

GCE

Geology

Unit **F795**: Evolution of Life, Earth and Climate

Advanced GCE

Mark Scheme for June 2016

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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.

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Annotations

Annotation	Meaning
	Benefit of doubt given
	Incorrect response
	Error carried forward
	Ignore
	Reject
	Benefit of doubt not given
	Omission mark
	Correct response
SEEN	Point has been noted, but no credit has been given (big)
MAX	

Abbreviations, annotations and conventions

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

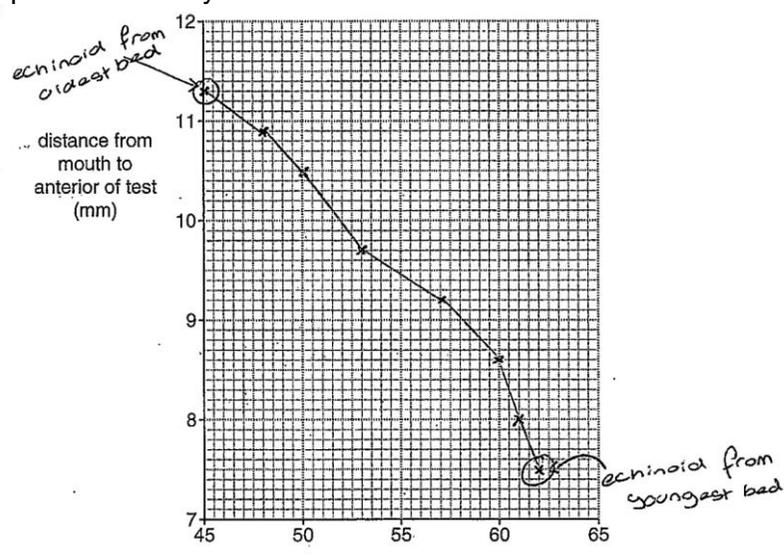
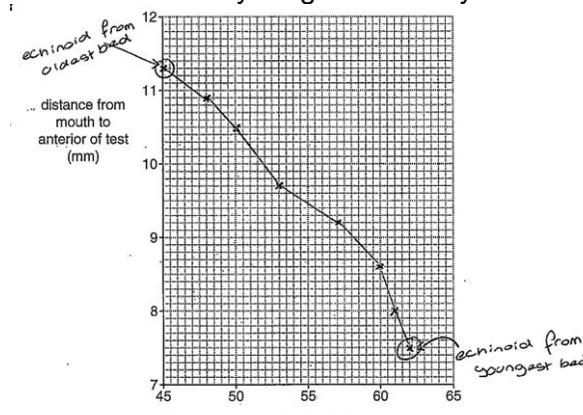
Question		Answer/Indicative content	Mark	Guidance
d	ii	<p>Fossil A</p> <p><u>Description of Mode of life</u> Any one point</p> <ul style="list-style-type: none"> • benthonic attached (to substrate); • epifaunal attached (to substrate); • sessile attached (to substrate); • lived in a high energy environment; • lived in turbulent waters; • particle / filter feeder. <p><u>Explanation</u> Any one point</p> <ul style="list-style-type: none"> • has a (pedicle) foramen / pedicle opening from which a pedicle emerges to attach to substrate; • has a (pedicle) foramen / pedicle opening as pedicle needed to withstand high energy; • has a (pedicle) foramen / pedicle opening as pedicle allows alignment in the current for feeding. <p>Fossil B</p> <p><u>Description of Mode of life</u> Any one point</p> <ul style="list-style-type: none"> • freelying; • benthonic lying on the substrate; • epifaunal lying on the substrate; • sessile lying on substrate; • lived on fine grained sediment; • lived in a low energy environment; • lived on soft substrate. <p><u>Explanation</u> Any one point</p> <ul style="list-style-type: none"> • heavy shell to spread mass on substrate; • thick shell to weigh shell down on substrate; • wide shell (with low centre of gravity) to remain stable on substrate; • spines anchored shell into sediment; • spines prevent sinking into the sediment; • spines for protection; • upturned edge keeps clear of sediment OR upturned edge for more efficient feeding. 	<p>1</p> <p>1</p> <p>1</p>	<p>1 mark max for correct mode of life stated with no description for both fossils A and B eg just benthonic for both A and B</p> <p>Mark diagrams as text</p> <p>AW eg muscle / stalk</p> <p>AW eg resting</p> <p>ALLOW hollow tubes as alternative to spines</p>
Total			14	

