Oxford Cambridge and RSA

GCE

Geology

H414/02: Scientific literacy in geology

Advanced GCE

Mark Scheme for November 2020

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

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

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	AO element	Guidance
1	(a)	(i)	subsiding / low lying areas of Earth's crust / rift valley / graben / geosyncline / depression **AND** where sediments accumulate ✓	1	1.1a	**ALLOW** if faulting is discussed at basin margins
1	(a)	(ii)	**ANY two** from: • use of mapping to deduce vertical and lateral changes in sediments / rocks ✓ • drill boreholes ✓ • analyse / correlate type of sediments / rocks / microfossils present in drill core ✓ • use of seismic surveys ✓ • seismic profiles show subsurface layering / geometry ✓ • use of well log subsurface techniques to show geometry of basin ✓ • coarse sediments / conglomerates indicate high energy / shallow water / marginal areas / edge of basin ✓ • identification of sedimentary structures (e.g. ripple marks) **OR** fossils (e.g. corals) linked to water depth / energy levels / position in basin ✓	2	1.1b 1.1d	**MAX 1 for** general discussion of different sedimentary rock types / sedimentary structures / fossils not linked to specific environmental conditions **ORA** **ALLOW** discussion of **ANY** correct sedimentary structures / fossils to indicate water depth / energy levels / conditions
1	(b)	(i)	magnification = size of image / size of real object = 38mm / 1.26mm magnification = x 30 +/- 1 ✓✓	2	2.1b	
1	(b)	(ii)	rock is an oolitic limestone **OR** oolitic ironstone ✓ **ANY 1** from: • concentric ooliths indicate high energy / currents **AND** shallow water ✓ • (chamosite / siderite / iron) minerals are precipitated from seawater ✓ • precipitation around a nucleus builds up concentric layers as grains roll back and forth ✓	1 1	2.1a	**ALLOW** wackestone **OR** oo-micrite

Question			Answer	Mark	AO element	Guidance
1	(c)	(i)	water depth shallow **AND** energy levels low ✓ **ANY 1** from: • (evaporites indicate) high rates of evaporation / higher evaporation than recharge **OR** a hot / arid climate **OR** periods of drying out **OR** marine regression ✓ • (thin limestones indicate) a warm / tropical environment ✓ • (bivalves and ostracods indicate) conditions suitable for life ✓	1 1	3.1b	
1	(c)	(ii)	description: cycle is limestones, overlain by clay and then sandstone ✓ **OR** ichnofauna of *Rhizocorallium* and *Arenicolites*, then *Thalassinoides* repeat (in different rocks / environments) ✓ **OR** cycle is marine limestone to terrestrial sandstone ✓ reason: each cycle is caused by changing sea level / regression ✓ **OR** subsidence / transgression allows cycle to repeat ✓	1 1	2.1a 3.1d	**ALLOW** any starting rock in correct cycle order
1	(c)	(iii)	for beds 1, 4 and 6 (in that order) *Gryphaea* 5 : 3 : 18 5/3 3/3 18/3 **1.66 : 1 : 6** ✓✓ **OR** *Pecten* 4 : 12 : 7 4/4 12/4 7/4 **1 : 3 : 1.75** ✓✓	2	2.1b	1 mark for a correct ratio 1 mark for reducing the ratio **DO NOT ALLOW** if more than 3 sig figs are used
			Total	13		

