



**GCE**

**Biology B**

**H422/03: Practical skills in 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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**MARKING INSTRUCTIONS****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. Award No Response (NR) if:
  - there is nothing written in the answer spaceAward Zero '0' if:
  - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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 **2(b)(ii)** and **4(d)(ii)**.




## 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

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Annotation	Meaning
	Noted but no credit given
	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).

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

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Question			Answer	Marks	AO	Guidance
1	(a)	(i)	(A =) bleb ✓  (B =) nuclear fragmentation / karyorrhexis ✓  (C =) apoptotic <u>body</u> ✓	3	2.3 2.7	<b>ALLOW</b> nuclear condensation / pyknosis
1	(a)	(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = <math>8.5 \times 10^{-7}</math> (m) award two marks</b>  17mm / 20 000, = 0.00085mm / 0.85µm / 0.00000085m ✓  $8.5 \times 10^{-7}$ (in standard form) ✓	2	2.4	<b>ALLOW</b> ECF for incorrect measurement for 1 max
1	(b)	(i)	(G2) <u>checkpoint</u> detected , DNA mutation / damaged DNA / unreplicated DNA / error (that) occurred in SCR ✓	1	2.5	<b>ALLOW</b> ' <u>checkpoint</u> detected, error in S stage' <b>IGNORE</b> references to generalised faults in 'cells'
1	(b)	(ii)	p53 / tumour suppressor protein, represses / stimulates , transcription factors  <b>or</b> CDKs / cyclins, activated / AW <b>or</b> cells, labelled, for destruction ✓	1	2.5	<b>ALLOW</b> correct example of CDK activity / function

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1	(c)		feature	totipotent	pluripotent	multipotent	2	1.1	<b>DO NOT CREDIT</b> hybrid ticks and crosses <b>2 rows correct = 1 mark</b> <b>3 rows correct = 2 marks</b>
			can differentiate into any type of cell	✓					
			present in an embryo	✓	✓				
			present in an adult human		✓	✓			

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Question		Answer	Mark	AO	Guidance	
2	(a)	<p>(photosynthesis) produces , triose phosphate / TP / (named) carbohydrates ✓</p> <p>for (use in) respiration ✓</p> <p>correct ref<sup>n</sup> to detail of Calvin cycle ✓</p> <p>correct ref<sup>n</sup> to light dependent stage producing ATP (which is used for survival) ✓</p>	<b>2 max</b>	1.2	<p>e.g. of named carbohydrates include: glucose / sucrose / assimilates</p> <p><b>DO NOT ALLOW</b> if 'energy is produced' from respiration</p> <p>e.g. conversion of TP to glucose / lipids, conversion of glucose to sucrose</p>	
2	(b)	(i)	<p>larger (stated) sample size ✓</p> <p>select sample locations <u>randomly</u> ✓ detail of how to achieve random sampling ✓</p> <p>(use) <u>stratified</u> sampling ✓ detail of how to carry out stratified sampling ✓</p> <p>(use of point / grid / frame) <u>quadrat</u> detail of how to use quadrat ✓</p>	<b>4 max</b>	2.8	<p><b>ALLOW</b> qualified number of sites e.g. 20 <b>IGNORE</b> reference to '10 locations' as this is in the question as 5 locations per site</p> <p>e.g. use of random number generator to determine co-ordinates</p> <p>e.g. the number of samples in the woodland and grassland should be <u>proportional</u> to their areas</p> <p>e.g. measure percentage cover, use of ACFOR scale, searching thoroughly and counting</p>