Question			Answer/Indicative content	Mark	Guidance
2	a	i	Any one point <ul style="list-style-type: none"> • traces of an animal's activity; • traces of animal behaviour; • traces of plant roots; • made by an animal but animal not preserved. 	1	
	a	ii	Any two points <ul style="list-style-type: none"> • (burrowing / infaunal) bivalve; • crustacean; • irregular echinoid; • worms. 	1	ALLOW any named organism which lives / lived in a vertical burrow eg inarticulate brachiopod lingula but not just brachiopod ALLOW two correct named fossils
	a	iii	Any one point <ul style="list-style-type: none"> • sediment is soft enough to allow burrowing; • sediment is mud / fine sand / silt which allows burrowing; • oxygen levels on the sea floor high enough to support life; • energy levels must have been high as organisms lived in burrows; • energy levels must have been low as burrows are preserved • energy level cannot be determined as conditions in burrows are different to those out of the burrows; • conditions may have changed between deposition of sediment and habitation by organism; • rapid deposition to infill / preserve the burrow. 	1	

Question	Answer/Indicative content	Mark	Guidance
a iv	<p>Size of sediment particles OR degree of sorting of sediment AND Coarse grains usually mean higher energy OR fine grained sand, silt or mud usually mean lower energy OR poorly sorted grains means changing energy OR poorly sorted grains means rapidly deposited ORA</p> <p>Grain shape AND Angular grains means little transport ORA Evidence of sedimentary structures AND High energy / palaeocurrent direction indicated by cross-bedding OR low / medium energy / palaeocurrent direction indicated by presence of ripples OR desiccation cracks show environment had limited water / arid OR flute casts shows turbulent water / palaeocurrent direction OR imbricate structure shows fluvial environment / palaeocurrent direction</p> <p>Colour of sediment AND Red sediment shows oxidation / arid / desert OR green sediment may show reducing conditions OR black sediment means anoxic conditions</p> <p>Alignment / orientation of fossils (eg belemnites) AND Indicates direction of palaeocurrents</p> <p>Life assemblage OR death assemblage AND Life assemblage indicates low energy conditions OR death assemblage indicates high energy conditions</p> <p>Fragmented fossils OR complete fossils AND Fragmented indicates high energy conditions OR complete fragments indicates low energy conditions</p>	2	<p>Evidence and reason need to be matched in pairs for full mark</p> <p>Max 1 for stating two pieces of evidence without explanation</p> <p>Max 1 for two explanations without stating the evidence</p> <p>ACCEPT two sedimentary structures for 2 marks</p>

Question		Answer/Indicative content	Mark	Guidance
a	v	<p>Any two points</p> <ul style="list-style-type: none"> • trilobite walked along the surface leaving a track / Cruziana; • scratches / track / Cruziana at top made by legs / gills; • trilobite rested on the surface leaving a trace / Rusophycous; • Rusophycous / oval marks / hollows / impressions / imprints are resting traces (as arthropod settles on surface); • Rusophycous / oval marks / hollows / impressions / imprints sometimes have impressions of gills or legs preserved; • Infilled with fine grained sediment; 	2	<p>Mark labels on diagram as text</p> <p>Max 1 if just state walking trace and resting trace with no detail</p>
b		<p><i>Archaeopteryx</i> OR bird like reptile with feathers</p> <p>Any three points</p> <ul style="list-style-type: none"> • lake cut off from sea in warm conditions; • evaporating water from the lake increases the salinity of the water (brine); • hypersaline / brine lake could not support life; • stratified conditions meant that the lake bottom was anoxic; • no currents to break up organisms OR low energy so not broken up; • organisms falling into the lake were trapped / killed / buried in carbonate mud; • scavengers unable to reach dead organisms to feed upon OR no bacteria available on the bottom to decay dead organisms; • fine detail preserved by the carbonate mud. 	1 3	<p>ALLOW any correctly named exceptionally preserved organism from the Solnhofen / Solenhofen Limestone</p> <p>ALLOW lagoon instead of lake / inland basin / barred basin</p>
c		<p>Any one point: Insects, spiders, flies, wasps, bees, beetles, small lizards, frogs, mites</p> <p>Animal gets stuck / covered / trapped / encased / caught in resin AND Covered so can't escape OR resin hardens / solidifies preserving fine detail OR no decay as oxygen is excluded OR animal not broken up (as they are trapped in resin)</p>	1 1	<p>DO NOT ALLOW parts of organisms such as feathers.</p> <p>DO NOT ALLOW sap AW</p>
Total			13	

