GCE

Biology B

H422/02: Scientific literacy in biology

A Level

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

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 space

   Award 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 **1(d)** and **5(c).**

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
I	Ignore
BP	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)	(i)	(named) substance (on surface of pathogen) that , stimulates / initiates, an immune response ✓	1	1.1	**ALLOW** toxin / protein / polypeptide / glycoprotein / lipoprotein for named substance **ALLOW** correctly named example of immune response e.g. release of cytokines by T-lymphocytes **ALLOW** epitope binds to paratope and stimulates immune response **DO NOT ALLOW** 'used for' an immune response **DO NOT ALLOW** 'something' that…
1	(a)	(ii)	combining different constant and (hyper)variable regions produces a different antibody / AW ✓ antigen binding site consists of $\underline{V_L}$ and $\underline{V_H}$ ✓ fragments / Fab / scFv / antibodies / Igs , formed by combining different V_L and V_H ✓	max 2	2.1 2.1 2.1	**IGNORE** combining genes **ALLOW** epitope for antigen **ALLOW** idea that $\underline{V_L}$ and $\underline{V_H}$ are complementary to the epitope / antigen **IGNORE** combining genes e.g 'combining different V_L and V_H with different constant regions produces different antibodies' = **MP1** and **MP3**
1	(a)	(iii)	C_H3 ✓	1	2.1	

Question			Answer	Marks	AO Element	Guidance
1	(b)	(i)	mouse antibodies are (recognised as) , foreign / non-self ✓ (mouse antibodies) will stimulate , HAMA / immune / inflammatory / allergic , response ✓ (fully) human / humanised , antibodies will reduce , HAMA / immune / inflammatory / allergic , response ✓	**max 2**	2.1 2.1	**ALLOW** ora **DO NOT ALLOW** reverse argument Only award in context of mouse antibodies **ALLOW** alternative wording e.g. there will be no allergic response with human antibodies Only award in context of human antibodies
1	(b)	(ii)	*effective as agglutinating / neutralizing because* (Fab / scFv , fragments) can bind to antigens **and** block , adhesion / entry of pathogens into cells ✓ *less effective as opsonins / activation of complement because* (Fab / scFv , fragments) lack (full) constant region ✓ (all) constant region is required for , opsonisation / binding to phagocytes / activation of complement ✓	**max 2** 2.1 2.1 2.1		**ALLOW** e.g. (Fab) can bind to antigens and begin agglutination / clump pathogens together **ALLOW** paratope for variable region **DO NOT ALLOW** can bind to active site of pathogen **ALLOW e.g.** C_H2 and C_H3 parts required for , opsonisation / binding to phagocytes / activation of complement

Question			Answer		Marks	AO Element	Guidance
1	(c)	(i)			max 3		**IGNORE** amino acid sequence is complementary – must be structure of mAb
			1	*idea that* mAbs specifically target cancer cells ✓		2.1	
			2	(mAbs) deliver / attach to , anti-cancer (pro-) drugs / radioisotopes ✓		2.1	**MP2 ALLOW** correct reference to ADEPT
			3	use of , mAb conjugate / liposome , to deliver (cytotoxic pro-) drug ✓		2.1	e.g. deliver a cytotoxic pro-drug using a mAb-enzyme conjugate = **MP2** and **MP3**
			4	(mAbs) bind to (cell-surface) receptors ✓		2.1	**MP4 IGNORE** proteins unqualified
			5	(and) inhibit cell division ✓		2.1	**MP5 ALLOW** block / inhibit , growth factors
			6	correct reference to marking cells for destruction ✓		2.1	**MP5 ALLOW** stimulate apoptosis

1	(c)	(ii)			max 3		**IGNORE** reference to increased survival time **IGNORE** responses based on mechanism of action / details of drug development process
				supporting justification for high costs: ***max 2 from***			
			1	may be no other treatments for advanced cancer ✓		3.2	
			2	(therapeutic mAbs) are (proven to be) effective ✓		3.2	
			3	may have few(er) side-effects ✓		3.2	
			4	*idea that* it is hard to put a value on human life / additional survival time may be valuable for patients ✓		3.2	**MP4 ALLOW** e.g. may improve mental wellbeing
				undermining justification for high costs: ***max 2 from***		3.2	
			5	increase in survival time may be (very) short ✓			**MP5 ALLOW** e.g. patients may not have prolonged life
						3.2	
			6	money may be better spent on , other / more cost-effective , treatments ✓		3.2	**MP6 IGNORE** better spent on new drugs / research
			7	*idea of* health inequality / affordability (of treatments) ✓			

<table>
<tr><td>1</td><td>(d)*</td><td></td><td colspan="4">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 italics):
○ 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.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5–6 marks)

A comprehensive account that covers the role and interrelationship of different types of T cells, B cells and memory cells in development of long-term immunity.

