OCR
RECOGNISING ACHIEVEMENT

GCE

Applied Science

Advanced Subsidiary GCE

Unit **G623:** Cells and Molecules

Mark Scheme for June 2011

Oxford Cambridge and RSA Examinations

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Planning Exercise

Plan an experiment to investigate the effect of sodium hydrogencarbonate concentration on the population growth of a Cyanobacterium.

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; (accept ref to any 3 from: glassware; electrical; chemical (HCO_3^-/ growth media i.e. dust); exposure to culture organism; disposal of culture organism.	1	Evidence of something that is going to make doing the investigation safer – an active document, a working document related to the plan. Reject anything 'over the top'.
B*	prediction made; Reject if yeast used	1	Prediction related to task. (Accept any named spp of algae e.g. Chlorella) Reject Yeast.
C*	with justification; Reject if yeast used.	1	Use evidence (Accept ref to release of CO_2 or high pH)
D	description of preliminary work;	1	At least one from: Limit to D & F if yeast used.
E*	clear and in detail;	1	Explain how to do it.
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/suitable extension linked to scientific ideas.
H	at least two secondary sources of information identified; (Accept Wikipedia if qualified.)	1	State at least 2 references – at least one new ref. Full website address needed. Full description of named text (Title, Author, Publisher)

Preliminary work here

Temperature of incubation; range of bicarb. conc; incubation time; volume/type of vessel; source of organism; culture technique; culture medium; volume of algae; dilution of stock culture; light source; suitable methods to measure pop growth e.g. dry mass/ colourimetry/ haemocytometer; pH range of HCO_3^- solutions

Main investigation starts here.

I	relevance explained;	1	Brief explanation as to how references helped in the planning.
J	basic practical skills and accuracy; Limit to 'J' if used haemocytometer & inappropriate organism in main investigation	1	Simple method / list of instructions. Basic. 'Is it a feasible approach?' Mark 'J' & 'K' as normal if yeast used.
K	sound practical skills and accuracy; (may also look for evidence of 'P' here)	1	Could someone follow the instructions unaided? Are quantities shown? Is it repeatable to appropriate degree of accuracy?
L	range of appropriate equipment listed;	1	List of names of main items of equipment and materials needed for the investigation. Generic terms: beakers, flasks etc are OK here.
M	full range of appropriate equipment listed; Award if quantities given plus at least 1 ref to volumetric size given.	1	Qualifications noted. Indication of number of each, specific sizes, e.g. 250 cm^3 beaker, 1dm^3 flask. If any major item is missing do not award.
N	appropriate number of measurements stated;	1	Accept 2 or more replicates for each concentration.
O	need for range of measurements stated; insufficient to indicate a control in method/results table without some explanation	1	Statement: need for a control as a comparison to HCO_3^- concs; or range needed to find optimum conc for growth.
P	appropriate range stated;	1	At least 4 different concentrations of sodium hydrogencarbonate used.
Q	relevant variables are identified (stated); controlled variables	1	At least 2 from: Accept dependent variables as dry mass; absorbance/ transmission values; length of Spirulina;
R	how variables to be controlled explained;	1	Explanation how at least 2 of the variables will be controlled specified.

VARIABLES
Age/type of organism; Source of organism; Starter culture conc; culture media; CO2; Temperature of incubation; Incubation time; surface area of flasks/; density of initial cells; light intensity; wavelength; nutrient conc;

S	one suitable method to display actual or intended data;	1	One display of results e.g. table with appropriate column headings with units. (Accept units in body of table)
T	additional method to display data;	1	Any <u>different</u> display e.g. graph. Accept any relevant display linking data given in 'S'
U	simple data handling;	1	mean / use of graph data
V*	possible conclusions; (Do not award if yeast used or incorrect task)	1	Statements of expectations or observations to confirm or reject prediction made in **B**. 'What would the results need to show to confirm or reject the prediction?'
W	recognises sources of error; Accept 2 different sources of human error	1	At least two examples: equipment / materials ($NaHCO_3$ not very soluble; decomposes at high temp)/ specific human error.
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.
Marks	Maximum for plan = 25	24 + *1 (scientific terminology)*	

Methods of culture – stirring/water disturbance improves growth. Magnetic stirrer faulty; heat source from light bank; light bank switched off at night; light distribution from source; size of initial cell sample;

Accuracy: precision of water bath; Alternative measurement of population growth; Increase range of HCO_3 concs; decrease intervals within conc range to find optimum growth. Validity: comparison with secondary source

Question			Expected Answers	Marks	Additional Guidance
1	a		**across**: 2. dead; 4. electromagnets; 5. vacuum; **down**: 1. heavy metals; 3. electrons;	**5**	**reject** 'magnets'
	b		**two** from: because electrons are easily absorbed; (thin sections must) allow electrons to penetrate specimen / to allow electrons or electron beam to pass through; to create sufficient contrast / light & dark areas on the screen/ to give a clearer image;	**2**	
	c		**advantage** - **one** from: greater magnification / clearer / more detailed/ greater resolution / able to distinguish between two points easily; **disadvantage** - **two** from: special accommodation / room needed; expensive; needs skilled operative; affected by magnetic fields; preparation of material is lengthy / complex; distortion / artefacts created during tissue preparation / staining / when making thin sections; high vacuum required; specimen is dead / living material cannot be viewed;	**1** **2**	**accept** reference to level of magnification achieved i.e. x500 000 **reject** 'big'
			Total	**10**	

