

Geology

Advanced Subsidiary GCE

Unit **F792**: Rocks – Processes and Products

Mark Scheme for January 2013

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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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Annotations

Annotation	Meaning
	Unclear
	Benefit of doubt
	Contradiction
	Cross
	Error carried forward
	Ignore
	Benefit of doubt not given
	Poor diagram
	Reject
	noted but no credit given
	Tick
	Omission mark
	Maximum (marks available for) Response

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	Marks	Guidance	
1	(a)	<p>rock made of grains OR crystals OR minerals; sediment that has hardened OR magma that has cooled; an aggregate of minerals; a mixture of minerals; naturally occurring substance composed of mineral/s</p> <p>mineral a naturally occurring inorganic / crystalline substance; a solid with a definite or fixed <u>chemical composition</u>; a solid with an ordered atomic structure; an inorganic crystalline compound OR element; AW</p>	1	Any 1 point	
			1	Any 1 point	
	(b)	(i)	sand dunes OR barchans	1	ALLOW dunes
		(ii)	cross bedding OR ripple marks	1	
		(iii)	<p><u>any one from</u> inside of meander bend on river; point bar; area of low energy where deposition occurs OR area of low energy shallow water;</p>	1	ALLOW description of slip off slope in meander
		(iv)	<p>1 - C 2 - B 3 - A</p>	2	3 correct = 2 1 or 2 correct = 1
	(c)	<p>compaction / diagenesis pushes grains together OR compaction / diagenesis reduces pore space OR grains fused / compacted together by load pressure OR grains fused / compacted together by weight of overlying sediments;</p> <p>cement fills pores between grains to make solid OR chemical cement glues grains together OR matrix infills gaps between grains to make solid</p>	2	<p>1 mark for compaction and 1 mark for cement</p> <p>if description is too limited but compaction and cement or matrix stated ALLOW 1 mark</p> <p>ALLOW named mineral for cement</p>	

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Question		Answer	Marks	Guidance
	(d)	<p>drawing: grains drawn as round or subrounded</p> <p>scale: scale that shows grains over 2mm to a maximum of 100cm</p>	1 1	at least 2 grains need to be drawn
	(e)	<p>name: saltation for sandstone and traction for conglomerate; grains moved by saltation where grains bounce / skip above river bed; pebbles moved by traction OR bed load by sliding / dragging / rolling on river bed;</p>	3	<p>ALLOW drawings to show grains bouncing or sliding if labelled 1 mark for 2 named methods and 1 mark for each description</p> <p>OR If only one correct method is given for a rock but method has a more detailed description such as actual grain sizes / energy levels / height of bounce max 2 marks</p> <p>ALLOW saltation for conglomerate</p>
Total			14	

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Question			Answer	Marks	Guidance
2	(a)	(i)	a mineral that is stable over a particular temperature and pressure range OR a mineral that is formed under specific temperature and pressure conditions OR a mineral that indicates particular temperature and pressure conditions	1	ALLOW found in a metamorphic zone or grade OR used to determine the degree of metamorphism
		(ii)	left side of garnet OR right side of chlorite for lower limit and left side of sillimanite for upper limit	1	both sides must be drawn for the mark
		(iii)	regional	1	
		(iv)	low slate medium schist high gneiss	3	1 mark for each correct rock
		(v)	shale OR mudstone OR clay	1	
	(b)	<p>similarity both have same composition OR both are made of Al_2SiO_5 OR both are polymorphs so have different forms OR both are found in schist OR both are found in gneiss OR both are index minerals for <u>regional</u> metamorphism</p> <p>difference sillimanite forms at high T/P while kyanite forms at medium T/P OR sillimanite forms at higher T/P than kyanite OR sillimanite forms at higher T than kyanite OR kyanite not found in contact metamorphic rocks due to low P sillimanite is found</p>	<p>1</p> <p>1</p>	<p>ALLOW correct reference to crystal shapes with kyanite triclinic and sillimanite orthorhombic or colours with kyanite mainly blue and sillimanite white/brown/green.</p> <p>both minerals need to be included to show difference</p>	
	(c)	(i)	garnet is large crystal in E labelled porphyroblast	1	
		(ii)	D <u>gneissose</u> banding E schistosity OR schistose foliation OR <u>porphyroblastic</u>	2	1 mark for each correct texture DO NOT ALLOW porphyroblast

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Question		Answer	Marks	Guidance
	(d) (i)	<p>garnet will scratch glass OR garnet cannot be scratched by steel;</p> <p>muscovite will be scratched by a copper coin but not a fingernail OR copper coin will scratch muscovite but not garnet</p>	2	<p>ALLOW 1 mark for a general correct statement of hardness testing for the minerals without the mineral names</p> <p>ALLOW muscovite can just be scratched by fingernail</p>
	(ii)	<p>no cleavage means it will fracture OR will break unevenly OR has no planes of weakness OR will not split or flake</p> <p>perfect cleavage will split easily into thin layers OR has planes of cleavage parallel to each other</p>	2	<p>ALLOW 1 mark for a general correct statement of cleavage for the minerals without the mineral names OR muscovite will split while garnet will not</p>
Total			16	

