OCR
Oxford Cambridge and RSA

GCE

Geology

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

Advanced GCE

Mark Scheme for June 2018

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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.

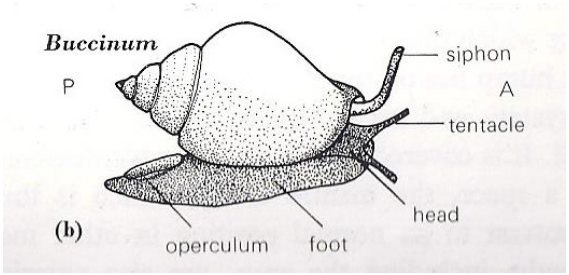
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations

Annotation	Meaning
	Unclear
BOD	Benefit of doubt given
CON	Contradiction
	Incorrect response
ECF	Error carried forward
I	Ignore
NBOD	Benefit of doubt not given
SEEN	Point has been noted, but no credit has been given
	Correct response
^	Omission mark
MR	Maximum (marks available for) Response

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>labels correct (on appropriate diagram):
1 OR thin corrugated valves on bivalve A ;
2 OR shell covered in a layer of periostracum on bivalve D ;
3 OR larger and heavy left valve on bivalve B OR C ;
4 OR irregular left valve on bivalve B ;
5 OR byssus on bivalve D ;
6 OR streamlined valves with no ribs on bivalve D ;
7 OR small lid-like right valve on bivalve B OR C ;
8 OR ears / wings on bivalve A ;</td><td>3</td><td>7 or 8 correct for 3 marks
4 to 6 correct for 2 marks
2 or 3 correct for 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>features correctly matched with functions:

<table><tr><th>Function</th><th>Feature</th></tr><tr><td>Provides protection from acidic water</td><td>2</td></tr><tr><td>Allows stability for free-lying mode of life</td><td>3</td></tr><tr><td>A flexible attachment to a hard substrate</td><td>5</td></tr><tr><td>Allows attachment by cementation</td><td>4</td></tr><tr><td>Provides strength with low mass</td><td>1</td></tr><tr><td>Directs water currents</td><td>8</td></tr><tr><td>Prevents sediment clogging</td><td>7 OR 3</td></tr><tr><td>Reduces resistance</td><td>6</td></tr></table></td><td>4</td><td>7 or 8 correct for 4 marks
5 or 6 correct for 3marks
4 or 3 correct for 2 marks
1 or 2 correct for 1 mark.</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>D ;</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>phylum = Mollusc OR Mollusca
AND
group = Gastropod OR Gastropoda OR Neptunea ;</td><td>1</td><td>BOTH phylum AND group correct for 1 mark.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>spire AND body chambered labelled correctly ;</td><td>1</td><td>spire MUST be bracketed
body chamber should be bracketed
ALLOW arrow into aperture for body chamber OR could be bracketed as ‘last whorl’</td></tr>
</table>

Question			Answer	Mark	Guidance
		(iii)	recognisable gastropod drawn in correct position relative to the substrate ;  **ANY 2 labels:** soft part label from: head, foot, siphon ;	**1** **1**	**ALLOW ANY** other correct label of a soft part e.g. tentacles, mantle, eye, proboscis **DO NOT ALLOW** operculum
		(iv)	siphon **OR** inhalant siphon ;	**1**	**DO NOT ALLOW** exhalent siphon **OR** siphonal canal
			Total	**13**	

