RECOGNISING ACHIEVEMENT

GCE

Geology

Advanced GCE

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

Mark Scheme for June 2013

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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.

1. **Annotations available in Scoris**

Annotation	Meaning
?	Unclear
BOD	Benefit of doubt given
CON	Contradiction
✗	Incorrect response
ECF	Error carried forward
I	Ignore
NBOD	Benefit of doubt not given
PD	Poor diagram
R	Reject
SEEN	Noted, but no credit given
✓	Correct response
^	Omission mark
MR	Maximum (marks available for) Response

2. **Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific 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	Marks	Guidance
1	(a)	(i)	**A** phylum = Arthropoda **OR** arthropod group = Trilobita **OR** trilobite **B** phylum = Mollusca **OR** mollusc group = bivalve **C** phylum = Mollusca **OR** mollusc group = cephalopod **OR** ammonoid **OR** ammonite **OR** ceratite **OR** goniatite	3	both phylum and group correct for one mark
		(ii)	1 = eye 2 = genal spine 3 = last chamber/body chamber/aperture 4 = protoconch	3	4 correct for 3 marks 3 correct for 2 marks 1 or 2 correct for 1 mark
		(iii)	**fossil A** **feature:** eyes on stalks **reason:** to allow forwards, sideways and backwards vision **OR** to aid seeing **OR** catching prey **OR** 360^{o} vision **feature:** large glabella **OR** inflated glabella **OR** fat filled glabella **reason:** to aid floatation/swimming **OR** for buoyancy **feature:** very small size **reason:** small to stay afloat **OR** for swimming in the water column **feature:** separated spines **OR** separated pleura **OR** large genal spines **reason:** increase surface area for floatation/swimming **OR** to stay afloat in the water column **feature:** good number of pleura **OR** 10 pleura **reason:** showing it had many legs (20) for floatation/swimming **OR** steering	1	the identified morphological feature and reason must be in pairs for 1 mark **DO NOT ALLOW** soft parts or discussion of appendages

Question			Answer	Marks	Guidance
			fossil B **feature:** ribbed shells **OR** corrugated shells **reason:** provides strength without mass/weight **OR** allows it to withstand currents **feature:** has ears extending to the hinge line **reason:** to direct the water currents **OR** improve stability **feature:** large adductor muscle scar **reason:** for flapping valves **OR** swimming **feature:** flat valve shape **OR** thin valves (shells) **reason:** to make swimming easier **fossil C** **feature:** coiled with hydrodynamic shape **OR** rounded/streamlined shaped **reason:** for ease of movement through the water **feature:** centre of buoyancy low **reason:** to remain upright in the water column **feature:** chambered shell **OR** gas and fluids present **OR** siphuncle present **reason:** to allow control of gases and buoyancy **OR** to allow it to move vertically **feature:** ribs/ornamentation **OR** complex suture **reason:** to strengthen shell **OR** allowing movement to greater depth	1 1	the identified morphological feature and reason must be in pairs for 1 mark **DO NOT ALLOW** soft parts the identified morphological feature and reason must be in pairs for 1 mark **DO NOT ALLOW** gas in body chamber
		(iv)	**C** found in open waters so falls out of the water column on death into different sediment types; surface waters where **C** lived did not reflect the sediments at depth; **C** lived in a variety of different environments.	1	any **one**
		(v)	calcite **OR** aragonite **OR** calcium carbonate **OR** $CaCO_3$	1	

