

GCE

Biology B

H422/01: Fundamentals of biology

A Level

Mark Scheme for June 2023

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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.

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**PREPARATION FOR MARKING
RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')

- OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **32(b)** and **33(a)(i)**

11. Annotations

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given

Annotation	Meaning
	Ignore
	Blank page

12. Subject Specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question	Answer	Marks	AO element	Guidance
1	D	1	AO2.5	
2	B	1	AO1.2	
3	D	1	AO1.1	
4	A	1	AO1.2	
5	B	1	AO2.8	
6	A	1	AO2.8	
7	A	1	AO2.7	
8	C	1	AO2.5	
9	C	1	AO1.2	
10	C	1	AO1.1	
11	C	1	AO1.1	
12	D	1	AO1.1	
13	C	1	AO2.5	
14	B	1	AO1.2	
15	D	1	AO1.1	
16	C	1	AO2.1	
17	C	1	AO1.1	
18	D	1	AO2.4	
19	D	1	AO1.1	
20	B	1	AO1.1	
21	D	1	AO2.5	
22	C	1	AO1.2	
23	A	1	AO2.5	
24	C	1	AO1.2	
25	D	1	AO2.5	

26	B	1	AO2.5	
27	B	1	AO1.1	
28	D	1	AO2.8	
29	D	1	AO1.1	
30	B	1	AO1.1	
	Total	30		

Question			Answer	Marks	AO Element	Guidance
31	(a)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8.6×10^7 (kg yr⁻¹) award 2 marks 141.5 x 200 000 ✓ 8.6 x 10 ⁷ ✓	2	AO2.6	ALLOW for 1 mark 86, 079 167 OR 86, 000 000
31	(a)	(ii)	1 Laaroussi (goats) has a larger variation in average milk yield (than Draa) ✓ 2 some Laaroussi (goats) produce much , more / less , milk than other Laaroussi ✓ 3 Draa (goats) are more likely to produce similar quantities of milk ✓	Max 1	AO3.2	ORA
31	(b)		<i>Support validity of claim</i> 1 offspring / hybrid , from breeding programme will inherit , same characteristics / high milk yield ✓ <i>Does not support validity</i> Max 2 2 (European / domestic) goats could introduce disease ✓ 3 (European / domestic) goats are not , suited / adapted , to , environment / mountain regions ✓ 4 idea that native breeds would not be conserved ✓	Max 3	AO3.2	Answer must have at least one supporting argument and one non-supporting argument for 3 marks ALLOW not adapted to diet / food

Question			Answer	Marks	AO Element	Guidance
31	(c)	(i)	FIRST CHECK THE ANSWER IN TABLE / ON ANSWER LINE If answer = 20 (%) award 3 marks ((20 x 7000) ÷ 2000) OR 70 ✓ (70 ÷ 350) × 100 ✓ 20 ✓	3	AO2.6	
31	(c)	(ii)	1 limiting movement of the goats so less energy used (in movement) ✓ 2 idea that the animals are slaughtered for meat earlier so less energy lost in food chain ✓ 3 idea of use of antibiotics / vaccination so less energy spent fighting infection ✓ 4 idea of keep in barns so less energy loss in thermoregulation ✓ 5 idea of enriching diet / high protein diet so more energy available for growth ✓	Max 2	AO2.5	ALLOW before sexually mature ALLOW keep indoors so less energy loss in thermoregulation
31	(d)	(i)	1 ruminants have four , stomachs / chambers ✓ 2 alpaca do not have a reticulum ✓	1	AO2.1	IGNORE alpaca has three , stomach / chambers
31	(d)	(ii)	1 rumen / C1 , contains microorganisms ✓ 2 microorganisms / bacteria produce cellulase ✓	3	AO1.1 AO2.1	

Question			Answer	Marks	AO Element	Guidance
			3 enables , breakdown / digestion , of <u>cellulose</u> ✓			

Question			Answer	Mark	AO Element	Guidance
32	(a)	(i)	<i>Stage</i> L ✓ <i>Reason</i> blood is entering , both atria and ventricles / all heart chambers ✓	2	AO1.2	ALLOW correct reference to left or right side
32	(a)	(ii)	prevents back flow of blood into (left) ventricle ✓	1	AO1.2	ALLOW ventricles

