Oxford Cambridge and RSA

GCE

Biology A

H420/03: Unified biology

A Level

Mark Scheme for June 2022

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 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 50% 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. Work crossed out:

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 email.

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 **3cii** and **4c**.

11. Annotations available in RM Assessor

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

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

Annotation	Meaning
/	alternative and ALLOWable 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 ALLOWed
( )	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	Mark	AO	Guidance
1	(a)		(R) opsonin ✓ (S) agglutinin ✓ (T) anti-toxin ✓	3	2.5	**ALLOW** R = opsonisation / opsonising **ALLOW** S = IgM / agglutin / agglutanin / agglutination / agglutinising / agglutinator **ALLOW** T = neutralisation / neutralising **IGNORE** detoxifyinig
1	(b)		autoimmune ✓	1	2.1	**ALLOW** autoimmunity
1	(c)		*in the heart disease ECG* *idea of* QRS (complex) closer together ✓ *idea of* inconsistent gaps between, QRS / ventricular systoles ✓ *idea of* more / no clear, P waves / atrial systoles ✓ *idea of* no clear, T (peak) / diastole ✓	2 max	2.1	**Assume answer refers to the heart disease ECG unless otherwise stated.** **Ora for *in the normal heart ECG*** e.g ventricular systoles closer together / more QRS waves / higher heart rate / more heart beats / tachycardia e.g. irregular heart beat / arrhythmia e.g. atria contract more often / atrial fibrillation / more / larger, P peaks / atrial systoles / no gap between P and Q **IGNORE** 'no P wave' e.g. no clear T section / T peaks are different sizes / no gap between, T and P / S and T **IGNORE** 'no T wave' / 'T wave more frequent'
1	(d)	(i)	more adenylyl cyclase ✓ on, cell surface / plasma, membranes ✓ more, cAMP / second messenger, produced ✓ *idea of* adrenaline has greater effect on heart cells ✓ *idea of* improved contraction of, cardiac muscle / heart ✓	2 max	2.5	**ALLOW** more, adenyl / adenylate, cyclase / enzyme e.g. increases responsiveness to, adrenaline / noradrenaline e.g. greater heart rate / increased contraction **IGNORE** 'improved heart function' alone as in question stem **IGNORE** ' heart pumps blood more efficiently'

1	**(d)**	**(ii)**	virus / viral vector ✓ liposome ✓	**1 max**	1.2	**ALLOW** plasmid / yeast artificial chromosome / YAC **IGNORE** 'injection' unqualified
1	**(d)**	**(iii)**	*idea of* to share knowledge (with other scientists) ✓ *idea of* to allow validation of new knowledge ✓	**1 max**	2.1	e.g. allow others to repeat the procedure / others can compare results with their own **IGNORE** 'peer review with other scientists' / 'to prevent bias' unqualified e.g. to ensure the integrity of scientific results / check if results are reproducible / to evaluate the results
2	**(a)**	**(i)**	(X) (T or B) lymphocyte ✓ (Y) neutrophil ✓	**2**	2.3	**ALLOW** T cell / B cell / T helper cell / T killer cell / T regulator cell **ALLOW** phagocyte
2	**(a)**	**(ii)**	flattened / biconcave (shape), to increase surface area (to volume ratio) ✓ no, nucleus / organelles, to give (more) space for haemoglobin ✓ flexible, to increase surface area in contact with <u>capillary</u> wall / to squeeze through <u>capillaries</u> ✓ small, for short diffusion pathway / to fit through <u>capillaries</u> ✓ transport proteins in plasma membrane, to allow chloride shift ✓ high concentrations of carbonic anhydrase (inside cells), to allow transport of carbon dioxide / described ✓	**2 max**	1.1 2.1	**IGNORE** concave **ALLOW** few organelles so more haemoglobin can be in the cell **IGNORE** to give (more) space for oxygen 'cells are small and flexible to fit through capillaries' = 2 marks