Question			Answer	Mark	AO element	Guidance
2	(a)*		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5-6 marks)** Sedimentary conditions and the geological setting of the Solnhofen Limestone is discussed in detail with good links to theory regarding exceptional preservation. Evidence is given as part of the narrative. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** Sedimentary conditions and the geological setting of the Solnhofen Limestone is addressed with some links to exceptional preservation. **OR** Preservation potential in different parts of the basin is discussed. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** Describes either the sedimentary conditions **OR** the geological setting of the Solnhofen Limestone without attempting to link to exceptional preservation. **OR** Describes the sedimentary conditions leading to exceptional preservation, but is not linked explicitly to the Solnhofen Limestone and may be linked to other sites of exceptional preservation. *There is an attempt at a logical structure with a line of reasoning. The information is, in the most part, relevant.* *No response or no response worthy of credit* **0 marks**.	6	2.1a 3.1b 3.1e	**AO2.1a Apply knowledge and understanding of geological ideas** may include: • exceptional preservation occurs when organisms are not transported / scavenged / decayed • fine detail preserved when energy levels are low / particle size is small • diagenesis needs to occur quickly **AO3.1b Interprets geological information, ideas and evidence** may include: • shallow lagoon/basin with coral and microbial reefs may be cut off from recharge • inland basin with no sea / limited rivers feeding basin • contain highs which have allowed for shallow water communities to form as reefs (corals/algae) • may describe areas of map where preservation potential is highest with reasons **AO3.1e Draws conclusions** may include: • reefs cut off areas of the basin allowing salinity to toxic levels (for life) • organisms in high salinity basins will be preserved once covered due to lack of scavengers / lack of oxygenation for decay • explains why preservation is good linked to the context of Solnhofen

Question			Answer	Mark	AO element	Guidance
2	(b)		gives clear conclusion that the specimens are unlikely to be the same species ✓	1	3.1b	**MUST** consider both time **AND** space for max marks
			ANY 2 from: • a species is a group of morphologically similar individuals that can interbreed to produce fertile offspring – it is not possible to know this as they are fossils ✓ • anatomical differences between number 12 and the other specimens suggest that it may be a different species **OR** morphology must be very similar to be considered a species, but several anatomical differences have been found ✓ • over a time span of 7 million years evolution is likely to have occurred so it is unlikely for them all to be the same species ✓ • specimen 12 is lowest in the sequence and may display fewer characteristics of birds / is least evolved ✓ • only two specimens have been found in the lowest strata, more would be needed to make a judgement **OR** most of the specimens found are in two members of one formation ✓ • no other specimens have been found in the east / most of the specimens have been found in the west / centre of the basin which may support a different species theory **OR** isolation between west / centre and east sides may have allowed different species to evolve ✓	2	3.1e	**ORA**
2	(c)		**ANY 2** similarities for 1 mark from: • furcula / wishbone • reversed first toe • have long forelimbs / wings ✓	1	2.1a	
			ANY 2 differences for 1 mark from: • *Archaeopteryx* has teeth, chicken no teeth • *Archaeopteryx* has long bony tail, chicken has a short tail • *Archaeopteryx* does not have breastbone, chicken has large breastbone • pubis pointing different ways (forwards in *Archaeopteryx* and backwards in chickens)	1		**ALLOW** two implicit differences for 1 mark

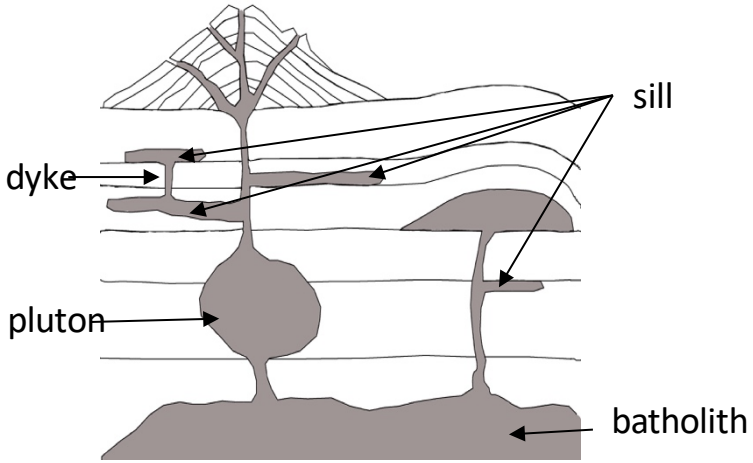
Question			Answer	Mark	AO element	Guidance
			• metatarsals not fused in *Archaeopteryx*, fused in chickens • *Archaeopteryx* has claws on wings, chicken does not ✓ •			
2	**(d)**		**ANY 2** descriptions **AND** matching explanations from: • evolved quickly **AND** (each species) had a short stratigraphic range / occupy a short time frame in geological history ✓ • abundant **AND** can find enough specimens to date a rock ✓ • easily identifiable morphology **AND** to be sure of assignation ✓ • can be found in many types of sediments and across different environments **AND** because a fossil restricted to one environment would be useless for zonation ✓ • had nektonic / pelagic mode of life **AND** is not confined to one rock type / is widespread geographically ✓ • can be found over a wide geographical area **AND** areas far apart can be zoned / correlated ✓ • strong skeletons / preservable hard parts **AND** is commonly preserved ✓	**2**	**1.1d**	each marking point **MUST** contain a description **AND** a matching explanation **ALLOW AW** **ALLOW MAX 1** for two correct descriptions with no / incorrect explanations
2	**(e)**		95m / 5.3 million years 95 / 5300 000 = 0.00001792 1.792×10^{-5} ✓✓	**2**	**2.1b**	**ALLOW** one mark if answer not in standard form
			Total	**15**		