Question			Answer/Indicative content	Mark	Guidance
3	a	i	<u>Tubercle</u> Labelled on fossil C as raised centres of interambulacral plates <u>Position of anus</u> Labelled in centre of fossil C, shaded pale grey <u>Anterior groove</u> Labelled on fossil D, in depression on top of diagram	2	3 correct = 2 marks 1 or 2 correct = 1 mark Only allow anus correctly labelled on fossil C
		ii	Interambulacra plate circled on both diagrams OR interambulacra shaded on both diagrams	1	Any plate shaded which does not contain pore pairs or is part of the apical system DO NOT ALLOW whole area or multiple plates circled
		iii	C = Regular AND D = Irregular	1	Both C and D correct for 1 mark

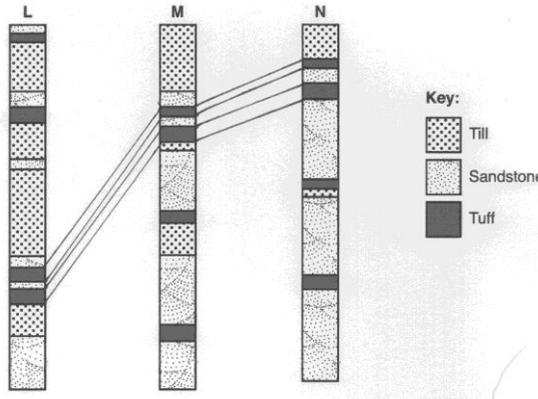
Question	Answer/Indicative content	Mark	Guidance
<p>b i</p>	<p>Graph plotted correctly</p> 	<p>2</p>	<p>1 to 3 points plotted correctly = 0 4 to 6 points plotted correctly with line drawn = 1 mark 7 or 8 points plotted correctly with line drawn = 2 marks</p> <p>Max 1 if 7 or 8 points plotted correctly but no line</p> <p>Max 1 if 7 or 8 points plotted correctly but incorrect line</p> <p>line may be extended to x axis</p>
<p>b ii</p>	<p>Maximum length of test = 54.5 OR 5.5 AND Distance from mouth to anterior of test = 9.5 OR 9.46</p>	<p>1</p>	<p>Both calculations correct for 1 mark</p>
<p>b iii</p>	<p>Oldest and youngest correctly labelled shown on the graph</p> 	<p>1</p>	

Question	Answer/Indicative content	Mark	Guidance
iii	<p><u>Mode of life</u> Any one point</p> <ul style="list-style-type: none"> • benthonic AND infaunal; • benthonic AND lived in soft sediment; • benthonic AND shallow burrower. <p><u>Evidence</u></p> <ul style="list-style-type: none"> • eyes on stalks could protrude above the sediment; • eyes on stalks could help overcome low visibility in turbid water; • eight pleura and large pygidium may have allowed enrolment for protection; • smooth / streamlined shape for moving through sediment. <p>ALTERNATIVE ANSWER</p> <p><u>Mode of life</u> Any one point</p> <ul style="list-style-type: none"> • benthonic AND epifaunal; • benthonic AND walked on sediment. <p><u>Evidence</u> Any one point</p> <ul style="list-style-type: none"> • many / eight pleura so many legs OR could walk; • many pleura so could enrol; • eyes on stalks for turbid water. 	<p>1</p> <p>1</p>	<p>1 mark for mode of life 1 mark for reason using evidence in the diagrams</p> <p>ALLOW nektonic OR swam in the water column</p> <p><u>Evidence</u> Eight pairs of legs legs meant it could swim; Large pygidium helps it to float; eyes on stalks allowed the trilobite to see above and below it whilst swimming; smooth / streamlined shape for swimming.</p>
iv	<p>Any two points</p> <ul style="list-style-type: none"> • may have housed sensory hairs OR may have had sensory function; • may have detected chemicals; • may have detected currents; • may have detected vibrations OR detected movement; • may have detected temperature; • have had a respiratory function; • have been used in filter feeding. 	2	
c	<p>i</p> <p>1 = compound eye OR lens</p> <p>trilobite can see OR for vision OR detect the environment OR to see predators OR to see prey OR to detect movement</p>	<p>1</p> <p>1</p>	