Question			Answer	Marks	Guidance
		(vi)	fossil shell could be replaced by the process of pyritisation **OR** fossil shell could be replaced by the process of silicification **OR** fossil composition changed by the process of carbonisation **OR** original material replaced by other correct named <u>mineral</u> **OR** original material replaced by another new mineral	1	**DO NOT ALLOW** aragonite to calcite
	(b)	(i)	recognisable labelled <u>diagram</u> of a graptolite *Didymograptus*/*Tetragraptus*/*Diplograptus* drawn any three labels from sicula, theca, stipe, nema and aperture rhabdosome indicated for whole skeleton	1 2	one mark for clear diagram that shows recognisable separate theca all the way along a minimum of one stipe **ALLOW** pendent, horizontal, reclined or scandent if correctly applied to diagram drawn 1 or 2 labels for 1 mark 3 labels for 2 marks
		(ii)	Silurian graptolites may have more elaborate thecae (hooked, lobate etc) than Ordovician **OR** Ordovician graptolites have simple thecae compared to Silurian; Silurian graptolites may be uniserial **OR** biserial but most Ordovician graptolites are uniserial; Silurian graptolites have one stipe and Ordovician have one or more stipes; theca become more complex over time; Silurian graptolites are scandent and Ordovician are pendant/reclined/horizontal.	1	any **one** point
		(iii)	nema served as a point of attachment to a flotation aid **OR** outlines of possibly gas filled membranes found with graptolites **OR** small size allows them to float	1	**ALLOW** ORA of graptolites have no means of locomotion and must have floated
			Total	**17**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><td>has growth lines parallel to the edge of the shell</td><td>✓</td><td>✓</td></tr>
<tr><td>has a pallial line seen around the margins of the shell</td><td>✓</td><td>X</td></tr>
<tr><td>uses gills for respiration</td><td>✓</td><td>X</td></tr>
<tr><td>has adductor and diductor muscles to open and close the shell</td><td>X</td><td>✓</td></tr>
<tr><td>has cardinal teeth located under the umbo and many teeth and sockets along the hinge line</td><td>✓</td><td>X</td></tr>
</table>
</td><td>4</td><td>5 correct pairs for 4 marks
4 correct pairs for 3 marks
3 correct pairs for 2 marks
2 or 1 correct pairs for 1 mark</td></tr>
<tr><td></td><td>(b)</td><td></td><td>bivalves usually have identical sized valves OR equivalve
AND brachiopods have a larger pedicle valve OR brachiopods have a smaller brachial valve OR brachiopods are inequivalve

bivalves are symmetrical about the hinge line (mirror images) OR bivalves are asymmetrical from umbo to margin
AND brachiopods are symmetrical along a medial plane.</td><td>1

1</td><td>there must be reference to both bivalves and brachiopods for each mark

ALLOW annotated diagrams</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>brachiopods have a lophophore;
lophophore can be a coiled or loop structure;
which has sticky filaments lined with cilia OR a fluid filled sack lined with cilia;
cilia/sticky filaments/mucus collect particles OR filter food;
particles passed to the mouth;
cilia generate currents OR currents are generated;
the lophophore is supported by the brachidium OR spiralia OR brachial loop;
inhalant currents bring in food;
exhalent currents removes waste (generated by the lophophore).</td><td>2</td><td>any four points

4 points for two marks
2 or 3 points for one mark</td></tr>
</table>

Question			Answer	Marks	Guidance
		(ii)	using a muscular foot; bivalve extends foot into the sediment and inflates the end; muscle contracts moving the shell down; the bivalve pulls itself down through the sediment; smooth/streamlined shell to allow movement through the sediment **OR** streamlined shell with growth lines to allow easier movement through sediment.	2	any **two** points **DO NOT ALLOW** foot on its own, must use a descriptive term
		(iii)	gives a large surface area to open shells to allow water in **OR** helps exclude sediment from entering **OR** stops lophophore being damaged by sediment **OR** stops valves from twisting **OR** locks the shells together	1	
	(d)		brachiopods use a pedicle **AND** bivalves use a byssus **OR** brachiopods are pedically attached **AND** bivalves are bysally attached the pedicle is a fleshy stalk **OR** muscular stalk; that protrudes from the pedicle valve/pedicle foramen; this aligns the brachiopod to best collect particles in the current so good for feeding; lacks strength in strong storms. the byssus is a collection of horny threads **OR** threads of protein **OR** thread like organic material; it is flexible allowing movement of bivalves in the current; cannot control the position in the current (not a muscle) so worse for feeding; very strong during a storm.	1 1 1	must have explanations for both the brachiopod and bivalve for three marks
			Total	**14**	

