

GCE

Geology

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

Advanced Subsidiary GCE

Mark Scheme for June 2018

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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.

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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 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)	(i)	Processes		2	1-2 correct for 1 mark 3-4 correct for 2 marks
			A	burial		
			B	crystallisation		
			C	uplift		
			D	magma accumulation		
		(ii)	compaction / cementation; occurs at low temperatures and low pressures; reduces porosity; part of diagenesis; groundwater contains minerals that precipitate;		2	
		(iii)	minerals are a naturally occurring chemical compound / definite composition / chemical structure / atomic structure / crystalline structure; rocks are composed of minerals / are an aggregate of one (monomineralic) or more (polymineralic) minerals OR multiple minerals/ can be composed of non-mineral matter e.g. obsidian, coal;		1 1	
	(b)	(i)	F	saltation	2	1-2 correct for 1 mark 3 correct for 2 marks
			G	suspension		
			H	solution		
		(ii)	bedload consists of grains which are moved by traction / load remains in constant contact with the bed / sliding / rolling;		1	
		(iii)	rounded / smoother / less angular; high sphericity; reduction in grain size; process of abrasion/attrition;		1 1	
	(c)	(i)	correctly plotted histogram		2	5-6 correctly plotted 7 correctly plotted
		(ii)	J is well sorted AND K is poorly sorted		1	
		(iii)	following features identified: angular fragments / large clasts / clay matrix / rock flour / compositionally immature / poorly sorted / rudaceous / striations; grain size from scale matches rock type;		1 1	2 features require for 1 mark
		(iv)	glacial (environment)		1	
				Total	17	

Question			Answer	Marks	Guidance
2	(a)	(i)	diagram with labels showing: water seeps into cracks and freezes; ice <u>expands / expansion</u> the crack; ice melts; repeated cycles of correct process to break the rock;	3	Max 2 if no diagram
		(ii)	carbon dioxide gas in the atmosphere reacts with rainwater / formation of carbonic acid; air in soil pore space is rich in carbon dioxide due to decomposing plant litter; groundwater is more acidic than rainwater; dissolves calcite; they are left behind as clay residues; $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca}^{2+} + 2 \text{HCO}_3^-$;	2	
		(iii)	roots grow along bedding planes and joints / roots force rocks apart; surface kept open so <u>water / rain / precipitation</u> penetrates to support further weathering;	1 1	ALLOW AW for forcing apart
	(b)	(i)	L – mechanically/physically formed/clastic formed sedimentary rocks N - biologically formed sedimentary rocks	1	both L and J required for 1 mark
		(ii)	tiny grains of sand / shell / seed / pellet; calcite precipitated OR around this nucleus concentric layers of calcium carbonate OR rolled in carbonate mud; rolled by tidal action / currents to form ooliths;	2	
	(c)	(i)	energy reduction / velocity reduction / low energy / little wave action / little tidal action / (high) sediment load / where rivers meet the sea	1	2 points for 1 mark
		(ii)	coarse grains sands and gravels / cross bedded sands /channel sandstones; clays (deposited between channels) / peat / coal / seat earth/ rootlets;	1 1	
		(iii)	foresets / fine sands OR silts	1	
		(iv)	low energy clays, mud, silts AND fine grained /thinly bedded / lack sedimentary structures / lithify to form shale / contain marine fossils	1 1	
	(d)		subsidence OR emergence; marine transgression / retrograde AND regression / prograde; changes in sea level;	2	

Question	Answer	Marks	Guidance
	local isostatic changes due to mass of sediments; migration of the delta lobe; changes to the rate of sedimentation;		
	Total	18	

Question			Answer	Marks	Guidance
3	(a)	(i)	dyke	1	
		(ii)	contact metamorphism produces baked margin; chilled margin – (rapid) cooling against cold country rock; baked margin - recrystallisation due to heat; rapid cooling of intrusion creates fine crystal grain size; larger the intrusion the wider the baked margin ORA ;	Max 3	ALLOW Max 1 for chilled or baked margin location
		(iii)	sill is medium as it has cooled slower but a lava flow is fine due to cooling rapidly / sills have larger crystals because they take longer to cool; sills are coarser due to cooling at depth; found above and below in a sill but no xenoliths from above in lava flow; found above in sill and not in lava flow;	1 1	
		(iv)	gas bubbles are trapped in the lava; holes left where the gas was once present; permeable so ground water can flow through it / groundwater contains dissolved minerals; minerals precipitated into the holes; larger vesicles can be filled to form geodes;	Max 3	
	(b)		country rock – any rock that the igneous rock intruded into / original rock / surrounding rock; discordant – cuts across / through / not parallel the original beds; concordant – follow / travels along / parallel the original beds of rock horizontally rock	1 1 1	
	(c)		crust is cold and brittle and batholiths intrude by stoping; magma moves upwards along joints/faults/bedding planes / separating masses of country rock; pieces / fragments of the rock detach / break / are plucked AND settle into the magma; no new space is created during stoping; the xenolith falls into the magma and melt to the magma; assimilated country rock changes composition of magma;	Max 3	
Total				16	

