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

(a) define the term *variation*;
(b) discuss the fact that variation occurs within as well as between species;
(c) describe the differences between continuous and discontinuous variation, using examples of a range of characteristics found in plants, animals and microorganisms;
(d) explain both genetic and environmental causes of variation;
(e) outline the behavioural, physiological and anatomical (structural) adaptations of organisms to their environments;
(f) explain the consequences of the four observations made by Darwin in proposing his theory of natural selection;
(g) define the term *speciation*;
(h) discuss the evidence supporting the theory of evolution, with reference to fossil, DNA and molecular evidence
(i) outline how variation, adaptation and selection are major components of evolution;
(j) discuss why the evolution of pesticide resistance in insects and drug resistance in microorganisms has implications for humans

Question	Answer	Marks	Guidance
8		6	

Biological Term	Description
Natural Selection	The theory proposed by Darwin on the evolution of species
Speciation	The formation of a new species ;
Continuous variation ;	Differences between individuals that cover a range of values rather than discrete categories
Adaptation	a variation that increases the chances of survival ;
Binomial ;	A system of naming organisms that uses two scientific (Latin) names for species
ex situ ;	The type of conservation of which seed banks are an example
Environmental Impact Assessment / EIA ;	A study carried out by a local planning authority in order to judge the effect of a development on the biodiversity of an area

IGNORE 'founding a new species'
IGNORE refs to classification / naming
ACCEPT descriptions of mechanism of speciation

ACCEPT 'something that helps survival'

DO NOT CREDIT 'EIA' if wrong words given
IGNORE 'environmental impact survey'

			Total	**6**	

Question			Answer	Marks	Guidance
3	(a)		1 natural / directional , selection ;	4 max	
			2 mutation ;		2 **DO NOT CREDIT** if implied as a consequence of selection pressure
			3 (mutation / genetic variation, is) random / due to chance / spontaneous / pre-existing ;		
			4 selection pressure is lack of / competition for , food / prey ;		4 **ACCEPT** 'selection pressure is ability to hunt' 4 **ACCEPT** 'selective pressure'
			5 individuals with mutation(s) / allele(s) / gene(s) (for echolocation) , survive ; **ora**		5 **IGNORE** refs to breeding / reproduction 5 **ACCEPT** 'individuals that can echolocate survive' **ora** 5 **DO NOT CREDIT** if answer implies that echolocation is a learned behaviour
			6 (echolocation) allele(s) / gene(s) / mutation(s) , passed on (to next generation) ;		6 **IGNORE** 'genetic trait(s)'
			7 over many generations frequency of , echolocation / allele / characteristic , increases ;		7 Answers must imply multiple generations 7 **ACCEPT** 'over time' as an alternative to 'over many generations' but must be further qualified
	(b)	(i)	*Pipistrellus* ;	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 'P' **DO NOT CREDIT** if species name given as well

Question			Answer	Marks	Guidance
3	(b)	(ii)	similar / same, (body) mass ; similar wingspan ; similar / same, colour ; all characteristics , similar / same, except echolocation / wingspan ; previously unable to measure echolocation (frequency) ;	1 max	**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** 'similar appearance' **ACCEPT** 'both 5.5 g' **IGNORE** 'same' **ACCEPT** 'almost the same' or 'small difference' or ref to figures **ACCEPT** 'both (medium to dark) brown'
	(b)	(iii)	**1** genetics / genes / DNA ; **2** RNA ; **3** amino acid sequences ; **4** cytochrome C / fibrinopeptide ;	2 max	**Mark the first two answers only.** **1 IGNORE** chromosomes **1 ACCEPT** (named) bases **1 or 2 CREDIT** 'nucleotide sequence / polynucleotide base sequence' for 1 mark if neither of mp 1 nor mp 2 have been awarded **3 ACCEPT** primary structure of polypeptide **4 ACCEPT** haemoglobin