Question			Answer	Mark	Guidance
2	(a)	(i)	**F** = corals **AND** brachiopods / bivalves **AND** **G =** crinoids ;	1	
		(ii)	**F** labelled on reef **OR** fore-reef **AND** **G** labelled on fore-reef ;	1	
		(iii)	**reason for F:** **F** labelled on reef **AND** explanation that corals are reef-building fossils **OR** corals require high energy for oxygen / nutrients **OR** shallow water to be in photic zone **OR** high energy as broken **OR F** labelled on fore-reef **AND** explanation as fossils formed on reef and were dislodged by wave action **OR** formed on reef and were broken and transported ; **reason for G:** **G** labelled on fore-reef **AND** explanation that stems have been broken by wave action **OR** crinoids could not survive the high energy of the reef **OR** crinoids could not survive the shallow water conditions of the lagoon **OR** crinoids are found in deeper water ;	1 1	reasons must match locations chosen in **(ii)** **ALLOW AW**
	(b)	(i)	modern coral reefs are all in tropical seas / between 30^{o} N and 30^{o} S **AND** Carboniferous coral reefs are mostly north of the Tropic of Cancer / north of 23.5^{o} N ; it is assumed that ancient reefs required similar environmental conditions to modern ones ; if ancient reefs were tropical they must have moved to their present positions **OR** continental drift must have taken place **OR** plate tectonic movement has taken place ;	1 1 1	**ALLOW AW**

Question			Answer	Mark	Guidance
		(ii)	**ANY 3** from: water temperatures between 23 and 27^{o}C / optimum temperature 27°C **AND** ensures rapid metabolism / growth **OR** means high nutrient supply **OR** abundant $CaCO_3$ in solution **OR** to allow algae / zooxanthellae to live / remain; shallow water / high energy conditions **AND** supplies nutrients for coral / polyp / zooid ; shallow water / high energy conditions **AND** supplies oxygen for coral / polyp / zooid ; shallow water / 15m depth / within photic zone for light penetration **AND** allows (symbiotic) algae / zooxanthellae to photosynthesise ; clear water / sediment free **AND** prevents corals / polyps / zooids clogging to allow feeding **OR** allows light penetration for algae to photosynthesise ; normal salinity / 30 – 40 ppt / 3 – 4 % salts **AND** chemistry / pH allows $CaCO_3$ to be precipitated **OR** allows growth of skeleton **OR** to allow algae / zooxanthellae to live / remain ;	**3**	**MAX 1** for 3 correct conditions with no explanation **ALLOW** temperature up to 30^{o}C **DO NOT ALLOW** warm waters **DO NOT ALLOW** tropical conditions / tropical latitudes **ALLOW** between 0 to 30m depth
			Total	**10**	