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

An account of the role some types of cells, or a superficial account of T cells, B cells and memory cells. Some idea of the development of long-term immunity.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

A superficial account of one of the types of cell involved but with no clear connection to long-term immunity.</td><td>6</td><td></td><td>Loss of communication mark for incorrect science e.g. T killer cells kill pathogens

Indicative scientific content

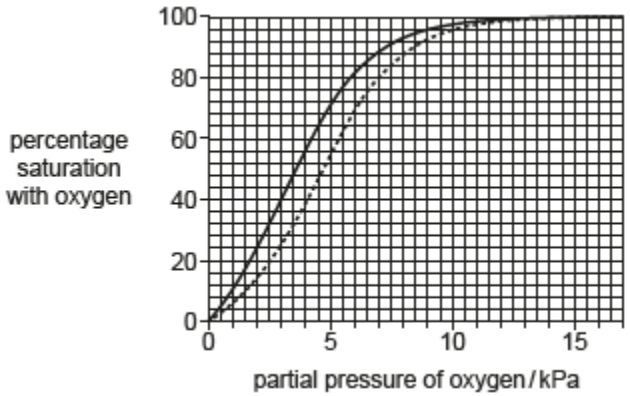
Role of T cells
• Macrophages / dendritic cells / antigen presenting cells (APCs)
• Clonal selection of T cells through complementary receptors.
• Clonal expansion of T cells.
• Role of cytokines in activation of B cells.
• Role of cytotoxic T cells / killer T cells.
• Role of regulatory T cells

Role of B cells
• B cells act as APCs
• Clonal selection of B cells through complementary receptors.
• Clonal expansion of B cells.
• Differentiation into plasma cells / antibody secreting cells.</td></tr>
</table>

			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response or no response worthy of credit.*			**Function of memory cells** • (T and B) memory cells formed by differentiation. • Able to survive many years / decades. • Description of secondary response. • Destruction of pathogen before it can reproduce / cause symptoms.

Question			Answer	Mark	AO Element	Guidance
2	(a)	(i)	maximum rate at which oxygen can be taken in and , used / utilised ✓	1	1.1	**ALLOW** maximum volume of oxygen that can be taken up and utilised in , given time period / one minute **ALLOW** metabolised for utilised
2	(a)	(ii)		3 max		**IGNORE** references to *estimation* of VO_2 max, e.g. using heart rate
			graded exercise test / progressive increase in intensity of exercise ✓		1.2	**ALLOW** description, e.g. exercise bike / running on treadmill at increasing intensity **ALLOW** GXT for graded exercise test
			measure ventilation rate ✓		1.2	**ALLOW** measure breathing rate
			measure O_2 and CO_2 concentration of inhaled **and** exhaled air / AW ✓		1.2	**ALLOW** e.g. measure concentration of gases in inspired and expired air
			VO_2 max is when oxygen consumption remains steady when , workload / intensity, increases ✓		1.2	

2	**(b)**	**(i)**	***evidence supporting the conclusion: max 2***	**max 3**		**IGNORE** references to young subjects because they do not have a low starting aerobic fitness
			negative correlation (between initial VO_2 max and percentage increase) ✓		3.2	**ALLOW** description of negative correlation
			increase in VO_2 max indicates increased aerobic fitness ✓		3.2	
			all (statistically significant) increases were subjects with low initial VO_2 max ✓		3.2	
			evidence undermining the conclusion: max 2			
			secondary data used ✓		3.2	**ALLOW** description of secondary data
			no information about the , size / methodology , of the studies ✓		3.2	
2	**(b)**	**(ii)**	(increase in muscle mass) would lead to greater O_2 consumption ✓	**1**	2.1	**ALLOW** more mitochondria / more aerobic respiration **IGNORE** references to myoglobin

2	**(c)**	**(i)**	 curve shown to the right of the given curve ✓	**1**	2.1	Curve should be relatively sigmoid in shape Curve must start at same value (0) and finish at same point as given curve
2	**(c)**	**(ii)**	decrease in affinity of , haemoglobin / Hb , for oxygen ✓ more oxygen is released, in the tissues / at low pO_2 ✓ (more oxygen) available for aerobic respiration ✓ higher rate of respiration (maintained) ✓	**max 2**	2.1	**ALLOW** e.g. greater dissociation of oxyhaemoglobin / oxygen can more readily dissociate , in tissues

