

**GCE**

**Geology**

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

Advanced Subsidiary GCE

**Mark Scheme for June 2014**

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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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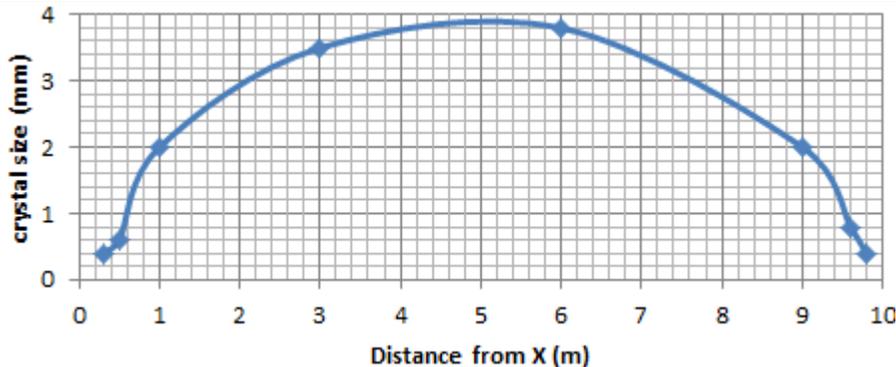
These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning
	Blank Page – this annotation <b>must</b> be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt <b>not</b> given
	error carried forward
	information omitted
	ignore
	reject
	poor diagram
	max response
	
	contradiction

Highlighting is also available to highlight any particular points on the script.

Question			Answer	Marks	Guidance
1	(a)	(i)	white area top left	1	
		(ii)	white area on the right	1	
		(iii)	regional	1	
		(iv)	measure of intensity of metamorphism; the amount of metamorphism; the temperature and pressure (conditions) under which the metamorphic rock forms; where there is an increase in both temperature (and pressure); determines the type of metamorphic rock; determines the mineral composition and therefore mineral index zones;	1	<b>ANY 1</b> <b>ALLOW</b> how much <b>OR</b> degree <b>OR</b> level for amount
		(v)	plotted dark grey area 1 cm from top of graph between 600 to 900°C	1	
	(b)	(i)	<u>medium <b>OR</b> high pressure</u> and <u>low temperature</u> ;	1	<b>ALLOW</b> correct T and P values
		(ii)	where rocks are deeply buried by overlying sediment; where rocks are deeply buried due to deposition; the weight of overlying rock creates high pressure; high pressure due to deposition of overlying rock; high pressure in subduction zones; rocks deep below fold mountain belts;	1	<b>ANY 1</b> <b>ALLOW</b> overburden as alternative term for overlying sediment  Answers must include terms such as deep or high
	(c)		<b>A</b> schist; <b>B</b> gneiss; <b>C</b> quartzite <b>OR</b> metaquartzite; <b>D</b> marble	1 1 1 1	<b>ALLOW</b> phyllite for <b>A</b>  <b>DO NOT ALLOW</b> orthoquartzite

Question		Answer	Marks	Guidance
	(d)	texture      slaty cleavage <b>OR</b> porphyroblastic <b>OR</b> porphyroblast <b>OR</b> foliation	1	<b>ALLOW</b> if correct texture is named under formation part of the answer
		formation      muscovite <b>OR</b> platy minerals <b>OR</b> flaky minerals <b>OR</b> clay minerals aligned; at right angles to the (maximum) pressure direction; pyrite / porphyroblasts form after the cleavage <b>OR</b> pyrite / porphyroblasts grow during metamorphism <b>OR</b> pyrite / porphyroblasts grow after the other minerals; pyrite grows larger as temperature and pressure increases;	2	<b>Any 2</b> for formation
<b>Total</b>			<b>14</b>	

		Answer	Marks	Guidance											
2	(a)	(i)	4	1 MARK each for intrusion type for E, F and G 1 MARK for both F and G ticks correct Ignore any crosses											
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">intrusion type</th> <th style="width: 33%;">concordant</th> <th style="width: 33%;">discordant</th> </tr> </thead> <tbody> <tr> <td>E transgressive sill</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>F sill</td> <td style="text-align: center;">✓</td> <td></td> </tr> <tr> <td>G dyke</td> <td></td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>		intrusion type	concordant	discordant	E transgressive sill	✓	✓	F sill	✓		G dyke		✓
intrusion type	concordant	discordant													
E transgressive sill	✓	✓													
F sill	✓														
G dyke		✓													
		(ii)	2	ALLOW one plotting error  ALLOW points within half a square  1 MARK for accurate line  Ignore any extensions of the curve to 0.  Line may be smooth curve or joining points											
		 <p style="text-align: center;">Distance from X (m)</p>		1 MARK for 7 or 8 points correct											