Question			Answer	Mark	AO element	Guidance
3	(a)	(i)	(bulk) composition stays the same **OR** changes (that involve heat and pressure) without addition or subtraction of materials / elements / atoms ✓	1	1.1c	
3	(a)	(ii)	rock formed is a <u>metaquartzite</u> ✓	1	1.1c	
			ANY 1 textural change **AND ANY 1** mineralogical change for 1 mark from: textural change: • texture changes from clastic / grains to crystalline • adjacent grains exert pressure and quartz goes into solution at boundaries / pressure solution occurs • the grains are fused together (to form crystals) • recrystallisation results in uneven grain boundaries / granoblastic / sugary / saccharoidal texture / crystals with 120° triple point intersections / an unfoliated rock • crystal size increases with grade / as temperature increases mineralogical change: • mineralogy remains as quartz • impure sandstone may from additional metamorphic minerals ✓	1	2.1a	**DO NOT ALLOW** use of igneous terminology **ALLOW** metaquartzite as indicating mineralogy remains as quartz

Question			Answer	Mark	AO element	Guidance
3	(b)*		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5-6 marks)** Identifies more than one phase of metamorphism / deformation, and may attribute the garnets to the earlier phase of metamorphism / deformation **AND** Correctly identifies the parent rock **AND** the resultant metamorphic rock, linked to medium metamorphic grade and regional metamorphism. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated* **Level 2 (3-4 marks)** Identifies a main foliation (which surrounds the porphyroblasts) and describes the formation of the foliation as part of the metamorphic history **AND** Correctly identifies the parent rock **AND / OR** the resultant metamorphic rock. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** Correctly identifies the rock as a schist due to mineralogy / fabric, without attempting to link to metamorphic history. **OR** Correctly identifies the rock as either a regional **OR** a medium grade metamorphic rock and gives some idea of the conditions in which it formed **OR**	6	3.1a 3.1b 3.1d	**AO3.1a Analyse geological information, ideas and evidence** • identifies the mineralogy/texture as medium grade metamorphism • rock regionally metamorphosed • rock has two clear foliations and contains porphyroblasts • describes the formation of a foliation **AO3.1b Interprets geological information, ideas and evidence** • identifies that the garnets show inclusions which mean that they formed at the same time as the first foliation (early formed minerals) • main foliation developed at the same time as the garnets • garnets have been rotated in response to the pressure / temperature regime as they grew • a secondary / later foliation cross cuts the first • less recrystallisation in the secondary foliation suggests metamorphism was less intense **AO3.1d Make judgements** • there are a minimum of two phases of metamorphism / deformation which cross cut each other • parent rock must have contained some aluminosilicates / clay minerals to enable the formation of large amounts of mica / garnet / new aluminosilicate minerals • parent rock was a shale / mudstone / clay or other suitable named rock (to produce a schist)