Question			Answer	Mark	AO Element	Guidance
3	(a)	(i)	**A** ✓	**1**	2.1	
3	(a)	(ii)	*fluid because* (named) component(s) can move , within / between , the bilayer(s) ✓ *mosaic because* (glyco- / lipo-) proteins are arranged , randomly / like a mosaic ✓	**2**	1.1 1.1	**ALLOW** e.g. proteins arranged in scattered pattern
3	(a)	(iii)	attracts (further) , macrophages / phagocytes ✓ activates / causes proliferation of , lymphocytes ✓ stimulates / increases rate of , phagocytosis ✓	**2**	2.1 2.1	**ALLOW** B cells / T cells for lymphocytes
3	(b)	(i)	phylogeny ✓	**1**	1.1	**ALLOW** phylogenetics
3	(b)	(ii)	(comparison of) DNA / mRNA, sequences ✓ (comparison of) amino acid sequences ✓ (comparison of) protein structures ✓ *idea that* greater similarity in sequences means the more closely related / **ora** ✓	**max 2**	2.1 2.1 2.1 2.1	**IGNORE** references to mtDNA / anatomical / fossil / behavioural / embryological evidence (as question refers to TLRs) **ALLOW** DNA barcodes **ALLOW** immunological evidence (described)

Question				Answer	Mark	AO Element	Guidance
3	(b)	(iii)		*Supporting the conclusion:*	max 3		
			1	supported by , anatomical / behavioural , evidence ✓		3.1	**IGNORE** even number of toes / herbivory unqualified
			2	cetaceans are aquatic but , all other ungulates / camels and ruminants , live on land ✓		3.1	
				undermining the conclusion:			
			3	cetaceans and ruminants are , most / more , closely related ✓		3.1	**EITHER MP3 and 4 OR MP5 and 6**
			4	(because) they share the most recent common ancestor ✓		3.1	**IGNORE** direct ancestor unqualified
				OR		3.1	
			5	camels and ruminants are , least / less , closely related ✓		3.1	**IGNORE** shared branching / least number of shared ancestors for common ancestor
			6	(because) they have the least recent common ancestor ✓			

Question			Answer	Mark	AO Element	Guidance
4	(a)	(i)	**E** = motor neurone ✓ **F** = sensory neurone ✓	**2**	2.1 2.1	
4	(a)	(ii)	it prevents contraction of , opposing / antagonistic , muscle ✓	**1**	2.1	**IGNORE** prevents contraction unqualified
4	(a)	(iii)	(because they allow) rapid / fast(er) , responses to <u>stimuli</u> ✓ (because they are) involuntary / unconscious, responses ✓ suitable example of stimulus that could threaten survival ✓	**max 2**	1.1	**IGNORE** fright, fight or flight response **ALLOW** innate / automatic , responses e.g. heat / pain could cause injury e.g. prevents damage / injury caused by hot objects e.g. blink reflex prevents damage to eye
4	(b)	(i)	does not involve , measurement / collection , of <u>quanti</u>tative data ✓ depends on the interpretation of the observer / AW ✓ correct named example of limitation ✓	**max 2**	2.3 2.3 2.3	**ALLOW** it is not quantitative / is qualitative **ALLOW** it is , subjective / not objective e.g. differences in hammer force e.g. assessors may give different scores (for the same response) e.g. variation in assessor scoring

4	**(b)**	**(ii)**	measure the speed of the response ✓ measure degree of , movement / knee jerk ✓ *idea of* ensuring hammer blow is same strength ✓ measure reaction times in different patients ✓	**max 3**	3.3 3.3 3.3	 **ALLOW** time the response **ALLOW** e.g. use machine to keep 'tap' force the same
4	**(c)**	**(i)**	there is no (significant) difference in <u>mean</u> reaction times (between male and female students) **OR** difference in <u>mean</u> reaction times is due to chance ✓	**1**	2.4	**DO NOT ALLOW** between males / between females **ALLOW** group 1 for males and group 2 for females **CON** correlation, gender
4	**(c)**	**(ii)**	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer t = 2.57, award 3 marks** $t = \frac{\lvert 183.3 - 203.7 \rvert}{\sqrt{\frac{(18.264)^2}{10} + \frac{(17.2694)^2}{10}}}$ ✓ $t = \frac{20.4(0)}{\sqrt{63.18}}$ ✓ = 2.57 ✓	**3**	2.4 2.4 2.4	**For 3 marks** **ALLOW** any number of d.p. / sig. figs. (calculator value of 2.56649 correctly rounded) **ALLOW** 2.56 if candidate has rounded SDs to 18.3 and 17.3 **If answer is incorrect** **ALLOW** for **2 marks** $t = = \frac{20.4(0)}{\sqrt{63.18}}$ **OR** *t* = 2.43 (use of n = 9) **OR** *t* = –2.57 (no MOD in numerator) **ALLOW** for **1 mark 63.18** seen anywhere if no other calculation seen