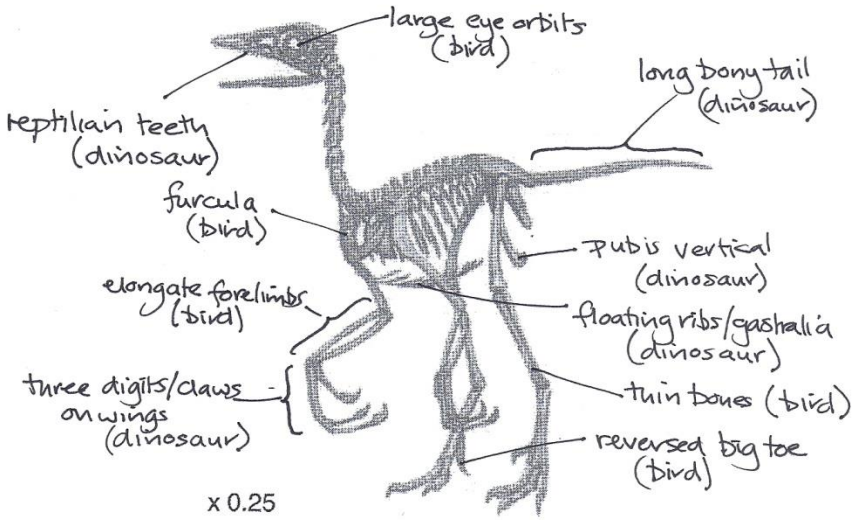
Question			Answer	Mark	Guidance
3	(a)	(i)	**E ;**	1	
		(ii)	**ANY 2** from: **D** is a sill **AND** intrudes the rock above **E** and so is younger ; **E** is a lava flow **AND** therefore conformable and older than **D** or **E** is a lava flow **AND** is below D and so is older; **G** is a batholith / intrusion **AND** cuts **D** and **E** therefore **G** is younger than **D** and **E** ; **C** is a dyke **AND** cuts **G** and is therefore the youngest ;	2	recognition of type of igneous body **AND** relative age needed for each mark **MAX** 1 if two correct statements but no recognition of igneous body
		(iii)	(Principle of) cross-cutting relationships ;	1	**ALLOW** superposition
	(b)	(i)	**ANY 2** from: ^{40}Ar is a gas and can easily escape ; increasing the ratio of parent to daughter isotope ; **ORA** ^{87}Sr is a solid and not easily lost ; ^{87}Rb-^{87}Sr unaffected by metamorphism ;	2	**ALLOW AW**
		(ii)	**ANY 2** from: it is a major intrusion / batholith and cools slowly / at different rates ; the margins of the intrusion crystallise / solidify quicker than the interior **OR** the margins are chilled so solidify quicker ; the interior of the intrusion cools more slowly so crystallises / solidifies later **OR** the interior is insulated and so crystallises / solidifies later ; different minerals become closed systems at different temperatures ;	2	
	(c)	(i)	Ordovician to Silurian ;	1	**ALLOW** Lower Devonian as upper limit **ALLOW** Lower Palaeozoic **ALLOW** appropriate age range in Ma
		(ii)	trilobites were extinct by 251 Ma / Permian **AND** **B** is younger than 170 Ma / middle Jurassic ;	1	both parts of arguments needed for the mark
		(iii)	the trilobites are derived fossils ; **ANY 2** for one mark from: trilobite / organism / hard parts are replaced by resistant / harder minerals ; erosion removes the surrounding rock / trilobite in a clast / trilobite	1 1	

Question			Answer	Mark	Guidance
			removed from the rock ; fossils are (transported and re)deposited in younger rock ;		**ALLOW** weathering for erosion
	(d)		**explanation:** **Any 3:** the ratio between ^{18}O and ^{16}O isotopes is measured ; (water containing) ^{16}O / the lighter isotope is more easily evaporated ; it is usually returned to the oceans by precipitation / rainfall / rivers ; in colder periods the ^{16}O / lighter isotope is locked up in (land) ice / glaciers / ice caps ; less ^{16}O / more ^{18}O is present in seawater during cold climates ; **description:** in warmer periods they would contain more ^{16}O / the lighter isotope **OR** be depleted in ^{18}O **OR** the ^{18}O to ^{16}O ratio would be lower ;	**3** **1**	 **ORA** **AW**
	(e)	**(i)**	recognisable diagram of a planktonic trilobite ; appropriate labels from: cephalon, thorax, pygidium, glabella, compound eyes **OR** no eyes, facial suture, free cheek, fixed cheek, spines, pleura ; recognisable diagram of a nektonic trilobite ; appropriate labels from: cephalon, thorax, pygidium, glabella, compound eyes **OR** eyes on stalks, facial suture, free cheek, fixed cheek, spines, pleura ;	**1** **2** **1** **2**	If incorrect trilobite drawn but 4 correct labels then **MAX** 1 cephalon / thorax / pygidium must be bracketed 4 or more correct labels for 2 marks 3 or 2 correct labels for 1 mark fewer than 2 labels 0 marks If incorrect trilobite drawn but 4 correct labels then **MAX** 1 cephalon / thorax / pygidium must be bracketed 4 or more correct labels for 2 marks 3 or 2 correct labels for 1 mark fewer than 2 labels 0 marks
		(ii)	planktonic forms tended to have poorly developed **OR** no compound eyes **AND** as they were not predators **OR** they were filter feeders **OR** had no need to watch for predators ; nektonic forms needed highly developed eyes **OR** eyes positioned on	**1** **1**	**MUST** have a description **AND** matching explanation for each mark **ACCEPT** a correctly named trilobite for nektonic and/or planktonic

