^3 of distilled water in a small dispensing bottle or a container with a pipette, labelled **distilled water**.

(v) Test-tube rack containing two empty, unlabelled test-tubes, a large test-tube and a test-tube labelled **A**.

(vi) Water-bath to perform Benedict's test, consisting of a Bunsen burner, tripod, gauze and beaker.

(vii) A bung and glass or plastic delivery tube, as shown in Fig. 1.1, to fit the large test-tube in **(v)**.

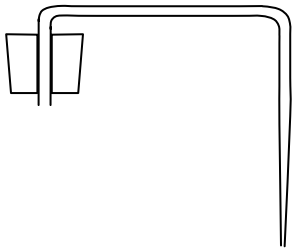

Fig. 1.1

(viii) A beaker large enough to contain 150 cm^3 of water and not overflow when the large test-tube is dipped in the water. This could be the same beaker as is used for the waterbath in **(vi)**.

(ix) Access to a tap dispensing water at, or below, room temperature.

(x) 20 cm^3 of yeast suspension S2, labelled **S2**. This should be made using a 1.0 mol dm^{-3} glucose solution. It could be made by dissolving 18 g of glucose in 80 cm^3 of water. This can be made up several days before the examination. About half-an-hour before the examination, 1 g of dried yeast powder or granules should be thoroughly stirred into the glucose solution, and this should

be made up to 100 cm^3 before the yeast starts to ferment and produce foam, which will make measurement of the volume difficult.

(xi) Thermometer capable of measuring at least from 0 to 60 ^oC (e.g. a standard -10 to 110 ^oC laboratory thermometer would be suitable)

(xii) A Bunsen burner. This could be the same burner as is used to heat the waterbath in **(vi)**.

Question 2

Each candidate will require:

(i) Specimen **S3**, a slice from a carrot, between 1 cm and 6 cm in diameter, and between 0.5 and 1 cm thick. The central stele should be clearly visible in the carrot used.

(ii) Slide **S4**, a transverse section of *Ranunculus* root, suitably stained to show the central stele and starch grains in the parenchyma cells. (A suitable slide may be purchased from CIE, through the publications catalogue.)

(iii) A microscope with:

- Low-power objective lens, e.g. x10 (equal to 16 mm or $\frac{2}{3}$ ")
- High-power objective lens, e.g. x40 (equal to 4 mm or $\frac{1}{6}$ ")
- Eyepiece graticule fitted within the eyepiece and visible in focus at the same time as the specimen.

(iv) Hand lens (e.g. x10)

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A/AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9700/31

BIOLOGY
ADVANCED PRACTICAL SKILLS

UNIVERSITY of CAMBRIDGE
International Examinations

Skill	Total marks	Breakdown of mark expectations		Question 1	Question 2
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	8 marks	2	6
		Decisions relating to measurements or observations	8 marks	4	4
Presentation of data and observations	12 marks	Recording data and observations	4 marks	2	2
		Display of calculation and reasoning	2 marks	1	1
		Data layout	6 marks	4	2
Analysis, conclusions and evaluation	12 marks	Interpretation of data or observations and identifying sources of error	6 marks	2	4
		Drawing conclusions	3 marks	4	0
		Suggesting improvements	3 marks	2	0

MMO = Manipulation, measurement and observation
Collection = Successful collection of data and observations
Decisions = Decisions relating to measurements or observations
PDO = Presentation of data and observations
Recording = Recording data and observations
Display = Display of calculation and reasoning
Layout = Data layout
ACE = Analysis, conclusions and evaluation
Interpretation = Interpretation of data or observations and identifying sources of error
Conclusions = Drawing conclusions
Improvements = Suggesting Improvements

Question			Sections	Learning outcomes	Indicative material	mark
1	**(a)**		MMO Decisions ACE Conclusions	• Decide how many tests, measurements or observations to perform • Make and record sufficient, accurate measurements and observations • Draw conclusions from interpretations of observations, data and calculated values	2 very simple tests ethanol emulsion, shake = clear AND benedicts + heat = red/ orange/yellow (R green); reducing sugar (R glucose/ other unqualified sugar);	1 1
	(b)	**(i)**	MMO Decisions	• decide how many tests, measurements or observations to perform • make measurements or observations that span the largest possible range within the limits either of the equipment provided or of the instructions given • make quantitative measurements or qualitative observations that are appropriately distributed within this range	for room temperature: at least 2 and not more than 4 readings, each of at least 10 seconds and nor more than 60 seconds;	1

		(ii)	MMO collection	• set up apparatus correctly • follow instructions given in the form of written instructions or diagrams	data reported as bubbles per unit time for at least two temperatures;	1
			MMO decisions	• decide how many tests, measurements or observations to perform • replicate readings or observations as necessary	decide to investigate three or more temperatures and to replicate readings	1
			MMO collection	• make and record sufficient, accurate measurements and observations	at least three temperatures investigated, and at least two replicate readings made;	1
			PDO recording	• present numerical data, values or observations in a single table of results • draw up the table before taking readings/making observations, so that candidates can record directly into the table, to avoid the need to copy up their results • include in the table of results, if necessary, columns for raw data, for calculated values and for deductions • use column headings that include the quantity and the unit (as appropriate) and that conform to accepted scientific conventions	all data recorded in a single table with appropriate means to record bubbling rate per unit time, replicated, at more than one temperature; column headings that include quantities and unit where appropriate (such as temperature/^{o}C, number of bubbles in 10 seconds);	2
			PDO layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	most data recorded in a table;	1

	(c)	**(i)**	ACE interpretation	• evaluate the effectiveness of control of variables and thus the confidence with which conclusions might be drawn	no attempt made to control it so not well controlled /distilled water used, so no acid or alkali added, but not well controlled/no buffer added so not well controlled/yeast contains proteins/buffers/weak acids + salts that might help buffer the solution a little;	1
		(ii)	ACE interpretation	• identify the most significant sources of error in an experiment	**Two** from: IDEA OF bubbles might vary in size/ temperature change might cause gas inside tube to change volume/one example of limited accuracy of measuring equipment e.g. syringe/AVP;	1
	(d)	**(i)**	MMO Decisions	• replicate readings or observations as necessary (individual readings or observations should be repeated where they appear to be anomalous)	something has gone wrong with the apparatus / the gas bubbles have leaked out somewhere / AVP (accept reading anomalous / not reliable unqualified) ;	1
		(ii)	PDO display	• show their working in calculations, and the key steps in their reasoning • use the correct number of significant figures for calculated quantities	4.9 with appropriate working shown; R no working shown R more than two significant figures	1

