

GCE

Geology

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

Advanced GCE

Mark Scheme for June 2017

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

Annotation	Meaning
	Unclear
	Benefit of doubt given
	Contradiction
	Incorrect response
	Error carried forward
	Ignore
	Benefit of doubt not given
	Poor Diagram
	Reject
	Point has been noted, but no credit has been given
	Correct response
	Omission mark
	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)	<u>bilateral</u> ;	1	
		(iii)	central line drawn and <u>labelled</u> 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)	<p>ANY one from:</p> <p>anaerobic ;</p> <p>presence of sulfur bacteria ;</p> <p>iron in the environment ;</p>	1	<p>ALLOW anoxic / reducing</p> <p>DO NOT ALLOW deep water</p>
		(ii)	<p>deep water / deep sea / deep marine</p> <p>OR</p> <p>swamp ;</p>	1	<p>DO NOT ALLOW low energy</p> <p>ACCEPT lake</p>
		(iii)	<p>silica / SiO₂</p> <p>OR</p> <p>quartz ;</p>	1	DO NOT ALLOW silicon
		(iv)	<p>ANY one from:</p> <p><u>aragonite</u> AND replaced by <u>calcite</u> ;</p> <p><u>calcite / aragonite</u> AND replaced by <u>silica</u> / quartz ;</p> <p><u>calcite / aragonite</u> AND replaced by <u>pyrite</u> ;</p> <p><u>calcite / aragonite</u> AND replaced by <u>haematite</u> ;</p> <p><u>carbon / organic material</u> AND replaced by <u>clay</u> ;</p>	1	ALLOW replacement by other compounds of iron e.g. limonite, siderite, marcasite
		(v)	<p>burial of organic material OR weight / mass of overlying sediment / rock causes compaction OR increased temperature and pressure ;</p> <p>volatiles driven off OR O₂ / CO₂ / CH₄ / water driven off ;</p> <p>increases proportion of carbon ;</p> <p>leaves a residue / thin film / 2D film of carbon ;</p>	2	<p>3 correct for 2 marks</p> <p>2 or 1 correct for 1 mark</p>
		(vi)	<p>ANY two from:</p> <p>hard parts / mineralised skeleton / shell</p>		each factor MUST be named AND

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

Question			Answer/Indicative content					Mark	Guidance
2	(b)	(i)	genera	illustration	type of trace	water depth	energy level	3	<u>type of trace:</u> 5 correct for 3 marks 3 or 4 correct for 2 marks 2 correct for 1 mark
		(ii)	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			
							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.	

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

Question		Answer/Indicative content	Mark	Guidance
3	(a)	A = graptolithinia / graptolites / graptoloids AND hemichordata / hemichordates ;	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 = trilobites / trilobita AND arthropoda / arthropods ;	1	
		D = ammonoids OR nautiloids AND mollusca / molluscs ;	1	
		E = corals AND cnidarian ;	1	
(b)	generally long-hinged OR straight-hinged OR strophic OR large OR no pedicle OR no foramen before P-T mass extinction ;	1		
	generally short-hinged OR curved-hinged OR astrophic / non-strophic OR smaller OR pedicle OR foramen after P-T mass extinction ;	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)		<p>2</p> <p>10 to 12 points plotted correctly for 2 marks 8 to 9 points correct for 1 mark</p>	
			<p>1</p> <p>straight line of best fit between 10 and 20 ka for 1 mark</p>		
			<p>ALLOW 1 square difference</p>		
		(ii)	<p>calculation of gradient showing correct method of working ; e.g.</p> $\frac{61 - 24}{10} = 3.7$ <p>value between <u>3.2</u> and <u>4.2</u> cm / 10³ years ;</p>	<p>1</p> <p>ALLOW ECF from graph</p>	
			<p>1</p>		
	(iii)	<p>value between <u>352</u> and <u>462</u> m ;</p>	<p>1</p> <p>ALLOW ECF from 4a(ii)</p>		
	(iv)	<p>bioturbation is the mixing / disturbance / reworking / disruption of sediments by (burrowing) organisms ;</p> <p>sediments are mixed creating a uniform / average age with depth ;</p>	<p>1</p> <p>ACCEPT displacing</p> <p>1</p> <p>ACCEPT consistent</p>		
	(b)	<p>ANY two from: sedimentary record can be lost due to erosion ;</p>			