32	(b)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. In summary: Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.) Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the Communication Statement (shown in <i>italics</i>): ○ award the higher mark where the Communication Statement has been met. ○ award the lower mark where aspects of the Communication Statement have been missed. • The science content determines the level. • The Communication Statement determines the mark within a level.			
		Level 3 (5–6 marks) Explanation that includes involvement of named heart tissues and their control of the cardiac cycle. Includes SAN, AVN and one other tissue. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Explanation that includes involvement of named heart tissues and their control of the cardiac cycle. Includes SAN and AVN or SAN and one other tissue or AVN and one other tissue. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1–2 marks) Basic descriptive statement that includes a named heart tissue and its control of the cardiac cycle. Includes SAN or AVN or one other tissue or all 3 tissues named without an explanation.	6	AO1.2	Indicative scientific points may include Structures should be correctly linked to location and control SAN • sinoatrial node / SAN • found in right atrium • known as pacemaker • controls contraction of heart muscle • initiates impulse across atria • causes atrial systole AVN • atrioventricular node (AVN) • found in septum • between two atria • receives impulses from SAN • delays impulse • allows time for atria to empty • passes impulse to ventricles

			<i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>			other tissues bundles of His • found in septum • between ventricles • conductile fibres • pass impulse down septum to apex Purkinje tissue / Purkyne tissue • found in ventricles • carries impulse from apex through ventricular walls • causes ventricular systole
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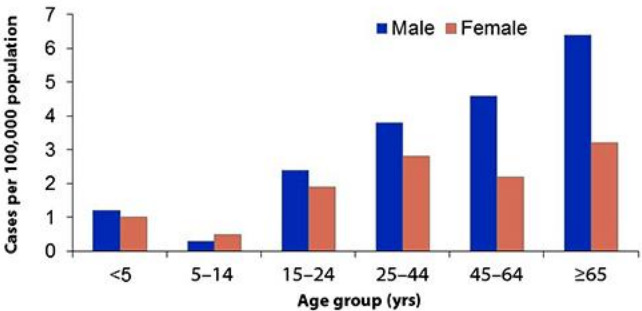
32	(c)	(i)	completing the final row of the table ✓ $\chi^2 = 10.77$ ✓✓ <table><tr><td></td><td>Heart rate bpm</td><td>Observed frequency (fo)</td><td>Expected frequency (fE)</td><td>(fo- fE)²</td><td>$\frac{(fo- fE)^2}{fE}$</td></tr><tr><td rowspan="2">Male</td><td><140</td><td>25</td><td>19.7</td><td>18.5</td><td>0.94</td></tr><tr><td>>140</td><td>12</td><td>17.3</td><td>28.1</td><td>1.62</td></tr><tr><td rowspan="2">Female</td><td><140</td><td>7</td><td>12.3</td><td>39.7</td><td>3.23</td></tr><tr><td>>140</td><td>16</td><td>10.7</td><td>53.3</td><td>4.98</td></tr><tr><td colspan="5"></td><td>$\chi^2 =$ 10.77 or 10.8 ✓✓</td></tr></table>		Heart rate bpm	Observed frequency (fo)	Expected frequency (fE)	(fo- fE)²	$\frac{(fo- fE)^2}{fE}$	Male	<140	25	19.7	18.5	0.94	>140	12	17.3	28.1	1.62	Female	<140	7	12.3	39.7	3.23	>140	16	10.7	53.3	4.98						$\chi^2 =$ 10.77 or 10.8 ✓✓	3	AO3.3	ALLOW for 3 marks <table><tr><td>0.9</td></tr><tr><td>1.6</td></tr><tr><td>3.2</td></tr><tr><td>5.0</td></tr><tr><td>10.7 or 10.77</td></tr></table>	0.9	1.6	3.2	5.0	10.7 or 10.77
	Heart rate bpm	Observed frequency (fo)	Expected frequency (fE)	(fo- fE)²	$\frac{(fo- fE)^2}{fE}$																																								
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5.0																																													
10.7 or 10.77																																													
32	(c)	(ii)	1 V / degrees of freedom / n-1 , = <u>3</u> ✓ 2 calculated value is greater than , critical value / <u>7.815</u> (at 5% probability) ✓ 3 results are , not due to chance / are significantly different to expected ✓	Max 2	AO3.4																																								
32	(c)	(iii)	idea that the probability of having a heart rate >140 can't be predicted ✓	1	AO3.4																																								
32	(c)	(iv)	1 same age of fetuses ✓ 2 mothers at same , stage in pregnancy / gestational period ✓ 3 fetuses had not been diagnosed with heart defect ✓	Max 1	AO3.4																																								

