



Geology

Advanced Subsidiary GCE

Unit F792: Rocks – Processes and Products

Mark Scheme for June 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
<u>(1111)</u>	Benefit of doubt
CON	Contradiction
×	Cross
I (4	Error carried forward
—	Ignore
	Benefit of doubt not given
PD	Poor diagram
	Reject
BEEN	Noted but no credit given
~	Tick
	Omission mark
	Maximum 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

G	uest	ion	Answer	Marks	Guidance
1	(a)	(i)	quartz	1	
		(ii)	well rounded should be nearly spherical and sub rounded have an irregular outline with no sharp corners	1	ALLOW if more than one grain drawn
		(iii)	 A shallow sea - contains mica OR yellow colour common in sea or beach OR rounded and moderately sorted OR calcite present B fluvial / river – poor sorting OR rock fragments OR contains mica C desert / sand dune – red (iron oxide) staining OR no mica OR no rock fragments OR well rounded and well sorted OR texturally and compositionally mature 	1 1 1	the reasons must match to the correct environment ALLOW 1 mark for 2 correct environments identified with no reasons
	(b)	(i)	D poorly sorted E well sorted	1	must have both for 1 mark
		(ii)	 D glacial / fluvial / alluvial fan / wadi as material of every size present OR glacial / fluvial / alluvial fan / wadi as contains coarse material E desert / aeolian as most grains are about 1mm in size (millet seed) OR well sorted and all sand sized 	1	must have environment named and reason for each mark ALLOW 1 mark for both environments identified with no reasons
	(c)		angular grain OR sub-angular grain OR sub-rounded grain; grain size from 2.6mm to 0.4mm OR arenaceous; poorly sorted OR sand and silt matrix OR texturally immature; varied composition OR contains (>25%) K feldspar OR rock fragments OR compositionally immature; arkose OR feldspathic sandstone	3	any three description points ALLOW fragment / sandstone / clast / particles / minerals as alternative to grain
			Total	12	

Q	uesti	on	Answer	Marks	Guidance
2	(a)	(i)	F mafic G silicic H intermediate	2	3 correct = 2 marks 1 or 2 correct = 1 mark DO NOT ALLOW silica for silicic ALLOW basic for F and acidic for G
		(ii)	porphyritic basalt	1 1	ECF from (a)(i) ALLOW term porphyritic if used in (a)(iii)
		(iii)	augite and/or olivine crystals OR phenocrysts formed slowly ; augite and / or olivine crystals OR phenocrysts formed in the magma chamber; augite and / or olivine crystals OR phenocrysts formed first; augite and / or olivine crystals OR phenocrysts forms large crystals (4mm OR medium size); groundmass cooled rapidly; groundmass form fine crystals (0.5mm); groundmass cooled at the surface; groundmass cooled last;	1	any two points for phenocryst formation ALLOW 1 mark for two stages of cooling OR general correct statement of large crystal slow cooling and fine fast cooling. any two points for groundmass formation
		(iv)	granite	1	ECF from (a)(i)
		(v)	Ca rich plagioclase forms (in F) at higher temperature while Na rich plagioclase forms (in G) at lower temperatures; Ca rich plagioclase (in F) forms first on the continuous reaction series and Na rich plagioclase (in G) forms later on the continuous reaction series; the feldspar changes from Ca rich plagioclase (in F) to Na rich (in G) on the continuous reaction series OR lower down the reaction series.	1	any one point

C	luesti	ion	Answer	Marks	Guidance
	(b)		drawing showing labelled rounded amygdales / vesicles	1	
			infilling crystals OR calcite OR quartz drawn and labelled OR infilling vesicle	1	
	(c)	(i)	J lava flow K sill	1	both need to be correct for mark
		(ii)	reddened top shows weathering at top of the lava flow; uneven top to the flow; eroded clasts of igneous rock in bed above; vesicles at the top; only 1 baked margin below; xenoliths only from rock below.	3	any three points ALLOW no baked margin above
		(iii)	2 baked margins both top and bottom; sandstone xenoliths can only come from above OR the sandstone xenoliths fell into the magma OR two different types of xenoliths at top and bottom OR xenoliths at both top and bottom; no vesicles present	2	any two points
			Total	16	

Q	Question		Answer	Marks	Guidance
3	(a)	(i)	the in situ breakdown of rock OR rock disintegrating by chemical, physical and biological processes OR destructive natural process by which rocks are altered with no transport OR the process by which rocks are broken down by wind, rain, temperature changes or plants or animals	1	DO NOT ALLOW any erosional terms
		(ii)	hydrolysis	1	
		(iii)	feldspars break down OR decompose OR feldspar produces clay; H ⁺ ions in water react with minerals OR carbonic acid dissolves minerals; K / Na / Ca / mineral ions /salts are dissolved out; clay minerals (aluminium silicate / china clay / kaolin) are insoluble and remain OR form a residue.	2	any two points accept either plagioclase or K feldspar or named feldspar 1 mark for general point of minerals (not rock) dissolved and clay left behind
		(iv)	it is very hard (7); it is chemically inert OR non reactive OR insoluble OR very stable; it has no cleavage so no planes of weakness for water to enter.	2	any two points
	(b)		granite 2 as it has more joints greater surface area of rocks to be weathered OR water can penetrate further into the rock OR more water enters the rock allowing chemical weathering	1 1	
	(c)		water enters cracks OR joints in rock must be shown on diagram; water freezes and forms ice so <u>expands</u> ; ice melts so <u>contraction</u> ; rock breaks down due to stresses of expansion and contraction OR rock fractures due to <u>repeated</u> stresses OR joint/crack widens due to <u>repeated</u> freezing and thawing OR rock breaks down due to <u>repeated</u> freezing and thawing.	1 2	if no diagram max mark is 2 any two points mark detailed labels as text DO NOT ALLOW diurnal changes

