OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **2806/03**

Practical Examination 2

Mark Scheme for June 2010

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Examiners will be expected to use their professional judgment in marking answers that contain more than the number required. Advice about specific cases will be given at the standardisation meeting.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

Abbreviations, annotations and conventions used in the Mark Scheme	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	R	=	reject
	( )	=	words which are not essential to gain credit
	___	=	(underlining) key words which **must** be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Planning Exercise

The mark scheme for the planning exercise is set out on page 3 and 4. The marking points **A** to **U** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

Practical Test

Pages 5 to 9 have the mark scheme for Questions 1 and 2 for the Practical Test.

A2 Biology. Planning exercise

Checking Point	Descriptor	The candidate
A	P.1a	Plans a suitable procedure that involves measuring the rate of, oxygen / gas, production from a (named) aquatic plant with different wavelengths of light **;**
B	P.1a	Gives a prediction about the action spectrum for the chosen plant **;**
C	P.1b	Selects suitable equipment and materials, to include at least 2 different filters, a lamp, a stopwatch and a way of, collecting gas / counting bubbles **;**
D	P.3a	States that oxygen is produced by photolysis (in light dependent stage of photosynthesis) **;**
E	P.3a	Identifies at least **two** key factors to control **;** e.g. temperature, carbon dioxide concentration, light intensity / distance of lamp, volume of water, mass / length / number of leaves, of plant, time for acclimation at each wavelength / time for collecting gas, initial oxygen concentration of water
F	P.3b	Decides on an appropriate number of measurements to take: minimum of **five** different wavelengths **;**
G	P.3b	Decides on a suitable range of wavelengths, e.g. 400 to 700 nm **;**
H	P.3b	Describes a way of obtaining reliable results by using a minimum of **three separate** sprigs of plant for each wavelength **; R** three 'runs' with same sprig
I	P.5a	**Uses** appropriate A2 scientific knowledge and understanding in developing a plan, e.g. details of light dependent stage / photolysis **;**
J	P.5a	**Uses** preliminary work or previous practical work in developing a plan **;**
K	P.5a	Refers to a hazard and an appropriate precaution, e.g. water and electricity / use of scalpel **;**
*L**	*P.5b*	*Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC)* **;**
M	P.5b	**Describes** way(s) of obtaining precise results **;** e.g. collect, oxygen / gas, in a gas syringe, syringe barrel, capillary tubing + ruler / calibrated test-tube **;**
N	P.7a	**Uses** relevant information from any **two written sources**, e.g. class notes / text book / web site, etc **;** *must be cited in plan*
O	P.7a	Shows how results are to be presented in a table including correct use of units for wavelength and rate of, oxygen / gas production **;**
*P**	*P.7a*	*Uses spelling, punctuation and grammar accurately (QWC)* **;**
Q	P.7a	**Uses** AS knowledge and understanding, e.g. the effect of temperature on enzymes (of photosynthesis), structure of chloroplast, membrane structure **;**
R	P.7b	Shows / describes, how results are to be presented as a graph of **rate** of photosynthesis against wavelength, units must be on the axes **;**
S	P.7b	Comments on precision **;** e.g. difficulty in determining meniscus, reason for acclimation, reason for light from one source only
T	P.7b	Comments on reliability **;** e.g. **explains** need to run replicates of each set of conditions
U	P.7b	Comments on validity of the dependent variable **;** e.g. bubble size, oxygen dissolves in water, not all oxygen evolved can be collected / other gases come out of solution / use aerated water, measuring gas production is rate of *apparent* photosynthesis as some is used in respiration
V	P.7b	Comments on validity of the independent variable **;**

Point mark up to **14** by placing letters **A** to **U excluding L and P** in the margin at appropriate points.

