

**Applied Science**

Advanced Subsidiary GCE

Unit **G623**: Cells and Molecules

**Mark Scheme for June 2012**

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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.

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## Annotations

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	separates marking points
<b>NOT</b>	answers which are not worthy of credit
<b>REJECT</b>	answers which are not worthy of credit
<b>IGNORE</b>	statements which are irrelevant
<b>ACCEPT</b>	answers that can be accepted
( )	words which are not essential to gain credit
—	underlined words must be present in order to score a mark
ecf	error carried forward
AW	alternative wording
ora	or reverse argument

**Planning Exercise**

An investigation to compare the solute potentials of tissues taken from one named drought tolerant and one named drought susceptible cultivar of potato.

Marking of the plan:

- 1 Read the material presented.
- 2 Then award 1 mark if *scientific terminology* has been used appropriately. Record using the letter Y.
- 3 Then re-read, this time point marking up to 24, by placing letters A to X in the margin where you see evidence of the marking criteria.
- 4 The same piece of evidence can be used to award one criterion only.

Marking Point	Marking Criteria	Mark	Additional notes
A	easily recognised safety procedures highlighted ✓ ( <i>electric-microscopes/balance; sharps: corkborers/ razors/ scalpels/ forceps; glassware; chemical: relevant stains/ sucrose solution</i> )	1	Evidence of something that is going to make doing the investigation safer – an active document, a working document related to the plan.
B	prediction made ✓	1	Comparative link of <u>solute potential</u> of one (named) drought tolerant & one (named) drought susceptible cultivar. Accept ref to osmotic pressure
C	with justification ✓	1	Statement using correct science related to water potential/solute potential & water uptake for the varieties chosen.
D	description of preliminary work ✓ ( <i>accept ref to use of onion epidermis rather than potato tissue if justified</i> )	1	e.g. how to prepare tissue / mass of tissue to be used / SA of tissue / time to get measurable change / range of sucrose concentrations / experience of identifying/counting plasmolysed cells/ ref to use of stains.
E	clear and in detail ✓	1	Explain how to do it. Limit to 'D' if onion epidermal tissue used.
F	reason (for doing it) explained ✓	1	Explain why it's necessary for completion of the whole investigation.
G	clear and in detail ✓	1	Extra information i.e. when 50% cells plasmolysed = incipient plasmolysis. Hence $\psi^{\text{cell}} = \psi_s^{\text{cell}} = \psi^{\text{external solution}}$

Marking Point	Marking Criteria	Mark	Additional notes
H	at least two secondary sources of information identified ✓	1	State at least 2 references (Accept 1 ref to Wikipedia; Reject Insert). Full website address needed. Full description of named text (T, Author/Editor; Pub)
I	relevance explained ✓	1	Brief explanation as to how references helped in the planning.
J	basic practical skills and accuracy ✓	1	Simple method / list of instructions. (Prep of samples of 2 cultivars; use of sucrose solutions; incubation time; recording mass change/number of plasmolysed cells)
K	sound practical skills and accuracy ✓	1	Could someone follow the instructions unaided? Are quantities shown? Is it repeatable to appropriate degree of accuracy? <i>Preparation of external solutions;</i> <i>Precision in the preparation of tissue samples to uniform size.</i> <i>Accuracy in measurements – drying tissue/ re weighing until constant mass;</i> <i>Intention to calculate % change in mass/ % plasmolysed cells;</i> <i>Comparison of two cultivars.</i>
L	range of appropriate equipment listed ✓ (Must be linked to chosen method). Limit to 'L' if potatoes missing.	1	List of names of main items of equipment and materials needed for the investigation. Generic terms: beakers, test tubes, pipettes etc are OK here.
M	full range of appropriate equipment listed ✓ (If any major item missing do not award)	1	Qualifications noted. Indication of 2 named cultivars; At least 1 ref to number of a specific item and 1 reference to a specific volumetric size, e.g. 10cm <sup>3</sup> graduated pipette. Accept ref to accuracy of balance/ suitable microscope of at least x100
N	appropriate number of measurements stated ✓	1	Mentions replicates / repeats. Min 2 for each cultivar. Accept comparisons with secondary data (e.g class results)
O	need for range of measurements stated ✓	1	Statement: e.g. range of sucrose solutions needed to plot a graph to find the molarity of sucrose which causes 50% plasmolysis; <b>OR</b> range of sucrose solutions needed to find where there is no % change in mass between the two cultivars.
P	appropriate range stated ✓	1	Minimum of 5 different concentrations of an appropriate solution; 2 cultivars of potato.
Q	relevant variables are identified (stated) ✓	1	<i>At least two from:</i> age of tissue / surface area of tissue / source of tissue / cultivars used / temperature / volume of solutions / range of concentrations/ time;
R	how variables to be controlled explained ✓	1	How for at least 2 of the variables relevant to Q. (look for 'R' in method)

