OCR
RECOGNISING ACHIEVEMENT

GCE

Geology

Advanced Subsidiary GCE

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

Mark Scheme for June 2011

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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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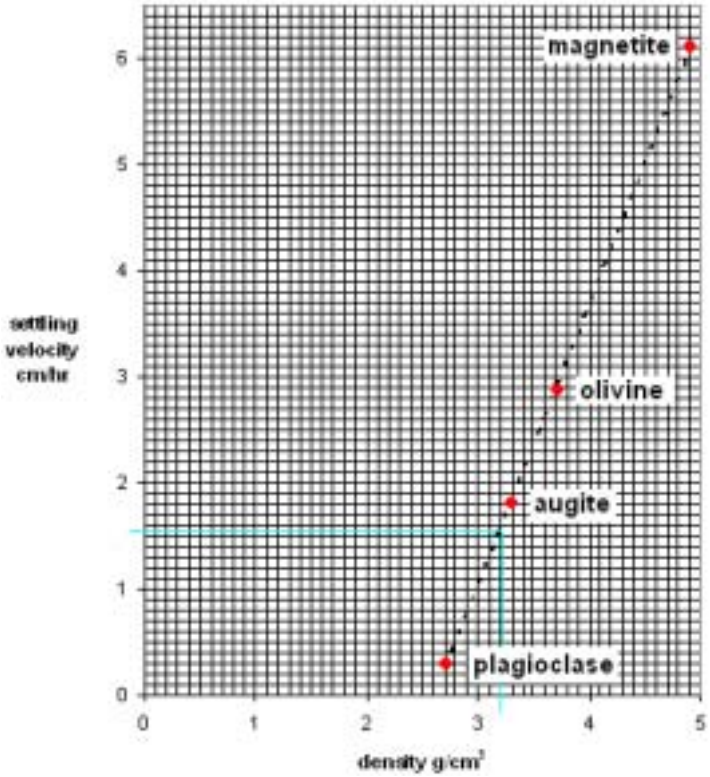
Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	dyke = steeply dipping igneous rock feature; sill = horizontal igneous rock feature	1 1	max 1 if labelling isn't clear
		(ii)	1 to 8 mm wide baked margin shaded and labelled in country rock next to either intrusion; 1 to 8 mm wide chilled margin shaded and labelled just inside the edge of either intrusion	1 1	both can be drawn on either intrusion or one feature on one and the second on the other must be a shaded area along margin not just labelled at a point
		(iii)	**B D C A** rock 1 = **B** (basalt/dolerite) rock 2 = **D** (limestone) rock 3 = **C** (marble) rock 4 = **A** (gabbro)	**max 3**	3 or 4 correct for 3 marks 2 correct for 2 marks 1 correct for 1 mark
	(b)		correct scale with grain size between 0.0625 and 2 mm; mix of sediment sizes to show poorly sorted; subangular shape	1 1 1	max 2 if drawn as interlocking grains/crystals grain shape should not be given if all rounded or all angular, allow subrounded
	(c)	(i)	**E** shale / mudstone; **F** slate	1 1	accept phyllite
		(ii)	(60 – 7) = 53% +/- 1	1	
		(iii)	description: water squeezed out from between grains / from pore spaces / individual grains become closely packed / grains move closer together / pore space is filled with cement / porosity is reduced; explanation: due to weight of overlying sediment / load pressure / compaction / cementation	any 1 any 1	1 for description and 1 for explanation
		(iv)	temperature increase / higher temperature / directed pressure / compressive stress	any 1	heat is insufficient accept recrystallisation
	(d)		diagenesis occurs below 150 - 200^{o}C and below 2kb / 200MPa; metamorphism occurs above 150 - 200° C and above 2kb / 200MPa	1 1	max 1 for general correct statement max 1 if only temperature or only pressure discussed must quote at least one figure for 2 marks
			Total	**18**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	 axes correct all points correct ne of best fit drawn	**1** **1** **1**	ignore any line extended below the plagioclase point
		(ii)	dense minerals (like olivine and magnetite) sink / denser minerals sink faster / low density minerals may float up (1) gravity settling involves early formed / high temperature minerals / minerals that crystallise first (1) (dense) minerals form a (cumulate) layer at the base of intrusion (1) mafic magma is fluid / has low viscosity (1) results in differentiation / fractional crystallisation (1)	**any 3**	answer must be correct for line drawn
		(iii)	1.6 +/- 0.1	**1**	allow ecf from line of best fit on graph