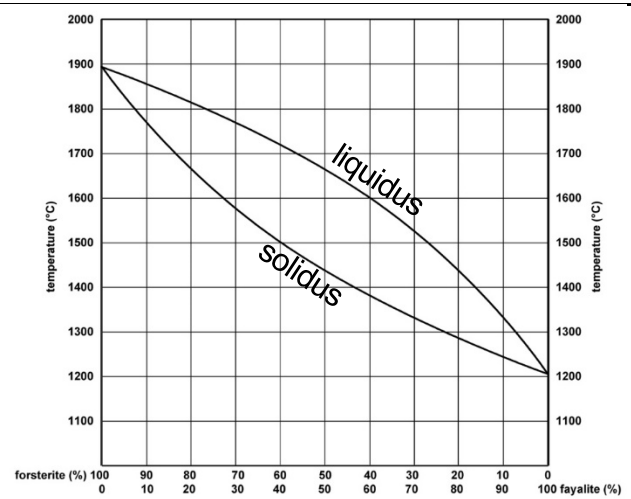
Question			Answer	Mark	AO element	Guidance
			Correctly identifies the parent rock as a shale / mudstone / clay. *There is an attempt at a logical structure with a line of reasoning. The information is, in the most part, relevant.* *No response or no response worthy of credit* **0 marks**.			
3	**(c)**	**(i)**	isograds drawn correctly ✓ ✓	**2**	**2.1b**	three lines drawn correctly for 2 marks two lines drawn correctly for 1 mark **ALLOW MAX 1** if 2+ correct lines are not completed across the entire map **OR** if lines continued around the edges of the map **DO NOT ALLOW** if lines are drawn through the letters
3	**(c)**	**(ii)**	area labelled **C** shaded on chart ✓	**1**	**3.1b**	
3	**(c)**	**(iii)**	Barrovian zones ✓	**1**	**1.1a**	
3	**(d)**		$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ ✓ ✓	**2**	**2.1a [M1.4]**	**1 MARK** for each half of the equation **ALLOW** correct reactants and products in either order **MAX 1** if the symbol equation does not balance
3	**(e)**	**(i)**	both axes labelled correctly: temperature (°C) **AND** pressure (MPa) ✓ data plotted correctly ✓ appropriate line drawn ✓	**3**	**2.1a [M2.9]**	axes can be plotted either way round 5 or 6 points plotted correctly **ALLOW** a line joining point to point **OR** a suitable line of best fit
3	**(e)**	**(ii)**	kyanite = higher pressure / lower temperature mineral ✓ andalusite = higher temperature / lower pressure mineral ✓	**1** **1**	**2.1a**	
			Total	**20**		

Question			Answer	Mark	AO element	Guidance
4	(a)	(i)	**ANY 2** stability problems for 1 mark from: • sandstone may be poorly consolidated / uncemented and lack strength • sandstone may contain joints / bedding planes which are zones of weakness / allow slippage • dipping beds may slip • clay and sandstone interface may not be stable • clay is weak / incompetent and may collapse / slump • sandstone is permeable allowing water ingress leading to slippage / collapse • clay may absorb water / undergo swelling leading to failure • overbreak / underbreak may occur due to differing rock strengths ✓ **ANY** 1 suitable stabilisation method from: • concrete <u>lining</u> / steel ribs ✓ • use <u>shotcrete</u> (to stabilise rocks) ✓ • grouting (to reduce permeability) ✓ • rock bolt the sandstones (to prevent slippage / rock falls) ✓ • install rock drains ✓ • use fill to stabilise tunnel if overbreak has occurred ✓	**1** **1**	**1.1a** **1.1d**	
4	(a)	(ii)	**ANY 1** from: smectite / montmorillonite / bentonite / saponite ✓	**1**	**1.1a**	
4	(b)		*K* = **<u>0.908</u>** ✓✓✓ evidence of correct working **ANY** two from: • calculation of cross-sectional area A = (20 x 500) = 10000 • calculation of (h2-h1) / L = (55 - 50) / 1000 = 0.005 • correct substitution of values into formula: 45.5 = *K* x 10000 x ((55 – 50) / 1000) • correct rearranging of formula to find *K*: *K* = Q / A ((h2-h1) / L) **OR** = 45.4 / (10000 ((55 – 50) / 1000)) **OR** = 45.4 / (10000 x 0.005) **OR** = 45.4 / 50	**3**	**2.1a**	**MAX 2** if answer is not to 3 significant figures **MAX 2** for evidence of correct working if calculated answer is incorrect
			Total	**6**		