Marking Point	Marking Criteria	Mark	Additional notes
S	one suitable method to display data ✓	1	One display of results e.g. table, with appropriate headings with units. (Reject if just 'molarity')
T	additional method to display data ✓	1	Any <u>different</u> display e.g. graph. (Suitable X & Y axes labelled correctly).
U	simple data handling ✓ <i>Reject 'change in mass'</i>	1	Mean/ % change in mass; use of graph data e.g. % change in mass; identification of intercepts on x-axis where 0% change in mass; use of graph to find 50% plasmolysis.
V	possible conclusions ✓ <i>e.g. DT cultivars will show zero change in mass at a higher concentration of sucrose than DS cultivars or DT will show a more negative solute potential than the DS variety at 50% plasmolysis, (when <math>\psi_w = \psi_s</math>)</i>	1	Statements of expectations or observations to confirm or reject prediction made in B. 'What would your results need to show to confirm or reject your prediction?'
W	recognises sources of error ✓ Time to take measurements; floating tissue; age of tissue; source of tissue; Evaporation of sucrose solution; Thin sectioning; Drying errors; Identification of plasmolysed cells; Damage to cells when sectioning; Counting of cells; limitations of magnification; Diurnal changes;	1	<i>At least two examples:</i> equipment / materials / specific human error. (A basic explanation is required).
X	suggests methods for improving accuracy and or validity ✓	1	Accuracy: relate to 'W' or use of alternative technique(s). AND / OR Validity: state aspect of collected data to be compared with secondary sources.  <i>Expand critical range of sucrose concentrations;</i> <i>Use pins to immerse chips; potato repeats if not in 'N'.</i> <i>Use of tally counters;</i> <i>Repeats with diff cultivars;</i> <i>Reject ref to use of Coulter counters/ haemocytometers.</i>
Marks	Maximum for plan = 25	24 + 1	(scientific terminology)

Question			Answer	Marks	Guidance
1	(a)	(i)	Light (microscope) ✓	1	
		(ii)	<p><i>any one from:</i></p> <p>Cheap (to purchase) / low cost ✓</p> <p>Unaffected by magnetic fields ✓</p> <p>Preparation of material is quick/simple/requires less complex staining ✓</p> <p>Easier to use ✓</p> <p>Material rarely distorted by preparation ✓</p> <p>Can observe more than 1 cell in field of view ✓</p>	1	<p>Ignore if state less skill needed in observation</p> <p>Ignore 'natural colour of material can be observed' since Pap smears stained</p>

Question	Answer	Marks	Guidance
	<p>(iii)</p> <p><b>[Level 0]</b> Candidate includes fewer than <b>three valid</b> points. Errors in spelling, punctuation and grammar may be intrusive, with little evidence of a logical order. <i>(0 marks)</i></p> <p><b>[Level 1]</b> Candidate shows a basic understanding of cell preparation including <b>at least three valid</b> points. Errors in spelling, punctuation and grammar may be intrusive, with little evidence of a logical order. <i>(1 mark)</i></p> <p><b>[Level 2]</b> Candidate shows an understanding and describes how the cells may have been prepared for observation, including <b>at least four valid</b> points expressed clearly and logically. There may be occasional errors in spelling, punctuation and grammar and the explanation may not fully follow a logical order. <i>(2 – 3 marks)</i></p> <p><b>[Level 3]</b> Candidate shows a high level of understanding and gives a full description of how the cells may have been prepared for observation, including <b>six valid</b> points expressed clearly and logically. There are few, if any errors in spelling, punctuation and grammar and the explanation follows a logical order. <i>(4 marks)</i></p> <p><i>N.B. The number of ticks on the script will not always directly equate with the numbers of marks given.</i></p>	4	<p>Valid points include:</p> <ul style="list-style-type: none"> <li>• Cells placed in (colourless) liquid (preservative)</li> <li>• Placed onto glass slide</li> <li>• Smearred</li> <li>• Fixed</li> <li>• Using 95% alcohol/alcohol based spray</li> <li>• Stained (Ignore ref to incorrect stain)</li> <li>• Pap stain/haematoxylin (for nucleus)/OG/EA for cytoplasm</li> <li>• Coverslip added</li> <li>• Description of how coverslip added/use of mounted needle</li> <li>• Attempt to remove air bubbles</li> <li>• Removal of excess stain</li> </ul> <p>Ignore reference to use of LM</p>

