GCE

Biology B

H422/01: Fundamentals of biology

A Level

Mark Scheme for June 2024

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 **32(c)** and **35(a).**

11. **Annotations**

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. **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	Guidance
1	B	**1**	
2	A	**1**	
3	A	**1**	
4	A	**1**	
5	D	**1**	
6	D	**1**	
7	C	**1**	
8	B	**1**	
9	C	**1**	
10	D	**1**	
11	C	**1**	
12	B	**1**	
13	A	**1**	
14	C	**1**	
15	C	**1**	
16	D	**1**	
17	B	**1**	
18	A	**1**	
19	A	**1**	
20	B	**1**	3.3×10^{-9} m = 3.3 nm
21	B	**1**	
22	B	**1**	
23	A	**1**	
24	B	**1**	
25	D	**1**	

26	C	**1**	
27	C	**1**	
28	B	**1**	
29	D	**1**	
30	D	**1**	
	Total	**30**	

Question			Answer	Marks	Guidance
31	(a)		deaminated ✓ carbon dioxide ✓ ornithine ✓	3	**Responses must be in order as on MS** **ALLOW** deamination **ALLOW** CO_2 **ALLOW** phonetic spelling
31	(b)	(i)	(samples **Y** and **Z**) prepared by dissolving (named) solutes in water ✓ *idea that* samples prepared using (named) buffer ✓ sample **Y** has glucose added ✓ sample **Z** has erythrocytes added ✓ sample **Z** has proteins added ✓ (yellow) colour added to look like urine ✓ *idea that* they should be checked against a combi strip ✓	Max 3	 **ALLOW** prepared to correct pH / to give pH shown on test strip **ALLOW** e.g. pH lowered for sample **X** **ALLOW** higher glucose **ALLOW** red blood cells/RBC **ALLOW** ERY = erythrocytes **ALLOW** higher protein **IGNORE** references to urine **IGNORE** references to conc. of additives (e.g. 10g of protein)
31	(b)	(ii)	(sample **Z**) contains erythrocytes ✓ *Ref to* prevent denaturing of (blood) proteins / enzymes ✓	Max 1	**ALLOW** red blood cells/RBC/ERY for erythrocytes **DO NOT ALLOW** *Ref* to erythrocytes unqualified **IGNORE** *Ref* to denature/breakdown of erythrocytes

31	**(b)**	**(iii)**	*Ref* to the use of Benedict's solution ✓ use of distilled water to zero / calibrate colorimeter ✓ red filter for coloured solution ✓ measures , absorbance / transmission , (of light) ✓ calibration curve/graph produced (using known concentrations) ✓ (%) absorbance / transmission , reading (of sample **Y**) checked/compared on calibration curve / AW ✓ provides quantitative results ✓	**Max 3**	
31	**(c)**	**(i)**	*Method* controlled / healthy diet / reduced intake of (refined) sugar / reduce obesity / increase exercise ✓ (named) drug / insulin pump / insulin injection ✓ *Explanations* avoids excess, glucose in the blood/body / intake of glucose (into body) ✓ lowers blood glucose concentration / cells take up more glucose ✓	**2**	**Max 1** for method if explanation does not match **ALLOW** weight loss e.g. metformin **ALLOW** reduces glucose produced by liver / reduces absorption of glucose from food
31	**(c)**	**(ii)**	put blood in contact with biosensor strip ✓ glucose, dehydrogenase / oxidase , on test strip ✓ glucose to gluconolactone (produces current) / AW ✓ measures (small electric) current ✓	**Max 2**	