		(iii)	PDO layout	• select which variable(s) to plot and plot appropriately on clearly labelled x- and y-axes • plot all points or bars to an appropriate accuracy • follow the IOB recommendations for putting lines on graphs	independent variable (temperature) on x-axis, dependent variable (mean number of bubbles min^{-1}) on y-axis AND axis labels appropriate (accept ecf from table if already penalised in **1 (b) (ii))**; scale should be chosen so that data spans at least half of the width and height of the grid AND scale appropriate such as 1:10, 1:5 or 1:2 (R awkward scales such as 3:10, 7:10, 8:10) (scale does not need to start at 0); data plotted accurately to within 1 mm, using crosses or circle-with-dot AND points joined with straight ruled lines OR fine curve drawn through the data points, **not** extrapolated beyond the first or last point;	3
	(e)		ACE Conclusions	•draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis, and making further predictions	at low temperatures an increase in temperature increases bubbling rate, AND at high temperatures an increase in temperature decreases bubbling rate/AW;	1

	(f)		ACE Conclusions	• draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis, and making further predictions	IDEA OF at low temperatures the data supports the student's hypothesis AND above 48 ^{o}C/at high temperatures the hypothesis is not supported/the rate drops as temperature increases; prediction including student's hypothesis for low temperatures PLUS at high temperatures, as temperature increases, the rate of production of gas will decrease/AW;	2
	(g)		ACE Improvements	• suggest modifications to an experimental arrangement that will improve the accuracy of the experiment or the accuracy of the observations that can be made, including the use of new methods or strategies to investigate the question • describe such modifications clearly in words or diagrams	*accept improvements that would enhance the reliability or accuracy of the experiment – three in outline or one or two explained – could be related to errors identified earlier or others* collect gas; measure its volume accurately; e.g. of specific method of doing so such as inverted burette over water/gas syringe; use more replicates/repeat more times at each temperature; use more temperatures/ specified wider range between 0 and 100 ^{o}C; use more accurate measuring devices/one named specific measuring device; use a buffer to control pH/ other specific means to control a plausible variable; AVP;;	2

2	**(a)**	**(i)**	MMO Collection	• set up apparatus correctly • use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials	*Rancunculus* root t.s. recognisable in drawing (large circle containing smaller circle containing star-shaped region); proportions of stele/root diameter acceptable (between 1:5 and 1:10) AND at least 4 tissues shown (epidermis, parenchyma, endodermis, xylem, phloem);	2
		(ii)	MMO Collection PDO Display	• make measurements using millimetre scales, graticules, protractors, stopwatches, balances, measuring cylinders, syringes, thermometers, and other common laboratory apparatus. • show their working in calculations, and the key steps in their reasoning	correct measurement of line shown on drawing to within 1 mm AND measurement of diameter of specimen between 1.5 and 4 mm, to no more than 0.5 mm reported accuracy; working shows measurement from drawing divided by measurement from slide;	1 1
		(iii)	ACE Interpretation	• estimate, quantitatively, the uncertainty in quantitative measurements • express such uncertainty in a measurement as an actual or percentage error	their reported measurement ± 0.5 mm (accept answers between ± 0.2 mm and ± 1.0 mm)	1
		(iv)	ACE Interpretation	• show an understanding of the distinction between systematic errors and random errors	ruler made with incorrect intervals/user not viewing at right angles/AVP;	1

	(b)		MMO Collection	• use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials	at least half of area of available space used to represent/describe a number of cells; drawings/descriptions of cells including starch granules, cell walls and air spaces between corners of the cells;	2
			MMO Decisions	• decide how many tests, measurements or observations to perform • make measurements or observations that span the largest possible range within the limits either of the equipment provided or of the instructions given • make quantitative measurements or qualitative observations that are appropriately distributed within this range	at least three and no more than six cells drawn/ described; largest cell drawn/described at least twice the size of smallest; cells with a range from 2 or less up to 10 or more starch grains; including both cells with air spaces between the corners and those without;	max 3
			PDO Layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	drawing used to represent observations – clear outline drawings, sharp pencil and no shading;	1
	(c)	**(i)**	PDO layout	• choose a suitable and clear method of presenting the data, e.g. tabulations, chart, graph, drawing or mixture of methods of presentation	table used to present data; (R comparative lists without lines to divide information)	1

		(ii)	MMO Collection PDO Recording	• use their apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour or other properties of materials • present numerical data, values or observations in a single table of results • draw up the table before taking readings/making observations, so that candidates can record directly into the table, to avoid the need to copy up their results • record raw readings of a quantity to the same degree of precision and observations to the same level of detail	Give at least 4 comparisons, including at least one similarity and at least one difference, and including one subtle judgement (judgement involving more than just size, colour or shape); all observations and comparisons recorded in a single table with difference(s) recorded to the same level of precision (e.g. sizes recorded in mm) or detail (e.g. stele 40% of total width of S3 vs. stele 8% of total width of specimen S4);	1 1
		(iii)	ACE Interpretation	• describe and summarise the key points of a set of observations	central stele/named feature (e.g. xylem/tubular cells);	1
	(d)		MMO Decisions ACE Interpretation	• make and record sufficient, accurate measurements and observations • describe and summarise the key points of a set of observations	correctly label xylem on both pictures; pick out at least one valid reason for each decision (e.g. Fig. 2.1 thick cell walls, Fig.2.2 end walls of cells absent);	1 1

Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Level

BIOLOGY

9700/04

Paper 4 Structured Questions

For Examination from 2007

Specimen Paper

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1 hour 15 minutes

Additional Materials: Answer Booklet/Paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **one** question.
Write your answer on the separate Answer Booklet/Paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **14** printed pages.

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International Examinations

[Turn over

1 **(a)** State what is meant by the term *respiratory quotient* (RQ).

.....

..... [1]

(b) **(i)** Complete the following equation for the aerobic respiration of the respiratory substrate A.

$C_{18}H_{36}O_2 + 26O_2$ ..... + ... [2]

(ii) Calculate the respiratory quotient (RQ) of this respiratory substrate.

[2]

(c) Explain the significance of the different values that may be obtained of RQ.

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.....

..... [2]

Two respirometers were set up as shown in Fig. 1.1.