Question			Answer	Marks	Guidance
3	(a)	(i)	Cnidarian **OR** Cnidaria	1	
		(ii)	scleractinian	1	
		(iii)	septum **OR** septa provide strength/support to the structure/corallite	1	must identify feature with a reason for one mark **ALLOW** to increase surface area of the gut to aid digestion
	(b)	(i)	**environmental condition:** shallow depth **OR** clear water **OR** in the photic zone **reason:** so that light penetrates the water for photosynthesis by algae **OR** description of coral symbiotic relationship with zooxanthellae **OR** so photosynthesis can take place (in algae) **environmental condition:** water free from particles/sediment **OR** away from river sources **reason:** so that the polyps are not clogged **environmental condition:** high energy action **reason:** to incorporate oxygen into the water for <u>respiration</u> **environmental condition:** high energy action **reason:** allows upwelling of nutrients **environmental condition:** fully marine conditions **OR** salinity 30–40 parts per thousand **reason:** as corals cannot tolerate a range of salinities **environmental condition:** sea temperature given between 23 and 29^{o}C **reason:** maximise growth **OR** more carbonate in solution	3	any **three** environmental conditions linked to reasons. If a list is simply stated, then a maximum of 1 mark for 3 conditions
		(ii)	assumptions that ancient and modern corals have similar <u>morphologies</u> **OR** using the law of Uniformitarianism **OR** the present is the key to the past **OR** scleractinian corals have lived throughout the Mesozoic to Present with little change	1	

Question			Answer	Marks	Guidance
	(c)	(i)	hot spot activity creates volcanoes and shallow seas colonised by corals **OR** volcano forms an island with shallow seas colonised by corals; hot spot moves away and crust begins to sink **OR** the volcano sinks beneath the sea; coral growth keeps pace with sinking forming reef and coral grows up to form an atoll; **alternative answer** volcanic island colonised by coral to form a fringing reef; volcano sinks (isostatically) (coral grow up at equal rate) to form a barrier reef; volcanic island completely sinks below sea level (coral grows up) to form an atoll;	3	one diagram for each stage 1 mark for each of the 3 stages one mark for diagrams and text showing the general processes max 2 marks if no reference to coral growth
		(ii)	Maldives/New Caledonia/outer islands of the Seychelles/Coral Sea islands/Marshall Islands/Solomon Islands/North-Western Hawaiian Islands/Indian Ocean/Pacific Ocean/Caribbean	1	
	(d)	(i)	high energy **AND** shallow sea environment; high number of thick-shelled fauna to withstand strong currents **OR** few thin smooth shells as they cannot stand the strong currents; a low number of whole fossils suggesting high fragmentation due to strong currents; no graptolites and few nautiloids as they cannot survive in strong currents **OR** corals require high energy.	1 2	**ALLOW** littoral as an alternative to high energy and shallow sea any **two** reasons 1 mark for 2 points of correct general evidence but no mention of strong currents **ALLOW** high energy as an alternative to strong currents in the explanation

Question			Answer	Marks	Guidance
		(ii)	**lithological evidence** coarse grain size; well rounded grains; high maturity **OR** all quartz; named rock of conglomerate/sandstone/oolite/bioclastic limestone; cross bedding/ripple marks; **explanation** coarse grains deposited, whilst finer grains remain in suspension **OR** coarse grains deposited, whilst finer grains transported away; well rounded grains due to a large number of high energy collisions/attrition; quartz is more able to resist changes in the environment (high energy) due to hardness/low chemical reactivity/lack of cleavage; (high energy) description of environment such as shallow (carbonate) seas/shallow clastic seas/reefs/beaches; description of ooliths formed by tidal action **OR** description of bioclastic limestone formed from reef debris on side of reef; sedimentary structures indicate (fast flowing) currents;	1 1	any **two** points of lithological evidence for one mark one mark for the explanation linked to the lithological evidence the lithological evidence and explanation must be linked for two marks description of environment must link directly to lithological evidence stated **ALLOW** vertical or U shaped burrows as (some) vertical burrows protect organisms from currents and indicate set energy levels
		(iii)	79%	1	
		(iv)	low environment energy and no currents for abrasion and attrition **OR** low environment energy and covered in fine sediment **OR** low energy as fossils are not disarticulated/damaged	1	**DO NOT ALLOW** just low energy
			Total	**18**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td><table>
<tr><td>has a test composed of calcite plates</td><td>regular irregular both</td></tr>
<tr><td>has only one plane of symmetry</td><td>regular irregular both</td></tr>
<tr><td>has spines for defence</td><td>regular irregular both</td></tr>
<tr><td>has a fasciole</td><td>regular irregular both</td></tr>
<tr><td>has ambulacra and interambulacra</td><td>regular irregular both</td></tr>
<tr><td>has tube feet</td><td>regular irregular both</td></tr>
</table></td><td>3</td><td>5 correct for 3 marks
4 or 3 correct for 2 marks
2 or 1 one correct for 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>plastron
description: area of tubercles/spines on base OR area between mouth and anus of tubercles/spines OR area of tubercles where small spines are attached

