

GCE

Biology A

H420/03: Unified biology

A Level

Mark Scheme for June 2025

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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 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 available in RM Assessor
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

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, email or via the RM Assessor messaging system.
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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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 is not 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.**

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 **3(a)** and **6(b)**

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
	Ignore

Annotation	Meaning
	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	(a)		A = sieve tube (element) ✓ B = xylem (vessel) ✓	2	2.3	ALLOW xylem cell
1	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.4 : 1 award three marks surface area of the root hair = $2 \times \pi \times 5 \times (5 + 800) =$ 25,289.8208614 ✓ volume of the root hair = $\pi \times 5^2 \times 800 = 62,831.8530718$ ✓ SA:V of root hair = $25,289.82 / 62,831.853 = 0.4025 =$ 0.4 : 1 ✓	3	2.2	2 marks for '0.4' alone or '0.40 : 1' or '0.4025 : 1' or '0.403 : 1' or '2 : 5' or '1 : 2.5' or '4 : 10' or '161 : 400' or any other correct ratio as final answer If final answer incorrect, award marks for correct SA or volume calculations. ALLOW standard form and correct rounding to minimum of 5 significant figures in working ALLOW 25,211.28 (area of circle deducted) or 25,277 (using 3.14 as π) or 25,293.1 (using 3.142) or 25,300 (using 22/7) or 8050π ALLOW 62,800 (using 3.14 as π) or 62,840 (using 3.142) or 62,857.14286 (using 22/7) or $20,000\pi$ ECF marks: 0.2:1 (diameter used in both calculations) = 1 mark 0.8:1 (diameter in SA calculation) = 2 marks 0.1:1 (diameter in vol calculation) = 2 marks 4:1 (not squaring in vol calculation) = 2 marks

Question			Answer	Marks	AO Element	Guidance
1	(b)	(ii)	increases / fast(er) , uptake of , water / (named) minerals / (named) ions ✓	1	1.2	ALLOW more , water / minerals / ions , absorbed / taken up / move(s) in IGNORE helps ALLOW more diffusion of water from soil ALLOW more osmosis (of water) into cells ALLOW greater (active) transport of , minerals / ions , into roots ALLOW 'assimilates / nutrients' for 'minerals' IGNORE 'diffusion / osmosis' unqualified e.g. no mark for 'increased diffusion of water' CON short(er) diffusion distance
1	(c)		1 (transported as) sucrose ✓ 2 (moves between cells from palisade cells) through , plasmodesmata / symplast (pathway) OR (or moves between cells) through , cell walls / inter-cell spaces / apoplast (pathway) ✓ 3 protons / H ⁺ (ions) , actively transported / pumped , out of companion cell ✓ 4 co-transport (of , sucrose / carbohydrates) with , protons / H ⁺ (ions) , into companion cell ✓ 5 <u>active loading</u> (of sucrose into companion cells) ✓	3 max	1.2	IGNORE 'palisade' throughout NOTE: mp2, 3, 4, and 5 can be awarded without sucrose being mentioned ALLOW 'facilitated diffusion of carbohydrate, together with protons, into companion cell' ECF from MP3 if an ion other than H ⁺ is used DO NOT ALLOW 'active transport of sucrose'

Question			Answer	Mark	AO Element	Guidance
2	(a)	(i)	ATP has one more phosphate ✓	1	1.1	ORA ALLOW ATP has three phosphates and ADP has two phosphates IGNORE molecule / ion ALLOW ATP has an extra phosphoanhydride bond ORA
2	(a)	(ii)	adrenaline cannot bind to receptor ✓ adenylyl cyclase , remains inactive / not stimulated / AW ✓ adenylyl cyclase cannot , catalyse / convert , ATP to cAMP ✓ AVP ✓	2 max	2.5	ALLOW 'adenyl' and 'adenylate' for 'adenylyl' throughout CON if context is 'change of shape of the receptor / allosteric effect' ALLOW adenylyl cyclase is not activated NOTE: 'adenyl cyclase is not triggered to convert ATP to cAMP' scores MP2 and MP3 e.g. G-protein , is not activated / does not work / is not switched on / does not split NOTE: 'G-protein does not activate adenylyl cyclase' scores MP2 and MP4 NOTE 'adrenaline (normally) binds to receptors to stimulate adenylyl cyclase. This cannot happen when the receptors are blocked' scores 2 marks