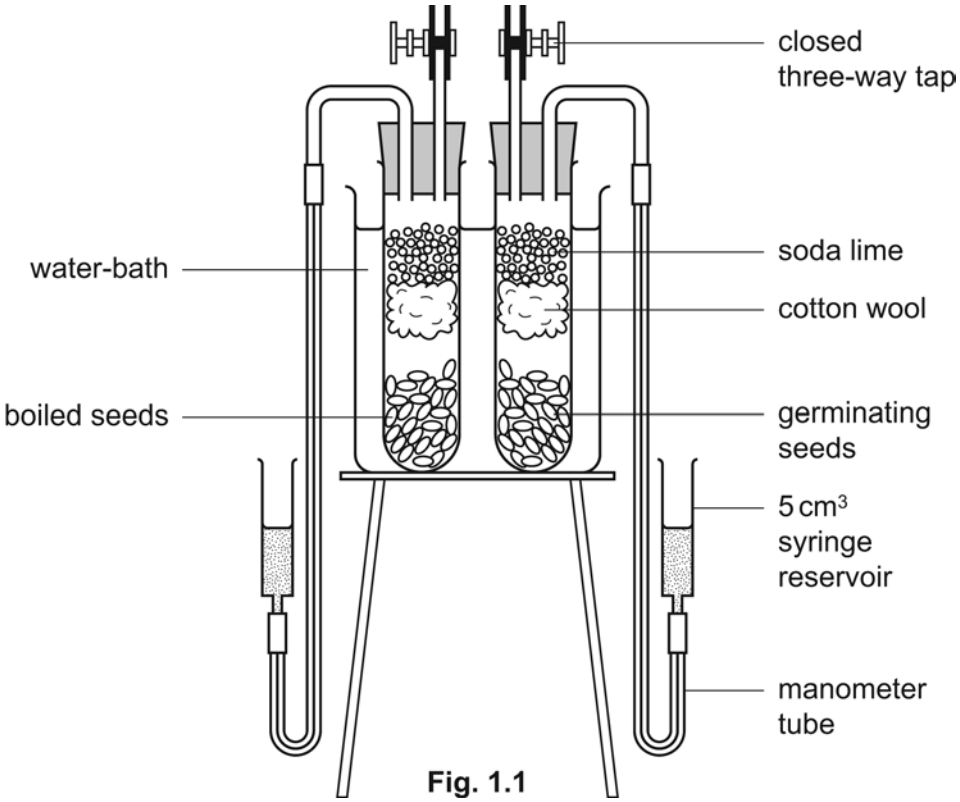

Fig. 1.1

(d) Outline how this apparatus is used to measure the rate of oxygen uptake by a known mass of germinating seeds.

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..... [4]

(e) Explain how the apparatus could be modified to measure the RQ of the germinating seeds.

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..... [2]

(f) Explain why an increase in temperature from 15 ^{o}C to 25 ^{o}C will increase the rate of oxygen uptake in germinating seeds.

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..... [2]

[Total: 15]

2 Fig. 2.1 shows the main stages of the Calvin cycle.

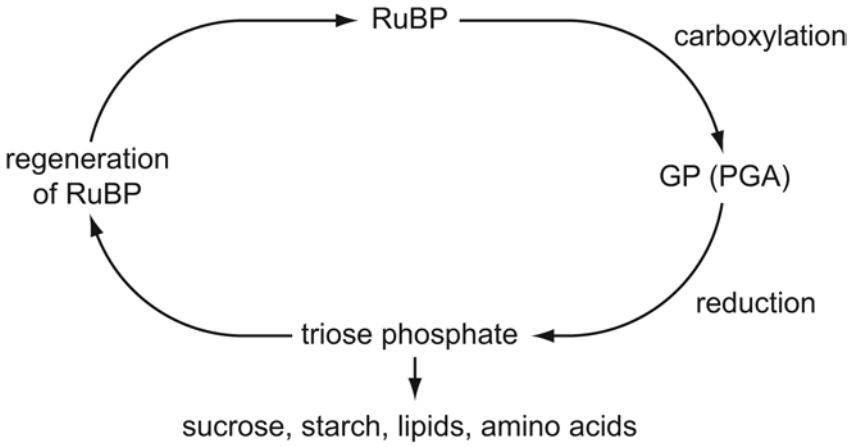

Fig. 2.1

(a) State precisely where the Calvin cycle occurs in plant cells.

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[1]

(b) Describe how carbon dioxide is fixed in the Calvin cycle.

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[2]

(c) Explain how the products of photophosphorylation are used in the Calvin cycle.

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[3]

(d) Explain what initially happens to the concentration of RuBP and GP if the supply of carbon dioxide is reduced.

RuBP .....

.....

GP .....

.....

[2]

[Total: 8]

3 Scallops, which are bivalve molluscs, are important commercially throughout the world. The marine bay scallop, *Agropecten irradians*, has three distinct shell colours, yellow, orange and black. The shell colour is controlled by a gene with three alleles, yellow, $\mathbf{S^y}$, orange, $\mathbf{S^o}$, and black, $\mathbf{S^b}$.

Scallops are hermaphrodite and are able to fertilise themselves to produce offspring.

Single mature adult specimens of yellow, orange and black scallops were collected and kept in separate tanks of seawater until they produced young. The young were then scored for shell colour. The results were as follows:

yellow scallop – 25 yellow and 8 black
orange scallop – 31 orange and 9 black
black scallop – 27 black

(a) Explain the results from the orange and black scallops, using the symbols given.

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[6]

(b) Orange scallops are more valued for human consumption.

Describe how a marine biologist could produce a pure-breeding line of orange scallops for commercial exploitation using the offspring from the single orange scallop.

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.....

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[2]

[Total: 8]

4 **(a)** Fig. 4.1. shows the above-ground parts of the orchid *Masdevallia caudata*.

Fig. 4.1

(i) State **one** feature, visible in Fig. 4.1, that indicates that this plant is an angiospermophyte.

..... [1]

(ii) State **two** features, visible in Fig. 4.1, that indicate that this plant is a monocotyledon.

1 .....

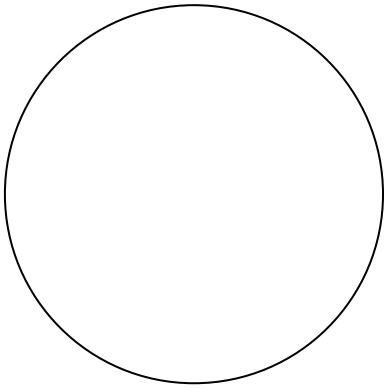
2 ..... [2]

(iii) Describe the type of root system that you would expect to be present on this plant.

.....

..... [2]

(iv) On the outline below of a transverse section of the stem of this orchid, sketch the positions of the vascular bundles that you would expect to find.