Question			Answer	Marks	Guidance
3	(b)	(iv)	(inter)breed / AW ; determine if offspring are fertile ; if offspring are infertile / no offspring produced, then different species ; **ora**	2 max	**ACCEPT** 'mate' / 'reproduce' **CREDIT** 'observe to see if populations are reproductively isolated' as resitting A2 candidate might consider phylogenetic species definition This mark is for assessing the fertility of the offspring 'if they belong to the same species they will be able to breed with each other and produce fertile offspring' = 2 marks (1st and 3rd)

Question			Answer		Marks	Guidance
3	(c)		***Most marks** (apart from **C2, C5** and **D5**) are stand alone and do not need to be linked to context. However, **max 5** if any statements are mismatched.*		6 max	*For example* ' some variation is controlled by only one gene this variation will have intermediates' **AWARD D2** and **C4** but **max 5** for the whole question and **DO NOT AWARD QWC** and put **CON** in the margin
			C1	continuous ;		
			C2	(continuous / AW , is) effect of , many genes / polygenic / genes and environment / genetic and environmental / environment ;		**C2 IGNORE** alleles **C2 IGNORE** example of environmental factor, e.g.diet **C2** Must be linked to context of continuous variation
			C3	quantitative ;		**C3** No ora for discontinuous
			C4	there is a range / any value is possible / intermediate values / no distinct groups / AW ;		
			C5	*example* to illustrate any C marking point ;		**C5 must be linked to another C mark** **CREDIT** only , body mass / wingspan / colour / range of pitch within species
			D1	discontinuous ;		
			D2	(effect of) one / few, genes ;		**D2 ACCEPT** 'there is a gene for pitch' or 'there are high-pitched and low-pitched alleles' **D2 ACCEPT** any suggestion of a low number of genes **D2 IGNORE** 'variation is genetic'
			D3	little / no, environmental effect ;		**D3 ACCEPT** 'only influences by genes' / AW **D3 IGNORE** unqualified refs to genes
			D4	discrete categories / no intermediates / AW ;		**D4 ACCEPT** 'set groups'
			D5	*example* to illustrate any D marking point ;		**D5 Must be linked to another D mark** **D5 CREDIT** only these examples: low-pitched or high-pitched / pitch variation between species / sex / no bat call between 47 and 52 Hz **D5 IGNORE** 'colour' as an example to support a D mark

Question			Answer	Marks	Guidance
3	(c)		**QWC** – Award for successfully relating continuous or discontinuous variation to the effect of genes or environment ;	1	Award if candidates have been awarded **either** **C2 and any other C mark** **or** **D2 / D3 and one of D1, D4 or D5** **DO NOT AWARD QWC** if any mark has been given in the wrong context
			Total	**17**	

Question			Answer	Marks	Guidance
6	(a)		<table><tr><td>Characteristics are passed on to the next generation</td><td>W</td><td>;</td></tr><tr><td>There is a struggle for existence</td><td>Y **and** Z</td><td>;</td></tr><tr><td>Individuals with beneficial characteristics are among the few who survive</td><td>X **and** Y **and** Z</td><td>;</td></tr></table>	3	**DO NOT CREDIT** if letter is unclear **DO NOT CREDIT** if more than one letter is given **DO NOT CREDIT** if an incorrect letter is given **DO NOT CREDIT** if an incorrect letter is given
	(b)		MRSA / it, is harder to treat / may become untreatable ; potential for, disease outbreak / epidemic / pandemic / killing many people ; developing new / more powerful, antibiotics, is expensive / takes time ;	2 max	**ACCEPT** MRSA / it, can't be killed (by antibiotics) **ACCEPT** antibiotics will no longer work on, MRSA / it **IGNORE** new antibiotics are hard to discover

Question			Answer		Marks	Guidance
6	(c)		1	fossils show that organisms have changed over time ;	3	**1 CREDIT** many fossil organisms dissimilar from modern organisms
			2	*idea that* fossils or rocks can be dated ;		**2 ACCEPT** idea of fossils in chronological order
			3	*idea of* fossils showing intermediate forms / sequences ;		**3** e.g. *Archaeopteryx* / *Tiktaalik* / horse **3** general trend from, small / simple, to, large / complex
				Total	8	