Question			Answer/Indicative content	Mark	Guidance
	c	ii	Any one point <ul style="list-style-type: none"> • not enough thoracic segments / pleura to be flexible enough to enrol; • too few articulating segments; • exoskeleton inflexible; • growth of pleural spines stops enrolment. 	1	
	c	iii	Any one point <ul style="list-style-type: none"> • walked using jointed limbs / jointed appendages / jointed legs / pairs of legs; • swam just above the sediment / sea floor (using jointed limbs / appendages). 	1	
Total				12	

Question		Answer/Indicative content	Mark	Guidance
5	a	H = Ornithischian J = Saurischian K = Theropod	2	1 correct = 0 marks 2 correct = 1 mark 3 correct = 2 marks
	b	Left hand diagram circled to represent <i>Tyrannosaurus</i> AND Pubis pointing forwards (left) and backwards (right) OR pubis of saurischian pointing forward and ornithischian backwards OR ilium larger in saurischian OR ilium smaller / thinner in saurischian OR left pubis larger than ischium OR right pubis and ischium similar	1	ORA
	c	Any two points <ul style="list-style-type: none"> • (some) dinosaurs had thin walled bones like birds OR some dinosaurs had hollow bones like birds; • (some) dinosaurs had S shaped necks like birds; • (some) dinosaurs had elongate forelimbs like birds; • (some) dinosaurs had feathers like birds; • (some) dinosaurs were warm blooded like birds; • (some) dinosaurs had large eye orbits in skull like birds; • (some) dinosaurs had hinged ankles like birds; • (some) dinosaurs have a reversed big / first toe like birds; • (some) dinosaurs have a pierced acetabulum like birds; • early birds / archaeopteryx have teeth in the skull like dinosaurs; • early birds / archaeopteryx have a bony tail like dinosaurs; • early birds / archaeopteryx had clawed hands like dinosaurs. 	2	Max 1 if two correct bullet points
	d	Any two points <ul style="list-style-type: none"> • has a toothless beak to strip / crop vegetation OR has a horny beak to strip / crop vegetation; • has leaf shaped cheek teeth for mincing / shredding vegetation; • jaw able to grind vegetation due to hinged / flexible / side to side nature; • many small back teeth for grinding vegetation. 	2	Any two features named without a description for one mark

Question		Answer/Indicative content	Mark	Guidance
	e	Any two points <ul style="list-style-type: none"> • extremely long neck to reach vegetation; • <u>peg</u> like teeth at front of jaw for tearing / striping / biting off vegetation; • undifferentiated teeth so could not chew; • presence of gastroliths in stomach area, to grind vegetation in stomach; 	2	AW for gastroliths
Total			9	

Question	Answer/Indicative content	Mark	Guidance
c	<p><u>Problem</u> Metamorphism</p> <p><u>Explanation</u> any one point</p> <ul style="list-style-type: none"> • resetting of the geological clock; • would change the parent / daughter isotope ratio giving a false age; • heats rock allowing argon / gas to escape. <p><u>Problem</u> weathering / erosion</p> <p><u>Explanation</u> any one point</p> <ul style="list-style-type: none"> • water can deposit parent isotope; • argon / gas allowed to escape through pore spaces / joints / fractures / becomes permeable. <p><u>Problem</u> not a closed system</p> <p><u>Explanation</u></p> <ul style="list-style-type: none"> • the daughter isotope can escape due to it being a gas / argon. 	<p>1</p> <p>1</p>	<p>Description and explanation must be linked for 2 marks</p> <p>ALLOW 1 mark for general point e.g. argon is lost but without explanation</p> <p>1 max if two correct problems with no explanation</p>
d	<p><u>Mineral</u> Muscovite mica OR biotite mica OR hornblende OR glauconite OR potash / K feldspar AND <u>Rock type</u> Granite OR diorite OR gabbro OR greensand OR sandstone</p>	<p>1</p>	<p>ALLOW any suitable igneous rock including basalt and dolerite</p>
e	<p>i Any line shown in the diagram below joining either the top or the bottom of the tuff bands</p> 	<p>1</p>	