[1]

(b) Table 4.1 lists three plant phyla and three features that may be found in them.

Complete the table by placing a tick to indicate when a feature is present in a phylum and a cross to indicate when it is not. (Do not leave any boxes blank).

Table 4.1

feature	bryophytes	filicinophytes	coniferophytes
dominant stage is diploid sporophyte			
vascular tissue present			
xylem vessels present			

[5]

(c) Describe two ways in which the life cycle of an angiospermophyte shows more complete adaptation to life on dry land than that of a bryophyte.

1 .....

.....

.....

2 .....

.....

..... [4]

[Total: 15]

[Turn over

5 Fig. 5.1 outlines the way in which the gene for human insulin is incorporated into plasmid DNA and inserted into a bacterium.

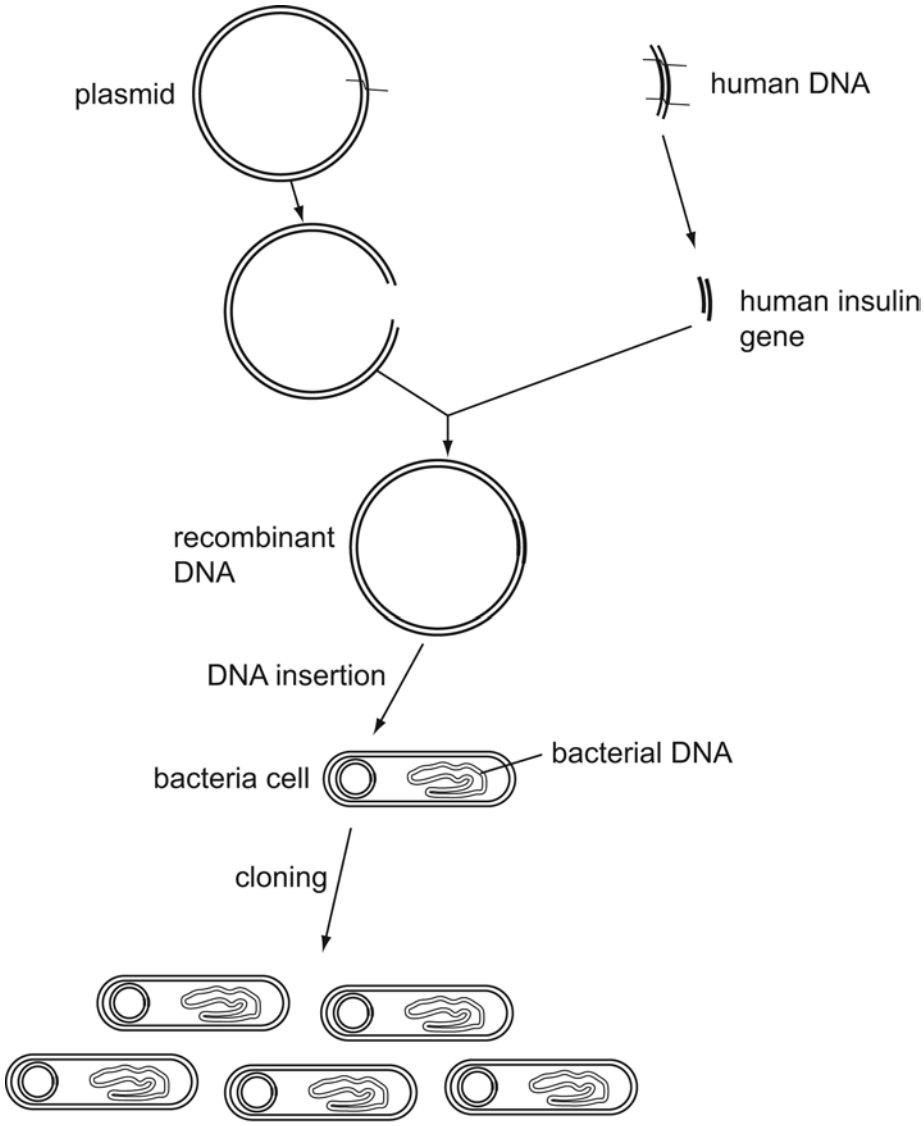


Fig. 5.1

(a) Describe how the plasmid DNA is cut.

.....

.....

.....

..... [3]

(b) Explain how the human insulin gene is joined to the plasmid DNA.

.....

.....

.....

..... [3]

(c) List **two** advantages of treating diabetics with human insulin produced by genetic engineering.

1 .....

.....

2 .....

..... [2]

[Total: 8]

6 **(a)** Describe the roles of barley and yeast enzymes in beer production.

.....

.....

.....

.....

.....

..... [3]

(b) Most beers contain starch. Recently, 'light' beers of low energy content have become more popular. Light beers have a low starch content. This is achieved by the addition of immobilised fungal amylase after the mashing process.

(i) Explain the advantage of using immobilised enzymes in this process.

.....

.....

.....

.....

..... [3]

(ii) The effect of two different types of immobilised fungal amylase on the hydrolysis of starch is shown in Table 6.1. In these reactions, starch is not a limiting factor.

Table 6.1

time/h	mass of maltose produced/g	
	α amylase	β amylase
0	0	0
1	0.05	0.05
2	0.20	0.10
3	0.60	0.20

With reference to Table 6.1, explain which of these enzymes would be used in the production of light beers with a low starch content.

.....

.....

..... [2]

[Total: 8]

7 **(a)** Describe the structural features of wind pollinated plants such as grasses.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) State two advantages of self pollination and two advantages of cross pollination.

self pollination

1 .....

.....

2 .....

.....

cross pollination

1 .....

.....

2 .....

..... [4]

[Total: 8]

[Turn over

8 **(a)** Name the precise sites of production in the human male of the following hormones:

(i) follicle stimulating hormone (FSH);

.....

(ii) luteinising hormone (LH) or interstital cell stimulating hormone (ICSH);

.....

(iii) testosterone.

.....

[3]

(b) Fig. 8.1 shows the concentration of the hormones FSH, LH (ICSH) and testosterone in the blood of a human male at different ages.