Question			Answer	Marks	Guidance
2	(a)	(iii)	description    fine crystals at both edges <b>AND</b> medium (coarser) crystals in the centre	1	<b>1 MARK</b> for description
			explanation    fine crystals cool faster due to cooler country rock; edges X and Y are the chilled margin where it cooled more rapidly; central area so crystals cool slowly so are larger; more time for crystals to grow in centre so larger; central area is insulated so crystals are larger;	2	<b>Any 2 MARKS</b> for explanation
	(b)		similarity    same mineral composition <b>OR</b> both mafic <b>OR</b> both SiO <sub>2</sub> % 45 – 52 <b>OR</b> both contain plagioclase and augite <b>OR</b> both dark in colour	1	<b>MUST</b> compare the two rocks
			difference <u>basalt is fine crystals AND dolerite is medium crystals</u> <b>OR</b> basalt crystals <1mm <b>AND</b> dolerite crystals 1 – 5 mm	1	
	(c)		vesicular drawn and labelled    oval or round shaped holes <b>OR</b> vesicles;	1	<b>Max 1</b> for both diagrams with no labels but clear and accurate.  amygdales must be shown filled in and labelled  <b>DO NOT ALLOW</b> gas escapes <b>ALLOW</b> magma as alternative to lava  <b>DO NOT ALLOW</b> just infilled with minerals
			amygdaloidal drawn and labelled    oval or round shaped areas filled with crystals <b>OR</b> minerals in amygdales;	1	
			vesicular formation    gas trapped in cavities <b>OR</b> holes <b>OR</b> bubbles <b>OR</b> vesicles as the lava cooled;	1	
			amygdaloidal formation    vesicles infilled with precipitated minerals <b>OR</b> vesicles filled by minerals formed from groundwater	1	
<b>Total</b>				<b>15</b>	



Question			Answer	Marks	Guidance
3	(b)	(ii)	topsets: coal seat earth sandstone  foresets: cross bedded sandstone  bottomsets: clays <b>OR</b> mudstone <b>OR</b> shale <b>OR</b> limestone	3	<b>1 MARK</b> for topset of coal, seat earth, sandstone any 2 in correct order  <b>1 MARK</b> for foreset sandstones  <b>1 MARK</b> for bottomsets of eg clay
	(c)		1.5 cm / year	1	
<b>Total</b>				<b>12</b>	

Question			Answer				Marks	Guidance
4	(a)	(i)	Sedimentary structure	Use as a way-up indicator	Use as a palaeo-current indicator	Use as a palaeo-environmental indicator	1	<b>1 MARK</b> for each row for both ticks and crosses correct  <b>ALTERNATE METHOD</b> 2 ticks = one mark 2 crosses = one mark
			large scale cross bedding	✓	✓	✓		
			desiccation cracks	✓	X	✓		
			graded bedding	✓	X	X		
			imbricate structure	X	✓	✓		
			salt pseudomorphs	X	X	✓		
		(ii)	labelled diagram (V shape/wider at top/inverted) showing V shaped cracks wider at the top; infill in cracks drawn and labelled <b>OR</b> sequence of labelled diagrams (younger <u>and</u> older) of inverted sequence to show way up; explanation of cracks wider at the top as evaporation is greater at the surface; explanation of sediment younger than the rock in which the crack forms <b>ORA</b> ;				3	<b>ANY 3 MARK</b> labels as text  Max 2 marks if no diagram Max 2 marks if no mention of way-up