explanation: attachment area for spines OR spines used to dig burrows OR spines for movement

pore pairs
description: (two) <u>holes</u> on the ambulacral (plate) OR <u>holes</u> in the <u>test</u>

explanation: used for tube feet to protrude</td><td>1

1

1
1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>regular – vagrant OR epifaunal
irregular - infaunal OR burrowing</td><td>1</td><td>requires both to be correct for one mark</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>brachia – any of the arms on the top of the diagram
calyx – cup between brachia and stem
stem – between the holdfast and calyx</td><td>2</td><td>three correct for 2 marks
two or one correct for 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>one segment in the stem shaded and labelled</td><td>1</td><td>ALLOW
segments in the brachia</td></tr>
</table>

Question			Answer	Marks	Guidance
		(iii)	fivefold symmetry; composed of plates of calcite **OR** description of calcite skeleton; water vascular system.	1	**DO NOT ALLOW** calcite only
		(iv)	soft parts decay and are not held together **OR** may have lived in a high energy environment	1	
	(c)	**(i)**	fossils with narrow stratigraphic ranges found in different areas can be assumed to be the same age **OR** same evolutionary stages assumed to be the same age **OR** biostratigraphic correlation using zone fossils to match areas **OR** biozones used as correlation between areas **OR** assemblages of particular fossils represent a particular age	1	
		(ii)	same (relative) thicknesses of varves can be matched **OR** sequences can be matched **OR** patterns of bands can be matched	1	
			Total	**15**	

Question			Answer	Marks	Guidance
5	(a)	(i)	Carboniferous — limestones formed in tropical seas, followed by coals formed in deltas associated with foresets Cretaceous — fossil plants indicate a warm and humid climate; ammonites common, but die out at the end of this period Jurassic — clays and limestones which contain some corals are deposited in sub-tropical seas in the south and east of the British Isles Permian — aeolian sandstones deposited in hot deserts. palaeocurrent direction indicates a north easterly wind	3	4 correct for 3 marks 3 correct for 2 marks 2 or 1 correct for 1 mark
		(ii)	coal forms in equatorial areas as it needs hot and wet conditions for rapid growth of vegetation; red/desert sandstones/evaporites form in desert latitudes/dry tropical environments which are about 20°N and 20°S as there are arid areas as a result of the dry winds; limestones which contain corals form in subtropical latitudes about 30°N and 30°S as corals require warm waters of about 25°C; chalk formed in (temperate) latitudes at about 35°N as ‘coccoliths’ required warm conditions; tillites are glacial deposits so formed in polar regions;	2	any **two** explanations of how the lithology is used **MAX** 1 mark for two correct rock types with little explanation **MAX** 1 mark for two correct environments with little explanation
	(b)	(i)	brachiopods	1	
		(ii)	they did not exist at the same time **OR** trilobites were extinct before the ammonites evolved **OR** the time range of Cambrian to Permian for trilobites and Jurassic to Cretaceous for ammonites (do not overlap)	1	**DO NOT ALLOW** answers that just give the data from the graph without explanation

Question			Answer	Marks	Guidance
		(iii)	Permo-Triassic extinction event **subcontinent formation (Pangaea)** fewer continental shelves means increased competition by organisms **OR** caused rapid fluctuations in climate **OR** fewer nutrients brought down from rivers **OR** altered salinity in the oceans as less shallow sea for evaporation; **major volcanic activity** emission of poisonous gases caused acid rain **OR** effect from gases caused rise in temperature **OR** ash lowered global temperature by blocking sunlight **OR** greenhouse gases CO_2/SO_2 cause increase in temperature; **methane hydrates** are solid up to around 18°C then gases are released above this temperature **OR** increases in global temperature releases methane from sediments which causes further warming;	1 2	any **two** causes stated **AND** then described for each mark.
	(c)	**(i)**	**suture type** **H** ceratitic **AND J** ammonitic **geological range** **G** Permian/Triassic **AND J** Cretaceous **suture diagram** **F** nautiloid simple curved line **OR** straight line **AND** ceratitic smooth saddles and crenulated lobes	1 1 1	6 correct for 3 marks 5 or 4 correct for 2 marks 3 or 2 correct for 1 mark
		(ii)	increase attachment area **OR** surface area for strength **OR** increase strength to swim deeper **OR** to allow exploitation of different environments	1	