Question			Expected Answers	Marks	Additional Guidance
2	a		**A** = mitochondrion; **B** = vacuole;	**2**	**accept** mitochondria

	b		distance **XY** = 88mm;
			conversion to µm = 88 000/ or ÷ 24;
			magnification = 3666.7 or 3666.6;
			reject 3666;
				1
				
				2
					accept tolerance 86-88mm
					mag if 86mm = x3583 or 3583.3
					mag if 87mm = x3625
					allow ecf for distance **XY**; Award 3 marks if only correct answer given
					reject 3666

	c		QWC: banded mark scheme. [0 marks] Candidate shows very limited understanding of the use of a haemocytometer to measure yeast cell counts. [1 mark] Candidate shows a basic understanding of the use of a haemocytometer to measure yeast cell counts, including at least 2 valid points. [2 - 3 marks] Candidate shows an understanding of the use of a haemocytometer to measure yeast cell counts, including at least 3 valid points, expressed clearly with some logical order. [4 marks] Candidate shows a high level of understanding of the use of a haemocytometer to measure yeast cell counts, including a full description with at least 4 valid points, expressed clearly and logically.	**4**	Points for consideration: Dilution of stock sample; Mixing of sample; Place sample in chamber/slide; Look at cells in central (triple lined/ 5x5) square; Count cells in 5 (4x4) squares (within central square); Count TL; TR; BL; BR; & central squares/ AW; Application of north and west/ top and left rule; Need for sample repeats; Need to count at regular intervals/specified times; Ignore ref to glucose concentration
	d	i	**one** from: monitor quality of product / alcohol content / flavour / taste / colour / smell; monitor quality of brewing materials / cereals / water quality; monitor microbial contaminants/ bacterial content;	**1**	AVP i.e: Temperature at which yeast cells are grown at; Time taken to activate yeast growth; **reject** 'temperature' without qualification
		ii	large sample numbers can be measured / quick / automated / rapid repeats;	**1**	**accept** 'avoids human error' OWTTE
		iii	cannot distinguish between dead and live cells / counts inanimate particles as cells;	**1**	
			Total	**12**	

Question			Expected Answers	Marks	Additional Guidance
3	a		biuret reagent / addition of sodium hydroxide **and** copper sulphate solution; purple / lilac colour;	2	
	b		folding of polypeptide chain or amino acid chain; into compact / rounded shape / specific shape/ 3D shape; maintained by ionic / hydrogen / disulfide bonds;	3	
	c	i	rate of digestion at 45^{o}C = 2.0 (h^{-1}); time taken at 65^{o}C = 2.5 (hr);	2	
		ii	3 – 4 points plotted correctly = 2 marks; 1 – 2 points plotted correctly = 1 mark;	2	**allow** ecf for calculation of rate of digestion at 45^{o}C
		iii	smooth 'bell-shaped' curve through all points (ignore any extrapolation on curve if 'best fit' drawn);	1	**reject** 'hairy lines' / tram lines **accept** IoB guidelines: points joined 'dot-to-dot' with a ruler with no extrapolation beyond 15^{o}C & 75^{o}C
	d		repeat experiment at shorter intervals between 35 – 50^{o}C / repeat experiment at shorter intervals (around the optimum/ highest temperature)/ AW;	1	**reject** ref to repeats **reject** reference to increased temperature range
	e		any **three** from: reference to optimum temperature from graph/ reference to decrease in rate; 'Bio-White' / enzyme activity decreases / falls; enzymes denatured / active site changes shape; heat + k.e. / vibrations increase; enzyme/substrate complex reduced / substrate no longer fits active site / AW; secondary / tertiary structure (of enzyme) disrupted; due to breaking hydrogen bonding;	3	**ignore** reference to 'enzymes killed/ enzymes destroyed'
			Total	14	

Question			Expected Answers	Marks	Additional Guidance
4	a		DNA; deletion / substitution / duplication / inversion / addition / changes in codons / nucleotides / organic bases / changes in base sequence;	1 1	**reject** chromosome **accept** reference to frame shift / single nucleotide repeat
	b		**two** from: definition of osmosis/ movement of water from high Ψ^w to low Ψ^w/ from a dilute to a concentrated solution; (across selectively permeable membrane); build up of Cl^- ions in cells / reduced secretion or transport of Cl^- ion out of cells (in CF sufferers); (as a consequence) too many chloride ions inside the cell / water potential of cell is less than normal / water potential of (epithelial) mucus / intercellular fluid is greater than normal; water loss from cells by osmosis reduced/ water uptake by cells (from epithelial mucus / intercellular fluid) increased;	2	
	c	i	**three** from: blocked airways / bronchi / bronchioles (by mucus); build up of mucus/ coughing; ventilation physically difficult / wheezing / harder to breathe/ heavy breathing/ breathlessness; obtain less oxygen/ lack of oxygen (in blood) / gas exchange impaired / AW; less energy/ respiration impaired; need for regular physiotherapy / chest patting / drug treatment; increased risk of infection in lungs; difficult to participate in sports / AW;	3	**ignore** 'tired'

Question			Expected Answers	Marks	Additional Guidance
		ii	**two** from: less pancreatic juice / named enzymes released/ secreted (in CF sufferers); to act as (digestive) enzyme supplements; to help the digestion of food/ protein/ lipids/ starch; to help absorption (of digested food); to overcome nutritional deficiency; to prevent/ overcome gut blockage/ constipation;	2	**ignore** reference to breakdown of food in stomach
			Total	9	

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