Question			Answer	Marks	Guidance
5	(a)	(i)	gabbro;	1	
		(ii)	<p>dense olivine crystals sink <b>OR</b> dense olivine forms cumulate layer near base; by gravity settling;</p> <p><b>OR ALTERNATIVE METHOD</b></p> <p>early formed / high temperature olivine crystals form while rest of magma is liquid; by fractional crystallisation;</p>	1 1	<p><b>ALLOW</b> magmatic segregation</p> <p><b>ALTERNATIVE METHOD</b></p> <p>Description must link to correct explanation</p>
		(iii)	<p>chilled margin <b>OR</b> area of fine grained mafic rock; cooled quickly before magma differentiated <b>OR</b> cooled quickly before depletion of any minerals;</p>	1 1	<b>ALLOW AW</b>
		(iv)	<p>magmatic differentiation means that early formed crystals are rich in any 2 of Fe, Mg, Ca <b>OR</b> fractional crystallisation means that early formed crystals are rich in any 2 of Fe, Mg, Ca;</p> <p>later magma is enriched in silica <b>OR</b> later magma is depleted in mafic minerals;</p> <p>Ca rich plagioclase and pyroxene (augite) form early so first rocks are 50% of each;</p> <p>last rock (in centre of sill around 200m ) is higher in plagioclase (65%) as magma is depleted in mafic minerals <b>OR</b> last rock (in centre of sill around 200m ) is higher in plagioclase (65%) as magma is enriched in silica;</p> <p>last rock (in centre of sill around 200m ) is lower in pyroxene (augite) (35%) as much of the pyroxene (augite) has been depleted;</p>	2	<b>ANY 2</b>
	(b)	(i)	<p>1 Ca rich plagioclase;</p> <p>2 biotite;</p> <p>3 Na rich plagioclase;</p> <p>4 K feldspar <b>OR</b> potash feldspar <b>OR</b> orthoclase</p>	1 1 1 1	<p><b>ALLOW 1 MARK</b> if Ca rich and Na rich are both correctly labelled without the term plagioclase</p> <p><b>ALLOW</b> 1 anorthite 3 albite</p>

Question			Answer	Marks	Guidance
5	(b)	(ii)	circle from olivine down to biotite;	1	<b>ALLOW</b> multiple circles around correct boxes on left
		(iii)	olivine is undersaturated with silica while quartz is all silica; olivine reacts with any excess silica to become pyroxene; olivine forms at high temperature and quartz forms at low temperature; olivine forms early on in the reaction series and will have reacted with magma before quartz forms;	1	<b>ANY 1</b> <b>DO NOT ALLOW</b> just forms at different temperatures
		(iv)	Ca plagioclase forms early so is present in the lower part of the intrusion <b>OR</b> Ca plagioclase forms at high temperature so is present in the lower part of the intrusion; Na rich plagioclase forms late so is present in the middle / last part of the intrusion <b>OR</b> Na rich plagioclase forms at low temperature so is present in the middle / last part of the intrusion;	1  1	Answer must refer to intrusion  Max 1 for general statement of temperature decreases from Ca rich to Na rich <b>OR</b> Ca rich forming first and Na rich forming later
	(c)	(i)	Quartz;  <b>Reason</b> formed at temperature closest to that of Earth's surface; is chemically unreactive <b>OR</b> inert <b>OR</b> insoluble <b>and</b> physically resistant <b>OR</b> hard (7) <b>OR</b> no cleavage; last to form on Bowen's Reaction Series making it the most stable ; last to form on Bowen's Reaction Series making it the most resistant to weathering;	1  1	<b>ANY 1</b> for reason

Question			Answer	Marks	Guidance
5	(c)	(ii)	hydrolysis; <b>Explanation</b> feldspar contains Ca / Na / K which is soluble and is dissolved out; rainwater / groundwater carries soluble ions out of the rock into rivers; feldspars react with hydrogen ions in water <b>OR</b> feldspars react with the carbonic acid; chemical salts such as potassium carbonate are soluble; feldspar reacts with acid in rainwater to form solutes;	1 1	<b>ANY 1</b> for explanation
	(d)		rainwater contains dissolved carbon dioxide <b>OR</b> carbonic acid; groundwater is acidic due to organic material; calcite / limestone reacts with acid and is dissolved; equation $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca}^{2+} + 2\text{HCO}_3^-$ ; calcite + carbonic acid → calcium + hydrogen carbonate;	2	<b>ANY 2</b> <b>ALLOW</b> calcium carbonate for calcite
	(e)		frost shattering <b>OR</b> freeze thaw; exfoliation; pressure release;	2	<b>Any 2</b> <b>ALLOW</b> onion skin weathering
<b>Total</b>				<b>23</b>	