Then award **1** mark for each of **L** and **P** (QWC). **Total: 16**

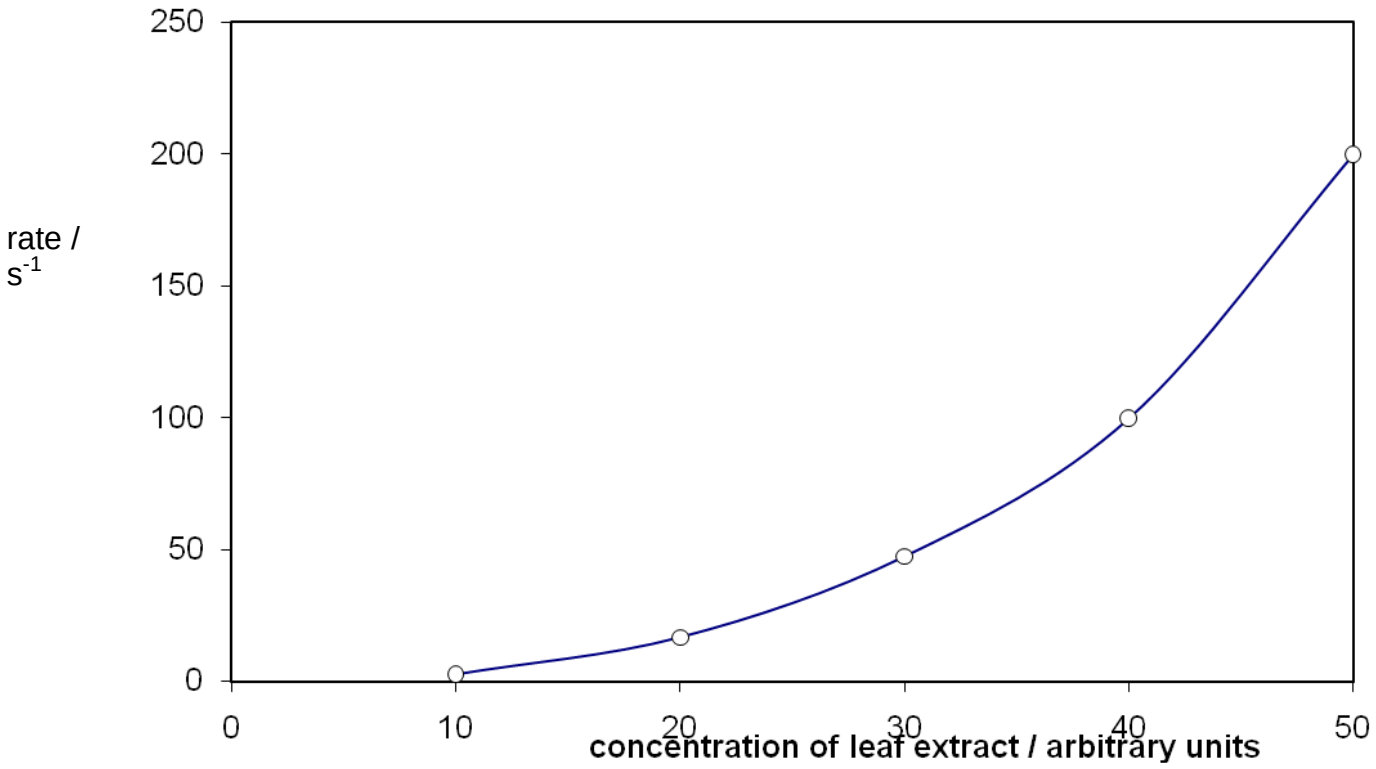
Further elaboration of checking points

A	The set up of the apparatus must be suitable for the successful collection of gas / counting bubbles. Minimum of two wavelengths.
B	This could be a graph. Could be the effect of 2 wavelengths.
C	Apparatus is usually in a list – but take from the method or a diagram if not.
D	No detail of photolysis required for this checking point. The term photolysis is not required but there must be a description.
E	Could be in the method rather than in a separate section headed Variables. Accept time for acclimation and collection of gas even if very short.
F	Take from the table if not in the method, but must have units (nm).
G	As per F.
H	As per F. Look out for candidates who take three results from each sprig **and** use at least three different sprigs – they should be awarded this point.
I	e.g. relates absorption spectrum to action spectrum. Needs to explain evolution of oxygen at A2 detail of PS II. Refers to limiting factors in section on control variables.
J	May be a reference to how to set up the apparatus. May see photosynthometers here. Qualitative results are acceptable.
K	
L*	Species name(s) must be presented properly, e.g. in italics / underlined if whole plan is handwritten (ignore handwritten annotations if whole plan is typed)
M	Must be stated volume of syringe barrel, accept 10 cm^3 measuring cylinder. Do not accept depth of gas collected in a test-tube measured with a ruler. **R** bubble counting Accept photosynthometer with scale from diagram.
N	
O*	Must have a column for rate or volume per given unit time.
P	
Q	
R	y-axis must be <u>rate</u>. Could be a bar chart ref. colours, each filter has a range of wavelengths / wavelength with maximum transmission **with units**. <u>Rate</u> must be given on the vertical axis. Graph could be described if so accept, but check that units are in the table or in any calculations.
S	**R** bubbles
T	Discussion of need for replicates, but difficulties with replicating conditions
U	Accept anything appropriate to do with collecting gas
V	This could be a discussion of the problems with using replicates. Also could be a discussion of the problems with using filters (see SAPS web page as given in the instructions). Lack of wavelength specificity is likely here.