Question			Expected Answers	Marks	Additional Guidance
2	(b)		mixture of crystals and liquids together in magma (1) weight of crystals settling at bottom / magma being put under pressure (1) squeezes out remaining liquid (1)	**any 2**	
	(c)	(i)	augite / pyroxene Na plagioclase / albite biotite	**1** **1** **1**	
		(ii)	quartz and olivine they do not form at the same temperature / olivine forms at high temperature and quartz at low temperature / olivine forms early and quartz forms late / olivine has a higher melting point / quartz has a lower melting point / olivine is undersaturated in silica so there is no free silica to form quartz / olivine is a low silica mineral and quartz is a high silica mineral / olivine is found in mafic rocks and quartz is found in silicic rocks / there wasn't enough silica in the magma to form quartz / olivine has already reacted to form another mineral	**1** **any 1**	1 mark for correct pair of minerals 1 mark for reason
			Total	**14**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		movement of ice / glacier; (as ice moves) sediment / pebbles / rock fragments / clasts scratch / abrade / form parallel grooves in the ground / bed rock below	**1** **any 1**	do **not** accept discussion of slickensides
	(b)		**unit X:** clays formed in (glacial) lake / as varves; low energy conditions (so suspended load dropped) / area with no current / coarser silt deposited in spring, finer clay rest of year when lake freezes over	 **1** **1**	accept floodplain / deep marine / prodelta for max 1
			unit Y: cross bedded sandstones formed in fluvial / glacial melt water rivers / in braided channels / on outwash plain / at snout of glacier; high energy / unidirectional current / form eskers / deposition where current velocity drops on point bar	 **1** **1**	accept desert / aeolian / delta front for max 1
			unit Z: (retreating) glacier / ice melts; till / boulder clay / form moraines / formed as all the debris from the ice is deposited in poorly sorted masses / rapid deposition forms poorly sorted masses / boulders were transported encased in the ice / clay is the crushed material from the base of the glacier	 **1** **1**	accept channel lag / wadi conglomerate / alluvial fan for max 1
	(c)		asymmetrical shape / steeper on down current side (1) foreset beds dipping down current and concave up (1) maximum angle = 37° (1) migration of sediment down current (1) unidirectional current / high energy (1) saltation of grains / sediment avalanches down lee slope (1) cross beds are truncated / cut off / eroded by next bed (1)	 **any 3**	diagram must be labelled max 2 if diagram only max 2 if text only
	(d)		cyclothem	**1**	accept fining up sequence / cyclic sedimentation accept 1 letter incorrect in spelling
	(e)		**G** = basalt **H** = quartzite (metaquartzite or orthoquartzite) **J** = schist	**1** **1** **1**	
			Total	**15**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	**K** = graded bedding **L** = desiccation cracks / mud cracks **M** = asymmetrical ripple marks	**3**	must be asymmetrical
		(ii)	decrease in energy of current / turbidity current (carrying mixture of grain sizes) slows (1) coarser / heavier grains settle out first at bottom (1) finer / lighter grains are deposited on top (1)	**any 2**	
		(iii)	from left to right	**1**	
	(b)	(i)	inverted / turned upside down	**1**	accept sand / sandstone has infilled cracks
		(ii)	hot and arid/dry climate / evaporation exceeds precipitation / (high rates of) evaporation (1) by the side of a shallow sea / barred basin / playa lake / sabkha / floodplain (1) low energy for deposition of mudstone (1) higher energy / rapid deposition of sandstone to infill cracks (1)	**any 2**	
	(c)	(i)	syncline to east drawn below the surface; anticline to west drawn above the surface	**1** **1**	
		(ii)	overfold(s) / syncline/synform and anticline/antiform	**1**	allow ecf of correct labelled folds from (i)
	(d)		diagram to show the curved shape at upstream end / deeper and pointed at upstream end (1) direction of current correctly marked on diagram / flute casts form parallel to the current direction (1) powerful / turbidity current scours out hollows in sediment (clay) (1) cast / hollows infilled with sediment (sand / greywacke) (1) flute casts found on base of bed (1)	**any 4**	diagram(s) must be labelled max 3 if diagram(s) only max 3 if text only accept labelled diagram of turbidity current flowing down continental slope for 1 mark
			Total	**16**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th></th><th>mechanical</th><th>chemical</th><th>biological</th></tr>
<tr><td>arkose</td><td>✓</td><td></td><td></td></tr>
<tr><td>breccia</td><td>✓</td><td></td><td></td></tr>
<tr><td>chalk</td><td></td><td></td><td>✓</td></tr>
<tr><td>coal</td><td></td><td></td><td>✓</td></tr>
<tr><td>conglomerate</td><td>✓</td><td></td><td></td></tr>
<tr><td>evaporite</td><td></td><td>✓</td><td></td></tr>
<tr><td>greywacke</td><td>✓</td><td></td><td></td></tr>
<tr><td>mudstone</td><td>✓</td><td></td><td></td></tr>
<tr><td>oolitic limestone</td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>max 4</td><td>7 or 8 correct for 4 marks
5 or 6 correct for 3 marks
3 or 4 correct for 2 marks
1 or 2 correct for 1 mark</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>chalk
breccia
arkose – accept greywacke
coal</td><td>1
1
1
1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>grain size (1)
mineralogy / composition (of grains) (1)
grain shape / roundness of grains (1)
percentage of matrix (1)</td><td>any 2</td><td>max 1 if only size and shape</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>water enters cracks in rock and expands when frozen (1)
puts rock under stress / rock breaks when process repeated many times (1)
requires daily fluctuations of temperature above and below zero (1)</td><td>any 2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(scree) made of angular rock fragments / poorly sorted fragments / coarse fragments</td><td>1</td><td>must describe</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>water enters mineral lattice / acidic water / carbonic acid enters rock (1)
water / H^+ ions react with elements / minerals (1)
silicate minerals break down / decompose / disintegrate (1)
soluble ions / dissolved / removed in solution leaving an insoluble residue (1)
K feldspar is most reactive mineral</td><td>any 2