Question			Answer	Mark	Guidance
			the anterior margin of the cephalon / front of trilobite **OR** eyes on stalks **AND** to hunt **OR** it was a predator **OR** to avoid predators **OR** to see forwards / 360° and below them ;		
		(iii)	photic zone / surface waters ;	**1**	
			Total	**25**	

Question			Answer	Mark	Guidance
4	(a)	(i)	mould and cast ; **ANY** two from: dinosaur treads in soft sediment / mud / clay creating a mould / imprint ; mould / imprint is filled with sediment / sand (making a cast) ; (lithification and) weathering / erosion only preserves the cast ; trace fossil / footprint is a bottom / sole structure ;	**1** **2**	**MAX** 1 if mould and cast are wrong way round
		(ii)	Theropods/Theropoda **OR** *Allosaurus* **OR** *Velociraptor* **OR** *Tyrannosaurus* ;	**1**	**ALLOW** Ornithopoda such as *Iguanodon* or Hadrosauridae **DO NOT ALLOW** Saurischian **DO NOT ALLOW** Aves / birds
	(b)	(i)	leg length = 0.85 m +/- 0.05 m ;	**1**	
		(ii)	stride = 2.75 m +/- 0.05 m ;	**1**	
	(c)	(i)	graph plotted correctly ; straight line of best fit drawn ;	**2** **1**	7 or 8 points plotted correctly = 2 marks 4 to 6 points plotted correctly = 1 mark 1 to 3 points plotted correctly = 0 marks **MAX** 1 for plotting graph if axes not correctly labelled **AND** 7 to 8 points plotted correctly
		(ii)	2.2 +/- 0.1 ; correct working ; $2.2 \times \sqrt{2.5} \times 10$ $2.2 \times \sqrt{25}$ 2.2×5 11.0 +/- 0.5 m/s ;	**1** **1** **1**	**ALLOW ECF** from graph if no working shown **ALLOW 3 MARKS** for correct answer of 10.5 to 11.5 m/s
			Total	**12**	

Question			Answer	Mark	Guidance
5	(a)		**ANY 2** from: (swim bladder) developed lungs **AND** allowed them to breathe on land / respiration ; fins become legs / limbs **AND** allow movement on land ; development of a girdle connecting the limb bones to the skeleton **AND** for better movement on land **OR** to support weight / mass ; a more robust skeleton **OR** strengthening the vertebral column **OR** strengthening rib bones **AND** to give more support (on land) ; eyelids **AND** to keep eyes moist ; development of a double-loop circulatory system **OR** three-chambered heart **AND** to allow more efficient gas exchange **OR** to provide more oxygen to cells ; a tongue (within the mouth) **AND** to catch prey **OR** perform a sensory role ; ears **AND** adapted to detect sounds in air ;	**2**	
	(b)	**(i)**	pubis points backwards ; **ANY** one from: front teeth are small **OR** absent ; cheek teeth are leaf-shaped ; has a horny beak / toothless beak / is 'duck-billed' ;	**1** **1**	**DO NOT ALLOW** hip bone
		(ii)	for heat exchange / regulation **OR** the plates contain grooves thought to house blood vessels **OR** display ;	**1**	
		(iii)	**ANY** one from: they can be both quadrupedal **AND** bipedal ; they were usually quadrupedal using its tail as counterbalance ; they could adopt a bipedal stance to run **OR** rear up ; **ANY** one from: had a thumb spike for use as a weapon **OR** to obtain food ; long prehensile fifth fingers able to forage for food ;	**1** **1**	**ACCEPT** conical thumb
	(c)	**(i)**	**ANY 3** from: preservation was in lagoons **OR** cut off from the ocean **AND** so low energy / no currents / no waves to destroy fossil ; (lagoons created) hypersaline conditions **AND** so no scavengers ; lagoons have anoxic (bottom) waters (due to dense saline waters)	**3**	description of environmental condition must be linked to preservation effect for each mark **MAX** 1 for list of two exceptional preservation characteristics linked to Solnhofen

