

Module 3: Biodiversity and Evolution
2.3.2 Classification
June 2009-January 2013
Mark schemes

(a) define the terms *classification*, *phylogeny* and *taxonomy*;

(b) explain the relationship between classification and phylogeny;

(c) describe the classification of species into the taxonomic hierarchy of domain, kingdom, phylum, class, order, family, genus and species;

(d) outline the characteristic features of the following five kingdoms: Prokaryotae (Monera), Protocista, Fungi, Plantae, Animalia;

(e) outline the binomial system of nomenclature and the use of scientific(Latin) names for species;

(f) use a dichotomous key to identify a group of at least six plants, animals or microorganisms;

(g) discuss the fact that classification systems were based originally on observable features but more recent approaches draw on a wider range of evidence to clarify relationships between organisms, including molecular evidence (HSW1, 7a);

(h) compare and contrast the five kingdom and three domain classification systems

F212

Mark Scheme

January 2013

Question	Answer	Marks	Guidance
1 (a)	(i) A mayfly (larva) B damsel fly (larva) C stonefly (larva) D caddisfly (larva) E diving beetle F bloodworm ;;	2	Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks All 6 correct = 2 marks 4 (or 5) correct = 1 mark
1 (a)	(ii) (each question has) two options / AW ; each question has yes or no option / AW ;	1	ACCEPT alternating
1 (b)	1 gills ; 2 streamlined (shape) / absence of wings ; 3 flattened shape ; 4 tail(s) / hind legs , for , propulsion / swimming / moving ; 5 blood pigment for storing oxygen ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks Answers must relate to adaptations for living in an aquatic environment. 4 IGNORE 'tail(s)' unqualified
1 (c)	(i) nucleus ; membrane bound organelles / named organelle ; 80S / 22nm / large(r) , ribosomes ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE lack of named prokaryotic feature ACCEPT big(ger) ribosomes

F212

Mark Scheme

January 2013

Question	Answer	Marks	Guidance
1 (c) (ii)	chloroplast(s) ; large / permanent , vacuole ; tonoplast ; starch (grains) ; AVP ;	2	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE chlorophyll</p> <p>ACCEPT cell wall (even though not actually inside a cell)</p>
Total		7	

Question	Answer				Marks	Guidance																	
2	<table border="1"> <tr> <td data-bbox="1236 414 1332 593">Kingdom</td> <td data-bbox="1236 593 1332 772">membrane-bound organelles</td> <td data-bbox="1236 772 1332 974">cell wall</td> <td data-bbox="1236 974 1332 1176">type(s) of nutrition</td> </tr> <tr> <td data-bbox="1109 414 1236 593"></td> <td data-bbox="1109 593 1236 772"></td> <td data-bbox="1109 772 1236 974"></td> <td data-bbox="1109 974 1236 1176">heterotrophic and autotrophic ;</td> </tr> <tr> <td data-bbox="981 414 1109 593">protocist(s) / Protoctista ;</td> <td data-bbox="981 593 1109 772">present ;</td> <td data-bbox="981 772 1109 974"></td> <td data-bbox="981 974 1109 1176"></td> </tr> <tr> <td data-bbox="853 414 981 593"></td> <td data-bbox="853 593 981 772">present ;</td> <td data-bbox="853 772 981 974"></td> <td data-bbox="853 974 981 1176"></td> </tr> <tr> <td data-bbox="726 414 853 593">plant(s) / Plantae ;</td> <td data-bbox="726 593 853 772">present ;</td> <td data-bbox="726 772 853 974">(present and made of) cellulose ;</td> <td data-bbox="726 974 853 1176"></td> </tr> </table>	Kingdom	membrane-bound organelles	cell wall	type(s) of nutrition				heterotrophic and autotrophic ;	protocist(s) / Protoctista ;	present ;				present ;			plant(s) / Plantae ;	present ;	(present and made of) cellulose ;		6	<p>Mark the first answer in each box. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE case of initial 'p'</p> <p>ACCEPT '✓' or 'yes'</p> <p>IGNORE case of initial 'p'</p> <p>ACCEPT '✓' or 'yes'</p> <p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ALLOW fungus / fungal / fungae</p> <p>IGNORE case of initial 'r'</p>
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(b)	fungi ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ALLOW fungus / fungal / fungae</p> <p>IGNORE case of initial 'r'</p>																				