Question	Answer	Marks	Guidance
6	<p><b>grain size</b></p> <ul style="list-style-type: none"> <li>• Any 2 of coarse <b>OR</b> over 2 mm <b>OR</b> rudaceous <b>OR</b> contain gravel / pebbles <b>AND</b> example of conglomerate <b>OR</b> breccia;</li> <li>• Any 2 of medium <b>OR</b> 0.0625 mm (0.02) mm to 2 mm <b>OR</b> arenaceous <b>OR</b> contain sand <b>AND</b> example of sandstone <b>OR</b> arkose <b>OR</b> greywacke <b>OR</b> orthoquartzite;</li> <li>• Any 2 of fine <b>OR</b> &lt;0.0625 mm (0.02 mm) <b>OR</b> argillaceous <b>AND</b> example of clay <b>OR</b> mudstone <b>OR</b> shale <b>OR</b> siltstone;</li> </ul>	1 1 1	<p><b>ALLOW</b> clastic rocks divided into 3 groups based on grain size for 1 mark if no detail</p> <p><b>ALLOW</b> 1 general point for 2 correct grain sizes with no rock names</p>
	<p><b>grain shape</b></p> <ul style="list-style-type: none"> <li>• angular grains form rock breccia <b>OR</b> greywacke;</li> <li>• rounded grains form conglomerate <b>OR</b> desert sandstone;</li> </ul>	1 1	<p><b>ALLOW</b> 1 general point for 2 correct grain shapes with no rock names</p> <p>Grain shape may be on a diagram</p>
	<p><b>mineral composition</b></p> <ul style="list-style-type: none"> <li>• sandstone is quartz rich <b>OR</b> orthoquartzite &gt; 90% quartz <b>OR</b> orthoquartzite is quartz with a quartz cement;</li> <li>• desert sandstone quartz with iron oxide;</li> <li>• arkose contains &gt;25% K feldspar;</li> <li>• greywacke contains rock fragments <b>AND</b> clay matrix;</li> <li>• clay <b>OR</b> mudstone <b>OR</b> shale contains clay minerals;</li> <li>• limestones contain high proportion of calcite;</li> <li>• coals contain high proportion of carbon;</li> <li>• evaporites contain calcite, gypsum, halite and K salts;</li> </ul>	4	<p><b>ANY 4</b> points</p> <p><b>ALLOW</b> general statement of sandstones can be subdivided on basis of composition for <b>MAX 1</b> mark if no specific examples given</p>

Question		Answer	Marks	Guidance
6		<p><b>fossil content</b></p> <ul style="list-style-type: none"> <li>• fossils are rare in coarse clastic rocks <b>OR</b> evaporites;</li> <li>• fossils are very common (forming around 50% of rock) <b>OR</b> forming fossiliferous limestone <b>OR</b> bioclastic limestone;</li> <li>• coals contain plant material;</li> <li>• chalk made of coccoliths <b>OR</b> oozes made of named microfossils such as foraminifera;</li> <li>• crinoidal limestone contains many crinoids <b>OR</b> reef limestone is rich in corals;</li> </ul>	2	<p><b>ANY 2</b> points</p> <p><b>ALLOW</b> specific named fossil crinoidal limestone</p> <p><b>ALLOW</b> other correct specific named fossiliferous rocks</p>
				<p><b>FULL MARK</b> answers must have a minimum of <b>1 MARK</b> for each section with rock names included <b>AND</b> a minimum of <b>1 MARK</b> for non-clastic</p>
		<b>Total</b>	<b>10</b>	