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Question			Answer	Marks	Guidance
3	(a)	(i)		2	1 mark for correct axes and line or curve on graph 1 mark for accurate points
		(ii)	<p>description ash is thickest close to the volcano and rapidly thins</p> <p>explanation the ash particles are dense so settle out close to the volcano OR the initial energy from the eruption diminishes with distance OR velocity of ash cloud decreases</p>	1 1	
		(iii)	75km +/-5km	1	ecf
		(iv)	lahars	1	
	(b)	(i)	composite OR strato-volcano OR intermediate	1	ALLOW just strato

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Question		Answer	Marks	Guidance
	(ii)	<p>steep sided volcano drawn with sides between 30 and 60 degrees</p> <p><u>crater</u> at the top as a hollow</p> <p><u>feeder vent</u> rising from depth or magma chamber to crater / parasitic cone</p> <p>alternating layers of <u>lava and ash</u> parallel to the sides of the volcano</p>	4	each point must be drawn and correctly labelled
	(c)	<p>any two from</p> <p>construction of <u>hazard maps</u>;</p> <p>extent of ash deposits;</p> <p>extent OR path of past lava flows;</p> <p>extent of blast damage;</p> <p>extent OR path of past lahars;</p> <p>extent OR path of past pyroclastic flows;</p> <p>study of geological history OR old deposits of ash / pyroclasts for thickness OR composition OR frequency <u>and</u> intensity;</p> <p>pattern of valleys as hazards of pyroclastic flows OR nuée ardentes OR lava flows OR lahars follow them;</p>	2	ALLOW use of either pyroclast term of <i>ash</i> or rock term of <i>tuff</i>
Total			13	

Question			Answer	Marks	Guidance
4	(a)	(i)	1 H 2 J 3 F 4 G	3	4 correct = 3 2 or 3 correct = 2 1 correct = 1
		(ii)	limestone marble; sandstone metaquartzite; shale spotted rock OR andalusite rock OR hornfels;	3	1 mark for each correct rock ALLOW quartzite DO NOT ALLOW orthoquartzite ALLOW slate for rock
		(iii)	andalusite	1	ALLOW cordierite
	(b)		oceanic and continental crust / plates drawn and labelled; <u>subduction</u> of oceanic plate below continent; partial melting of oceanic crust and rising magma; rising magma melts continental crust to form granite batholith	4	MAX 3 if no description MAX 3 if no diagram
	(c)	(i)	area at each side of the layered intrusion in the chilled margin	1	Must be shaded just inside the intrusion on at least one side. Area shaded must be less than 5mm wide
		(ii)	cumulate	1	ALLOW if correct answer given in part (iii)
		(iii)	<u>Any two from</u> <u>denser</u> mafic minerals OR pyroxene OR olivine sink faster; high temperature minerals OR high melting point minerals crystallise and sink; plagioclase has lower density so sinks more slowly; the layers are formed by gravity settling; convection currents in the magma cause layering;	2	ALLOW if correct answer given in part (ii)

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Question		Answer	Marks	Guidance
	(iv)	<p><u>any two from</u></p> <p>silicic minerals form last on Bowens Reaction Series OR form at low temperature;</p> <p>quartz, K feldspar, muscovite are late stage products of differentiation OR Na rich plagioclase forms late;</p> <p>all mafic minerals already used in forming the layers OR magma is depleted in iron/magnesium;</p> <p>formation of mafic minerals uses less silica so more silica is left OR magma is enriched in silica;</p> <p>filter pressing causes lighter, silicic to accumulate at the top;</p>	2	DO NOT ALLOW silicic minerals rise up
Total			17	

Question			Answer	Marks	Guidance
5	(a)	(i)	K 8 weathering L 6 erosion M 7 transport N 5 deposition	3	4 correct = 3 2 or 3 correct = 2 1 correct = 1
	(b)	(i)	rock flour and / or clay and boulders carried in ice OR material of all sizes carried in ice OR frost shattered rocks fall on to ice OR rocks plucked from base and carried in ice; ice melts and load deposited OR deposition in a moraine in front of ice OR deposition as the ice retreats OR deposition from ice and not transported by water;	2	1 mark for the material transported and 1 for deposited
		(ii)	silt layer formed in spring or summer OR silt layer forms from snow melt; clay layer forms in autumn or winter as thin layer OR clay layer forms rich in organic material or rich in algal bloom;	2	ALLOW 1 mark for general idea of two layers per year OR variations in seasonal deposition ALLOW 1 mark for deposition of fine sediment
		(iii)	rivers from meltwater from the ice carried sand and gravel OR sands and gravels transported by ice and then rivers OR sediments transported in meltwater rivers and deposited.	1	
	(c)		pebbles aligned by the current with long axis parallel; pebbles come to rest with a clear long axis leaning down current OR dipping up current;	2	arrow for current is essential on the diagram OR description of correct current direction 1 mark for diagram and 1 mark for description