Question	Answer	Marks	Guidance
(c)	<p>Assume answers refer to 3 domain classification unless otherwise stated</p> <p>1 based on (differences in) , DNA / RNA / nucleic acids / polynucleotides ;</p> <p>2 <i>idea that more accurately reflects origins (of, prokaryotes / eukaryotes) ;</i></p> <p>3 (domain) divides / AW , prokaryotes ; ora</p> <p>4 <i>idea that domain reflects differences / AW , between (eu)bacteria and archaea ;</i></p> <p>5 example of two differences to support point 3 or 4 ;</p> <p>6 (domain) groups / AW , eukaryotes together ; ora</p> <p>7 <i>idea that domain reflects the fact that there are similarities between eukaryotic kingdoms ;</i></p> <p>8 example of two or more similarities to support point 6 or 7 ;</p>	3 max	<p>CREDIT Latin forms of domain names throughout IGNORE case of initial letter</p> <p>1 CREDIT in the context of an example</p> <p>3 'prokaryotes are split into groups because bacteria and archaea are different' = 2 marks (mp 3 and 4)</p> <p>4 ACCEPT phonetic spellings of 'archaea'</p> <p>4 ACCEPT 'archaebacteria'</p> <p>4 IGNORE multiple examples for this mp, must be a general statement</p> <p>5 IGNORE if mp 3 or 4 not awarded</p> <p>5 e.g. (differences between) cell wall / cell membrane / flagella / (named) RNA enzymes / ATPase / proteins bound to genetic material / DNA replication / transcription etc</p> <p>6 IGNORE as part of a list of domains. Answer must state that eukaryotes have been placed in the same group.</p> <p>6 'eukaryotes are placed in the same group because they have similarities' = 2 marks (mp 6 and 7)</p> <p>6 IGNORE 'are similar'</p> <p>7 IGNORE multiple examples for this mp, must be a general statement</p> <p>8 IGNORE if mp 6 or 7 not awarded</p> <p>8 e.g. all eukaryotes have, nuclei / membrane bound organelles / 80S ribosomes / large cell size / linear DNA / chromosomes / histones etc.</p>
	Total	10	

Question	Answer	Marks	Guidance
4 (a)	taxonomy / taxonomic ; hierarchy ; phylogeny / phylogenetic ;	3	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks ACCEPT phonetic spelling throughout ACCEPT hierarchical system
(b)	(i) 1 (cells have) no cell wall ; 2 <u>heterotrophic</u> ; 3 eukaryotic ; 4 multicellular ; 5 (fertilized eggs develop into), blastula / ball of cells ; 6 high degree of mobility / AW ;	2 max	Mark the first answer on each prompt line. 1 DO NOT CREDIT absence of a qualified cell wall, e.g. 'no cellulose cell wall' 2 ACCEPT phonetic spelling 3 ACCEPT named eukaryotic cell feature 4 IGNORE references to tissues 6 DO NOT CREDIT unqualified references to movement ACCEPT refs to mobility during part of life cycle IGNORE cilia / flagella
(ii)	Eukaryota(e) / Eukarya / eukaryote(s) ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE case of initial letter

Question	Answer	Marks	Guidance
(iii)	<p>1 <u>all</u> are in same <u>family</u> as all, are closely related ;</p> <p>2 kea and kaka are both, same genus / <i>Nestor</i> ; ora for kakapo</p> <p>3 kea and kaka, are more closely related / share more recent common ancestor, (than with kakapo) ;</p> <p>4 kea and kaka have <u>more</u> genes in common / AW (than with kakapo) ;</p> <p>5 example of genetic similarity (between kaka and kea) evident from Fig 4.1 ;</p> <p>6 differences between, kea and kaka / all three, are great enough for each to be described as a different species ;</p>	4 max	<p>Candidates may refer to <i>individual species using common or scientific names. ACCEPT use of either or both. IGNORE case of initial letter</i></p> <p>1 idea of link between family and close relationship must be made</p> <p>3 ACCEPT ora for less close relationship between kakapo and others</p> <p>4 ACCEPT ora</p> <p>4 Answers must refer to genes / genetics / DNA</p> <p>4 IGNORE cytochrome c</p> <p>5 E.g. kaka and kea both brown / kaka and kea both have similar shaped beaks</p> <p>5 IGNORE unqualified references to appearance</p>
(c) (i)	differences ; in / <u>within</u> / <u>between</u> , species ;	2	ACCEPT within a population

