

**Geology**

Advanced GCE F792

Rocks – Processes and Products

**Mark Scheme for June 2010**

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Question	Expected Answers	Marks	Additional Guidance
1 a i	<p>part of east side shaded – west coast of central and N America, Aleutians</p> <p>part of west sided shaded – Kamchatka, Japan, Philippines, Indonesia, New Zealand</p>	1 1	shading should be a narrow band that must include at least one island arc ignore one incorrect area shaded; max 1 if large incorrect area shaded
ii	<p><u>Unzen</u> convergent / destructive plate boundary / oceanic - oceanic plate boundary / Pacific / oceanic plate subducting beneath Asia / subduction zone / island arc</p> <p><u>Kilauea</u> hotspot / mantle plume / in centre of plate / not at a plate boundary / intraplate</p>	any 1 any 1	
b	<p><u>Katmai</u> explosive / violent / high VEI / infrequent eruptions / Strombolian upwards</p> <p><u>intermediate</u> / andesite lava / viscosity high / gas content high / lots of pyroclasts and ash / nuée ardente / ignimbrites / tuffs / agglomerates / gases / strato-volcano or composite cone volcano</p> <p><u>Kilauea</u> non explosive / gentle / effusive / low VEI / frequent eruptions / Icelandic / Hawaiian <u>style eruption</u></p> <p>mafic / basaltic lava / pahoehoe lava / aa lava / viscosity low / fluid / gas content low / no pyroclasts / shield volcano</p>	any 1 any 2 any 1 any 1	1 for type of activity and 2 for products  1 for type of activity and 1 for products  do not accept runny

Question	Expected Answers	Marks	Additional Guidance
<b>c</b>	<p><u>pyroclastic flows</u> / nuée ardente that move down valleys / at speed / blast damage (1)            ash fall covering buildings / fields / prevents air travel (1)            gases / ash cause breathing difficulties / suffocation / are toxic (1)            mudflows / lahars engulf people / buildings / are ash and water mixed (1)            landslides destroy buildings / fields (1)            pyroclastics – blocks and /or bombs (1)</p>	any 2	1 mark for each hazard – must be geological do not accept lava flow max 1 for a list
<b>1 d</b>	<p><u>labelled diagram</u> (1)            highly explosive / violent eruption / high VEI / Krakatoan / Plinian eruption / eruption from strato-volcano (1)            top of volcano blown off / load removed (1)            magma chamber (partially) empties (1)            volcano / crater collapses (into magma chamber) / there is no support / cauldron subsidence occurs (1)            remaining magma compressed (so violent eruption) (1)            leaves large depression / caldera / empty volcano fills with water (1)            water mixing with magma makes eruption more explosive (1)</p>	1	max 3 if no labelled diagram mark labels on diagram(s) as text
<b>e</b>	<p>geysers are hot springs from which a column of <u>hot water / steam / water vapour</u> erupts explosively / ejection of superheated water and steam / hot water under pressure / eruption of groundwater heated by magma / volcanic activity</p>	any 3	must name gas as steam / water vapour
	<b>Total</b>	<b>16</b>	

Question	Expected Answers	Marks	Additional Guidance
2		1	allow range of values do not accept if hornfels shaded
	<p>shaded area <u>must include slate, schist and gneiss</u></p>		
	<p>gneiss hornfels slate gneiss hornfels schist / slate</p>	max 4	<p>1 correct = 1 2 correct = 2 3 or 4 correct = 3 5 or 6 correct = 4</p>
	<p><b>b</b></p> <p><b>i</b></p> <p>both are (regional) metamorphic (1)</p> <p>cleavage forms due to low pressure / at low grade / in slate, but schistosity forms at high(er) pressure / high(er) compressive stress / at medium grade / in schist (1)</p> <p>cleavage the minerals rotate at right angles to the pressure / parallel to axial plane, schistosity new minerals grow (1)</p> <p>slate partly recrystallised, schist totally recrystallised (1)</p> <p>slate fine crystals, schist medium crystals (1)</p>		<p>each point should be a comparison so both cleavage and schistosity to be given for one mark</p> <p>accept labelled diagram(s)</p> <p>max 2 if describes differences between the two without explanation</p> <p>max 1 for correct descriptive points for either cleavage or schistosity</p>
	<p><b>ii</b></p> <p>phenocrysts are formed first in a liquid / igneous rock / cooled slowly / at depth / formed during two stages of cooling</p> <p>porphyroblasts form last / grow in a metamorphic rock / disrupt the schistosity / grow in solid state</p>	<p>1</p> <p>1</p>	<p>max 1 for phenocrysts are igneous and porphyroblasts are metamorphic with no explanation</p>

