OCR
Oxford Cambridge and RSA

GCE

Biology A

Unit **H420A/02:** Biological diversity

Advanced GCE

Mark Scheme for June 2017

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations

In mark scheme:

Annotation	Meaning
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

In RM Assessor:

Annotation	Meaning
	Correct response
	Incorrect response
	Ignore
	Point already given (i.e. Given Mark)
	Underline (for ambiguous / contradictory wording)
	Omission
	Marking point partially met
	Benefit of doubt
	Benefit of doubt not given
	Contradiction
	Error carried forward
	Blank page

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			C ✓	1	
2			A ✓	1	
3			B ✓	1	
4			C ✓	1	
5			C ✓	1	**ALLOW** A
6			B ✓	1	
7			A ✓	1	**ALLOW** B
8			B ✓	1	
9			B ✓	1	
10			B ✓	1	**ALLOW** C
11			D ✓	1	
12			A ✓	1	
13			B ✓	1	
14			B ✓	1	
15			D ✓	1	
			Total	**15**	

DO NOT CREDIT ambiguous letters, e.g. B/D hybrids

Question			Answer	Marks	Guidance
16	(a)	(i)	estimate will be inaccurate (because of low numbers) ✓ dangerous (for collector or jaguar) ✓	2	**IGNORE** refs to conspicuousness of tags **ALLOW** catching one more jaguar will make a big difference to the calculated number **ALLOW** the technique only works well with large populations **IGNORE** difficult to catch **ALLOW** the jaguars might die **IGNORE** inhumane / cruel / stressful
		(ii)	**1** appropriate calculation of , observed / expected , population density ✓ **2** lower than estimate ✓ **3** so does not support ✓ **4** low / unknown , repeatability / reproducibility (of results) ✓ **5** (some) support because , figure / 3 , is close (enough) to , estimate / 5 ✓ **6** some individuals not photographed ✓ **7** *idea that* if many individuals not trapped population could be higher than estimate ✓	4 max	**1 CREDIT** e.g. • 3.3 / 3 (jaguars per 100 km^2) • 13.55 / 13 / 14 (est. pop. in 271 km^2) • 0.05 and 0.033 / 0.03 (jaguars per km^2) • 20 and 30.1 / 30 (mean area per jaguar) **1 IGNORE** significant figures **2 ALLOW** ecf from candidate's calculation **3** Must be in context of mp 1 or 2 **4 ALLOW** low reliability **4 ALLOW** ref. to one-off study / should be repeated **4 IGNORE** accurate / valid **6 ALLOW** some not caught by camera

Question			Answer	Marks	Guidance
		(iii)	*human sightings* *idea of any one of the following* misidentification seeing the same individual twice exaggeration / lying poor recollection jaguars likely to be in , places / times , humans are not method unlikely to spot cubs (as still in den) ✓ *footprints* *idea of any one of the following* misidentification might disappear (before recording) multiple prints in same spot makes counting difficult same print might be counted on different occasions many prints made by the same individual hard to distinguish individual jaguars footprints not always left ✓	2	**IGNORE** hard to spot **IGNORE** misidentification if given in human sighting
	(b)		*conservation because…* there are (local) people there ✓ sustainable use ✓ (area used for) logging / farming / nut production ✓ active measures / work , to maintain , biodiversity / habitat / park ✓	3 max	Cannot be implied from another marking point. Look for positive statement, **CREDIT** if preservation people would not be there **CREDIT** logging / farming / nut production , not consistent with preservation **CREDIT** preservation would leave park untouched **CREDIT** active management **NB** preservation would leave park untouched by people = mp 4 not mp 1
			Total	11	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>17</td><td>(a)</td><td>(i)</td><td>YR, Yr, yR, yr ✓</td><td>1</td><td>ALLOW ry, Ry, RY, rY</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>genotypes
YyRr, Yyrr, yyRr, yyrr ✓

phenotypes
yellow round, yellow wrinkled, green round, green wrinkled ✓</td><td>2</td><td>ALLOW YRyr , Yryr, yRyr, yryr

phenotypes must correspond to correct genotype
DO NOT CREDIT if no or incorrect genotypes are given</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>8.73 or 8.8 ✓✓✓

<table><tr><th>O</th><th>E</th><th colspan="2">$(O-E)^2 / E$</th></tr><tr><td>58</td><td>63</td><td>0.40</td><td>25/63</td></tr><tr><td>31</td><td>21</td><td>4.76</td><td>100/21</td></tr><tr><td>21</td><td>21</td><td>0</td><td>0</td></tr><tr><td>2</td><td>7</td><td>3.57</td><td>25/7</td></tr></table></td><td>3</td><td>ALLOW correct answers up to 4 s.f.
ALLOW 2 marks any answer between 8.73 and 8.8