Question			Answer	Mark	AO element	Guidance
5	(a)	(i)	✓✓  	2	1.1a 1.1c	**ANY 2 OR 3** correct for 1 mark **4** correct for 2 marks **ALLOW** any vertical / discordant linear intrusion as dyke **ALLOW** any concordant linear intrusion as sill
5	(a)	(ii)	**ANY 1** from: • emplacement of the laccolith will dome the crust above ✓ • geodetic surveying will measure the movement of the ground / change in shape ✓ • the positive gravity anomaly will be detected ✓	1	2.1a	**ALLOW AW**
5	(a)	(iii)	intrusions at depth are classified as plutonic **AND** shallow level intrusions are classified as hypabyssal ✓	1	1.1a	

Question			Answer	Mark	AO element	Guidance
5	(b)		description and explanation of magma / lava composition: mafic / low silica content lava / magma **AND** has low viscosity **/** has low gas content **AND** silicic **/** high silica content lava / magma **AND** has high viscosity **/** has high gas content ✓	1	1.1d	**ALLOW** implicit comparisons
			ANY 1 comparison of volcanic landscapes for mafic and silicic volcanoes from: • mafic magma forms fissure / shield volcanoes / flattened features / plateaus / mafic volcanoes have shallow sides / slopes less than 10° **AND** silicic magma form stratovolcanoes / (composite) cones / domes / elevated features / calderas / silicic volcanoes have steep sides / slopes ~ 30° ✓ • mafic volcanoes have a roughly circular shape **AND** silicic volcanoes have an irregular shape ✓ • mafic volcanoes are made up of successive lava flows **AND** silicic volcanoes are composite **OR** made up of alternating layers of ash / tuff and lava ✓ • mafic lava flows extend long distances **AND** silicic lava flows are close to the vent ✓	1		
			ANY 1 comparison of volcanic hazards for mafic and silicic volcanoes from: • mafic volcanoes are effusive / have low explosivity **AND** silicic volcanoes are explosive / have high explosivity ✓ • main hazards for mafic volcanoes are lava flows **AND** main hazards for silicic volcanoes are pyroclastics / pyroclastic flows / lahars ✓ • lava flows from mafic volcanoes tend to be at higher temperatures / flow faster **AND** lava flows from silicic volcanoes tend to be at lower temperatures / flow slower ✓	1		**ALLOW** any correct named hazard of a mafic volcano and any correct named hazard of a silicic volcano
5	(c)	(i)	1. pyroxene / augite ✓ 2. amphibole / hornblende ✓ 3. biotite (mica) ✓	3	1.1a	
5	(c)	(ii)	olivine to biotite (mica) circled ✓	1	1.1a	

Question			Answer	Mark	AO element	Guidance
5	(c)	(iii)	early formed / high temperature minerals usually react with the magma to form the next mineral down in the series ✓ if the reaction is not complete **OR** if cooling is too rapid **AND** the early mineral will be preserved **OR** a rim of the next mineral down will be formed around the edge of the crystal **OR** a corona texture forms ✓	**1** **1**	**2.1a**	**ALLOW** correct named examples, e.g. olivine reacts with the magma to produce pyroxene
5	(c)	(iv)	fractional crystallisation: as chromite / early-formed / high temperature minerals crystallise the composition of the remaining magma changes **OR** minerals crystallise in order of melting point **OR** different minerals crystallise at different temperatures ✓ gravity settling: chromite / ore minerals / metallic minerals have a high density (compared with the density of the magma) **AND** sink / settle out to the bottom of the magma chamber (as cumulate layer) ✓ filter pressing: if a liquid-crystal magma mixture is subjected to pressure the liquid is squeezed out / layers form ✓	**1** **1** **1**	**1.1a** **2.1a**	

Question			Answer	Mark	AO element	Guidance
5	(d)	(i)	 ✓	1	2.1a	both lines labelled correctly for 1 mark
5	(d)	(ii)	temperature: 1600°C ✓ composition: 72% forsterite **OR** 28% fayalite ✓	1 1	2.1b 3.1a	**MUST** include correct units **ALLOW** + or – 2% of given values
5	(d)	(iii)	composition: 60% forsterite **OR** 40% fayalite ✓	1	3.1a	**ALLOW** + or – 2% of given values
5	(d)	(iv)	temperature: 1380°C ✓	1	3.1a	**MUST** include correct units
			Total	21		