Question	Answer	Marks	Guidance
(c) (ii)	genetic differences / different alleles / inherited differences ; environment / diet / disease ;	2	Mark the first suggestion on each prompt line. ACCEPT different genes ACCEPT mutation ACCEPT sex IGNORE 'different habitat'
(c) (iii)	only small number have been sampled / AW ; <i>idea that individuals sampled may not be representative of population ;</i> data collected when population was larger / smaller population may mean range has changed ;	2	Mark the first two reasons – ignore prompt lines. ACCEPT 'whole population has not been sampled'. IGNORE rare unqualified ACCEPT larger ones more likely to be caught / measured ACCEPT individuals sampled from one area might be different from average of whole population

Question	Answer	Marks	Guidance
4 (d)	<p>Name</p> <p>1 <u>speciation</u> ;</p> <p><i>Mechanism – max 2 marks</i></p> <p>2 <u>isolation / separation</u>, (of populations) ;</p> <p>3 further detail of isolating mechanism ;</p> <p>4 mutation / genetic variation ;</p> <p>5 natural selection / description of natural selection ;</p> <p>6 <u>different selection pressure(s)</u> (in different environment) ;</p> <p>7 (enough) time to allow changes in population to prevent interbreeding / AW ;</p>	3 max	<p>1 IGNORE 'natural selection' on name line</p> <p>2 IGNORE barrier</p> <p>3 e.g. river, mountain, reproductive, geographical, temporal, polyploidy, qualified barrier</p> <p>3 IGNORE allopatric / sympatric unqualified</p> <p>5 description must mention differential survival and genes being passed on</p> <p>6 IGNORE selection pressure unqualified</p> <p>6 'different' can be described using an example</p>
	Total	19	

Question	Expected Answer	Mark	Additional Guidance																
5 (a)	<table border="1"> <thead> <tr> <th data-bbox="316 1420 496 1794">statement</th> <th data-bbox="316 1093 496 1420">DNA only (D) or RNA only (R) or both DNA and RNA (B)</th> </tr> </thead> <tbody> <tr> <td data-bbox="496 1420 592 1794">contains thymine</td> <td data-bbox="496 1093 592 1420">D</td> </tr> <tr> <td data-bbox="592 1420 687 1794">contains ribose</td> <td data-bbox="592 1093 687 1420">R</td> </tr> <tr> <td data-bbox="687 1420 783 1794">consists of 2 chains connected to each other with hydrogen bonds</td> <td data-bbox="687 1093 783 1420">D</td> </tr> <tr> <td data-bbox="783 1420 879 1794">has a sugar-phosphate backbone</td> <td data-bbox="783 1093 879 1420">B</td> </tr> <tr> <td data-bbox="879 1420 975 1794">has 4 different nitrogenous bases</td> <td data-bbox="879 1093 975 1420">B</td> </tr> <tr> <td data-bbox="975 1420 1070 1794">contains a pentose sugar</td> <td data-bbox="975 1093 1070 1420">B</td> </tr> <tr> <td data-bbox="1070 1420 1182 1794">is found in the nucleus and cytoplasm</td> <td data-bbox="1070 1093 1182 1420">R</td> </tr> </tbody> </table>	statement	DNA only (D) or RNA only (R) or both DNA and RNA (B)	contains thymine	D	contains ribose	R	consists of 2 chains connected to each other with hydrogen bonds	D	has a sugar-phosphate backbone	B	has 4 different nitrogenous bases	B	contains a pentose sugar	B	is found in the nucleus and cytoplasm	R	6	Award 1 mark for each correct row DO NOT CREDIT if more than one letter in a box
statement	DNA only (D) or RNA only (R) or both DNA and RNA (B)																		
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Question	Expected Answer	Mark	Additional Guidance
5 (b) (i) 1	(information used to) decide which, group / taxon, organism / species / named example, fits in ;		1 answers must refer to the information provided by the study of DNA, rather than simply the job of taxonomists, e.g. ACCEPT 'it can be used to put organisms into groups' 1 IGNORE 'for classification' unqualified – look for idea of: groups 1 CREDIT ref to belonging to same taxonomic group, e.g. 'to see if it belongs in the genus <i>Homo</i> '
2	compare the proportion of (different) bases ;		2 IGNORE 'examine proportion of bases' 2 CREDIT idea for looking at similarities / differences
3	compare the DNA / genes / sequence of bases ;		3 IGNORE 'examine sequence of bases' 3 CREDIT idea for looking at similarities / differences
4	idea of: the more similar the, DNA / genes, the closer the relationship / AW ;	2 max	4 Must contain reference to similarity of DNA
5 (b) (ii) 1 2 3	fossil record ; anatomy / physiology / behaviour ; embryology / AW ;		Mark the first <u>two</u> suggestions IGNORE ref to genetics as DNA is 'biochemical'
5 (c) J ; T ;		2 max 2	2 ACCEPT AW for anatomy, e.g. observable / physical features / cell structure 2 ACCEPT AW for physiology, e.g. method of reproduction DO NOT CREDIT names