If answer is incorrect
ALLOW 1 mark for correct expected numbers: 63, 21, 21, 7
ALLOW 1 mark for correctly calculated $(O-E)^2/E$ numbers: 0.40, 4.76, 0, 3.57

OR

ALLOW 2 marks for 636 to 638 (ECF from incorrect expected numbers – 9, 3, 3, 1)</td></tr>
</table>

		(ii)	*supports because…* **1** (critical / table , value =) 7.82 ✓ **2** difference is significant as (X^2) , higher than , 7.82 / critical value ✓ **3** (less than) 5% / 1 in 20 , probability / chance , that difference is due to chance ✓ ora **4** X^2 / calculated value is , smaller than , 9.35 / value at p=0.025 ✓ **5** greater than , 2.5% / 1 in 40 , probability that difference is due to chance ✓ ora	**3 max**		**ALLOW** correct interpretation of significance of incorrect X^2 value in part (i) If candidate has miscalculated degrees of freedom **CREDIT only** mps 2 and 3 **IGNORE** reject null hypothesis **1 ALLOW** 7.82 highlighted in table **2 ALLOW** difference is not significant as (selected number) less than (selected) critical value **3 ALLOW** > 5% chance that difference is due to chance (if consistent with candidate's X^2 and critical value) **4 ACCEPT** X^2 / calculated value is , close to critical value / 7.82 / value at p=0.05 **4 ACCEPT** X^2 / calculated value , < , 11.34 / value at p=0.01 **5 ACCEPT** > 1% probability that difference is due to chance
		(iii)	**1** (autosomal) linkage ✓ **2** (both) genes / alleles , occur on same , chromosome / autosome / chromatid ✓ **3** no independent assortment ✓ **4** (so) alleles , inherited together / end up in same gamete ✓ **5** (unless) crossing over occurs / chiasma forms between gene loci ✓	**3 max**		**1 IGNORE** sex linkage **/** mutations **1 ALLOW** *idea of* lethal genes **1 ALLOW** genetic drift if number of individuals is small (in suggestion or explanation) **5 ALLOW** if the genes are close together there is less chance of crossing over

	(c)	**(i)**	***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.***				
			Level 3 (5–6 marks) A reference to the nature of the genetic code **AND** an outline of how alleles are transcribed and translated **AND** a detailed explanation of why the **y** allele results in a different primary structure. *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** An outline of some key aspects of transcription and translation **AND** an explanation of why a change in the sequence of bases in a gene causes a change in the primary structure of the polypeptide it codes for. **OR** A detailed explanation of why a change in the sequence of bases in a gene causes a change in the primary structure of the polypeptide it codes for. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.*	**6**		**Indicative scientific points may include:** **Genetic code (G)** • DNA base sequence codes for amino acid sequence • reference to mRNA base sequence • triplet code / 3 bases = 1 amino acid • degenerate code • substitution could result in same amino acid **Transcription (C)** • transcription then translation • complementary base pairing • synthesis of mRNA strand • role of RNA polymerase **Translation (L)** • mRNA binds to ribosome • tRNA binds to mRNA • tRNA brings specific amino acid • mRNA translated into polypeptide **Effect of y allele (M)**

			Level 1 (1–2 marks) A reference to the mechanism of protein synthesis **AND** reference to the effects of a mutation or the nature of the genetic code. **OR** A description of some aspects of the mechanism of protein synthesis. **OR** A description of the nature of the genetic code or the effects of mutation. *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.*			• substitution / frame-shift • different base sequence of DNA • different mRNA codon • different tRNA anticodon • tRNA brings different amino acid • different sequence of amino acids • amino acid sequence is primary structure
	(c)	**(ii)**	(active) enzyme / protein / product , will still be synthesized even if you only have one Y allele ✓	**1**		**CREDIT** you need 2 y alleles to prevent the (functional) enzyme being synthesized
			Total	**19**		