Question			Expected Answers	Mark	Additional Guidance
6	(a)	(i)	3 parts to body ; head + thorax + tail ; segmented ; lateral spines / spines from both sides of head ; thorax / tail , similar shape ;	3 max	**Mark the first answer on each numbered line.** **ACCEPT** wherever seen **ACCEPT** 'a lateral spine' **ACCEPT** description of thorax / tail shape
6	(a)	(ii)	anterior spine (from head) on A ; longer lateral spines on B ; less rounded / AW , head on B ; any other reasonable difference ; ;	2 max	**Mark the first answer on each numbered line.** Answers must state either species A or species B **ACCEPT** ora throughout e.g. (greater) fusion of tail segments in B grooves around edge of head in B outline of tail section (more) curved in A A has more segments **CREDIT** any clear description of a difference
6	(b)		**1** *idea of* fossils show changes over time ; **2** *idea that* there are methods to date fossils ; **3** *idea of* simplest / most different from modern , species / AW , in oldest rocks ; **4** *idea of* showing , links / relationships , between , groups / species / organisms / taxa ; **5** many fossils organisms no longer exist ; **6** *idea of* compare DNA extracted from some fossils ;	2 max	**2** **ACCEPT** it is possible to date fossils **4** **ACCEPT** ref to common ancestor of two species Answers could refer to links between species A and species B
			Total	[7]	

Question			Expected Answers	Marks	Additional Guidance
3	(b)	(ii)	*with inhibitor* **1** inhibitor / sulfonamide, can, fit / block / bind to / compete for, active site ; **2** (occupies it) for a short time / temporary / reversibly ; **3** fewer active sites available (for substrate) / AW ; **4** (idea of) more substrate reduces chance of inhibitor getting in;	**2 max**	**3 ACCEPT** substrate can't access active site **4 ACCEPT** more ESC formed in context of overcoming inhibition / substrate can out-compete inhibitor
3	(c)		**1** mutation ; **2** sulfonamide is selective, agent / pressure ; **3** resistant survive / non resistant die ; **4** (resistance) allele / gene / mutation, passed to, offspring / next generation ; **5** (happens) over many generations ; **6** AVP ;	**4 max**	**DO NOT CREDIT** immune for **any** mark point **3 IGNORE** refs to (survivors) breed / reproduce ; **5 IGNORE** refs to time. Look for generations **6** e.g. mutation is, **random** / spontaneous allele / gene, passed on by, plasmids / horizontal transmission
3	(d)	(i)	bacteria, killed / destroyed / cannot grow / lyse, in presence of antibiotic ;	**1**	**DO NOT CREDIT** 'antibiotic works better' **or** 'there are no bacteria there' **or** 'bacteria are broken down'
3	(d)	(ii)	streptomycin ;	**1**	**IGNORE** '4' as it is the number rather than the name

Question			Expected Answers	Marks	Additional Guidance
3	(d)	(iii)	1 cheap / AW ; 2 (test is) quick to carry out / (deals with several antibiotics) at same time / AW ; 3 (idea of) allowing early treatment of patient ; 4 (idea of) compares antibiotics under same conditions ; 5 (correct antibiotic first time) to prevent antibiotic resistance developing ;	3 max	**DO NOT CREDIT** responses which simply refer to selecting the best antibiotic 2 **DO NOT CREDIT** speed of antibiotic action
3	(e)		(new) drugs come from (named) organisms ; biodiversity is reducing ; habitats / named habitat, destroyed / lost ; reason for habitat destruction ;	2 max	**ACCEPT** plants / animals / fungi / species / etc. **ACCEPT** deforestation / natural environment lost e.g. global warming logging fuel crops construction / industrialisation mining fishing pollution tourism **ACCEPT** any other valid reason that will destroy natural habitats but **not** general statements such as 'human development' or 'business'
			Total	20	