OCR
Oxford Cambridge and RSA

GCE

Geology

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

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.

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking:

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	Point has been noted, but no credit has been given
	Correct response
^	Omission mark
MR	Maximum (marks available for) Response

Here are the subject specific instructions for this question paper:

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
1	(a)	(i)	recognisable drawing of external morphology allowing labelling **;** recognisable drawing of internal morphology allowing labelling **;** correct labelling of listed morphological features on correct diagram **;**	**1** **1** **4**	**ALLOW** cross-section diagram for internal 5 or 6 correctly labelled for 4 marks 4 correctly labelled for 3 marks 3 correctly labelled for 2 marks 1 or 2 correctly labelled for 1 mark
		(ii)	bilateral **;**	**1**	
		(iii)	central line drawn and labelled through umbo / foramen to margin / commissure **;**	**1**	can be drawn on internal or external view
		(iv)	**ANY one** from: helps to separate inhalant and exhalent currents **OR** separates waste water from fresh **;** increases surface area of opening without allowing in predators / sediment **;**	 **1**	**IGNORE** answers relating to strength of closed shell
			Total	**9**	

Question			Answer/Indicative content	Mark	Guidance
2	(a)	(i)	**ANY one** from: anaerobic **;** presence of sulfur bacteria **;** iron in the environment **;**	**1**	**ALLOW** anoxic / reducing **DO NOT ALLOW** deep water
		(ii)	deep water / deep sea / deep marine **OR** swamp **;**	**1**	**DO NOT ALLOW** low energy **ACCEPT** lake
		(iii)	silica / SiO_2 **OR** quartz **;**	**1**	**DO NOT ALLOW** silicon
		(iv)	**ANY** one from: aragonite **AND** replaced by calcite **;** calcite / aragonite **AND** replaced by silica / quartz ; calcite / aragonite **AND** replaced by pyrite **;** calcite / aragonite **AND** replaced by haematite **;** carbon / organic material **AND** replaced by clay ;	**1**	**ALLOW** replacement by other compounds of iron e.g. limonite, siderite, marcasite
		(v)	burial of organic material **OR** weight / mass of overlying sediment / rock causes compaction **OR** increased temperature and pressure **;** volatiles driven off **OR** O_2 / CO_2 / CH_4 / water driven off **;** increases proportion of carbon **;** leaves a residue / thin film / 2D film of carbon **;**	**2**	3 correct for 2 marks 2 or 1 correct for 1 mark
		(vi)	**ANY two** from: **hard parts / mineralised skeleton / shell**		each factor **MUST** be named **AND**

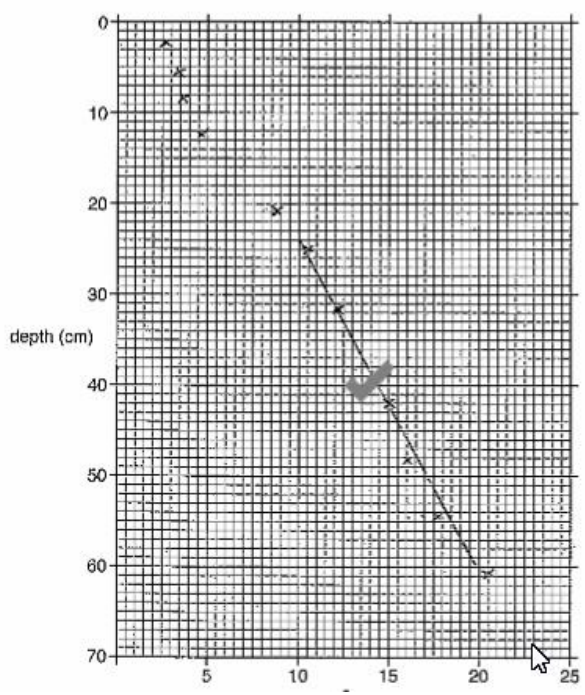
Question			Answer/Indicative content	Mark	Guidance
			less chance of predation / scavenging / decay **;** **composition of hard parts** silica is resistant to solution / alteration **OR** calcite / aragonite is susceptible to solution **;** **energy levels** high energy results in erosion / attrition / abrasion / damage / disarticulation to organism **ORA ;** **transport distance** More transport results in erosion / attrition / abrasion / damage / disarticulation to organism **ORA** ; **rate of burial** fast burial improves potential as predators / scavengers / oxygen are excluded **ORA ;** **oxygen availability** **(**bacterial**)** decay / scavenging / predation is slow in anoxic conditions **ORA ;** **sediment size** fine sediment preserves detail **OR** excludes oxygen **ORA ;** **rate of diagenesis / lithification** lithifies surrounding sediment protecting organism **OR** composition of groundwater may affect solution / replacement **ORA ;**	**2**	explained for 1 mark **MAX** 1 for 2 correct factors with poor or no explanation