Question		Answer/Indicative content	Mark	Guidance
e	ii	<p>Any one point</p> <ul style="list-style-type: none"> tuffs as they are events affecting large areas; ash / tuff laid down rapidly over a short time / instantaneous / the same event; tuff contains minerals that can be used in radiometric dating; tuffs are igneous so can be radiometrically dated; tuffs form a sequence OR the tuffs form a pattern. 	1	
e	iii	<p><u>Description</u></p> <ul style="list-style-type: none"> More till was deposited at L than M or N ORA Till thickness decreases from L to N ORA L has 4 beds of till, M has 3 beds of till and N has 2 beds of till <p><u>Explanation</u></p> <ul style="list-style-type: none"> L was closer to the ice sheet / glacier ORA; L was close to the glacier and N was fluvioglacial; 4 glacial advances / retreats for L, 3 glacial advances / retreats for M and 2 glacial passes for N; Ice did not advance as far as M or N. 	1 1	General mark for movement of glacier OR lateral variation due to moving glacier
f		<p>Any three points</p> <p><u>Biostratigraphy</u></p> <ul style="list-style-type: none"> zone fossils may be used OR biozones may be used; easier to recognise biozones; use first appearance OR last appearance OR fossil assemblage; zone fossils evolved quickly OR zone fossils have short stratigraphic ranges OR zone fossils give a more precise correlation; some organisms can live in lots of different environments / facies independent making biostratigraphic correlation good. <p><u>Lithostratigraphy</u></p> <ul style="list-style-type: none"> similar rocks may be diachronous making lithostratigraphy a problem ; lithostratigraphy is a problem where you have lateral variation; similar rocks may be different ages and so may be incorrectly matched by lithostratigraphy. 	3	<p>Max marks require advantages of biostratigraphic correlation as well as disadvantages of lithostratigraphic correlation</p> <p>1 mark for 2 correct properties of a zone fossil (easy to recognise / evolved rapidly / widespread / hard parts / numerous)</p> <p>Max 2 for biostratigraphy</p> <p>Max 2 for lithostratigraphy</p>

Question		Answer/Indicative content	Mark	Guidance
	g i	1.2 X 1000 X 2.2 = 2640m Convert to km = 2.64km	1	ALLOW 2.6km
	ii	Any one point <ul style="list-style-type: none"> • different environments lay down sediment at different rates; • compaction of sediment leads to a reduction in thickness, so comparing the two is not realistic; • assumes constant sedimentation which may not be the case OR sedimentation rate varies; • there may be gaps in sedimentation OR times of no deposition; • sediment supply in the river may not be constant; • there may be erosion as well as deposition within a sequence; • rate of deposition varies laterally. 	1	
Total			18	

Question	Answer/Indicative content	Mark	Guidance
7	<p><u>Morphology of Ordovician graptolite</u></p> <ul style="list-style-type: none"> • description of morphological features from stipe as branch of the rhabdosome OR 8 / 4/ 2 stipes; rhabdosome is the whole skeleton; made of scleroprotein; nema an extension of the sicula OR nema is a stiffening rod; sicula conical tube secreted (by the first member of the colony); theca houses a zooid; uniserial with theca on one side of stipe; biserial with thecae on two sides of stipe stipe attitude pendant OR reclined OR horizontal. • labelled diagram of Ordovician graptolite eg <i>Tetragraptus</i>, <i>Didymograptus</i>, <i>glyptograptus</i>, <i>orthograptus</i>, <i>climacograptus</i>, <i>diplograptus</i> 	10	<p>MAX 4 for morphology</p> <p>MAX 3 for good descriptions</p> <p>ALLOW descriptions of virgella, aperture, common canal</p> <p>MAX 3 marks if no diagram is used.</p> <p>ALLOW any Ordovician graptolite diagram</p> <p>ALLOW labels correctly applied in context of graptolite eg pendant</p> <p>MAX 2 marks for labels on a recognisable diagram: 2 correct labels for 1 mark 4 correct labels for 2 marks If poor diagram then 0 marks</p>
	<p><u>Mode of life</u></p> <ul style="list-style-type: none"> • lived in water column OR was planktonic OR pelagic; • (may have been) attached to floating object by nema OR (may have) had a floatation device such as gas filled sac; • colonial as each theca housed a zooid ; • filter feeders (extracting nutrients from particles in water); • may have spiralled as they moved in the water column to feed 		<p>MAX 4 marks for mode of life section</p>

