Mark Scheme (SAM)

Pearson Edexcel International Advanced Level in Biology

Unit 6: Practical Biology and Investigative Skills

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of Quality of Written Communication, are being assessed. The strands are as follows:
    i. ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
    ii. select and use a form and style of writing appropriate to purpose and to complex subject matter
    iii. organise information clearly and coherently, using specialist vocabulary when appropriate.

Using the Mark Scheme

Examiners should NOT give credit for incorrect or inadequate answers, but allow candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected, it may still be creditworthy.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/	Means that the responses are alternatives and either answer should receive full credit.
()	Means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Bold	Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq	(error carried forward)(transfer error)(consequential) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Question Number	Answer	Additional Guidance	Mark
1(a)	1. and 2. Idea of clear dependent variables, e.g. tidal volume, minute ventilation, breathing rate, rate of oxygen absorption 3. Reference to suitable units for a chosen dependent variable 4. Idea of calibration of spirometer trace 5. Description of how trace used to obtain dependent variable 6. Idea of repeats	ACCEPT Mps from suitably annotated diagram, e.g. Mps 1, 2, 5. Mp1 and 2. NOT 'depth of breathing', 'tidal intake', vital capacity, IRV, ERV. Mp4 detail not required. Mp5 some detail required, e.g. count the number of peaks per minute. ACCEPT repeat in terms of measurement of an individual or using several subjects.	**(4)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	Any two from: 1. Same person 2. Same age 3. Same gender 4. Temperature 5. Time of day/eq 6. Diet before testing/eq 7. Speed of kymograph/eq 8. Any other credible alternative variable	Apply list principle – mark first two variables given. Do NOT accept mass volume of soda lime KOH (should be in excess), reference to oxygen source or oxygen concentration/level in spirometer. ACCEPT size/mass/BMI/physical activity of subject, time to acclimatise, humidity.	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. Appropriate variable chosen from 1(b)(i), with suitable control method described 2. Description of likely effect on the dependent variable provided	Marks can be awarded as long as the variable chosen was suggested in 1(b)(i) even if not credit worthy in 1(b)(i). Mp1 ACCEPT use a temperature-controlled room/room thermostat/air-conditioned room/eq. NOT carry out at room temperature. Similarly with 'time' they need to give some detail, e.g. record breathing for 5 minutes/use a stopwatch to ensure breathing was recorded for same length of time. When describing the likely effect, we expect to see a reasonable attempt to describe effect of change in control variable on dependent variable. Do NOT ACCEPT: general statements such as 'would give inaccurate results' Mp2 in context of this experiment increased environmental temperature will lead to a reduced breathing rate and tidal volume (converse for decreased temperature). 'At higher temperatures the breathing rate would decrease' gains Mp2.	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)	1. More {energy/respiration/oxygen/eq} needed/eq 2. Reference {autonomic/sympathetic (increases)/parasympathetic (decreases)/somatic} nervous system/phrenic nerve/eq 3. Reference {ventilation/respiratory/inspiratory/expiratory} centre 4. (In) medulla 5. Idea of chemoreceptors (carotid/aortic) 6. Reference changes in {carbon dioxide/pH/temperature} (in blood) detected 7. Reference (motor) cortex 8. Idea that nerve impulses go to muscles involved in breathing	ACCEPT converse if it is clear the student is referring to lying down. IGNORE nerve impulses/nervous system. NOT if incorrectly qualified. ACCEPT breathing control centre. Must be in context of controlling breathing. NOT if incorrectly qualified by location. ACCEPT chemoreceptors in arteries. IGNORE stretch receptors.	**(4)**

Total for Question 1 = 12 Marks

Question Number	Answer	Additional Guidance	Mark
2(a)	1. (There will be) no significant difference 2. In the number of worms {coming to the surface in each 0.5 m^2 {quadrat/found/eq} between each {ploughing technique/field/eq}/eq	Different number of worms in the fields OR because of different ploughing.	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	1. (Median for) field A = 8 2. (Median for) field B = 7 3. Raw data ranked and in suitable table format of rows and columns 4. Accurate headings e.g.	ACCEPT suitable tables turned 90°. IGNORE omission of ruled lines within body of table and unranked data. NOT $0.5m^2$. NOT if no reference to quadrat/area.	**(4)**

	Number of worms in {quadrat/0.25m^2}	
	Field A	Field B
	13	15
	10	12
	9	10
	9	9
	8	8
	5	7
	4	6
	4	6
	3	4
		3
		0