Question	Answer	Marks	Guidance
(d)	temperature changes from day to night OR <u>repeated</u> frequent temperature changes OR differential thermal expansion; rock expands when hot and contracts when cool OR <u>repeated</u> expansion and contraction; surface layers peel off OR onion skin weathering breaks up the rock OR sheet like fragments break off OR rock breaks off in layers OR outside layers of rock peel off; different minerals in rocks have different expansion and contraction rates. OR plutonic igneous rocks are exposed at the surface; rock splits along horizontal pressure release joints; sheets of rock break off parallel to the surface.	2	any two points ALLOW diagram to show surface layers flaking off ALLOW alternative answers on pressure release
(e)	roots of plants burrowing organisms	1 1	DO NOT ALLOW animals digging
	Total	15	

G	Question		Answer	Marks	Guidance
4	(a)		L tuff M pahoehoe lava N agglomerate P pillow lava Q ignimbrite	5	
	(b)	(i)	R mafic OR shield OR basaltic OR HawaiianS intermediate OR composite OR strato volcano OR andesitic	1 1	
		(ii)	crater at top of vent above line at top of vent vent within vertical white area	1	if vent is labelled near to the crater the labels must show a clear distinction
		(iii)	 R hotspot OR divergent OR MOR S convergent OR oceanic-continental OR oceanic-oceanic OR subduction zone 	1	ALLOW R constructive and S destructive
		(iv)	low viscosity lava OR mafic OR basaltic - means - low angle OR broad shallow sides OR long flows OR can travel much further high viscosity lava OR intermediate OR andesite - means - high angle OR steep sides OR short flows OR cannot travel far	1	 ALLOW 1 mark for general statement of viscosity correctly linked to each volcano ALLOW runny for low viscosity

(c)		ash enters atmosphere (and can stay up for years) causing cooling:	2	any two points
		ash reflects sunlight from causing cooling particles causing cooling OR stops heat reaching the surface;		DO NOT ALLOW ash blocking the sun making it dark for short term weather
		sulfur dioxide gas released enters atmosphere and forms sulfate particles; sulfate aerosols reflect heat energy causes cooling for several years OR worldwide effect of no summers;		
		carbon dioxide may cause global warming if very large amounts are produced.		
(d)	(i)	as magma moves up it releases gases so increase in gases (like CO_2 and SO_2) OR the ratio of CO_2 to SO_2 changes	1	DO NOT ALLOW radon gas must have explanation not just statement
	(ii)	swelling of the volcano is <u>due to magma</u> moving up OR slope steepening can indicate the start of a landslip which releases magma	1	must have explanation not just statement
	(iii)	earthquake swarms OR harmonic tremor OR short period earthquakes OR long period earthquakes OR a sequence of many small magnitude earthquakes often precede an eruption	1	1 mark for general point of earthquakes caused by magma moving up in the vent
		magma vibrates in the vent as it moves up OR magma pushes against overlying rock below the surface OR magma fracturing brittle rock OR magma pushes through a blocked/new vent OR long period earthquakes form from increased gas pressure	1	DO NOT ALLOW just rising magma DO NOT ALLOW harmonic tremor or short period caused by gas pressure
		Total	19	

G	luest	ion	Answer	Marks	Guidance
5	(a)	(i)	a turbidity current is a high velocity current that flows down a slope carrying dense <u>sediment</u> OR currents caused by an excess density of suspended <u>sediment</u> load moving downslope at high speed OR a current of rapidly moving, <u>sediment</u> -laden water moving down a slope through water OR oceanic gravity currents which derive their motive force through suspended <u>sediment</u> OR an underwater current flowing swiftly downslope owing to the weight of <u>sediment</u> it carries OR an underwater avalanche of <u>sediment</u>	1	AW ALLOW description of sediment
		(ii)	$\frac{140}{59}$ = 2.37	1	answers should be to 2 decimal places
		(iii)	$\frac{41}{77} = 0.53$	1	answers should be to 2 decimal places
		(iv)	current slows down as the slope flattens out OR as meets the abyssal plain OR between cables 1 and 2 current is on a slope so fast while between cables 3 and 4 it is on flat abyssal plain so slow; current slows with distance from the epicentre OR current slows with distance as it loses energy; current slows as sediment is deposited.	2	any two points
	(b)	(i)	from base of coarse sandstone at 12cm to base of clay at 97cm OR to top of bed T at 50cm	1	
		(ii)	greywacke high % of rock fragments with <u>clay matrix</u>	1	ALLOW clay matrix and one non diagnostic descriptor of poor sorting / angular grains / K feldspar / texturally immature / compositionally immature / arenaceous OR ALLOW three non-diagnostic descriptors of rock fragments / poor sorting / angular grains / K feldspar / texturally immature / compositionally immature / arenaceous