Question	Expected Answer	Mark	Additional Guidance
5	(d)		
	1 no DNA from living specimens in Wales analysed ;		
	2 population (may have) <u>evolved</u> / mutations have occurred / genetic variation, (since 1948) ;	1 max	2 ACCEPT description of evolved 2 DO NOT CREDIT 'evolution' unqualified by context of pine marten population
5	(d)		
	(ii)		
	1 (introduced) pine martens might not be adapted to local conditions / AW ;		ACCEPT animals as AW for pine martens throughout answer 1 ACCEPT not adapted to the habitat 1 DO NOT CREDIT 'used to'
	2 (local) <u>habitat</u> , might have changed / is no longer suitable (for any pine martens) / AW ;		
	3 introduced, pine martens, might <u>outcompete</u> native, population / pine martens ;		3 ACCEPT introduced pine martens might kill native / Welsh pine martens 3 IGNORE 'compete' unqualified
	4 introduced pine martens might bring disease ;		
	5 Welsh pine marten would lose its, distinctiveness / identity, because of <u>interbreeding</u> ;	1 max	
		14	
		Total	

Question	Expected Answer	Mark	Additional Guidance
2 (a)	placing, living things / organisms / named organisms, into, groups / categories / taxa / named taxonomic groups ; based on / AW, similarity / difference ;	2	ACCEPT 'grouping living things' Look for the idea of similar organisms being placed in the same group or different organisms being placed in different groups
2 (b) (i)	1 morphology / anatomy / (observable / physical) features / appearance / AW ; 2 biochemistry / cytochrome C ; 3 genes / DNA / genetics / RNA ; 4 behaviour / physiology / embryology ; 5 idea of shared, evolutionary past / phylogeny ;	3 max	ACCEPT suitable examples for mps 1 to 4 1 CREDIT cell features e.g. nucleus / membrane-bound organelles / cell wall / prokaryotic-eukaryotic features / unicellular 2 CREDIT component of cell wall 3 IGNORE chromosomes 4 ACCEPT 'how they feed' / nutrition / 'how they reproduce' 5 ACCEPT 'how closely related' IGNORE refs to interbreeding / fertile offspring
2 (b) (ii)	T S R W U Q ; ;	3	Mark the order of letters (ignoring the dotted lines) All 6 in correct order = 3 marks If any incorrect, then credit T S in order at beginning = 1 mark U Q in order at end = 1 mark R before W anywhere in the sequence = 1 mark