33	(a)	(i)*	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. In summary: Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.) Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the Communication Statement (shown in <i>italics</i>): - award the higher mark where the Communication Statement has been met. - award the lower mark where aspects of the Communication Statement have been missed. • The science content determines the level. • The Communication Statement determines the mark within a level.			
			Level 3 (5–6 marks) Comparison that includes flowering patterns for both species. Reference to two or more light dark variations in Fig. 33.1. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Comparison that includes flowering patterns for both species. Reference to one light dark variation in Fig. 33.1. OR Comparison that includes flowering patterns for one species. Reference to two or more light dark variation in Fig. 33.1. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1–2 marks) Basic descriptive statement that includes either short day or long day plant. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i>	6	AO1.2 AO2.5	Indicative scientific points may include: Variation 1 (10 dark and 14 light hours) - light / daylength is above critical threshold <i>H. niger</i> / short day plant will not flower <i>E. pulcherrima</i> / long day plant will flower - Period of darkness is less than critical threshold Variation 2 (14 dark and 10 light hours) - light / daylength is below critical threshold <i>H. niger</i> / short day plant will flower <i>E. pulcherrima</i> / long day plant will not flower - Period of darkness exceeds critical threshold - Period of darkness is uninterrupted

			0 marks <i>No response or no response worthy of credit.</i>			Variation 3 (6 dark, flash, 8 dark and 10 light hours) • Period of darkness exceeds critical threshold but is interrupted • <i>H. niger</i> / short day plant will not flower if dark period interrupted • Flash of light causes <i>E. pulcherrima</i> / long day plant to flower
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Question			Answer	Mark	AO Element	Guidance
33	(a)	(ii)	1 photoreceptors / phytochromes ✓ 2 Pr is converted to Pfr when plant is exposed to red light ✓ 3 Pfr accumulates during the day ✓ 4 Pfr is converted back to Pr when plant is , in darkness / at night / exposed to far-red light ✓ 5 relative proportions / ratio , of Pfr and Pr enable plants to measure daylength ✓	Max 3	AO1.2	ALLOW Pred / 660nm for Pr and Pfar-red / 730nm for Pfr ALLOW higher concentration of Pfr in the day ALLOW higher concentration of Pr in darkness
33	(a)	(iii)	temperature OR humidity ✓	1	AO2.5	
33	(b)	(i)	<i>Structure X</i> = pollen tube ✓ <i>Structure Z</i> = micropyle ✓	2	AO2.5	
33	(b)	(ii)	<i>during fertilisation</i> they / polar nuclei , fuse with , male nucleus / gamete ✓ <i>after fertilisation</i> develop into , endosperm / embryo food supply ✓	2	AO2.5	
33	(b)	(iii)	1 gametes are haploid ✓ 2 crossing-over ✓ 3 independent / random , assortment ✓ 4 creates new combination of alleles ✓	Max 3	AO2.5	

Question			Answer	Mark	AO Element	Guidance
34	(a)		<i>Mycobacterium tuberculosis</i> ✓	1	AO1.1	ALLOW <i>Mycobacterium bovis</i>
34	(b)	(i)	1 resources / vaccines / education , to be directed to where they are needed ✓ 2 show how often the disease occurs ✓ 3 can identify disease trends ✓ 4 can identify disease outbreaks ✓ 5 can help control future outbreaks ✓	Max 1	AO2.6	ALLOW isolation of disease location
34	(b)	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.97 (per 100 000) award 2 marks $(9\,500 \div 320\,000\,000) \times 100\,000$ or 2.96875 ✓ 2.97 ✓	2	AO2.8	ALLOW 1 mark max for incorrect number of sig. figs e.g. 3.0 / 2.969 / 2.9688
34	(b)	(iii)	<i>cases increase because</i> increase in migrants (from countries with TB) ✓ <i>idea of TB being opportunistic so</i> caused by another disease e.g. AIDS ✓	Max 1	AO3.1	IGNORE new strains develop