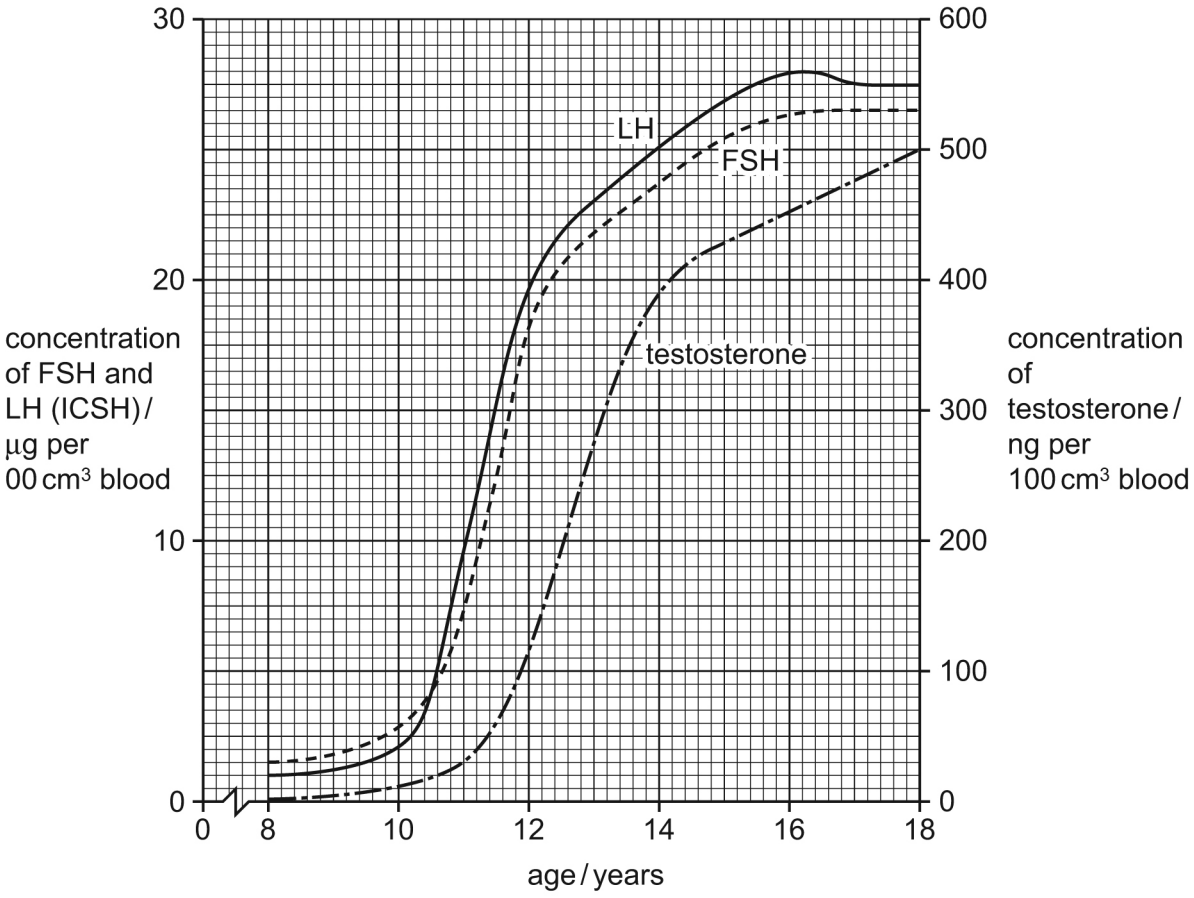


Fig. 8.1

With reference to Fig. 8.1, describe and explain the changes in concentration of:

(i) FSH and LH (ICSH); .....

.....

.....

.....

..... [4]

(ii) testosterone. .....

.....

.....

.....

..... [4]

(c) Table 8.1 shows the mean mass of the human testis at different ages.

Table 8.1

age/years	mean mass of human testis/g
10	2.0
12	3.0
14	8.0
16	18.0
18	28.0

With reference to Table 8.1, calculate, showing your working in each case,

(i) the **absolute** growth rate of the testis between ages 14 and 18 years;

.....

.....

..... [2]

(ii) the **relative** growth rate of the testis between ages 14 and 18 years.

.....

.....

..... [2]

[Total: 15]

Section B

Answer **one** question

9 **(a)** Explain how a synapse functions. [9]

(b) Describe the role of glucagon in regulating blood glucose. [6]

[Total: 15]

10 **(a)** Describe why variation is important in natural selection. [6]

(b) Explain the role of isolating mechanisms in the evolution of new species. [9]

[Total: 15]

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 9700/04

BIOLOGY
STRUCTURED QUESTIONS

UNIVERSITY of CAMBRIDGE
International Examinations

1 **(a)** RQ = volume of carbon dioxide given off; **R** amount **A** moles
volume of oxygen taken up **[1]**

(b) **(i)** $18H^2O$;
$18CO^{2;}$ **[2]**

(ii) 18/26;
= 0.69 – 0.70; *allow 2 marks for correct answer* **[2]**

(c) depends on substrate;
greater than 1 some anaerobic respiration/ref. to an anaerobic respiration;
carbohydrate 1/protein 0.9/fat 0.7 ;; *2 out of 3* **[2 max]**
ref. to other metabolic processes using oxygen/produce carbon dioxide;

(d) time/allowed to equilibrate;
record level of fluid in manometer;
change in known time/ref. time;
repeat;
open clip and reset level;
ref. units;
ref. to boiled seeds as a control;
as soda lime absorbs carbon dioxide given off;
ref. to calculation; **[4 max]**

(e) remove soda lime;
repeat experiment/ref. to comparison;
ref. to whether manometer rose or fell;
ref. to calculation; **[2 max]**

(f) ref. effect of temperature on <u>enzymes in respiration</u>;
ref. <u>named</u> effect of temperature e.g. increased collisions/kinetic energy/more substrate molecules with activation energy;
ref. to $Q_{10} = 2$ **[2 max]**

Total: 15

2 **(a)** stroma of chloroplast; **[1]**

(b) combines with (5C compound) RuBP;
to form unstable 6C compound/forms 2 molecules of (3C) GP;
ref. enzyme/rubisco; **[2 max]**

(c) reduced NADP and ATP;
(ATP is) source of energy;
(reduced NADP is for) reduction of GP(PGA) to triose phosphate (TP);
ref. use of ATP in regeneration of RuBP;
ref. to source of phosphate/phosphorylation; **[3 max]**

(d) RuBP, accumulates/goes up;
due to reduced combination with CO_2/AW; *in either RuBP or GP, not both*
GP, goes down/not as much being formed;
due to conversion to TP; **[2 max]**