2	**(a)**	**(iii)**	**FIRST CHECK ON ANSWER LINE** **If answer = 13 award 2 marks** 10 mm / 800 (= 0.0125mm) ✓ 0.0125mm x 1 000 (= 12.5µm) ✓	**2**	2.8	**ALLOW** 12.5 for 2 marks **ALLOW** answer to more than 3 s.f. for 1 mark **ALLOW ECF** if incorrect measurement of cell W **with units** used but divided by 800 for 1 mark **or** measurement of cell W **with units** correctly converted to µm for 1 mark **ALLOW** 0.01m / 800 (= 0.0000125m) **and** 0.0000125m x 1 000 000 (= 12.5µm) **ALLOW** 1cm / 800 (= 0.00125cm) **and** 0.00125 x 10 000 = (12.5µm) **If candidate measures cell W as 9.5 mm** **ALLOW 12 /11.9 for 2 marks and 11.88/11.875 for 1 mark** **If candidate measures cell W as 10.5 mm** **ALLOW 13 /13.1 for 2 marks and 13.13 / 13.125 for 1 mark**
2	**(b)**	**(i)**	digests / hydrolyses / destroys / kills / breaks down, pathogens ✓	**1**	1.1	**IGNORE** 'get rid of pathogens' **IGNORE** ref to antigens **ALLOW** ref to parasites / damaged cells / tumour cells / old cells / old organelles for 'pathogens' **DO NOT ALLOW** 'engulf pathogens'
2	**(b)**	**(ii)**	**FIRST CHECK ON ANSWER LINE** **If answer = 2 x 10^{-5} award 2 marks** 1.3 x 10^{-21} / 6.5 x 10^{-14} = 2 x 10^{-8} (mol cm^{-3}) ✓ 2 x 10^{-8} (mol cm^{-3}) x 1000 = 2 x 10^{-5} (mol dm^{-3}) ✓	**2**	2.2	**ALLOW** 0.00002 for 2 marks **ALLOW 'x** 1000' seen anywhere in the answer
2	**(b)**	**(iii)**	(-log 0.00002 =) 4.7 ✓	**1**	2.2	**This mark is for a correct calculation**, therefore **ALLOW ECF** from part (ii) if the pH value calculated is given to 2 sig figs, even if outside the normal pH range, including correctly calculated negative values

2	**(b)**	**(iv)**	B ✓	**1**	3.1	**Apply ECF from part (iii)** **ALLOW** B if calculated pH is less than 7 **ALLOW** A if calculated pH is greater than 7 **ALLOW** C if calculated pH is 7. **ALLOW** B if no pH calculation given in (iii) **ALLOW** answer if shown on table if no answer given on answer line
2	**(c)**		*step 1 add crystal violet* *step 2 add iodide solution* *step 3 add alcohol / ethanol* *step 4 add safranin* All steps in correct order ✓✓ 3 steps in correct order ✓	**2**	3.3 3.4	**ALLOW** iodine for iodide
2	**(d)**	**(i)**	*L = artery because* small(er), diameter / lumen ✓ thick(er) layer of, (smooth) muscle / elastic tissue / elastin ✓ *idea of* lumen is more open ✓ tunica intima / endothelium, folded ✓	**2 max**	2.1	**DO NOT ALLOW** mark points if L identified as vein or not identified at all **ALLOW** narrow(er) lumen **ALLOW** greater proportion of, muscle / elastic tissue /elastin (than veins) **ALLOW** thick(er) tunica media / thick(er) wall **ALLOW** 'less flattened' than veins
2	**(d)**	**(ii)**	collagen ✓	**1**	2.1	

3	**(a)**		D: select stem with no flowers / remove flowers from stem ✓ E: *idea of* encourage root growth / reduce water loss ✓ D: remove most leaves / reduce leaves to 1-4 / cover with a plastic bag ✓ E: *idea of* reduce, water loss / transpiration ✓ D: (use) aseptic techniques / sterilise equipment / sterilise stem ✓ E: *idea of* stop, infection / contamination ✓ D: use propagator / propagation box / greenhouse ✓ E: *idea of* control, (optimum) temperature / humidity / moisture ✓ D: do not overwater compost ✓ E: *idea of* to allow air, to reach roots / for root respiration ✓	**3 max**	3.3	**Explanations (E) can be awarded only with a correct Description (D) mark.** **Max 2 for descriptions alone** e.g. more energy for roots to grow **DO NOT ALLOW** 'stops water loss'
3	**(b)**	**(i)**	10^{-5} (mol dm^{-3}) ✓	**1**	2.8	**ALLOW** answers in range 9×10^{-6} to 1×10^{-5} (mol dm^{-3})
3	**(b)**	**(ii)**	repeat measurements (for that concentration) ✓	**1**	2.7	**IGNORE** 'repeat the experiment' unqualified