Question	Expected Answers	Marks	Additional Guidance
2		1	allow from edge of aureole to half way to contact
i	in outer part of the aureole		
ii	<p>low grade <u>contact</u> metamorphism / heat from cooling igneous intrusion / metamorphism of a clay / mudstone / shale (1)</p> <p>rock is <u>partially</u> recrystallised / altered / only recrystallised in the spots / not fully metamorphosed (1)</p> <p>(relic) sedimentary textures / bedding / fossils may occur (1)</p> <p>spots are growth of new minerals / biotite / chlorite / iron minerals / graphite / organic material (1)</p>	any 2	
iii	<p><u>dip</u> of sides / contact of intrusion varies (1)</p> <p>narrow if side is dipping steeply / wide if shallow dip (1)</p> <p>country rock type varies – heat is absorbed / conducted differently / some are more reactive (1)</p> <p>presence of water – increases amount of metamorphism / carries heat further (1)</p> <p>size / volume of magma – large intrusion produces wider aureole / will retain heat longer (1)</p> <p>initial temperature of magma / temperature difference – higher temperature will produce wider aureole (1)</p> <p>composition of magma – silicic magmas produce wider aureoles / contain more volatiles (1)</p>	any 2	<p>may be shown as cross section diagram</p> <p>max 1 if general statement width varies because the intrusion / country rock varies</p> <p>max 1 for list of factors with no explanation</p>
	<b>Total</b>	<b>15</b>	







Question	Expected Answers	Marks	Additional Guidance
4	<p><b>a</b> <b>i</b> <u>climate</u> – tropical / <u>hot</u> and <u>arid</u> or <u>dry</u></p> <p><u>explanation</u> – form within 20° of / close to the equator / evaporites are forming / evaporation is occurring</p>	1	do not accept description of environment for climate
		any 1	accept if climate is correctly described in explanation
	<p><b>ii</b> salts form by evaporation of sea water / salts in solution / dissolved in sea water (1)</p> <p>salts become more concentrated / precipitate out / seawater is saturated (1)</p> <p>water becomes dense and cannot return to the open sea (1)</p> <p>in a barred basin / area with restricted circulation (1)</p>	any 2	accept diagram with text allow discussion of sabkha for max 1
	<p><b>iii</b> the sea evaporated / dried out four times / over four periods / more than once (1)</p> <p>water was diluted four times as basin refilled (1)</p> <p>influxes of sea water over the bar / barrier (1)</p>	any 2	allow in a barred basin / area with restricted circulation if not given in part (ii) accept discussion of sabkha provided correct reasoning is given
<b>b</b>	<p><b>i</b> <b>B</b> gypsum <b>C</b> halite <b>D</b> calcite or dolomite</p>		3 correct = 2 1 or 2 correct = 1
	<p><b>ii</b> gypsum / mineral with hardness 2 can be scratched by finger nail (1)</p> <p>halite / calcite / mineral with hardness 3 can be scratched by copper coin (and not by fingernail) (1)</p>	1 1	max 1 for comparison with reference minerals / harder mineral will scratch softer mineral / simply states can use finger nail and copper coin

Question	Expected Answers	Marks	Additional Guidance
4	<p>iii b</p> <p>calcite is the least soluble / most insoluble so forms first (1) potash salts are the most soluble so form last (1) controlled by order of solubility (1)</p>	any 2	
c	<p><u>labelled diagram</u> showing V shaped cracks (wet) mud dries out in the sun / water evaporates (1) mud contracts / shrinks / V shaped / polygonal cracks open up (1) cracks infilled / preserved by sediment / sand / silt / next bed (1)</p>	1  any 2	max 2 with no diagram. mark labelled diagram(s) as text
	<b>Total</b>	<b>15</b>	