Question			Answer	Mark	AO Element	Guidance
2	(b)		supporting (why beta blockers are less effective) : 1 idea that beta blockers have a higher risk in all comparisons ✓ 2 beta blockers have <u>significantly higher</u> risk (of stroke) , in 2 cases / than W and Z ✓ not supporting (why beta blockers are effective): 3 only , <u>significant</u> differences / <u>significant</u> results / <u>significantly</u> higher risk (of stroke) , in two cases / (compared) with W and Z ✓ 4 no <u>significant</u> , results / difference(s) , for heart attack (in all cases) ✓ 5 no <u>significant</u> , results / difference(s) , (compared) with two drugs / with drugs X and Y ✓ additional information needed: 6 other (named) cardiovascular conditions not assessed ✓ 7 idea of comparison to people not having treatment ✓ 8 age / gender / (initial) level of illness / exercise / diet / other drugs , of patients ✓ 9 no , sample size / number of patients (stated) ✓	4 max	3.1 3.2	ORA other drugs have lower risk in all cases ALLOW (beta blockers RR) >1 in all cases ORA W and Z have <u>significantly</u> lower risk (of stroke) ALLOW error bars (generally) overlap with RR of 1 ALLOW does not assess CVD in general ALLOW control group given no drug is needed / placebo is needed IGNORE 'control group' unqualified IGNORE no statistical tests

Question			Answer	Mark	AO Element	Guidance
2	(c)		<i>peripheral because...</i> connects , CNS / brain / spinal cord , to, the heart / rest of body / effector OR it is (largely) outside / not part of , CNS / brain / spinal cord OR it contains, sensory / motor , neurones ✓ <i>autonomic because...</i> (control of heart rate is / it controls responses that are) involuntary or connected to / AW , medulla oblongata ✓	2	2.1	NOTE: award marking points even when 'peripheral' and 'autonomic' are not mentioned IGNORE 'spine' alone CON relay neurones / interneurones ALLOW <i>idea of</i> transmits impulses , from receptors / to (named) effectors ALLOW 'nerve cells' for 'neurones' ALLOW 'unconscious / not conscious / needs no thought / requires no decision-making' for 'involuntary' IGNORE 'have no control over / automatic / subconscious'

3	(a)	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.			
		Level 3 (5-6 marks) All tissues identified correctly with detailed evidence for each 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) All tissues identified correctly with a piece of evidence for each tissue or A tissue identified correctly with detailed evidence for that tissue or No tissues identified but detailed evidence that matches each photo <i>There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) A tissue identified correctly with a piece of evidence included or No tissues identified but a piece of evidence that matches each photo <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit.	6	2.3 3.1	Indicative scientific points may include (but are not limited to): D is smooth/involuntary evidence: • no , striations / sarcomeres / I bands / A bands • one nucleus per cell / uninucleated (cells) • no intercalated discs • small / spindle-shaped / tapering , cells • unbranched E is skeletal evidence: • striations / sarcomeres / I bands / A bands • several nuclei per , cell / fibre or multinucleated • no intercalated discs • tubular / long , cells • unbranched F is cardiac evidence: • striations / sarcomeres / I bands / A bands • intercalated discs • one nucleus per cell / uninucleated (cells) • tubular cells • branched Aspects of the communication statement might not be met when information irrelevant to the question (e.g. locations of muscle tissue, function of muscles, and details of the sliding filament theory) has been included.

Question			Answer	Mark	AO Element	Guidance
3	(b)		(M) I N J K H L ✓✓✓	3	1.1	If the order is incorrect, award: one mark for I first (second after M) and L last one mark for N, J, and K in the correct order (but not necessarily listed together). e.g. I N J H K L = 2 marks I J N K H L = 1 mark I N J H L K = 1 mark
3	(c)	(i)	autoimmune ✓	1	2.1	
3	(c)	(ii)	no / few(er) , Na ⁺ ions enter , sarcoplasm / muscle cell ✓ less / no , depolarisation of , sarcolemma / muscle cell membrane / T-tubules / sarcoplasmic reticulum / SR ✓ no / few(er) , Ca ²⁺ released from , sarcoplasmic reticulum / SR ✓	2 max	2.5	IGNORE sodium / Na / calcium / Ca / Ca ⁺ ALLOW no / fewer , Na ⁺ channels open in , sarcolemma / muscle cell membrane ALLOW 'action potential in' for 'depolarisation of' NOTE 'normally, the T-tubules are depolarised, which causes the SR to release calcium ions. This cannot happen when the receptors are blocked' scores 2 marks (MP2 and MP3)

Question			Answer	Mark	AO Element	Guidance												
4	(a)		<table><tr><th>Property</th><th>Messenger RNA</th><th>Transfer RNA</th></tr><tr><td>Anticodons are present</td><td></td><td>✓</td></tr><tr><td>The nucleotide base sequence codes for a protein</td><td>✓</td><td></td></tr><tr><td>Uracil is bonded to adenine by hydrogen bonds within the molecule</td><td>(✓)</td><td>✓</td></tr></table> ✓✓	Property	Messenger RNA	Transfer RNA	Anticodons are present		✓	The nucleotide base sequence codes for a protein	✓		Uracil is bonded to adenine by hydrogen bonds within the molecule	(✓)	✓	2	1.1 1.2	One mark per correct column ALLOW 'yes' for '✓' DO NOT ALLOW hybrid ticks
Property	Messenger RNA	Transfer RNA																
Anticodons are present		✓																
The nucleotide base sequence codes for a protein	✓																	
Uracil is bonded to adenine by hydrogen bonds within the molecule	(✓)	✓																
4	(b)		removal of , introns / non-coding <u>m</u> RNA ✓ joining / rearrangement , of , exons / coding <u>m</u> RNA ✓ RNA editing ✓ AVP ✓	2 max	1.2	ALLOW 'spliced out' for 'removed' ALLOW 'spliced' for 'joined' e.g. (5') capping of mRNA or addition of poly-A tails in mRNA e.g. ref. spliceosome												
4	(c)	(i)	(grinding / it / step 1) breaks / AW , <u>cell walls</u> ✓ animal cells / they , do not have <u>cell walls</u> ✓	2	3.3	ALLOW detergent / step 2 , will , break down / emulsify , membranes / phospholipid bilayer												

Question			Answer	Mark	AO Element	Guidance
4	(c)	(ii)	add protease and break down proteins , associated with / AW , DNA ✓ add salt and helps DNA precipitate / makes DNA less soluble / separates DNA from water ✓ add RNAase and breaks down RNA (in sample) ✓ cool / reduce temperature and prevent damage to DNA / reduce enzyme activity ✓ centrifuge and to separate DNA from , other cell components / cell debris ✓	1 max	3.3	ALLOW 'digest / hydrolyse' for 'break down' ALLOW 'breaks down histone (proteins)' ALLOW to pellet cell debris and leave DNA in the supernatant
4	(d)	(i)	S1 buffer (solution) ✓ E1 maintains / controls / for optimum , pH or carry / provides ions for , current (through gel) ✓ S2 reference / marker / ladder , DNA (fragments in solution) ✓ E2 (to) compare / know / observe / identify , position / mass / size (of sample fragments) ✓ S3 dye / stain / fluorescent marker / fluorescent tag (solution) ✓ E3 to , see / monitor progress of , bands / DNA / fragments ✓	4 max	3.3 3.4	Only award an explanation mark when it is paired with the correct solution mark as prose IGNORE a stated pH value ALLOW AW, e.g. 'allows charge to pass across (gel)' ALLOW DNA fragments of known , length / mass / size IGNORE probe / UV ALLOW radioactive marker / colour marker / colour tag ALLOW named dyes, e.g. ethidium bromide

Question			Answer	Mark	AO Element	Guidance
4	(d)	(ii)	homozygous sickle cell = 2 and 5 ✓ homozygous normal = 1 and 4 AND heterozygous = 3 ✓	2	3.1	ALLOW 1 mark for: homozygous sickle cell = 2 or 5 and homozygous normal = 1 or 4 and heterozygous = 3
4	(e)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 160,000 award two marks ($10^9 / 2500 =$) 400,000 ✓ 400,000 x 0.4 = 160,000 ✓	2	2.6	ALLOW 1.6×10^5 ALLOW 4×10^5
4	(e)	(ii)	temperature ✓ (use of) electroporation (instead of other transformation methods) ✓ use optimal pH ✓ (composition of) growth medium ✓ use small plasmids ✓ AVP ✓	1 max	3.3	IGNORE more , cells / plasmids (because this is unlikely to improve efficiency) CON decrease temperature IGNORE heat shock ALLOW descriptions; e.g. 'use electricity to make holes in bacterial membranes' concentration of Ca^{2+} / use bacteria in log phase (of population growth)

Question			Answer	Mark	AO Element	Guidance
6	(a)	(i)	(original is) alanine (new is) aspartic acid ✓	1	2.5	
6	(a)	(ii)	shorter (protein/chain) and (because early) stop codon (has been introduced) ✓	1	2.5	ALLOW 'unfinished / truncated / incomplete / fewer amino acids in the chain' for 'shorter' ALLOW 'nonsense mutation' for 'stop codon' CON frameshift / silent mutation / missense

6	(b)*	<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i>			
		Level 3 (5-6 marks) Detailed discussion of the advantages of gene editing and detailed discussion of the ethical issues shared by both forms of gene therapy. <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) Description of advantages of gene editing and mention of an ethical issue shared by both forms of gene therapy. <i>There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) Description of an advantage of gene editing or mention of an ethical issue shared by both forms of gene therapy. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit.	6	2.5 3.2	Indicative scientific points may include (but are not limited to): <i>advantages of gene editing</i> • longer lasting / more permanent • reduced need for repeat treatments • editing of dominant alleles could treat dominant inherited conditions • standard gene therapy treats only disease caused by recessive alleles • no need for a (viral) vector • so fewer problems delivering the treatment to cells / more precise • reduce potential for , immune response / rejection <i>ethical issues</i> • relatively untested technologies • long-term / harmful , effects (unknown) • high costs could prevent access for certain groups of people • potential problems deciding which genes can be edited / added (e.g. cosmetic use / non-disease) • children cannot give consent for treatment (note: do not credit ref. to embryos) • religious objections Aspects of the communication statement might not be met when information irrelevant to the question (e.g. references to germline therapy, ethical issues in the context of only one form of therapy) has been included.

Question			Answer	Mark	AO Element	Guidance
7	(a)	(i)	number of diseases analysed ✓ how , climate change was / disease cases were , measured ✓ population (sizes) / numbers , of , animals / vectors ✓ whether , increases (in cases) / results / data / AW , were (statistically) significant ✓ <i>idea of</i> whether the data were regional or global ✓	1 max	3.2	ALLOW number of diseases that , did not increase / were reduced ALLOW time period over which climate change was assessed ALLOW time of year (when data were collected) IGNORE 'there are no statistical tests mentioned' unqualified
7	(a)	(ii)	increases / changes to , range / migration , of (named) , vector / host / animals ✓ increases , reproduction (rate) / population size / number , of (named) , vectors / pathogens ✓ more (standing) water for (named) vector breeding areas ✓	1 max	2.1	ALLOW vector present for a longer part of the year ALLOW vector / pathogen , can reproduce for more of the year ALLOW greater food supply for vector CON 'disease' for 'pathogen'
7	(b)	(i)	bone marrow ✓	1	1.1	

Question			Answer	Mark	AO Element	Guidance
7	(b)	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = $0.6 \mu\text{mol dm}^{-3} \text{ min}^{-1}$ award three marks ruled tangent following the trajectory of the initial curve from 0 ✓ correct calculation using the tangent (e.g. $14 \mu\text{mol dm}^{-3} / 25 \text{ min} = 0.56 \mu\text{mol dm}^{-3} \text{ min}^{-1}$) ✓ units = $\mu\text{mol dm}^{-3} \text{ min}^{-1}$ ✓	3	2.8	ALLOW any value in the range 0.50 to 0.80 ALLOW any number of significant figures If answer incorrect, ALLOW one mark for evidence of using a tangent from time 0. DO NOT ALLOW if 2 tangents have been drawn and one does not go to 0 If answer incorrect, ALLOW one mark for units of $\mu\text{mol dm}^{-3} \text{ min}^{-1}$ DO NOT CREDIT: $\mu\text{mol dm}^{-3} / \text{min}$
7	(b)	(iii)	break down / hydrolyse / kill / digest / AW , pathogens ✓	1	2.1	ALLOW bacteria / viruses / microbes / fungi / protocista / protozoa IGNORE foreign cell / antigens IGNORE damage / harm / disrupt
7	(b)	(iv)	opsonin(s) ✓	1	1.1	NOTE: must be a phonetic spelling (e.g. not 'oposnin', but 'opsanin' is acceptable) and should begin with 'o'
7	(c)		callose ✓ plasmodesma(ta) ✓ sieve pores ✓	3	1.1 1.2	IGNORE callus / callous IGNORE 'tube / plate' after 'sieve'

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