Question			Answer	Marks	Guidance
18	(a)		production / AW of , <u>callose</u> ✓ release / production , of (named / toxic) chemical ✓ leaf drop / abscission ✓ necrosis ✓	2 max	**IGNORE** cell signalling **ALLOW** formation of tylose **ALLOW** production of chemical to prevent spread **ALLOW** production of lignin **IGNORE** insecticide / antibacterial / pheromones **IGNORE** contain chemicals **CREDIT** (rapid) death of , plant / tissue (to limit spread) **IGNORE** death unqualified
	(b)	(i)	reduced / no , genetic variation ✓ control (more) <u>variables</u> ✓ increases <u>validity</u> ✓	2 max	**ALLOW** genetically identical / same genetics **ALLOW** same / similar , alleles **IGNORE** same / similar , genes **ALLOW** makes it valid
		(ii)	*procedure* tissue culture / micropropagation ✓ *asepsis important because* reduces , microorganisms / contamination ✓	2	**IGNORE** cuttings / vegetative propagation **ALLOW** clear description **ALLOW** without asepsis microbes might grow **ALLOW** reduces competition **for** , space / nutrients / resources **IGNORE** infection / pathogens

		(iii)	clone C = 952 ± 2 ✓✓✓	**3**	**ALLOW** 2 marks for any answer between 915 and 990 *If answer is incorrect* **ALLOW** 1 mark for 700 (area of triangle) and **ALLOW 1** mark for 252 (area of rectangle)
		(iv)	0.76(16) ✓	**1**	**ALLOW** 76(.2)% / 76/100 / 19/25 / 7.6 x 10^{-1} **ALLOW** ECF for answer to part (iii) ÷ 1250 **ALLOW** e.g. 0.564 / 56% (if answer to (iii) is 700)
		(v)	(shows) total / cumulative , infection over time (of study) ✓ *idea that* on different days the level of infection could be different ✓ any reference Fig.18 to support ✓	**2 max**	 **ALLOW** descriptive or numeric reference
		(vi)	light intensity ✓ light duration ✓ soil (named) mineral (content) ✓ soil , water / moisture (content) ✓ soil type ✓ soil pH ✓ humidity ✓ air pollution ✓	**2 max**	Mark the first 2 answers with exception of ignored answers below. **IGNORE** temperature / wind speed / rainfall **ALLOW** day length **IGNORE** light exposure **IGNORE** nutrients / ions / solutes / nitrogen **IGNORE** water availability **IGNORE** carbon dioxide
			Total	**14**	

Question			Answer	Marks	Guidance
19	(a)		*chimpanzee has (relatively)* smaller / shorter / thinner , thumb ✓ longer / narrower , palm ✓ thicker fingers ✓ wider wrists ✓	2 max	**ACCEPT** ora for human **IGNORE** size **IGNORE** creases **IGNORE** longer fingers **IGNORE** less space between fingers
	(b)	(i)	0.177 ± 0.004 ✓✓	2	Max 1 if answer not given to 3 s.f. **ALLOW** 1 mark for a number between 5.2 and 5.3 ÷ 30
		(ii)	*time since divergence* *5.25 ± 0.25 million years* ✓ *range* 4.2 ± *0.2* to 6.3 ± *0.3* (million years) ✓	2	Unit is required for mark **ACCEPT** 2.1 ± 0.1 (million years)

<table>
<tr><td></td><td></td><td>(iii)</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 supported reason for AND a supported reason against reclassification AND discussion of the basis of the classification system.

There is a well-developed line of reasoning, which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.

Level 2 (3–4 marks)
A supported reason for OR against reclassification AND a reference to how organisms are classified.
OR
A reference to some evidence that supports AND does not support reclassification AND a reference to how organisms are classified.

There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</td><td>6</td><td></td><td>Indicative scientific points may include:

valid (V) because
the indicative point may be subsumed within reference to a supporting figure
• recent divergence
○ figs to support from Fig 19.3
• occupy same branch on phylogenetic tree
○ as seen in Fig 19.1

invalid (I) because
the indicative point may be subsumed within reference to a supporting figure
• divergence less recent than chimpanzee and bonobo
○ figs to support from Fig 19.3</td></tr>
</table>

			Level 1 (1–2 marks) A supported reason for **OR** against reclassification. **OR** A reference to some evidence that supports **OR** does not support reclassification **AND** a reference to how organisms are classified. *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.*			○ as seen in Fig 19.1 • different anatomy ○ as seen in Fig 19.2 **prinicples of classification (P)** *may be implied during discussion of V and I points* • phylogeny is basis of classification • species that , diverged recently / share similar base sequence , occupy same group • original classification based on comparative anatomy • recognition that biochemistry is more accurate than comparative anatomy • scientific knowledge develops over time • change justified by new molecular evidence
		(iv)	no / little , because , homeobox genes / they , are highly conserved (within animal kingdom) ✓ (only) that humans and chimpanzees , belong to the same kingdom / are animals ✓	**1 max**		
			Total	**13**		