Question	Expected Answer	Mark	Additional Guidance
2 (c)	<p>1 <u>3</u> domains AND <u>5</u> kingdoms ;</p> <p>2 domains are, bacteria / eubacteria, AND, archaea / archaeobacteria, AND, eukarya / eukaryotes ;</p> <p>3 kingdoms are prokaryotes AND protocists AND fungi AND plants AND animals ;</p> <p>4 eukaryotes split into different kingdoms / all eukaryotes are in the same domain ;</p> <p>5 all prokaryotes are in the same kingdom / prokaryotes split into different domains ;</p> <p>6 domain classification based on, rRNA / ribosomes / RNA polymerase / protein synthesis / enzymes / flagella / membrane structure ;</p>	<p>4 max</p>	<p>ACCEPT phonetic spellings throughout ACCEPT alternative terms for names of kingdoms and domains throughout (e.g. plants / plantae)</p> <p>2 ACCEPT 'eukaryota'</p> <p>3 DO NOT CREDIT protists / protozoa</p> <p>6 IGNORE RNA unqualified DO NOT CREDIT other forms of RNA ACCEPT any detail of protein synthesis</p>
Total		12	

Question	Expected Answers	Marks	Additional Guidance
5 (a) (i)	nucleus / nuclei ;	1	<i>If more than 1 answer given = 0</i>
5 (a) (ii)	<i>mildew ...</i> (usually) chitin / not cellulose (cell) , wall ; <u>external</u> digestion / secretes enzymes <u>externally</u> ; heterotrophic / saprophytic / saprotrophic / saprobiont ; no , plastids / chloroplasts / amyloplasts ; spores ; hyphae / mycelium ; multi-nucleate / coenocytic / aseptate ;	2 max	<i>If 1st statement INCORRECT, max 1</i> Must be external or outside or equivalent CREDIT syncytium / syncytial
5 (a) (iii)	<i>pear tree ...</i> <u>cellulose</u> cell walls ; multicellular ; has , chloroplasts / plastids / chlorophyll / photosynthetic pigment ; (photo)autotrophic / <u>performs</u> photosynthesis ;	2 max	<i>If 1st statement INCORRECT, max 1</i> IGNORE any references to vacuoles or other organelles 'makes its own food' is not enough
5 (a) (iv)	Protoctista / Protoctist(s) ; Animalia / animal(s) ;	2	CREDIT in either order DO NOT CREDIT Profista / Protist <i>look for the 'c'</i>

Question	Expected Answers	Marks	Additional Guidance
5 (b) (i)	<p>discontinuous ;</p> <p>single / few , genes ;</p> <p><u>qualitative</u> ;</p> <p>discrete categories / either low or high resistance / no intermediates ;</p> <p>no / small / little , environmental effects ;</p>	1	<p>CREDIT at any point in the answer</p> <p>IGNORE genetic</p> <p>CREDIT a description of discontinuous variation (to max.2) even if the type of variation given is incorrect.</p>
5 (b) (ii)	<p>artificial <u>selection</u> / <u>selective</u> breeding ;</p> <p>cross / breed , Iranian / resistant , wheat with , high yield / UK , wheat ;</p> <p>method to prevent self , pollination / fertilisation ;</p> <p>select , best offspring / offspring with good yield and resistant ;</p> <p>(back) cross to high yield (UK) wheat / interbreed best offspring / interbreed offspring with both characteristics ;</p> <p>idea of breeding (and selecting) for many generations ;</p>	2 max	<p>CREDIT 'large / only , genetic effect'</p>
5		3 max	<p>IGNORE country incorrectly linked to characteristic as long as the correct cross has been described e.g. removing anthers / bag stigma</p>

Question	Expected Answers	Marks	Additional Guidance
5 (c)	<p>genetic variation ;</p> <p>(due to) mutation ;</p> <p>(mutation is) spontaneous / random / pre-existing ;</p> <p>(due to) <u>sexual</u> reproduction ;</p> <p>mildew fungus produces large numbers of , spores / gametes / offspring ;</p> <p>wheat resistance acts as a <u>selection pressure</u> ;</p> <p>(individuals that overcome resistance) have selective advantage / are more likely to survive ;</p> <p>pass on , mutation / (mutated) allele (to offspring) ;</p> <p>increase in allele frequency (of allele to overcome resistance) ;</p>	4 max	<p>IGNORE 'survival of the fittest' as this is not an explanation</p> <p>CREDIT ora for those with selective disadvantage</p> <p>ALLOW gene characteristic / ability</p> <p>DO NOT CREDIT</p>
	Total	17	