1</td><td>2 marks for process

1 mark for K feldspar as most reactive</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>clay minerals / named clay mineral e.g. kaolinite / quartz / silica left as residue
/
K^+ / Na^+ / Ca^{2+} / HCO_3^- / CO_3^{2-} removed in solution</td><td>any 1</td><td>must describe
allow muscovite as residue</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>17</td><td></td></tr>
</table>

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Expected Answers	Marks	Additional Guidance
general points: parent rock is aluminium-rich / rich in clay minerals (1) crystal size increases with grade – do not credit if repetition (1) rocks are unfoliated as no directed pressure (1) porphyroblasts are large new crystals that grow during metamorphism (1) general diagram showing the three zones around an intrusion (1) T / P graph with contact metamorphism correctly plotted (1) correct phase diagram showing Al_2Si0_5 polymorphs (1)	**max 3**	do **not** accept discussion of regional metamorphic rocks
low grade: rock is <u>spotted rock / spotted slate</u> low temperatures and <u>low pressure</u> / forms furthest from intrusion (1) fine crystal size / < 1 mm (1) only partial recrystallisation (1) biotite as index mineral (1) composed of clay minerals / quartz / chlorite / mica / muscovite – any 2 (1) spots of biotite / graphite / organic material / carbon / black diffuse areas form (1) relict fossils / bedding / original structures (e.g. pre-existing slaty cleavage) may be present (1)	**1** **max 3**	for each grade - 1 for correct name of rock and max 3 marks for description mark labelled diagram(s) of textures as text
medium grade: rock is <u>andalusite rock / andalusite slate</u> medium temperatures and <u>low pressure</u> (1) medium crystal size / 1- 5 mm (1) andalusite (allow chiastolite) as index mineral (1) composed of micas / quartz / cordierite – any 2 (1) andalusite is low pressure Al_2Si0_5 polymorph (1) andalusite crystals are randomly oriented / has porphyroblastic texture (1) no relict textures remain (1)	**1** **max 3**	
high grade: rock is <u>hornfels</u> high temperatures and <u>low pressure</u> / forms close to contact of intrusion (1) coarse crystal size / > 5 mm (1) complete recrystallisation (1) sillimanite as index mineral / quartz and mafic minerals / cordierite occur (1) sillimanite is high temperature (and high pressure) Al_2Si0_5 polymorph (1) granoblastic texture / interlocking mosaic of crystals (1) hard / splintery rock formed (1)	**1** **max 3**	
Total	**max 10**	

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Expected Answers	Marks	Additional Guidance
historic patterns of activity intervals between eruptions may be regular / average time between eruptions calculated (1) sequence of volcanoes erupting in turn, e.g. from north to south (1) past routes of lava, pyroclastic flows, lahars used to create hazard maps (1) length of time since last eruption gives indication of explosivity / longer time interval produces more explosive eruption (1) products of previous eruptions can be dated / analysed to show silica content (1)	**max 3**	mark labelled diagrams as text
changes in ground level ground rises / swells / domes / inflates / ground displacement may occur before eruption (1) caused by rising magma / expansion of rocks due to heat (1) can be measured using tiltmeters / laser beams / GPS (1) satellite measurements / synthetic aperture radar measurements can be made (1) changes in ground temperature / geysers become more active / thermal / infra-red imaging can be used (1)	**max 3**	
changes in gases quantity of gases produced may increase as volcano becomes more active (1) quantity of gases produced may decrease if vent is blocked / indicates pressure is rising (1) type / composition of gases emitted change / SO_2 / sulphurous gases produced / ratio of gases may change prior to eruption (1) due to magma close to surface / increased magma supply / change in magma (1) fumaroles become more active / can be monitored (1)	**max 3**	do **not** accept discussion of radon gas allow cospec as method
seismic activity precursor earthquakes / harmonic tremors / earthquakes swarms occur / frequency of earthquakes increases before eruption (1) depth of foci get shallower as magma rises / foci directly below crater / volcano (1) caused by pressure of rising magma / magma fracturing rocks (1) short period earthquakes are caused by fracturing of rock / long period earthquakes indicate increased gas pressure in magma chamber (1) monitored using seismometers / seismographs (1)	**max 3**	do **not** accept discussion of seismic gap theory
Total	**max 10**	

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