Question			Answer	Mark	Guidance
32	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF ANSWER = 68 (dB) AWARD 1 MARK** 68 ✓	1	
32	(a)	(ii)	*Advantage* natural , habitat / environment ✓ *Disadvantage* *idea that* transmission of sound affected by , forest / trees / jungle ✓ **OR** difficulties in placing equipment ✓	Max 2	**IGNORE** realistic **ALLOW** close to real life / the place in which it normally lives **IGNORE** not controlled / unqualified external factors / other sounds interfere
32	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF ANSWER = 18 / 17.6** (%) **AWARD 2 MARKS** (68 – 56) ÷ 68 x 100 ✓ 17.6 % ✓	2	**ALLOW** 1 mark for equation **OR** incorrect rounding / 17.64(70588)
32	(b)	(ii)	*Valid because* small (%) loss in performance (over 100m) ✓ means language, can still be understood / heard / is still coherent ✓ *Invalid because* only two species used ✓ different species may , use different sounds / have different language ✓ insufficient data ✓	Max 3	**ALLOW** supporting figure for small loss e.g. species 1 = 68-56, 17.6%, species 2 = 61-49, 19.7% **ALLOW** ref. to different species gave different results/performance levels **ALLOW** idea that only 100m tested

<table>
<tr><td>32</td><td>(c)*</td><td></td><td colspan="3">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)
Evaluation that includes positive and negative statements for fossil and anatomical evidence.
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)
Evaluation that includes positive and negative statements for fossil or anatomical evidence
OR
Evaluation that includes positive only or negative only statements for fossil and anatomical evidence.
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)
Evaluation that includes positive or negative statement for fossil or anatomical evidence.
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.</td><td>6</td><td>Communication statement can be awarded if there is no incorrect use of terminology.

Indicative scientific points may include:

POSITIVE
FOSSIL or ANATOMICAL
• organisms based on morphological similarities / same shape
• can see evidence
• useful for scientists

FOSSIL ONLY
• useful in studying extinct species
• there can be an abundance of fossils
• can see evolutionary relationships / distance from common ancestor
• carbon-dating/age can be determined
• can sometimes extract DNA
• can sometimes use molecular analysis

ANATOMICAL ONLY
• can see features that do not fossilise
• e.g. colour/hair length
• can see the full structure/no missing parts</td></tr>
</table>

					NEGATIVE ***FOSSIL or ANATOMICAL*** • members of same species can look very different • members of different species classified together due to having similar / homologous structure / looking similar • e.g. wings • pitfalls of convergent evolution ***FOSSIL ONLY*** • DNA does not preserve well • difficult to extract DNA from old fossils • limited to skeletal similarities / differences • e.g. cannot see colour of feathers or tissues or organ features • different theories/interpretations arise • can only estimate evolutionary relationships • damaged / missing part / weathered ***ANATOMICAL ONLY*** • not using DNA • cannot use molecular analysis

Question			Answer	Mark	Guidance
33	(a)	(i)	lenticel ✓	1	**ALLOW** phonetic spelling
33	(a)	(ii)	*Underside of leaf* occurs faster / higher rate ✓ only occurs at certain times of the day e.g. during the day / occurs less at night ✓ (can be controlled by) guard cells ✓ uses stomata ✓ stomata / pores , can open and close ✓	Max 3	**ALLOW** ORA statements for gas exchange on bark where relevant **ALLOW** underside of leaf has larger SA (for gaseous exchange)
33	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF ANSWER = 305 AWARD 2 MARKS** 4 x π $(4.5)^2$ = 254.5 cm^2 ✓ 254.5 x 1.2 ✓	2	**ALLOW** 1 mark for calculation of surface area i.e. 254(.4690049408) **ALLOW** 1 mark for correct surface area ÷1.2 = 212(.0575) **ALLOW** 1 mark for 305.3(62805929)

Question			Answer	Mark	Guidance
34	(a)	(i)	seminiferous tubule ✓	1	**ALLOW** phonetic spelling
34	(a)	(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE IF ANSWER = 295 / 300 / 305 AWARD 2 MARKS** (30 x 1000) ÷ 100 ✓ = 300 ✓	2	**ALLOW** 1 mark for 30÷100 or 0.3 or 30 or 310 or 290
34	(a)	(iii)	secrete / produce , testosterone ✓	1	**ALLOW** androgen for testosterone
34	(b)		few(er) / no , (mature) sperm(atozoa) ✓ thin(ner) germinal epithelium layer ✓ spermatogenesis stages absent ✓ more Leydig cells ✓ few(er) / no , (named) cells (undergoing cell division) e.g. spermatogonia ✓ fewer Sertoli cells ✓	Max 3	**INGORE** ref. to different numbers / density of seminiferous tubules