Total: 8

3 (a) **Either**

If genetic diagram used **Penalise once for incorrect symbols**

orange dominant to black (for converse);

orange scallop

parents		S^oS^b		X	S^oS^b	
gametes	S^o		S^b		S^o	S^b
genotype	S^o S^o		S^o S^b		S^o S^b	S^b S^b
phenotype			orange			black

black scallop S^b S^b X S^b S^b

parent

gametes (S^b S^b)

genotype S^b S^b

phenotype black

Or

If text explanation given

orange dominant to black (or converse);
orange are heterozygous;
(because) ref. 3:1 ratio;
link data to ratio;
black are homozygous;
because all offspring are black; **[6]**

(b) separate orange scallops produced from first cross/test cross orange with black;
some will produce only orange offspring;
these will be homozygous for orange allele/pure breeding; **[2max]**

Total: 8

4 (a) **(i)** flowers **[1]**

(ii) 3-petalled flowers; ignore elongated leaves **[2]**
parallel veins (in leaves)

(iii) adventitious;
fibrous/branching;
no tap root; **[2 max]**

(iv) bundles scattered and not in a ring; **[1]**

(b)

	Bryophyta	Filicinophyta	Coniferophyta
dominant stage is diploid sporophyte	x	✓	✓
vascular tissue present	x	✓	✓
xylem vessels present	x	x	x

half mark per correct box, round up **[5]**

(c) *assume statement refers to angiiospermophyte unless otherwise stated.*

gametophytes/male gametes, inside pollen grain;
protected from desiccation/can be dispersed over wide area;

internal fertilisation/fertilisation described;
not dependent on water/male gametes do not swim;

young sporophyte/embryo, develops within seed;
not dependent on gametophyte/can lie dormant for long periods/can survive dry conditions **[4 max]**

Total: 15

5 **(a)** restriction (endonuclease) enzyme;
named example; e.g. EcoR1
specific, sequence of bases/point;
ref. to sticky ends/exposed bases; **[3 max]**

(b) sticky ends added to insulin gene;
ref. to complimentary base pairing/C and G bases pair up;
ref. H bonds;
(DNA) ligase;
formation of phosphodiester bond/seals sugar phosphate backbone; **[3 max]**

(c) identical to human insulin (ref. to bovine/porcine insulin used previously);
ref. to reduced immune response/side effects;
cheaper to produce;
more rapid response;
pure/uncontaminated;
regular production not dependent on livestock;
ethical issues;
AVP; e.g. tolerance **[2 max]**

Total: 8

6 **(a)** amylase;
hydrolyses starch;
to maltose;
ref. α and β amylase;
maltose to glucose;
maltase;
anaerobic breakdown/glycolysis, of sugar;
into ethanol and carbon dioxide; **[3 max]**

(b) **(i)** end product not contaminated;
enzyme, more stable/less likely to be denatured;
enzyme recovery easier;
idea of enzyme being reused;
AVP; e.g. cost **[3 max]**

(ii) α amylase;
more maltose produce;
use of figures; **[2 max]**

Total: 8

7 **(a)** no petals;
no nectaries;
no scent produced;
large stigma;
feathery stigma;
to trap pollen;
stamens hang outside flowers;
flowers held on tall inflorescences;
pollen light and smooth; **[4 max]**

(b) *self pollination*
reliable;
if plants widely scattered;
effective in harsh environments;
e.g. high mountains max 2

cross pollination
genetic variation;
ref. outbreeding;
genes shuffled every generation;
species more likely to survive environmental change; max 2 **[4 max]**

Total: 8

8 **(a)** **(i)** anterior pituitary gland;

(ii) anterior pituitary gland;

(iii) interstitial cells/Leydig cells, (of testis);

pituitary + pituitary + testis = 1) **[3]**

(b) **(i)** significant rise in both at age 10-12 years;
plateau in both at ages 16/17 years;
ref. figures;
triggered by GnRF;
from hypothalamus;
steep rise triggers puberty;
LH/ICSH stimulates synthesis of testosterone;
FSH stimulates spermatogenesis; **[4 max]**

(ii) significant rise at age 10/11-14 years;
rise less steep age 14-18 years;
ref. figures;
triggered by rise in LH(ICSH)
testis increases in size at the same time;
responsible for secondary sexual characteristics; **[4 max]**

(c) **(i)** $\frac{28.0 - 8.0g}{4y}$ = 5; g per year; **[2]**

(ii) $\frac{20}{4}$ x $\frac{1}{8}$ or $\frac{5}{8}$; = 0.625 (0.63 s.f.); **[2]**

Total: 15

9 **(a)** *Explain how a synapse functions.* **[9]**

(b) *Describe the role of glucagon in regulating blood glucose.* **[6]**

(a)
1 depolarisation/action potential;
2 of presynaptic membrane/synaptic knob;
3 opening calcium ion channels;
4 calcium ions in;
5 vesicles containing transmitter/acetylcholine;
6 fuse with membrane;
7 contents emptied into synaptic cleft/exocytosis;
8 transmitter/acetylcholine diffuses across synaptic cleft;
9 transmitter/acetychloine binds to receptor; **R** protein channel
10 on post synaptic membrane;
11 Na^+ channels open/NA^+ enters;
12 depolarises post synaptic membrane;
13 action potential set up/impulse transmitted
14 breakdown/hydrolysis of transmitter/acetylcholine by enzyme/cholinesterase; **[9 max]**

(b)
15 when blood glucose levels low;
16 glucagon released from alpha cells (in pancreas);
17 (acts on) liver (cells);
18 breakdown of glycogen to glucose;
19 use of fatty acides in respiration; **R** fats
20 production of glucose from other compounds/fats/amino acids/gluconeogenesis;
21 liver releases glucose into blood;
22 glucose levels rise/return to normal;
23 switching off glucagon secretion;
24 antagonistic to insulin; **[6 max]**

Total: 15

10 (a)
1 ref. continuous/discontinuous variation;
2 genetic/inherited variation;
3 variation in phenotype/characteristics/AW;
4 (can be due to) interaction of genotype and environment;
5 e.g. of characteristic that influences survival;
6 ref. intraspecific competition/struggle for existence;
7 those with favourable characteristics survive/AW;
8 pass on favourable characteristics to offspring;
9 those with disadvantageous characteristics die; **[6 max]**

(b)
10 ref. to definition of species;
11 ref. allopatric;
12 geographical isolation;
13 ref. to examples e.g. islands/lakes/mountain chains/idea of barrier;
14 ref. to example organism;
15 ref. to populations prevented from interbreeding;
16 isolated populations subjected to different selection pressures/conditions;
17 over time sufficient differences to prevent interbreeding;
18 ref. sympatric;
19 ref. to reproductive isolation;
20 ref. behavioural barriers (within a population);
21 e.g. day active/night active;
22 correct ref. to gene pool;
23 change to allele frequencies; **[9 max]**

Total: 15

Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

BIOLOGY

9700/05

Paper 5 Planning, Analysis and Evaluation

For Examination from 2007

Specimen Paper

Candidates answer on the Question Paper.
No Additional Materials are required.