2	(b)	(ii)	<p><b>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</b></p> <p><b><i>In summary:</i></b>  <i>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, <b>Level 1</b>, <b>Level 2</b> or <b>Level 3</b>, best describes the overall quality of the answer.  Then, award the higher or lower mark within the level, according to the <b>Communication Statement</b> (shown in italics):</i></p> <ul style="list-style-type: none"> <li>○ <i>award the higher mark where the Communication Statement has been met.</i></li> <li>○ <i>award the lower mark where aspects of the Communication Statement have been missed.</i></li> </ul> <p>• <b>The science content determines the level.</b>  • <b>The Communication Statement determines the mark within a level.</b></p>			
			<p><b>Level 3 (5-6 marks)</b>  Comprehensive outline of both a <b>valid</b> experimental method <b>and</b> statistical test for the investigation.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3-4 marks)</b>  Detail experimental method <b>and</b> statistical test for the investigation.</p> <p><i>There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</i></p>	6	3.3 3.4	<p><b>Indicative scientific points may include (but are not limited to):</b></p> <p><i>Experimental method</i></p> <ul style="list-style-type: none"> <li>• Details of safety considerations: e.g. hazard, risk &amp; precaution</li> <li>• Details of the independent variable (e.g. at least three different light wavelengths)</li> <li>• Details of how to vary wavelength e.g. use of filters to remove particular wavelengths, different acetate sheets</li> <li>• Details of period of acclimatisation (of plant)</li> <li>• Details of large sample sizes</li> <li>• Minimum of 3 repeats (for each wavelength)</li> <li>• Idea of identifying anomalies and calculating <u>means</u></li> </ul>

		<p><b>Level 1 (1-2 marks)</b> Some detail of experimental method <b>and / or</b> statistical analysis for the investigation.</p> <p><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></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>		<p><i>Validity</i></p> <ul style="list-style-type: none"> <li>• Details of control variables (e.g. size / mass / age of plant or leaf area, light <u>intensity</u>, light <u>duration</u>, <u>initial</u> carbon dioxide concentration, temperature)</li> </ul> <p><i>Statistical testing</i></p> <ul style="list-style-type: none"> <li>• Calculation of standard deviation (for each data set)</li> <li>• <b>Unpaired</b> t-test to determine if there is a significant difference in the <b>mean</b> rate of PHS between the 2 <i>different</i> plant species at a single (specified) wavelength <b>or</b> <b>Paired</b> t-test to determine if there is a significant difference in the <b>mean</b> rate of PHS by a single species of plant at 2 (specified) wavelengths <b>or</b> <b>SRCC</b> for each species of plant to determine <b>correlation</b> between the wavelength and rate of PHS for each spp of plant</li> </ul>
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2	(b)	(iii)	<p><i>describe</i>          (collect) additional repeats, and calculate <u>mean</u> ✓          named example of how to reduce <u>random</u> error ✓</p> <p><i>explain</i>          to reduce effect of <u>random</u> error ✓          detail of how named example reduces <u>random</u> error ✓</p>	2 max	3.3 3.4	<p>E.g.</p> <ul style="list-style-type: none"> <li>• (named example) use colorimetry</li> <li>• (explanation) to prevent random error when using colour charts as this produces quantitative results</li> </ul>
2	(b)	(iv)	add , iodine / I <sub>2</sub> , <b>and</b> , (potassium) iodide / KI / I <sup>-</sup> ✓	1	2.1	<b>ALLOW</b> iodine <u>solution</u> / potassium iodide <u>solution</u>

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2	(c)	(i)	<p>fewer electrons enter electron transport chain / AW ✓</p> <p>less reduced NADP , generated for / supplied to , Calvin cycle (from light-dependent stage) ✓</p> <p>less ATP , generated for / supplied to , Calvin cycle (from light-dependent stage) ✓</p> <p>correct ref to photorespiration may occur (if <u>environmental</u> temperature remains higher despite low light intensity) ✓</p>	2 max	2.5 3.1	<p><b>ALLOW</b> NADPH as alternative to 'reduced NADP'</p> <p><b>DO NOT ALLOW</b> 'references to less energy produced'</p> <p><b>e.g.</b> (so) RUBISCO acts as oxygenase (rather than carboxylase) ✓</p>
2	(c)	(ii)	<p><b>mark first answer</b></p> <p>protease ✓ (ice cold) ethanol ✓</p>	2	2.5	<p><b>ALLOW</b> alcohol</p>