Question			Answer	Mark	Guidance
			AND so few bacteria / scavengers ; carbonate muds precipitated / deposited **AND** so fine material preserves detail ;		**ALLOW** inland sea / barred basin as alternative to lagoon **AW** e.g. calcite / micrite instead of carbonate
		(ii)	**ANY 4** correct labels from: teeth (dinosaur) ; furcula / wishbone (bird) ; elongate forelimbs (bird) ; three digits / claws on wings (dinosaur) ; large eye orbits (bird); long bony tail (dinosaur) ; pubis forward-facing / vertical (dinosaur) ; floating ribs / gastralia (dinosaur) ; thin / hollow bones (bird) ; reversed toe (bird) OR toe extends backwards (bird) ; hinged ankles (bird) ;  	**4**	**ALLOW** features only seen on skeleton diagram so **NOT** feathers labels must be accurate **NOT** just text around the diagram labels must include reference to bird or dinosaur
			Total	**14**	

Question			Answer	Mark	Guidance
6	(a)	(i)	**shallow marine environment:** fossil **J OR** fossil **K** ; **ANY** one from: fossil **J** because strongly folded margin would prevent sediment ingress ; fossil **J** because strong ribbing prevents damage in high energy conditions ; fossil **K** because streamlined shell deflects energy fossil **J OR K** because it has a pedicle to anchor it to hard substrate in high energy water ; **muddy marine environment:** fossil **H OR** fossil **L** ; **ANY** one from: Fossil **H** because it has spines to anchor it / stop it sinking in muddy substrate ; Fossil **H** has a large surface area / snowshoe effect to stop it sinking in muddy substrate ; Fossil **H OR L** because wide / strophic hinge line allows large surface area to rest on soft substrate ;	**1** **1** **1** **1**	one mark for correct selection one mark for correct matching explanation based on diagram **AW** one mark for correct selection one mark for correct matching explanation based on diagram
		(ii)	**ANY** one from: feeds / respires at the surface / top of burrow at high water / tide ; retracts its <u>pedicle</u> to pull it beneath the surface/down the burrow at low water / tide **;** holds itself in the burrow using the <u>pedicle</u> ;	**1**	**ALLOW AW** **DO NOT ALLOW** foot
		(iii)	elongated OR streamlined shell ; **AND** smooth shell **OR** no ornament / ribs ;	**1**	**DO NOT ALLOW** evidence of long pedicle
			Total	**6**	

Question			Answer	Mark	Guidance
7			**description:** **ANY 2:** icehouse conditions have permanent ice caps **OR** much of the Earth covered in ice **OR** have the entire Earth covered by ice ; greenhouse conditions have small / temporary icecaps **OR** no ice caps ; icehouse has low average temperatures **AND** greenhouse has high average temperatures ; **examples:** **ANY 2:** there have been 3 cold periods in the Phanerozoic ; present-day **OR** Quaternary is an icehouse ; present-day is interglacial **OR** mean temperature is 15°C **OR** may not be a full Icehouse period ; icehouse was in the Permian **OR** Carboniferous **OR** Permian – Triassic boundary ; icehouse was over the Ordovician **OR** Silurian ; Late Precambrian Icehouse ; greenhouse in Devonian ; greenhouse in Cretaceous **OR** K/T boundary ; **mechanisms:** **ANY 4**: by changes in the Earth's orbit / Milankovitch cycles ; eccentricity explained with period 100 ka **OR** obliquity / tilt of axis with period 41 ka **OR** precession with periods 19 & 23 ka ; breakup of supercontinents, increased rainfall and weathering; increased weathering causes reduced CO_2 and reduced greenhouse effect ; formation of supercontinents increases reflectivity / albedo and lowers temperatures;	 **1** **1** **1** **1** **1** **1** **1** **1** **1** **1** **1** **1** **1** **1** **1**	**MAX 8** if no extinction links made **MAX** 2 for descriptions **DO NOT ALLOW** Icehouse cold, Greenhouse warm **MAX 2** for examples **MAX 4** for mechanisms

Question			Answer	Mark	Guidance
			distribution of continents affects ocean currents and heat budget / distribution of the Earth ;	1	
			(major) temperature cycles linked to Wilson cycle ;		
			major volcanism produces ash and aerosols that reflects radiation causing reduced temperatures / volcanic winter ;	1 1	
			major (flood basalt) volcanism causes release of CO_2 / greenhouse gases causing raised temperatures ;	1	
			large meteorite / asteroid impact leading to an impact winter ;	1	
			feedback effects:		
			ANY 2:		**Max 2** for feedback effects
			albedo / reflectivity of snow is very high / 80 – 95% **AND** water / rock is low ;	1	
			more ice / snow gives more reflection causing colder temperatures ;		
			ORA	1	
			higher temperatures causes release of CO_2 / methane from oceans causing increased greenhouse effect ;	1	
			higher temperatures causes melting of permafrost releasing methane causing increased greenhouse effect ;	1	
			extinction links:		
			Any 3:		**MAX 3** for extinction links
			icehouse – decreased biological activity / extinctions especially on land ;	1	
			icehouse – more continental ice and lower sea level / reduced shallow waters / continental shelf causes increased competition ;	1	
			increased CO_2 – acidification of the oceans leading to extinctions ;		
			warming – transgressions causing algal blooms / anoxic conditions leading to extinctions ;	1 1	
			organisms unable to evolve / adapt (quickly enough) to temperature changes so become extinct ;	1	

Question			Answer	Mark	Guidance
			food chains are disrupted ;	1	
			Total	**10**	

Question			Answer	Mark	Guidance
8			**diagrams:** diagrams with minimum of 2 morphological labels of pendent four stiped ; diagrams with minimum of 2 morphological labels of pendent two stiped ; diagrams with minimum of 2 morphological labels of horizontal / reclined two stiped ; diagrams with minimum of 2 morphological labels of scandent biserial form ; diagrams with minimum of 2 morphological labels of uniserial single stiped ; diagrams with minimum of 2 morphological labels of thecal shape change ; diagrams showing general change of stipe attitude over time ; **information:** early forms (Ordovician) had numerous stipes to 4 stipes (*Tetragraptus) ;* later (Ordovician) forms two-branched pendent (*Didymograptus)* ; reclined or horizontal forms develop after pendent forms ; early forms have simple theca ; single branched forms with thecae back-to-back OR biserial (*Diplograptus) ;* mixed forms like (D*icellograptus)* evolved to scandent (in late Ordovician and early Silurian) ; sigmoidal thecae evolved ; single stipe colonies (*Monograptus); (*Silurian) ; last stage of evolution was uniserial <u>and</u> scandent ; detail of simple / sigmoidal / hooked / isolate theca **OR** details of thecal shapes ; complex forms of curves and spirals ; **OR general trends:** later forms with complex / varied thecal types compared to early forms ; the direction of growth of the stipes evolved from pendant to scandent ; theca change from uniserial to biserial (back to uniserial) ;	**10**	**MAX 3** for diagrams answers that are diagrammatic lists **MAX 5** mark well annotated diagrams as text genus names are not essential **ALLOW** general evolutionary trends as alternative to detail in each section

Question			Answer	Mark	Guidance
			general evolution from forms with more stipes to forms with few or only one stipe ; evolution starts in early Ordovician and continues to end Silurian ; these changes may have allowed increased efficiency of feeding ;		
			Total	**10**	

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