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			Mark	Guidance
5	(a)	<p>Answer/Indicative content</p> <p>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 ;</p> <p>ALTERNATIVE ANSWER</p> <p>macrofossils are >1mm AND microfossils are <1 mm</p>	1	
	(b)	<p>(i) recognisable labelled diagram of a stemmed (sessile) crinoid ;</p> <p>ANY three labels from:</p> <ul style="list-style-type: none"> • calyx (must be bracketed), • brachia, • stem (must be bracketed), • ossicles / columnals, • holdfast, • anal tube, 	1	<p>ALLOW ‘arms’ for brachia ‘dorsal cup’ for calyx ‘roots’ for holdfast</p> <p>3 labels for two marks 1 or 2 labels for 1 mark</p>
		<p>(ii) ANY three from:</p> <p><u>stem</u>: 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) ;</p> <p><u>holdfast</u>: 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 ;</p> <p><u>brachia</u>: branches / arms</p>		

		<p>AND involved with filter feeding OR by using tube feet / cilia / food groove / create currents</p> <p><u>calyx</u>: composed of (calcite) plates AND which provide protection for the soft body OR houses the soft tissues ;</p> <p><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;</p> <p><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</p>	3	ACCEPT cup-like cavity
	(iii)	<p>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;</p>	1	MUST show understanding that connective tissue is lost after death
	(iv)	<p>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</p> <p>lengths of stem OR brachia may show alignment / preferred orientation</p> <p>components may be sorted / winnowed</p>	2	
(c)	(i)	spores AND pollen	1	

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

Question	Answer/Indicative content	Mark	Guidance																				
	chamber walls/septa AND create the chambers (septal necks) / siphuncle AND allowed change of buoyancy / position in water column ; keel AND gives stability	any 2	explanation to allow pelagic mode of life i.e. buoyancy DO NOT ALLOW any soft parts																				
(ii)	<table border="1" data-bbox="421 550 1384 837"> <thead> <tr> <th>adaptation</th> <th>advantage for horizontal movement</th> <th>disadvantage for horizontal movement</th> <th>no effect on horizontal movement</th> </tr> </thead> <tbody> <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> </tbody> </table>	adaptation	advantage for horizontal movement	disadvantage for horizontal movement	no effect on horizontal movement	ribbing		✓		evolute shell	✓	OR	✓	keel	✓			complex suture			✓	2	3 or 4 correct for 2 marks 2 correct for 1 mark ALLOW either advantage OR no effect for evolute shell
adaptation	advantage for horizontal movement	disadvantage for horizontal movement	no effect on horizontal movement																				
ribbing		✓																					
evolute shell	✓	OR	✓																				
keel	✓																						
complex suture			✓																				
(iii)	<p>ANY one from:</p> <p>It is difficult to manoeuvre / change direction;</p> <p>chambers with buoyancy cause organism to float in vertical orientation ;</p> <p>dense soft parts / head / tentacles cause organism to float in vertical orientation ;</p> <p>vertical attitude / position made it difficult to move horizontally ;</p> <p>vertical attitude / position made it difficult to use funnel / jet propulsion for escape / hunting ;</p> <p>vertical attitude / position made it difficult to use tentacles for swimming ;</p>	1																					