Sample results for Q.1(a)

tube	concentration of leaf extract / arbitrary units	time / s	rate / s^{-1}
A	50	5	41.6
B	40	10	24.4
C	30	21	14.1
D	20	59	2.0
E	10	351	0.0

Sample graph for Q.1(b)



Question		Expected Answers	Marks
1	(a)	table format, with column / row headings **;** concentration of leaf extract, time, rate / relative rate units in column headings not in the body of the table **;** arbitrary units, s, s^{-1} / 1000/t concentration in the left hand column **;** *ignore tube labels (A to E)* **A** concentrations in reverse order time recorded to nearest seconds **;** **R** minutes and seconds results show correct trend **;** all rates calculated correctly to the same number of d.p. (or whole numbers) **;** repeats taken and a mean calculated **;**	**7**
	(b)	concentration of leaf extract on the horizontal axis, rate on vertical axis **;** **R** time axes scaled appropriately **;** *ecf* from table if rate not calculated **A** if minutes used and scaled correctly axes with units **;** **A** *ecf* from the table points plotted accurately **;** **A** *ecf* from **(a)** **A** ± ½ small square joined by, an appropriate line of best fit / straight lines between points **;** **ignore** if line is extrapolated to, zero / origin / x-axis **R** if extends beyond 50 arbitrary units	**5**
	(c) **d1**	increasing rate / decreasing time, with increasing concentration of leaf extract **;** *ora*	
	d2	suitable, comment / description, of own results **;** e.g. linear / exponential / sigmoid / plateau	
	d3	correct data quote **;** minimum of two rates with concentrations ecf for rate units	
		linked to	
	e1	hydrogen ions produced by photolysis **;**	
	e2	more hydrogen ions linked to more reduction **;**	
	e3	concentration of, chloroplasts / pigments / chlorophylls **;** **A** *photosystems*	
	e4	density of, lamellae / thylakoids / grana, linked to, ETS / proton pumps **;** **A** *greater number*	
	e5	ref to <u>NADP</u> as, hydrogen / H / H^+, acceptor **;** **R** NAD	
	e6	(instead) potassium manganate (VII) is reduced **;**	**max 7**
	(d)	**R** *refs to cells – but allow ecf after penalising once*	
	1	(sucrose solution) same, water / solute, potential **;**	
	2	as <u>stroma</u> **;**	
	3	(to) stop, envelope / chloroplasts, bursting **;** **A** *ora*	
	4	by osmosis / prevent osmotic damage **;** **A** *ora – but must be good, detailed explanation*	
	5	sucrose solution used to dilute the extract is the same, water potential / concentration, as used in the isolation medium **;**	
	6	sucrose concentration is a variable that needs to be controlled **;**	
		If water used:	
	7	chloroplasts, burst / rupture **;**	
	8	thylakoids exposed to potassium manganate (VII) **;**	
	9	(so solution) discoloured more quickly **;** **A** – *reaction faster*	
	10	AVP **;**	**max 6**

Question **Expected Answers** **Marks**

(e)