1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **5** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE
International Examinations

[Turn over

1 **(a)** The rate of respiration in two tissues, **A** and **B** was measured using DCPIP as an indicator. 50 g of each tissue was ground into paste using 10 cm^3 of ice cold buffer and made into a suspension with 250 cm^3 of buffer solution. The two suspensions were placed into a water bath at 20 °C.

Two sets of ten tubes, each containing 10 cm^3 of buffer and 1 cm^3 of DCPIP, were placed into separate water baths at 20 °C and left for 10 minutes.

To one set of ten tubes, 0.5 cm^3 of suspension **A** was added. To the other set of ten tubes, 0.5 cm^3 of suspension B was added. The time taken for DCPIP to become colourless was measured separately in each tube.

(i) State the dependent and independent variable in this investigation.

independent variable .....

dependent variable ..... [1]

(ii) Identify the key variables that have been controlled in this investigation.

For each variable, describe how it has been controlled.

.....

.....

.....

.....

.....

..... [3]

(iii) Suggest how the colourless end point of the DCPIP might have been standardised.

.....

..... [1]

(b) The results of this investigation are shown in Table 1.1.

Table 1.1

time taken for DCPIP to become colourless/s										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Tissue A	55	56	59	54	52	56	55	55	59	59
Tissue B	125	126	122	126	122	119	121	123	124	125

(i) Use the formulae below to calculate the standard error for each of the tissues tested.

Standard deviation (s)

$$s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

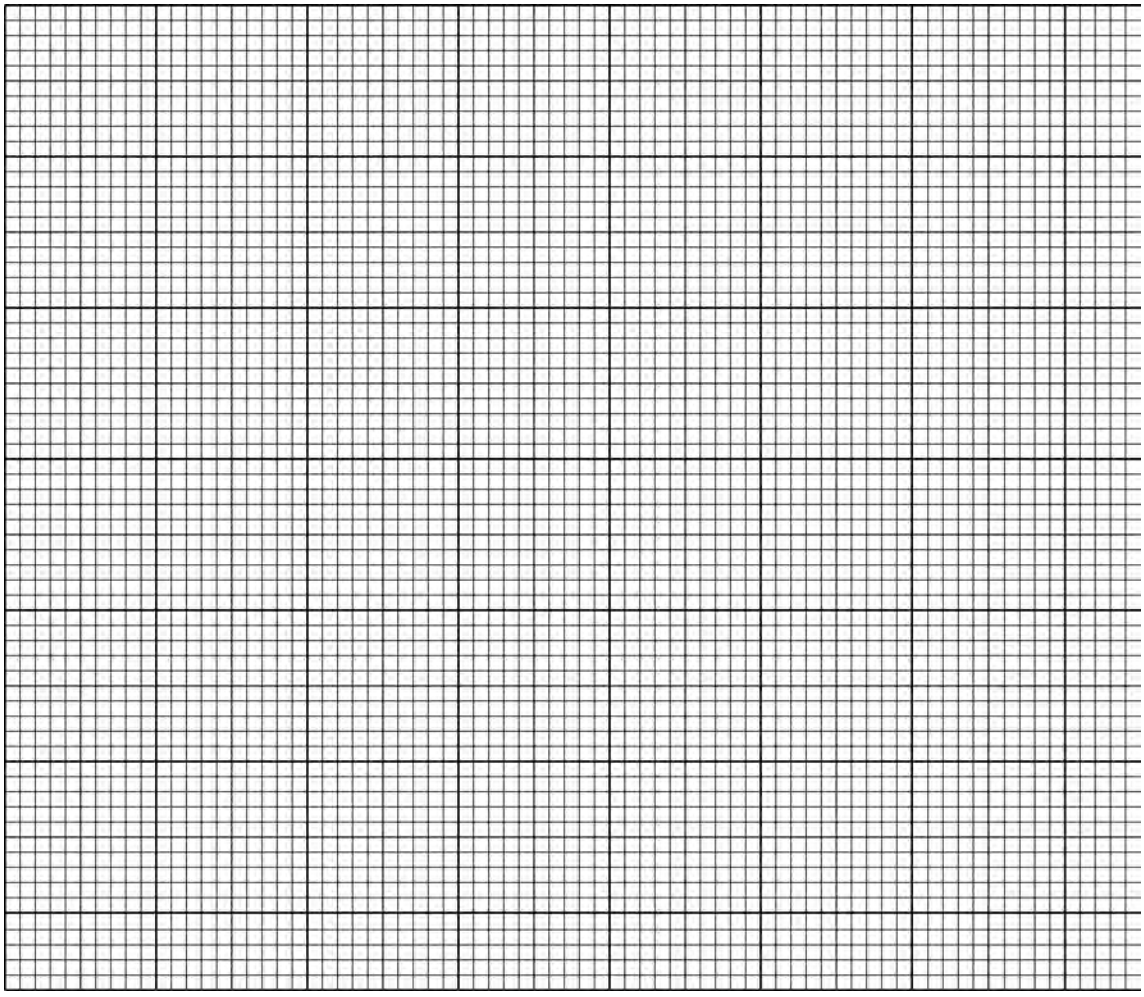
Standard error S_M

$$S_M = \frac{S}{\sqrt{n}}$$

Standard error for sample **A** .....

Standard error for sample **B** ..... [4]

(ii) Use the grid to plot a bar chart of the mean results and standard error for this investigation.



[3]

(iii) What do the values for standard error indicate about the accuracy of the results of this investigation?

.....

..... [1]

[Total 13]

2 Fig. 2.1 shows the structure of a root tip.

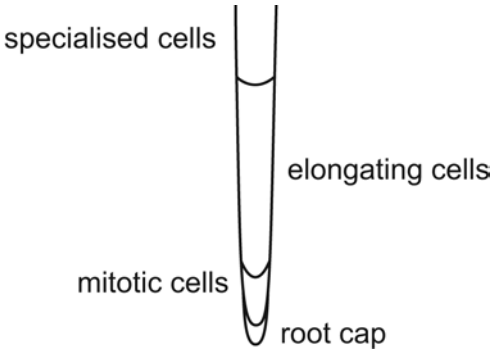


Fig. 2.1

Radicles of seedlings constantly produce new cells by mitosis. As these cells develop they become elongated by absorbing water and the vacuole expanding and causing the cell wall to stretch. Growth regulators control the plasticity of the cell wall so it is able to stretch.