Question			Answer/Indicative content	Mark	Guidance
2	(b)	(i)		3	<u>type of trace:</u> 5 correct for 3 marks 3 or 4 correct for 2 marks 2 correct for 1 mark
		(ii)		2	<u>water depth / energy level:</u> 4 or 5 correct for 2 marks 2 or 3 correct for 1 mark **DO NOT ALLOW** shallow without qualification of nearshore or offshore or equivalent wording.

genera	illustration	type of trace	water depth	energy level
Rusophycus		resting trace	shallow, offshore	
Nereites		grazing **OR** feeding trace		low
Skolithos		dwelling trace		high
Cruziana		locomotion trace		low
Diplocraterion		feeding **OR** dwelling trace	shallow, nearshore	

Question			Answer/Indicative content	Mark	Guidance
2	(c)		foot labelled **;** to grip the substrate and rotate / twist / rocks the shell ; raised ornament **OR** ribs **OR** rasp labelled**;** grinds / drills / rasps away the surrounding rock **;** rounded hinge / base / anterior area labelled **;** on which the valves rock due to action of the adductor muscles **;**	**2**	**1 MARK** for correct label of **ANY** morphological feature listed **1 MARK** for associating labelled feature with mode of life as borer into hard substrate. **IGNORE** answers involving siphons
			Total	**15**	

Question			Answer/Indicative content	Mark	Guidance
3	(a)		**A** = graptolithinia / graptolites / graptoloids **AND** hemichordata / hemichordates **;** **B** = trilobites / trilobita **AND** arthropoda / arthropods **;** **D** = ammonoids **OR** nautiloids **AND** mollusca / molluscs **;** **E** = corals **AND** cnidarian **;**	**1** **1** **1** **1**	**ALLOW** some flexibility in spelling max 1 if 3 or 4 correct fossil groups named max 1 if 3 or 4 correct phyla named **DO NOT ALLOW** cephalopods / ammonites / ceratites / goniatites **DO NOT ALLOW** rugose / tabulate / scleractinian **ALLOW** echinoids and echinodermata for **E**
	(b)		generally long-hinged **OR** straight-hinged **OR** strophic **OR** large **OR** no pedicle **OR** no foramen before P-T mass extinction **;** generally short-hinged **OR** curved-hinged **OR** astrophic / non-strophic **OR** smaller **OR** pedicle **OR** foramen after P-T mass extinction **;**	**1** **1**	
	(c)		group **A** / graptolites **OR** group **D** / ammonoids **A** / graptolites has the shortest stratigraphic / time range **OR** genera within group **A** / graptolites have short stratigraphic ranges **OR** genera within **A** / graptolites within group show rapid evolutionary changes **;** genera within group **D** / ammonoids have short stratigraphic ranges **OR** genera within **D** / ammonoids within group show rapid evolutionary changes ;	**1** **any 1**	
	(d)		from Ordovician **OR** Devonian **AND** to Carboniferous **;**	**1**	
	(e)		Ceratites **;**	**1**	
			Total	**10**	

Question			Answer/Indicative content	Mark	Guidance
4	(a)	(i)		**2** **1**	10 to 12 points plotted correctly for 2 marks 8 to 9 points correct for 1 mark straight line of best fit between 10 and 20 ka for 1 mark **ALLOW** 1 square difference
		(ii)	calculation of gradient showing correct method of working ; e.g. $\frac{61-24}{10}=3.7$ value between 3.2 and 4.2 cm / 10^3 years **;**	**1** **1**	**ALLOW ECF** from graph
		(iii)	value between 352 and 462 m **;**	**1**	**ALLOW ECF** from **4a(ii)**
		(iv)	bioturbation is the mixing / disturbance / reworking / disruption of sediments by (burrowing) organisms **;** sediments are mixed creating a uniform / average age with depth **;**	**1** **1**	**ACCEPT** displacing **ACCEPT** consistent
	(b)		**ANY** two from: sedimentary record can be lost due to erosion **;**		