3	**(b)**	**(iii)**	*Apical shoots* **at** high(er) auxin concentrations / from 10^{-9} (to 10^{-4} mol dm^{-3}) , apical growth / apical dominance is, stimulated / increased ✓ (apical shoot growth) peaks at 10^{-5} (mol dm^{-3}) ✓ *Idea of* very high concentrations of auxin inhibit apical (shoot) growth ✓ *lateral shoots* **at** low(er) auxin concentrations / from 10^{-11} (to 10^{-7} mol dm^{-3}), lateral (shoot) growth is , stimulated / increased ✓ **at** high(er) auxin concentrations / above 3 x 10^{-7} (mol dm^{-3}), lateral (shoot) growth is inhibited ✓	**3 max**	3.1	**IGNORE** units throughout **ALLOW** any value within this range. **IGNORE** 'as auxin concentration increases apical growth increases' **without ref** to 'high / higher auxin concentration' **or** correct data quote e.g. apical (shoot) growth is inhibited at 10^{-3} (mol dm^{-3}) **ALLOW** any value within this range. 'at high auxin concentrations, apical dominance is greatest and lateral shoot growth is inhibited' = 2 marks (mp1 and 5)
3	**(c)**	**(i)**	mm h^{-1} **or** cm h^{-1} **or** mm d^{-1} **or** cm d^{-1} ✓	**1**	3.3	**ALLOW** 'day' for 'd' 'hour' for 'h' **DO NOT ALLOW** s / secs/ seconds /min / minutes **ALLOW** '/' for $^{-1}$ **IGNORE** 'per' **DO NOT ALLOW** use of both $^{-1}$ and '/' together

<table>
<tr><td>3</td><td>(c)</td><td>(ii)</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)
Comprehensive outline of a valid experimental method, including details of all three types of variable, and statistical analysis for the investigation.

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)
The answer contains detailed reference to variables and statistical analysis for the investigation.

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

Level 1 (1-2 marks)
The answer contains brief reference to a variable or statistical analysis for the investigation.

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.

0 marks
No response or no response worthy of credit.</td><td>6</td><td>3.3
3.4</td><td>Indicative scientific points may include (but are not limited to):

AO3: To develop and refine practical design and procedures

Experimental method
Validity
• Details of sample sizes and repeats
• Details of group design (e.g. two groups: one without additional gibberellin, or several groups receiving different gibberellin concentrations, plus a control group)
• Details of gibberellin application
Variables
• Details of control variables (e.g. plant/seedling size, water availability, light, temperature)
• Details of the independent variable (varying gibberellin concentrations)
• Details of the measurement of the dependent variable (measurement of stem length)</td></tr>
</table>

						Statistical analysis • Idea of identifying anomalies • Mean calculations • Standard deviation • Statistical testing (e.g. t-test if two groups are used, or Spearman's rank/Pearson correlation test if a range of concentrations are used)
3	**(d)**		ethene , promotes / AW , fruit ripening ✓ concentration of ethene / stage of apple development , needs to be known ✓ *idea that* use of ethene to ripen fruit (normally) needs controlled conditions ✓ ethene is a gas **AND** *idea that* it will not be effective outside ✓ ethene promotes fruit dropping (therefore apples may fall to the ground and be damaged) ✓	**3 max**	3.2	**ALLOW** ethene promotes fruit maturing **ALLOW** using too much ethene may make the apples too ripe / ethene will affect different fruits at different rates (due to varying stages of development or time of year used) e.g. ethene is usually applied at a particular temperature e.g. ethene should be applied in closed conditions e.g. ethene should be released gradually e.g. ethene gas would diffuse away in the air and not land on the fruit **IGNORE** ' spraying a gas would be ineffective' **ALLOW** ethene promotes (fruit) abscission **IGNORE** leaf abscission

4	**(a)**	**(i)**	large surface area to volume ratio ✓ *idea that* it can obtain all required substances (largely) through diffusion ✓ low metabolic rate ✓	**1 max**	2.1	**IGNORE** small size e.g. 'diffusion pathway is short' / 'diffusion alone is sufficient'
4	**(a)**	**(ii)**	closed / described ✓ single / described ✓	**2**	2.1	
4	**(b)**		*idea that* sponges produce, genetically identical offspring / clones ✓ *idea that* shark offspring will not be, genetically identical / clones ✓ shark offspring have alleles from only, the mother / one parent ✓ (but) crossing over / independent assortment, (in meiosis) creates, new allele combinations / genetic variation ✓	**max 3**	3.2	e.g. offspring of sponges share same, DNA / genome / genetic material **IGNORE** 'similar DNA' 'only sponges, produce clones of themselves / share same DNA' = 2 marks **ALLOW** 'shark offspring have, DNA / genetic material, only from the mother' **IGNORE** 'changes the DNA'

<table>
<tr><td>4</td><td>(c)</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)
Detailed descriptions of both embryo splitting and somatic cell nuclear transfer.