C	uest	ion	Answer	Marks	Guidance
		(iii)	graded bedding	1	
			coarse grains at the bottom and fine grains at the top OR dense grains at the base and less dense grains above	1	
		(iv)	bed T turbidite formed from high energy turbidity current fine sand and silts formed at medium energy end of turbidity current shale deposited from suspended sediment low energy	1	1 mark for general statement of energy levels decreasing up1 mark for general statement of sequence of rocks fining up
		(v)	flute casts drawn as U shaped structures with closed end up current; scour structure with deep end at closed end; explanation of scouring / erosion at base of turbidity current; hollow infilled with sediment.	3	any three points max 2 marks with no diagram drawing must have current direction clearly shown DO NOT ALLOW erosion of rock
	(c)	(i)	plankton OR small organisms in the surface layers of the ocean die and sink / accumulate / deposited on the sea floor to form ooze OR biogenic skeletal material, made of silica or calcite sinks / accumulate / deposited on the sea floor	1	ALLOW specific named plankton
		(ii)	1mm per thousand years to 30mm (3cm) per thousand years (0.001mm per year to 0.03mm per year 1000mm per Ma to 30,000mm per Ma 100cm per Ma to 3,000cm per Ma 1m per Ma to 30m per Ma)	1	ALLOW few mm per thousand years
			Total	18	

Question	Answer	Marks	Guidance
6	igneous always crystalline OR minerals interlocked in a mosaic OR crystallised from magma; crystals not usually lined up OR unfoliated OR distinctive igneous textures given; three main minerals from quartz, feldspar, augite, olivine, mica, hornblende OR minerals specific to igneous rocks, augite / olivine; no beds - forms lava flow, dyke, sill, batholith; fossils absent; hard - not easily split or broken. (May be crumbly when rotted by weathering);		max 4 for igneous where diagrams are used such as to show crystalline structure, mark as text if fully labelled
	<pre>sedimentary fragmental made of grains OR fragments or fossils cemented together and / or can be crystalline; three main minerals from clay minerals, quartz, K feldspar, calcite, mica, rock fragments OR minerals specific to sedimentary rocks clay minerals / glauconite; deposition in beds OR sedimentary structures are common; fossils may be present; may be soft and crumbly but some sedimentary rocks are difficult to break if crystalline or well cemented;</pre>		max 4 for sedimentary where diagrams are used such as to show grain structure mark as text if fully labelled
	metamorphic always crystalline / recrystallised OR minerals interlocked in a mosaic OR granoblastic; crystals usually lined up / aligned OR foliated; main minerals quartz, K feldspar, mica, garnet, calcite OR mineral specific to metamorphic rocks–garnet / andalusite / kyanite / sillimanite; no beds apart from relict beds ; fossils absent apart from relict fossils / deformed fossils; hard - but may split in layers.		 max 4 for metamorphic where diagrams are used such as to show foliation mark as text if labelled ALLOW specific foliated texture such as schistosity or gneissose banding or porphyroblastic as an alternative to foliation

Question	Answer	Marks	Guidance
7	shales are made of clay minerals with very fine quartz OR shale has a varied chemical composition so different metamorphic minerals can be formed OR shales have clay minerals with alignment parallel to beds;	1	Temperatures and pressures may be shown on a P/T diagram or given numerically
	regional metamorphism forms at convergent plate boundaries OR deep below fold mountain ranges OR in collision zones;	1	
	low grade regional metamorphism–low temperatures and pressures form slate:	1	max 4
	index mineral chlorite and/or biotite OR chlorite and/or biotite formed by recrystallization;	1	mark diagrams as text if labelled
	formation of slaty cleavage where micas are aligned OR minerals	1	
	may contain pyrite porphyroblasts;	1	
	medium grade regional metamorphism–medium temperatures and pressures form schist:	1	max 4
	schistose texture OR schistosity where muscovite (and biotite) are aligned:	1	mark diagrams as text if labelled
	porphyroblasts of garnet crystallise:	1	
	index mineral biotite and/or garnet minerals grow:	1	
	index mineral kyanite grows OR kyanite forms at higher T/P OR kyanite as $Al_2 SiO_5$ polymorph;	1	
	high grade regional metamorphism –high temperatures and pressures form gneiss;	1	max 4 ALLOW migmatite
	gneissose banding with light and dark bands;	1	mark diagrams as text if labelled
	light bands rich in quartz and K feldspar dark bands rich in biotite;	1	
	index mineral sillimanite OR sillimanite as $Al_2 SiO_5$ polymorph;	1	
	Total	10	

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