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Question		Answer	Mark	AO Element	Guidance
3	(a)	<p>line drawing with clear continuous lines <b>and</b> areas in correct proportion ✓</p> <p>cortex, renal pyramids, and ureter <b>all</b> correctly labelled ✓</p> <p>label lines horizontal, touching structure, no arrowheads ✓</p>	3	2.1 2.3	<p><b>ALLOW</b> a variety of shapes and sizes for the structures (but they must be in the correct positions and clear)</p> <p><b>ALLOW</b> any orientation of drawing e.g. pelvis on the left</p> <p><b>DO NOT ALLOW</b> drawings that reflect theoretical diagram rather than image in Fig. 3.1</p> <p><b>DO NOT ALLOW</b> incomplete, overlapping or sketched lines</p> <p><b>DO NOT ALLOW</b> shading or cross-hatching</p>

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3	(b)	<p><b>more</b> ADH secreted than normal/at lower sodium ion concentrations, therefore...</p> <p><u>more</u> ADH binds, to (specific) receptors on (cell membranes of) cells in the, <u>collecting duct</u> wall ✓</p> <p>(more) aquaporins fuse to the (collecting duct) cell membranes ✓</p> <p>collecting duct permeability is, <u>greater</u> / <u>higher</u>, than normal ✓</p> <p>more / AW , water reabsorbed (into blood plasma) <b>ora</b> ✓</p> <p>(causes) <u>increased</u> / <u>higher</u> , water potential (in the blood than normal) <b>ora</b> ✓</p>	3 max	3.1 3.2	<b>IGNORE</b> data quotes as command word is to explain not describe
3	(c)	<p>glucose oxidase ✓ (hydrogen) peroxidase ✓ mmol dm<sup>-3</sup> / mmol (d)L<sup>-1</sup> / mg dm<sup>-3</sup> / mg (d)L<sup>-1</sup> ✓</p>	3	1.2 2.6	<b>ALLOW</b> glucose dehydrogenase
3	(d)	<p><b>cause</b> polycystic <u>kidney</u> disease / <u>kidney</u> cancer ✓</p> <p><b>reason</b> failure was, chronic / <u>not</u> acute <b>or</b> (unusual tissue may be) cyst(s) / tumour(s) ✓</p>	2	3.2	<b>IGNORE</b> ref to symptoms developing over long period of time as in stem of Q

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3	(e)	<p>grow / AW , kidney (tissue) from , embryonic stem cells ✓</p> <p><i>idea of</i> using stem cells from the patient / induced pluripotent stem cells ✓</p> <p>detail of stem cell source ✓</p> <p>to avoid / reduce (risk of) , kidney / organ / tissue , rejection ✓</p> <p>to reduce / prevent, the need for immunosuppressants ✓</p>	2 max	1.1 1.2	<p><b>ACCEPT</b> iPSCs</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>• iPSCs reset from differentiated cells</li> <li>• 'use stem cells from person's bone marrow'</li> <li>• embryonic stem cells from umbilical cord, use of discarded embryos from IVF</li> </ul> <p><b>IGNORE</b> reference to rejection unqualified</p> <p><b>ALLOW</b> reference to no immune response</p>
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Question		Answer	Mark	AO Element	Guidance
4	(a)	<p>(Domain =) <u>Eukarya</u> / <u>Eukaryota</u>            (Kingdom =) <u>Animalia</u>            (Genus =) <u>Oryctolagus</u>            (Species =) <u>cuniculus</u> (domesticus)</p>	2	2.1	<p>2 or 3 correct = 1 mark            4 correct = 2 marks</p>
4	(b)	(i)			
			3	2.4 2.8	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 3.83 award three marks</b></p> <p>(squared differences = 4, 25, 16, 1)            divided by 12 = 0.333, 2.08, 1.33, 0.083 ✓</p> <p><math>\Sigma = 3.8333333333 \checkmark</math></p> <p>to 3 significant figures = 3.83 ✓</p> <p><b>ALLOW</b> ECF or correct addition of values where candidates have used inconsistent dp/sf when recording correctly calculated values for mp1 (as this MP is for correctly substituting values into formula and calculating the value of chi squared)</p> <p><b>ALLOW</b> ECF for final answer recorded to 3sf from mp2 (as this MP is for the skill of correct use of significant figures)</p>