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 detailed description of one method and an outline of the other method.

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

Level 1 (1-2 marks)
A detailed description of either embryo splitting or somatic cell nuclear transfer
OR
outlines of both methods

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.
0 marks
No response or no response worthy of credit.</td><td>6</td><td>1.2</td><td>Indicative scientific points may include (but are not limited to):

Embryo splitting / artificial twinning / embryo twinning

• Sperm taken from a male (with desired traits)
• Artificial insemination or IVF
• Embryo splitting
• Incubation in a lab
• Implantation into a surrogate
• Offspring are clones of each other

Somatic cell nuclear transfer

• Nucleus removed from a somatic cell
• Enucleation of an egg
• Electrofusion
• Embryo is transferred into a surrogate
• Offspring are clones of the original somatic cell</td></tr>
</table>

5	**(a)**		(cell / nuclear / mitochondrial / chloroplast) membrane(s) ✓ protease ✓ alcohol / ethanol ✓	**3**	1.2	**Mark the first answer in each space** **ALLOW** nuclear envelope **ALLOW** named protease e.g. pepsin / trypsin
5	**(b)**		few gene loci studied ✓ *idea of* small sample sizes (within each population) ✓ *idea that* the two measures show different patterns of results ✓	**2 max**	3.1 3.2	**Mark as continuous prose** **ALLOW** 'only 23 gene loci studied' e.g. 'only 6 trees sampled in population A' **IGNORE** ref to different sample sizes in each population **ALLOW** descriptions such as 'B has the joint highest diversity based on polymorphic loci but only the third highest based on heterozygosity'.
5	**(c)**		**FIRST CHECK ON ANSWER LINE** **If answer = 150 award 2 marks** 150/600 = 0.25 (q^2) square root of 0.25 = 0.5 (q) ✓ p = 1 - 0.5 = 0.5 $p^2 = 0.5^2 = 0.25$ 0.25 x 600 (= 150) ✓	**2**	2.2	**ALLOW** 0.25 for 1 mark **ALLOW** 1 mark for any 2 correct steps of process Step 1 150/600 = 0.25 (q^2) **ALLOW ECF** for steps 2 -5 2. Find square root of q^2 (q) 3. Subtract figure(q) from 1 (p) 4. Multiply p x p (p^2) 5. (p^2) x 600

<table>
<tr>
<td>6</td>
<td>(a)</td>
<td></td>
<td>Similarities

(both) use enzyme that cuts DNA ✓
(both) change base, sequence / order, in the organism ✓

idea that they both result in the production of a new polypeptide ✓

differences

no , gene / DNA , insertion in (this method of) CRISPR ✓

no, marker genes / ligase / bacterial cells / vector, used in CRISPR ✓

idea that traditional genetic engineering is illegal in humans ✓</td>
<td>4 max</td>
<td>2.5</td>
<td>DO NOT ALLOW ‘both use restriction enzymes’
DO NOT ALLOW ‘both change bases’ alone (as this implies base substitution)

Ora for genetic engineering

ALLOW no donor organism in CRISPR
ALLOW no deletion in genetic engineering / DNA insertion only in genetic engineering / DNA deletion only in CRISPR

ALLOW needs an RNA guide sequence in CRISPR
IGNORE ‘plasmids / restriction enzymes, only in genetic engineering’
IGNORE ‘Cas9 only in CRISPR’
(because they are mentioned in the question stem)</td>
</tr>
<tr>
<td>6</td>
<td>(b)</td>
<td></td>
<td>
<table>
<tr><th>Ion</th><th>Has a negative charge</th><th>Binds to haemoglobin</th><th>A product of the dissociation of carbonic acid</th><th>Involved in the chloride shift</th></tr>
<tr><td>Hydrogen</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Hydrogencarbonate</td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Chloride</td><td>✓</td><td></td><td></td><td>✓</td></tr>
</table>
✓
✓
✓
</td>
<td>3</td>
<td>1.1</td>
<td>AWARD one mark per correct row</td>
</tr>
</table>

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Please get in touch if you want to discuss the accessibility of resources we offer to support you in delivering our qualifications.