4	**(c)**	**(iii)**	null hypothesis can be rejected ✓ (because) calculated *t* value higher than , 2.10 / critical value for 18 degrees of freedom ✓ there is <5% probability (p<0.05) that difference is due to chance ✓	**max 2**	2.4 2.4	**ALLOW** ECF for incorrect value for *t* calculated in **(c)(ii)** **ALLOW** value circled in table for '18 degrees of freedom' **ALLOW** ECF from incorrect value for degrees of freedom **ALLOW** >95% probability that the difference is, significant / not due to chance
4	**(c)**	**(iv)**	*idea that* there is more variability in the participants (in group 3) ✓	**1**	3.2	**ALLOW** greater variation amongst participants (in group 3) **IGNORE** variance / deviations / mean **IGNORE** greater range of data
4	**(c)**	**(v)**	(there might be a) greater range of , ages / health / nerve damage (in group 3 subjects) ✓	**1**	3.2	

Question			Answer	Mark	AO Element	Guidance
5	(a)	(i)	*control* (labelled) antibodies that do not have , LH / antigens , attached ✓ *test* (labelled) antibodies that have , LH / antigens , attached ✓	2	2.5 2.5	
5	(a)	(ii)	because the (labelled) antibody has not moved , along / up , the strip ✓	1	2.5	
5	(b)		***Males** (**any one from**):* abnormal sperm / failure to develop properly ✓ production of antibodies that destroy sperm ✓ blockage of the sperm ducts ✓ low sperm count ✓ AVP ✓ ***Females (any one from):*** ovulation disorder / failure to ovulate / low hormone levels ✓ production of antibodies that destroy sperm (in uterus) ✓ blockage of , oviducts / fallopian tubes ✓ endometriosis ✓ AVP ✓	max 2	1.1 1.1	**IGNORE** vasectomy / hysterectomy e.g. advanced prostate cancer / cystic fibrosis / erectile dysfunction **ALLOW** description of endometriosis e.g. development of uterine lining outside uterus e.g. hormone imbalance e.g. early menopause

<table>
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• The science content determines the level.
• The Communication Statement determines the mark within a level.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5–6 marks)

A comprehensive discussion of treatments for infertility, including of both male and female origin, that includes discussion of ethical issue(s) and risk(s) and benefit(s).

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

A discussion of treatments for infertility of male or female origin, that includes a discussion of ethical issue(s) and risk(s) OR benefits.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

A basic discussion of treatments for infertility and may identify an ethical issue or benefit or risk.</td><td>6</td><td>1.1

1.1

3.2</td><td>Loss of communication mark for incorrect science e.g in IVF sperm must come from a donor

Indicative scientific content
Treatments (some detail needed not just the acronym)
• IVF
• Frozen embryo replacement
• ICSI
• GIFT
• ZIFT
• Artificial insemination (from male partner or donor)
• Intrauterine insemination
• Surgical sperm retrieval
• Ovulation induction

Risks
• Multiple births (IVF or ovulation induction)
• Increased risk of miscarriage / stillbirth / maternal mortality
• Uterine cramping (with intrauterine insemination)
• Some are highly invasive procedures</td></tr>
</table>

			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response or no response worthy of credit.*		3.2	• Low success rate • Congenital defects / pass on genes for non-motile sperm with ICSI **Benefits** • Infertility may affect mental health • Infertility may affect personal relationships • pre-implantation screening for inherited disorders • opportunity to have a biological child (rather than adopt) **Ethical issues** • IVF produces 'spare' embryos that must be destroyed • Children born from donated sperm may not know / be told their genetic background • Embryo research into assisted fertilisation • Diverts resources from other areas • Physically / mentally stressful • Requires time / resources • ICSI has increased risk of autism

Question			Answer		Mark	AO Element	Guidance
6	(a)	(i)	(the point / light intensity at which) carbon dioxide released in respiration equals that taken up in photosynthesis ✓		1	1.2	**ALLOW** rate of photosynthesis = rate of respiration
6	(a)	(ii)	**1**	light intensity is low(er) (in winter) ✓	max 3	1.1	**MP1 IGNORE** light unqualified, e.g. less sunlight
			2	light duration is low(er) (in winter) ✓			**MP2 IGNORE** 'days are short' **MP2 ALLOW** e.g. daylight is limited
			3	*idea that* at low light intensity respiration is faster than photosynthesis ✓		2.5	**MP3 ALLOW** rate of photosynthesis must be greater than rate of respiration for plants to grow
			4	(artificial light means that) compensation point will have been reached ✓			**MP4** should be in context of artificial light **MP4 ALLOW** e.g. in artificial light the rate of photosynthesis will be greater than rate of respiration / ORA
			5	(so there will be) more , energy / sucrose , for growth ✓			
			6	correct reference to data with units ✓			e.g above 900 AU CO_2 uptake is 8 µmol m^{-2} s^{-1}