The developing radicles of seedlings placed horizontally respond by curving and growing in the direction of gravity.

One hypothesis to explain this curvature is that the root cap contains gravity receptors that causes changes in the distribution of auxin secreted by the root tip.

Describe how this hypothesis could be tested.

.....

.....

.....

.....

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.....

.....

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.....

.....

.....

..... [10]

3 Fig. 3.1 shows genetic fingerprints made from DNA samples of a number of different mammals.

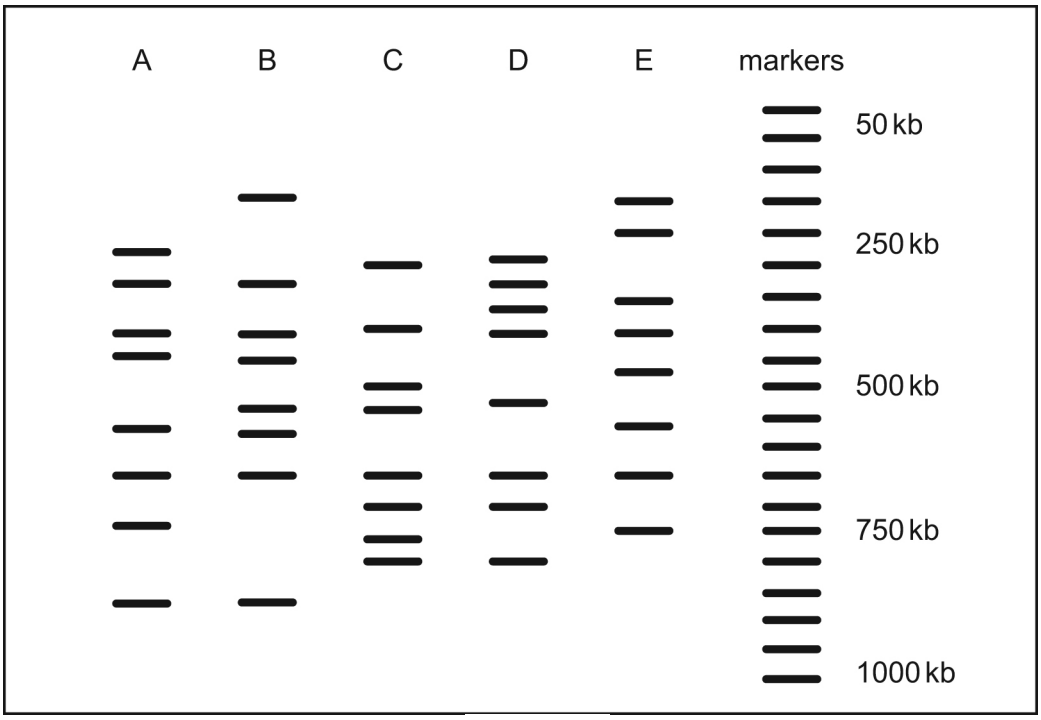

Fig. 3.1

(a) Explain how the genetic finger print provides evidence that these mammals share a common ancestor.

.....

..... [2]

(b) Use the information in the diagram to explain the evolutionary relationship between these mammals.

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total 7]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A LEVEL

MARK SCHEME
MAXIMUM MARK: 30
SYLLABUS/COMPONENT: 9700/05 BIOLOGY PRACTICAL

UNIVERSITY of CAMBRIDGE
International Examinations

Skill	Total marks	Breakdown of mark expectations		Question 1	Question 2	Question 3
Planning	15 marks	**PP** Defining the problem	5	5		
		PM Methods	10		10	
Analysis, conclusions and evaluation	15 marks	**DD** Dealing with data	8	8		
		E Evaluation	4			4
		C Conclusion	3			3

The abbreviations in bold are used to identify the marks in the mark scheme below

1 (a) (i) tissue source,
time (for DCPIP to decolourise); 1 PP

(ii) temperature – water bath at 20 ^{0}C
pH – buffer solution
osmotic balance - buffer solution
relative concentrations indicator, tissue sample – standard volumes of each
quantity of tissue sample – same mass and volumes buffer used

1-2 decognised	1
3-4 recgnised	2
5 recognised	3

3 PP

(iii) 10 cm^3 buffer,
1 cm^3 water/buffer,
0.5cm^3 tissue sample (same as that being tested) 1 PP

(b) (i) s= 2.23, S_M =.1.58;;

s= 2.49, S_M = 0.79;; 4 DD

(ii) axes correct orientation;

both plots correct (means 55.9 sand 122 s)

both standard error bars correctly plotted; 3 DD

(iii) results for sample B more accurate than sample A as there is less spread 1 DD

Total 13 PP and DD

2 *Independent variables*

radicles all same approximate age/ length/measured;
half left with root caps intact/half root caps removed;
one set with root caps and one set without root caps placed horizontally;
one set with root caps and one set without root caps left vertically;
suitable number of seedlings – batches not less than 25; max 2

Dependent variable

suitable method of measuring – accuracy using mm/callipers
before and after standard time (24-48 hours;)
method of measuring curvature; max 2

Key variable and controls:

ref. to standard conditions/examples of conditions for germination(any2);

radicles all same approximate age/ length/measured;

ref. to standard conditions and explantion re. growth of radicles;

indentification of the 3 sets of controls and their role; max 2

Apparatus and quantities;

suitable method of germinating seedlings – petridishes+ paper/cotton wool;
germination conditions standardised;
suitable number of seedlings – batches not less than 25;

Risks and precautions

ref. to safety – cutting and care needed; max 2

Data presentation

table showing results presentation –suitable headings with units;

Use of data

ref. to how results might confirm/disprove hypothesis ;

(idea that root cap removed – no response but growth continues

root cap intact responds if horizontal by uneven growth); max 2

10 PM

3 **(a)** DNA fragments of similar size/ positions for all types of mammal;

ref. to bands at 400kband 700kb; 2 E

(b) A and B more closely related to each other 3 bands in common

around 300 kb, 55-6000 kb, 800 kb

have separated most recently in evolution

E is distantly related – has only one other bandt/350 kb in common with D;

and no others with A and B;

separated early in evolution from any of the other types of mammal

C and D closely related each other as 2 bands in common;

around 700 kb and 800 kb;

A and B/C and D more distantly related/separated in evolution;

D has common band/ 300-350kb with A and B

C has common band/500-550kb with B and D 5 EC

Total 7 EC