Question			Answer/Indicative content	Mark	Guidance
			sedimentation rates vary with time ; sedimentation rate depends on grain size **;** different environments have different rates of sedimentation ; sedimentary record is destroyed by plate tectonics **OR** mountain building **OR** subduction **;** sediment thickness is affected by burial **OR** compaction **OR** load pressure **OR** metamorphism **;** rate of sediment deposition is affected by climate **;** continental areas have low or negative rates of deposition **;**	**2**	
			Total	**10**	

Question			Answer/Indicative content	Mark	Guidance
5	(a)		macrofossils can be recognised in hand samples **OR** by naked eye **OR** without microscope / hand lens **AND** microfossils require a microscope / hand lens for identification **;** **ALTERNATIVE ANSWER** macrofossils are >1mm **AND** microfossils are <1 mm	**1**	
	(b)	**(i)**	recognisable labelled diagram of a stemmed (sessile) crinoid **;** **ANY** three labels from: • calyx (must be bracketed), • brachia, • stem (must be bracketed), • ossicles / columnals, • holdfast, • anal tube**,**	**1** **2**	 **ALLOW** 'arms' for brachia 'dorsal cup' for calyx 'roots' for holdfast 3 labels for two marks 1 or 2 labels for 1 mark
		(ii)	**ANY** three from: stem: flexible support / column / made of ossicles **AND** to raise the organism above the sea bed **OR** raises the organism out of the sediment **OR** to optimise filter feeding **OR** into clearer waters with more food (higher currents) **;** holdfast: roots **AND** attachment to substrate **OR** anchoring the crinoid in the sediment **OR** to allow survival in high energy shallow waters **OR** so crinoid is not washed away **;** brachia: branches / arms		

			AND involved with filter feeding **OR** by using tube feet / cilia / food groove / create currents <u>calyx:</u> composed of (calcite) plates **AND** which provide protection for the soft body **OR** houses the soft tissues ; <u>ossicles / columnals:</u> plates with (axial) canal **OR** discs with central hole **AND** through which an extension of the soft parts pass **OR** through which a string of living material passes **OR** form a flexible yet strong support **OR** form the stem**;** <u>anal tube:</u> structure protruding from centre of calyx **OR** anal tube **AND** ensures waste is discharged down current of the brachial feeding system **OR** waste is away from mouth	**3**	**ACCEPT** cup-like cavity
		(iii)	It is held together by an internal organic sinew **OR** by soft tissue **OR** plates are covered with external living / soft tissue **AND** on death the organic material / soft tissue decays**;**	**1**	**MUST** show understanding that connective tissue is lost after death
		(iv)	**ANY** two from: skeleton will be broken **OR** disarticulated **OR** fragmented **OR** abraded **OR** few intact skeletons **OR** ossicles / columnals will be (mostly) separated **OR** only short lengths of stem remain intact lengths of stem **OR** brachia may show alignment / preferred orientation components may be sorted / winnowed	**2**	
	(c)	**(i)**	spores **AND** pollen	**1**	

Question			Answer/Indicative content	Mark	Guidance
		(ii)	**ANY** two from: found in freshwater / continental / terrestrial environment **;** may be washed or blown into marine sediments **;** easy to extract from rock due to organic / resistant / sporopollenin composition **;** small enough to extract whole from drill chippings / core **;** resistant so often preserved **;** widespread **AND** abundant / numerous **;**	**2**	

Question			Answer/Indicative content	Mark	Guidance
	(d)	(i)	**F** = ostracod **AND** chitin **/** calcium carbonate / $CaCO_3$ **;** **G** = conodonts **AND** apatite / calcium phosphate **;** **H** = radiolaria **AND** silica / SiO_2 **;**	**1** **1** **1**	**ALLOW** calcite **MAX** 1 for 3 correct fossils named
		(ii)	different species are adapted to different salinities **OR** benthonic mode of life shows conditions on sea floor **OR** shows water quality **;**	**1**	
		(iii)	teeth **OR** mouth parts **;**	**1**	**ALLOW** feeding / eating
			Total	**18**	