Question			Answer	Mark	AO Element	Guidance
34	(c)	(i)	bar chart AND appropriate labelled axes and scales ✓ bars plotted correctly for females ✓ bars plotted correctly for males ✓	3	AO2.8 AO3.2	
34	(c)	(ii)	<i>Arguments for</i> 1 cases increase with age in males ✓ 2 overall number of cases is males is higher than in females ✓ <i>Arguments against</i> 3 cases in females fluctuates with age ✓ 4 no statistical analysis ✓ 5 between ages 5 and 14 there is little difference in number of cases between males and females ✓ 6 comparative figs. to support either argument ✓	Max 4	AO3.2	ALLOW increase with combined age DO NOT ALLOW increase with age in females ALLOW decrease / change in trend in males at age 5-14 ALLOW females have a higher risk than males at age 5-14

Question			Answer	Mark	AO Element	Guidance								
35	(a)		<table><tr><td>Role in the growing fetus</td><td>Nutrient</td></tr><tr><td>DNA synthesis, production of erythrocytes and cell division</td><td>folic acid ✓</td></tr><tr><td>Synthesis of haemoglobin</td><td>iron ✓</td></tr><tr><td>Synthesis of the pigment, rhodopsin</td><td>vitamin A ✓</td></tr></table>	Role in the growing fetus	Nutrient	DNA synthesis, production of erythrocytes and cell division	folic acid ✓	Synthesis of haemoglobin	iron ✓	Synthesis of the pigment, rhodopsin	vitamin A ✓	3	AO1.1	
Role in the growing fetus	Nutrient													
DNA synthesis, production of erythrocytes and cell division	folic acid ✓													
Synthesis of haemoglobin	iron ✓													
Synthesis of the pigment, rhodopsin	vitamin A ✓													
35	(b)		<i>Test</i> monitoring blood pressure ✓ <i>Reason</i> check pregnant woman is not developing , hypertension / pre-eclampsia ✓ OR <i>Test</i> blood tests ✓ <i>Reason</i> check blood groups / check Rhesus status / check for infection ✓	Max 2	AO1.2	Test must match the reason for 2 marks								
35	(c)	(i)	beta / β , cells AND islets of Langerhans / pancreas ✓	1	AO2.5	IGNORE chemoreceptor								

Question			Answer	Mark	AO Element	Guidance
35	(c)	(ii)	1 uptake more glucose (from blood) ✓ 2 increase respiration of glucose ✓ 3 increase , conversion of glucose to glycogen / glycogenesis ✓	Max 2	AO2.5	
35	(c)	(iii)	1 insulin resistance ✓ 2 effectors do not respond to insulin / reduced sensitivity ✓ 3 AVP ✓	Max 2	AO2.1	ALLOW named effector / target cell e.g. glucose control mechanism affected by pregnancy hormones
35	(d)	(i)	1 (women) gain weight (in pregnancy) ✓ 2 (women) may have increased blood pressure (in pregnancy) ✓ 3 insulin resistance persists after pregnancy ✓	Max 2	AO2.1	
35	(d)	(ii)	controlling diet ✓ weight loss / limited weight gain ✓	Max 1	AO2.1	ALLOW increase (moderate) exercise

Question			Answer	Mark	AO Element	Guidance
36	(a)	(i)	1 apply rule for counting e.g. north-west rule ✓ 2 count cells that fall within grid AND on top / north and left / west lines ✓ 3 do not count cells on right / east and bottom / south lines ✓	Max 2	AO1.2	
36	(a)	(ii)	1 cell count would , be too high / higher ✓ 2 this student's results would be anomalous ✓ 3 mean would be affected / higher ✓	Max 2	AO3.2	IGNORE average or range
36	(b)		flow cytometry ✓ fluoresce ✓ chemical ✓	3	AO1.2	ACCEPT luminescent

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