Question	Answer	Marks	Guidance
7	<p><b>Mafic volcano <u>distribution of volcanic products</u></b></p> <ul style="list-style-type: none"> <li>• lava forms long flows several km in length <u>due to</u> low viscosity <b>OR</b> fissure eruptions <b>OR</b> flood basalts cover 1000's of km<sup>2</sup> <b>OR</b> fast flowing lava flows <u>due to</u> low viscosity <b>OR</b> due to high lava temperature ;</li> <li>• lava flows go in all directions from a central crater <b>OR</b> lava flows from fissures cover large area <u>due to</u> low viscosity magma spreading out <b>OR</b> due to high lava temperature;</li> <li>• lava flows down shallow sided (2-10 degrees) shield volcano <u>due to</u> low viscosity <b>OR</b> due to high lava temperature;</li> </ul> <p><b>Mafic volcano <u>type of volcanic products</u></b></p> <ul style="list-style-type: none"> <li>• lava is commonly low viscosity <b>OR</b> lava is fluid <b>OR</b> runny <u>due to</u> low silica content;</li> <li>• lava is basaltic in composition <u>due to</u> low silica content <b>OR</b> 52-45% SiO<sub>2</sub>;</li> <li>• lava surface can be pahoehoe (ropy) <b>OR</b> aa (blocky) <u>due to</u> temperature / viscosity <b>OR</b> pillow lava <u>due to</u> cooling in sea water;</li> <li>• few pyroclastics <b>OR</b> some ash <u>due to</u> gas escaping easily <b>OR</b> low viscosity <b>OR</b> quiet / effusive eruptions <b>OR</b> lava dominates <u>due to</u> low gas content <b>OR</b> low viscosity;</li> </ul> <ul style="list-style-type: none"> <li>• labelled diagram <u>low angle</u> slopes drawn or labelled or in text (any 2 labels: vent, crater, wide base, lava flows) for mafic shield or fissure volcano</li> </ul>	5	<p>1 mark for each point that is described <b>AND</b> explained.</p> <p><b>ALLOW</b> 2 descriptive points for 1 mark for each section for max 2</p> <p><b>ALLOW</b> correct reason such as low viscosity to be given once for more than one marking point in distribution of volcanic products</p> <p>Max 4 marks if both distribution and products are not included</p> <p>Max 1 for labelled drawing</p>

Question	Answer	Marks	Guidance
	<p><b>Intermediate volcano <u>distribution of volcanic products</u></b></p> <ul style="list-style-type: none"> <li>• lava flows are short <b>OR</b> lava flows just a few 100m <b>OR</b> lava flows only close to vent <u>due to</u> high viscosity;</li> <li>• lava forms steep sides &gt;30 degrees <b>OR</b> lava may form parasitic cones <u>due to</u> high viscosity <b>OR</b> <u>due to</u> low lava temperature;</li> <li>• lava and ash form alternating layers <u>due to</u> vent being blocked at times;</li> <li>• pyroclastic flows <b>OR</b> nuée ardente follow valleys <u>due to</u> dense flows;</li> <li>• may result in blast damage entirely on one side <u>due to</u> explosions;</li> <li>• ash <b>OR</b> tuff may be blown by in one direction <u>due to</u> wind <b>OR</b> ash <b>OR</b> tuff <b>OR</b> pumice can be carried long distances <b>OR</b> cover large areas <u>due to</u> small size <b>OR</b> light weight <b>OR</b> allows them to be carried by wind;</li> <li>• agglomerate may be found close to the crater <u>due to</u> large <b>OR</b> heavy blocks</li> </ul> <p><b>Intermediate volcano <u>type of volcanic products</u></b></p> <ul style="list-style-type: none"> <li>• lava flows are short as it is viscous <b>OR</b> pyroclasts are common <u>as</u> it is explosive</li> <li>• lava is thick <b>OR</b> sticky <b>OR</b> non-fluid due to high viscosity</li> <li>• lava is andesitic in composition <u>as</u> it is silica rich <b>OR</b> 52-66% SiO<sub>2</sub> ;</li> <li>• alternating layers of lava <u>and</u> ash <b>OR</b> pyroclasts <b>OR</b> tuff <b>OR</b> agglomerate <u>due to</u> gas rich explosive <b>OR</b> violent eruptions;</li> <li>• large volume of pyroclasts <u>due to</u> magma blocking vent <b>OR</b> large volume of pyroclasts <u>due to</u> explosive eruptions;</li> <li>• pyroclastic flows <b>OR</b> nuée ardente occur <u>due to</u> gas rich magma erupted violently as gaseous froth;</li> </ul> <ul style="list-style-type: none"> <li>• labelled diagram <u>alternating layers of lava and ash drawn</u>: (any 2 labels ash, lava flow, vent, crater, steeper sides, parasitic cone) for intermediate strato or composite volcano</li> </ul>	5	<p>1 mark for each point that is described and explained</p> <p><b>ALLOW</b> 2 descriptive points for 1 mark for each section for max 2</p> <p>Max 4 marks if both distribution and products are not included</p> <p><b>ALLOW</b> can produce silicic <b>OR</b> felsic <b>OR</b> rhyolitic lava <b>OR</b> &gt;66% SiO<sub>2</sub>;</p> <p>Max 1 for labelled drawing</p>
	<b>Total</b>	<b>10</b>	

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