Question	Expected Answers	Marks	Additional Guidance
<b>5 a i</b>	(when igneous rocks) form <u>deep</u> / <u>at depth</u> below the surface	1	
<b>ii</b>	<b>E</b> silicic / felsic / acid <b>G</b> ultramafic / ultrabasic <b>F</b> intermediate <b>H</b> mafic / basic	3 max	4 or 3 correct = 3 2 correct = 2 1 correct = 1 if correct rock names of E granite, F diorite, G peridotite, H gabbro used then max 2
<b>b i</b>	<b>J</b> intermediate mafic / basic <b>L</b> silicic / felsic / acid	2 max	3 correct = 2 2 or 1 correct = 1
<b>ii</b>	rich in magnesium and iron / ferro-magnesium minerals / dark coloured (and dense) / melanocratic / low in silica	1	
<b>iii</b>	quartz is a mineral (in silicic rocks) / forms only if magma is oversaturated / % quartz is lower than % silica in a rock	1	
<b>iv</b>	silica is found in all the rock forming minerals / all silicates / the more quartz the higher the silica content % of quartz is easier / quartz can be seen with the eye	1	allow ecf from part (iii)
<b>c</b>	silica content requires the rock to be destroyed / % of silica is measured using expensive equipment / chemical analysis / testing / silica is not a mineral	1	max 1 for argument silica is better because silica rich rocks are light coloured and quartz can be hard to see
	andesite dolerite rhyolite diorite gabbro granite	1 1 1 1 1 1	
	<b>Total</b>	<b>17</b>	

**Describe the deposition and characteristics of conglomerates, sandstones and mudstones on beaches and in sediment-rich shallow seas. You may use diagrams to illustrate your answer.**

Question	Expected Answers	Marks	Additional Guidance
6	<p><b>Conglomerates: only on beaches / close to shore (1)</b>            rounded / well rounded pebbles (1)            coarse grain size / rudaceous / &gt; 2mm grain size (1)            coarse sand matrix or cement (1)            high energy / rounded by wave action (1)            not transported far as large grain size (1)            composition can be mixed / depends on surrounding rocks / pebbles eroded from cliffs (1)</p> <p><b>Sandstones: on beaches / close to shore / in shallow sea (1)</b>            quartz rich (can have mica) / usually orthoquartzites (1)            well rounded / well sorted / texturally mature (1)            medium grained / arenaceous (1)            high energy / affected by currents / tides (1)            may show cross bedding / symmetrical ripples / herringbone cross bedding (1)            many fossils / may contain calcite / shell fragments (1)            may contain glauconite (1)</p>	max 4	each point can have a mark if it is described and not just listed  mark labelled diagrams as text  max 2 for conglomerates if incorrect or no environment given
	<p><b>Mudstones: only in shallow sea / deep shelf / offshore (1)</b>            fine grained / argillaceous / &lt; 0.0625 mm grain size (1)            rich in clay minerals / platy minerals (1)            deposition of material carried in suspension (1)            low energy (1)            dark in colour due to anaerobic conditions / high carbon / organic content (1)            many fossils / bioturbation / laminations / burrows (1)</p>	max 4	max 2 for sandstones if incorrect or no environment given
	<p>diagram showing sequence of decreasing grain size out to sea / energy reduction off shore (1)</p>	max 4 1	max 2 for mudstones if incorrect or no environment given
	<b>Total</b>	<b>10</b>	

**Describe the processes that operate in the rock cycle to form each of the main groups of rocks. You may use diagrams to illustrate your answer.**

	<b>Expected Answers</b>	<b>Marks</b>		<b>Additional Guidance</b>
7	weathering – breakdown of rock in-situ producing sediment	1	sedimentary	must name and describe processes (not just list) to gain marks  max 3 if sequence of processes are listed or shown on diagram without definitions  do not accept discussion of melting for metamorphism or recrystallisation
	erosion – removal of weathered material / wearing away of sediment	1	sedimentary	
	transport – movement of sediment by water, wind, ice and gravity	1	sedimentary	
	deposition – occurs when transporting agent loses energy / beds laid down	1	sedimentary	
	burial – occurs as sediment accumulates over time / oldest material is at the bottom of the sequence	1	sedimentary	
	diagenesis – processes of compaction and / or cementation that turn a sediment into rock	1	sedimentary	
	metamorphism – rock changed by heat and / or pressure	1	metamorphic	
	recrystallisation – minerals change into new minerals in the solid state / no melting		metamorphic	
	partial melting – occurs in the upper mantle or lower crust / due to the geothermal gradient crossing over the mantle melting temperature / because different minerals have different melting points	1	igneous	
	magma accumulation – magma collects in magma chamber / magma rises as low density diapirs	1	igneous	
	intrusion – igneous material / magma (crystallises) below the surface	1	igneous	
	extrusion – erupted igneous material (lava) reaches the surface (and crystallises)	1	igneous	
	crystallisation – solid minerals / crystals form during cooling of magma or lava	1	igneous	
	uplift – any rock type uplifted to the surface due to earth movements	1	all	
	diagram – 1 mark for sedimentary processes labelled (minimum 2), 1 mark for metamorphic processes labelled (minimum 1), 1 mark for igneous processes labelled (minimum 2)	max 3	all	
	<b>Total</b>	<b>10</b>		

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