Question			Answer	Marks	Guidance
		(iii)	in **F** septal necks point towards the protoconch (retrosiphonate) **AND** in **J** they point towards the aperture (prosiphonate) **Alternative answer** In **F** the septal necks are central in the chambers **AND** In **J** they are eccentric or ventral	1	both needed for one mark
		(iv)	to support the siphuncle	1	
			Total	**16**	

Question			Answer	Marks	Guidance
6			**epifaunal benthonic trilobite** many pleura (in the thorax) shows the numbers of pairs of legs for walking on the substrate; many pleura (in the thorax) shows the numbers of pairs of gills for respiration; many pleura so is flexible and can enroll **OR** thorax is flexible and can enroll this is for protection against predators **OR** to protect soft underbelly; pleura extended into spines for protection against predators; crescent shaped **OR** (large) compound eyes **OR** eyes on top of the carapace **OR** complex eyes with many calcite plates to see forwards, sideways and backwards (360^{o} vision); crescent shaped **OR** large compound eyes **OR** eyes on top of the carapace **OR** complex eyes with many calcite plates binocular vision used to detect prey **OR** binocular vision used to scavenge on the sea floor **OR** binocular vision to see predators; large size not streamlined for swimming or floating;	5	answers must be in pairs giving an explanation to gain credit detailed labels on diagrams to be marked as text

Question			Answer	Marks	Guidance
			infaunal benthonic trilobite no eyes was not a hunter, probably fed on organic sediment; no eyes it did not need them as it lived in the dark or a burrow; large cephalic shield **OR** semi circular shape of cephalon to stay stable on the sediment **OR** large surface area to prevent sinking; large cephalic shield **OR** semi circular shape of cephalon may have used it to dig a burrow **OR** may have been used like a shovel; extended genal spines to spread mass on soft substrate ; extended genal spines used as defence; pitted fringe on cephalon/cephalic fringe/pitted fringe to perhaps house sensory hairs; pitted fringe on cephalon/cephalic fringe/pitted fringe to detect the environment (prey or water currents) **OR** detect chemicals **OR** detect vibrations;	5	answers must be in pairs giving an explanation to gain credit
			Total	**10**	

Question			Answer	Marks	Guidance
7			**characteristics of ornithiscians** pubis points backwards; hip bones similar to that of birds/bird-hipped; front teeth small or absent; teeth maybe replaced at the front by a horn beak **OR** are described as duck-billed dinosaurs; many had bony plates e.g. *Stegosaurus* for armour or defence; tiny grooves in plates may have housed blood vessels acting as heat exchangers;	4	may state the characteristics as a list

Question			Answer	Marks	Guidance
			adaptation to life on land – <u>*Iguanodon*</u> large heavily built with heavy shoulders and forelimbs for stability and defence; skull large and thick for protection; toothless beak or horny plate described used to crop vegetation; cheek teeth (small and leaf shaped) or long series of teeth in the jaw described used to grind up vegetation; hinged upper jaw **OR** moves side to side to allow chewing vegetation; hands had three digits (fingers) which ended in hooves to escape from predators; hands had thumb spike present to be a weapon or obtain food; hands had elongate fifth finger to allow foraging for food; quadrupedal to walk on all four legs **OR** used tail as a counterbalance **OR** to remain stable whilst grazing; bipedal rear up to protect itself from attacking predators **OR** to reach high vegetation; backbone and tail stiffened (as it grew) **OR** backbone and tail ossified made it easier for adults to walk on all fours **OR** increase stability; tail stiffened **OR** heavy strong tail allowed tail to be used as a defence;	6	must match each morphological adaptation to the mode of life not simply state a list
			Total	**10**	

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