Question		Answer/Indicative content	Mark	Guidance	
	(iv)	<p>additional calcite deposits / cameral deposits OR coiling the shell OR planispiral ;</p> <p><u>explanation for calcite deposits / cameral deposits:</u> counterbalance the dense / heavy soft parts OR brings orthocone into horizontal attitude ready for movement ;</p> <p><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 ;</p>	<p>1</p> <p>1</p> <p>1</p>	ACCEPT evolute OR involute for coiling	
	(c)	(i)	heteromorphs / <i>Leptoceras</i> ;	1	
		(ii)	<p>benthonic OR lived close to the seabed ;</p> <p>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 ;</p>	<p>1</p> <p>1</p>	ACCEPT epifaunal
			Total	18	

7		<p><u>Precambrian OR Cambrian / 542 – 488 Ma AND high latitudes / close to pole > 30°S</u></p> <ul style="list-style-type: none"> tillites / boulder clay / glacial deposits ; <p><u>Ordovician / 488 – 444 AND 30°S - 10°S / temperate</u></p> <p><u>Silurian / 444 – 416 Ma AND 30°S - 20°S / tropical latitudes</u></p> <ul style="list-style-type: none"> reef limestones (colonial) corals associated with warm seas ; <p><u>Devonian / 416 – 360 Ma AND 20°S - 10°S / subtropical</u></p> <ul style="list-style-type: none"> desert / dune sandstones OR Old Red Sandstone ; wadi conglomerate OR wadi deposits ; 		<p>1 mark for the period and location 2 marks for the evidence max 3 for each period</p> <p>ALLOW reference to unfossiliferous desert rocks in tropics or glacial rocks in high latitudes</p> <p>ALLOW any age in Ma within the ranges given for each time period</p> <p>MAX 8 unless both fossil and lithological evidence provided</p>
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		<p><u>Carboniferous / 360 – 299 Ma AND 10°S - 10°N / Equatorial</u></p> <ul style="list-style-type: none"> • 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 ; <p><u>Permian / 299 – 251 Ma AND 0° to 20°N / equatorial</u></p> <p><u>Triassic / 251 – 200 Ma AND 20°N to 32°N / tropical</u></p> <ul style="list-style-type: none"> • desert / dune sandstones OR New Red Sandstone (give once) ; • wadi conglomerate OR wadi deposits (give once) ; • evaporite deposits (give once) ; <p><u>Jurassic / 200 -145 Ma AND 30°N - 40°N / tropical latitudes</u></p> <ul style="list-style-type: none"> • (colonial) corals ; • limestones (and clays) OR Blue Lias • oolitic limestones ; <p><u>Cretaceous / 145 – 65 Ma AND 35°N - 40°N / temperate latitude</u></p> <ul style="list-style-type: none"> • (abundant) coccoliths / calcareous algae ; • chalk ; <p><u>Tertiary / 65 Ma – recent AND 40°N - 50°N / temperate latitude</u></p> <ul style="list-style-type: none"> • palm trees OR tropical plants ; <p><u>Quaternary / recent AND 55°N / northerly latitude</u></p> <ul style="list-style-type: none"> • 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 ; 		<p>MAX 9 if not in time order</p> <p>ALLOW 1 MARK for discussion of palaeomagnetic evidence preserved in rocks</p> <p>ALLOW 1 MARK for accurate detail of palaeomagnetic evidence e.g. equatorial latitude from Carboniferous lavas</p> <p>ACCEPT appropriate megafauna (hippos, hyenas etc.)</p>
		Total	10	

Question	Answer/Indicative content	Mark	Guidance
8	<p><u>characteristics</u></p> <ul style="list-style-type: none"> • 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 ; <p><u>Diplodocus adaptations</u></p> <ul style="list-style-type: none"> • 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	<p>MAX 4 for characteristics ALLOW 'lizard-hipped' pelvic diagram must have pubis, ilium and ischium in correct position</p> <p>MAX 7 for <i>Diplodocus</i> adaptations</p> <p>MUST link adaptation to use in mode of life for each mark</p> <p>DO NOT ACCEPT chew</p> <p>ALLOW chevron bones</p>
	Total	10	

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