	limitation	**improvement**
1	reaction already begun when timing begins / AW **;**	start timing when potassium manganate (VII) is added / AW **;**
2	difficult to judge the end point **;**	use a colorimeter / repeat several times to improve decision of end point **;** **R** use a colour comparator
3	*either* only carried out once **/** no repeats / not enough repeats / no replicates **;** **R** not reliable unqualified *or* no check for anomalous results **;**	repeat twice **/** carry out three readings for each concentration, calculate mean **;**
4	difficult to plot curve with confidence **/** not enough concentrations **/** too few points plotted on graph / not enough intermediates **;**	use more concentrations of leaf extract **/** use any stated concentration(s), within range used **;**
5	100% extract not tested / maximum rate not determined / not above 50% / limited range **;**	use, 100% / > 50%, under identical conditions and determine the rate **;** **A** extend the range
6	temperature not controlled / AW **;**	use thermostatically-controlled water bath **;**
7	stray light / light intensity changed / AW **;**	appropriate method to exclude stray light **;**
8	pH increase as carbon dioxide used / pH not controlled **;**	use a buffer solution **;**
9	difficult to see volume of potassium manganate VII in syringe **;** **A** bubbles in syringe	use, graduated pipette / burette / automatic (e.g. Finn) pipette **;**
10	chloroplast concentration varies **;** **A** numbers of chloroplasts vary	standardise stirring of leaf extract before taking sample **;** **A** stated number of times
11	no control **;** sucrose solution with acid and potassium manganate VII **;** to show leaf extract necessary for colour change **;** leaf extract (and sucrose) with potassium manganate VII **;** to show acid needed for colour change **;** leaf extract (and sucrose) with acid and potassium manganate VII in dark **;** to show light necessary for colour change **;**	
12	AVP **;**	AVP **;** e.g. an appropriate improvement

max 8

[Total: max 28]

Question	Expected Answers	Marks

2 (a) *part (a) to max 12*

drawing to max 4 (check slides to see if cuticle is visible)

clear, continuous lines **;** *(circle offending lines)*
two lines for cell walls **;**
correct shape for palisade cells (longer than wide) **;**
correct juxtaposition of palisade cells and upper epidermal cells **;**
cell detail shown in palisade cell – nucleus and / or chloroplasts **;**

labelling to max 4

cell wall **;**
palisade, mesophyll / cell **;**
upper epidermal cell **; A** upper epidermis if bracketed / upper epidermis cell
air space **;**
nucleus **;**
chloroplast **;**
vacuole **;**

annotations to max 4

large number / high density, of chloroplasts, for maximum absorption of light **;**
close packing of cells / AW, for maximum absorption of light **;**
(cell wall forms) surface area for gaseous exchange **;**
idea that long axis at right angles to upper epidermis, no cross walls to deflect light **;**
near upper epidermis so close to light source / AW **;**

ref to movement of chloroplasts, for maximum absorption of light / avoid damage by high light intensity **;**
ref to structure of chloroplasts (e.g. grana), for maximum absorption of light **;**
vacuole to push chloroplasts to edge of cells, for maximum absorption of light **;** **max 12**

(b) (large) air spaces / in spongy mesophyll, allow diffusion of gases to and from palisade cells **; A** storage of carbon dioxide
xylem / vascular tissue / vein , close to palisade cells to provide water **;**
phloem / vascular tissue / vein, close to palisade cells to remove, sucrose / assimilates **;** **R** glucose
stomata on lower epidermis for diffusion of carbon dioxide into leaf **;** **R** gas exchange unqualified
cuticle / upper epidermis, is transparent to allow light into leaf **;**
AVP **;** e.g. leaf is thin to give short diffusion distance of carbon dioxide **max 2**

Question **Expected Answers** **Marks**

(c) *do not accept smaller unqualified*

smaller width **;**
thicker / AW **;**
curved / rolled / AW **;**
hairs / trichomes, on, internal / lower, surface **;**
thicker cuticle **;**
smaller air spaces **;**

AVP **;** e.g. details of mesophyll cells (dark staining in some cells)
AVP **;** e.g. details of epidermal / palisade cells
AVP **;** e.g. detail of stomata / sub-stomatal space / sunken stomata **max 3**

(d) *one mark for **each** structural feature linked to an adaptation (even if linked to the same adaptation, e.g. reduction of transpiration, but **reject** 'prevents' once in the answer)*

structural feature 1 + adaptation **;**
structural feature 2 + adaptation **;**
structural feature 3 + adaptation **;**

structural features

rolled leaf
hairs / trichomes, on lower surface
sunken stomata
small internal air spaces
thick(er) cuticle
no stomata on upper surface
less vascular tissue
AVP e.g. fewer stomata

adaptations

reduce water loss / transpiration / evaporation / diffusion of water vapour
R 'prevents water loss' once in the answer
reduce air flow
increase humidity
reduce, water potential gradient / diffusion gradient for water vapour
reduce surface area (:volume ratio) for transpiration
AVP **max 3**

[Total: max 16]

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