34	**(c)**		*man produces sperm but sperm ducts are blocked* **Max 2** (surgical) sperm retrieval / sperm removed from epididymis / AW ✓ (followed by) intrauterine insemination / sperm inserted in uterus ✓ *sperm and oocytes produced but fertilisation does not occur* **Max 2** intra-cytoplasmic sperm injection / ICSI ✓ single sperm injected into oocyte ✓ fertilisation outside the , body / female / uterus ✓ fertilised oocyte / embryo / zygote implanted ✓	**4**	**IGNORE** ref. to treatment of blocked urethra **IGNORE** references to semen extraction **ALLOW** insertion into oviduct e.g. ZIFT / GIFT **IGNORE** AI / IVF **ALLOW** IVF / in vitro fertilization **ALLOW** in a lab / petri dish / test tube, for outside the body
34	**(d)**		produces (large quantities of) , gametes / sperm ✓ gametes are haploid / formed by meiosis ✓ restores diploid number , after fertilisation / in zygote ✓ prevents doubling of chromosome number (in each generation) ✓	**Max 3**	**DO NOT ALLOW** haploid cells become diploid

<table>
<tr><td>35</td><td>(a)*</td><td></td><td colspan="3">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):
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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)
Well-balanced comparison that includes statements of similarities and clear statements for differences between transcription in prokaryotes and humans.
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)
Comparison that includes a statement of similarity and a differences between transcription in prokaryotes and humans.
OR
Statements of similarities in the transcription of prokaryotes and eukaryotes.
OR
Statements of differences in the transcription of prokaryotes and eukaryotes.
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)
Comparison that includes similarities or differences between transcription in prokaryotes and humans.</td><td>6</td><td>Communication statement can be awarded if there is no incorrect use of terminology.

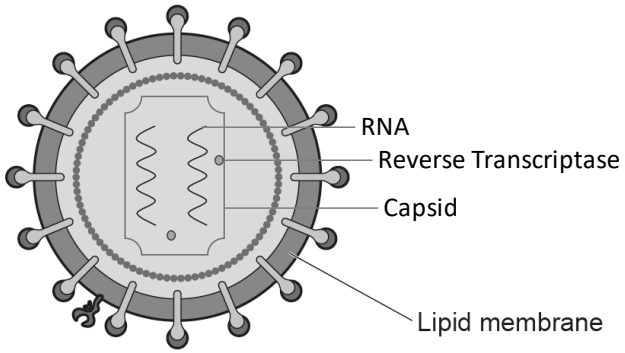
Indicative scientific points may include

SIMILARITIES
• DNA acts as the template
• role of DNA helicase
• mRNA is produced
• ribonucleotides are used
• phosphodiester bonds formed
• enzyme is RNA polymerase
• binding site on DNA for RNA polymerase

DIFFERENCES
• takes place in nucleus in humans but in cytoplasm of prokaryotes
• prokaryotic DNA template / chromosome is circular but is linear in human
• translation and transcription occur simultaneously in prokaryotes but not in humans
• mRNA in humans needs to be modified / spliced / edited but not in prokaryotes
• detail of the differences in RNA splicing e.g. pre-mRNA contains introns</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.*		• humans form pre-mRNA but mRNA in prokaryotes is (already) mature • prokaryotic DNA is not bound to histones but human DNA is bound to histones