Question		Answer	Marks	Guidance
	(d) (i)	<p><u>any three from</u></p> <p>saline water enters from open sea OR bar restricts entry of water from the sea OR shallow water increases the rate of evaporation OR saline water cannot flow out into sea;</p> <p>evaporation causes the water in the basin to become more saline OR supersaturated OR hypersaline (due to water level reducing);</p> <p>salts are precipitated / crystallise out from saturated solution;</p> <p>dense salts are deposited on basin floor OR minerals crystallise out with least soluble first;</p> <p>cycles of evaporite deposits may form</p>	3	labels on the diagram can be credited as text
	(ii)	<p>last K salts / polyhalite / correct K salts halite anhydrite or gypsum</p> <p>first calcite OR carbonates</p>	3	<p>4 correct = 3 2 or 3 correct = 2 1 correct = 1 max 1 for inverted sequence of 3+ minerals or 2 correct minerals written in wrong place ALLOW anhydrite and gypsum if calcite omitted</p>
	(e) (i)	<p><u>cubic salt</u> OR halite crystals form; halite <u>dissolved</u> leaving cubic hole; holes <u>infilled</u> by (fine) sediment or silt</p>	3	<p>can be shown as a series of labelled diagrams</p> <p>mark diagrams as text 2 max if no diagrams</p>
	(ii)	desiccation cracks OR mud cracks OR ripples	1	
Total			20	

Question	Answer	Marks	Guidance
6	<p>porphyritic</p> <ul style="list-style-type: none"> large crystals are called <u>phenocrysts</u> and they formed first; large crystals / phenocrysts form at great depth OR >10 km OR in batholith OR in intrusion OR in the magma chamber below the volcano; large crystals / phenocrysts, (usually K feldspar) forms by cooling slowly finer grained <u>groundmass</u> forms later; finer crystals / groundmass cooled more quickly OR by rapid cooling; magma and crystals move up within the crust (by diapiric action) OR magma and crystals are erupted to the surface when an eruption occurs; labelled diagram showing two sizes of crystals in a correct named rock matched to description e.g. granite or porphyritic basalt; 		max 5 for porphyritic texture
	<p>flow banding</p> <ul style="list-style-type: none"> bands of dark / mafic / biotite and light / silicic / quartz with feldspars; bands are often contorted OR folded - due to silicic magma OR viscous lava OR because the lava is thick /sticky; the colour bands form due to the separation of minerals in a lava flow; the mineral are aligned roughly parallel to the flow direction; labelled diagrams showing layers in a correct named rock such as rhyolite; 		max 4 for flow banding texture
	<p>amygdaloidal</p> <ul style="list-style-type: none"> where vesicles formed in a rock due to trapped gas bubbles leaving holes; vesicles are infilled by minerals deposited from ground water; common minerals are calcite OR quartz crystals; crystals grow in towards the centre of the hole; large amygdales partially filled with crystals are called geodes; labelled diagram to show amygdales in a correct named rock; 		max 4 for amygdaloidal texture ALLOW any correct minerals DO NOT ALLOW pumice as example of amygdaloidal rock amygdales must have crystals drawn in them max 8 if no diagrams max 8 if no rock names
	Total	10	

Question	Answer	Marks	Guidance
7	<p>chemical</p> <ul style="list-style-type: none"> • oolitic limestone is formed by chemical process; • spherical grains of aragonite or calcite or calcium carbonate; • nucleus of shell fragment or sand grains; • rolled along shallow sea floor or sand bank under high energy conditions / wave action; • evaporation causes precipitation of calcium carbonate from sea water; • calcium carbonate (aragonite) deposited around nucleus/ concentric layers and in cement; • micritic limestone or micrite is formed by chemical process; • fine grained lime rich mud • formed in low energy conditions in lagoon; • evaporation of sea water and precipitation of calcium carbonate; 		<p>max 5 for chemical processes</p> <p>labelled diagram can be marked as text</p> <p>ALLOW micrite as a biological limestone if the explanation is that it formed from animal faeces</p>
	<ul style="list-style-type: none"> • ooliths OR fossils cemented by calcite (in form of sparite); 		
	<p>biological</p> <ul style="list-style-type: none"> • fossiliferous limestone OR bioclastic OR shelly OR reef OR crinoidal is formed by biological processes; • made of broken shell fragments • made of correct named fossils including coral; • reefs form unbedded / massive limestones due to upward growth • if fossils are whole formed in lower energy environment; • if fossils are broken formed in moderate or high energy conditions OR on reef slope; <ul style="list-style-type: none"> • chalk is formed by biological processes; • skeletal remains of microfossils OR coccoliths; • calcareous algae, which breaks down when algae die; • formed in low energy conditions 		<p>max 5 for biological processes</p> <p>ALLOW specific fossil parts eg ossicles/stem of crinoid</p> <p>mark diagrams as text</p>
	Total	10	

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