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4	(b)	(ii)	<p>calculated value / 3.83, is lower than, critical value / 7.82, at 3 degrees of freedom ✓</p> <p>(so there is) no significant difference at, <math>p = 0.05</math> ✓</p> <p>(indicates) greater than 95% confidence, that difference is due to <u>chance</u> ✓</p> <p>null hypothesis can be accepted (at <math>p = 0.05</math>) <b>ora</b> ✓</p>	3 max	3.1 3.2	<p><b>ACCEPT ECF for incorrect answer to 4(b)(i)</b> e.g. if calculated value is greater than 7.82, award marks for the reverse arguments (i.e. is significant at <math>p = 0.05</math>, difference is not due to chance, and null hypothesis can be rejected)</p> <p><b>ALLOW</b> 'student's chi-squared value lower than critical value for 3 degrees of freedom'</p> <p><b>ALLOW</b> 'greater than 5% probability that difference is due to <u>chance</u>'</p>
4	(c)		<p><i>Correct use superscript is required as given in the Q stem</i></p> <p><math>C^F C^A / C^A C^F</math> ✓ <math>C^S C^A / C^A C^S</math> ✓</p>	2	2.6 2.8	
4	(d)	(i)	pedigree analysis ✓	1	1.2	<b>IGNORE</b> 'study the pedigree' (as command word is name)

4	(d)	(ii)	<p><b>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</b></p> <p><b><i>In summary:</i></b>  <i>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, <b>Level 1</b>, <b>Level 2</b> or <b>Level 3</b>, best describes the overall quality of the answer.  Then, award the higher or lower mark within the level, according to the <b>Communication Statement</b> (shown in italics):</i></p> <ul style="list-style-type: none"> <li><i>○ award the higher mark where the Communication Statement has been met.</i></li> <li><i>○ award the lower mark where aspects of the Communication Statement have been missed.</i></li> </ul> <p><b>• The science content determines the level.</b>  <b>• The Communication Statement determines the mark within a level.</b></p>			
			<p><b>Level 3 (5-6 marks)</b>  Detailed methods for observing and identifying cells may include reference to safety.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3-4 marks)</b>  Methods for observing and identifying cells, with one of the methods given in detail.</p> <p><i>There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1-2 marks)</b>  Method for either observing or identifying cells.</p>	<b>6</b>	1.2 2.7	<p><b>Indicative scientific points may include (but are not limited to):</b></p> <p><i>General</i></p> <ul style="list-style-type: none"> <li>• <i>safety consideration e.g. named hazard, level of risk and precaution</i></li> </ul> <p><i>Observation method</i></p> <ul style="list-style-type: none"> <li>• use <u>light</u> microscope</li> <li>• prepare blood smear (to view under the LM)</li> <li>• <b>detail</b> of blood smear preparation (e.g. sterile microscope slide, use of spreader, use of fixative)</li> </ul>

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		<p><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></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>			<p><i>Identification method</i></p> <ul style="list-style-type: none"> <li>• use of, <u>differential</u> staining</li> <li>• correctly named stain (e.g. Leishman's)</li> <li>• <b>detail</b> of staining (e.g. distinguishing different types of leucocytes)</li> <li>• <b>detail</b> of distinguishing leucocytes (e.g. lobed nuclei in neutrophils vs large nucleus in lymphocytes)</li> <li>• use of, flow cytometry</li> <li>• <b>detail</b> of flow cytometry (e.g. sorting by mass / density, shape)</li> </ul>
<b>4</b>	<b>(e)</b>	<p>(to ensure) oxygenated and deoxygenated blood do not mix ✓</p> <p><i>idea that</i> blood pressure in the separate circuits, can be <u>maintained</u> at different pressures ✓</p> <p><u>increased</u> efficiency / <u>more</u> efficient, delivery of, oxygen / nutrients, to the, cells / tissues / organs ✓</p>	<b>2 max</b>	1.1	ALLOW 'more efficient...' as AW for 'increased'

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