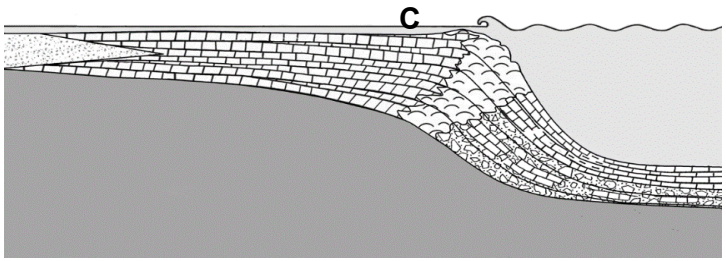
Question			Answer	Mark	AO element	Guidance
6	(a)		**ANY 2** from: • the iron in seawater originated from volcanism at the mid-ocean-ridges / hydrothermal vents ✓ • Fe^{2+} / ferrous iron is soluble / dissolved in seawater **OR** Fe^{3+} / ferric iron is insoluble ✓ • oxygen was produced by photoferrotrophs / photosynthesis (by bacteria) ✓ • oxidation caused iron minerals to come out of solution **OR** caused the iron minerals to be precipitated ✓ • form interbedded iron oxide and chert layers (suggesting cyclic variations) ✓	**2**	**3.1c** **3.1e**	**ALLOW** transport of iron in solution from rivers **ALLOW** cyanobacteria
	(b)		**ANY 2** from: • coral reefs form in shallow marine / continental shelf environments ✓ • oceans open by seafloor spreading and close due to subduction, forming and destroying these continental shelf environments ✓ • formation of supercontinents reduces shallow marine environments / coastlines and destroys coral reefs ✓ • break-up of supercontinents increases shallow marine environments / coastlines creating suitable environments for coral reef formation ✓ • the movement of continents affects the area of shallow marine environments between 30° N and S of the equator where coral reefs form ✓	**2**	**2.1a**	**ORA**
	(c)		coral skeletons enriched in ^{18}O indicate a cold palaeoclimate and low sea levels **AND** coral skeletons enriched in ^{13}C indicate a warm palaeoclimate and high sea levels ✓ **ANY 1** explanation from: • in colder periods / periods of low sea level ^{16}O is locked in glaciers / ice caps and not returned to the ocean so seawater / coral skeletons are enriched in ^{18}O **OR** depleted in ^{16}O ✓	**1** **1**	**1.1d**	**ORA** for valid alternative description relating to ^{16}O **OR** ^{12}C

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>• in warmer periods / periods of high sea level ^{12}C is locked in plants / vegetation and not returned to the ocean so seawater / coral skeletons are enriched in ^{13}C OR depleted in ^{12}C ✓</td><td></td><td></td><td></td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>
<table>
<tr><td colspan="4">mass in g</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>114.00</td><td>114.00</td><td>114.00</td><td>114.00</td></tr>
<tr><td>2.00</td><td>2.00</td><td>2.00</td><td>2.00</td></tr>
<tr><td>116.00</td><td>116.00</td><td>116.00</td><td>116.00</td></tr>
<tr><td>115.12</td><td>115.26</td><td>115.41</td><td>115.19</td></tr>
<tr><td>0.88</td><td>0.74</td><td>0.59</td><td>0.81</td></tr>
<tr><td>2.00</td><td><u>1.68</u></td><td>1.34</td><td><u>1.84</u></td><td>✓</td></tr>
<tr><td>100%</td><td><u>84</u>%</td><td>67%</td><td><u>92</u>%</td><td>✓</td></tr>
</table>
</td><td>2</td><td>3.1a</td><td>1 mark for mass of $CaCO_3$
1 mark for % $CaCO_3$
OR
1 mark for B correct
1 mark for D correct

e.g. (0.81 x 100) / 44 = 1.84g
1.84 / 2 x 100 = 92%</td></tr>
<tr><td></td><td>(d)</td><td>(ii)</td><td>ANY 1 from:
• the experiment should have been repeated multiple times for each sample to allow for any erroneous results ✓
• the limestones (from each age group) may not be homogeneous / there may be lateral variation in beds ✓
• there could be experimental errors, e.g. electronic balance variation, loss of sample during transfer to beaker, etc. ✓
• the temperature could affect the rate of reaction ✓
• the reaction might not be complete after 6 minutes ✓</td><td>1</td><td>3.1f</td><td>DO NOT ALLOW experimental error without a specific example
ALLOW any valid example of experimental error</td></tr>
<tr><td></td><td>(d)</td><td>(iii)</td><td>student is partly correct as purity increases with time for samples C to A (Cretaceous to Neogene) ✓

student is partly incorrect as sample D (Permian) is older than C or B but has a higher purity ✓</td><td>2</td><td>3.1e</td><td>ALLOW ECF from (d)(i)</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>11</td><td></td><td></td></tr>
</table>