Question			Answer	Marks	Guidance						
4	(a)	(i)	eruptions formed from fractures / fissures / joints on the flanks of the volcano; flank of the volcano is unstable; can be formed from a dyke or sill cutting up to the surface from the central magma chamber; lava is silicic and builds up close to the vent / vent becomes plugged;	2							
		(ii)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;"></td> <td style="width: 33%; text-align: center;">T</td> <td style="width: 33%; text-align: center;">U</td> </tr> <tr> <td style="text-align: center;">name</td> <td style="text-align: center;">Pumice/ ignimbrite</td> <td style="text-align: center;">lapilli tuff</td> </tr> </table>		T	U	name	Pumice/ ignimbrite	lapilli tuff	2	
	T	U									
name	Pumice/ ignimbrite	lapilli tuff									
		(iii)	mafic example – basalt AND silicic example – rhyolite mafic is lower viscosity ORA ; mafic richer in magnesium and iron; mafic have higher temperature lavas ORA ; mafic has a lower silica content ORA ; mafic is more common ORA ;	1 Max 2							
	(b)	(i)	(harmonic tremors) created through rising magma vibrating up the vent; (short period earthquakes) caused by the fracturing of brittle rock forcing its way upwards; (long period earthquakes) indicate an increase in <u>gas</u> pressure;	2							
		(ii)	Description spreads in south-easterly direction; elliptical shape spread; ash depth decreases with distance from the; spreads to a distance of 180-220 km; spreads to a width of 65-85 km; Explanation ash depth decreases with distance from the volcano due to weight/loss of energy; ash follows south-easterly direction due to prevailing wind direction/lateral blast;	1 1	CREDIT figures taken from diagram						
		(iii)	isopachyte	1							

Question	Answer	Marks	Guidance
	<p>(iv) gas emissions - magma nears surface and pressure decreases / amount of gas increases prior to eruption / changes in the composition of gas;</p> <p>ground deformation – magma moving up under the volcano increase / inflates / bulges / swells OR use of tilt meters to establish deformation;</p> <p>changes in groundwater – borehole and well measurements are used to monitor changes in volcanic subsurface / ground water levels increase and decrease prior to eruption / temperature causes thermal expansion and ground water levels rise / increase in gas of magmatic pressure causes ground water to rise / magma moving causes fractures which leads to secondary porosity and groundwater levels decrease;</p> <p>historic pattern – studying frequency of eruptions may be possible to predict eruption;</p>	<p>1</p> <p>1</p>	<p>DO NOT CREDIT radon gas</p>
	<p>(v) Description of ash fall analysis</p> <p>allows prediction of future ash fall; allows prediction of areas at risk; allows awareness of explosivity;</p> <p>Evaluation of ash fall analysis</p> <p>useful for eruptive pattern to be established; not precise/useful due to dependent on wind direction / infrequent / weather conditions / direction of volcanic blast / variation in strength of eruption / risk associated with other hazards; comparison with other methods e.g. lava flows, pyroclastic flows, lahars;</p>	<p>1</p> <p>1</p>	<p>Must have judgement for evaluation</p>
	Total	15	

Question			Answer	Marks	Guidance
5	(a)	(i)	contact	1	
		(ii)	5km shaded correctly	1	
		(iii)	W hornfels	1	
			X spotted rock	1	
			Y metaquartzite	1	
		(iv)	increased temperature OR heat from the intrusion OR magma; recrystallisation / new mineral growth; increase in temperature of the country rock creates a reaction; higher temperatures increase the rate at which ions diffuse between minerals; process can be speeded up by water which allows the ions to diffuse more rapidly;	1 1	
		(v)	the degree of metamorphism; extent of metamorphism / recrystallization; amount of metamorphism / recrystallization; intensity of metamorphism / recrystallization; the relative temperature and pressure conditions under which metamorphic rocks form;	1	
		(vi)	dip of contact – shallow angle gives wide aureole / steep angle gives narrow aureole; composition of country rock – sandstones are narrower than clay rich rocks / permeable rocks allow groundwater creating convection allowing for a wide aureole; composition of magma – mafic magma has higher temperatures creating wider aureole / silicic magma contains more volatiles; temperature of magma – small intrusion so little change / larger intrusion large change / there is time for metamorphic reactions to take place / higher temperature creates greater width of aureole; volume of magma – larger intrusions cool slowly and heat the surrounding rocks over a long period of time / develops a wide metamorphic aureole;	3	Max 1 for 2 correctly named reasons with no explanation
	(b)	(i)	granoblastic texture	1	ALLOW sugary / saccharoidal