Question Number	Answer	Additional Guidance	Mark
2(c)	**A** axes correct orientation and scale with suitable labels **P** data plotted as bar chart with bars plotted correctly **B** range bar included	A Expect to see 'median' in y-axis label. ACCEPT ecf for units but not no units. P ACCEPT means if in 2(b) means calculated or medians incorrectly calculated.	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(d)	1. The (smaller) value of {U/eq} is higher than the critical value 2. Reference to critical value of 23 3. Therefore there is no **significant difference** between the number of worms {coming to the surface in each quadrat/found in each field/eq} 4. Accept null hypothesis/eq 5. Reference to {wide variability of data/medians are very close together/eq}	ACCEPT clearly marked value in table. Credit 'do not reject' IGNORE overlapping error bars.	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(e)	1. Idea that other factors may not have been taken into consideration 2. Sample size small/sample only taken at one time period/eq 3. Reference to {wide variability of data/eq}	ACCEPT named factor. IGNORE difference in number of quadrats sampled. IGNORE overlapping error/range bars.	**(3)**

Total for Question 2 = 16 Marks

Question Number	Answer	Additional Guidance	Mark
3(a)	1. Suitable ethical argument, e.g. there is no significant ethical issue 2. There are no significant safety issues 3. Safety issue related to minerals, e.g. mineral allergies or irritants 4. Safety issue related to plants, e.g. plant allergies or irritants 5. Safety related to hydroponics, e.g. may provide good growing conditions for bacteria/fungi	IGNORE idea that removing plants from environment is an ethical concern. IGNORE {solutions/chemicals} may be corrosive.	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	1. See if proposed method will work/eq 2. See if the plant chosen will grow in hydroponic unit/eq 3. Idea of selecting range of Mg concentrations 4. Find suitable method of measuring {growth/yield/colour of leaves /number of leaves/eq} 5. Check most suitable conditions (for growth of plants) /eq 6. Select suitable timescale for measuring growth/eq	Ignore 'practice proposed method'.	**(3)**

Question Number	Answer	Additional Guidance	Mark
3 (c)	1. Clear statement of dependent variable, i.e. exactly what is to be measured stated, e.g. mass of plant tissue, mass of fruit, length of shoot, {number/colour} of leaves/eq	Need to see term dependent variable.	**(8) + (2 SPG - see below)**
	2. Clear description of method of measuring change in dependent variable	Description of calculations not required.	
	3. Clear statement of independent variable = concentration of magnesium	Need to see term independent variable.	
	4. Range of suitable concentrations suggested (at least 5)	ACCEPT a statement that 5 different concentrations would be used. IGNORE answers of fewer than 3 days.	
	5. Some clear consideration of time period over which the growth will be measured/eq	ACCEPT volume of solutions for one of these marks.	
	6. and 7. Identification of up to 2 other variables that could affect growth	Must describe how variables are controlled. Ignore responses such as 'use a greenhouse'/'put them somewhere with the same light intensity'.	
	8. and 9. Description of how those 2 identified variables can be controlled		
	10. Idea of need for replica at each concentration	Idea of controlling for genetic variability.	
	11. control of source of plant, e.g. use of same species/variety/source of seeds		
	12. Use of graph to identify other values of concentration to test to identify optimum concentration/eq		

Spelling, Punctuation and Grammar (SPG) - Award up to 2 marks

Start with 2 marks and if criteria not met move to 1 and then 0

Level	Mark	Descriptor
Level 3	**2**	The account is well organised with no undue repetition and a correct sequence. There is good use of scientific vocabulary in the context of the investigation described. The account is written in continuous prose which is grammatically sound with no major spelling errors.
Level 2	**1**	There is some disorganisation in the account which is not always in the correct sequence. Some relevant scientific vocabulary is used. The account is not always in continuous prose and there are grammatical errors and some important spelling mistakes.
Level 1	**0**	The account is very disorganised and is very difficult to follow. Scientific vocabulary is very limited with many spelling and grammatical errors.

Question Number	Answer	Additional Guidance	Mark
3(d)	1. Clear table which matches method described with headings and units 2. Change in {growth/eq} calculated, e.g. by measuring {change in length/percentage change in mass/eq} 3. Means calculated from repeat data 4. {Scatter/line} graph format with correctly-labelled axes/eq 5. Use of graph to {estimate range for optimum/to identify other values of concentration to test to identify optimum concentration/eq}	Table with columns/rows for raw data. Ignore units in body of table.	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(e)	1. Difficult to control all variables affecting plant growth 2. Example of uncontrolled variable, e.g. seeds do not germinate at the same time, genetic differences between the plants 3. Reference to limiting factor(s) 4. Reference to need for more than one type of mineral for effective growth of plants 5. Specified difficulty in measuring dependent variable/eq	Needs to be related to plant growth. Simply stating that a particular variable was not controlled gains only. ACCEPT contamination with microorganisms may affect plant growth. IGNORE reference to poor choice of dependent variable.	**(3)**

Total for Question 3 = 22 Marks

Total for Paper = 50 Marks