6	(b)	(i)		*(for both plants)*	**max 4**		*explanation (**E**) and step (**S**) **must** match*
			S1	light intensity should be the same ✓			
			E1	because light intensity affects rate of photosynthesis but not respiration ✓		2.7	**E1 ALLOW** light source at same distance
			S2	temperature should be the same ✓			
			E2	because temperature affects rate of respiration more than photosynthesis ✓			
			S3	the length of exposure to light should be the same ✓			
			E3	to ensure that photosynthesis **and** respiration are occuring ✓			**E3 ALLOW** correct reference to photorespiration occurring above 25°C
			S4	same volume of leaf extract ✓			
			E4	idea that number / density , of chloroplasts will be the same ✓			
			S5	same , volume / concentration, of indicator solution ✓			**S5 DO NOT ALLOW** amount for volume / concentration
			E5	*idea that* this could affect the colour change ✓			

6	(b)	(ii)	***supporting the conclusion - max 2*** (purple) colour of indicator with plant **J** suggests that more carbon dioxide is being used than produced ✓ plant **J** has a lower compensation point / at compensation point plant **J** has a higher rate of photosynthesis ✓ (so) plant **J** would grow faster (in winter) ✓ ***undermining the conclusion*** no information about the light intensity used (so may not be relevant to winter conditions) ✓ *idea that* results may not apply to actual conditions (*in situ*) ✓	**max 4**	3.2 3.2 3.2 3.2 3.2	**ALLOW** (yellow) colour of indicator for plant **H** suggests that more carbon dioxide is being produced than used **ALLOW** ORA for plant **H** **ALLOW** ORA for plant **H**

Question			Answer	Mark	AO Element	Guidance
7	(a)	(i)	curve has not , completely flattened off / reached a plateau ✓ (but) it is possible to , extrapolate / extend / continue , the curve (to make an estimate) ✓	2	3.2 3.2	
7	(a)	(ii)	FEV_1 for **K** = 4.0 **and** L = 1.2 **and** VC for **K** = 5.2 ✓ correct calculation of FEV_1 to VC ratio for **K** **OR** estimate of FEV_1 to VC ratio for **L** ✓ (so) **K** is normal **/ L** has COPD ✓	3	3.1 3.1 3.1	**K** = 4/5.2 = 0.77 **L** = 1.2/(any value >4.65), e.g 1.2/4.7 = 0.26 **ALLOW ECF for MPs 2** and **3** if incorrect values read from graph **MP3** must show evidence of calculation even if incorrect
7	(a)	(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 23 (.4) award 2 marks** rearrangement of formula: $age = \frac{(4.3 \times height) - 2.49 - FEV_1}{0.029}$ **OR** $age = \frac{(4.3 \times 1.76) - 2.49 - 4.4}{0.029}$ ✓ correct calculation age = 23 (.4) (years) ✓	2	2.6 2.6	

7	(b)	(i)	***1*** to protect yourself **and** the patient ✓ ***2*** to move the tongue from the back of the throat / to open the airway ✓ ***3*** to check that airway is , clear / not obstructed ✓ ***4*** to ensure that the brain is not starved of oxygen ✓	**4**	2 x 1.2, 2 x 2.1	**IGNORE** avoid infection / prevent contamination **ALLOW** 'avoid choking' **ALLOW** to check if air is reaching lungs **ALLOW** to avoid risk of brain death if starved of oxygen
7	(b)	(ii)	use mouth-to-nose and mouth / cover both mouth and nose ✓ reduce , force / volume, of breath ✓	**max 2**	2.1 2.1	**IGNORE** changes to CPR **ALLOW** use 'puffing' or 'frog breathing' method
7	(c)		ribosomes transport Golgi (body / apparatus) secretory exocytosis cytoskeleton / microtubules / microfilaments ✓✓✓✓	**max 4**	4 x 1.2	**6 correct** = 4 marks **5 correct** = 3 marks **4 or 3 correct** = 2 marks **2 correct** = 1 mark **1 or 0 correct** = 0 marks **IGNORE** transportation

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