Question			Answer/Indicative content	Mark	Guidance
6	(a)	(i)	**J** = nautiloid / *Nautilus* **AND** **K** = ammonoid / ammonite **;**	1	**ALLOW** goniatite for **J** (septal necks are correct) **ALLOW** any correctly named ammonite
		(ii)	labels: aperture, body chamber, siphuncle, septum / septa, septal neck, chamber / camera **;**	2	**ALLOW** correctly labelled cephalopod **K** **ALLOW** venter, protoconch, phragmocone (if bracketed) 4 labels correct for 2 marks 2 or 3 labels correct for 1 mark
		(iii)	in **J** / nautiloids septal necks are retrosiphonate / point towards the protoconch / centre OR away from the aperture **AND** in **K** / ammonoids septal necks are mainly prosiphonate / point towards the aperture **OR** away from the protoconch / centre; in **J** / nautiloids siphuncle is central **AND** in **K** / ammonoids siphuncle is ventral / positioned towards the outer margin / marginal / towards the edge **;**	1 1	**ALLOW** goniatite for J **ALLOW** ammonite for K **MUST** compare **J** and **K** for each mark **DO NOT ALLOW** answers about shape of septa **ACCEPT** rim
		(iv)	**ANY** two from: nautiloids **/ J** are involute **AND** ammonoids **/ K** can be evolute **;** nautiloids **/ J** have a small umbilicus **AND** ammonoids **/ K** can have a wide umbilicus **;** nautiloids **/ J** are smooth / unornamented **AND** ammonoids **/ K** can have ribs / ornamentation **;** nautiloids **/ J** have no keel **OR** sulcus **AND** ammonoids **/ K** can have keel **OR** sulcus **;** nautiloids **/ J** have large aperture **AND** ammonoids **/ K** can have small aperture **;**	2	**ALLOW** goniatite for J **ALLOW** ammonite for K **DO NOT ALLOW** any internal morphological features such as suture complexity
	(b)	(i)	chambers **AND** give buoyancy **;**		feature named must be linked by an

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>chamber walls/septa
AND create the chambers

(septal necks) / siphuncle
AND allowed change of buoyancy / position in water column ;

keel
AND gives stability</td><td>any 2</td><td>explanation to allow pelagic mode of life i.e. buoyancy

DO NOT ALLOW any soft parts</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>adaptation</th><th>advantage for horizontal movement</th><th>disadvantage for horizontal movement</th><th>no effect on horizontal movement</th></tr>
<tr><td>ribbing</td><td></td><td>✓</td><td></td></tr>
<tr><td>evolute shell</td><td>✓</td><td>OR</td><td>✓</td></tr>
<tr><td>keel</td><td>✓</td><td></td><td></td></tr>
<tr><td>complex suture</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>2</td><td>3 or 4 correct for 2 marks
2 correct for 1 mark

ALLOW either advantage OR no effect for evolute shell</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>ANY one from:
It is difficult to manoeuvre / change direction;

chambers with buoyancy cause organism to float in vertical orientation ;

dense soft parts / head / tentacles cause organism to float in vertical orientation ;

vertical attitude / position made it difficult to move horizontally ;

vertical attitude / position made it difficult to use funnel / jet propulsion for escape / hunting ;

vertical attitude / position made it difficult to use tentacles for swimming ;</td><td>1</td><td></td></tr>
</table>

Question			Answer/Indicative content	Mark	Guidance
		(iv)	additional calcite deposits / cameral deposits **OR** coiling the shell **OR** planispiral ; <u>explanation for calcite deposits / cameral deposits:</u> counterbalance the dense / heavy soft parts **OR** brings orthocone into horizontal attitude ready for movement **;** <u>explanation for coiling the shell:</u> brings centre of mass / gravity below buoyancy force **OR** allows use of tentacles / funnel for horizontal movement **OR** easier to manoeuvre **;**	**1** **1** **1**	**ACCEPT** evolute **OR** involute for coiling
	(c)	**(i)**	heteromorphs / *Leptoceras* **;**	**1**	
		(ii)	benthonic **OR** lived close to the seabed **;** **ANY** one from: shape unsuitable for efficient swimming **;** would float with soft parts pointing downwards **;** used tentacles to pull / drag / walk itself along bottom ; tentacles in ideal attitude to grip sea bed **;**	**1** **1**	**ACCEPT** epifaunal
			Total	**18**	