Question		Answer	Marks	Guidance
	(ii)	(calcite grains and fossils) recrystallise / recrystallisation takes place; recrystallisation occurs through increased temperature and (pressure); metamorphism causes the original calcite crystals to grow larger random orientated; equi-dimentional crystals due to little pressure; limestone predominantly made of calcite stable over wide range of temperatures; 120 degree intersections / equal-sized / inter-locking mosaic;	2	
Total			14	

Question	Answer	Marks	Guidance
6	<p>Cross bedding</p> <ul style="list-style-type: none"> • desert / sand dunes / large scale measured in metres; • sand grains moved by wind, river or marine in high energy environments; • foresets dip / point in direction of the current; • currents are unidirectional; <p>Graded bedding</p> <ul style="list-style-type: none"> • common is deep marine / fluvial; • turbidity currents flow onto the abyssal plain from the continental slope • depositing heavier particles first / largest particles at the bottom and finer particles at the top; • decreases reduction in energy / reduction in velocity; <p>Desiccation cracks</p> <ul style="list-style-type: none"> • associated with playa lakes / flood plains / common in hot and arid; • caused by loss of water due to evaporation; • mud contracts forming polygonal shaped blocks separated by cracks; • v shaped cross-section indicating more evaporation at the surface; <p>Salt pseudomorphs</p> <ul style="list-style-type: none"> • associated with playa lake location / hot and arid; • indicate arid environments where evaporation of salty water causes cubic halite crystals to grow; • dried up lake re-fills suggesting seasonal variation; <p>Symmetrical ripple marks</p> <ul style="list-style-type: none"> • associated with shallow marine environments; • oscillating currents so tidal; <p>Asymmetrical ripple marks</p> <ul style="list-style-type: none"> • associated with river / shallow sea environments / deserts • unidirectional current / formed by currents that travel in one direction <p>Imbricate structures</p> <ul style="list-style-type: none"> • river / stream environment / high energy environments; 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>Mark diagrams with text Max 3</p> <p>Max 3</p> <p>Max 3</p> <p>Max 3</p> <p>Max 2</p> <p>Max 2</p> <p>Max 3</p>

Question			Answer	Marks	Guidance
			<ul style="list-style-type: none"> • unidirectional current / formed by currents that travel in one direction; • pebbles are inclined in the upstream direction / tops of the pebbles point downstream; <p>Flute casts</p> <ul style="list-style-type: none"> • fluvial / deep-marine indicator; • indicate high energy OR turbidity currents; • form parallel to the current; • deeper and pointed at the upstream end; 	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>Max 3</p>
			Total	10	

Question	Answer	Marks	Guidance
7			max 8 if no Al_2SiO_5 polymorph discussed
	<p><u>Slate</u></p> <p>low grade and low pressure and low temperature; chlorite zone; chlorite and/or biotite are index minerals; crystal grain size is fine; recrystallisation occurs but some clay minerals may still exist; formation of slaty cleavage where micas are aligned OR minerals align; aligned at 90 to maximum pressure; may contain pyrite porphyroblasts;</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>max 4</p> <p>Mark labelled diagrams as text</p>
	<p><u>Schist</u></p> <p>medium grade AND medium pressure and temperature; biotite and garnet are index minerals / kyanite as Al_2SiO_5 polymorph / kyanite forms at high OR medium pressures and medium temperatures; schistose texture OR schistosity where muscovite (and biotite) are aligned; porphyroblasts of garnet crystallise; crystal grain size is medium;</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>max 4</p> <p>Mark labelled diagrams as text</p>
	<p><u>Gneiss</u></p> <p>high grade AND high temperatures and pressures; index mineral sillimanite / sillimanite as Al_2SiO_5 polymorph / sillimanite forms at high temperatures and pressures; gneissose banding with light and dark bands; crystal grain size is coarse; light bands rich in quartz and K feldspar dark bands rich in biotite;</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>max 4</p> <p>Mark labelled diagrams as text</p>
	Total	10	

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