Question	Answer	Marks	Guidance
	<p>(iv) <i>any two from:</i></p> <p><b>Rough</b> endoplasmic reticulum / RER ✓  <i>Function:</i> protein/polypeptide, assembly / protein synthesis / transport of materials / provides large surface area (for protein assembly) ✓</p> <p><b>Smooth</b> endoplasmic reticulum ✓  <i>Function:</i> Lipid synthesis / lipid transport / steroid synthesis ✓</p> <p>Golgi (apparatus/body) ✓  <i>Function - any one from:</i>            Glycoprotein / mucin secretion / modification of proteins ✓            Packaging of secretory enzymes ✓            Transport/ storage of lipids ✓            Lysosome / vesicle formation ✓            Secretion / exocytosis ✓</p> <p>Ribosomes ✓  <i>Function:</i> site of protein synthesis / transcription/ assembly of peptide/ polypeptide chains ✓</p> <p>Lysosomes ✓  <i>Function:</i> Exocytosis / autophagy / autolysis ✓</p> <p>Mitochondria ✓  <i>Function:</i> site of ATP production / Krebs cycle / citric acid cycle / electron transport chain / <b>aerobic</b> respiration / oxidative phosphorylation ✓</p>	4	Award one mark for function if linked correctly to named organelle.

Question	Answer	Marks	Guidance
(b)	<p>any <b>two</b> from:</p> <p><i>Cells in Fig. 1.1:</i>            Relatively large ✓            Polygonal in shape ✓            Cell boundaries defined ✓            Cytoplasm is thin ✓            Nucleus small ✓            Nucleus is dense ✓            Many occur singularly ✓</p> <p><i>Cells in Fig. 1.2:</i>            Large nuclei ✓            Irregular shaped (nucleus) ✓            Nucleus wrinkled/ indented/with protrusions ✓            Nucleus hyperchromatic/ darker ✓            Cells clumped/ grouped together ✓</p>	2	Assume comparison to Fig 1.2 unless otherwise stated.
(c)	Cells in Fig. 1.1 = normal ✓ Cells in Fig. 1.2 = dysplastic/abnormal/cancer cells ✓	2	
(d)	<b>(C) I D E (A) G B H (F)</b>	3	5 - 6 correct = 3 marks 4 correct = 2 marks 3 correct = 1 mark 2 or less = 0 marks
	<b>Total</b>	<b>17</b>	

Question	Answer	Marks	Guidance
2 (a)		3	All 4 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 mark
(b)	<p><i>Type of bond:</i> Covalent ✓</p> <p><i>Explanation:</i> Can form C-C/ single bonds/ can produce large C- rings (skeletons)/ long chains ✓</p> <p>Can form multiple/ double/ triple (covalent) bonds (with other carbon, oxygen and nitrogen atoms) ✓</p>	3	Ignore reference to polymers  Accept reference to C=O bonds.
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
3	(a)	Type of reaction = hydrolysis ✓ Bond broken = glycosidic ✓	2	
	(b)	(Invertase breaks down/ digests / hydrolyses / catalyses/ converts/ liquefies) <b>solid</b> sucrose to <b>liquid</b> fructose (and glucose), (once chocolate surround added) ✓	1	
	(c) (i)	Benedict's (reagent) ✓	1	
	(ii)	Chemical reagents – <i>any two from</i> :  Hydrochloric acid ✓ Sodium hydrogen carbonate / sodium carbonate / sodium hydroxide / suitable named alkali ✓ Universal indicator paper ✓	2	
	(iii)	<i>any one from</i> :  (A colour shift from green/yellow/orange to brick) red ✓  More precipitate forms ✓  Colour change occurs more rapidly ✓	1	

Question		Answer	Marks	Guidance
	(d) (i)	Biuret (reagent)/ sodium or potassium hydroxide <b>and</b> copper sulphate ✓	1	
	(ii)	<p>Test: add lipid sample to, (absolute) ethanol/ alcohol, <b>and</b> water and shake ✓</p> <p>Result: milky suspension/cloudy/emulsion ✓</p> <p><b>OR alternative answer:</b> add lipid sample to Sudan III/IV shake ✓</p> <p><i>sudan III/IV:</i> red dye associates with fat droplets <b>OR</b> red colour stains fat droplets <b>OR</b> red ring on surface of liquid ✓</p>	<p>1</p> <p>1</p>	<p>Accept 1 mark for description of relevant test. Ignore reference to 'emulsion test'.</p> <p>1 mark for result linked to the description.</p> <p>Ignore reference to translucent mark test.</p>
<b>Total</b>			<b>10</b>	

Question		Answer	Marks	Guidance
4	(a)	1. Deoxyribose ✓ 2. Hydrogen ✓ 3. Thymine ✓  4. Ribose ✓ 5. Nucleolus ✓ 6. Messenger ✓  7. Ribosomes ✓ 8. Transfer ✓ 9. Protein ✓	9	
	(b)	% of C/G bases = 100 – 76% or 24% ✓ % of guanine bases = 12% ✓	2	
	(c)	Accept 1, 2 or 3 PLUS correct relevant explanation: Explanation: Non overlapping codons for 2 / 1 codon plus 2 part codons (OWTTE) ✓	1	
<b>Total</b>			<b>12</b>	

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