7			<u>Precambrian **OR** Cambrian / 542 – 488 Ma **AND** high latitudes / close to pole > 30°S</u> • tillites / boulder clay / glacial deposits **;** <u>Ordovician / 488 – 444 **AND** 30°S - 10°S / temperate</u> <u>Silurian / 444 – 416 Ma **AND** 30°S - 20°S / tropical latitudes</u> • reef limestones • (colonial) corals associated with warm seas **;** <u>Devonian / 416 – 360 Ma **AND** 20°S - 10°S **/** subtropical</u> • desert / dune sandstones **OR** Old Red Sandstone ; • wadi conglomerate **OR** wadi deposits **;**		1 mark for the period and location 2 marks for the evidence max 3 for each period **ALLOW** reference to unfossiliferous desert rocks in tropics or glacial rocks in high latitudes **ALLOW** any age in Ma within the ranges given for each time period **MAX 8** unless both fossil and lithological evidence provided

			Carboniferous / 360 – 299 Ma **AND** 10°S - 10°N / Equatorial • corals • reef limestones **;** • coal **;** • rainforest **OR** large trees / plants **OR** broad / smooth leaves **OR** lack of growth rings in trees indicates warm humid conditions **;** • large insects **;** Permian / 299 – 251 Ma AND 0° to 20°N / equatorial Triassic / 251 – 200 Ma **AND** 20°N to 32°N / tropical • desert / dune sandstones **OR** New Red Sandstone (give once) ; • wadi conglomerate **OR** wadi deposits (give once) ; • evaporite deposits (give once) ; Jurassic / 200 -145 Ma **AND** 30°N - 40°N / tropical latitudes • (colonial) corals **;** • limestones (and clays) **OR** Blue Lias • oolitic limestones **;** Cretaceous / 145 – 65 Ma **AND** 35°N - 40°N / temperate latitude • (abundant) coccoliths / calcareous algae **;** • chalk **;** Tertiary / 65 Ma – recent **AND** 40°N - 50°N / temperate latitude • palm trees **OR** tropical plants **;** Quaternary / recent **AND** 55°N / northerly latitude • pollen evidence for glacial and interglacial periods **;** • pine / birch pollen indicate glacial periods and oak / beech pollen indicate interglacial periods **;** • tillites / boulder clay / glacial deposits **;**		**MAX 9** if not in time order **ALLOW 1 MARK** for discussion of palaeomagnetic evidence preserved in rocks **ALLOW 1 MARK** for accurate detail of palaeomagnetic evidence e.g. equatorial latitude from Carboniferous lavas **ACCEPT** appropriate megafauna (hippos, hyenas etc.)
			Total	**10**	

Question			Answer/Indicative content	Mark	Guidance
8			<u>characteristics</u> • primitive / reptile-like hip bone arrangement **;** • pubis points forward **OR** fully labelled diagram of pelvic structure **;** • flexible **AND** S-shaped neck **;** • 3-digit hands **OR** 3 asymmetrical digits **OR** explanation of 'thumb' and long second digit**;** • able to grasp **;** <u>*Diplodocus* adaptations</u> • long neck **AND** enabling it to reach vegetation in trees **OR** to reach into wetlands to graze **;** • (very) long tail **AND** as counterbalance ; • (very) long tail **AND** for whip-like defence ; • peg-like teeth (at the front of the jaw) **AND** to cut off / strip /tear/ rip vegetation **;** • undifferentiated / no grinding teeth **AND** so swallowed vegetation whole **;** • gastroliths / stomach stones **AND** aid digestion **;** • extra bones in the spine **AND** to help support the long neck and tail **;** • long / small / slender skull **AND** as wide / large / jaw / large brain not needed for vegetarian mode of life **;** • sturdy / stout / columnar legs **AND** to support mass ; • round / padded feet to distribute weight ; • quadrupedal **AND** to suit grazing / herd behaviour **;** • large size **AND** for large gut **OR** for heat regulation ;	**10**	**MAX 4** for characteristics **ALLOW** 'lizard-hipped' pelvic diagram must have pubis, ilium and ischium in correct position **MAX 7** for *Diplodocus* adaptations **MUST** link adaptation to use in mode of life for each mark **DO NOT ACCEPT** chew **ALLOW** chevron bones
			Total	**10**	

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