<table>
<tr><th colspan="2">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>35</td><td>(b)</td><td></td><td>
<table>
<tr><th>Statement</th><th>T / F</th></tr>
<tr><td>Argonaute proteins allow miRNA to bind to many different mRNA molecules.</td><td>True / T ✓</td></tr>
<tr><td>miRNA and siRNA are both derived from double-stranded RNA molecules.</td><td>True / T ✓</td></tr>
<tr><td>siRNA binds to a specific sequence of complementary DNA nucleotides which allows the Argonaute protein to bind.</td><td>False / F ✓</td></tr>
</table>
</td><td>3</td><td></td></tr>
</table>

Question			Answer	Mark	Guidance
36	(a)		 inner core of HIV virus drawn to show, capsid, RNA and reverse transcriptase ✓ **two** correctly labelled features ✓✓	**Max 3**	**ALLOW** only correct positions for the 3 inner core components **ALLOW** a max. 2 marks for labels e.g. reverse transcriptase / enzyme / capsid / capsomeres / RNA / glycoprotein / antigen / attachment protein
36	(b)	(i)	(viral) RNA is inserted into host cell / AW ✓ reserve transcriptase turns RNA into (viral) DNA ✓ (viral) DNA integrated into host cell DNA ✓ host cell used , for transcription / to produce (viral) mRNA (from , viral / copy, DNA) ✓ protease / enzyme / protein , synthesised / translated (by host cell) ✓	**Max 2**	

36	**(b)**	**(ii)**	inhibitor / saquinavir , is similar shape to , substrate / large proteins ✓ (saquinavir) binds to active site of (protease enzyme) ✓ prevents / blocks, substrate / large proteins , binding ✓ prevents formation of enzyme-substrate complexes / ESC ✓ binding of inhibitor / saquinavir is , reversible / temporary / not permanent ✓	**Max 3**	**DO NOT ALLOW** reference to target molecules **IGNORE** causes a decrease in enzyme activity
36	**(b)**	**(iii)**	cannot , breakdown (large) proteins / produce smaller polypeptides ✓ cannot form , structural / functional , viral , polypeptides / proteins / enzymes / protease ✓ example e.g. small polypeptides may be needed to form (viral) protein coat ✓	**Max 2**	
36	**(c)**	**(i)**	many / collection of , symptoms / may affect different body organs ✓ *idea that* involves different (named) diseases caused by suppressed immune system ✓ characteristic of a condition ✓	**Max 2**	**ALLOW** systems for organs e.g. pnuemonia
36	**(c)**	**(ii)**	**Any two from** use of (named) antivirals for infected people ✓ screening blood ✓ encouraging , protected sex / use of condoms ✓ testing 'at risk' groups ✓ encouraging use of clean needles e.g. for drug users ✓	**Max 2**	

Question			Answer	Mark	Guidance
37	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE OR IN THE TABLE** **IF ANSWER = 250 OR 261 (bpm) AWARD 2 MARKS** 60÷0.24 or 60÷0.23 ✓ Ans x 100 ✓	**2**	**ALLOW 2 marks for** 60÷(0.47÷2) = 255 **ALLOW** 1 mark if answer not to whole number
37	(a)	(ii)	repeat the method (at least) three times ✓ to , obtain / calculate , a mean ✓ to identify anomalies ✓	**Max 2**	**IGNORE** prevent anomalies
37	(a)	(iii)	*supporting* - ***any one from*** avoids stress ✓ (isoflurane) does not reduce heart rate as much as others / AW ✓ *non-supporting* - ***any one from*** ethical concerns ✓ high heart rate not maintained / sedation lowers heart rate ✓ can't maintain high metabolic rate / body temperature ✓	**Max 2**	**ALLOW** idea that isoflurane is closer to normal than the others

37	**(b)**		increased VO_2 max ✓ enlarged heart / hypertrophy ✓ increased force of ventricular systole ✓ increased thickness of heart muscle wall ✓ decreased resting heart rate / bradycardia ✓ increased stroke volume / cardiac output ✓ decreased recovery time (for resting heart rate) ✓ increase in erythrocytes number ✓	**Max 3**	**Answers must relate to circulatory system only**

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