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>20</td><td>(a)</td><td>(i)</td><td>two , 6-membered rings / hexoses ✓

(1-4) glycosidic bond ✓

two CH_2OH (groups) ✓
rings contain one , oxygen atom / O ✓</td><td>2 max</td><td>IGNORE 6-carbon ring
ALLOW two 5C-rings

IGNORE molecule
IGNORE oxygen / 0 , molecule</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><td>lactose</td><td>maltose</td><td></td></tr><tr><td>(contains) beta / β-glucose</td><td>(contains) alpha / α-glucose</td><td>✓</td></tr><tr><td>β-glycosidic bond</td><td>α-glycosidic bond</td><td>✓</td></tr><tr><td>sugars in opposing orientation / flipped / AW</td><td>both (monomers) in same direction / AW</td><td>✓</td></tr></table></td><td>3</td><td>IGNORE description of structural difference between glucose and galactose

IGNORE refs to inversion of, e.g. CH_2OH</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>bonds contain energy ✓
(bonds) can be broken by (respiratory) enzymes ✓

soluble so , can move (within cell) ✓

H / OH , (groups) can form H bonds with water / allow solubility ✓

AVP ✓</td><td>3 max</td><td>

CREDIT used in glycolysis / converted to pyruvate / phosphorylated / (easily) converted to glucose</td></tr>
</table>

Question			Answer	Marks	Guidance
		(ii)	(too) big ✓ unable to pass between phospholipids ✓ **OR** no / small , concentration gradient ✓ needs , carrier protein / pump ✓	**2**	**IGNORE** charged / polar **CREDIT** needs , channel / (lactose) permease **IGNORE** phospholipid bilayer **DO NOT CREDIT** channel **ALLOW** needs active transport protein
		(iii)	(mammal diet high in milk, so) high lactose concentration ✓ (structural) gene for protein channel / lactose permease gene / lac Y , is , transcribed / expressed / switched on ✓ (protein is) lactose permease ✓	**2 max**	**ORA** for older mammals **ALLOW** lactose is present **ALLOW** description of lactose causing repressor protein to leave operator **ALLOW** *lac* operon is switched on
	(c)		**1** zero the colorimeter / set to zero ✓ **2** using blank ✓ **3** use red filter ✓ **4** use known concentrations (of lactose) ✓ **5** (produce) serial / series , dilutions ✓ **6** construct calibration curve ✓	**4 max**	**ALLOW** calibrate to zero **3 ALLOW** red light / orange filter **4 ALLOW** a list of stated concentrations **5 ALLOW** clear description **6 ALLOW** plot concentration against , transmission / absorbance

Question			Answer	Marks	Guidance
			7 test unknown sample (using the same method) ✓ **8** use / read from , graph / calibration curve , to determine (unknown) concentration ✓		**8** Cannot be assumed from mp 6
			Total	**16**	

Question			Answer	Marks	Guidance
21	**(a)**		restriction , enzyme / endonuclease ✓ same ✓ complementary ✓	**3 max**	**ALLOW** restriction (endonuclease) **IGNORE** sticky ends
	(b)		the gene / the DNA fragment , inserted into plasmid ✓ complementary bases (pair / anneal) ✓ formation of hydrogen bonds ✓ formation of phosphodiester bonds ✓ using (DNA) ligase ✓	**3 max**	**ALLOW** the bit of DNA combines with ring of bacterial DNA **ALLOW** complementary sticky ends **DO NOT CREDIT** in context of making hydrogen bonds
	(c)		use of marker (gene) ✓ (genes for) fluorescence / colour change ✓ (examine fluorescence under) UV , light / radiation ✓ antibiotic resistance (gene) ✓ (then) grow on agar containing antibiotic ✓	**3 max**	**IGNORE** replica plating **ALLOW** (gene for) glowing **ALLOW** use GFP **ALLOW** test for survival in antibiotic

Question			Answer	Marks	Guidance
	(d)		make , single stranded DNA / cDNA / complementary DNA ✓ using , reverse transcriptase / reverse transcription ✓ make double-stranded DNA using DNA polymerase ✓	**2 max**	**IGNORE** mRNA **ALLOW** make copy DNA
	(e)		(increase in antibiotic) <u>resistan</u>ce ✓	**1**	**DO NOT CREDIT** immune
			Total	**12**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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