Question			Answer	Mark	AO element	Guidance
7	(a)	(i)	**ANY 2** descriptions from: • domed corals are found in all locations **OR** dish corals are only found on the lower slope **OR** branching corals are not found on the lower slope ✓ • the number of domed coral colonies increases with depth **AND** the number of branching coral colonies decreases with depth ✓ • branching corals dominate the upper slope **AND** dish corals dominate the lower slope ✓ **ANY 1** reason for distribution of dish corals from: • the plate-like form is an adaptation to low light levels **OR** maximises surface area for photosynthesis (of algae) ✓ • the dish corals are fragile and cannot survive currents / wave action / higher energy at shallower depths ✓ • large surface area allows dish corals to catch organic matter fallout from the reef above ✓	**2** **1**	**3.1b** **3.1c**	**MUST** make a comparison to get **MAX** marks for description
7	(a)	(ii)	(cementing) algae / Zooxanthellae thrive in warmer sea temperatures / temperatures of 23 to 27°C ✓	**1**	**3.1a**	**ALLOW** where sea temperature does not fall below 18°C for extended periods of time
7	(b)	(i)	grainstone ✓	**1**	**2.1a**	**ALLOW** bio-sparite
7	(b)	(ii)	**ANY 1** characteristic from: • rock is made of reef talus / reef debris ✓ • rock is bioclastic / composed of fossil / skeleton / coral fragments (from the reef / reef slope) ✓ • rock contains carbonate mud / micrite ✓ **ANY 1** geological process from: • wave action / currents / high energy (on fore-reef) ✓ • fragments / material transported down the reef slope ✓ • deposition occurs to form beds ✓ • rock will be cemented with carbonate mud / micrite ✓	**1** **1**	**2.1a**	

Question			Answer	Mark	AO element	Guidance
7	(b)	(iii)	✓  	1	2.1a	**ALLOW** area immediately behind reef crest up to half-way along reef flat
7	(b)	(iv)	a group of sedimentary facies / rocks that represent one depositional environment ✓	1	2.1a	
7	(c)	(i)	**ANY 1** description of weathering from: chemical weathering **OR** rainwater is acidic due to dissolved carbon dioxide from the atmosphere **OR** hydrolysis breaks down feldspar / silicate minerals releasing Ca^{2+} **OR** carbonation breaks down carbonates releasing Ca^{2+} ✓ **ANY 1** description of transport from: Ca^{2+} / calcium ions / carbonate ions are transported **OR** dissolved calcium is removed in solution **OR** rivers / surface run-off transport the material to the sea / ocean ✓	1 1	2.1a	

Question			Answer	Mark	AO element	Guidance
7	(c)	(ii)	**ANY 3** from: • 4.5 km is approximately the Carbonate Compensation Depth / CCD ✓ • below the CCD calcite goes into solution **OR** calcareous ooze will not form **OR** increasing pressure with depth increases the solubility of $CaCO_3$ ✓ • (above this depth) carbonate tests / calcareous microorganisms / calcareous nanofossils / foraminifera / coccoliths fall to the sea floor **OR** form a calcareous ooze ✓ • below the CCD only siliceous microorganisms / radiolaria fall to the sea floor **OR** form a siliceous ooze ✓ • rates of deposition are very low / slow **OR** mm /1000 years **OR** deposition requires low energy conditions ✓	**3**	**1.1a**	**ALLOW** 1 mark for general discussion of planktonic microorganisms sinking to the sea floor **ALLOW** any other correct named example of calcareous microorganism **ALLOW** any other correct named example of siliceous microorganism
			Total	**14**		

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk