OCR
Oxford Cambridge and RSA

GCE

Geology

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

Advanced GCE

Mark Scheme for June 2014

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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
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Unclear
BOD	Benefit of doubt given
CON	Contradiction
	Incorrect response
ECF	Error carried forward
I	Ignore
R	Reject
NBOD	Benefit of doubt not given
^	Omission mark
	Correct response
SEEN	Point has been noted, but no credit has been given
PD	Poor diagram
MR	Maximum Response

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

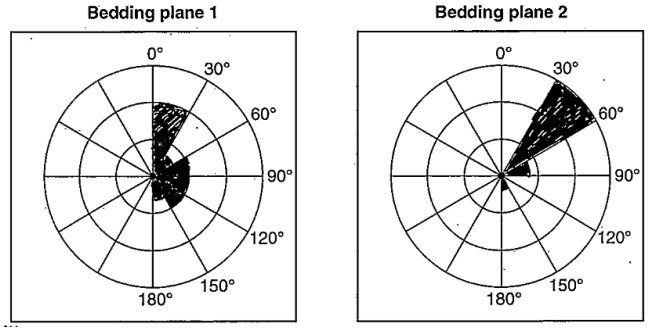
Question			Answer	Mark	Guidance
1	(a)	(i)	**A** Mollusca **OR** mollusc **AND** Gastropoda **OR** gastropod; **B** Echinodermata **OR** echinoderm **AND** echinoid **OR** irregular (echinoid) **OR** echinoidea; **C** Mollusca **OR** mollusc **AND** cephalopod **OR** belemnite **OR** belemnoid **OR** coleoid; **D** radiolarian **OR** radiolaria;	1 1 1 1	**ALLOW** correctly identified genera for group
	(a)	(ii)	1. spire; 2. body chamber **OR** opening **OR** aperture; 3. petaloid ambulacra **OR** ambulacra **OR** ambulacral plate; 4. phragmocone **OR** chamber;	3	4 correct = 3 mark 3 correct = 2 marks 2 or 1 correct = 1 mark **DO NOT ALLOW** body chamber for belemnite
	(a)	(iii)	fossil **A** is benthonic **OR** epifaunal **AND** fossil **C** is nektonic; fossil **A** is slow moving **OR** is vagrant **OR** has a foot **OR** moves on sea floor **OR** lives on the sea floor **AND** fossil **C** has quick movement **OR** swims in the water column **OR** swims by jet propulsion **OR** swims using tentacles; fossil **A** may be a predator (boring into shells) **OR A** may be a detritus feeder **OR A** feeds on algae **AND** fossil **C** actively hunts using tentacles **OR** is a predator;	2	**ANY 2** paired statements **MUST** compare **A** and **C** for 1 mark **DO NOT ALLOW** predator unqualified for both A and C
	(a)	(iv)	**D** floats in the (upper surfaces) water column **OR D** is fully marine **OR D** floats in open water **OR D** can live in different environments **OR D** is preserved below the CCD **OR** silica tests are more stable (than calcite);	1	**ORA**

Question			Answer	Mark	Guidance
1	(b)	(i)	cephalon, pygidium, thorax bracketed **OR** shaded on trilobite **F OR E**; 1	1 1	3 labels correct = 2 marks 2 labels correct = 1 mark 1 correct = 0 marks **DO NOT ALLOW** labels to a single point
	(b)	(ii)	one thoracic segment correctly shaded **OR** labelled	1	**ALLOW** use of pleuron or pleura for thoracic segment
	(b)	(iii)	11 pairs of legs	1	
	(c)	(i)	enrollment (into a ball to protect soft underbody) **OR** many thoracic segments allow them to roll up **OR** separated / articulating plates that allow them to enrol **OR** spines on pleura deter predators **OR** genal spines deter predators	1	
		(ii)	fossil **F** has more crescentic **OR** semi-circular eyes **OR** curved eyes **OR** convex eyes **AND** **F** has greater all round vision **OR** has a wider field of view **OR** has nearly 360^{o} vision **OR** could spot predators more easily **OR** could spot prey more easily	1	**MUST** have morphological feature and reason for 1 mark
		(iii)	spines are longer on fossil **E** (than on fossil **F);** spines are larger on fossil **E (**than on fossil **F);** spines are thinner on fossil **E (**than on fossil **F);** fossil **E** has two /more pygidial spines (whilst fossil **F** has one);	1	**ORA** **ANY 1**
			Total	**17**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th colspan="3">Bedding plane 1</th><th></th><th colspan="3">Bedding plane 2</th></tr>
<tr><th colspan="2">Orientation</th><th>Tallied number of specimens</th><th></th><th colspan="2">Orientation</th><th>Tallied number of specimens</th></tr>
<tr><td>000 – 030 °</td><td>181 – 210 °</td><td>1111 4</td><td></td><td>000 – 030 °</td><td>181 – 210 °</td><td></td></tr>
<tr><td>031 – 060 °</td><td>211 – 240 °</td><td>1 1</td><td></td><td>031 – 060 °</td><td>211 – 240 °</td><td>11111 1111 9</td></tr>
<tr><td>061 - 090 °</td><td>241 – 270 °</td><td>11 2</td><td></td><td>061 - 090 °</td><td>241 – 270 °</td><td>11 2</td></tr>
<tr><td>091 – 120 °</td><td>271 – 300 °</td><td>11 2</td><td></td><td>091 – 120 °</td><td>271 – 300 °</td><td></td></tr>
<tr><td>121 – 150 °</td><td>301 – 330 °</td><td>11 2</td><td></td><td>121 – 150 °</td><td>301 – 330 °</td><td></td></tr>
<tr><td>151 - 180 °</td><td>331 - 360 °</td><td>1 1</td><td></td><td>151 - 180 °</td><td>331 - 360 °</td><td>1 1</td></tr>
</table>
</td><td>2</td><td>bedding plane 1: tally correct for 1 mark

bedding plane 2: tally correct for 1 mark

ALLOW where 2 columns of numbers have been completed</td></tr>
<tr><td></td><td>(a)</td><td>(ii)</td><td>Rose diagram 1 plotted correctly;
Rose diagram 2 plotted correctly;

 
</td><td>1
1</td><td>ALLOW plots as either whole plots or up to 180°

ALLOW different scale for each diagram. Scale does not have to be shown

ECF from part (i)</td></tr>
</table>

Question			Answer	Mark	Guidance
	(a)	(iii)	bedding plane 1 has random orientation **OR** alignment of between 0^o and 30^o (to 180^o and 210^o) / N to S **AND** bedding plane 2 shows an alignment of between 30^o and 60^o (to 210^o and 240^o) / NE to SW; bedding plane 1 lacks a current on the bottom **OR** bedding plane 1 had weak current **OR** they are not aligned on bedding plane 1 due to lack of current **OR** bedding plane 1 formed in low energy; bedding plane 2 has alignment in the direction of a current **OR** bedding plane 2 had strong current **OR** bedding plane 2 was aligned at right angles to current direction **OR** bedding plane 2 was aligned parallel to current direction **OR** bedding plane 2 has formed in high energy;	1 1 1	**ALLOW** non-numerical descriptors for compass directions **ALLOW** max 1 for a general description for alignment with the current in both bedding planes
2	**(b)**	**(i)**	long neck to allow it to graze on vegetation **OR** to reach vegetation in tree tops; peg like teeth for biting vegetation **OR** peg like teeth to strip vegetation **OR** peg like teeth not suitable for tearing flesh **OR** teeth found only at the front of the jaw for biting vegetation **OR** teeth found only at the front of the jaw to strip vegetation; gastroliths present in stomach for aiding digestion **OR** gastroliths present in stomach for grinding food **OR** collection of stones present in stomach for aiding digestion; tail long and whip like used for defence; large / heavy / quadruped would be slow moving so not a predator;	2	**ANY 2** **ALLOW** rounded teeth instead of peg like **DO NOT ALLOW** grinding or chewing
	(b)	**(ii)**	large / sharp / serrated teeth for tearing flesh / eating meat **OR** bone crushing teeth to attack prey **OR** bone crushing jaw strong enough to attack prey; bipedal / large back or rear legs (be fast moving) to chase prey; small eyes / front facing eyes as did not need to see other predators **OR** forward facing eyes for good binocular vision (to judge distance); sharp claws useful for tearing flesh **OR** sharp claws useful for securing prey olfactory lobe present to give sense of smell / enable scavenging	2	**ANY 2**
			Total	**11**	

Question			Answer	Mark	Guidance
3	(a)	(i)	columella labelled on fossil **H** in centre of coral; individual corallite identified on either fossil **G** or **H**; dissepiments identified on transverse (cross) section of fossil **H** only, in between septa; tabulae labelled on either fossil **G** or **H**, as near horizontal plates on longitudinal section;	3	4 correct for 3 marks 3 correct for 2 marks 1 or 2 correct for 1 mark
	(a)	(ii)	**G** – tabulate **OR** tabulata	1	
	(a)	(iii)	give support / rigidity / strength to the coral skeleton / calice / corallum / polyp septa increase surface area of gut to aid digestion;	1	**ANY 1** **DO NOT ALLOW** reference to horizontal support or support of coral or division of chambers **DO NOT ALLOW** for support or strength only, unless it is qualified
	(a)	(iv)	they are symbiotic / live with photosynthetic algae **OR** they are symbiotic / live with zooxanthellae; • algae provide oxygen for the corals (for respiration); • corals provide carbon dioxide for algae (for photosynthesis); • algae get nutrition / food / nitrates / phosphates from coral waste products; • algae get protection from the coral as they live within the soft tissue;	1 1	**ANY 1** of the bullet points
	(b)	(i)	**J** – bioclastic limestone **OR** fossiliferous limestone **OR** reef limestone **OR** biosparite **K** – bioclastic limestone **OR** crinoidal limestone **OR** biosparite	1 1	**MAX 1** if biosparite given as answer for both **J** and **K** **MAX 1** if bioclastic limestone given as answer for both **J** and **K**
	(b)	(ii)	brachiopod **AND / OR** bivalve shells	1	

Question			Answer	Mark	Guidance
	(b)	**(iii)**	recognisable drawing of a crinoid **AND** identified as crinoid any labels from the following list: calyx, brachia, stem, ossicles, five-fold symmetry	1 2	1 or 2 correct labels =1 mark 3 correct labels = 2 marks **ALLOW** roots / holdfast, basals, infrabasal, anal tube, tegument, calcite plate
3	**(b)**	**(iv)**	rock **J** labelled anywhere on the reef or carbonate ramp; **AND** if reef labelled - the fossils in the rock are reef building and reef dwelling **OR** high energy **OR** form a life assemblage in a coral reef **OR** where corals lived due to shallow water; if carbonate ramp labelled – the fossil have been transported by currents **OR** area of high energy which has broken up coral;	1	reason **MUST** match location chosen
	(b)	**(v)**	high energy environment for well oxygenated water **OR** for nutrients; shallow water most within 30 m of surface **OR** within the photic zone; clear water due to lack of (clastic) sediment **OR** clear water for light penetration **OR** sediment in water clogs polyps; normal salinity **OR** 30 to 40 parts per thousand salt; temperatures between 23 to 29°C **OR** optimum is stated between 23°C and 29°C;	3	**ANY 4 for 3 marks** **ANY 3 for 2 marks** **ANY 2 or 1 for 1 mark** **MAX 1** if list given as: warm, clear, shallow sea
			Total	**17**	

Question			Answer	Mark	Guidance
4	(a)		varve; lithostratigraphy; diachronous; chronostratigraphy; assemblage	4	5 correct = 4 marks 4 correct = 3 marks 3 correct = 2 marks 1 or 2 correct = 1 mark
	(b)	(i)	labelled diagram showing included fragments in younger rock derived from older rocks eg older clasts in a conglomerate **OR** xenoliths of older country rock in a granite or other intrusion **OR** basal bed above an unconformity containing fragments of the older rocks below the unconformity; explanation: included fragments are older than the rock they are in **OR** fragments come from rocks laid down before the rock they are included in;	1 1	**MUST label** younger / older rocks **OR** formed first / last **MARK** labels as text **ALLOW** a diagram that is numbered with an explanation within the answer indicating the oldest / youngest number
	(b)	(ii)	labelled diagram showing rocks with cross-cutting relationship, e.g. dyke cutting across sedimentary rocks **OR** younger rocks on top of unconformity cutting across older rocks **OR** two faults cross cutting each other with the older one displaced; explanation: older rocks are cross-cut by younger ones;	1 1	**MUST label** younger / older rocks **OR** formed first / last **MARK** labels as text **ALLOW** a diagram that is numbered with an explanation within the answer indicating the oldest / youngest number
	(c)		energy level; infill with sediment **OR** sediment size; rate of sedimentation; burial; bioturbation; diagenesis	1	**ANY 2**

Question			Answer	Mark	Guidance
	(d)	(i)	silicification: replacement of wood by silica / SiO_2 precipitated from groundwater **OR** if fossil dissolved away then silica / SiO_2 precipitated from groundwater in voids **OR** addition of silica / SiO_2 by petrification increasing density replacement: (atom by atom) of wood by a named mineral (haematite) precipitated from groundwater; carbonisation **/** coalification: volatiles are removed by compaction and carbon content increases **OR** preserved as a film / residue with imprint of wood **/** lignite / coal;	2	**ANY 2** **1 mark max** for 2 methods stated and not described **ALLOW** any correctly named iron / uranium mineral for replacement **ALLOW** thin branches / bark trapped in amber
	(d)	(ii)	requires low energy conditions; bacteria uses sulfur to respire **OR** bacteria break down organism; sulfur is reduced to bisulfide; (bisulfide) reacts with iron in the environment forming pyrites	2	**ANY 2**
4	(d)	(iii)	Diagrams showing before diagenesis - shell trapped in sediment **AND** after diagenesis with internal and external moulds labelled (dead) organism becoming trapped in sediment / burial in fine sediment **OR** decay of organism's soft parts; inside of shell infilled by sediment **OR** inside of shell infilled by precipitated minerals; groundwater dissolves original material / dissolution; impression of the outside of the shell is the external mould (can be seen on breakage); impression of the inside of the shell is the internal mould (can be seen on breakage).	1 1 1	Mark description on diagrams as text **ANY 1** **ANY 1**
			Total	**16**	

Question			Answer	Mark	Guidance
5	(a)	(i)	event marked at 7m above base	1	
	(a)	(ii)	**describe** ^{13}C is low when sea level is low (below 7m) **OR** ^{13}C rises when sea level rises (above 7m); ^{13}C rises when brachiopod numbers rise; number of brachiopods change just prior to the change in sea level **OR** number of brachiopods increase as sea level rises; **explain** increase in sea level may reflect an increase in temperature (warmer climate) **OR** increase in ^{13}C may reflect an increase in temperature (warmer climate); higher sea level may reflect temperature increase which will give higher growth rates of plants; temperature increase may result in algal blooms (which reduce oxygen) hence brachiopod numbers; availability of continental shelf / shallow sea / habitat / ecological niche will change brachiopod numbers as a result of sea level change; carbon isotopes increase sharply at 7 to 8m showing changing uptake of carbon in plants (suggesting a change in environment); ^{12}C taken up preferentially by plants **OR** increases in ^{13}C mean more ^{12}C locked up in plants; increases in ^{13}C mean more plant growth on land;	2 2	**ANY 2** for description **ORA** **ANY 2** for explanation **ORA** **DO NOT ALLOW** any connection with widespread glaciation events
	(b)	(i)	crust sinks locally when depressed by extra mass (e.g. ice or extra sediment); crust rises when extra mass is removed (ice melts or sediment removed) **OR** crust rebounds back up again; Scotland is rising due to ice melting **AND** southern England is sinking; raised beaches due to land rising **AND** submerged forests due to land sinking;	2	**ANY 2** **MAX 1** for crust sinks so sea level appears to rise **AND** crust rises so sea level appears to fall

Question			Answer	Mark	Guidance
	(b)	(ii)	melting ice caps release water into the ocean **OR** increase in ice caps traps water; sea level rises when ice melts **OR** sea level falls when ice forms; **OR** increase in sizes of oceanic ridges (MOR) due to increased vulcanicity **OR** increase in spreading rate (at MOR); sea level rises when MOR is active / expands **OR** changes in the size of the ocean basins; Increased sedimentation from erosion of land;	2	**MAX 1** if two reasons given with no explanation **ORA** **ALLOW** sea levels rise with thermal expansion of water due to climate change for 1 mark
	(c)		shallow shelf dwellers may be affected more due to increased competition for space; sessile benthonic forms (eg crinoids, bivalves, brachiopods) may be affected most as they cannot easily move if changes are rapid; vagrant / non sessile benthonic forms (eg echinoids, gastropods) can physically move to keep pace with changing environment; vagrant / non sessile benthonic forms (eg echinoids, gastropods) may move into already inhabited areas, increasing competition; nektonic or planktonic forms (eg graptolites, ammonites) not affected as much as they stay at constant level in the water column reef building corals are affected due to the symbiotic relationship with the zooxanthellae (algae) which need to photosynthesise **OR** corals may not be able to grow upwards at the same rate the sea level rises **ORA**	3	**ANY 3** **Each point must have a clear explanation** **MAX 1** if no suitable examples are given
			Total	**12**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Description</th><th>Term</th></tr>
<tr><td>consists of the Tertiary and Quaternary</td><td>Cenozoic</td></tr>
<tr><td>the time before hard bodied fossils existed</td><td>Precambrian</td></tr>
<tr><td>geological system when ferns and fast growing plants were abundant</td><td>Carboniferous</td></tr>
<tr><td>geological system dominated by chalk deposition</td><td>Cretaceous</td></tr>
<tr><td>oldest geological system in the Palaeozoic era</td><td>Cambrian</td></tr>
<tr><td>era when dinosaurs existed</td><td>Mesozoic</td></tr>
</table>
</td><td>3</td><td>5 or 6 correct for 3 marks
3 or 4 correct for 2 marks
1 or 2 correct for 1 mark</td></tr>
<tr><td></td><td>(a)</td><td>(ii)</td><td>divided into systems based on fossil evidence;
divided into systems based on lithological evidence;
major changes in life on Earth mark major boundaries;
extinction of fossils mark major boundaries;
boundaries between systems are set at major events / unconformities / mountain building events;
systems are not all the same length as based on fossils / events;
boundaries were decided by individual geologists;
modern radiometric dating has helped define the boundaries</td><td>1</td><td>ANY 1</td></tr>
<tr><td></td><td>(a)</td><td>(iii)</td><td>1700m = 1700 x 100 = 170000cm OR 1700000mm
80Ma = 80 000 000 years

170 0000/80 000 000 = <u>0.021mm</u> OR <u>0.02mm</u> per year</td><td>

1</td><td>ALLOW if additional decimal places are given</td></tr>
</table>

Question			Answer	Mark	Guidance
6	(b)		**Kelvin's method:** Kelvin assumed the Earth started as a molten body of rock; he assumed the Earth had cooled gradually over time (as in a cooling curve) **OR** used the rate of cooling to give the age of the Earth as 20 – 40 million years; he assumed that as cooling proceeded, the drop in temperature slowed; he measured the geothermal gradient in mines; he measured conductivity of rock samples in a laboratory **why his method was incorrect:** he did not take into account that the rocks had been metamorphosed; he did not about radioactivity **OR** radioactive decay adding heat; he did not know the correct mass of the core; he did not know the thermal conductivity of all rocks; he did not have the technology to measure heat flow accurately; he scaled up small-scale measurements to represent the whole Earth	1 1	**ANY 1** **ANY 1**
			Total	**7**	

Question			Answer	Mark	Guidance
7			bivalves bilaterally symmetrical along the hinge line brachiopods bilaterally symmetrical about a plane from the umbo to the shell margin;	1	answers must be in pairs to gain credit when discussing differences mark diagrams as text Where marking points overlap, only credit once
			bivalve individual valves are asymmetrical brachiopods individual valves are symmetrical;	1	
			bivalve has valves the same size brachiopod has different sized valves;	1	
			bivalve have calcareous shells that are partly organic brachiopods have calcareous shells (unless they are inarticulate – chitin);	1	
			bivalve shells can grow very large (e.g. clams over 1m in size) brachiopods smaller (generally are less than 10cm);	1	
			bivalve maybe attached to the substrate with cement or using a byssus brachiopods maybe attached to the substrate by a pedicle stalk;	1	
			bivalves have gills / siphons brachiopods have a lophophore;	1	
			bivalves have many / large teeth and sockets **OR** cardinal teeth and sockets at the hinge brachiopods have two teeth and one socket **OR** few / small teeth and socket at the hinge;	1	
			bivalves have adductor muscles only **OR** adductor muscle scars brachiopods have adductor and diductor muscles **OR** adductor and diductor muscle scars;	1	
			bivalves usually have an asymmetrical umbo brachiopods usually have a symmetrical umbo;	1	
			bivalves have a (muscular) foot brachiopods do not have a foot;	1	
			(burrowing) bivalves have a gape brachiopods do not have a gape;	1	
			bivalves have a pallial line **OR** pallial sinus	1	

Question			Answer	Mark	Guidance
			brachiopods do not have a a pallial line **OR** pallial sinus; bivalves have a ligament brachiopods do not have a ligament; bivalves do not have a pedicle foramen / deltidial plates brachiopods have a pedicle foramen / deltidial plates; bivalves do not have diductor muscles brachiopods have diductor muscles; bivalves do not have a brachidium **OR** brachial support (for the lophophore) brachiopods have a brachidium **OR** brachial support (for the lophophore) bivalves do not have a a fold and sulcus **/** zig zag commissure brachiopods may have a fold and sulcus **/** zig zag commissure; **<u>bivalves only</u>** bivalves have a (muscular) foot **OR** (burrowing) bivalves have a gape **OR** bivalves have a pallial line **OR** pallial sinus **OR** bivalves have a ligament; **<u>brachiopods only</u>** brachiopods have a pedicle foramen **OR** deltidial plates **OR** brachiopods have a diductor muscles **OR** brachiopods have a brachidium **OR** brachial support (for the lophophore) **OR** brachiopods may have a fold and sulcus **OR** brachiopods may have a zig zag commisure	1 1 1 1 1 1 1	**MAX 1** for unpaired answers for both bivalves <u>and</u> brachiopods
			Total	**10**	

Question			Answer	Mark	Guidance
8			**Advantages- microfossils**		
			very small so found in large numbers in sedimentary rocks;	1	For maximum marks, answers much have a minimum of 1 mark for advantages of graptolites 1 mark for disadvantages of graptolites 1 mark for advantages of microfossils 1 mark for disadvantages of microfossils No more than 4 marks can be obtained for any one section Where marking points overlap, only credit once
			planktonic so can be found in most sedimentary rocks **OR** planktonic so can be extracted from most sedimentary rocks **OR** planktonic so can be found in lots of different facies;	1	
			small so usually well preserved **OR** small so usually found whole **OR** small enough to be found whole in drill cores;	1	
			evolved very quickly so resolution of zones very fine **OR** rock units split into fine divisions;	1	
			easily identifiable as many different species / genera / forms existed;	1	
			some microfossils (radiolaria) skeletons can survive below the CCD;	1	
			Disadvantages - microfossils		
			extraction may be difficult as they easily break;	1	
			time consuming as processing rock for extraction is slow;	1	
			may need access to high level laboratory for processing samples;	1	
			different processing methods destroy some fossils;	1	
			some may be hard to identify **OR** some need specialist microscopes to see fossils;	1	
			hard to know which ones are zone fossils **OR** have to look at many specimens to find zone fossils **OR** requires more expertise to identify specimens;	1	
			calcite skeletons may be dissolved below CCD;	1	
			diagenesis / metamorphism destroys skeletons;	1	

Question			Answer	Mark	Guidance
			Advantages- graptolites		
			large enough to see with the naked eye;	1	
			found in large numbers so abundant in (some) sedimentary rocks;	1	
			geographically widespread as they were planktonic;	1	
			evolved relatively quickly so resolution of zones is good **OR** used to zone Ordovician and Silurian;	1	
			easily identifiable as changes such as stipe number **OR** stipe attitude **OR** thecal shape are clear;	1	
			composed of scleroprotein so easily preserved **OR** can be preserved in 3D by pyritisation **OR** survives below CCD as made of scleroprotein;	1	
			Disadvantages - graptolites		
			some may be hard to identify, due to poor preservation eg thin carbon film / carbonisation;	1	
			alteration to clay minerals during diagenesis;	1	
			only found in fine grained sediments so restricted;	1	
			too fragile to survive in shallow sea / high energy rocks;	1	
			may not be found in the rocks you want to zone;	1	
			Advantages- both graptolites and microfossils		
			found in lots of different rock types **OR** widely distributed due to being planktonic;	1	
			live in surface waters and fall to sea bed on death **OR** live in water column and fall to sea bed on death;	1	
			Disadvantages- both graptolites and microfossils		
			diagenesis **OR** the weight of overlying rock **OR** low grade heating destroys fossils;	1	
			both are fragile so will not be found in shallow sea / high energy rocks / coarse clastic	1	
			Total	**10**	

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