Question	Answer/Indicative content	Mark	Guidance
	<p><u>Preservation</u></p> <p><i>carbonisation</i></p> <ul style="list-style-type: none"> • mass of overlying rocks OR burial increases the pressure and temperature OR causes compaction; • volatiles in rock (gases) escape; • any two volatiles such as CH₄, CO₂, O₂ and H₂O; • carbon content increases; • preserved as a film or 2D. <p><i>pyritisation</i></p> <ul style="list-style-type: none"> • anaerobic / anoxic environment (on sea floor); • bacteria use sulfur to respire OR sulphur fixing bacteria OR sulphur reducing bacteria; • sulfur reduced to bisulfide which reacts with iron in water or environment; • replaces fossil material as pyrites; <p><i>other preservation</i></p> <ul style="list-style-type: none"> • may <i>be exceptionally preserved</i> in 3D scleroprotein / pyrite (when not flattened) ; • may be preserved as clay minerals; • anoxic /anaerobic AND low energy. 		<p>MAX 4 marks for preservation section</p> <p>MAX 2 marks for each preservation method</p> <p>DO NOT ALLOW substitution by calcite</p> <p>1 mark for general comments e.g. low energy and anoxic but not linked to a preservation method</p> <p>max 1 mark for name of two correct preservation methods but no explanation</p>
	Total	10	

Question	Answer/Indicative content	Mark	Guidance
8	<p>volcanism</p> <ul style="list-style-type: none"> • volcanism was from the Siberian traps OR flood basalts erupted onto surface in Siberia; • the largest scale volcanism of all time OR area covered was the size of Europe OR area covered was about two million km² / 2.5 million km²; • eruptions lasted for about a million years so affected life /no chance of recovery; • maximum 3.5 km thick. <p>local effects</p> <ul style="list-style-type: none"> • emission of poisonous / toxic gases killed plants and animals in close proximity to the eruptions; • fire on land as vegetation ignites so habitats were destroyed / animals killed OR fire on land as vegetation ignites so there is little food available ; <p>climate change</p> <ul style="list-style-type: none"> • ash particles emitted lowers global temperatures by blocking out the sun affecting food chains / habitats / reduces photosynthesis; • SO₂ / H₂SO₄ causes a drop in global temperature; • drop in temperature increase masses of ice in the ice caps OR drop in temperature caused global glaciation affecting where organisms could live; • (large scale) emissions of greenhouse gases causes global increases in temperature which affected food chains and habitats OR (large scale) emission of CO₂ causes global increases in temperature which affected food chains and habitats; • increase in ocean temperatures caused the release of methane hydrates / CO₂ raising temperature and affecting food chains and habitats; • global change in climate happened quickly so that organisms could not adapt to live in the environment. 	9	

Question	Answer/Indicative content	Mark	Guidance
	<p>ocean effects</p> <ul style="list-style-type: none"> • global glaciation caused a drop in sea level affecting the shallow water marine dwellers OR global glaciation caused a reduction in continental shelf area affecting the shallow water marine dwellers; • sea level rise during global warming affects marine life; • changing ocean water pH / acidity during eruptions killed organisms; • changes to oceanic circulation as a result of eruption changed environment (so organisms died); • oxygen levels decrease / more anoxic in the oceans which kills organisms. <p>Organisms</p> <ul style="list-style-type: none"> • 90 - 95% of marine organisms became extinct OR 57% of families OR 83% genera; • trilobites OR tabulate corals OR rugose corals became extinct; • foraminifera reduced in numbers OR cephalopods reduced in numbers OR brachiopods reduced in numbers OR crinoids reduced in numbers OR echinoids reduced in numbers OR ammonoids reduced in numbers; • reduced number of plant species OR plants reduced in diversity; • reduction (77%) in tetrapods OR reduction in <u>large</u> amphibians OR reduced number of insects; • planktonic forms less affected by changes as they live in open water; 	2	<p>MAX 9 marks if no organisms are discussed</p>
	Total	10	

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